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LEITLINIENREPORT zur S3-Leitlinie:

Polytrauma/Schwerverletzten-Behandlung

der

Deutschen Gesellschaft für Unfallchirurgie e.V. &
Deutschen Gesellschaft für Orthopädie und Unfallchirurgie

und

Deutsche Arbeitsgemeinschaft Krankenhaus-Einsatzplanung (DAKEP)
Deutsche Gesellschaft der Plastischen, Rekonstruktiven und Ästhetischen Chirurgen e.V. (DGPRÄC)
Deutsche Gesellschaft für Allgemein- und Viszeral Chirurgie e.V. (DGAV)
Deutsche Gesellschaft für Anästhesiologie und Intensivmedizin e.V. (DGAI)
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Deutsche Gesellschaft für Fachkrankenpflege und Funktionsdienste e.V. (DGF)
Deutsche Gesellschaft für Gefäßchirurgie und Gefäßmedizin e.V. (DGG)
Deutsche Gesellschaft für Gynäkologie und Frauenheilkunde e.V. (DGGG)
Deutsche Gesellschaft für Handchirurgie e.V. (DGH)
Deutsche Gesellschaft für HNO-Heilkunde, Kopf- und Hals-Chirurgie e.V. (DGHNO)
Deutsche Gesellschaft für interventionelle Radiologie und minimal-invasive Therapie (DeGIR)
Deutsche Gesellschaft für Neurochirurgie e.V. (DGNC)
Deutsche Gesellschaft für Neurorehabilitation e.V. (DGNR)
Deutsche Gesellschaft für Thorax-, Herz- und Gefäßchirurgie (DGTHG)
Deutsche Gesellschaft für Thoraxchirurgie e.V. (DGT)
Deutsche Gesellschaft für Transfusionsmedizin und Immunhämatologie e.V. (DGTI)
Deutsche Gesellschaft für Urologie e.V. (DGU)
Deutsche Gesellschaft für Verbrennungsmedizin e.V. (DGV)
Deutsche Gesellschaft interdisziplinäre Notfall- und Akutmedizin (DGINA)
Deutsche Interdisziplinäre Vereinigung für Intensiv- und Notfallmedizin e.V. (DIVI)
Deutsche Röntgengesellschaft e.V. (DRG)
Deutscher Berufsverband Rettungsdienst e.V. (DBRD)
Gesellschaft für Mund-, Kiefer- und Gesichtschirurgie e.V. (DGMKG)
Gesellschaft für Pädiatrische Radiologie e.V. (GPR)
Sektion Pflege der Deutsche Interdisziplinären Vereinigung für Intensiv- und Notfallmedizin e.V. (DIVI)

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DEUTSCHE GESELLSCHAFT FÜR UNFALLCHIRURGIE
DGOU Deutsche Gesellschaft für Orthopädie und Unfallchirurgie

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1 Informationen zum Leitlinienreport

Dieser Leitlinienreport dokumentiert das Aktualisierungsverfahren der Leitlinie von Juli 2022 (Version 4.0). Der Leitlinienreport der vorherigen Version von 2016 (Version 3.0) mit Details zur Erstellung der Version 2 (Juli 2011) und 3 (Juli 2016) der Leitlinie ist über die folgende Seite zugänglich: https://www.awmf.org/leitlinien/detail/ll/187-023.html. Die initiale S1-Leitlinie aus dem Jahr 2002 (Version 1) verfügt über keinen Leitliniereport. Methodische Änderungen im Vergleich zu den Vorversionen dieser Leitlinie wurden an den entsprechenden Stellen gekennzeichnet und erläutert.

1.1 Autoren des Leitlinienreports

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1.2 Herausgeber der Leitlinie und federführende Fachgesellschaft

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1.4 Zitierweise

S3-Leitlinie Polytrauma/Schwerverletzten-Behandlung, Registernummer 187-023 (2022), Version 4.0, Leitlinienreport. https://www.awmf.org/leitlinien/detail/ll/187-023.html.

1.5 Weitere Dokumente zur Leitlinie

Die Leitlinie liegt als Lang- und Kurzversion vor. Diese Dokumente, sowie der Leitlinienreport von 2016 (Version 3.0, frühere Registernummer 012-019), sind über die folgende Seite zugänglich:
https://www.awmf.org/leitlinien/detail/ll/187-023.html

1.6 Schlüsselwörter/Keywords

Schlüsselwörter: Trauma, Polytrauma, Schwerverletzte

Keywords: trauma, polytrauma, major trauma, severe injuries

1.7 Abkürzungsverzeichnis

AAOS	American Academy of Orthopaedic Surgeons
AGREE II	Appraisal of Guidelines for Research & Evaluation II
AWMF	Arbeitsgemeinschaft der Wissenschaftlichen Medizinischen Fachgesellschaften e.V.
BTF	Brain Trauma Foundation
cCT	craniale Computertomographie
CCT	Controlled clinical trial: kontrollierte klinische Studie
CI	Confidence interval: Konfidenzintervall
DGAI	Deutsche Gesellschaft für Anästhesiologie und Intensivmedizin e.V.
DGU	Deutsche Gesellschaft für Unfallchirurgie e.V.
ECRI	Emergency Care Research Institute
GCS	Glasgow coma scale
GIN	Guidelines international network
GoR	Grade of recommendation: Empfehlungsgrad
GPP	Good (clinical) practice point: Expertenkonsens
IF	Journal Citation Reports Impact Factor 2019
IFOM	Institut für Forschung in der Operativen Medizin der Universität Witten/Herdecke
ISS	Injury severity score
LL	Leitlinie
LoE	Level of Evidence: Evidenzlevel

MANV	Massenanfall von Verletzen
MeSH	Medical Subject Headings
METRC	Major Extremity Trauma and Rehabilitation Consortium
NICE	National Institute for Health and Care Excellence
OP-Phase	Operative Phase
PICO	Population, Intervention, Comparison, Outcome: Population, Intervention, Kontrolle, Endpunkt
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RCT	Randomised controlled trial: randomisierte, kontrollierte Studie
RISC	Revised Injury Severity Classification
RTS	Revised trauma score
SR	Systematic Review: systematische Übersichtsarbeit
SD	Standard deviation
TRISS	Trauma and Injury Severity Score

2 Organisation der Leitliniengruppe

Die Aktualisierung der Leitlinie im Jahr 2022 erfolgte im Auftrag und unter Federführung der Deutschen Gesellschaft für Unfallchirurgie e.V. (DGU).

Für die Aktualisierung wurde Herr PD Dr. med. Dan Bieler durch den Vorstand der DGU als Koordinator berufen. Das Projektmanagement wurde durch Herrn Michael Kalsen (Leitliniensekretariat) unterstützt. Die Leitlinie wurde methodisch durch Dr. Käthe Gooßen (Leitlinienmethodik, Institut für Forschung in der Operativen Medizin) begleitet.

Die Aktualisierung erfolgte in einem interdisziplinären Konsensusprozess gemäß den Empfehlungen der AWMF zur Erstellung von S3-Leitlinien unter neutraler Moderation einer Vertreterin der Ständigen Kommission Leitlinien der AWMF (Dr. med. Monika Nothacker, stellvertretende Leiterin, AWMF-Institut für Medizinisches Wissensmanagement).

Den Delegierten der beteiligten Fachgruppen, Mitgliedern der Steuergruppe und den Autoren ist für ihre ehrenamtliche Arbeit zu danken.

2.1 Steuergruppe

Mitglieder der Steuergruppe waren:

- Priv.-Doz. Dr. med. Dan Bieler, Koblenz
- Dr. med. Helena Düsing, Münster
- Prof. Dr. med. Sascha Flohé, Solingen
- Prof. Dr. med. Benedikt Friemert, Ulm
- Dr. Käthe Gooßen, Köln
- Prof. Dr. med. Frank Hildebrand, Aachen
- Prof. Dr. med. Stefan Huber-Wagner, Schwäbisch-Hall
- Prof. Dr. med. Philipp Kobbe, Aachen
- Prof. Dr. med. Sven Lendemans, Essen
- Prof. Dr. med. Gerrit Matthes, Potsdam
- Prof. Dr. Dawid Pieper, Rüdersdorf b. Berlin
- Dr. med. Heiko Trentzsch, München
- Prof. Dr. med. Christian Waydhas, Bochum

Die Aufgaben der Steuergruppe bei der Aktualisierung waren:

- Erstellung und Festlegung des Projektablaufplans
- Erstellung eines Finanzierungskonzepts
- Identifizierung und Festlegung überarbeitungsbedürftiger Themenbereiche
- Festlegung der einzuladenden Fachgesellschaften
- Definition der Modalitäten der Aktualisierung (partielles Update auf der Basis vorab definierter Fragestellungen)
- Bewertung der eingebrachten klinisch relevanten Fragestellungen, die in der Leitlinie adressiert werden sollen (in Zusammenarbeit mit der Leitliniengruppe)
- Vorschlag für die Autorengruppen mit jeweiligen Kapitelverantwortlichen
- Festlegung der redaktionellen Bearbeitung der Leitlinien
- Interessenskonfliktmanagement

Die Leitlinie ist in die drei Themenbereiche Präklinik, Schockraum und erste Operationsphase (OP-Phase) gegliedert. Für jeden dieser drei Themenbereiche wurden aus der Steuergruppe verantwortliche Koordinatoren benannt:

Präklinik: Prof. Dr. med. Christian Waydhas (BG Universitätsklinikum Bergmannsheil, Bochum)
Dr. med. Heiko Trentzsch (LMU München)

Schockraum: Prof. Dr. med. Sven Lendemans (Alfried-Krupp-Krankenhaus Essen Steele)
Prof. Dr. med. Stefan Huber-Wagner (Diakonie-Klinikum Schwäbisch Hall)
Dr. med. Helena Düsing, Universitätsklinikum Münster)

1. OP-Phase: Prof. Dr. med. Frank Hildebrand (Uniklinik RWTH Aachen)
Prof. Dr. Philipp Kobbe (Uniklinik RWTH Aachen)

Die Aufgaben der Koordinatoren bei der Aktualisierung waren:

- Unterstützung der Autoren bei der Erstellung der zu konsentierenden Empfehlungen (inkl. Empfehlungsgrade) und bei der Aktualisierung der Hintergrundtexte
- Ggf. Aktualisierung der einführenden Hintergrundtexte der jeweiligen Kapitelabschnitte
- Abschließende Durchsicht und Prüfung der erstellten Kapitel innerhalb eines Themenbereichs

2.2 Methodenteam

Die federführende Fachgesellschaft DGU übertrug dem Institut für Forschung in der Operativen Medizin (IFOM) die methodische Leitung der Aktualisierung. Mitglieder des Methodenteams waren unter der Leitung von Dr. Käthe Gooßen: Jessica Breuing, Miriam Hertwig, Simone Hess, Nadja Könsgen, Charlotte Kugler, Nora Meyer, Barbara Prediger, Sarah Wahlen und Alina Weise. An der Ermittlung des Aktualisierungsbedarfs der Leitlinie waren Jessica Breuing, Monika Becker, Stefanie Bühn, Charlotte Kugler, Dr. Tim Mathes und Barbara Prediger unter der Leitung von Dr. Käthe Gooßen und Dr. Dawid Pieper beteiligt. Sie wurden unterstützt von den studentischen Hilfskräften Lena Heinen und Fabian Schlumberger.

Die Aufgaben des IFOM bei der Aktualisierung waren:

- Systematische Ermittlung des Aktualisierungsbedarfs auf Basis der Ottawa-Methode
- Erstellung von PICO Fragen auf Basis bestehender und neuer Fragestellungen
- Systematische Literaturrecherche, Literaturbeschaffung
- Überarbeitung der Einschlusskriterien in Abstimmung mit den Kapitelverantwortlichen
- Studienselektion auf Basis der Einschlusskriterien
- Datenextraktion, systematische Bewertung der Qualität der eingeschlossenen Studien (Bias-Risiko), Vergabe von Evidenzlevels (LoE)
- Methodische Begleitung und Qualitätssicherung

2.3 Autorengruppen

Vor dem Start der Aktualisierung schlug die Steuergruppe für jedes zu aktualisierende Kapitel Experten für eine ehrenamtliche Mitarbeit als Kapitelverantwortlicher bzw. Kapitelautor vor und holte deren Zustimmung ein. Alle Beteiligten an früheren Leitlinienversionen wurden um ihre Mitarbeit gebeten. Darüber hinaus war eine eigene Meldung als Kapitelautor aus der Gruppe der Delegierten möglich. Die Mitglieder der Autorengruppen sind der Leitlinie (Langfassung) zu entnehmen.

Die Aufgaben der Autorengruppen bei der Aktualisierung waren:

- Festlegung von Fragestellungen (insbesondere für neue Kapitel) bei Bedarf
- Abstimmung der Einschlusskriterien mit dem Methodenteam
- Sichtung und klinische Bewertung der eingeschlossenen Evidenz
- Formulierung neuer Empfehlungen mit Empfehlungsgraden, Umformulierungen oder Streichung alter Empfehlungen
- Vorstellung des Kapitels bei einer Konsensuskonferenz
- Schreiben der Hintergrundtexte

2.4 Leitliniengruppe

Die Leitliniengruppe setzt sich zusammen aus Delegierten der beteiligten Fachgesellschaften sowie dem Koordinator, der Moderatorin und der Leitlinienmethodikerin. Die Mitglieder der Leitliniengruppe sind der Leitlinie (Langfassung) zu entnehmen.

3 Genauigkeit der Leitlinienentwicklung

3.1 Methodische Grundlagen

Die Methodik zur Erstellung dieser Leitlinie richtet sich nach dem AWMF-Regelwerk zur Leitlinienentwicklung [1].

3.2 Ermittlung des Aktualisierungs- und Ergänzungsbedarfs

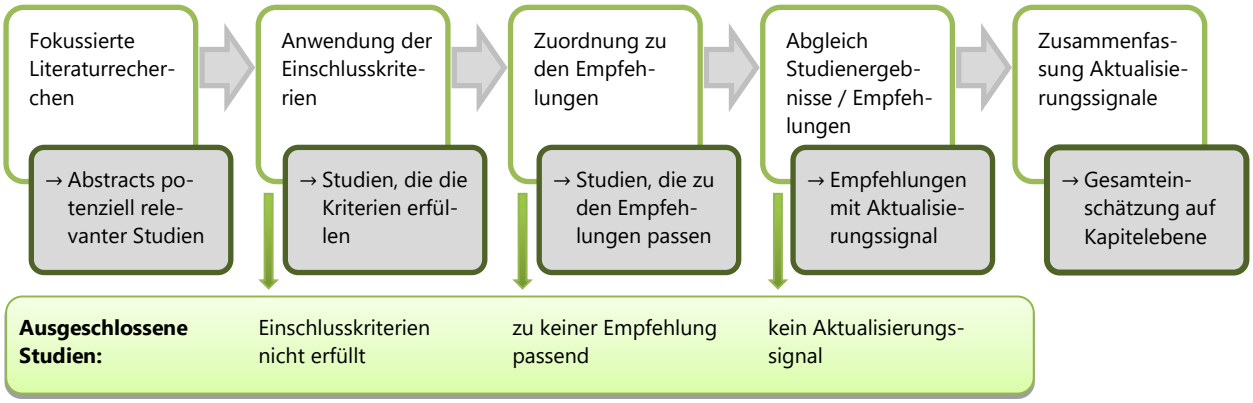
Bestandsanalyse: Formulierung neuer Fragestellungen

Im Einladungsschreiben der DGU an die Fachgesellschaften wurden diese gebeten, neue Fragestellungen zu formulieren, die sie für die Leitlinie als relevant erachten, die aber in der Leitlinie bisher nicht abgebildet waren. Auch bei der konstituierenden Sitzung der Leitlinie erhielten die Delegierten die Gelegenheit, weitere Fragestellungen einzureichen. Insgesamt wurden 69 Fragestellungen gesammelt, von der Steuergruppe überprüft und den passenden Kapiteln zugeordnet.

Bedarfsanalyse: Ermittlung des Aktualisierungsbedarfs mit der Ottawa-Methode

Vor der eigentlichen Aktualisierung der Leitlinie wurde in der Zeit von September bis Dezember 2020 ein Entscheidungsprozess über die vorrangig zu aktualisierenden Leitlinienkapitel durchlaufen. Hierzu wurde eine adaptierte Ottawa-Methode verwendet (Abb. 1), die es erlaubt, den Aktualisierungsbedarf auf Kapitelebene zu bewerten [2].

Abb. 1. Prozess der modifizierten Ottawa-Methode.



Im ersten Schritt wurden auf Kapitelebene Vorab-Literaturrecherchen mit hoher Spezifität durchgeführt. Die Suchstrategie enthielt für alle Kapitel gleiche Bestandteile für die Population (Patienten mit Schwerverletzung oder Polytrauma), den Studientyp und die Publikationssprache. Sie enthielt einen Journalfilter bestehend aus fachübergreifenden Journalen für Medizin mit *Journal Citation Reports Impact Factor 2019* (IF) >6 und fachspezifischen Journalen mit IF >2 [2]. Ergänzt wurde sie durch spezifische, themenbezogene Stichworte für die einzelnen Kapitel, die sich an vorangegangenen Recherchen orientierten oder sich direkt aus den bisherigen Empfehlungen ableiteten. Die Vorabrecherche erfolgte in der Datenbank MEDLINE (via Ovid) im Suchzeitraum ab der letzten Recherche (Originalversion 2011 oder Aktualisierung 2016) bis September 2020 mittels kombinierter Schlagwort- (Medical Subject Headings/MeSH) und Freitextsuche.

Der zweite Schritt umfasste die Auswahl und Bewertung der Studien auf Basis ihrer Abstracts.

Aus den Ergebnissen der Vorabrecherchen wurden passende Studien entsprechend vorab definierter, verkürzter Einschlusskriterien ausgewählt (Tabelle 1). Die Studien wurden einer oder mehreren bestehenden Empfehlungen eines Kapitels zugeordnet. Studien, die zu keiner bestehenden Empfehlung passten, wurden ausgeschlossen. Durch Abgleich der Studienergebnisse mit den dazugehörigen Empfehlungen wurden qualitative Aktualisierungssignale für die Empfehlungen identifiziert (Tabelle 2). Sobald für mindestens 10% der Empfehlungen eines Kapitels ein starkes qualitatives Aktualisierungssignal (A1 bis A3) vorlag, werden keine weiteren Studien gesichtet.

Im dritten Schritt wurde auf Basis der Aktualisierungssignale für jedes Kapitel nach definierten Kriterien ein Aktualisierungsvorschlag gemacht (Tabelle 3). Die zugrundeliegende Evidenz wurde strukturiert zusammengefasst und der Leitliniengruppe während der konstituierenden Sitzung als Entscheidungsgrundlage für die Festlegung zu aktualisierender Kapitel vorgelegt.

Tabelle 1. Verkürzte Einschlusskriterien für das Screening der Vorabrecherche.

Verkürzte Einschlusskriterien	
1. Studienpopulation:	erwachsene Patienten (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung
2. Studientyp:	Systematic Review (auf Basis vergleichender Studien), RCT, non-RCT/CCT, prospektive Kohortenstudien & vergleichende Registerdaten
Bereits über die Literaturrecherche abgedeckte Einschlusskriterien	
3. Publikationssprache:	Englisch oder Deutsch (Sprachfilter)
4. noch nicht in bisheriger Leitlinie berücksichtigt (Zeitfilter)	

CCT = controlled clinical trial, RCT = randomised controlled trial.

Tabelle 2. Aktualisierungssignale auf Empfehlungsebene nach modifizierter Ottawa-Methode.

Starke qualitative Aktualisierungssignale	
Veränderte Evidenzlage *mit LoE 1 bis 2* [3], die eine Empfehlung invalidieren kann	
A1	**Gegensätzliche Ergebnisse zur aktuellen LL-Empfehlung** Neubewertung einer Intervention*, Veränderung von ≥2 Schritten auf der Skala in Abb. 2
A2	**Erheblicher Schaden, der eine LL-Empfehlung infrage stellt** Risiko einer empfohlenen Intervention überwiegt ihrem Nutzen
A3	**Überlegene neue Intervention** Eine neue Methode ist wirksamer und/oder sicherer verglichen mit der empfohlenen Methode und sollte bevorzugt angewendet werden
Schwächere qualitative Aktualisierungssignale	
Veränderte Evidenzlage, die eine Empfehlung erheblich beeinflussen kann	
A4	**Wichtige Änderungen in der Wirksamkeit/Sicherheit** Neubewertung einer Intervention, Veränderung von 1 Schritt auf der Skala in Abb. 2
A5	**Klinisch wichtige Erweiterung der Intervention** erweiterte Indikation, zusätzliche Population o.ä.
A6	**Klinisch wichtiger Vorbehalt** Neues/höheres Risiko bei einer Intervention, Einschränkung der Anwendungsart oder der Population, eingeschränkte Nachhaltigkeit der Wirkung
A7	**Neue Studie im Widerspruch mit der bisherigen Evidenzlage** Neubewertung einer Intervention analog A1, aber *LoE ≥3*

* Begriff verwendet für jegliche Intervention (diagnostisch, therapeutisch etc.). LL = Leitlinie; LoE = Level of Evidence

Abb. 2. Skala zur Operationalisierung der Wirksamkeit von Interventionen nach der Ottawa-Methode [4]; Schaden lässt sich analog bewerten.

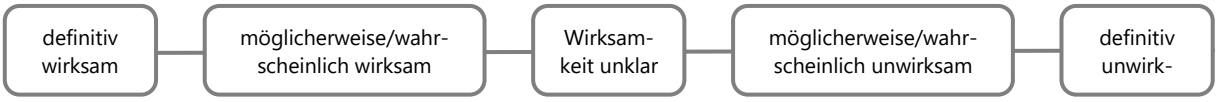


Tabelle 3. Kriterien für Aktualisierungsvorschläge auf Kapitelebene.

Vorschlag	Kriterien
sollte aktualisiert werden	• starke Signale (A1-A3) für ≥10% der Empfehlungen oder • jegliche Signale (A1-A7) für ≥20% der Empfehlungen
kann aktualisiert werden	• starke Signale (A1-A3) für <10% der Empfehlungen oder • schwächere Signale (A4-A7) für <20% der Empfehlungen
kein Aktualisierungsbedarf	anderenfalls

Festlegung des Aktualisierungsumfangs, Änderungen in der Kapitelstruktur

Mittels der Ottawa-Methode wurden 16 Kapitel mit Aktualisierungsbedarf ermittelt:

- Präklinik: *Atemwegsmanagement*, *Beatmung und Notfallnarkose* („sollte“), *Volumentherapie* („sollte“), *Schädel-Hirn-Trauma* („kann“)
- Schockraum: *Kriterien Schockraumaktivierung* („sollte“), *Thorax* („kann“), *Schädel-Hirn-Trauma* („sollte“), *Unterkiefer und Mittelgesicht* („sollte“), *Hals* („kann“), *Reanimation* („kann“), *Gerinnungssystem* („sollte“), *Interventionelle Blutungskontrolle* („sollte“)
- 1. OP-Phase: *Thorax* („kann“), *Abdomen* („kann“), *Schädel-Hirn-Trauma* („sollte“), *Wirbelsäule* („kann“), *Untere Extremitäten* („kann“).

Einem Konsens-Beschluss der Leitliniengruppe auf der konstituierenden Sitzung folgend wurden alle mittels der Ottawa-Methode identifizierten Kapitel sowie folgende zusätzliche Kapitel aktualisiert: *Thorax, Präklinik* aufgrund gemeinsamer Recherche mit den innerklinischen Thoraxkapiteln; *Massenanfall von Verletzten (MANV)* nach Bestandsanalyse, da das Kapitel bereits in Vorversion von 2016 zur Aktualisierung vorgemerkt war; *Bildgebung* nach Bestandsanalyse aufgrund der Einschätzung der Leitliniengruppe, dass Aktualisierungsbedarf besteht; *Urogenitaltrakt, 1. OP-Phase* nach Bestandsanalyse aufgrund der Einschätzung der Leitliniengruppe, dass Aktualisierungsbedarf besteht. Für *Becken, Schockraum* wurden neue Fragestellungen identifiziert. Hier wurde eine Aktualisierung nur dieser Fragestellungen geplant. Aufgrund der Breite der notwendigen Literaturrecherche wurde schließlich das vollständige Kapitel aktualisiert.

Es wurde beschlossen, zwei neue Kapitel zu erstellen: Im Kapitel *Stop the bleeding* (Präklinik) wurden Empfehlungen zu blutstillenden Interventionen in der Präklinik aus anderen Kapiteln (1.7 *Extremitäten*, 2.7 *Becken*) zusammengeführt und aktualisiert, sowie eine systematische Literaturrecherche auf Basis neu definierter PICO-Fragen durchgeführt. Für das Kapitel *Analgesie* (Präklinik) wurde auf einen vorliegenden systematischen Review beteiligter Leitlinienautoren zurückgegriffen [5]. Dies bedeutet, dass das Kapitel nicht im Rahmen der beschriebenen Methodik erstellt wurde.

Kapitel 2.2 und 2.3 wurden neu strukturiert: personelle Voraussetzungen aus 2.2 *Der Schockraum – personelle und apparative Voraussetzungen* wurde verschoben in 2.3 *Kriterien Schockraumaktivierung*. Dementsprechend wurde Kapitel 2.3 umbenannt in *Schockraumalarmierung und personelle Voraussetzungen.*

Kapitel 2.17 *Interventionelle Blutungskontrolle* wurde umbenannt in *Endovaskuläre Therapie von Blutungen und Gefäßläsionen* und verschoben hinter *Bildgebung*.

Gültigkeitsüberprüfung nicht aktualisierter Kapitel

Alle Empfehlungen aus Kapiteln, die mittels Vorabrecherche nach der Ottawa-Methode nicht aktualisiert werden mussten, sind durch die Leitliniengrupe geprüft worden.

Der Prozess wurde im Rahmen einer Konsensuskonferenz anhand des Kapitels 3.8 Obere Extremitäten pilotiert und für alle weiteren Kapitel mittels online-Umfrage durchgeführt. Hier wurde das Onlinewerkzeug Questionstar® verwendet. Jede Empfehlung ist im Originaltext aus der Leitlinienversion 2016 dargestellt worden. Als Bewertungsmöglichkeiten wurden angeboten „Zustimmung“, „keine Zustimmung“ oder „Enthaltung“.

Alle Delegierten der jeweiligen Fachgesellschaft haben alle Empfehlungen bewertet. Die Ergebnisse sind in Form der Konsensstärke in jeder Empfehlung verschriftlicht und in der Leitlinie dargestellt.

Des weiteren überprüften die Autorengruppen die Hintergrundtexte auf ihre Aktualität und überarbeiteten sie bei Bedarf.

3.3 Recherche, Auswahl, Bewertung wissenschaftlicher Evidenz

Formulierung klinisch relevanter Fragestellungen, Priorisierung von Endpunkten

Auf Basis bestehender und neuer Fragestellungen (siehe Abschnitt 3.1) wurden vom Methodenteam alle Fragen in den aktualisierten Kapiteln nach dem Population–Intervention–Control–Outcomes (PICO)-Schema formuliert. Es wurden klinische oder patientenrelevante Endpunkte (z.B. Mortalität, Komplikationen, funktionelle Outcomes, Lebensqualität) sowie Testgüte bei diagnostischen oder prognostischen Fragestellungen betrachtet. Eine formale Priorisierung von Endpunkten fand in dieser Leitlinienversion nicht statt.

⇒ Änderungen Aktualisierung 2022: Erstmalige Festlegung von Fragestellungen im PICO-Format.

Eine detaillierte Darstellung der PICO-Fragen pro Kapitel wird in Appendix A1 wiedergegeben.

Systematische Literaturrecherche

Für die Aktualisierung erfolgte jeweils pro Kapitel eine oder mehrere Literaturrecherche(n) in den Datenbanken MEDLINE (Ovid) und Embase (Elsevier). Es wurde sowohl mittels medizinischer Schlagwörter (Medical Subject Headings, MeSH) als auch mittels Freitextsuche gesucht. Die Suchstrategien sind untergliedert in einen Populationsteil, der für nahezu die gesamte Leitlinie verwendet und über die Kapitel vereinheitlicht wurde. Dieser wurde ergänzt durch einen für die einzelnen Kapitel spezifischen Interventionsteil. Die Suchstrategien wurden aus der Vorversion übernommen und aktualisiert, um alle relevanten Suchbegriffe zu berücksichtigen. Gesucht wurde ab dem Ende des Suchzeitraums der letzten Aktualisierung des jeweiligen Kapitels. Bei Kapiteln, die im Aktualisierungsprozess neu erstellt wurden, wurde die Recherche ohne Startdatum durchgeführt.

⇒ *Änderungen Aktualisierung 2022*: Die MEDLINE-Recherche wurde über Ovid durchgeführt, in den früheren Versionen der Leitlinie über PubMed.

Eine detaillierte Darstellung der Suchzeiträume und Recherchestrategie pro Kapitel wird in Appendix A2 wiedergegeben.

Auswahl der Evidenz

Für jedes Kapitel wurden *a priori* Einschlusskriterien definiert (Appendix A3). Als Population wurden erwachsene Patienten (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung berücksichtigt. Diese wurden definiert über den *Injury severity score* (ISS) >15 bzw. *Glasgow coma scale* (GCS) <9 oder vergleichbare Werte auf anderen Skalen, bzw. im prähospitalen Bereich ein klinischer Verdacht auf Polytrauma/Schwerverletzung mit Bedarf an lebensrettenden Interventionen. Abweichend hiervon wurde in neuen Kapiteln und für neue Fragestellungen auch indirekte Evidenz eingeschlossen, sofern keine direkte Evidenz verfügbar war. Es wurde ausschließlich Literatur mit hohem Evidenzlevel eingeschlossen. Die Aussagen, die auf Basis dieser Literatur getroffen werden, beruhen somit auf Studiendesigns, die einem möglichst geringen Verzerrungsrisiko (Bias) unterliegen.

⇒ *Änderung Aktualisierung 2022*: Die Zielpopulation wurde auf Erwachsene (≥14 Jahre) beschränkt; in den Vorversionen wurden auch Studien an Kindern eingeschlossen. Grund ist, dass die „Polytraumaversorgung im Kindesalter“ seit 31.10.2020 durch eine eigene Leitlinie (AWMF-Registernummer 006-120) abgedeckt ist.

⇒ *Änderung Aktualisierung 2022*: Als Konsequenz der Festlegung von PICO-Fragen wurde ein neues Einschlusskriterium festgelegt (E8: Studie kann einer konkreten Empfehlung oder vorab festgelegten Fragestellung (nach PICO-Schema) zugeordnet werden).

⇒ *Änderung Aktualisierung 2022*: Einschluss indirekter Evidenz bezogen auf die Population (Patienten mit isoliertem Trauma bzw. Verletzung, von denen nicht alle als Schwerverletzte gelten) nur für neue Fragestellungen, sofern keine direkte Evidenz verfügbar war.

Für die Auswahl der Evidenz wurden zunächst die Titel und Abstracts der identifizierten Literatur gesichtet. Dabei wurde entweder durch zwei Personen unabhängig gescreent oder das „liberal-accelerated screening“ [6, 7] angewendet: eine Person screent alle Referenzen, die zweite nur solche, die durch die erste ausgeschlossen wurden. Alle durch mindestens eine Person als relevant angesehenen Referenzen wurden im Volltext gesichtet. Die Volltexte wurden hinsichtlich der Erfüllung der Einschlusskriterien von zwei Methodikerinnen unabhängig voneinander geprüft. Alternativ wurde für einige Kapitel das Volltextscreening von einer Person durchgeführt und von einer zweiten verifiziert.

Bei der Selektion der Volltexte wurde eine Konsensentscheidung gefällt, bei Unklarheiten wurden die Kapitelverantwortlichen konsultiert. Eine detaillierte Darstellung des Selektionsprozesses in Form von PRISMA-Flowcharts ist in Appendix A4 dargestellt.

Kritische Bewertung der Evidenz und Erstellung von Evidenzzusammenfassungen

Für die kritische Bewertung der methodischen Qualität der Primärstudien wurden die Checklisten vom National Institute for Health and Care Excellence (NICE), Version 2012, verwendet. Die methodische Qualität von systematischen Übersichtsarbeiten wurde mit dem AMSTAR-Instrument bewertet. Die Bewertung wurde unabhängig von zwei Methodikerinnen vorgenommen. Jegliche Diskrepanz wurde bis zum Konsens diskutiert.

Die Datenextraktion erfolgte in vorab getesteten, standardisierten Extraktionstabellen (Appendix A5). Die gesamte Datenextraktion wurde von einer Methodikerin vorgenommen und von einer zweiten Methodikerin qualitätsgesichert. Jegliche Unstimmigkeiten wurden bis zum Konsens diskutiert.

Für Primärstudien wurden, je nach Studientyp, folgende Daten extrahiert:

- Titel, Referenz, Ziel der Studie und Setting (Land und Jahr der Durchführung)
- *Baseline-Charakteristika:* Alter, Geschlecht, ISS, TRISS, RTS, GCS bzw., falls nicht angegeben, die in den Scores berücksichtigten Items; ggf. weitere den Schweregrad der Verletzung beschreibende Scores und/oder relevante Einflussvariablen
- *Ein-/Ausschlusskriterien:* demografische und klinische Ein- und Ausschlusskriterien; formale Einschlusskriterien (z.B. Einverständniserklärung) sowie übergeordnete Einschlusskriterien für Register wurden nicht berücksichtigt.
- *Patientenfluss:* Die Anzahl an eingeschlossenen und analysierten Patienten sowie Patienten, die die Studie abgebrochen haben (Drop-outs + Lost to follow-up).
- *Beschreibung der Interventions-/Kontrollgruppe:* detaillierte Beschreibung der Intervention(en) und der Kontrolle; bzw. für Diagnosestudien wurden der Indextest und der Referenztest beschrieben. Zusätzlich wurden relevante Ko-Interventionen beschrieben.
- *Variablen:* Bei adjustierten Studien bzw. solchen mit Propensity score matching wurden die Variablen dokumentiert, die zur Adjustierung / zum Matching verwendet wurden.
- *Ergebnisse zu klinischen/patientenrelevanten Endpunkten:* Für Ereignisse wurde für jeden Endpunkt die Anzahl je Gruppe (n), Grundgesamtheit (N) und Rate (%) extrahiert und, falls angegeben, die relativen Effektmaße (Odds Ratio, relatives Risiko, Hazard Ratio). Die statistische Signifikanz wurde mit *p*-Werten und/oder den Konfidenzintervallen (95% confidence interval, 95% CI) angegeben. Für kontinuierliche Variablen wurde der Mittelwert bzw. die Mittelwertdifferenz mit 95% CI bzw. *p*-Wert angegeben. Es wurden alle berichteten Zeitpunkte extrahiert.

Die Datenextraktionen für die systematischen Reviews umfassten Angaben zu den Ein- und Ausschlusskriterien für die Studienselektion, den Recherchezeitraum sowie Angaben zur Intervention und Kontrolle. Zusätzlich wurden für jeden Vergleich die Heterogenität (I^2) sowie die Anzahl der einbezogenen Studien (N) und der Patienten (n) angegeben. Für die gepoolten Ergebnisse der Metaanalysen wurden die relativen oder die standardisierten Effektmaße extrahiert. Falls keine Metaanalyse durchgeführt worden ist, wurden die Ergebnisse deskriptiv berichtet.

Vergabe von Evidenzgraden

Die Klassifikation des Studientyps erfolgte entsprechend des Algorithmus von Hartling et al. [8] bzw. Mathes et al. [9]. Das „Level of Evidence“ (LoE) wurde pro Studie entsprechend den Vorgaben des Oxford Centre for Evidence-Based Medicine in der Version von März 2009 zugeteilt (Tabelle 4) [10]. Die Basis des LoEs bildet dabei der Studientyp. Für die finale Vergabe des Evidenzgrads wurden das Biasrisiko der Studie, sowie die Konsistenz und Präzision der Effektschätzer berücksichtigt. Für Studien mit unausgewogenen Ausgangswerten und nicht adjustierten Analysen, Post-hoc-Sekundäranalysen, Indirektheit der Studienpopulation oder

geringer Power und Ungenauigkeit der Effektschätzer wurde das LoE herabgestuft und mit einem Pfeil (↓) gekennzeichnet.

⇒ *Änderung Aktualisierung 2022*: Präzisierung der Kriterien, die zur Herabstufung des LoEs von Studien herangezogen wurden. In einzelnen Kapiteln wurde diese Änderung noch nicht umgesetzt, die Vorgehensweise bei diesen Kapiteln ist in Appendix A5 entsprechend erläutert.

Tabelle 4. Evidenzklassifizierung des Oxford Centre for Evidence-Based Medicine (2009)

Grad	Studien zu Therapie/Prävention/Ätiologie
1a	Systematische Übersicht über randomisierte kontrollierte Studien (RCT)
1b	Eine RCT (mit engem Konfidenzintervall)
1c	Alle-oder-keiner-Prinzip
2a	Systematische Übersicht über gut geplante Kohortenstudien
2b	Eine gut geplante Kohortenstudie[a] oder eine RCT minderer Qualität
2c	Outcome-Studien, ökologische Studien
3a	Systematische Übersicht über Fall-Kontroll-Studien
3b	Eine Fall-Kontroll-Studie
4	Fallserien oder Kohorten-/Fall-Kontroll-Studien minderer Qualität
5	Expertenmeinung ohne explizite Bewertung der Evidenz oder basierend auf physiologischen Modellen/Laborforschung

RCT = randomised controlled trial. [a] Einschließlich Registerstudien.

Verknüpfung von Evidenz und Empfehlung

Alle im Rahmen der Aktualisierung verabschiedeten Empfehlungen sind in der Leitlinie direkt mit der zugrunde liegenden Evidenz verknüpft. In den Hintergrundtexten wird beschrieben, wie die Evidenz klinischen bewertet wurde und in Empfehlungen mündete. Dazu werden die Evidenzgrundlage dargelegt, eine Abwägung von Nutzen und Schaden der Intervention beschrieben, wichtige Diskussionspunkte der Konsensuskonferenzen wiedergegeben und die Empfehlungsgrade begründet.

⇒ *Änderungen Aktualisierung 2022*: Nutzung des neuen AWMF-Templats, in dem evidenzbasierte Leitlinienempfehlungen mit Literaturzitaten und Evidenzgraden verknüpft dargestellt werden.

3.4 Formulierung und Graduierung von Empfehlungen

Strukturierte Konsensfindung: Verfahren und Durchführung

Die Konsensfindung erfolgte im Rahmen von strukturierten Konsenskonferenzen, die durch eine externe, neutrale und in den Methoden der strukturierten Konsensfindung geschulte AWMF-Leitlinienberaterin moderiert wurden.

Die beteiligten Fachgesellschaften benannten jeweils mindestens einen Delegierten, welcher als Vertreter der jeweiligen Fachdisziplin bei der Aktualisierung der Leitlinie mitwirkte. Jede Fachgesellschaft hatte eine Stimme im Konsensverfahren. Die stimmberechtigten Delegierten

stimmten jede Empfehlung anonym mittels des Umfragetools der Webkonferenz-Software Zoom[1] ab.

Es fanden fünf strukturierte Konsensuskonferenzen (14.06.2021, 13.09.2021, 26.01.2022, 14.02.2022, 15.03.2022) als Webkonferenzen mittels Zoom statt. In diesen Konferenzen wurden die Empfehlungen sowie die Empfehlungsgrade diskutiert und bei Bedarf modifiziert, abgestimmt und verabschiedet. Die Abstimmungsergebnisse sind in der Leitlinie zusammen mit den Empfehlungen dokumentiert. Für die meisten Empfehlungen wurde ein starker Konsens erreicht (Konsensstärke s. Tabelle 5). Bei Empfehlungen, die mit einer Zustimmungsrate von >75 bis 95% abgestimmt wurden, sind die unterschiedlichen Positionen in den Hintergrundtexten entsprechend dargelegt. Empfehlungen mit mehrheitlicher Zustimmung aber ohne Konsens wurden zur Überarbeitung an die Autorengruppen zurückgegeben und in einer späteren Konsensuskonferenz erneut diskutiert. Empfehlungen ohne mehrheitliche Zustimmung wurden gestrichen.

Tabelle 5. Klassifikation der Konsensstärke

Beschreibung	Zustimmungsrate
starker Konsens	>95% der Stimmberechtigten
Konsens	>75 bis 95% der Stimmberechtigten
mehrheitliche Zustimmung	>50 bis 75% der Stimmberechtigten
keine mehrheitliche Zustimmung	<50% der Stimmberechtigten

Berücksichtigung von Nutzen, Nebenwirkungen und Risiken

Entsprechend der Vorgaben der AWMF [1] wurden Endpunkte zum Nutzen, den Nebenwirkungen und Risiken aus den Studien in die Evidenztabellen extrahiert. Die Autorengruppen wogen für jede Intervention potenziellen Nutzen und Schaden gegeneinander ab. Die Ergebnisse dieser Abwägung flossen in die Formulierung und Graduierung von Empfehlungen ein und wurden in den Hintergrundtexten dokumentiert.

Formulierung der Empfehlungen, Vergabe von Evidenz- und Empfehlungsgraden

Die Autorengruppen der jeweiligen Kapitel arbeiteten Vorschläge für die Formulierung und Graduierung von Empfehlungen aus. Der AWMF-Vorgabe folgend wurde darauf geachtet, eindeutig und spezifisch formulierte, handlungsleitende Leitlinienempfehlungen zu entwickeln.

Bestehende Empfehlungen wurden entweder unverändert übernommen, redaktionell überarbeitet, auf Grundlage neuer Evidenz angepasst oder – im Falle nicht mehr gültiger Aussagen – gestrichen. Auf der Grundlage der vorab definierten Fragestellungen, der methodisch aufbereiteten Evidenz und von Nutzen-Schaden-Abwägungen wurden von den Autorengruppen Vorschläge für neue Empfehlungen formuliert.

⇒ *Änderungen Aktualisierung 2022*: Alle Empfehlungen wurden auf die Zielpopulation von Erwachsenen (≥14 Jahre) ausgerichtet, in den Vorversionen formulierte, altersadaptierte Empfehlungen für Kinder wurden entfernt. Grund ist, dass die „Polytraumaversorgung im Kindesalter“ seit 31.10.2020 durch eine eigene Leitlinie (AWMF-Registernummer 006-120) abgedeckt ist.

[1] https://zoom.us/

Es wurde ein dreistufiges Schema zur Graduierung von Empfehlungen verwendet (Tabelle 6). Bei der Graduierung der Empfehlungen wurden die Stärke, Direktheit und Konsistenz der eingeschlossenen Evidenz, Nutzen-Schaden-Abwägungen, die klinische Erfahrung der Leitliniengruppe, Anwendbarkeit und Umsetzbarkeit im Alltag einbezogen [1]. Überlegungen, die in die Formulierung und Graduierung von Empfehlungen eingeflossen sind, werden in den Hintergrundtexten ausgeführt.

Tabelle 6. Dreistufiges Schema zur Graduierung von Empfehlungen

Symbol	Empfehlungsgrad	Beschreibung	Formulierung
⇑⇑	A	starke Empfehlung	soll / soll nicht
⇑	B	schwache Empfehlung	sollte / sollte nicht
⇔	0	Empfehlung offen	kann erwogen/verzichtet werden

Good (Clinical) Practice Points. War für eine Empfehlung oder Fragestellung keine Evidenz verfügbar, so konnten Empfehlungen auf Basis einer konsentierten Expertenmeinung formuliert werden, die die Formulierung aus Tabelle 6 nutzten, jedoch ohne GoR als *Good (Clinical) Practice Points* (GPP) beschriftet wurden. Dieser Expertenkonsens beruhte im Wesentlichen auf der klinischen Erfahrung der Leitliniengruppe und stellte somit den aktuellen klinischen Standard in einer Behandlung bei nicht verfügbarer Evidenz dar.

3.5 Abgleich mit internationalen Leitlinien

In den Leitliniendatenbanken *GIN international guideline library*[2] und *ECRI guidelines trust*[3] wurde systematisch nach internationalen Leitlinien zur Polytrauma/Schwerverletztenversorgung recherchiert, die im Zeitraum 2016 bis 2021 publiziert wurden. Die Leitliniendatenbanken wurden unter Verwendung von Freitext durchsucht. Die Suchstrategie richtete sich nach dem Aufbau und den Möglichkeiten der jeweiligen Internetseiten. Ergänzt wurde die Liste an potenziell relevanten Leitlinien durch Leitlinien, die im Rahmen der systematischen Literaturrecherchen zu den einzelnen Kapiteln in MEDLINE/Embase identifiziert wurden und durch solche, die von den Kapitelautoren eingereicht wurden.

Recherchezeitraum und verwendete Suchbegriffe

Die Recherchen in Leitliniendatenbanken wurden am 15.03.2021 (GIN) und 17.03.2021 (ECRI) durchgeführt. Suchbegriffe waren *trauma*, *traumatic*, *polytrauma* und *injury* bzw. *injuries*.

Eine Methodikerin selektierte die Leitlinien zum Einschluss auf Basis der Auswahlkriterien in Tabelle 7, eine zweite kontrollierte die Entscheidung.

Bewertung der methodischen Qualität der Leitlinien

Leitlinien, die Kriterien E1 bis einschließlich E10 erfüllten und thematisch für eine Übernahme bzw. Adaptation der Empfehlung in Frage kamen, wurden mit dem AGREE-II-Instrument, Domäne 3 („Rigour of Development“) von zwei Methodikerinnen unabhängig voneinander bewertet, dann konsentiert. Bei größeren Unstimmigkeiten wurde eine dritte Methodikerin hinzugezogen. Die Bewertungen der einzelnen Leitlinien werden auf Anfrage vom IFOM bereitgestellt.

[2] https://guidelines.ebmportal.com/
[3] https://guidelines.ecri.org/

Ergebnisse der Leitlinienrecherche

Insgesamt wurden 255 Leitlinien (exklusive Dubletten) in Leitliniendatenbanken und 28 weitere in Literaturdatenbanken identifiziert. Sieben Leitlinien wurden von Kapitelautoren eingereicht. Es wurden 78 Leitlinien im Volltext auf Einschluss geprüft (Abb. 3). Eingeschlossen wurden 2 allgemeine Leitlinien zum schweren Trauma und 5 zu spezifischen, für die vorliegende Leitlinie relevanten Aspekten (Tabelle 8).

Tabelle 7. Ein- und Ausschlusskriterien für die Leitlinienrecherche

E1	Es handelt sich um eine Leitlinie
E2	Die Leitlinie beinhaltet Empfehlungen zum Thema „Trauma“
E3	Die Leitlinie beinhaltet Empfehlungen für die Behandlung von erwachsenen Patienten mit Polytrauma bzw. Schwerverletzung
E4	Die Leitlinie beinhaltet Empfehlungen zu mindestens einem der folgenden Themen: • Diagnostik • Patienteninformation/-kommunikation • Therapie (Pharmakotherapie / sonstige nicht-medikamentöse Therapien / Psychotherapie) • Koordination von Maßnahmen und Kooperation der Versorger
E5	Die Leitlinie beinhaltet Empfehlungen zu Präklinik, Schockraumversorgung und/oder 1. OP-Phase in Deutschland bzw. die Leitlinien werden als übertragbar in den Zielkontext eingestuft.
E6	Publikationszeitraum: 2015-2021
E7	Publikationssprache: Deutsch, Englisch
E8	Die Leitlinie ist kostenfrei im Volltext verfügbar
E9	Die Leitlinie wird von den Autoren als aktuell bezeichnet bzw. das Überarbeitungsdatum ist nicht überschritten und es liegt keine aktualisierte Fassung vor.
E10	Recherchestrategie (des relevanten Kapitels) und Evidenztabellen müssen angegeben sein
E11	Die Leitlinie wurde mit dem AGREE-II-Instrument von zwei unabhängigen Bewertenden im Konsens als methodisch angemessen eingestuft (methodische Qualität entspricht S3-Niveau)[§]

[§] >70% von AGREE II Domäne 3

Abb. 3. Flowchart zur Leitlinienrecherche

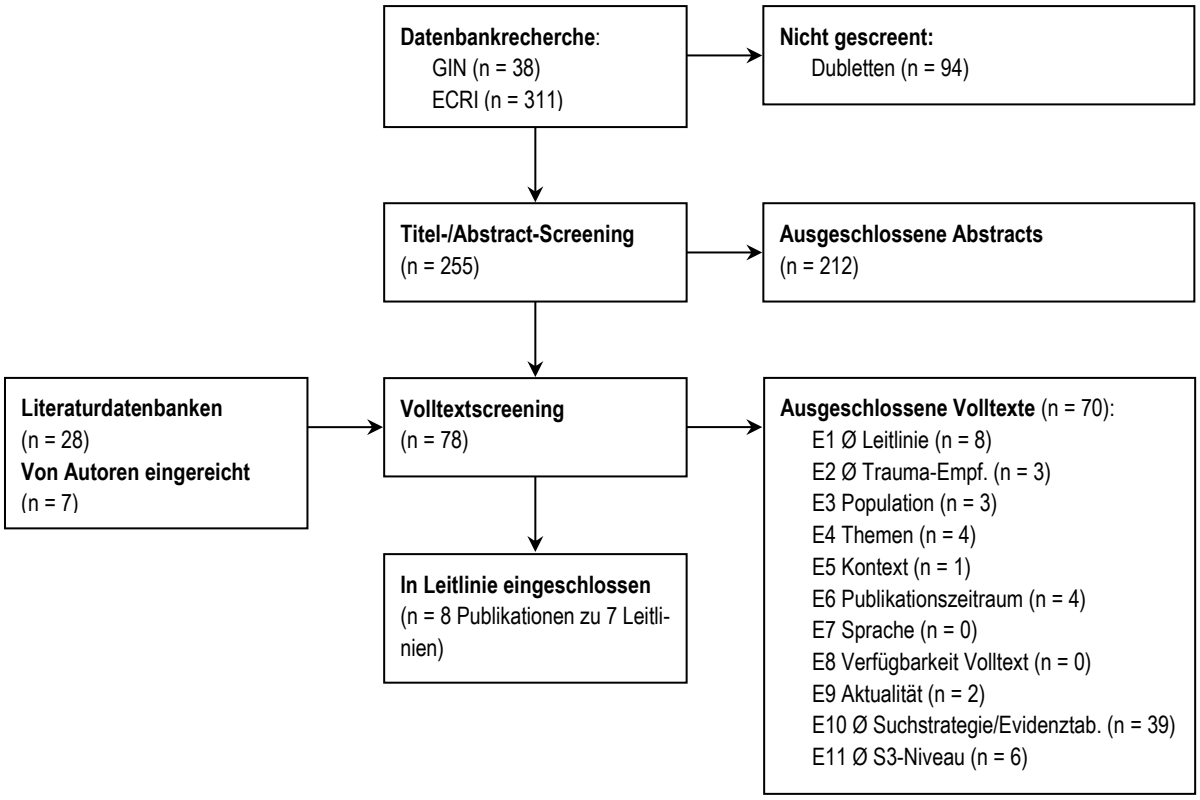


Tabelle 8. Eingeschlossene internationale Leitlinien

Gesellschaft	Leitlinien-Titel	Land	Jahr
NICE	Major trauma: assessment and initial management (NG39)	UK	2016
NICE	Major trauma: service delivery (NG40)	UK	2016
NICE	Spinal injury: assessment and initial management (NG41)	UK	2016
NICE	Update Head injury – assessment and early management	UK	2019
AAOS /METRC	Clinical Practice Guideline on Management of Acute Compartment Syndrome	USA	2018
AAOS /METRC	Clinical Practice Guideline for Limb Salvage or Early Amputation	USA	2019
BTF	Guidelines for the management of severe traumatic brain injury, 4th edition (incl. 2020 Update of the Decompressive Craniectomy Recommendations)	USA	2016

AAOS = American Academy of Orthopaedic Surgeons, BTF = Brain Trauma Foundation, METRC = Major Extremity Trauma and Rehabilitation Consortium, NICE = National Institute for Health and Care Excellence

Ein ausführliches Protokoll der Leitlinienrecherche, eine Liste der gesichteten Volltexte, sowie die Ein- bzw. Ausschlussgründe einzelner Leitlinien werden auf Anfrage vom IFOM bereitgestellt.

Abgleich der Empfehlungen eingeschlossener Leitlinien mit dieser Leitlinie

Nach Abschluss des partiellen Updates dieser Leitlinie wurden alle Empfehlungen mit denen internationaler Leitlinien abgeglichen (Appendix A6). Die Ergebnisse des Abgleichs wurden in

der Steuergruppe diskutiert. Widersprüchliche Empfehlungen sind vor dem Hintergrund der Aktualität der jeweils zugrundeliegenden Evidenz und dem Geltungsbereich der Leitlinie für die Bundesreepublik Deutschand zu bewerten. Von der Möglichkeit der Adoption bzw. Adaptation von Empfehlungen wurde kein Gebrauch gemacht.

4 Externe Begutachtung und Verabschiedung

4.1 Externe Begutachtung

In einer Konsultationsphase durch Peers wurden die Schlüsselempfehlungen und Hintergrundtexte der Leitlinie allen beteiligten Fachgesellschaften zur Prüfung und Kommentierung durch das Präsidium bzw. den Vorstand vorgelegt. Zur Erfassung von Änderungsvorschlägen und Begründungen wurde ein strukturierter Kommentierungsbogen verwendet. Die Ergebnisse wurden dann durch den Leitlinienkoordinator mit den entsprechenden Autorengruppe bewertet, diskutiert und in den Text eingearbeitet.

Alle 2022 aktualisierten Kapitel werden nach Erscheinung der Leitlinie als einzelne Artikel im *European Journal of Trauma and Emergency Surgery* zur Publikation eingereicht.

4.2 Verabschiedung durch den Vorstand der herausgebenden Fachgesellschaft

Alle beteiligten Fachgesellschaften haben der vorliegenden Version inhaltlich zugestimmt.

Alle eingegangenen Änderungswünsche über das Standardrückmeldeformular der AMWF wurden bearbeitet.

Die Leitlinie wurde vom geschäftsführenden Vorstand der Deutschen Gesellschaft für Unfallchirurgie am 17.01.2023 verabschiedet.

5 Redaktionelle Unabhängigkeit

5.1 Finanzierung der Leitlinie

Finanzielle Mittel für die Leitlinienerstellung, u.a. die Entwicklung und Umsetzung der Methodik, wurden von der Deutsche Gesellschaft für Unfallchirurgie e.V. (DGU) zur Verfügung gestellt. Es bestand keine darüber hinausgehende finanzielle Unterstützung. Insbesondere gab es keine Unterstützung durch die Industrie oder durch Kostenträger. Reisekosten für Mandatstragende fielen aufgrund des ausschließlich virtuellen Formats der Treffen nicht an.

5.2 Darlegung von Interessen und Umgang mit Interessenkonflikten

Vor der ersten Konsensuskonferenz der Leitliniengruppe legten alle an der Erstellung der Leitlinie beteiligten Leitlinienautoren ihre Interessen schriftlich mit Hilfe eines online-Formblatts[4] offen, das alle direkten, finanziellen und indirekten Interessen umfasst. Zu den indirekten Interessen gehören ggf. die mandatierende Organisation (z.B. Fachgesellschaft) und der wissenschaftliche Schwerpunkt der betroffenen Person.

Bei Bedarf aktualisierten alle Leitlinienautoren ihre Interessenkonflikterklärungen bis zum Abschluss ihrer Leitlinienarbeit. Eine Übersicht der Erklärungen findet sich in Appendix B dieses Leitlinienreports. Designierte Interessenkonfliktbeauftragte (Prof. M. Bernhard (DGAI), PD Dr. D. Bieler (DGU), Prof. S. Flohé (DGU), Dr. M. Nothacker (AWMF)) waren gemeinsam für die Evaluierung der Ausprägung und Relevanz bestehender Interessenkonflikte nach AWMF-Kriterien[5] verantwortlich.

Dem Risiko von Verzerrungen der Leitlinieninhalte durch etwaige Interessenkonflikte wurde zusätzlich durch die ausgewogene Zusammensetzung der Leitliniengruppe, die Evidenzaufbereitung durch ein unabhängiges Institut (IFOM) und den Einsatz einer formalen Konsensus-Technik mit unabhängiger Moderation entgegengewirkt.

Folgende Interessenskonflikte wurden durch die Interessenkonfliktbeauftragten erarbeitet und in der Steuergruppe verabschiedet.

Geringer Interessenskonflikt:

Vortragshonorare (Industrie)

Moderater Interessenskonflikt:

Advisory Board-Tätigkeiten

Drittmittelforschung für Industrie/Firmen

Hoher Interessenskonflikt:

Lobbyarbeit Industrie

Patente auf Medizinprodukte etc.

[4] Webseite der AWMF zum Interessenkonfliktmanagement, https://interessenerklaerung-online.awmf.org/
[5] AWMF Regelwerk 2020: Erklärung von Interessen und Umgang mit Interessenkonflikten bei Leitlinienvorhaben. https://www.awmf.org/leitlinien/awmf-regelwerk/ll-entwicklung/awmf-regelwerk-01-planung-und-organisation/po-interessenkonflikte/interessenskonflikte.html

Forschung mit Mitteln folgender Geldgeber, die lediglich als Antragsteller eingeworben werden bzw. verwaltet werden, wurden erfasst, stellen aber an sich primär keinen Interessenskonflikt dar.

- DFG
- BMBF
- Innovationsfonds
- gemeinnützige Stiftungen
- Militär
- Ministerien
- andere öffentliche Gelder.

Es gelten Geringfügigkeitsgrenzen. Die Gesamtsumme bei Sponsoring/Förderung durch einen Industriepartner/Firma wurde mit € 3000 pro Jahr pro industriellem Partner festgelegt. Wird diese Summe in der Gesamtförderung nicht überschritten, liegt ein geringer Interessenskonflikt vor, ansonsten wäre von einem moderaten Interessenskonflikt in Bezug auf dieses Unternehmen auszugehen.

Einwerbung von Sponsoring durch (mehrere) Firmen für Fortbildungen, die als

- institutionelle Veranstaltung
- institutioneller Kurs
- Kurse einer Fachgesellschaft

durchgeführt wurden, stellen per se keinen Interessenskonflikt dar, wurden aber erfasst.

Drittmittelforschung für industrielle Partner/Firmen stellen *per se* nicht immer einen moderaten Interessenskonflikt dar. Es muss ein unmittelbarer thematischer Bezug vorliegen, um diesen so zu bewerten. Daher sollen der Drittmittelgeber und der Zweck der Forschung angegeben werden. Ein thematischer Bezug wäre beispielsweise für die in Rede stehende Leitlinie gegeben für:

- Gerinnung
- Endovaskuläre Versorgung
- Großgerätediagnostik
- prähospitale Hilfsmittel
- klinische Hilfsmittel

Das Management der Interessenkonflikterklärungen erfolgte über das AMWF-Portal „Interessenerklärung Online“.

6 Verbreitung und Implementierung

6.1 Konzept zur Verbreitung und Implementierung

Die Leitlinie soll auf folgenden Wegen verbreitet werden:

- Online-Medien: Internetauftritt der AWMF, Internetseite der DGU
- Druckmedien: Publikation der Leitlinie als Manual/Buch durch die DGU. Allen am Trauma-Netzwerk der DGU beteiligten Kliniken wird ein Exemplar zur Verfügung gestellt.
- Fachjournale: Geplant ist ein Sonderband im European Journal of Trauma and Emergency Surgery
- Fachkongresse, Workshops, Fortbildungen der beteiligten Fachgesellschaften

Weiterhin werden alle beteiligten Kliniken angeschrieben und darüber informiert, wie und wo die Leitlinie auf der AWMF-Homepage eingesehen werden kann.

Bei der vorliegenden Leitlinie sollen verschiedene sich ergänzende Maßnahmen zur Implementierung umgesetzt werden. Neben der Präsentation der Empfehlungen auf Kongressen ist eine Verknüpfung mit themenspezifischen Fortbildungsmaßnahmen vorgesehen.

Weiterhin soll rund ein Jahr nach Publikation der Leitlinie eine Evaluation der Implementierung an allen am Trauma-Netzwerk beteiligten deutschen Kliniken erfolgen. Insbesondere sollte erfasst werden, wie die Leitlinie genutzt wurde und welche praktischen Vorschläge die Beteiligten aus ihrer Praxis für andere Anwender haben.

6.2 Unterstützende Materialien für die Anwendung der Leitlinie

Mit der Leitlinie wird eine Kurzversion publiziert, die alle Empfehlungen in übersichtlicher Form enthält. Sie wird als A4-Vorlage zur Verfügung gestellt. Eine Leitlinienversion als mobile Applikationen ist in Planung.

6.3 Diskussion möglicher förderlicher und hinderlicher Faktoren für die Anwendung der Leitlinie

(s. AGREE II Kriterium 18, 20)

6.4 Bewertung der Prozess- und/oder Ergebnisqualität der Leitlinie: Qualitätsziele, Qualitätsindikatoren

Qualitätsindikatoren und Evaluierung:

Für das Traumaregister der DGU wurden die Audit-Filter als Kriterien für ein Qualitätsmanagement entwickelt. Ausgehend von den vorhandenen Audit-Filtern wurden für die vorliegende Leitlinie folgende Kriterien festgelegt:

Prozessqualität zur Evaluation in der Präklinik:

- Dauer der präklinischen Zeit zwischen Unfall und Klinikaufnahme bei Schwerverletzten mit ISS ≥16 [Ø min ± SD]
- Intubationsrate bei Patienten mit schwerem Thoraxtrauma (AIS 4–5) durch den Notarzt [%, n/gesamt]
- Intubationsrate bei Patienten mit Verdacht auf Schädel-Hirn-Trauma (bewusstlos, Glasgow Coma Scale [GCS] ≤8) [%, n/gesamt]

Prozessqualität zur Evaluation des Schockraummanagements:

- Zeit zwischen Klinikaufnahme und Durchführung der Röntgenaufnahme des Thorax bei Schwerverletzten (ISS ≥16) [Ø min ± SD]
- Zeit zwischen Klinikaufnahme und Durchführung der Abdomen-/Thorax-Sonografie bei schwerem Trauma (ISS ≥16) [Ø min ± SD]
- Zeit bis zur Durchführung einer Computertomografie des Schädels (cCT) bei präklinisch bewusstlosen Patienten (GCS ≤8) [Ø min ± SD]
- Dauer bis zur Durchführung eines Ganzkörper-Computertomogramms (CT) bei allen Patienten, falls durchgeführt [Ø min ± SD]
- Dauer von Ankunft Notaufnahme bis Abschluss der Diagnostik, wenn diese regulär beendet wurde, bei Schwerverletzten (ISS ≥16) [Ø min ± SD]
- Dauer von Ankunft Notaufnahme bis Abschluss Diagnostik, wenn diese notfallmäßig abgebrochen wurde, bei Schwerverletzten (ISS ≥16) [Ø min ± SD]

Ergebnisqualität zur Gesamtevaluation:

- Standardisierte Mortalitätsrate: Beobachtete Mortalität dividiert durch die erwartete Prognose basierend auf RISC (Revised Injury Severity Classification) bei Schwerverletzten (ISS ≥16)
- Standardisierte Mortalitätsrate: Beobachtete Mortalität dividiert durch die erwartete Prognose basierend auf TRISS (Trauma and Injury Severity Score) bei Schwerverletzten (ISS ≥16)

Die regelmäßige Erfassung und Bewertung dieser Daten bietet eine grundsätzliche Möglichkeit, die Qualitätsverbesserung in der Versorgung polytraumatisierter und schwer verletzter Patienten zu überprüfen. Welche Effekte dabei auf die Leitlinie zurückzuführen sind, kann auf diese Weise nicht erhoben werden. Es sollte auf Basis der vorgenannten Kriterien eine systematische Weiterentwicklung von Qualitätsindikatoren erfolgen.

7 Gültigkeitsdauer und Aktualisierungsverfahren

7.1 Datum der letzten inhaltlichen Überarbeitung und Status

Die Leitlinie ist ab dem 01.10.2022 bis zur nächsten Aktualisierung (voraussichtlich bis zum 30.09.2027) gültig. Die Gültigkeitsdauer beträgt maximal 5 Jahre und ist abhängig vom eingeschätzten Aktualisierungsbedarf.

7.2 Aktualisierungsverfahren

Verantwortlich für die Einleitung eines Aktualisierungsverfahrens ist die Deutsche Gesellschaft für Unfallchirurgie. Dies soll spätestens ein Jahr vor Ende des 5-jährigen Gültigkeitszeitraums erfolgen. Die Aktualisierung wird analog zum beschriebenen Vorgehen erfolgen, wobei die Methodik auf den neuesten Stand gebracht wird (u.a. Einsatz aktueller Instrumente zur Ermittlung des Biasrisikos, Verwendung der GRADE-Methode zur Bewertung der Vertrauenswürdigkeit der Gesamtheit der Evidenz). Alternativ wird die Überführung in eine „Living Guideline“ in Betracht gezogen, sollte hierzu ein entsprechender Finanzierungsantrag bewilligt werden. Kommentare und Hinweise für den Aktualisierungsprozess sind ausdrücklich erwünscht und können an das Leitliniensekretariat gesendet werden (siehe 1.3).

7.3 Änderungsprotokolle

7.3.1 Änderungen Version 4.1

Seite 1 und 2: Kurz-, Langversion Methodenreport	Ergänzung der Deutschen Gesellschaft für Orthopädie und Kurz Unfallchirurgie e. V.
Seite 27: Methodenreport	Einfügen Änderungsprotokoll
Seite 47: Langversion	Präzisierung letzter Absatz hinsichtlich Ausschluss militärischer Studien zur Tourniquetanwendung
Seite 53 – 56: Langversion	Entfernung aller Marken- und Produktnamen
Seite 73: Kurzversion	Korrektur Empfehlung 3.3.3 – „Neu“ statt „Geprüft“, Ergänzung Literatur
Seite 267: Langversion	Entfernung „Zusammenfassend haben die“ – Ende 2. Absatz
Seite 270 – 277: Langversion	Korrektur Formatierungsfehler im Literaturverzeichnis
Seite 342 Langversion	Korrektur „life before limb“
Seite 367: Langversion	Korrektur Zitat - nun [27] statt [29]
Seite 380: Langversion	Korrektur Empfehlung 3.3.3 – „Neu“ statt „Geprüft“, Ergänzung Literatur

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Appendix A. Evidenzbericht der Aktualisierung 2022

Appendix A1. PICO-Fragen

Alle Fragestellungen, die bei die Aktualisierung 2022 dieser Leitlinie zu beantworten waren, wurden nach dem Schema Population/Intervention/Kontrolle/Outcome (PICO) definiert.

Die Zielpopulation der Leitlinie besteht aus Erwachsenen (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung (ISS ≥16 und/oder GCS <9). In den tabellarisch dargestellten PICO-Fragen sind nur Abweichungen davon sowie Subpopulationen aufgeführt.

Das Setting (Präklinik, Schockraum, 1. OP-Phase) ergibt sich aus den Abschnittstiteln. Die Recherchezeiträume sind in Appendix A2 (Literaturrecherche) dokumentiert, die Studientypen in den Einschlusskriterien definiert.

1 Präklinik

1.1 Stop the bleeding

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
1§	Zielpopulation, Verletzung am Körperstamm/Becken, mit aktiver Blutung	prähospitale REBOA, Thorakotomie und manuelle Kompression der Aorta	nicht spezifiziert	Blutungsstillstand, Mortalität (insbes. früh: 6h, 24h), Transfusionsbedarf, hämodynamische Stabilität, weitere klinisch relevante Outcomes
2	Zielpopulation, Verletzung am Becken, mit aktiver Blutung	prähospitaler Beckengurt, Pelvic Sheeting, evtl. sonstige mechanische Notfallstabilisierung	nicht spezifiziert	Blutungsstillstand, Mortalität (insbes. früh: 6h, 24h), Transfusionsbedarf, hämodynamische Stabilität, weitere klinisch relevante Outcomes
3§	Zielpopulation, Verletzung in Übergangsregionen (Junktional/körperstammnah), mit aktiver Blutung	prähospitale manuelle Kompression, junctional tourniquet	nicht spezifiziert	Blutungsstopp, Vermeiden von Todesfällen vor Erreichen der Klinik, Blutsparender Effekt/Verringerung des Transfusionsbedarfs, Hämodynamische Stabilität bei Erreichen der Klinik, Reduzierte Mortalität (Früh/24 Stunden, Gesamtklinikmortalität), Reduzierte Intensivaufenthaltsdauer
4	Zielpopulation, Verletzung an den Extremitäten, mit aktiver Blutung	prähospitale manuelle Kompression, Kompressionsverbände, Devices mit	nicht spezifiziert	Blutungsstopp, Vermeiden von Todesfällen vor Erreichen der Klinik, Blutsparender

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
		komprimierender Wirkung, Wound Packing; Hämostyptika, Tourniquet		Effekt/Verringerung des Transfusionsbedarfs, Hämodynamische Stabilität bei Erreichen der Klinik, Reduzierte Mortalität (Früh/24 Stunden, Gesamtklinikmortalität), Reduzierte Intensivaufenthaltsdauer
5	Zielpopulation, Verletzung an den Extremitäten, mit aktiver Blutung oder definierte Subpopulation zur Indikationsstellung	prähospitaler Tourniquet	kein Tourniquet	Blutungsstopp, Vermeiden von Todesfällen vor Erreichen der Klinik, Blutsparender Effekt/Verringerung des Transfusionsbedarfs, Hämodynamische Stabilität bei Erreichen der Klinik, Reduzierte Mortalität (Früh/24 Stunden, Gesamtklinikmortalität), Reduzierte Intensivaufenthaltsdauer
6§	Zielpopulation, mit Femurschaftfraktur	prähospitale Extraktionsschienen (z.B. Thomas-Schiene)	nicht spezifiziert	Blutungsstopp, Vermeiden von Todesfällen vor Erreichen der Klinik, Blutsparender Effekt/Verringerung des Transfusionsbedarfs, Hämodynamische Stabilität bei Erreichen der Klinik, Reduzierte Mortalität (Früh/24 Stunden, Gesamtklinikmortalität), Reduzierte Intensivaufenthaltsdauer
7§	Zielpopulation, mit lebensbedrohlicher Blutung unter medikamentöser Antikoagulation (konkret: Thrombininhibitoren)	Hämostyptika (konkret: Chitosan)	Kompressionen mittels manuellem Druck oder Druckverband	Blutungskontrolle, weitere klinisch relevante Outcomes

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
8§	Zielpopulation, Verletzung an Kopf/Gesicht, mit aktiver Blutung bzw. Epistaxis	Manuelle Kompression, Druckverband, Tamponaden, Ballon-Katheter (Bellocq-Tamponade), Klammernahtgeräte (wound clamps), Tamponaden aus Hartfett mit Bissmuth und Tannin (z.B. Stryphnasal® N Nasenstift), topische Tranexamsäure	nicht spezifiziert	Blutungsstopp, Vermeiden von Todesfällen vor Erreichen der Klinik, Blutsparender Effekt/Verringerung des Transfusionsbedarfs, Hämodynamische Stabilität bei Erreichen der Klinik, Reduzierte Mortalität (Früh/24 Stunden, Gesamtklinikmortalität), Reduzierte Intensivaufenthaltsdauer

§ neue Fragestellung

1.2 Atemwegsmanagement, Beatmung und Notfallnarkose

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
1	Patienten mit Apnoe oder Schnappatmung (Atemfrequenz <6)	Präklinische Notfallnarkose, endotracheale Intubation und Beatmung	Keine/nicht alle der oben genannten Interventionen	Patientenrelevante Endpunkte
2	Patienten mit Apnoe oder Schnappatmung (Atemfrequenz <6), Hypoxie (SpO2 <90%), schweres SHT (GCS <9), hämodynamisch instabil (RRsys <90 mmHg), respiratorische Insuffizienz (Atemfrequenz >29)	Präklinische Notfallnarkose, endotracheale Intubation und Beatmung	Keine/nicht alle der oben genannten Interventionen	Patientenrelevante Endpunkte
3	Zielpopulation	Präoxygenierung vor Narkoseeinleitung	Keine Präoxygenierung vor Narkoseeinleitung	Patientenrelevante Endpunkte
4	Zielpopulation	Endotracheale Intubation, Beatmung, Narkoseeinleitung durch trainiertes anästhesiologisches Personal oder anästhesiologischer Facharzt	Kein trainiertes anästhesiologisches Personal oder anästhesiologischer Facharzt	Patientenrelevante Endpunkte
5	Notärztliches Personal	Regelmäßiges Training in Notfallnarkose, endotrachealer	Keine (regelmäßigen) Trainings	First pass intubation access, overall intu-

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
		Intubation und alternativen Methoden zur Atemwegssicherung		bation access, patientenrelevante Endpunkte
6	Zielpopulation, bei der endotrachealen Intubation	Sicherstellung der Oxygenierung, Einsatz entsprechender Algorithmen zur die Maskenbeatmung und/oder alternative Methoden zur Atemwegssicherung	Keine alternativen Methoden zur Atemwegssicherung	Patientenrelevante Endpunkte, Atemwegssicherung
7	Zielpopulation, bei Narkoseeinleitung	Sicherstellung der Oxygenierung, Einsatz entsprechender Algorithmen zur die Maskenbeatmung und/oder alternative Methoden zur Atemwegssicherung	Keine alternativen Methoden zur Atemwegssicherung	Patientenrelevante Endpunkte, Atemwegssicherung
8	Zielpopulation, bei Narkoseeinleitung	Innerklinische Verfügbarkeit von Fiberoptik	Keine Fiberoptik	Patientenrelevante Endpunkte, Atemwegssicherung
9	Zielpopulation, bei Narkoseeinleitung nach mehr als 2 Intubationsversuchen	Alternative Methoden zur Beatmung / Atemwegssicherung	Weitere Intubationsversuche	Patientenrelevante Endpunkte, Atemwegssicherung
10	Zielpopulation	Überwachung mittels EKG, Blutdruckmessung, Pulsoxymetrie und Kapnografie	Keine / andere Überwachung	Patientenrelevante Endpunkte
11	Zielpopulation	Kapnometrie/-grafie im Rahmen der endotrachealen Intubation zur Tubuslagekontrolle und danach zur Dislokations- und Beatmungskontrolle	Keine / andere Überwachung	Patientenrelevante Endpunkte
12	Zielpopulation, endotracheal intubiert und narkotisiert	Normoventilation Herstellung/Überwachung (mit Kapnometrie/-grafie)	Keine Normoventilation Herstellung/Überwachung (mit Kapnometrie/-grafie), andere Verfahren z.B. 10er Regel	Patientenrelevante Endpunkte
13	Zielpopulation, endotracheal intubiert und narkotisiert	engmaschige arterielle Blutgasanalysen in Schockraumphase	Keine/weitmaschige Blutgasanalyse, andere Verfahren	Patientenrelevante Endpunkte

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
14	Zielpopulation	Rapid Sequence Induction als Notfallnarkoseverfahren	Kein RSI/andere Verfahren	Patientenrelevante Endpunkte
15	Zielpopulation	Ketamin (andere) als Einleitungshypnotikum	Etomidat	Patientenrelevante Endpunkte
16	Zielpopulation	Manuelle In-Line-Stabilisation	Andere/Keine Stabilisation	Patientenrelevante Endpunkte
17	Zielpopulation	Videolaryngoskopie zur Steigerung des Intubationserfolgs, bessere Darstellung der Stimmbandebene	Keine Videolaryngoskopie, andere Verfahren (direkte Laryngoskopie)	Patientenrelevante Endpunkte, Intubationserfolg, Sichtbarkeit der Stimmbänder
18	Zielpopulation	Videolaryngoskopie zur Steigerung des Intubationserfolgs	Keine Videolaryngoskopie, andere Verfahren (direkte Laryngoskopie)	Patientenrelevante Endpunkte, Intubationserfolg
19§	Zielpopulation	Traumaspezifische Besonderheiten vorhandener Atemwegsalgorithmen	Kein Atemwegsalgorithmus, andere (Entscheidung-)Optionen	Patientenrelevante Endpunkte
20§	Zielpopulation	Umintubation eines prähospital eingebrachten supraglottischen Atemwegs zur endotrachealen Intubation	Keine Umintubation	Patientenrelevante Endpunkte
21§	Zielpopulation	Invasive Notfalltechniken (Koniotomie)	Andere invasive Notfalltechniken, keine invasiven Notfalltechniken	Patientenrelevante Endpunkte
22§	Zielpopulation	Videolaryngoskopie, Bronchoskopie (Tubus-Carina-Abstand), CT (Dokumentation der korrekten Tubustiefe nach sicherer endotrachealer Intubation)	Vergleiche der oben genannten Verfahren	Patientenrelevante Endpunkte, Intubationserfolg

§ neue Fragestellung

1.3 Gerinnungsmanagement und Volumentherapie

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
	Volumentherapie			
1	Zielpopulation	präklinische Volumentherapie	keine präklinische Volumentherapie	Blutungen, weitere klinisch relevante Outcomes
2	Zielpopulation, mit unkontrollierbaren Blutungen	präklinische Volumentherapie in reduzierter Form (Blutdruckziel niedrig-stabil)	präklinische Volumentherapie in nicht-reduzierter Form (Blutdruckziel Normotension)	Blutungen, weitere klinisch relevante Outcomes
3	Zielpopulation, hypotensive Patienten mit Schädel-Hirn-Trauma	Volumentherapie mit Blutdruckziel Normotension	Reduzierte Volumentherapie mit Blutdruckziel Hypotension	klinisch relevante Outcomes
4	Zielpopulation, ohne Hinweis auf Volumenmangel	keine präklinische Volumentherapie	präklinische Volumentherapie	klinisch relevante Outcomes
	Infusionslösungen			
5	Zielpopulation, mit Volumenmangel	Kristalloide	offen	klinisch relevante Outcomes
6	Zielpopulation, mit Volumenmangel	isotone Kochsalzlösung	offen	klinisch relevante Outcomes
7	Zielpopulation, mit Volumenmangel	balancierte, isotone Vollelektrolytlösungen	offen	klinisch relevante Outcomes
8	Zielpopulation, mit Volumenmangel	balancierte, isotone Vollelektrolytlösungen mit Acetat oder Malat	balancierte, isotone Vollelektrolytlösungen mit Laktat	klinisch relevante Outcomes
9	Zielpopulation, mit Volumenmangel	Volumentherapie mit Humanalbumin-haltigen Lösungen	offen	klinisch relevante Outcomes
	Hypertone Lösungen			
10	Zielpopulation, nach stumpfem Trauma mit hypotonen Kreislaufverhältnissen	hypertone Lösungen	offen	klinisch relevante Outcomes
11	Zielpopulation, mit penetrierendem Trauma und Volumenmangel	hypertone Lösungen	offen	klinisch relevante Outcomes

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
12	Zielpopulation, hypoton, mit schwerem Schädel-Hirn-Trauma	hypertone Lösungen	offen	klinisch relevante Outcomes
	Zugänge			
13	Zielpopulation	venöser Zugang	kein venöser Zugang	klinisch relevante Outcomes
14§	Zielpopulation	zentralvenöse Katheter (Subclavia, Femoralis oder Jugularis)	periphervenöse Kathether	klinisch relevante Outcomes
15§	Zielpopulation	arterielle Kathether	venöse Kathether	klinisch relevante Outcomes
16§	Zielpopulation	intraossäre Zugänge	andere Zugänge (periphärvenös, zentralvenös, arteriell)	klinisch relevante Outcomes
17§	Zielpopulation, die einen Zugang erhält	Anlage von Zugängen mit Ultraschalldiagnostik	Anlage von Zugängen ohne Ultraschalldiagnostik	klinisch relevante Outcomes
	Tranexamsäure			
18§	Zielpopulation, massiv blutend	Tranexamsäure (präklinisch)	keine Tranexamsäure (präklinisch); andere Intervention	klinisch relevante Outcomes
	Blutprodukte			
19§	Zielpopulation	Transfusion mit Vollblut oder Blutkomponenten	offen	klinisch relevante Outcomes
20§	Zielpopulation	Fibrinogen (präklinisch)	kein Fibrinogen (präklinisch); andere Intervention	klinisch relevante Outcomes

§ neue Fragestellung

1.4 Analgesie

Es wurden vorab keine PICO-Fragen definiert.

1.5 Thorax

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
1	Zielpopulation	Klinische Untersuchung des Thorax und der Atemfunktion, inkl. Bestimmung der Atemfre-	Keine/nicht alle der oben genannten Untersuchungen	Patientenrelevante Endpunkte

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
		quenz und Auskultation der Lunge, Verlaufskontrolle. Inspektion, Palpation, Perkussion des Thorax, Pulsoxymetrie und, bei beatmeten Patienten, Überwachung des Beatmungsdrucks und Kapnografie		
2	Zielpopulation	Auskultation auf Normapnoe und thorakaler Schmerzfreiheit zum Ausschluss eines größeren Pneumothorax (ggf. der Einsatz von Ultraschalldiagnostik)	Keine Auskultation in Hinblick auf einen Pneumothorax	Patientenrelevante Endpunkte
3	Zielpopulation	Mögliche okkulte, progredierende Pneumothoraces überwachen	Keine Überwachung von progredierenden Pneumothoraces	Patientenrelevante Endpunkte
4	Zielpopulation, mit einseitig fehlendem Atemgeräusch bei der Auskultation der Lunge und dem zusätzlichen Vorliegen von typischen Symptomen insbesondere einer schweren respiratorischen oder zirkulatorischen Störung	Verdachtsdiagnose Spannungspneumothorax (mit therapeutischer Konsequenz)	Keine Verdachtsdiagnose	Patientenrelevante Endpunkte
5	Zielpopulation, mit Spannungspneumothorax	Frühzeitige Entlastung durch Dekompression	Späte (keine) Entlastung	Patientenrelevante Outcomes
6	Zielpopulation, mit Spannungspneumothorax unter Überdruck Beatmung	Entlastung durch Dekompression	Keine Entlastung, späte Entlastung	Patientenrelevante Outcomes
7	Zielpopulation, mit Spannungspneumothorax ohne Beatmung	Engmaschige klinische Kontrolle	Keine engmaschige klinische Kontrolle	Patientenrelevante Outcomes

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
8	Zielpopulation, mit Spannungs-pneumothorax	Nadeldekompression und anschließende chirurgische Öffnung des Pleuraspalts mit oder ohne Thoraxdrainage **oder** Nadeldekompression, bei unzureichender Wirksamkeit anschließende chirurgische Öffnung des Pleuraspalts mit oder ohne Thoraxdrainage	Keine Entlastung durch Nadeldekompression **oder** Alleinige Entlastung durch Nadeldekompression	Patientenrelevante Outcomes
9	Zielpopulation, mit Pneumothorax	Thoraxdrainage	Keine Thoraxdrainage	Patientenrelevante Outcomes
10 §	Zielpopulation, mit Hämatothorax, Hämatopneumothorax oder Pneumothorax	kleinlumige Drainage (≤24Ch)	großlumige Drainage (>24 Ch)	Patientenrelevante Outcomes
11	Zielpopulation, mit Pneumothorax	Eröffnung des Pleuraraums mittels Minithorakotomie	Andere Öffnung des Pleuraraums	Patientenrelevante Outcomes
12	Zielpopulation, mit Pneumothorax	Einlage der Thoraxdrainage ohne Verwendung eines Trokars	Einlage der Thoraxdrainage mit Trokar	Patientenrelevante Outcomes

§ neue Fragestellung

1.6 Schädel-Hirn-Trauma

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
1	SHT	Vergleich verschiedener Schwellenwerte des systolischen Blutdrucks	Vergleich verschiedener Schwellenwerte des systolischen Blutdrucks	Patientenrelevante Outcomes
2	SHT	Vergleich verschiedener Schwellenwerte der arterielle Sauerstoffsättigung	Vergleich verschiedener Schwellenwerte der arterielle Sauerstoffsättigung	Patientenrelevante Outcomes
3	SHT	wiederholte Erfassung und Dokumentation von Bewusstseinslage, Pupillenfunktion und Glasgow Coma Scale (auch einzelne Aspekte möglich)	keine (wiederholte) Erfassung und Dokumentation von Bewusstseinslage, Pupillenfunktion und Glasgow Coma Scale	Patientenrelevante Outcomes, auch diagnostische Kriterien

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
4	SHT	Gabe von Glukokortikoiden	Keine Gabe von Glukokortikoiden oder andere Maßnahmen	Patientenrelevante Outcomes
5	SHT mit Verdacht auf stark erhöhten intrakraniellen Druck, insbesondere bei Zeichen der transtentoriellen Herniation	Hyperventilation, hypertone Kochsalzlösung, Mannitol	Hyperventilation, hypertone Kochsalzlösung, Mannitol, Barbiturate, potenzielle andere Maßnahmen	Patientenrelevante Outcomes
6	SHT mit perforierender Verletzung	Perforierenden Gegenstand belassen, ggf. abtrennen	Perforierenden Gegenstand entfernen	Patientenrelevante Outcomes
7	SHT mit herausgeschlagenen Zähnen/Zahnfragmenten	Aufnahme, feuchte Lagerung und Transport von herausgeschlagenen Zähnen und Zahnfragmenten ins Traumazentrum	keine Aufnahme, feuchte Lagerung und Transport von herausgeschlagenen Zähnen und Zahnfragmenten ins Traumazentrum	Patientenrelevante Outcomes

1.10 Massenanfall von Verletzten

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
1§	Zielpopulation, bei echtem MANV / simulierten MANV mit echten Patientendaten	validierter Triage-Algorithmus (prähospital oder innerklinisch)	anderer/kein Triage-Algorithmus	Sensitivität, Spezifität, AUC, % korrekte Triage, Über- und Untertriage-Rate* Triagedauer
2§	medizinisch geschultes Personal	Trainingsprogramm	anderes Trainingsprogramm, kein Training	% korrekte Triage, Über- und Untertriage-Rate*
3§	medizinisch geschultes Personal	Trainingsprogramm	Trainingsprogramm, Outcomes in späteren Verlauf (Nachhaltigkeit)	% korrekte Triage, Über- und Untertriage-Rate*
4§	medizinisch geschultes Personal	Evakuierungs-/Transportmethode, Logistikintervention	andere Evakuierungs-/Transportmethode, andere/keine Logistikintervention	zeitliche oder personelle Ressourcen, Aus-/Überlastungsraten, patientenrelevante Outcomes
5§	Zielpopulation, bei echtem MANV / simulierten MANV mit echten Patientendaten	therapeutische Intervention (z.B. Analgesie, Notfallintervention, Operation)	andere/keine therapeutische Intervention	Patientenrelevante Outcomes

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
6§	Zielpopulation, bei echtem MANV / simulierten MANV mit echten Patientendaten	diagnostische Intervention	andere/keine diagnostische Intervention	Dauer bis Ergebnis, Sensitivität, Spezifität, PPV, NPV, AUC, patientenrelevante Outcomes
7§	Zielpopulation, bei echtem MANV, oder Freiwillige mit simulierter Kontamination	Dekontaminationsprotokoll	anderes Dekontaminationsprotokoll / keine Dekontamination	lokale / systemische Reduktion der Kontamination, weitere patientenrelevante Outcomes

§ neue Fragestellung
* jeweils bezogen auf Detektion von P1-Status / Prognose von Mortalität oder lebensrettenden Interventionen

2 Schockraum

2.2 Schockraum – Team und Alarmierung

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
1	Potenziell schwerverletzte oder polytraumatisierte Patienten	Schockraumteam-Aktivierung bei bestimmten Kriterien /Expositionen	Vergleich zu keine Schockraumteam-Aktivierung/verschiedener Level der Notfallversorgung *oder* Schockraumteam-Aktivierung bei anderen Kriterien/Expositionen	Patientenrelevante Outcomes
2	Potenziell schwerverletzte oder polytraumatisierte Patienten	Vergleich verschiedener Kriterien/Expositionen zur Vorhersage von Schwerverletzten oder des Bedarfs an Notfallinterventionen (im Kontext der Schockraumaktivierung/Trauma-Triage)	Vergleich verschiedener Kriterien/Expositionen zur Vorhersage von Schwerverletzten oder des Bedarfs an Notfallinterventionen (im Kontext der Schockraumaktivierung/Trauma-Triage)	Patientenrelevante Outcomes oder Gütekriterien für die Vorhersage von Schwerverletzten oder des Bedarfs an Notfallinterventionen (z.B. Sensitivität, Spezifität)
3	Potenziell schwerverletzte oder polytraumatisierte Patienten	Versorgung durch feste Teams, die nach vorstrukturierten Plänen arbeiten und/oder ein spezielles Training absolviert haben	offen	Patientenrelevante Outcomes
4	Behandelnde (Ärzte, Pflegende) in der Versorgung von polytraumatisierten oder	Training zur Schockraumversorgung *oder*	offen	(Patientenrelevante) Testergebnisse

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
	schwerverletzten Patienten	Vorstrukturierte Pläne zur Schockraumversorgung		
5	Potenziell schwerverletzte oder polytraumatisierte Patienten	Versorgung im Schockraum durch ein Team mit definierter Zusammensetzung	offen	Patientenrelevante Outcomes
6	Potenziell schwerverletzte oder polytraumatisierte Patienten	Erweitere Schockraumteams je nach Versorgungsstufe vorgehalten	offen	Patientenrelevante Outcomes
7	Potenziell schwerverletzte oder polytraumatisierte Patienten	Weitere Patientenversorgung durch Ärzte, die nach ihrer Anforderung innerhalb eines bestimmten Zeitfensters anwesend sind	offen	Patientenrelevante Outcomes
8§	Potenziell schwerverletzte oder polytraumatisierte Patienten	Anmeldung von Schockraum-B ohne Notarzt	Anmeldung von Schockraum-B mit Notarzt	Überlastung der Behandlungskapazitäten in der Notaufnahme/patientenrelevante Outcomes

§ neue Fragestellung

2.3 Reanimation

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
1	Zielpopulation, mit traumatologisch bedingtem Herzkreislaufstillstand	Vorgehen entsprechend eines traumatisch bedingten Herzkreislaufstillstandes (nähere Spezifizierung s.u.)	Vorgehen entsprechend eines nichttraumatisch bedingten Herzkreislaufstillstandes (z.B. Europäische Reanimationsleitline)	Patientenrelevante Outcomes
2	Zielpopulation, mit mit fehlenden Lebenszeichen, Unsicherheit im Nachweis eines Pulses oder mit anderen klinischen Zeichen, die einen Herzkreislaufstillstand wahrscheinlich machen	(frühe) kardiopulmonale Reanimation	Späte kardiopulmonale Reanimation Keine kardiopulmonale Reanimation	Patientenrelevante Outcomes

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
3	Zielpopulation, mit (vermuteter) nicht-traumatischer Ursache eines Herzkreislaufstillstandes	Vorgehen entsprechend der Europäischen Reanimationsleitline	offen	Patientenrelevante Outcomes
4	Zielpopulation, mit (vermutetem) Herzkreislaufstillstand	Diagnostik traumaspezifischer reversibler Ursachen des Herzkreislaufstillstandes während der kardiopulmonalen Reanimation nach ABCDE-Schema Therapie traumaspezifischer reversibler Ursachen des Herzkreislaustillstandes während der kardiopulmonalen Reanimation	Keine Diagnostik traumaspezifischer reversibler Ursachen des Herzkreislaufstillstandes während der kardiopulmonalen Reanimation (nach ABCDE-Schema) Keine Therapie traumaspezifischer reversibler Ursachen des Herzkreislaustillstandes während der kardiopulmonalen Reanimation *oder* offen	Patientenrelevante Outcomes
5	Zielpopulation, mit traumabedingtem Herzkreislaufstillstand und vermutetem Spannungspneumothorax	Beidseitige Entlastung mittels Minithorakotomie	offen	Patientenrelevante Outcomes
6	Zielpopulation, mit Herzkreislaufstillstand	Diagnostik traumaspezifischer reversibler Ursachen des Herzkreislaufstillstandes mittels eFAST (in der Präklinik/im Schockraum)	keine/andere diagnostische Verfahren (in der Präklinik/im Schockraum)	Klinisch relevante Outcomes (Pneumothorax, Hypovolämie, Perikardtamponade, Lungenembolie, Pseudo-PEA), diagnostische Gütekriterien
7	Zielpopulation, mit (vermuteten) traumabedingten Herzkreislaufstillstand durch stumpfes Trauma	Behebung reversibler Ursachen des traumabedingten Herzkreislaufstillstandes Behebung reversibler Ursachen des traumabedingten Herzkreislaufstillstandes bei paralleler Thoraxkompression	Thoraxkompression ohne Behebung reversibler Ursachen des traumabedingten Herzkreislaufstillstandes	Patientenrelevante Outcomes
8	Zielpopulation, mit vermuteten) traum-	Behebung reversibler Ursachen des traum-	Behebung reversibler Ursachen des traum-	Patientenrelevante Outcomes

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
	abedingten Herzkreislaufstillstand durch stumpfes Trauma	abedingten Herzkreislaufstillstandes vor Beginn der Thoraxkompression	abedingten Herzkreislaufstillstandes nach Thoraxkompression	
9	Zielpopulation	Intraarterieller Katheter zur invasiven kontinuierlichen Blutdruckmessung (Schockraum)	Kein intraarterieller Katheter (Schockraum) / anderes Verfahren zur Blutdruckmessung	Klinisch relevante Outcomes
10	Zielpopulation, mit Herzkreislaufstillstand	Ausschluss/Behandlung aller potenziell reversibler Ursachen eines traumatischen Herzkreislaufstillstandes vor Abbruch der Reanimationsmaßnahmen	Abbruch der Reanimationsmaßnahmen ohne vorherige/n Ausschluss/Behandlung aller potenziell reversiblen Ursachen eines traumatischen Herzkreislaufstillstandes	Patientenrelevante Outcomes
11	Zielpopulation, mit Herzkreislaufstillstand und frustraner Reanimation nach Beseitigung möglicher traumaspezifischer reversibler Ursachen	Beendung der kardiopulmonalen Reanimation	Fortführung der kardiopulmonalen Reanimation	Patientenrelevante Outcomes
12	Zielpopulation, mit sicheren Todeszeichen oder mit dem Leben nicht zu vereinbarenden Verletzungen	Kardiopulmonale Reanimation	Keine kardiopulmonale Reanimation	Patientenrelevante Outcomes, Gefahr für das Team
13	Zielpopulation, mit Herzkreislaufstillstand, penetrierenden Verletzungen und initial bestehenden Lebenszeichen	Notfallthorakotomie	offen	Patientenrelevante Outcomes
14	Zielpopulation, mit Herzkreislaufstillstand, penetrierenden Verletzungen und initial bestehenden Lebenszeichen	Notfallthoraktomie zum Zeitpunkt 1 nach Herzkreislaufstillstand	Notfallthoraktomie zum Zeitpunkt 2 nach Herzkreislaufstillstand	Patientenrelevante Outcomes
15	Zielpopulation, mit therapierefraktärem Kreislaufstillstand	Extrakorporale Zirkulation und Oxygenierung	Offen	Patientenrelevante Outcomes

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
16§	Zielpopulation, nach traumatisch bedingtem Herzkreislaufstillstand	Intervention (nicht näher definiert)	andere Intervention (nicht näher definiert)	Patientenrelevante Outcomes

§ neue Fragestellung

2.4 Gerinnungsmanagement und Volumentherapie

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
	Gerinnungsdiagnostik und Therapie			
1	Zielpopulation	frühe Gerinnungsdiagnostik	spätere Gerinnungsdiagnostik	diagnostische Testgüte, klinisch relevante Outcomes (Koagulopathie, weitere)
2	Zielpopulation	frühe Gerinnungstherapie	spätere Gerinnungstherapie	klinisch relevante Outcomes (Koagulopathie, weitere)
3	Zielpopulation	Standardlabor: BGA, Quick (Prothrombinzeit), aPTT, Fibrinogen und Thrombozytenzahl	offen	diagnostische Testgüte, klinisch relevante Outcomes (Koagulopathie, weitere)
4	Zielpopulation	frühzeitige Messung von BGA, Quick (Prothrombinzeit), aPTT, Fibrinogen und Thrombozytenzahl	spätere Messung	diagnostische Testgüte, klinisch relevante Outcomes (Koagulopathie, weitere)
5	Zielpopulation	mehrfache Messung von BGA, Quick (Prothrombinzeit), aPTT, Fibrinogen und Thrombozytenzahl	einfache Messung	diagnostische Testgüte, klinisch relevante Outcomes (Koagulopathie, weitere)
6	Zielpopulation	Blutgruppenbestimmung	keine Blutgruppenbestimmung	klinisch relevante Outcomes (Koagulopathie, weitere)
7	Zielpopulation	viskoelastisches Testverfahren	offen (inkl. andere viskoelastisches Testverfahren)	diagnostische Testgüte, Koagulopathie und andere klinisch relevante Outcomes
8	Zielpopulation	Frühzeitiges viskoelastisches Testverfahren	Anderer Zeitpunkt viskoelastisches Testverfahren	diagnostische Testgüte, Koagulopathie und andere klinisch relevante Outcomes

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
	Volumentherapie			
9	Zielpopulation, aktiv blutend	Volumentherapie mit permissiver Hypotension (definiertes Blutdruckziel)	Volumentherapie mit Blutdruckziel Normotension (anderes definiertes Blutdruckziel)	klinisch relevante Outcomes
10	Zielpopulation, mit hämorrhagischem Schock und • Schädel-Hirn-Trauma (GCS <9) • spinalem Trauma mit neurologischer Symptomatik	Volumentherapie mit Blutdruckziel MAP 85-90 mmHg	Volumentherapie mit anderem Blutdruckziel	klinisch relevante Outcomes
11	Zielpopulation, ohne zentralnervöse Verletzung und ohne KHK	Volumentherapie mit Blutdruckziel MAP ~50 mmHg	Volumentherapie mit anderem Blutdruckziel	klinisch relevante Outcomes
	Infusionslösungen			
12§	Zielpopulation	Kolloide	offen	Koagulopathie, Mortalität, weitere klinisch relevante Endpunkte
	Basenüberschuss/Laktat			
13	Zielpopulation, mit Schock	Messung von Basenüberschuss / Laktat bei der Schockbehandlung	offen	diagnostische Testgüte, Koagulopathie, anderes Outcome, Therapieentscheidung, ausreichende Perfusion trotz Hypotension
14	Zielpopulation, mit Schock	wiederholte Messung von Basenüberschuss / Laktat bei der Schockbehandlung	einmalige Messung von Basenüberschuss / Laktat	Koagulopathie, anderes Outcome, Therapieentscheidung, ausreichende Perfusion trotz Hypotension
	Temperaturmanagement			
15	Zielpopulation	Maßnahmen zur Vermeidung von Auskühlung (≤34 °C), Anstreben von Normothermie, (Verwendung von gewärmten Infusionslösungen (40-42°C), Decken, Entfernung	Keine / andere Maßnahme, keine Normothermie	Mortalität und andere klinisch relevante Outcomes, Thrombozytenfunktion, Aktivität der Gerinnungsfaktoren

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
		nasser Kleidung, Wärmematte, Wärmestrahler, Heißluft-Gebläse, RT 28-29°C)		
16§	Zielpopulation	Wärmeaustausch-Katheter	offen	Mortalität und andere klinisch relevante Outcomes
	Azidämie, Hypokalzämie			
17	Zielpopulation	Vermeidung Azidämie (≤7,2, Pufferung)	Keine Vermeidung Azidämie (Verfahren, die eine Azidose verstärken, wie Hypoventilation, NaCl-Infusion)	Koagulopathie, Mortalität, weitere klinisch relevante Outcomes
18	Zielpopulation	Behandlung Azidämie (≤7,2) durch geeignete Schocktherapie	Keine Behandlung Azidämie	Azidämie, Mortalität, andere klinisch relevante Outcomes
19	Zielpopulation	Verfahren zur Vermeidung von Hypokalzämie <0,9 mmol/l (z.B. weniger FFP oder langsamere Transfusion)	Keine Vermeidung von Hypokalzämie	Hypokalzämie, Mortalität, andere klinisch relevante Outcomes
20	Zielpopulation	Anstreben Normokalzämie (Substitution mit Ca^{2+})	Kein Anstreben Normokalzämie	Hypokalzämie, Mortalität und andere klinisch relevante Outcomes
	Blutprodukte, Transfusion			
21	Zielpopulation	Behandlung nach Massivtransfusions- oder Gerinnungstherapieprotokoll	Behandlung nicht nach Massivtransfusions- oder Gerinnungstherapieprotokoll	Mortalität, Koagulopathie, weitere klinisch relevante Outcomes
22	Zielpopulation, aktiv blutend	Entscheidung zur Indikation zur Transfusion individuell nach klinischen Kriterien, dem Verletzungsgrad, dem Ausmaß des Blutverlustes, der Kreislaufsituation und der Oxygenierung	Keine individuelle Entscheidung / Entscheidung anhand anderer Kriterien (inkl. scores)	Mortalität, Koagulopathie, andere klinisch relevante Outcomes

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
23§	Zielpopulation	Plasma (FFP, lyophilisiertes Plasma, SD-Plasma)	offen	Mortalität, Koagulopathie, andere klinisch relevante Outcomes
24	Zielpopulation, (erwartete) Massivtransfusion	Frühzeitiger Einsatz von FFP	Anderer Zeitpunkt zum Einsatz von FFP	Mortalität, Koagulopathie, andere klinisch relevante Outcomes
25	Zielpopulation, mit (Massiv-)transfusion	Gabe von FFP:EK:TK in einem definierten Verhältnis (z.B. 4:4:1)	Anderes Verhältnis von FFP:EK:TK	Mortalität, andere klinisch relevante Outcomes
26	Zielpopulation, mit Massivtransfusion	Massivtransfusion mit Faktorkonzentraten gesteuert durch geeignetes Testverfahren	Massivtransfusion mit Faktorkonzentraten ohne Testverfahren (immer gleiche Dosis)	Mortalität, andere klinisch relevante Outcomes
27	Zielpopulation, die eine Massivtransfusion mit Faktorkonzentraten erhält	Testverfahren zur Steuerung von Interventionen mit Faktorkonzentraten	anderes Testverfahren	diagnostische Testgüte, Mortalität, andere klinisch relevante Outcomes
28	Zielpopulation	Substitution mit Fibrinogen	offen	Mortalität, andere klinisch relevante Outcomes
29	Zielpopulation	Substitution mit Fibrinogen bei Fibrinogenwerten von etwa <1,5 g/l (150 mg/dl)	Substitution mit Fibrinogen nach anderen Kriterien	Mortalität, andere klinisch relevante Outcomes
	Tranexamsäure (TXA)			
30	Zielpopulation	TXA	Keine TXA; andere Intervention	Mortalität, andere klinisch relevante Outcomes
31	Zielpopulation	ein Dosisschema TXA (Menge, Infusionsdauer, Zeitpunkt(e))	anderes Dosisschema TXA (Menge, Infusionsdauer, Zeitpunkt(e))	Mortalität, andere klinisch relevante Outcomes
32	Zielpopulation	Keine TXA >3h nach Trauma	TXA >3h nach Trauma	Mortalität, andere klinisch relevante Outcomes
33	Zielpopulation	TXA ohne zeitliche Begrenzung	Keine TXA	Mortalität, andere klinisch relevante Outcomes
	Thromboseprophylaxe			
30	Zielpopulation	frühe Thromboseprophylaxe	spätere Thromboseprophylaxe	Mortalität, andere klinisch relevante Outcomes, VTE

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
	Zugänge			
31§	Zielpopulation, die einen Zugang erhält	Anlage von Zugängen mit Ultraschalldiagnostik	Anlage von Zugängen ohne Ultraschalldiagnostik	klinisch relevante Outcomes

§ neue Fragestellung

2.5 Bildgebung

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
1	Zielpopulation, mit stumpfem oder penetrierendem Abdominaltrauma	eFAST* im Rahmen des Primary Survey	CT, Röntgen, andere	Patientenrelevante Endpunkte, DTA
2	Zielpopulation, ohne zeitnahe Durchführung eines CT	Sonografische Wiederholungsuntersuchungen	Singuläre Sonografische Untersuchung	Patientenrelevante Endpunkte, DTA
3	Zielpopulation, mit v.A. Pneumo- oder Hämatothorax	transthorakale Ultraschalluntersuchung	Andere, CT, etc.	Patientenrelevante Endpunkte, DTA
4	Zielpopulation, mit unklarer thorakaler Verletzung, ohne zeitnahe Durchführung eines CT	Röntgen des Thorax	Andere Verfahren, keine	Patientenrelevante Endpunkte, DTA
5	Zielpopulation, mit unklarer pelviner Verletzung, ohne zeitnahe Durchführung eines CT	Röntgen der Beckenregion	Andere Verfahren, keine	Patientenrelevante Endpunkte, DTA
6	Zielpopulation, mit V.a. relevante Verletzungen von Thorax, Abdomen, Becken oder Frakturen der Wirbelsäule oder großen Röhrenknochen	Ganzkörper CT mit traumaspezifischem Protokoll	Andere Verfahren, selektive CT, keine	Patientenrelevante Endpunkte, DTA
7	Zielpopulation, mit einer Störung der Vitalparameter (Kreislauf, Atmung, Bewusstsein), bestimmtem Unfallmechanismus, mindestens 2 relevant verletzte Körperregionen	Ganzkörper CT	Andere Verfahren, selektive CT, keine	Patientenrelevante Endpunkte, DTA
8	Zielpopulation	CT nahe des Schockraums	CT weiter entfernt vom Schockraum	Patientenrelevante Endpunkte

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
9	Zielpopulation, hämodynamisch instabil	Ganzkörper-CT mit Kontrastmittel	Andere Verfahren, kein Kontrastmittel, keine	Patientenrelevante Endpunkte, DTA
10§	Zielpopulation, mit spezifischen Indikationen	CT	Kein CT/ anderes Verfahren	Patientenrelevante Endpunkte, DTA
11§	Zielpopulation, mit spezifischen Indikationen	Prähospitale Sonographie	Keine (spätere) Sonographie / anderes Verfahren	Patientenrelevante Endpunkte, DTA
12§	Zielpopulation, mit spezifischen Indikationen	Ganzkörper-CT	Kein Ganzkörper-CT / anderes Verfahren	Patientenrelevante Endpunkte, DTA
13§	Zielpopulation, mit initial unauffälligem Anteil des abdominellen CT	Re-Fast	Kein Re-Fast / singuläres e-Fast / anderes Verfahren	Patientenrelevante Endpunkte, DTA
14§	Zielpopulation, mit spezifischen Indikationen	MRT	Kein MRT / andere Verfahren	Patientenrelevante Endpunkte, DTA
15§	Zielpopulation	Prähospitale invasive Notfalltechnik (z.B. Entlastung Pneumothorax, Herzbeuteltamponade) mit Sonografie	Nicht invasive Notfalltechnik/ Invasive Notfalltechnik ohne Sonografie	Patientenrelevante Endpunkte

§ neue Fragestellung

2.6 Endovaskuläre Therapie von Blutungen und Gefäßläsionen

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
1	Zielpopulation, mit aktiver innerer Blutung (bzw. definierte Subpopulation(en) zur Indikationsstellung)	frühe Embolisation	spätere Embolisation	Blutungsstillung, Mortalität, hämodynamische Stabilität, Transfusionsbedarf, Komplikationen, weitere klinisch relevante Outcomes
2	Zielpopulation, mit aktiver innerer Blutung und Intimadissektion, Gefäßzerreißung (Perforation), AV-Fistel, Pseudoaneurysma oder traumatischer Aortenruptur	endovaskuläre Therapie (nichtgecoverte und gecoverte Stents, Ballonkatheter sowie feste und flüssige Embolisate, z.B. Metallspiralen, Mikrosphären/Gelatinepartikel, PTFE-beschichtete Plugs oder Gewebekleber)	nicht spezifiziert (u.a. konservative Therapie, offenchirurgische Operation)	Blutungsstillung, Mortalität, hämodynamische Stabilität, Transfusionsbedarf, Komplikationen, weitere klinisch relevante Outcomes

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
3	Zielpopulation, mit aktiver innerer Blutung, entweder kreislaufinstabil oder anders definierte Subpopulation(en) zur Indikationsstellung	REBOA (resuscitative endovascular balloon occlusion of the aorta)	nicht spezifiziert; auch REBOA (andere Zone, anderer Zeitpunkt, mit vs. ohne weitere Eingriffe, mit vs. ohne Zertifizierung) oder keine Intervention	Blutungsstillung, Mortalität, hämodynamische Stabilität, Transfusionsbedarf, Komplikationen, weitere klinisch relevante Outcomes
4	Zielpopulation, mit aktiver innerer Blutung nach Embolisation	endovaskuläre Therapie (nichtgecoverte und gecoverte Stents, Ballonkatheter sowie feste und flüssige Embolisate, z.B. Metallspiralen, Mikrosphären/Gelatinepartikel, PTFE-beschichtete Plugs oder Gewebekleber)	nicht-endovaskuläre Therapie	Blutungsstillung, Mortalität, hämodynamische Stabilität, Transfusionsbedarf, Komplikationen, weitere klinisch relevante Outcomes
5‡	Zielpopulation, mit pelvinem Trauma	Computertomographie mit Kontrastmittel identification of bleeding at angiography or by direct inspection using laparotomy that required hemostasis by angioembolization or surgery	Angiographie, andere Verfahren	diagnostische Testgüte, klinisch relevante Outcomes

‡ PICO-Frage nachträglich hinzugefügt, Literaturrecherche durch aktuellen SR ersetzt

2.7 Thorax

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
1	Zielpopulation, im Bereich des Thorax	Anamnese mit Einbezug des Unfallhergang bei Verkehrsunfällen	Keine Anamnese	Sensitivität/Spezifität Thoraxtrauma/Aortenruptur
2	Zielpopulation, im Bereich des Thorax	Klinische Untersuchungen am Thorax inkl. Auskultation	Ausschließlich präklinische Untersuchung, Untersuchung ohne Auskultation	Sensitivität/Spezifität Thoraxtrauma
3	Zielpopulation, im Bereich des Thorax	Spiral-CT mit Kontrastmittel	Keine Bildgebung, CT ohne Kontrast, CT und Röntgen, andere Bildgebung (nur Sonographie, nur Röntgen)	Sensitivität/Spezifität Thoraxtrauma

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
4	Zielpopulation, im Bereich des Thorax ohne initiale CT mit KM	Initiale Sonographie	CT, Röntgen	Sensitivität/Spezifität Pneumothorax
5	Zielpopulation, im Bereich des Thorax	Dreikanal-EKG	Kein EKG	Kontrolle der Vitalfunktion
6	Zielpopulation, im Bereich des Thorax mit V.a. stumpfe Myokardverletzung	Zwölfkanal-EKG	Kein EKG, Dreikanal EKG	Sensitivität/Spezifität
7	Zielpopulation, im Bereich des Thorax mit V.a. stumpfe Myokardverletzung	Labor Troponin	Kein Labor Troponin	Sensitivität/Spezifität stumpfen Myokardverletzungen
8	Zielpopulation, beatmet oder nicht beatmet, Verletzung im Bereich des Thorax mit klinisch relevantem oder progredientem Pneumothorax	Thoraxdrainage Größe 24-32	Keine Thoraxdrainage, Thoraxdrainage mit größem Charrière	Spannungspneumothorax, andere Komplikationen
9	Zielpopulation, Verletzung im Bereich des Thorax mit nachgewiesener Herzbeuteltamponade und sich verschlechternden Vitalparametern	Perikardentlastung (sonographisch gestütze Punktion)	Thorakotomie	Hämodynamische Entgleisung, Mortalität
10	Zielpopulation, hämodynamisch instabil, Verletzung im Bereich des Thorax	eFAST	Anlage eines perikardialen Fensters, Perikardpunktion	Sensitivität/Spezifität Perikardtamponade, Indikationsstellung zur Operation
11	Zielpopulation, Verletzung im Bereich des Thorax mit initialem Blutverlust >1500ml aus Drainage oder >250ml/h über 4h	Thorakotomie	Alleinige Bildgebung (Sonographie, CT)	Blutverlust, hämorrhagischer Schock, Mortalität
12	Zielpopulation, Verletzung im Bereich des Thorax	Keine Thorakotomie	Thorakotomie	Mortalität

[§] neue Fragestellung

2.9 Becken

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
1	Zielpopulation, mit (potentieller) Becken(ring)fraktur	Stabilisierung des Beckenrings mittels Beckengurt	Vergleich von verschiedenen Zeitpunkten (frühe vs. Späte) Stabilisierung mittels Beckengurt Keine Stabilisierung mittels Beckengurt Andere Verfahren	Patientenrelevante Outcomes (z. B. Überleben, C-Problem, Komplikationen)
2	Zielpopulation, mit (potentieller) Becken(ring)fraktur	Stabilisierung des Beckenrings mittels Zwinge Stabilisierung des Beckenrings mittels Fixateur externe Stabilisierung des Beckenrings mittels rescue SI Schraube Stabilisierung des Beckenrings mittels Rückzugsosteosynthese	Vergleich verschiedener der o.g. Verfahren miteinander Vergleich von verschiedenen Zeitpunkten (frühe vs. späte) Stabilisierung Vergleich zu keiner Stabilisierung	Patientenrelevante Outcomes (z.B. Überleben, C-Problem, Komplikationen)
3	Zielpopulation, mit (potentieller) Becken(ring)fraktur	Blutstillung mittels packing Blutstillung mittels Angioembolisation Blutstillung mittels REBOA	Vergleich verschiedener der o.g. Verfahren miteinander Vergleich eines der o.g. Verfahren mit einem anderen Verfahren Vergleich verschiedener Zeitpunkte (frühe vs. späte Blutstillung)	Patientenrelevante Outcomes (z.B. Überleben, C-Problem, Komplikationen), Verbrauch an Erythrozytenkonzentrat
4	Zielpopulation, mit (potentieller) Becken(ring)fraktur	Blutstillungsalgorithmus: pelvic binder→Fixex/Zwinge→Packing→Angio	Blutstillungsalgorithmus: pelvic binder→Angio→Stabilisierung→Packing	Patientenrelevante Outcomes (z.B. Überleben, C-Problem, Komplikationen), Verbrauch an Erythrozytenkonzentrat
5	Zielpopulation, mit (potentieller) Becken(ring)fraktur	Klinische Stabilitätsprüfung Andere klinische Untersuchung	Vergleich der o.g. Verfahren miteinander Vergleich zu keiner klinischen Untersuchung/Stabilitätsprüfung Vergleich zu anderen diagnostischen Maßnahmen	Patientenrelevante Outcomes (z.B. Überleben, C-Problem, Komplikationen), Testgüte

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
6	Zielpopulation, mit (potentieller) Becken(ring)fraktur	Diagnostik mittels Rö-Beckenübersicht Diagnostik mittels CT Ganzkörper Scan (clear the pelvis Algorithmus) Diagnostik mittels CT mit Kontrastmittel Diagnostik mittels Angiographie	Vergleich verschiedener der o.g. Verfahren miteinander Vergleich zu anderen diagnostischen Maßnahmen Vergleich verschiedener Algorithmen der o.g. Verfahren	Patientenrelevante Outcomes (z. B. Überleben, C-Problem, Komplikationen), Testgüte
7§	Zielpopulation, mit klinischem Hinweis auf eine Beckenfraktur/Harnröhrenverletzung	Transurethrale Katheterisierung	offen	Patientenrelevante Outcomes

§ neue Fragestellung

2.10 Schädel-Hirn-Trauma

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
1	SHT	wiederholte Erfassung und Dokumentation von Bewusstseinslage, mit Pupillenfunktion und Glasgow Coma Scale (Motorik bds.); auch einzelne Aspekte möglich	keine (wiederholte) Erfassung und Dokumentation von Bewusstseinslage, mit Pupillenfunktion und Glasgow Coma Scale (Motorik bds.)	patientenrelevante Outcomes, auch diagnostische Kriterien
2	SHT	Vergleich verschiedener Schwellenwerte der arteriellen Sauerstoffsättigung	Vergleich verschiedener Schwellenwerte der arteriellen Sauerstoffsättigung	Patientenrelevante Outcomes
3	Bewusstlose Patienten (Anhaltsgröße GCS ≤8) mit SHT	Intubation	Keine Intubation oder andere Form der Intubation	Patientenrelevante Outcomes
4	SHT	Vergleich verschiedener Schwellenwerte des systolischen Blutdrucks	Vergleich verschiedener Schwellenwerte des systolischen Blutdrucks	Patientenrelevante Outcomes
5	Polytrauma mit Verdacht auf SHT	Durchführung cCT	Keine Durchführung von cCT oder andere bildgebende Verfahren	Patientenrelevante Outcomes
6	SHT mit neurologischer Verschlechterung	(Kontroll-)CT	keine (Kontroll-)CT oder andere bildgebende Verfahren	Patientenrelevante Outcomes

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
7	Bewusstlose Patienten und/oder Verletzungszeichen in der initialen cCT	Verlaufs-cCT innerhalb von 8 Stunden	Keine Verlaufs-cCT innerhalb von 8 Stunden oder andere bildgebende Verfahren	Patientenrelevante Outcomes
8	SHT	Gabe von Glukokortikoiden	Keine Gabe von Glukokortikoiden oder andere Maßnahmen	Patientenrelevante Outcomes
9	SHT mit Verdacht auf stark erhöhten intrakraniellen Druck, insbesondere bei Zeichen der transtentoriellen Herniation	Hyperventilation, Mannitol, hypertone Kochsalzlösung	Hyperventilation, hypertone Kochsalzlösung, Mannitol, Barbiturate, potenzielle andere Maßnahmen	Patientenrelevante Outcomes

2.12 Unterkiefer und Mittelgesicht

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
1	Zielpopulation	Ausschluss von funktionellen oder ästhetischen Verletzungen im Kopf-Hals-Bereich während der klinischen Untersuchung	Kein Ausschluss von funktionellen oder ästhetischen Verletzungen im Kopf-Hals-Bereich	Patientenrelevante Outcomes, Ästhetik
2	Zielpopulation, mit klinischem Anhalt für Unterkiefer- und Mittelgesichtsverletzungen	Weiterführende diagnostische Maßnahme (1)	Keine weiterführende diagnostische Maßnahmen Andere diagnostische Maßnahme (2)	Patientenrelevante Outcomes, Testgüte

2.13 Hals

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
1	Zielpopulation, mit Halsverletzung	Sicherstellung der Atemwege	Therapie ohne Sicherstellung der Atemwege/ anderes Verfahren	klinische, patientenrelevante Outcomes
2	Zielpopulation, mit Trachealeinrissen, -abrissen oder offenen Trachealverletzungen	Chirurgische Exploration mit Anlage eines Tracheostomas	keine chirurgische Exploration mit Anlage eines Tracheostomas / anderes Verfahren	klinische, patientenrelevante Outcomes
3	Zielpopulation, mit Trachealeinrissen, -	direkte Rekonstruktion	anderes Verfahren / keine Rekonstruktion	klinische, patientenrelevante Outcomes

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
	abrissen oder offenen Trachealverletzungen			
4	Zielpopulation, mit Halsverletzung	frühzeitige Intubation	keine (frühzeitige) Intubation/ anderes Verfahren	klinische, patientenrelevante Outcomes
5	Zielpopulation, mit Halsverletzung	Anlage eines Tracheostomas	keine Anlage eines Tracheostomas/ anderes Verfahren	klinische, patientenrelevante Outcomes
6	Zielpopulation, mit Verdacht auf Halsverletzung	Computertomografie der Halsweichteile	keine Computertomografie der Halsweichteile / anderes diagnostisches Verfahren	klinische, patientenrelevante Outcomes, diagnostische Gütekriterien
7	Zielpopulation, mit Verdacht auf Halsverletzung	endoskopische Untersuchung des traumatisierten Bereiches	keine endoskopische Untersuchung des traumatisierten Bereiches / anderes diagnostisches Verfahren	klinische, patientenrelevante Outcomes, diagnostische Gütekriterien
8	Zielpopulation, mit offenem Halstrauma mit akuter Blutung	Kompression mit anschließender chirurgischer Exploration	keine Kompression/ keine chirurgische Exploration / anderes Verfahren	klinische, patientenrelevante Outcomes
9	Zielpopulation, mit gedecktem Halstrauma	Abklärung des Gefäßstatus / diagnostisches Verfahren 1	keine Abklärung des Gefäßstatus / diagnostisches Verfahren 2	klinische, patientenrelevante Outcomes, diagnostische Gütekriterien

3 Erste OP-Phase

3.1 Thorax

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
1	Zielpopulation, im Bereich des Thorax	Anterolaterale Thorakotomie / Sternotomie Clamshell Thorakotomie bei unklarer Verletzungslokalisation	Anterolaterale Thorakotomie/Sternotomie/Clamshell-Thorakotomie oder therapeutische Thoraskopie	Patientenrelevante Outcomes, Mortalität
2	Zielpopulation, im Bereich des Thorax mit einliegenden Fremdkörpern	Entfernung unter kontrollierten Bedingungen im OP nach Thoraxeröffnung	Entfernung im Schockraum/Präklinisch	Patientenrelevante Outcomes, Mortalität
3	Zielpopulation, mit penetrierenden Thoraxverletzungen	Explorative Thorakotomie	CT, Thoraxdrainage	Patientenrelevante Outcomes, Mortalität

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
4	Zielpopulation, im Bereich des Thorax mit initialem Blutverlust >1500 ml aus Drainage oder >250 ml/h über 4h	Thorakotomie	Alleinige Bildgebung (Sonographie, CT)	Blutverlust, hämorrhagischer Schock, Mortalität
5	Zielpopulation, im Bereich des Thorax mit Operationsindikation (persistierende Blutung/Luftleckage)	Parenchymsparende OP: Übernähung, Traktomie, atypische Resektion, Segmentresektion	Lobektomie, Pneumonektomie	Patientenrelevante Outcomes, Komplikationen, Mortalität
6	Zielpopulation, im Bereich des Thorax mit thorakaler Aortenruptur	Implantation einer Endostentprothese	Offene Revaskularisationsverfahren	Patientenrelevante Outcomes, Komplikationen (zerebrale oder spinale Minderperfuration, postoperative neurologische Ausfälle, Paraplegie, akutes Nierenversagen), Mortalität
7	Zielpopulation, im Bereich des Thorax mit geplanter operativer Aortenrekonstruktion oder konservativem Management	Pharmakologische Blutdruckeinstellung zwischen 90 und 120 mmHg systolisch (Betablocker, Vasodilatatoren)	Anderer Blutdruckbereich, nicht-pharmakologische Blutdrucksenkung	Patientenrelevante Outcomes, Komplikationen, Mortalität
8	Zielpopulation, im Bereich des Thorax mit V.a. Verletzung des Tracheobonchoskopie	Treacheobonchoskopie	Keine Treacheobon-cho-skopie	Sensitivität/Spezifität
9	Zielpopulation, im Bereich des Thorax mit traumatischer oder umschriebener Verletzung des Tracheobronchialsystems	Operative Versorgung	Konservativer Therapieversuch	Patientenrelevante Outcomes, Komplikationen, Mortalität
10[§]	Zielpopulation, mit einem stumpfen oder penetrierenden Thoraxtrauma und Hämatothorax oder Lungenverletzung	Videoassistierte Thorakoskopie	Alle anderen (operativen) Behandlungen des Hämatothorax/Lungenverletzung	Patientenrelevante Outcomes, Komplikationen, Mortalität

[§] neue Fragestellung

3.3 Abdomen

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
1	Zielpopulation, im Bereich des Abdomens	Medianlaparatomie	Andere Zugangswege (quere Inzisionen)	Patientenrelevante Outcomes
2	Zielpopulation, (kreislaufinstabile) im Bereich des Abdomens	Damage-Control-Prinzip (Blutstillung, Packing, temporärer Bauchdeckenverschluss/Lapatostoma)	Definitive Sanierung (Laparotomie)	Patientenrelevante Outcomes
3	Zielpopulation, im Bereich des Abdomens nach Damage-Control-Laparotomie	Temporärer abdominaller Verschluss	Ausschließlicher Hautverschluss, Bogotá-Bag, Faziennaht	Patientenrelevante Outcomes
4	Zielpopulation, im Bereich des Abdomens	Second-Look-OP zwischen 24-72h nach Packing	Second-Look-OP >72h nach Packing, keine Second-Look-OP	Patientenrelevante Outcomes
5	Zielpopulation, im Bereich des Abdomens mit Laparostoma	Definitiver Verschluss so früh wie möglich	Verzögerter Verschluss	Patientenrelevante Outcomes
6	Zielpopulation, im Bereich des Abdomens mit isolierter stumpfer Leber- oder Milzverletzung	Nicht operatives Management	Operatives Management (z.B. Splenektomie)	Patientenrelevante Outcomes
7	Zielpopulation, im Bereich des Abdomens – Leber, Kontrastmittel CT positiv für arterielle Blutungen	Selektive Angioembolisation oder Laparotomie	andere Verfahren	Patientenrelevante Outcomes
8	Zielpopulation, im Bereich des Abdomens – Interventionspflichtige Milzverletzungen	Selektive Angioembolisation	Operative Blutstillung	Patientenrelevante Outcomes
9	Zielpopulation, im Bereich des Abdomens – Operationspflichtige Milzverletzungen mit Schweregrad 1-3 nach AAST/Moore	Milzerhaltene Operation	Splenektomie	Patientenrelevante Outcomes
10	Zielpopulation, im Bereich des Abdomens – Milz mit	Splenektomie	Erhaltungsversuche	Patientenrelevante Outcomes

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
	Schweregrad 4-5 nach AAST/Moore			
11	Zielpopulation, im Bereich des Abdomens – Penetrierendes Kolon	Übernähen/Resektion	Andere Zugangswege (quere Inzisionen)	Intraabdominelle Infektionen

3.4 Schädel-Hirn-Trauma

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
1	Patienten mit raumfordernden intrakraniellen Verletzungen	Notfallmäßiger operativer Eingriff	Kein notfallmäßiger operativer Eingriff inklusive anderer Verfahren	Patientenrelevante Outcomes
2	Bewusstlose schädelhirnverletzte Patienten	ICP Monitoring	Kein ICP Monitoring	Patientenrelevante Outcomes
3	Patienten mit erhöhtem Hirndruck	Operative Dekompression durch Kraniektomie/ Duraerweiterungsplastik	Keine operative Dekompression durch Kraniektomie/ Duraerweiterungsplastik inklusive anderer Verfahren	Patientenrelevante Outcomes

3.5 Wirbelsäule

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
1	Zielpopulation, mit instabilen Wirbelsäulenverletzungen mit gesicherten oder anzunehmenden neurologischen Ausfällen	Frühe operative Versorgung	Späte operative Versorgung	Patientenrelevante Outcomes (z. B. Mortalität, Komplikationen, Neurologie, Beatmungszeit, Intensivbehandlungszeit, Hospitalisierungszeit)
2	Zielpopulation, mit instabilen Wirbelsäulenverletzungen ohne Neurologie	operative Versorgung	Nicht-operative Versorgung	Patientenrelevante Outcomes (z. B. Mortalität, Komplikationen, Neurologie, Beatmungszeit, Intensivbehandlungszeit, Hospitalisierungszeit)
3	Zielpopulation, mit instabilen Wirbelsäulenverletzungen ohne Neurologie	frühe operative Versorgung	späte operative Versorgung	Patientenrelevante Outcomes (z. B. Mortalität, Komplikationen, Neurologie, Be-

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
				atmungszeit, Intensivbehandlungszeit, Hospitalisierungszeit)
4	Zielpopulation, mit stabiler Wirbelsäulenverletzung ohne Neurologie	Konservative Versorgung	Operative Versorgung	Patientenrelevante Outcomes (z. B. Mortalität, Komplikationen, Neurologie, Beatmungszeit, Intensivbehandlungszeit, Hospitalisierungszeit)
5	Zielpopulation, mit instabilen Verletzungen der Halswirbelsäule	Halo-Fixateur	Dorsale o. ventrale Stabilisierungsverfahren	Patientenrelevante Outcomes (z. B. Mortalität, Komplikationen, Neurologie, Beatmungszeit, Intensivbehandlungszeit, Hospitalisierungszeit)
6	Zielpopulation, mit instabilen Verletzungen der Halswirbelsäule	ventrale Stabilisierungsverfahren	dorsale Stabilisierungsverfahren o. Halo-Fixateur	Patientenrelevante Outcomes (z. B. Mortalität, Komplikationen, Neurologie, Beatmungszeit, Intensivbehandlungszeit, Hospitalisierungszeit)
7	Zielpopulation, mit instabilen Verletzungen der thorakolumbalen Wirbelsäule	Dorsaler Fixateur interne als primäre Operationsmethode	Ventrale Operationstechniken als primäre Operationsmethode o. Andere dorsale Operationstechniken als primäre Operationsmethode	Patientenrelevante Outcomes (z. B. Mortalität, Komplikationen, Neurologie, Beatmungszeit, Intensivbehandlungszeit, Hospitalisierungszeit)

3.10 Untere Extremitäten

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
1	Zielpopulation, mit isolierten und multiplen Schaftfrakturen langer Röhrenknochen der unteren Extremitäten	primär-definitive, primär-temporäre oder sekundär-definitive osteosynthetische Versorgung	primär-definitive, primär-temporäre oder sekundär-definitive osteosynthetische Versorgung oder keine Osteosynthese	Patientenrelevante Outcomes
2	Zielpopulation, mit isolierten geschlossenen Schaftfrakturen der Tibia	primär-temporäre Stabilisierung durch Gipsverband	Keine primärtemporäre Stabilisierung durch Gips (Osteosynthetische Versorgung)	Patientenrelevante Outcomes

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
3	Zielpopulation, mit proximaler Femurfraktur	Primär osteosynthetische Stabilisierung	Keine primäre osteosynthetische Versorgung (Gelenkübergreifender Fixateur ex.)	Patientenrelevante Outcomes
4	Zielpopulation, mit proximaler Femurfraktur	Verriegelungsmarknagelung	Keine Verriegelungsmarknagelung (Plattenosteosynthese)	Patientenrelevante Outcomes
5	Zielpopulation, mit instabilen distalen Femurfrakturen	Primäre operative Stabilisierung (nicht definitiv)	Keine primäre operative Stabilisierung (definitive osteosynthetische Versorgung)	Patientenrelevante Outcomes.
6	Zielpopulation, mit Knieluxation	Frühe geschlossene Reposition, wenn geschlossene Reposition erfolglos offene Reposition. Retention durch Fixateur externe oder ähnliches möglich	Späte Reposition	Patientenrelevante Outcomes
7	Zielpopulation, mit proximalen Tibia- und Tibiakopffrakturen	Primäre Stabilisierung durch Schienung	Keine primäre Stabilisierung durch Schienung (Operative Fixierung mit Osteosynthese)	Patientenrelevante Outcomes
8	Zielpopulation, mit proximalen Tibiakopffrakturen	Operative Stabilisierung (meist durch intramedullare Nagelung)	Stabilisierung durch Gips	Patientenrelevante Outcomes
9	Zielpopulation, mit distalen Unterschenkelfrakturen einschließlich artikulärer distaler Tibiafrakturen	Definitive osteosynthetische Versorgung	Keine definitive osteosynthetische Versorgung (Primärversorgung mit Fixateur externe oder ggf. K-Drähten je nach Lokalisation)	Patientenrelevante Outcomes
10	Zielpopulation, mit Sprunggelenksfrakturen	primäre Stabilisierung (operativ/nicht operativ)	Keine primäre Stabilisierung (operativ/nicht operativ)	Patientenrelevante Outcomes
11	Zielpopulation, mit offenen und geschlossenen Frakturen der unteren Extremitäten	perioperative Antibiotikaprophylaxe	Keine perioperative Antibiotikaprophylaxe	Postoperative Wundinfekte, Patientenrelevante Outcomes
12	Zielpopulation, mit Gefäßverletzungen	Frühe operative Versorgung von Gefäßverletzungen, sobald	Späte Versorgung von Gefäßverletzungen	Amputationsrate, Patientenrelevante Outcomes

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
	der unteren Extremitäten	Vitalparameter dies zulassen (noch bevor Reposition von Frakturen)		
13	Zielpopulation, mit Kompartmentsyndrom der unteren Extremität (und begleitender Fraktur)	Frühe (möglicherweise sogar prophylaktische) Fasziotomie zur Kompartmententlastung. Ggf. gefolgt von Osteosynthese durch intramedulläre Marknagelung	Späte Fasziotomie	Irreversible Schäden, Patientenrelevante Outcomes
14	Zielpopulation, mit Schwerverletzungen der unteren Extremität	Amputation	Extremitätenerhalt	Patientenrelevante Outcomes

§ neue Fragestellung

3.12 Urogenitaltrakt

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
1	Zielpopulation, mit Nierenverletzung Grad V nach AAST	Operative Exploration	Konservativ	Patientenrelevante Outcomes
2	Zielpopulation, (kreislaufstabil) mit Nierenverletzung <Grad V nach AAST	Konservativ	Operativ	Patientenrelevante Outcomes
3	Zielpopulation, mit Nierenverletzung Grad III oder IV nach AAST und Indikation zur Laparotomie	operative Exploration	Konservativ	Patientenrelevante Outcomes
4	Zielpopulation, (kreislaufstabil) mit arterieller Nierengefäßverletzung	Therapeutische, selective angiografische Embolisation	Konservativ, anderes Verfahren	Patientenrelevante Outcomes
5	Zielpopulation, mit Nierenverletzung	Übernähung, Nierenteilresektion, organerhaltene Operation	Anderes Verfahren	Patientenrelevante Outcomes
6	Zielpopulation, mit Nierenverletzung Grad V	Primäre Nephrektomie	Anderes Verfahren, Übernähung, Nierenteilresektion, organerhaltene Operation	Patientenrelevante Outcomes

	Population	Intervention(en)	Kontrolle(n)	Outcome(s)
7	Zielpopulation, mit intraperitonealen Harnblasenrupturen	Chirurgische Exploration	Suprapubische Harnableitung	Patientenrelevante Outcomes
8	Zielpopulation, mit extraperitonealen Harnblasenrupturen ohne Beteiligung des Blasenhalses	Suprapubische Harnableitung	Chirurgisches Verfahren/Exploration	Patientenrelevante Outcomes
9	Zielpopulation, mit Urethrarupturen	Suprapubische Harnableitung (ggf. mit Harnröhrenschienung)	Andere Verfahren	Patientenrelevante Outcomes
10	Zielpopulation, mit Urethrarupturen mit Becken oder anderen intraabdominellen Verletzungen	Urethrarurptur Versorgung in einer OP Session	Spätere Versorgung/Operation der Urethraruptur	Patientenrelevante Outcomes

Appendix A2. Literaturrecherche

1 Präklinik

1.1 Stop the bleeding

Suchstrategie 2021, MEDLINE (via Ovid)	Datum: 23.06.2021	650 Treffer

1. exp Multiple Trauma/
2. (polytrauma* or trauma patient? or (severe adj2 shock)).ti,ab,kf.
3. ((multiple or major or severe* or serious*) adj3 (trauma* or injur*)).ti,ab,kf.
4. ((blunt or penetrating) adj5 (trauma* or injur*)).ti,ab,kf.
5. (*Critical Care/ or *Emergencies/ or (life threatening or critical care or emergen*).ti,ab,kf.) and (trauma* or injur*).ti,ab,kf.
6. 1 or 2 or 3 or 4 or 5
7. exp animals/ not humans.sh.
8. (comment or editorial or letter).pt. or case report*.mp.
9. (pelvic adj1 (binder? or binding or sheet? or sheeting)).ti,ab,kf.
10. circumferential compression.ti,ab,kf.
11. (((pressure or compression) adj2 (bandage? or dressing?)) or tourniquet? or ((wound or pelvic or preperitoneal or extraperitoneal) and packing)).ti,ab,kf. or exp Tourniquets/ or *Compression Bandages/ or (traction splint? or thomas splint?).ti,ab,kf.
12. (exp Chitosan/ or (h?emostyptic or chitosan or Celox or QuikClot or HemCon).ti,ab,kf.) and (exp Hemorrhage/ or exp Exsanguination/ or (bleed* or h?emorrhag* or exsanguination).ti,ab,kf.)
13. ((nasopharyngeal or nasal or bellocq) adj2 (tamponade or packing or balloon)).ti,ab,kf.
14. (massive or life-threatening).ti,ab,kf. and (exp Epistaxis/ or epistaxis.ti,ab,kf.)
15. (wound clamp or itclamp).ti,ab,kf.
16. (injectable adj3 sponge?).ti,ab,kf.
17. 9 or 10 or 11 or 12 or 13 or 15 or 16
18. 6 and 17
19. 18 not 7
20. 19 not 8

Suchstrategie 2021, Embase (via Elsevier)	Datum: 23.06.2021	147 Treffer

#1 'multiple trauma'/exp

#2 (polytrauma* OR "trauma patient?"):ti,ab,kw OR (severe NEXT/2 shock):ti,ab,kw

#3 ((multiple OR major OR severe* OR serious*) NEXT/3 (trauma* OR injur*)):ti,ab,kw

#4 ((blunt OR penetrating) NEXT/5 (trauma* OR injur*)):ti,ab,kw

#5 ('intensive care'/mj OR 'emergency'/mj OR ("life threatening" OR "critical care" OR emergen*):ti,ab,kw) AND (trauma* OR injur*):ti,ab,kw

#6 #1 OR #2 OR #3 OR #4 OR #5

#7 'animals'/exp NOT 'humans'/de

#8 (comment OR editorial OR letter):it OR "case report*":ti,ab,kw

#9 [embase]/lim

#10 embase NOT (embase AND medline)

#11 (pelvic NEAR/1 (binder? OR binding OR sheet? OR sheeting)):ti,ab,kw OR 'pelvic binder'/exp

#12 "circumferential compression":ti,ab,kw

#13 (((pressure OR compression) NEAR/2 (bandage? OR dressing?)) OR tourniquet? OR ((wound OR pelvic OR preperitoneal OR extraperitoneal) AND packing)):ti,ab,kw OR 'tourniquet'/exp OR

'compression bandage'/exp OR ("traction splint?" OR "thomas splint?"):ti,ab,kw OR 'traction splint'/exp OR 'Thomas splint'/exp

#14 ('chitosan'/exp OR (h?emostyptic OR chitosan OR Celox OR QuikClot OR HemCon):ti,ab,kw) AND ('bleeding'/exp OR 'exsanguination'/exp OR (bleed* OR h?emorrhag* OR exsanguination):ti,ab,kw)

#15 ((nasopharyngeal OR nasal OR bellocq) NEAR/2 (tamponade OR packing OR balloon)):ti,ab,kw OR 'epistaxis balloon'/exp

#16 (massive OR life-threatening):ti,ab,kw AND ('epistaxis'/exp OR epistaxis:ti,ab,kw)

#17 ("wound clamp" OR itclamp):ti,ab,kw

#18 (injectable NEAR/3 sponge?):ti,ab,kw

#19 #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18

#20 #6 AND #17

#21 #20 NOT #7

#22 #21 NOT #8

#23 #22 AND #9

#24 #23 AND #10

#24 AND ('article'/it OR 'article in press'/it OR 'review'/it)

1.2 Atemwegsmanagement, Beatmung und Notfallnarkose

Suchstrategie 2021, MEDLINE (via Ovid) Datum: 01.07.2021 2.324 Treffer

1. exp Emergency Medicine/ or exp Intubation, Intratracheal/ or exp Noninvasive Ventilation/

2. (intubat* or ventilation or airway management or ventilation management or an?esthe* or sedat*).ti,ab,kf.

3. 1 or 2

4. (pre-hospital or prehospital or out-of-hospital or preclinic* or pre-clinic* or field or scene or emergen* or urgent or trauma room or shock room or resuscitation area? or resuscitation room).ti,ab,kf.

5. 3 and 4

6. exp Multiple Trauma/

7. (polytrauma* or trauma patient?).ti,ab,kf. or (severe adj2 shock).ti,ab,kf.

8. ((multiple or major or severe* or serious*) adj3 (trauma* or injur*)).ti,ab,kf.

9. ((blunt or penetrating) adj5 (trauma* or injur*)).ti,ab,kf.

10. (*Critical Care/ or *Emergencies/ or (life threatening or critical care or emergen*).ti,ab,kf.) and (trauma* or injur*).ti,ab,kf.

11. 6 or 7 or 8 or 9 or 10

12. 5 and 11

13. exp animals/ not humans.sh.

14. 12 not 13

15. (comment or editorial or letter).pt. or case report*.mp.

16. 14 not 15

17. limit 16 to dt=20150101-20210731

Suchstrategie 2021, Zusatzfragen MEDLINE (via Ovid) Datum: 01.09.2021 593 Treffer

1. exp Emergency Medicine/ or exp Intubation, Intratracheal/ or exp Noninvasive Ventilation/

2. (intubat* or ventilation or airway management or ventilation management or an?esthe* or sedat*).ti,ab,kf.

3. 1 or 2

4. (pre-hospital or prehospital or out-of-hospital or preclinic* or pre-clinic* or field or scene or emergen* or urgent or early or trauma room or shock room or resuscitation area? or resuscitation room).ti,ab,kf.

5. 3 and 4

6. exp Multiple Trauma/

7. (polytrauma* or trauma patient? or (severe adj2 shock)).ti,ab,kf.

8. ((multiple or major or severe* or serious*) adj3 (trauma* or injur*)).ti,ab,kf.

9. ((blunt or penetrating) adj5 (trauma* or injur*)).ti,ab,kf.

10. (*Critical Care/ or *Emergencies/ or (life threatening or critical care or emergen*).ti,ab,kf.) and (trauma* or injur*).ti,ab,kf.

11. 6 or 7 or 8 or 9 or 10

12. 5 and 11

13. exp animals/ not humans.sh.

14. 12 not 13

15. (comment or editorial or letter).pt. or case report*.mp.

16. 14 not 15

17. exp Bronchoscopy/ or exp Tomography, X-Ray Computed/ or (bronchoscop* or compute* tomograph* or ct or cricothyrotom* or coniotom* or minitracheotom* or video laryngoscop* or video-laryngoscop* or bougie* or airway exchanger*).ti,ab,kf.

18. 16 and 17

Suchstrategie 2021, Embase (via Elsevier) Datum: 01.07.2021 665 Treffer

#1 'emergency medicine'/exp OR 'endotracheal intubation'/exp OR 'noninvasive ventilation'/exp

#2 (intubat* OR ventilation OR "airway management" OR "ventilation management" OR an?esthe* OR sedat*):ti,ab,kw

#3 #1 OR #2

#4 (pre-hospital or prehospital or out-of-hospital or preclinic* or pre-clinic* or field or scene or emergen* or urgent or “trauma room” or “shock room” or “resuscitation area?” or “resuscitation room”):ti,ab,kw

#5 #3 AND #4

#6 'multiple trauma'/exp

#7 (polytrauma* OR "trauma patient?"):ti,ab,kw OR (severe NEXT/2 shock):ti,ab,kw

#8 ((multiple OR major OR severe* OR serious*) NEXT/3 (trauma* OR injur*)):ti,ab,kw

#9 ((blunt OR penetrating) NEXT/5 (trauma* OR injur*)):ti,ab,kw

#10 ('intensive care'/mj OR 'emergency'/mj OR ("life threatening" OR "critical care" OR emergen*):ti,ab,kw) AND (trauma* OR injur*):ti,ab,kw

#11 #6 OR #7 OR #8 OR #9 OR #10

#12 #5 AND #11

#13 'animals'/exp NOT 'humans'/de

#14 #12 NOT #13

#15 (comment OR editorial OR letter):it OR "case report*":ti,ab,kw

#16 #14 NOT #15

#17 [1-1-2015]/sd NOT [1-8-2021]/sd

#18 #16 AND #17

#19 [embase]/lim

#20 #18 AND #19

#21 embase NOT (embase AND medline)

#22 #20 AND #21

#23 #22 AND ('article'/it OR 'article in press'/it OR 'review'/it)

Suchstrategie 2021, Zusatzfragen Embase (via Elsevier) Datum: 01.09.2021 118 Treffer

#1 'emergency medicine'/exp OR 'endotracheal intubation'/exp OR 'noninvasive ventilation'/exp

#2 (intubat* OR ventilation OR "airway management" OR "ventilation management" OR an?esthe* OR sedat*):ti,ab,kw

#3 #1 OR #2

#4 (pre-hospital or prehospital or out-of-hospital or preclinic* or pre-clinic* or field or scene or emergen* or urgent or “trauma room” or “shock room” or “resuscitation area?” or “resuscitation room”):ti,ab,kw

#5 #3 AND #4

#6 'multiple trauma'/exp

#7 (polytrauma* OR "trauma patient?"):ti,ab,kw OR (severe NEXT/2 shock):ti,ab,kw

#8 ((multiple OR major OR severe* OR serious*) NEXT/3 (trauma* OR injur*)):ti,ab,kw

#9 ((blunt OR penetrating) NEXT/5 (trauma* OR injur*)):ti,ab,kw

#10 ('intensive care'/mj OR 'emergency'/mj OR ("life threatening" OR "critical care" OR emergen*):ti,ab,kw) AND (trauma* OR injur*):ti,ab,kw

#11 #6 OR #7 OR #8 OR #9 OR #10

#12 #5 AND #11

#13 'animals'/exp NOT 'humans'/de

#14 #12 NOT #13

#15 (comment OR editorial OR letter):it OR "case report*":ti,ab,kw

#16 #14 NOT #15

#17 'bronchoscopy'/exp OR 'computer assisted tomography'/exp OR 'coniotomy'/exp OR 'videolaryngoscopy'/exp OR 'bougie'/exp OR 'airway exchange catheter'/exp OR (bronchoscop* OR “compute* tomograph*” OR ct OR cricothyrotom* OR coniotom* OR minitracheotom* OR “video laryngoscop*” OR videolaryngoscop* OR bougie* OR “airway exchanger*”):ti,ab,kw

#18 #16 AND #17

#19 [embase]/lim

#20 #18 AND #19

#21 embase NOT (embase AND medline)

#22 #20 AND #21

#23 #22 AND ('article'/it OR 'article in press'/it OR “erratum” OR 'review'/it)

1.3 Gerinnungsmanagement und Volumentherapie

Suchstrategie 2021, MEDLINE (via Ovid) Datum: 07.05.2021 2.545 Treffer

1. exp Multiple Trauma/

2. (polytrauma* or trauma patient?).ti,ab,kf. or (severe adj2 shock).ti,ab,kf.

3. ((multiple or major or severe* or serious*) adj3 (trauma* or injur*)).ti,ab,kf.

4. ((blunt or penetrating) adj5 (trauma* or injur*)).ti,ab,kf.

5. (*Critical Care/ or *Emergencies/ or (life threatening or critical care or emergen*).ti,ab,kf.) and (trauma* or injur*).ti,ab,kf.

6. 1 or 2 or 3 or 4 or 5

7. exp animals/ not humans.sh.

8. (comment or editorial or letter).pt. or case report*.mp.

9. Shock, Hemorrhagic/ or exp Exsanguination/ or exp Hypovolemia/ or exp Shock, Traumatic/

10. (((uncontrolled or uncontrollable or acute or active or massive or life threatening or severe) adj2 (bleeding or h?emorrhage)) or ((hypovol?emic or h?emorrhagic or traumatic) adj (shock or trauma*)) or "damage control resuscitation").ti,ab,kf.
11. exp Hemostasis/ or exp Blood Coagulation/ or exp disseminated intravascular coagulation/ or exp Hemorrhage/
12. (h?emosta* or coagula* or clotting or coagulopath* or h?emorrhag* or bleed*).ti,ab,kf.
13. 9 or 10 or 11 or 12
14. exp Fluid Therapy/ or exp rehydration solutions/ or exp hypotonic solutions/ or exp isotonic solutions/ or exp crystalloid solutions/ or exp Colloids/ or exp ringer's lactate/ or exp saline solution/ or exp ringer's solution/ or exp Hydroxyethyl Starch Derivatives/ or Hypertonic Solutions/ or exp Saline Solution, Hypertonic/ or exp Plasma/ or exp Erythrocytes/ or exp Blood Transfusion/ or prothrombin complex concentrates.mp. or exp Deamino Arginine Vasopressin/ or exp Factor VIII/ or exp Platelet Transfusion/ or exp Fibrinogen/ or exp Tranexamic Acid/ or exp Blood Coagulation Tests/ or exp Thrombelastography/
15. (((fluid or volume) adj2 (therap* or replacement? or expansion or management or substitute or substitution or administration or resuscitation)) or "hypotensive resuscitation" or "permissive hypotension").ti,ab,kf. or (((isotonic or normal) adj (saline or sodium chloride or NACL)) or ((hypotonic or isotonic or buffered or balanced) adj (infusion? or solution? or electrolyte?)) or crystalloid? or colloid? or ringer* or albumin or hydroxyethyl starch* or hetastarch or dextran).ti,ab,kf. or ((hypertonic or hyperosmotic or hyperoncotic or hyperosmolar) adj2 (infusion? or solution? or electrolyte? or saline or resuscitation)).ti,ab,kf. or (((lactic acid or lactate) and shock) or (base adj (excess or deficit)) or acidosis or acid-base-status).ti,ab,kf. or (normotherm* or hypotherm* or ((preservation or retention or conservation or control or management) adj1 (temperature or thermic* or heat or warm*))).ti,ab,kf. or acid?emia.ti,ab,kf. or (hypocalc?emia or (reduced adj2 calcium)).ti,ab,kf. or (plasma or PRBC or PRBCs or transfusion or "factor concentrate?" or fibrinogen or hypofibrinogen?emia or factor xiia or factor viia or rfviia or thrombin).ti,ab,kf. or (tranexamic acid or txa).ti,ab,kf. or (thrombo* adj1 prophyla*).ti,ab,kf. or (blood gas analysis or quick or partial thromboplastin time or aptt or ((platelet or thrombocyte) adj count) or viscoelastic test? or thromb?elasto* or ROTEM or (rotation* and thromb?elastometry)).ti,ab,kf.
16. 14 or 15
17. 13 and 6 and 16
18. 17 not 7
19. 18 not 8
20. limit 19 to dt=20140101-20210322

Suchstrategie 2021, Zusatzfrage intraossärer Zugang, MEDLINE (via Ovid)
Datum: 07.05.2021 83 Treffer

1. exp Multiple Trauma/
2. (polytrauma* or trauma patient?).ti,ab,kf. or (severe adj2 shock).ti,ab,kf.
3. ((multiple or major or severe* or serious*) adj3 (trauma* or injur*)).ti,ab,kf.
4. ((blunt or penetrating) adj5 (trauma* or injur*)).ti,ab,kf.
5. (*Critical Care/ or *Emergencies/ or (life threatening or critical care or emergen*).ti,ab,kf.) and (trauma* or injur*).ti,ab,kf.
6. 1 or 2 or 3 or 4 or 5
7. exp animals/ not humans.sh.
8. (comment or editorial or letter).pt. or case report*.mp.
9. exp Infusions, Intraosseous/
10. ((intraosseous adj2 (infusion? or puncture? or access or device?))).ti,ab,kf.
11. 9 or 10
12. 6 and 11

13. 12 not 7
14. 13 not 8
15. limit 13 to dt=19460101-20210322

Suchstrategie 2021, Zusatzfragen Zugänge/Katheter, MEDLINE (via Ovid) **Datum: 07.05.2021** **46 Treffer**

1. exp Multiple Trauma/
2. (polytrauma* or trauma patient?).ti,ab,kf. or (severe adj2 shock).ti,ab,kf.
3. ((multiple or major or severe* or serious*) adj3 (trauma* or injur*)).ti,ab,kf.
4. ((blunt or penetrating) adj5 (trauma* or injur*)).ti,ab,kf.
5. (*Critical Care/ or *Emergencies/ or (life threatening or critical care or emergen*).ti,ab,kf.) and (trauma* or injur*).ti,ab,kf.
6. 1 or 2 or 3 or 4 or 5
7. exp animals/ not humans.sh.
8. (comment or editorial or letter).pt. or case report*.mp.
9. Shock, Hemorrhagic/ or exp Exsanguination/ or exp Hypovolemia/ or exp Shock, Traumatic/
10. (((uncontrolled or uncontrollable or acute or active or massive or life threatening or severe) adj2 (bleeding or h?emorrhage)) or ((hypovol?emic or h?emorrhagic or traumatic) adj (shock or trauma*)) or "damage control resuscitation").ti,ab,kf.
11. exp Hemostasis/ or exp Blood Coagulation/ or exp disseminated intravascular coagulation/ or exp Hemorrhage/
12. (h?emosta* or coagula* or clotting or coagulopath* or h?emorrhag* or bleed*).ti,ab,kf.
13. 9 or 10 or 11 or 12
14. exp Catheterization, Central Venous/
15. (((heat exchang* or thermoregulatory or warming or hypothermia) adj4 catheter) or ((endovascular or intravascular) adj cooling)).ti,ab,kf. or (((central venous or arterial) adj catheter*) and (subclavian or femoral* or jugular*)).ti,ab,kf. or ((intravascular or vascular or intravenous or venous or iv or vein or arterial) adj (access* or cannulation)).ti,ab,kf. and (exp Ultrasonography/ or (ultrasonography* or ultrasound).ti,ab,kf.)
16 14 or 15
17. 13 and 6 and 16
18. 17 not 7
19. 18 not 8
20. limit 19 to dt=19460101-20210322

Suchstrategie 2021, Embase (via Elsevier) **Datum: 07.05.2021** **667 Treffer**

#1 'multiple trauma'/exp
#2 (polytrauma* OR "trauma patient?"):ti,ab,kw OR (severe NEXT/2 shock):ti,ab,kw
#3 ((multiple OR major OR severe* OR serious*) NEXT/3 (trauma* OR injur*)):ti,ab,kw
#4 ((blunt OR penetrating) NEXT/5 (trauma* OR injur*)):ti,ab,kw
#5 ('intensive care'/mj OR 'emergency'/mj OR ("life threatening" OR "critical care" OR emergen*):ti,ab,kw) AND (trauma* OR injur*):ti,ab,kw
#6 #1 OR #2 OR #3 OR #4 #5
#7 'animals'/exp NOT 'humans'/de
#8 (comment OR editorial OR letter):it OR "case report*":ti,ab,kw
#9 [1-1-2014]/sd NOT [23-3-2021]/sd
#10 [embase]/lim
#11 embase NOT (embase AND medline)

#12 'hemorrhagic shock'/exp OR 'hypovolemic shock'/exp OR 'traumatic shock'/exp OR 'exsanguination'/exp OR 'hypovolemia'/exp

#13 (((uncontrolled OR uncontrollable OR acute OR active OR massive OR "life threatening" OR severe) NEAR/2 (bleeding OR h$emorrhage)) OR ((hypovol$emic OR h$emorrhagic OR traumatic) NEXT/1 (shock OR trauma*)) OR "damage control resuscitation"):ti,ab,kw

#14 'hemostasis'/exp OR 'blood clotting'/exp OR 'disseminated intravascular clotting'/exp OR 'bleeding'/exp

#15 (h$emosta* OR coagula* OR clotting OR coagulopath*OR h$emorrhag* OR bleed*):ti,ab,kw

#16 #12 OR #13 OR #14 OR #15

#17 'fluid therapy'/exp OR 'rehydration'/exp OR 'hypotonic solution'/exp OR 'isotonic solution'/exp OR 'crystalloid'/exp OR 'colloid'/exp OR 'Ringer lactate solution'/exp OR 'sodium chloride'/exp OR 'Ringer solution'/exp OR 'hetastarch'/exp OR 'hypertonic solution'/exp OR 'sodium chloride'/exp OR 'blood clotting test'/exp OR 'thromboelastography'/exp OR 'plasma'/exp OR 'erythrocyte'/exp OR 'blood transfusion'/exp OR 'prothrombin complex'/exp OR 'argipressin[1 deamino]'/exp OR 'blood clotting factor 8'/exp OR 'thrombocyte transfusion'/exp OR 'fibrinogen'/exp OR 'tranexamic acid'/exp

#18 (((fluid OR volume) NEAR/2 (therap* OR replacement? OR expansion OR management OR substitute OR substitution OR administration OR resuscitation)) OR "hypotensive resuscitation" OR "permissive hypotension"):ti,ab,kw OR (((isotonic OR normal) NEAR/1 (saline OR “sodium chloride” OR NACL)) OR ((hypotonic OR isotonic OR buffered OR balanced) NEAR/1 (infusion? OR solution? OR electrolyte?)) OR crystalloid? OR colloid? OR ringer* OR albumin OR “hydroxyethyl starch*” OR hetastarch OR dextran):ti,ab,kw OR ((hypertonic OR hyperosmotic OR hyperoncotic OR hyperosmolar) NEAR/2 (infusion? OR solution? OR electrolyte? OR saline OR resuscitation)):ti,ab,kw OR (“blood gas analysis” OR quick OR “partial thromboplastin time” OR aptt OR ((platelet OR thrombocyte) NEXT/1 count) OR “viscoelastic test?” OR thromb$elasto* OR ROTEM OR (rotation* AND thromb$elastometry)):ti,ab,kw OR (((“lactic acid” OR lactate) AND shock) OR (base NEXT/1 (excess or deficit)) OR acidosis OR acid-base-status):ti,ab,kw OR (normotherm* OR hypotherm* OR ((preservation OR retention OR conservation OR control OR management) NEAR/1 (temperature OR thermic* OR heat OR warm*))):ti,ab,kw OR acid$emia:ti,ab,kw OR (hypocalc$emia OR (reduced NEAR/2 calcium)):ti,ab,kw OR (plasma OR PRBC OR PRBCs OR transfusion OR "factor concentrate?" OR fibrinogen OR hypofibrinogen$emia OR “factor xiia” OR “factor viia” OR rfviia OR thrombin):ti,ab,kw OR (“tranexamic acid” OR txa):ti,ab,kw OR (thrombo* NEAR/1 prophyla*):ti,ab,kw

#19 #17 OR #18

#20 #6 AND #16 AND #19

#21 #20 NOT #7

#22 #21 NOT #8

#23 #22 AND #9

#24 #23 AND #10

#25 #24 AND #11

#26 #25 AND ('article'/it OR 'article in press'/it OR 'erratum'/it)

Suchstrategie 2021, Zusatzfrage intraossärer Zugang, Embase (via Elsevier)
Datum: 06.05.2021 15 Treffer

#1 'multiple trauma'/exp

#2 (polytrauma* OR "trauma patient?"):ti,ab,kw OR (severe NEXT/2 shock):ti,ab,kw

#3 ((multiple OR major OR severe* OR serious*) NEXT/3 (trauma* OR injur*)):ti,ab,kw

#4 ((blunt OR penetrating) NEXT/5 (trauma* OR injur*)):ti,ab,kw

#5 ('intensive care'/mj OR 'emergency'/mj OR ("life threatening" OR "critical care" OR emergen*):ti,ab,kw) AND (trauma* OR injur*):ti,ab,kw

#6 #1 OR #2 OR #3 OR #4 #5

#7 'animals'/exp NOT 'humans'/de
#8 (comment OR editorial OR letter):it OR "case report*":ti,ab,kw
#9 [embase]/lim
#10 embase NOT (embase AND medline)
#11 'intraosseous drug administration'/exp
#12 (intraosseous NEAR/2 (infusion? OR puncture? OR access OR device?)):ti,ab,kw
#13 #11 OR #12
#14 #6 AND #13
#15 #14 NOT #7
#16 #15 NOT #8
#17 #16 AND #9
#18 #17 AND #10
#19 #18 AND ('article'/it OR 'article in press'/it OR 'review'/it)
#20 [1-1-1947]/sd NOT [23-3-2021]/sd
#21 #19 AND #20

Suchstrategie 2021, Zusatzfragen Zugänge/Katheter, Embase (via Elsevier)
Datum: 06.05.2021 17 Treffer

#1 'multiple trauma'/exp
#2 (polytrauma* OR "trauma patient?"):ti,ab,kw OR (severe NEXT/2 shock):ti,ab,kw
#3 ((multiple OR major OR severe* OR serious*) NEXT/3 (trauma* OR injur*)):ti,ab,kw
#4 ((blunt OR penetrating) NEXT/5 (trauma* OR injur*)):ti,ab,kw
#5 ('intensive care'/mj OR 'emergency'/mj OR ("life threatening" OR "critical care" OR emergen*):ti,ab,kw) AND (trauma* OR injur*):ti,ab,kw
#6 #1 OR #2 OR #3 OR #4 #5
#7 'animals'/exp NOT 'humans'/de
#8 (comment OR editorial OR letter):it OR "case report*":ti,ab,kw
#9 [embase]/lim
#10 embase NOT (embase AND medline)
#11 'hemorrhagic shock'/exp OR 'hypovolemic shock'/exp OR 'traumatic shock'/exp OR 'exsanguination'/exp OR 'hypovolemia'/exp
#12 (((uncontrolled OR uncontrollable OR acute OR active OR massive OR "life threatening" OR severe) NEAR/2 (bleeding OR h$emorrhage)) OR ((hypovol$emic OR h$emorrhagic OR traumatic) NEXT/1 (shock OR trauma*)) OR "damage control resuscitation"):ti,ab,kw
#13 'hemostasis'/exp OR 'blood clotting'/exp OR 'disseminated intravascular clotting'/exp OR 'bleeding'/exp
#14 (h$emosta* OR coagula* OR clotting OR coagulopath*OR h$emorrhag* OR bleed*):ti,ab,kw
#15 #11 OR #12 OR #13 OR #14
#16 'central venous catheterization'/exp
#17 ((("heat exchang*" OR thermoregulatory OR warming OR hypothermia) NEXT/4 catheter) OR ((endovascular OR intravascular) NEXT/1 cooling)):ti,ab,kw OR ((("central venous" OR arterial) NEXT/1 catheter*) AND (subclavian OR femoral* OR jugular*)):ti,ab,kw OR (((intravascular OR vascular OR intravenous OR venous OR i.v. OR vein OR arterial) NEXT/1 (access* or cannulation)):ti,ab,kw AND ('echography'/exp OR (ultrasonography* OR ultrasound):ti,ab,kw))
#18 #16 OR #17
#19 #6 AND #15 AND #18
#20 #19 NOT #7
#21 #20 NOT #8

#22 #21 AND #9
#23 #22 AND #10
#24 #23 AND ('article'/it OR 'review'/it)
#25 [1-1-1947]/sd NOT [23-3-2021]/sd
#26 #15 AND #20

1.4 Analgesie

Am IFOM wurde keine systematische Literaturrecherche durchgeführt. Als Evidenzgrundlage dieses Kapitels diente ein systematischer Review [5].

1.5 Thorax

Suchstrategie 2021, MEDLINE (via Ovid)	Datum: 19.05.2021	3.241 Treffer

1. exp Pneumothorax/ or exp hemopneumothorax/ or exp thoracic injuries/ or exp Thorax/ or exp Cardiac Tamponade/ or exp Lung Injury/
2. (pneumothora* or h?emopneumothora* or h?emothorax or thora* injur* or chest injur* or thora* trauma* or chest trauma* or myocardial injur* or myocardial trauma* or heart tamponade or cardiac tamponade or lung injur* or lung trauma* or tracheobronchial injur* or tracheobronchial trauma*).ab,ti,kf.
3. 1 or 2
4. exp Multiple Trauma/
5. (polytrauma* or trauma patient?).ti,ab,kf. or (severe adj2 shock).ti,ab,kf.
6. ((multiple or major or severe* or serious*) adj3 (trauma* or injur*)).ti,ab,kf.
7. ((blunt or penetrating) adj5 (trauma* or injur*)).ti,ab,kf.
8. (*Critical Care/ or *Emergencies/ or (life threatening or critical care or emergen*).ti,ab,kf.) and (trauma* or injur*).ti,ab,kf.
9. 4 or 5 or 6 or 7 or 8
10. 3 and 9
11. exp animals/ not humans.sh.
12. 10 not 11
13. (comment or editorial or letter).pt. or case report*.mp.
14. 12 not 13
15. limit 14 to dt=20140601-20210531

Suchstrategie 2021, Embase (via Elsevier)	Datum: 19.05.2021	1.407 Treffer

#1 'pneumothorax'/exp OR 'hematopneumothorax'/exp OR 'thorax injury'/exp OR 'thorax'/exp OR 'heart tamponade'/exp OR 'lung injury'/exp
#2 (pneumothora* OR h?emopneumothora* OR h?emothorax OR "thora* injur*" OR "chest injur*" OR "thora* trauma*" OR "chest trauma*" OR “myocardial injur*” OR “myocardial trauma*” OR “heart tamponade” OR “cardiac tamponade” OR “lung injur*” OR “lung trauma*” OR “tracheobronchial injur*” OR “tracheobronchial trauma*”):ti,ab,kw
#3 #1 OR #2
#4 'multiple trauma'/exp
#5 (polytrauma* OR "trauma patient?"):ti,ab,kw OR (severe NEXT/2 shock):ti,ab,kw
#6 ((multiple OR major OR severe* OR serious*) NEXT/3 (trauma* OR injur*)):ti,ab,kw
#7 ((blunt OR penetrating) NEXT/5 (trauma* OR injur*)):ti,ab,kw

#8 ('intensive care'/mj OR 'emergency'/mj OR ("life threatening" OR "critical care" OR emergen*):ti,ab,kw) AND (trauma* OR injur*):ti,ab,kw
#9 #4 OR #5 OR #6 OR #7 OR #8
#10 #3 AND #9
#11 'animals'/exp NOT 'humans'/de
#12 #10 NOT #11
#13 (comment OR editorial OR letter):it OR "case report*":ti,ab,kw
#14 #12 NOT #13
#15 [1-6-2014]/sd NOT [1-6-2021]/sd
#16 #14 AND #15
#17 [embase]/lim
#18 #16 AND #17
#19 embase NOT (embase AND medline)
#20 #18 AND #19
#21 #20 AND ('article'/it OR 'article in press'/it OR 'erratum'/it OR 'review'/it)

1.6 Schädel-Hirn-Trauma

Suchstrategie 2021, MEDLINE (via Ovid) Datum: 06.05.2021 4.070 Treffer

1. *craniocerebral trauma/ or *brain injuries/ or exp brain injuries, traumatic/ or exp head injuries, closed/ or exp head injuries, penetrating/ or exp skull fractures/ or exp Skull/in
2. (((craniocerebral or cerebral or head or skull or brain) adj2 (trauma* or injur*)) or skull fracture* or traumatic brain injur* or tbi).ti,ab,kf.
3. 1 or 2
4. exp Multiple Trauma/
5. (polytrauma* or trauma patient?).ti,ab,kf. or (severe adj2 shock).ti,ab,kf.
6. ((multiple or major or severe* or serious*) adj3 (trauma* or injur*)).ti,ab,kf.
7. ((blunt or penetrating) adj5 (trauma* or injur*)).ti,ab,kf.
8. (*Critical Care/ or *Emergencies/ or (life threatening or critical care or emergen*).ti,ab,kf.) and (trauma* or injur*).ti,ab,kf.
9. 4 or 5 or 6 or 7 or 8
10. 3 and 9
11. exp animals/ not humans.sh.
12. 10 not 11
13. (comment or editorial or letter).pt. or case report*.mp.
14. 12 not 13
15. limit 14 to dt=20100101-20210325
16. *Reflex, Pupillary/ or *Glasgow Coma Scale/ or *intubation, intratracheal/ or *Tomography, X-Ray Computed/ or *Glucocorticoids/ or (pupil* or glasgow coma scale or gcs or intubation or intubated or normoxia or normotension or normocapnia or systolic blood pressure or arterial oxygen saturation or comput* tomograph* or CT or glucocorticoid? or corticoid? or corticosteroid? or perforating or tooth or teeth).ti,ab,kf.
17. 15 and 16

Suchstrategie 2021, Teilbereich[$], MEDLINE (via Ovid) Datum: 06.05.2021 190 Treffer

1. *craniocerebral trauma/ or *brain injuries/ or exp brain injuries, traumatic/ or exp head injuries, closed/ or exp head injuries, penetrating/ or exp skull fractures/ or exp Skull/in

2. (((craniocerebral or cerebral or head or skull or brain) adj2 (trauma* or injur*)) or skull fracture* or traumatic brain injur* or tbi or intracranial pressure or ICP or herniation).ti,ab,kf.

3. 1 or 2

4. exp Multiple Trauma/

5. (polytrauma* or trauma patient?).ti,ab,kf. or (severe adj2 shock).ti,ab,kf.

6. ((multiple or major or severe* or serious*) adj3 (trauma* or injur*)).ti,ab,kf.

7. ((blunt or penetrating) adj5 (trauma* or injur*)).ti,ab,kf.

8. (*Critical Care/ or *Emergencies/ or (life threatening or critical care or emergen*).ti,ab,kf.) and (trauma* or injur*).ti,ab,kf.

9. 4 or 5 or 6 or 7 or 8

10. 3 and 9

11. exp animals/ not humans.sh.

12. 10 not 11

13. (comment or editorial or letter).pt. or case report*.mp.

14. 12 not 13

15. limit 14 to dt=20100101-20210416

16. *Hyperventilation/ or *Mannitol/ or *Saline Solution, Hypertonic/ or (hyperventilation or hyperventilated or mannitol or (hypertonic and (saline or sodium chloride))).ti,ab,kf.

17. 15 and 16

Suchstrategie 2021, Embase (via Elsevier) Datum: 06.05.2021 1.321 Treffer

#1 'head injury'/exp OR 'brain injury'/exp OR 'traumatic brain injury'/exp OR 'skull fracture'/exp

#2 (((craniocerebral OR cerebral OR head OR skull OR brain) NEAR/2 (trauma* OR injur*)) OR "skull fracture*" OR "traumatic brain injur*" OR tbi):ti,ab,kw

#3 #1 OR #2

#4 'multiple trauma'/exp

#5 (polytrauma* OR "trauma patient?"):ti,ab,kw OR (severe NEXT/2 shock):ti,ab,kw

#6 ((multiple OR major OR severe* OR serious*) NEXT/3 (trauma* OR injur*)):ti,ab,kw

#7 ((blunt OR penetrating) NEXT/5 (trauma* OR injur*)):ti,ab,kw

#8 ('intensive care'/mj OR 'emergency'/mj OR ("life threatening" OR "critical care" OR emergen*):ti,ab,kw) AND (trauma* OR injur*):ti,ab,kw

#9 #4 OR #5 OR #6 OR #7 OR #8

#10 #3 AND #9

#11 'animals'/exp NOT 'humans'/de

#12 #10 NOT #11

#13 (comment OR editorial OR letter):it OR "case report*":ti,ab,kw

#14 #12 NOT #13

#15 [1-1-2010]/sd NOT [26-3-2021]/sd

#16 #14 AND #15

#17 'pupil reflex'/exp OR 'Glasgow coma scale'/exp OR 'endotracheal intubation'/exp OR 'x-ray computed tomography'/exp OR 'glucocorticoid'/exp OR (pupil* OR "glasgow coma scale" OR gcs OR intubation OR intubated OR normoxia OR normotension OR normocapnia OR “systolic blood pressure” OR “arterial oxygen saturation” OR "comput* tomograph*" OR CT OR glucocorticoid? OR corticoid? OR corticosteroid? OR perforating OR tooth OR teeth):ti,ab,kw

#18 #16 AND #17

#19 [embase]/lim

#20 #18 AND #19

#21 embase NOT (embase AND medline)

#22 #20 AND #21

#23 #22 AND ('article'/it OR 'article in press'/it OR 'erratum'/it OR 'review'/it)

Suchstrategie 2021, Teilbereich[$], Embase (via Elsevier) Datum: 06.05.2021 122 Treffer

#1 'head injury'/exp OR 'brain injury'/exp OR 'traumatic brain injury'/exp OR 'skull fracture'/exp

#2 (((craniocerebral OR cerebral OR head OR skull OR brain) NEAR/2 (trauma* OR injur*)) OR "skull fracture*" OR "traumatic brain injur*" OR tbi OR “intracranial pressure” OR ICP OR herniation):ti,ab,kw

#3 #1 OR #2

#4 'multiple trauma'/exp

#5 (polytrauma* OR "trauma patient?"):ti,ab,kw OR (severe NEXT/2 shock):ti,ab,kw

#6 ((multiple OR major OR severe* OR serious*) NEXT/3 (trauma* OR injur*)):ti,ab,kw

#7 ((blunt OR penetrating) NEXT/5 (trauma* OR injur*)):ti,ab,kw

#8 ('intensive care'/mj OR 'emergency'/mj OR ("life threatening" OR "critical care" OR emergen*):ti,ab,kw) AND (trauma* OR injur*):ti,ab,kw

#9 #4 OR #5 OR #6 OR #7 OR #8

#10 #3 AND #9

#11 'animals'/exp NOT 'humans'/de

#12 #10 NOT #11

#13 (comment OR editorial OR letter):it OR "case report*":ti,ab,kw

#14 #12 NOT #13

#15 [1-1-2010]/sd NOT [17-4-2021]/sd

#16 #14 AND #15

#17 'hyperventilation'/exp OR 'mannitol'/exp OR 'sodium chloride'/exp OR (hyperventilation OR hyperventilated OR mannitol OR (hypertonic AND (saline OR "sodium chloride"))):ti,ab,kw

#18 #16 AND #17

#19 [embase]/lim

#20 #18 AND #19

#21 embase NOT (embase AND medline)

#22 #20 AND #21

#23 #22 AND ('article'/it OR 'article in press'/it OR 'erratum'/it OR 'review'/it)

[$] Der Teilbereich zu Hyperventilierung, Mannitol und hypertonen Kochsalzlösungen wurde getrennt recherchiert und im Rahmen einer Bachelorarbeit bearbeitet.

1.10 Massenanfall von Verletzten

Bei der Literaturrecherche zu diesem Thema wurden keine Stichworte zur Schwerverletzung/Polytrauma verwendet, da es im MANV-Kontext auch um Sichtungsalgorithmen geht, die schwer Verletzte von weniger schwer Verletzten trennen.

Suchstrategie 2021, MEDLINE (via Ovid) Datum: 27.08.2021 3.854 Treffer

1. exp mass casualty incidents/

2. (((mass or multiple) adj1 casualt*) or ((major or multiple or large scale) adj2 (disaster? or incident?)) or mass attack?).ti,ab,kf.

3. 1 or 2

4. exp animals/ not humans.sh.

5. 3 not 4

6. (comment or editorial or letter).pt. or case report*.mp.

7. 5 not 6
8. limit 7 to dt=20090101-20210831

Suchstrategie 2021, Embase (via Elsevier)	Datum: 27.08.2021	507 Treffer

#1 'mass disaster'/exp
#2 (((mass OR multiple) NEXT/1 casualt*) OR ((major OR multiple OR "large scale") NEXT/2 (disaster? OR incident?)) OR "mass attack?"):ti,ab,kw
#3 #1 OR #2
#4 'animals'/exp NOT 'humans'/de
#5 #3 NOT #4
#6 (comment OR editorial OR letter):it OR "case report*":ti,ab,kw
#7 #5 NOT #6
#8 [1-1-2009]/sd NOT [1-9-2021]/sd
#9 #7 AND #8
#10 [embase]/lim
#11 #9 AND #10
#12 embase NOT (embase AND medline)
#13 #11 AND #12
#14 #13 AND ('article'/it OR 'article in press'/it OR 'erratum'/it OR 'review'/it)

2 Schockraum

2.2 Schockraum – Team und Alarmierung

Suchstrategie 2021, MEDLINE (via Ovid)	Datum: 27.08.2021	2.011 Treffer

1. (trauma team adj2 (activation? or requirement)).ab,ti,kf.
2. (trauma room or shock room or resuscitation area? or resuscitation room or emergency room or reanimation room or trauma bay).ti,ab,kf. and (exp Triage/ or (triage or patient selection).ab,ti,kf.)
3. exp Trauma Centers/og
4. ((trauma room or shock room or resuscitation area? or resuscitation room or emergency room or reanimation room or trauma bay) and (team? or surgeon? or physician?)).ab,ti,kf.
5. (trauma team or trauma surgeon? or trauma physician?).ab,ti,kf. and (response time* or ((in-house or on-call) adj1 attend*)).ti,ab,kf.
6. 1 or 2 or 3 or 4 or 5
7. exp Multiple Trauma/
8. (polytrauma* or trauma patient? or (severe adj2 shock)).ti,ab,kf.
9. ((multiple or major or severe* or serious*) adj3 (trauma* or injur*)).ti,ab,kf.
10. ((blunt or penetrating) adj5 (trauma* or injur*)).ti,ab,kf.
11. (*Critical Care/ or *Emergencies/ or (life threatening or critical* care or emergen*).ti,ab,kf.) and (trauma* or injur*).ti,ab,kf.
12. 7 or 8 or 9 or 10 or 11
13. 6 and 12
14. exp animals/ not humans.sh.
15. 13 not 14
16. (comment or editorial or letter).pt. or case report*.mp.
17. 15 not 16

Suchstrategie 2021, Embase (via Elsevier)	Datum: 27.08.2021	145 Treffer

#1 (“trauma team” NEAR/2 (activation? OR requirement)):ti,ab,kw

#2 ("trauma room" OR "shock room" OR "resuscitation area?" OR "resuscitation room" OR "emergency room" OR “reanimation room” OR “trauma bay”):ti,ab,kw AND ('emergency health service'/exp OR (triage OR “patient selection”):ti,ab,kw)

#3 ((“trauma room” OR “shock room” OR “resuscitation area?” OR “resuscitation room” OR “emergency room” OR “reanimation room” OR “trauma bay”) AND (team? or surgeon? or physician?)):ti,ab,kw

#4 (“trauma team” OR “trauma surgeon?” OR “trauma physician?”):ti,ab,kw AND (“response time*” OR ((“in-house” OR “on-call”) NEXT/1 attend*)):ti,ab,kw

#5 #1 OR #2 OR #3 OR #4

#6 'multiple trauma'/exp

#7 (polytrauma* OR "trauma patient?"):ti,ab,kw OR (severe NEXT/2 shock):ti,ab,kw

#8 ((multiple OR major OR severe* OR serious*) NEXT/3 (trauma* OR injur*)):ti,ab,kw

#9 ((blunt OR penetrating) NEXT/5 (trauma* OR injur*)):ti,ab,kw

#10 ('intensive care'/mj OR 'emergency'/mj OR ("life threatening" OR "critical care" OR emergen*):ti,ab,kw) AND (trauma* OR injur*):ti,ab,kw

#11 #6 OR #7 OR #8 OR #9 OR #10

#12 #5 AND #11

#13 'animals'/exp NOT 'humans'/de

#14 #12 NOT #13

#15 (comment OR editorial OR letter):it OR "case report*":ti,ab,kw

#16 #14 NOT #15

#17 [embase]/lim

#18 #16 AND #17

#19 embase NOT (embase AND medline)

#20 #18 AND #19

#21 #20 AND ('article'/it OR 'article in press'/it OR 'review'/it)

2.3 Reanimation

Suchstrategie 2021, MEDLINE (via Ovid)	Datum: 27.05.2021	1.699 Treffer

1. exp heart arrest/ or exp out-of-hospital cardiac arrest/

2. (((heart or cardiac or cardiopulmonary or cardiorespiratory or circulatory or breathing) adj1 arrest*) or (traumatic adj2 arrest*) or asystole).ti,ab,kf. or ((cardiopulmonary or respiratory) adj1 failure).ti,ab,kf.

3. 1 or 2

4. exp Multiple Trauma/

5. (polytrauma* or trauma patient?).ti,ab,kf. or (severe adj2 shock).ti,ab,kf.

6. ((multiple or major or severe* or serious*) adj3 (trauma* or injur*)).ti,ab,kf.

7. ((blunt or penetrating) adj5 (trauma* or injur*)).ti,ab,kf.

8. (*Critical Care/ or *Emergencies/ or (life threatening or critical* care or emergen*).ti,ab,kf.) and (trauma* or injur*).ti,ab,kf.

9. 4 or 5 or 6 or 7or 8

10. 3 and 9 or (traumatic cardiac arrest* or traumatic cardiopulmonary arrest*).ti,ab,kf.

11. exp animals/ not humans.sh.

12. 10 not 11

13. (comment or editorial or letter).pt. or case report*.mp.

14. 12 not 13

15. limit 14 to dt=20140101-20210531

Suchstrategie 2021, Embase (via Elsevier)	Datum: 27.05.2021	472 Treffer

#1 'heart arrest'/exp OR 'out of hospital cardiac arrest'/exp

#2 (((heart OR cardiac OR cardiopulmonary OR cardiorespiratory OR circulatory OR breathing) NEXT/1 arrest*) OR (traumatic NEXT/2 arrest*) OR asystole):ti,ab,kw OR ((cardiopulmonary or respiratory) NEXT/1 failure):ti,ab,kw

#3 #1 or #2

#4 'multiple trauma'/exp

#5 (polytrauma* OR "trauma patient?"):ti,ab,kw OR (severe NEXT/2 shock):ti,ab,kw

#6 ((multiple OR major OR severe* OR serious*) NEXT/3 (trauma* OR injur*)):ti,ab,kw

#7 ((blunt OR penetrating) NEXT/5 (trauma* OR injur*)):ti,ab,kw

#8 ('intensive care'/mj OR 'emergency'/mj OR ("life threatening" OR "critical care" OR emergen*):ti,ab,kw) AND (trauma* OR injur*):ti,ab,kw

#9 #4 OR #5 OR #6 or #7 OR #8

#10 #3 AND #9 OR (“traumatic cardiac arrest*” or “traumatic cardiopulmonary arrest*”):ti,ab,kw

#11 'animals'/exp NOT 'humans'/de

#12 #10 NOT #11

#13 (comment OR editorial OR letter):it OR "case report*":ti,ab,kw

#14 #12 NOT #13

#15 [1-1-2014]/sd NOT [1-6-2021]/sd

#16 #14 AND #15

#17 [embase]/lim

#18 #16 AND #17

#19 embase NOT (embase AND medline)

#20 #18 AND #19

#21 #20 AND ('article'/it OR 'article in press'/it OR 'erratum'/it OR 'review'/it)

2.4 Gerinnungsmanagement und Volumentherapie

Die Recherche für dieses Kapitel wurde gemeinsam mit 1.3 Gerinnungsmanagement und Volumentherapie durchgeführt und ist dort einzusehen.

2.5 Bildgebung

Suchstrategie 2021, MEDLINE (via Ovid)	Datum: 27.08.2021	3.152 Treffer

1. exp Whole Body Imaging/ or *Radiography, Abdominal/ or *Radiography/ or *Radiography, Thoracic/ or *Tomography/ or *Tomography Scanners, X-Ray Computed/ or *Tomography, X-Ray Computed/ or *Tomography, Spiral Computed/ or *Tomography, X-Ray/ or *Magnetic Resonance Imaging/ or *Ultrasonography, Doppler/ or *Ultrasonography/ or *Ultrasonography, Doppler, Duplex/ or *Ultrasonography, Doppler, Color/ or *Focused Assessment with Sonography for Trauma/ or exp "Wounds and Injuries"/dg

2. ((whole body adj (imag* or scan* or CT or MR* or NMR or tomograph* or comput* tomograph*)) or radiograph* or x-ray or diagnostic x-ray or ((chest or thora* or abdom* or pelvic) adj radiograph*) or radar technology or comput* tomograph* or ct or ((ct or cat) adj scan*) or mdct or ((chest or thora* or abdom* or pelvic or spiral) adj ct) or magnetic resonance imag* or mrt or ((mr or nmr) adj tomograph*) or sonograph* or ultrasonograph* or ultrasound or focused assessment with sonography for trauma or Fast or eFast or ((cranial or spine) adj (ct or mr*)) or cct).ti,ab,kf.

3. 1 or 2

4. *Trauma Centers/ or (trauma cent* or trauma room or shock room or resuscitation area? or resuscitation room or (initial and (treatment or diagnos*)) or early phase or bedside or bed-side or hand-carried).ti,ab,kf. or (emergency or emergencies or emergent).ti. or (emergency or emergencies or emergent).ab. /freq=2

5. 3 and 4

6. exp Multiple Trauma/

7. (polytrauma* or trauma patient?).ti,ab,kf. or (severe adj2 shock).ti,ab,kf.

8. ((multiple or major or severe* or serious*) adj3 (trauma* or injur*)).ti,ab,kf.

9. ((blunt or penetrating) adj5 (trauma* or injur*)).ti,ab,kf.

10. (*Critical Care/ or *Emergencies/ or (life threatening or critical care or emergen*).ti,ab,kf.) and (trauma* or injur*).ti,ab,kf.

11. 6 or 7 or 8 or 9 or 10

12. 5 and 11

13. exp animals/ not humans.sh.

14. 12 not 13

15. (comment or editorial or letter).pt. or case report*.mp.

16. 14 not 15

17. limit 16 to dt=20140101-20210831

Suchstrategie 2021, Embase (via Elsevier) Datum: 27.08.2021 1.251 Treffer

#1 'whole body imaging'/exp OR 'abdominal radiography'/mj OR 'radiography'/mj OR 'thorax radiography'/mj OR 'tomography'/mj OR 'computed tomography scanner'/mj OR 'x-ray computed tomography'/mj OR 'spiral computer assisted tomography'/mj OR 'x-ray tomography'/mj OR 'nuclear magnetic resonance imaging'/mj OR 'Doppler ultrasonography'/mj OR 'echography'/mj OR 'duplex Doppler ultrasonography'/mj OR 'color Doppler flowmetry'/mj OR 'focused assessment with sonography for trauma'/mj

#2 (("whole body" NEXT/1 (imag* OR scan* OR CT OR MR* OR NMR OR tomograph* OR "comput* tomograph*")) OR radiograph* OR x-ray OR "diagnostic x-ray" OR ((chest OR thora* OR abdom* OR pelvic) NEXT/1 radiograph*) OR "radar technology" OR "comput* tomograph*" OR ct OR ((ct OR cat) NEXT/1 scan*) OR mdct OR ((chest OR thora* OR abdom* OR pelvic OR spiral) NEXT/1 ct) OR "magnetic resonance imag*" OR mrt OR ((mr OR nmr) NEXT/1 tomograph*) OR sonograph* OR ultrasonograph* OR ultrasound OR "focused assessment with sonography for trauma" OR Fast OR eFast OR ((cranial OR spine) NEXT/1 (ct OR mr*)) OR cct):ti,ab,kw

#3 #1 OR #2

#4 'hospital emergency service'/mj OR ("trauma cent*" OR emergency OR emergencies OR emergent OR "trauma room" OR "shock room" OR "resuscitation area?" OR "resuscitation room" OR (initial AND (treatment OR diagnos*)) OR "early phase" OR bedside OR bed-side OR hand-carried):ti,ab,kw

#5 #3 AND #4

#6 'multiple trauma'/exp

#7 (polytrauma* OR "trauma patient?"):ti,ab,kw OR (severe NEXT/2 shock):ti,ab,kw

#8 ((multiple OR major OR severe* OR serious*) NEXT/3 (trauma* OR injur*)):ti,ab,kw

#9 ((blunt OR penetrating) NEXT/5 (trauma* OR injur*)):ti,ab,kw

#10 ('intensive care'/mj OR 'emergency'/mj OR ("life threatening" OR "critical care" OR emergen*):ti,ab,kw) AND (trauma* OR injur*):ti,ab,kw

#11 #6 OR #7 OR #8 OR #9 OR #10

#12 #5 AND #11

#13 'animals'/exp NOT 'humans'/de

#14 #12 NOT #13

#15 (comment OR editorial OR letter):it OR "case report*":ti,ab,kw
#16 #14 NOT #15
#17 [1-1-2014]/sd NOT [31-8-2021]/sd
#18 #16 AND #17
#19 [embase]/lim
#20 #18 AND #19
#21 embase NOT (embase AND medline)
#22 #20 AND #21
#23 #22 AND ('article'/it OR 'article in press'/it OR 'erratum'/it OR 'review'/it)

2.6 Endovaskuläre Therapie von Blutungen und Gefäßläsionen

Suchstrategie 2021, MEDLINE (via Ovid)	Datum: 16.06.2021	906 Treffer

1. exp Hemorrhage/ or exp Aneurysm, False/ or exp Arteriovenous Fistula/
2. (h?emorrhag* or h?emorrag* or bleeding or aorta or aortic or (traumatic adj2 (vascular or aort*) adj (injur* or rupture* or perforat*)) or ((fals* or spuri*) and aneurysm*) or pseudoaneurysm* or intima dissection? or arteriovenous fistula? or av fistula?).ti,ab,kf.
3. 1 or 2
4. exp Multiple Trauma/
5. (polytrauma* or trauma patient?).ti,ab,kf. or (severe adj2 shock).ti,ab,kf.
6. ((multiple or major or severe* or serious*) adj3 (trauma* or injur*)).ti,ab,kf.
7. ((blunt or penetrating) adj5 (trauma* or injur*)).ti,ab,kf.
8. (*Critical Care/ or *Emergencies/ or (life threatening or critical* care or emergen*).ti,ab,kf.) and (trauma* or injur*).ti,ab,kf.
9. 4 or 5 or 6 or 7 or 8
10. 3 and 9
11. exp animals/ not humans.sh.
12. 10 not 11
13. (comment or editorial or letter).pt. or case report*.mp.
14. 12 not 13
15. limit 14 to dt=20140601-20210601
16. exp Embolization, Therapeutic/ or exp Balloon Occlusion/ or (emboli?ation or angioembolization or balloon occlusion or REBOA or endovascular).ti,ab,kf.
17. 15 and 16

Suchstrategie 2021, Embase (via Elsevier)	Datum: 16.06.2021	410 Treffer

#1 'bleeding'/exp OR 'false aneurysm'/exp OR 'arteriovenous fistula'/exp
#2 (h?emorrhag* OR h?emorrag* OR bleeding OR aorta OR aortic OR (traumatic NEXT/2 (vascular OR aort*) NEXT/1 (injur* OR rupture* OR perforat*)) OR ((fals* OR spuri*) AND aneurysm*) OR pseudoaneurysm* OR "intima dissection?" OR "arteriovenous fistula?" OR "av fistula?"):ti,ab,kw
#3 #1 or #2
#4 'multiple trauma'/exp
#5 (polytrauma* OR "trauma patient?"):ti,ab,kw OR (severe NEXT/2 shock):ti,ab,kw
#6 ((multiple OR major OR severe* OR serious*) NEXT/3 (trauma* OR injur*)):ti,ab,kw
#7 ((blunt OR penetrating) NEXT/5 (trauma* OR injur*)):ti,ab,kw
#8 ('intensive care'/mj OR 'emergency'/mj OR ("life threatening" OR "critical care" OR emergen*):ti,ab,kw) AND (trauma* OR injur*):ti,ab,kw
#9 #4 OR #5 OR #6 or #7 OR #8

#10 #3 AND #9
#11 'animals'/exp NOT 'humans'/de
#12 #10 NOT #11
#13 (comment OR editorial OR letter):it OR "case report*":ti,ab,kw
#14 #12 NOT #13
#15 [1-6-2014]/sd NOT [2-6-2021]/sd
#16 #14 AND #15
#17 'artificial embolization'/exp OR 'balloon occlusion'/exp or (emboli?ation OR "balloon occlusion" OR REBOA OR endovascular):ti,ab,kw
#18 #16 AND #17
#19 [embase]/lim
#20 #18 AND #19
#21 embase NOT (embase AND medline)
#22 #20 AND #21
#23 #22 AND ('article'/it OR 'article in press'/it OR 'review'/it)

2.7 Thorax

Die Recherche für dieses Kapitel wurde gemeinsam mit 1.5 Thorax durchgeführt und ist dort einzusehen.

2.9 Becken

Suchstrategie 2021, MEDLINE (via Ovid)	Datum: 22.09.2021	1430 Treffer

1. exp Pelvis/ or exp Pelvic Bones/in or exp pubic symphysis/ or exp sacroiliac joint/ or exp Hip Injuries/ or exp Hip Fractures/
2. ((pelvis or pelvic or hip or acetabul* or sacrum or pubic or sacroiliac or symphys*) adj2 (trauma* or injur* or fracture* or disrupt*)).ti,ab,kf.
3. 1 or 2
4. exp Multiple Trauma/
5. (polytrauma* or trauma patient?).ti,ab,kf. or (severe adj2 shock).ti,ab,kf.
6. ((multiple or major or severe* or serious*) adj3 (trauma* or injur*)).ti,ab,kf.
7. ((blunt or penetrating) adj5 (trauma* or injur*)).ti,ab,kf.
8. (*Critical Care/ or *Emergencies/ or (life threatening or critical care or emergen*).ti,ab,kf.) and (trauma* or injur*).ti,ab,kf.
9. 4 or 5 or 6 or 7 or 8
10. 3 and 9
11. exp animals/ not humans.sh.
12. 10 not 11
13. (comment or editorial or letter).pt. or case report*.mp.
14. 12 not 13
15. limit 14 to dt=20140101-20210831

Suchstrategie 2021, Zusatzfrage transurethrale Katheterisierung, MEDLINE (via Ovid)	Datum: 19.08.2021	108 Treffer

1. exp Pelvis/ or exp Pelvic Bones/in or exp pubic symphysis/ or exp sacroiliac joint/ or exp Hip Injuries/ or exp Hip Fractures/ or exp Urethra/in

2. ((pelvis or pelvic or hip or acetabul* or sacrum or pubic or sacroiliac or symphys* or urethra*) adj3 (trauma* or injur* or fracture* or disrupt* or rupture*)).ti,ab,kf.

3. 1 or 2

4. exp Multiple Trauma/

5. (polytrauma* or trauma patient?).ti,ab,kf. or (severe adj2 shock).ti,ab,kf.

6. ((multiple or major or severe* or serious*) adj3 (trauma* or injur*)).ti,ab,kf.

7. ((blunt or penetrating) adj5 (trauma* or injur*)).ti,ab,kf.

8. (*Critical Care/ or *Emergencies/ or (life threatening or critical care or emergen*).ti,ab,kf.) and (trauma* or injur*).ti,ab,kf.

9. 4 or 5 or 6 or 7 or 8

10. 3 and 9

11. exp animals/ not humans.sh.

12. 10 not 11

13. (comment or editorial or letter).pt. or case report*.mp.

14. 12 not 13

15. exp Urinary Catheters/ or exp Urinary Catheterization/ or ((transurethral* or urethra* or urinary or foley or bladder) adj2 (catheter* or drainage)).ti,ab,kf.

16. 14 and 15

Suchstrategie 2021, Embase (via Elsevier) Datum: 22.08.2021 668 Treffer

#1 'pelvis'/exp OR 'pelvic girdle'/exp OR 'pelvis fracture'/exp OR 'pubis symphysis'/exp OR 'sacroiliac joint'/exp OR 'hip injury'/exp OR 'hip fracture'/exp

#2 ((pelvis OR pelvic OR hip OR acetabul* OR sacrum OR pubic OR sacroiliac OR symphys*) NEAR/2 (trauma* OR injur* OR fracture* OR disrupt*)):ti,ab,kw

#3 #1 OR #2

#4 'multiple trauma'/exp

#5 (polytrauma* OR "trauma patient?"):ti,ab,kw OR (severe NEXT/2 shock):ti,ab,kw

#6 ((multiple OR major OR severe* OR serious*) NEXT/3 (trauma* OR injur*)):ti,ab,kw

#7 ((blunt OR penetrating) NEXT/5 (trauma* OR injur*)):ti,ab,kw

#8 ('intensive care'/mj OR 'emergency'/mj OR ("life threatening" OR "critical care" OR emergen*):ti,ab,kw) AND (trauma* OR injur*):ti,ab,kw

#9 #4 OR #5 OR #6 OR #7 OR #8

#10 #3 AND #9

#11 'animals'/exp NOT 'humans'/de

#12 #10 NOT #11

#13 (comment OR editorial OR letter):it OR "case report*":ti,ab,kw

#14 #12 NOT #13

#15 [1-1-2014]/sd NOT [1-1-2021]/sd

#16 #14 AND #15

#17 [embase]/lim

#18 #16 AND #17

#19 embase NOT (embase AND medline)

#20 #18 AND #19

#21 #20 AND ('article'/it OR 'article in press'/it OR 'review'/it)

Suchstrategie 2021, Zusatzfrage transurethrale Katheterisierung, Embase (via Elsevier)	Datum: 19.08.2021	47 Treffer

#1 'pelvis'/exp OR 'pelvic girdle'/exp OR 'pelvis fracture'/exp OR 'pubis symphysis'/exp OR 'sacroiliac joint'/exp OR 'hip injury'/exp OR 'hip fracture'/exp OR 'urethra injury'/exp OR 'urethra rupture'/exp

#2 ((pelvis OR pelvic OR hip OR acetabul* OR sacrum OR pubic OR sacroiliac OR symphys* OR urethra*) NEAR/3 (trauma* OR injur* OR fracture* OR disrupt* OR rupture*)):ti,ab,kw

#3 #1 OR #2

#4 'multiple trauma'/exp

#5 (polytrauma* OR "trauma patient?"):ti,ab,kw OR (severe NEXT/2 shock):ti,ab,kw

#6 ((multiple OR major OR severe* OR serious*) NEXT/3 (trauma* OR injur*)):ti,ab,kw

#7 ((blunt OR penetrating) NEXT/5 (trauma* OR injur*)):ti,ab,kw

#8 ('intensive care'/mj OR 'emergency'/mj OR ("life threatening" OR "critical care" OR emergen*):ti,ab,kw) AND (trauma* OR injur*):ti,ab,kw

#9 #4 OR #5 OR #6 OR #7 OR #8

#10 #3 AND #9

#11 'animals'/exp NOT 'humans'/de

#12 #10 NOT #11

#13 (comment OR editorial OR letter):it OR "case report*":ti,ab,kw

#14 #12 NOT #13

#15 'Foley balloon catheter'/exp OR 'urinary catheter'/exp OR 'bladder catheterization'/exp OR ((transurethral* OR urethra* OR urinary OR foley OR bladder) NEAR/2 (catheter* OR drainage)):ti,ab,kw

#16 #14 AND #15

#17 [embase]/lim

#18 #16 AND #17

#19 embase NOT (embase AND medline)

#20 #18 AND #19

#21 #20 AND ('article'/it OR 'review'/it)

2.10 Schädel-Hirn-Trauma

Die Recherche für dieses Kapitel wurde gemeinsam mit 1.6 Schädel-Hirn-Trauma durchgeführt und ist dort einzusehen.

2.12 Unterkiefer und Mittelgesicht

Suchstrategie 2021, MEDLINE (via Ovid)	Datum: 25.06.2021	2.440 Treffer

1. *facial injuries/ or *eye injuries/ or *corneal injuries/ or *corneal perforation/ or *eye foreign bodies/ or *eye injuries, penetrating/ or *maxillofacial injuries/ or *jaw fractures/ or *mandibular fractures/ or *maxillary fractures/ or *mandibular injuries/ or *orbital fractures/ or *zygomatic fractures/ or exp Facial Nerve Injuries/ or *Optic Nerve Injuries/

2. ((jaw or maxill* or mandibul* or facial or face or craniofacial or orbital or eye* or optic or craniomaxill* or tooth or theeth or zygomatic) adj2 (fracture* or injur* or trauma* or damage?)).ab,ti,kf.

3. 1 or 2

4. exp Multiple Trauma/

5. (polytrauma* or trauma patient?).ti,ab,kf. or (severe adj2 shock).ti,ab,kf.

6. ((multiple or major or severe* or serious*) adj3 (trauma* or injur*)).ti,ab,kf.
7. ((blunt or penetrating) adj5 (trauma* or injur*)).ti,ab,kf.
8. (*Critical Care/ or *Emergencies/ or (life threatening or critical care or emergen*).ti,ab,kf.) and (trauma* or injur*).ti,ab,kf.
9. 4 or 5 or 6 or 7 or 8
10. 3 and 9
11. exp animals/ not humans.sh.
12. 10 not 11
13. (comment or editorial or letter).pt. or case report*.mp.
14. 12 not 13
15. limit 14 to dt=20090101-20210630

Suchstrategie 2021, Embase (via Elsevier) Datum: 25.06.2021 903 Treffer

#1 'face injury'/exp OR 'eye injury'/exp OR 'cornea injury'/exp OR 'cornea perforation'/exp OR 'intraocular foreign body'/exp OR 'maxillofacial injury'/exp OR 'jaw fracture'/exp OR 'mandible fracture'/exp OR 'orbit fracture'/exp OR 'zygoma arch fracture'/exp OR 'facial nerve injury'/exp OR 'optic nerve injury'/exp

#2 ((jaw OR maxill* OR mandibul* OR facial OR face OR craniofacial OR orbital OR eye* OR optic OR craniomaxill* OR tooth OR theeth OR zygomatic) NEXT/2 (fracture* OR injur* OR trauma* OR damage?)):ti,ab,kw

#3 #1 OR #2

#4 'multiple trauma'/exp

#5 (polytrauma* OR "trauma patient?"):ti,ab,kw OR (severe NEXT/2 shock):ti,ab,kw

#6 ((multiple OR major OR severe* OR serious*) NEXT/3 (trauma* OR injur*)):ti,ab,kw

#7 ((blunt OR penetrating) NEXT/5 (trauma* OR injur*)):ti,ab,kw

#8 ('intensive care'/mj OR 'emergency'/mj OR ("life threatening" OR "critical care" OR emergen*):ti,ab,kw) AND (trauma* OR injur*):ti,ab,kw

#9 #4 OR #5 OR #6 OR #7 OR #8

#10 #3 AND #9

#11 'animals'/exp NOT 'humans'/de

#12 #10 NOT #11

#13 (comment OR editorial OR letter):it OR "case report*":ti,ab,kw

#14 #12 NOT #13

#15 [1-1-2009]/sd NOT [1-7-2021]/sd

#16 #14 AND #15

#17 [embase]/lim

#18 #16 AND #17

#19 embase NOT (embase AND medline)

#20 #18 AND #19

#21 #20 AND ('article'/it OR 'article in press'/it OR 'erratum'/it OR 'review'/it)

2.13 Hals

Suchstrategie 2021, MEDLINE (via Ovid) Datum: 17.08.2021 1.337 Treffer

1. exp Neck/ or exp Neck Injuries/ or exp Pharynx/in or exp Larynx/in or exp Trachea/in or exp Esophagus/in
2. ((neck or pharyn* or laryn* or trache* or ?esophag* or cervical vascular) adj2 (injur* or trauma*)).ab,ti,kf.

3. 1 or 2
4. exp Multiple Trauma/
5. (polytrauma* or trauma patient?).ti,ab,kf. or (severe adj2 shock).ti,ab,kf.
6. ((multiple or major or severe* or serious*) adj3 (trauma* or injur*)).ti,ab,kf.
7. ((blunt or penetrating) adj5 (trauma* or injur*)).ti,ab,kf.
8. (*Critical Care/ or *Emergencies/ or (life threatening or critical care or emergen*).ti,ab,kf.) and (trauma* or injur*).ti,ab,kf.
9. 4 or 5 or 6 or 7 or 8
10. 3 and 9
11. exp animals/ not humans.sh.
12. 10 not 11
13. (comment or editorial or letter).pt. or case report*.mp.
14. 12 not 13
15. limit 14 to dt=20090101-20210831

Suchstrategie 2021, Embase (via Elsevier) Datum: 17.08.2021 485 Treffer

#1 'neck'/mj OR 'neck injury'/exp OR 'pharynx'/exp OR 'larynx injury'/exp OR 'trachea injury'/exp OR 'esophagus injury'/exp

#2 ((neck OR pharyn* OR laryn* OR trache* OR ?esophag* or “cervical vascular”) NEAR/2 (injur* OR trauma*)):ti,ab,kw

#3 #1 OR #2

#4 'multiple trauma'/exp

#5 (polytrauma* OR "trauma patient?"):ti,ab,kw OR (severe NEXT/2 shock):ti,ab,kw

#6 ((multiple OR major OR severe* OR serious*) NEXT/3 (trauma* OR injur*)):ti,ab,kw

#7 ((blunt OR penetrating) NEXT/5 (trauma* OR injur*)):ti,ab,kw

#8 ('intensive care'/mj OR 'emergency'/mj OR ("life threatening" OR "critical care" OR emergen*):ti,ab,kw) AND (trauma* OR injur*):ti,ab,kw

#9 #4 OR #5 OR #6 OR #7 OR #8

#10 #3 AND #9

#11 'animals'/exp NOT 'humans'/de

#12 #10 NOT #11

#13 (comment OR editorial OR letter):it OR "case report*":ti,ab,kw

#14 #12 NOT #13

#15 [1-1-2009]/sd NOT [1-9-2021]/sd

#16 #14 AND #15

#17 [embase]/lim

#18 #16 AND #17

#19 embase NOT (embase AND medline)

#20 #18 AND #19

#21 #20 AND ('article'/it OR 'article in press'/it OR 'erratum'/it OR 'review'/it)

3 Erste OP-Phase

3.1 Thorax

Die Hauptrecherche für dieses Kapitel wurde gemeinsam mit 1.5 Thorax durchgeführt.

Suchstrategie 2021, Zusatzfragen zu Kapitel 3.2, MEDLINE (via Ovid)
Datum: 08.06.2021 79 Treffer

1. exp Pneumothorax/ or exp hemopneumothorax/ or exp thoracic injuries/ or exp Thorax/ or exp Cardiac Tamponade/ or exp Lung Injury/
2. (pneumothora* or h?emopneumothora* or h?emothorax or thora* injur* or chest injur* or thora* trauma* or chest trauma* or myocardial injur* or myocardial trauma* or heart tamponade or cardiac tamponade or lung injur* or lung trauma* or tracheobronchial injur* or tracheobronchial trauma*).ab,ti,kf.
3. 1 or 2
4. exp Multiple Trauma/
5. (polytrauma* or trauma patient?).ti,ab,kf. or (severe adj2 shock).ti,ab,kf.
6. ((multiple or major or severe* or serious*) adj3 (trauma* or injur*)).ti,ab,kf.
7. ((blunt or penetrating) adj5 (trauma* or injur*)).ti,ab,kf.
8. (*Critical Care/ or *Emergencies/ or (life threatening or critical care or emergen*).ti,ab,kf.) and (trauma* or injur*).ti,ab,kf.
9. 4 or 5 or 6 or 7 or 8
10. 3 and 9
11. exp animals/ not humans.sh.
12. 10 not 11
13. (comment or editorial or letter).pt. or case report*.mp.
14. 12 not 13
15. exp Thoracic Surgery, Video-Assisted/ or (video-assisted and thoracoscop*).ti,ab,kf.
16. 14 and 15

Suchstrategie 2021, Zusatzfragen zu Kapitel 3.2, Embase (via Elsevier)
Datum: 08.06.2021 57 Treffer

#1 'pneumothorax'/exp OR 'hematopneumothorax'/exp OR 'thorax injury'/exp OR 'thorax'/exp OR 'heart tamponade'/exp OR 'lung injury'/exp

#2 (pneumothora* OR h?emopneumothora* OR h?emothorax OR "thora* injur*" OR "chest injur*" OR "thora* trauma*" OR "chest trauma*" OR “myocardial injur*” OR “myocardial trauma*” OR “heart tamponade” OR “cardiac tamponade” OR “lung injur*” OR “lung trauma*” OR “tracheobronchial injur*” OR “tracheobronchial trauma*”):ti,ab,kw

#3 #1 OR #2

#4 'multiple trauma'/exp

#5 (polytrauma* OR "trauma patient?"):ti,ab,kw OR (severe NEXT/2 shock):ti,ab,kw

#6 ((multiple OR major OR severe* OR serious*) NEXT/3 (trauma* OR injur*)):ti,ab,kw

#7 ((blunt OR penetrating) NEXT/5 (trauma* OR injur*)):ti,ab,kw

#8 ('intensive care'/mj OR 'emergency'/mj OR ("life threatening" OR "critical care" OR emergen*):ti,ab,kw) AND (trauma* OR injur*):ti,ab,kw

#9 #4 OR #5 OR #6 OR #7 OR #8

#10 #3 AND #9

#11 'animals'/exp NOT 'humans'/de

#12 #10 NOT #11

#13 (comment OR editorial OR letter):it OR "case report*":ti,ab,kw

#14 #12 NOT #13

#15 [embase]/lim

#16 #14 AND #15

#17 embase NOT (embase AND medline)

#18 #16 AND #17

#19 'video assisted thoracoscopic surgery'/exp OR 'video assisted thoracoscopy'/exp OR (video-assisted AND thoracoscop*):ti,ab,kw

#20 #18 AND #19

#21 #20 AND ('article'/it OR 'review'/it)

3.3 Abdomen

Suchstrategie 2021, MEDLINE (via Ovid) Datum: 06.05.2021 1.087 Treffer

1. exp Abdomen or exp Abdominal Injuries/

2. ((abdom* or mesenteric or bowel or liver or hepatic or spleen or splenic or colo* or peritone* or retroperitone*) adj2 (injur* or trauma*)).ti,ab,kf.

3. 1 or 2

4. exp Multiple Trauma/

5. (polytrauma* or trauma patient?).ti,ab,kf. or (severe adj2 shock).ti,ab,kf.

6. ((multiple or major or severe* or serious*) adj3 (trauma* or injur*)).ti,ab,kf.

7. ((blunt or penetrating) adj5 (trauma* or injur*)).ti,ab,kf.

8. (*Critical Care/ or *Emergencies/ or (life threatening or critical care or emergen*).ti,ab,kf.) and (trauma* or injur*).ti,ab,kf.

9. 4 or 5 or 6 or 7 or 8

10. 3 and 9

11. exp animals/ not humans.sh.

12. 10 not 11

13. (comment or editorial or letter).pt. or case report*.mp.

14. 12 not 13

15. limit 14 to dt=20150101-20210315

16. exp Laparotomy/ or exp embolization, therapeutic/ or exp hemostasis, surgical/ or exp second-look surgery/ or exp splenectomy/ or (laparotom* or damage control or h?emosta* or pack* or ((abdom* or fascial) adj2 closure) or laparostom* or second look or second-look or nonoperative or "non-operative" or angioemboli?ation or emboli?ation or splenectom* or anastom* or ostom* or resection).ti,ab,kf.

17. 15 and 16

Suchstrategie 2021, Embase (via Elsevier) Datum: 06.05.2021 449 Treffer

#1 'abdomen'/exp OR 'abdominal injury'/exp

#2 ((abdom* OR mesenteric OR bowel OR liver OR hepatic OR spleen OR splenic OR colo* OR peritone* OR retroperitone*) NEXT/2 (injur* OR trauma*)):ti,ab,kw

#3 #1 or #2

#4 'multiple trauma'/exp

#5 (polytrauma* OR "trauma patient?"):ti,ab,kw OR (severe NEXT/2 shock):ti,ab,kw

#6 ((multiple OR major OR severe* OR serious*) NEXT/3 (trauma* OR injur*)):ti,ab,kw

#7 ((blunt OR penetrating) NEXT/5 (trauma* OR injur*)):ti,ab,kw

#8 ('intensive care'/mj OR 'emergency'/mj OR ("life threatening" OR "critical care" OR emergen*):ti,ab,kw) AND (trauma* OR injur*):ti,ab,kw

#9 #4 OR #5 OR #6 or #7 OR #8

#10 #3 AND #9

#11 'animals'/exp NOT 'humans'/de

#12 #10 NOT #11

#13 (comment OR editorial OR letter):it OR "case report*":ti,ab,kw

#14 #12 NOT #13

#15 [1-1-2015]/sd NOT [16-3-2021]/sd

#16 #14 AND #15

#17 'laparotomy'/exp OR 'artificial embolization'/exp OR 'hemostasis'/exp OR 'second look surgery'/exp OR 'splenectomy'/exp OR (laparotom* OR "damage control" OR h?emosta* OR pack* OR ((abdom* OR fascial) NEXT/2 closure) OR laparostom* OR "second look" OR second-look OR non-operative OR non-operative OR angioemboli?ation OR emboli?ation OR splenectom* OR anastom* OR ostom* OR resection):ti,ab,kw

#18 #16 AND #17

#19 [embase]/lim

#20 #18 AND #19

#21 embase NOT (embase AND medline)

#22 #20 AND #21

#23 #22 AND ('article'/it OR 'article in press'/it OR 'erratum'/it OR 'review'/it)

3.4 Schädel-Hirn-Trauma

Suchstrategie 2021, MEDLINE (via Ovid) Datum: 06.05.2021 1.024 Treffer

1. *craniocerebral trauma/ or *brain injuries/ or exp brain injuries, traumatic/ or exp head injuries, closed/ or exp skull fractures/ or Skull/in or exp Intracranial Hemorrhage, Traumatic/

2. (craniocerebral trauma* or skull fracture* or traumatic brain injur* or tbi or ((head or brain) adj2 (injur* or trauma*)) or ((subdural or epidural or extradural) adj1 h?ematoma*)).ti,ab,kf.

3. 1 or 2

4. exp Multiple Trauma/

5. (polytrauma* or trauma patient?).ti,ab,kf. or (severe adj2 shock).ti,ab,kf.

6. ((multiple or major or severe* or serious*) adj3 (trauma* or injur*)).ti,ab,kf.

7. ((blunt or penetrating) adj5 (trauma* or injur*)).ti,ab,kf.

8. (*Critical Care/ or *Emergencies/ or (life threatening or critical care or emergen*).ti,ab,kf.) and (trauma* or injur*).ti,ab,kf.

9. 4 or 5 or 6 or 7 or 8

10. 3 and 9

11. exp animals/ not humans.sh.

12. 10 not 11

13. (comment or editorial or letter).pt. or case report*.mp.

14. 12 not 13

15. limit 14 to dt=20150101-20210315

16. exp craniotomy/ or exp decompressive craniectomy/ or ("surgical management" or "operative management" or craniotom* or craniectom* or intracranial pressure or ICP).ti,ab,kf.

17. 15 and 16

Suchstrategie 2021, Embase (via Elsevier) Datum: 06.05.2021 339 Treffer

#1 'head injury'/exp OR 'brain injury'/exp OR 'traumatic brain injury'/exp OR 'skull fracture'/exp OR 'brain hemorrhage'/exp

#2 ("craniocerebral trauma*" OR "skull fracture*" OR "traumatic brain injur*" OR tbi OR ((head OR brain) NEXT/2 (injur* OR trauma*)) OR ((subdural OR epidural OR extradural) NEXT/1 h?ematoma*)):ti,ab,kw

#3 #1 or #2

#4 'multiple trauma'/exp

#5 (polytrauma* OR "trauma patient?"):ti,ab,kw OR (severe NEXT/2 shock):ti,ab,kw

#6 ((multiple OR major OR severe* OR serious*) NEXT/3 (trauma* OR injur*)):ti,ab,kw

#7 ((blunt OR penetrating) NEXT/5 (trauma* OR injur*)):ti,ab,kw

#8 ('intensive care'/mj OR 'emergency'/mj OR ("life threatening" OR "critical care" OR emergen*):ti,ab,kw) AND (trauma* OR injur*):ti,ab,kw

#9 #4 OR #5 OR #6 or #7 OR #8

#10 #3 AND #9

#11 'animals'/exp NOT 'humans'/de

#12 #10 NOT #11

#13 (comment OR editorial OR letter):it OR "case report*":ti,ab,kw

#14 #12 NOT #13

#15 [1-1-2015]/sd NOT [16-3-2021]/sd

#16 #14 AND #15

#17 'craniotomy'/exp OR 'decompressive craniectomy'/exp OR ("surgical management" or "operative management" OR craniotom* OR craniectom* OR "intracranial pressure" OR ICP):ti,ab,kw

#18 #16 AND #17

#19 [embase]/lim

#20 #18 AND #19

#21 embase NOT (embase AND medline)

#22 #20 AND #21

#23 #22 AND ('article'/it OR 'article in press'/it OR 'erratum'/it OR 'review'/it)

3.5 Wirbelsäule

Suchstrategie 2021, MEDLINE (via Ovid)	Datum: 06.05.2021	1.721 Treffer

1. exp Spinal Cord Injuries/ or exp Spinal Injuries/ or exp Spinal Fractures/

2. ((spinal or spine or cervical or thoracic or thoracolumbar or thoraco-lumbar or lumbar or vertebral) adj2 (trauma* or injur* or fracture*)).ti,ab,kf.

3. 1 or 2

4. exp Multiple Trauma/

5. (polytrauma* or trauma patient?).ti,ab,kf. or (severe adj2 shock).ti,ab,kf.

6. ((multiple or major or severe* or serious*) adj3 (trauma* or injur*)).ti,ab,kf.

7. ((blunt or penetrating) adj5 (trauma* or injur*)).ti,ab,kf.

8. (*Critical Care/ or *Emergencies/ or (life threatening or critical care or emergen*).ti,ab,kf.) and (trauma* or injur*).ti,ab,kf.

9. 4 or 5 or 6 or 7 or 8

10. 3 and 9

11. exp animals/ not humans.sh.

12. 10 not 11

13. (comment or editorial or letter).pt. or case report*.mp.

14. 12 not 13

15. limit 14 to dt=20090101-20210317

16. *Fracture Fixation/ or exp Fracture Fixation, Internal/ or exp External Fixators/ or exp Internal Fixators/ or (surger* or surgical or operation* or operative or fixation or fixator? or stabili* or decompression).ti,ab,kf.

17. 15 and 16

Suchstrategie 2021, Embase (via Elsevier)	Datum: 06.05.2021	526 Treffer

#1 'spinal cord injury'/exp OR 'spine injury'/exp oR 'spine fracture'/exp

#2 ((spinal OR spine OR cervical OR thoracic OR thoracolumbar OR thoraco-lumbar OR lumbar OR vertebral) NEXT/2 (trauma* OR injur* OR fracture*)):ti,ab,kw

#3 #1 or #2

#4 'multiple trauma'/exp

#5 (polytrauma* OR "trauma patient?"):ti,ab,kw OR (severe NEXT/2 shock):ti,ab,kw

#6 ((multiple OR major OR severe* OR serious*) NEXT/3 (trauma* OR injur*)):ti,ab,kw

#7 ((blunt OR penetrating) NEXT/5 (trauma* OR injur*)):ti,ab,kw

#8 ('intensive care'/mj OR 'emergency'/mj OR ("life threatening" OR "critical care" OR emergen*):ti,ab,kw) AND (trauma* OR injur*):ti,ab,kw

#9 #4 OR #5 OR #6 or #7 OR #8

#10 #3 AND #9

#11 'animals'/exp NOT 'humans'/de

#12 #10 NOT #11

#13 (comment OR editorial OR letter):it OR "case report*":ti,ab,kw

#14 #12 NOT #13

#15 [1-1-2009]/sd NOT [18-3-2021]/sd

#16 #14 AND #15

#17 'spine surgery'/exp OR 'spine stabilization'/mj OR 'spinal cord decompression'/mj OR (surger* OR surgical OR operation* OR operative OR fixation OR fixator? OR stabili* OR decompression):ti,ab,kw

#18 #16 AND #17

#19 [embase]/lim

#20 #18 AND #19

#21 embase NOT (embase AND medline)

#22 #20 AND #21

#23 #22 AND ('article'/it OR 'article in press'/it OR 'erratum'/it OR 'review'/it)

3.10 Untere Extremitäten

Suchstrategie 2021, MEDLINE (via Ovid)	Datum: 06.05.2021	1.717 Treffer

1. exp Lower Extremity/in

2. ((lower extremit* or lower limb* or leg* or thigh or femur or femoral or tibia* or fibula* or knee* or ankle or malleolus or calcaneus or talus) adj2 (trauma* or injur* or fracture* or luxat*)).ti,ab,kf.

3. 1 or 2

4. exp Multiple Trauma/

5. (polytrauma* or trauma patient?).ti,ab,kf. or (severe adj2 shock).ti,ab,kf.

6. ((multiple or major or severe* or serious*) adj3 (trauma* or injur*)).ti,ab,kf.

7. ((blunt or penetrating) adj5 (trauma* or injur*)).ti,ab,kf.

8. (*Critical Care/ or *Emergencies/ or (life threatening or critical care or emergen*).ti,ab,kf.) and (trauma* or injur*).ti,ab,kf.

9. 4 or 5 or 6 or 7 or 8

10. 3 and 9

11. exp animals/ not humans.sh.

12. 10 not 11

13. (comment or editorial or letter).pt. or case report*.mp.

14. 12 not 13

15. limit 14 to dt=20090101-20210315

16. exp Fracture Fixation/ or exp Fracture Fixation, Internal/ or exp fracture fixation, intramedullary/ or *surgical fixation devices/ or *orthopedic fixation devices/ or exp external fixators/ or exp internal fixators/ or exp Compartment Syndromes/ or (surger* or surgical or operation* or operative or fixation or fixator? or stabili* or nail? or plate? or screw? or wire? or pin? or osteosynthe* or compartment or antibio* prophyla* or reduction or retain or cast or amputation).ti,ab,kf.

17. 15 and 16

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#1 'lower limb'/exp OR 'leg injury'/exp

#2 (("lower extremit*" OR "lower limb*" OR leg* OR thigh OR femur OR femoral OR tibia* OR fibula* OR knee* OR ankle or malleolus or calcaneus or talus) NEXT/2 (trauma* OR injur* OR fracture* OR luxat*)):ti,ab,kw

#3 #1 or #2

#4 'multiple trauma'/exp

#5 (polytrauma* OR "trauma patient?"):ti,ab,kw OR (severe NEXT/2 shock):ti,ab,kw

#6 ((multiple OR major OR severe* OR serious*) NEXT/3 (trauma* OR injur*)):ti,ab,kw

#7 ((blunt OR penetrating) NEXT/5 (trauma* OR injur*)):ti,ab,kw

#8 ('intensive care'/mj OR 'emergency'/mj OR ("life threatening" OR "critical care" OR emergen*):ti,ab,kw) AND (trauma* OR injur*):ti,ab,kw

#9 #4 OR #5 OR #6 or #7 OR #8

#10 #3 AND #9

#11 'animals'/exp NOT 'humans'/de

#12 #10 NOT #11

#13 (comment OR editorial OR letter):it OR "case report*":ti,ab,kw

#14 #12 NOT #13

#15 [1-1-2009]/sd NOT [16-3-2021]/sd

#16 #14 AND #15

#17 'fracture fixation'/exp OR 'osteosynthesis'/exp OR 'intramedullary nailing'/exp OR 'orthopedic fixation device'/exp OR 'external fixator'/exp OR 'internal fixator'/exp OR 'compartment syndrome'/exp OR (surger* OR surgical OR operation* OR operative OR fixation OR fixator? OR stabili* OR nail? OR plate? OR screw? OR wire? OR pin? OR osteosynthe* OR compartment OR “antibio* prophyla*” or reduction or retain or cast or amputation):ti,ab,kw

#18 #16 AND #17

#19 [embase]/lim

#20 #18 AND #19

#21 embase NOT (embase AND medline)

#22 #20 AND #21

#23 #22 AND ('article'/it OR 'article in press'/it OR 'erratum'/it OR 'review'/it)

3.12 Urogenitaltrakt

Suchstrategie 2021, MEDLINE (via Ovid) Datum: 01.07.2021 3.880 Treffer

1. *kidney/in, su or *urethra/in, su or *urinary bladder/in, su or (((urethra* or bladder or kidney or renal) adj2 (injur* or trauma*)) or ((urethra* or bladder) adj1 rupture)).ti,ab,kf.

2. exp Multiple Trauma/

3. (polytrauma* or trauma patient?).ti,ab,kf. or (severe adj2 shock).ti,ab,kf.
4. ((multiple or major or severe* or serious*) adj3 (trauma* or injur*)).ti,ab,kf.
5. ((blunt or penetrating) adj5 (trauma* or injur*)).ti,ab,kf.
6. (*Critical Care/ or *Emergencies/ or (life threatening or critical* care or emergen*).ti,ab,kf.) and (trauma* or injur*).ti,ab,kf.
7. 2 or 3 or 4 or 5 or 6
8. 1 and 7
9. exp animals/ not humans.sh.
10. 8 not 9
11. (comment or editorial or letter).pt. or case report*.mp.
12. 10 not 11
13. limit 12 to dt=20090101-20210731

Suchstrategie 2021, Embase (via Elsevier) Datum: 01.07.2021 989 Treffer

#1 'kidney injury'/exp OR 'urethra injury'/exp OR 'bladder'/exp OR (((urethra* OR bladder OR kidney OR renal) NEAR/2 (injur* OR trauma*)) OR ((urethra* OR bladder) NEXT/1 rupture)):ti,ab,kw
#2 'multiple trauma'/exp
#3 (polytrauma* OR "trauma patient?"):ti,ab,kw OR (severe NEXT/2 shock):ti,ab,kw
#4 ((multiple OR major OR severe* OR serious*) NEXT/3 (trauma* OR injur*)):ti,ab,kw
#5 ((blunt OR penetrating) NEXT/5 (trauma* OR injur*)):ti,ab,kw
#6 ('intensive care'/mj OR 'emergency'/mj OR ("life threatening" OR "critical care" OR emergen*):ti,ab,kw) AND (trauma* OR injur*):ti,ab,kw
#7 #2 OR #3 OR #4 OR #5 OR #6
#8 #1 AND #7
#9 'animals'/exp NOT 'humans'/de
#10 #8 NOT #9
#11 (comment OR editorial OR letter):it OR "case report*":ti,ab,kw
#12 #10 NOT #11
#13 [1-1-2009]/sd NOT [1-8-2021]/sd
#14 #12 AND #13
#15 [embase]/lim
#16 #14 AND #15
#17 embase NOT (embase AND medline)
#18 #16 AND #17
#19 #18 AND ('article'/it OR 'article in press'/it OR 'erratum'/it OR 'review'/it)

Appendix A3. Einschlusskriterien

1 Präklinik

1.1 Stop the bleeding

Da es sich um ein neues Kapitel handelt, wird für einzelne Fragestellungen auch indirekte Evidenz mit einer weiter definierten Studienpopulation zugelassen, solange keine direkte Evidenz an erwachsenen Patienten (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung identifiziert werden kann.

E1 Studienpopulation: Erwachsene Patienten (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung. Bei Bedarf indirekte Evidenz mit Population: Erwachsene Patienten (≥14 Jahre) mit aktiver Blutung.

E2 Intervention: prähospitale Blutungsstillung durch Kompression, Hämostyptika, Tourniquet, Beckenstabilisierung, Extensionsschienen

E3 Studientyp:

- Vergleichende, prospektive Studien *oder*
- vergleichende Registerdaten[6] (inkl. Fall-Kontroll-Studien; keine non-comparative studies) *oder*
- Querschnittstudien (nur bei diagnostischen Fragestellungen) *oder*
- Systematic Reviews auf Basis der genannten Primärstudientypen,

die jeweils relevante (klinische) Endpunkte berichten.

E4 Publikationssprache: Englisch oder Deutsch

E5 Keine Mehrfachpublikation ohne Zusatzinformationen

E6 Studie ist im Volltext publiziert und beschaffbar

E7 Referenz wurde in bisheriger Leitlinie noch nicht berücksichtigt

E8 Studie kann einer konkreten Empfehlung oder vorab festgelegten Fragestellung (nach PICO-Schema) zugeordnet werden

1.2 Atemwegsmanagement, Beatmung und Notfallnarkose

E1 Studienpopulation: Erwachsene Patienten (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung

E2 Intervention: Maßnahmen zur Atemwegssicherung, Intubation, Beatmung, Narkoseeinleitung, Training und Ausbildungsmaßnahmen; Kapnografie, sichere Intubationszeichen, Videolaryngoskopie, Bougie, Airwayexchanger, First Pass Success, invasive Notfalltechniken zur Atemwegssicherung, Koniotomie, Umintubation, definitive Atemwegssicherung nach supraglottischem Atemweg, Bronchoskopie, Computertomographie, traumaspezifischer Atemwegsalgorithmus

E3 Studientyp:

- Vergleichende, prospektive Studien *oder*
- vergleichende Registerdaten[7] (inkl. Fall-Kontroll-Studien; keine non-comparative studies) *oder*

[6] Nur multizentrische Register nach Registerdefinition der AHRQ, siehe Fußnote 7 auf Seite 87.

[7] Es wurden nur multizentrische Register nach folgender Registerdefinition der US Agency for Healthcare Research and Quality (AHRQ) eingeschlossen: „A patient registry is an organized system that uses observational study methods to collect uniform data (clinical and other) to evaluate specified outcomes for a population defined by a particular disease, condition, or exposure, and that serves one or more predetermined scientific, clinical, or policy purposes." [Gliklich R, Dreyer N, Leavy M, eds. Registries for Evaluating Patient Outcomes: A User's Guide. Third edition. Two volumes. (Prepared by the Outcome DEcIDE Center [Outcome Sciences, Inc., a Quintiles company] under Contract No. 290 2005 00351 TO7.) AHRQ Publication No. 13(14)-EHC111. Rockville,

- Querschnittstudien (nur bei diagnostischen Fragestellungen) *oder*
- Systematic Reviews auf Basis der genannten Primärstudientypen,

die jeweils relevante (klinische) Endpunkte berichten.

E4 Publikationssprache: Englisch oder Deutsch

E5 Keine Mehrfachpublikation ohne Zusatzinformationen

E6 Studie ist im Volltext publiziert und beschaffbar

E7 Referenz wurde in bisheriger Leitlinie noch nicht berücksichtigt

E8 Studie kann einer konkreten Empfehlung oder vorab festgelegten Fragestellung (nach PICO-Schema) zugeordnet werden

1.3 Gerinnungsmanagement und Volumentherapie

E1 Studienpopulation: Erwachsene Patienten (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung

E2 Intervention: prähospitale Volumentherapie, Transfusion oder Diagnostik des Volumenstatus Gerinnungsdiagnostik oder Therapie einer Gerinnungsstörung / starken Blutung in der Präklinik prähospitaler intraossärer Zugang

E3 Studientyp:

- Vergleichende, prospektive Studien *oder*
- vergleichende Registerdaten[7] (inkl. Fall-Kontroll-Studien; keine non-comparative studies) *oder*
- Querschnittstudien (nur bei diagnostischen Fragestellungen) *oder*
- Systematic Reviews auf Basis der genannten Primärstudientypen,

die jeweils relevante (klinische) Endpunkte berichten.

E4 Publikationssprache: Englisch oder Deutsch

E5 Keine Mehrfachpublikation ohne Zusatzinformationen

E6 Studie ist im Volltext publiziert und beschaffbar

E7 Referenz wurde in bisheriger Leitlinie noch nicht berücksichtigt

E8 Studie kann einer konkreten Empfehlung oder vorab festgelegten Fragestellung (nach PICO-Schema) zugeordnet werden

1.4 Analgesie

Da es sich um ein neues Kapitel handelt, wird auch indirekte Evidenz mit einer weiter definierten Studienpopulation zugelassen, solange keine direkte Evidenz an erwachsenen Patienten (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung identifiziert werden kann.

E1 Studienpopulation: Erwachsene Patienten (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung. Bei Bedarf indirekte Evidenz mit Population: Erwachsene Patienten (≥14 Jahre) mit traumabedingtem Akutschmerz.

E2 Intervention: prähospitale und innerklinische Schmerztherapie

E3 Studientyp:

- Vergleichende, prospektive Studien *oder*

MD: Agency for Healthcare Research and Quality. April 2014. http://www.effectivehealthcare.ahrq.gov/registries-guide-3.cfm.]

- vergleichende Registerdaten[8] (inkl. Fall-Kontroll-Studien; keine non-comparative studies) *oder*
- Querschnittstudien (nur bei diagnostischen Fragestellungen) *oder*
- Systematic Reviews auf Basis der genannten Primärstudientypen,

die jeweils relevante (klinische) Endpunkte berichten.

E4 Publikationssprache: Englisch oder Deutsch

E5 Keine Mehrfachpublikation ohne Zusatzinformationen

E6 Studie ist im Volltext publiziert und beschaffbar

E7 Referenz wurde in bisheriger Leitlinie noch nicht berücksichtigt

E8 Studie kann einer konkreten Empfehlung oder vorab festgelegten Fragestellung (nach PICO-Schema) zugeordnet werden

1.5 Thorax

E1 Studienpopulation: Erwachsene Patienten (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung

E2 Intervention: Behandlung eines Spannungspneumothorax‘ / einer Thoraxverletzung in Präklinik / Schockraum / 1. OP-Phase

E3 Studientyp:

- Vergleichende, prospektive Studien *oder*
- vergleichende Registerdaten[9] (inkl. Fall-Kontroll-Studien; keine non-comparative studies) *oder*
- Querschnittstudien (nur bei diagnostischen Fragestellungen) *oder*
- Systematic Reviews auf Basis der genannten Primärstudientypen,

die jeweils relevante (klinische) Endpunkte berichten.

E4 Publikationssprache: Englisch oder Deutsch

E5 Keine Mehrfachpublikation ohne Zusatzinformationen

E6 Studie ist im Volltext publiziert und beschaffbar

E7 Referenz wurde in bisheriger Leitlinie noch nicht berücksichtigt

E8 Studie kann einer konkreten Empfehlung oder vorab festgelegten Fragestellung (nach PICO-Schema) zugeordnet werden

1.6 Schädel-Hirn-Trauma

E1 Studienpopulation: Erwachsene Patienten (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung

E2 Intervention: Behandlung / Diagnostik eines Schädel-Hirn-Traumas am Unfallort / in der Präklinik

E3 Studientyp:

- Vergleichende, prospektive Studien *oder*
- vergleichende Registerdaten[10] (inkl. Fall-Kontroll-Studien; keine non-comparative studies) *oder*
- Querschnittstudien (nur bei diagnostischen Fragestellungen) *oder*
- Systematic Reviews auf Basis der genannten Primärstudientypen,

[8] Nur multizentrische Register nach Registerdefinition der AHRQ, siehe Fußnote 7 auf Seite 87.
[9] Nur multizentrische Register nach Registerdefinition der AHRQ, siehe Fußnote 7 auf Seite 87.
[10] Nur multizentrische Register nach Registerdefinition der AHRQ, siehe Fußnote 7 auf Seite 87.

	die jeweils relevante (klinische) Endpunkte berichten.
E4	Publikationssprache: Englisch oder Deutsch
E5	Keine Mehrfachpublikation ohne Zusatzinformationen
E6	Studie ist im Volltext publiziert und beschaffbar
E7	Referenz wurde in bisheriger Leitlinie noch nicht berücksichtigt
E8	Studie kann einer konkreten Empfehlung oder vorab festgelegten Fragestellung (nach PICO-Schema) zugeordnet werden

1.10 Massenanfall von Verletzten

Aufgrund der geringen Häufigkeit und Planbarkeit von MANV Ereignissen wurden in diesem Kapitel die Einschlusskriterien E1 (Studienpopulation), E2 (Intervention) und E3 (Studientyp) auf die Einschränkungen bei der Durchführung von Studien je nach Intervention angepasst. Zudem wurden in der Population auch Kinder zugelassen, da bei MANV Ereignissen auch Kinder unter den Betroffenen sein können.

Triage

Das Ziel der Triage ist, Schwerverletzte mit sofortigem Interventionsbedarf/dringlichem Behandlungsbedarf von geringer Verletzten zu trennen.

E1	Studienpopulation: Alle verletzten Patienten bei einem echten oder simulierten Massenanfall von Verletzten, mit Patientendaten aus vergleichenden, prospektiven Studien oder vergleichenden Registerstudien. Ausgeschlossen wurden Studien mit Daten von nicht-Trauma-Patienten oder mit simulierten Patientendaten.
E2	Intervention: primäre (prähospitale) und sekundäre (innerklinische) Triagemethoden und -algorithmen im MANV-Kontext
E3	Studientyp: Querschnittstudien; Outcomes: Sensitivität, Spezifität, AUC, % korrekte Triage, Über- und Untertriagerate, Triagedauer.

Training/Ausbildung

Die Studienpopulation umfasst die Teilnehmenden an Trainingsprogrammen, daher wurden die Patienten nicht weiter eingeschränkt.

E1	Studienpopulation: medizinisch geschultes Personal
E2	Intervention: Trainingsinterventionen im MANV-Kontext
E3	Studientyp: vergleichende, prospektive Studien, vergleichende Registerdaten[7] sowie Systematic Reviews (auf Basis der genannten Primärstudientypen); Outcomes: % korrekte Triage, Über- und Untertriagerate.

Logistik/Transport

Die Studienpopulation umfasst medizinisch geschultes Personal, daher wurden die Patienten nicht weiter eingeschränkt.

E1	Studienpopulation: medizinisch geschultes Personal
E2	Intervention: Interventionen zu Logistik, Evakuierung, Transport oder Zielklinik von/bei Verletzten im MANV-Kontext

E3	Studientyp: vergleichende, prospektive Studien, vergleichende Registerdaten[11] sowie Systematic Reviews (auf Basis der genannten Primärstudientypen); Outcomes: zeitliche oder personelle Ressourcen, Aus-/Überlastungsraten, patientenrelevante Outcomes.

Diagnostik

E1	Studienpopulation: offen. Ausgeschlossen werden Studien an Zellen, Kadavern o.ä.
E2	Intervention: prähospitale oder innerklinische Diagnostik im MANV-Kontext
E3	Studientyp: Querschnittstudien, vergleichende, prospektive Studien, vergleichende Registerdaten[7] sowie Systematic Reviews (auf Basis der genannten Primärstudientypen); Outcomes: Sensitivität, Spezifität, PPV, NPV, AUC, Dauer bis Ergebnis vorliegt.

Therapie inkl. Dekontamination

E1	Studienpopulation: offen (z.B. Mannekins/Freiwillige in simulierten MANV Situationen)
E2	Intervention: therapeutische Interventionen (Notfall, Dekontamination, Operation) im MANV-Kontext
E3	Studientyp: vergleichende, prospektive Studien, vergleichende Registerdaten[12] sowie Systematic Reviews (auf Basis der genannten Primärstudientypen); Outcomes: Interventionsdauer, Interventionserfolg, patientenrelevante Outcomes.

Einschlusskriterien für alle Interventionen:

E4	Publikationssprache: Englisch oder Deutsch
E5	Keine Mehrfachpublikation ohne Zusatzinformationen
E6	Studie ist im Volltext publiziert und beschaffbar
E7	Referenz wurde in bisheriger Leitlinie noch nicht berücksichtigt
E8	Studie kann einer konkreten Empfehlung oder vorab festgelegten Fragestellung (nach PICO-Schema) zugeordnet werden

2 Schockraum

2.2 Schockraum – Team und Alarmierung

E1	Studienpopulation: Erwachsene Patienten (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung
E2	Intervention: Kriterien für die Teamdefinition und/oder -aktivierung im Schockraum
E3	Studientyp: • Vergleichende, prospektive Studien *oder* • vergleichende Registerdaten[13] (inkl. Fall-Kontroll-Studien; keine non-comparative studies) *oder* • Querschnittstudien (nur bei diagnostischen Fragestellungen) *oder* • Systematic Reviews auf Basis der genannten Primärstudientypen,

[11] Nur multizentrische Register nach Registerdefinition der AHRQ, siehe Fußnote 7 auf Seite 87.
[12] Nur multizentrische Register nach Registerdefinition der AHRQ, siehe Fußnote 7 auf Seite 87.
[13] Nur multizentrische Register nach Registerdefinition der AHRQ, siehe Fußnote 7 auf Seite 87.

die jeweils relevante (klinische) Endpunkte berichten.

E4 Publikationssprache: Englisch oder Deutsch

E5 Keine Mehrfachpublikation ohne Zusatzinformationen

E6 Studie ist im Volltext publiziert und beschaffbar

E7 Referenz wurde in bisheriger Leitlinie noch nicht berücksichtigt

E8 Studie kann einer konkreten Empfehlung oder vorab festgelegten Fragestellung (nach PICO-Schema) zugeordnet werden

2.3 Reanimation

E1 Studienpopulation: Erwachsene Patienten (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung

E2 Intervention: (kardiopulmonale) Reanimation / Behandlung eines Herz- / Herz-Kreislauf- / Atem-Stillstandes (durch Herz-Druck-Massage, medikamentös, etc.) in Präklinik / Schockraum / 1. OP-Phase

E3 Studientyp:

- Vergleichende, prospektive Studien *oder*
- vergleichende Registerdaten[14] (inkl. Fall-Kontroll-Studien; keine non-comparative studies) *oder*
- Querschnittstudien (nur bei diagnostischen Fragestellungen) *oder*
- Systematic Reviews auf Basis der genannten Primärstudientypen,

die jeweils relevante (klinische) Endpunkte berichten.

E4 Publikationssprache: Englisch oder Deutsch

E5 Keine Mehrfachpublikation ohne Zusatzinformationen

E6 Studie ist im Volltext publiziert und beschaffbar

E7 Referenz wurde in bisheriger Leitlinie noch nicht berücksichtigt

E8 Studie kann einer konkreten Empfehlung oder vorab festgelegten Fragestellung (nach PICO-Schema) zugeordnet werden

2.4 Gerinnungsmanagement und Volumentherapie

Für neue Fragestellungen wird auch indirekte Evidenz mit einer weiter definierten Studienpopulation zugelassen, sofern keine direkte Evidenz an erwachsenen Patienten (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung identifiziert werden kann.

E1 Studienpopulation: Erwachsene Patienten (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung

E2 Intervention: Gerinnungsdiagnostik oder Therapie einer Gerinnungsstörung / starken Blutung, Massivtransfusion oder Thromboseprophylaxe in Schockraum / 1. OP-Phase
Volumentherapie oder Diagnostik des Volumenstatus in Schockraum / 1. OP-Phase
Anlage zentraler Zugänge in Schockraum / 1. OP-Phase

E3 Studientyp:

- Vergleichende, prospektive Studien *oder*
- vergleichende Registerdaten[15] (inkl. Fall-Kontroll-Studien; keine non-comparative studies) *oder*

[14] Nur multizentrische Register nach Registerdefinition der AHRQ, siehe Fußnote 7 auf Seite 87.
[15] Nur multizentrische Register nach Registerdefinition der AHRQ, siehe Fußnote 7 auf Seite 87.

- Querschnittstudien (nur bei diagnostischen Fragestellungen) *oder*
- Systematic Reviews auf Basis der genannten Primärstudientypen,

die jeweils relevante (klinische) Endpunkte berichten.

E4 Publikationssprache: Englisch oder Deutsch

E5 Keine Mehrfachpublikation ohne Zusatzinformationen

E6 Studie ist im Volltext publiziert und beschaffbar

E7 Referenz wurde in bisheriger Leitlinie noch nicht berücksichtigt

E8 Studie kann einer konkreten Empfehlung oder vorab festgelegten Fragestellung (nach PICO-Schema) zugeordnet werden

2.5 Bildgebung

E1 Studienpopulation: Erwachsene Patienten (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung

E2 Intervention: Bildgebung aller Art während der Schockraumphase (inkl. organisatorische Aspekte, bauliche Anordnungen, etc.)

E3 Studientyp:

- Vergleichende, prospektive Studien *oder*
- vergleichende Registerdaten[16] (inkl. Fall-Kontroll-Studien; keine non-comparative studies) *oder*
- Querschnittstudien (nur bei diagnostischen Fragestellungen) *oder*
- Systematic Reviews auf Basis der genannten Primärstudientypen,

die jeweils relevante (klinische) Endpunkte berichten.

E4 Publikationssprache: Englisch oder Deutsch

E5 Keine Mehrfachpublikation ohne Zusatzinformationen

E6 Studie ist im Volltext publiziert und beschaffbar

E7 Referenz wurde in bisheriger Leitlinie noch nicht berücksichtigt

E8 Studie kann einer konkreten Empfehlung oder vorab festgelegten Fragestellung (nach PICO-Schema) zugeordnet werden

2.6 Endovaskuläre Therapie von Blutungen und Gefäßläsionen

E1 Studienpopulation: Erwachsene Patienten (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung

E2 Intervention: Maßnahmen zur endovaskulären Therapie relevanter Blutungen und/oder relevanter Gefäßverletzungen

E3 Studientyp:

- Vergleichende, prospektive Studien *oder*
- vergleichende Registerdaten[17] (inkl. Fall-Kontroll-Studien; keine non-comparative studies) *oder*
- Querschnittstudien (nur bei diagnostischen Fragestellungen) *oder*
- Systematic Reviews auf Basis der genannten Primärstudientypen,

die jeweils relevante (klinische) Endpunkte berichten.

E4 Publikationssprache: Englisch oder Deutsch

[16] Nur multizentrische Register nach Registerdefinition der AHRQ, siehe Fußnote 7 auf Seite 87.
[17] Nur multizentrische Register nach Registerdefinition der AHRQ, siehe Fußnote 7 auf Seite 87.

E5	Keine Mehrfachpublikation ohne Zusatzinformationen
E6	Studie ist im Volltext publiziert und beschaffbar
E7	Referenz wurde in bisheriger Leitlinie noch nicht berücksichtigt
E8	Studie kann einer konkreten Empfehlung oder vorab festgelegten Fragestellung (nach PICO-Schema) zugeordnet werden

2.7 Thorax

E1	Studienpopulation: Erwachsene Patienten (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung
E2	Intervention: Behandlung eines Spannungspneumothorax‘ / einer Thoraxverletzung im Schockraum
E3	Studientyp: • Vergleichende, prospektive Studien *oder* • vergleichende Registerdaten[18] (inkl. Fall-Kontroll-Studien; keine non-comparative studies) *oder* • Querschnittstudien (nur bei diagnostischen Fragestellungen) *oder* • Systematic Reviews auf Basis der genannten Primärstudientypen, die jeweils relevante (klinische) Endpunkte berichten.
E4	Publikationssprache: Englisch oder Deutsch
E5	Keine Mehrfachpublikation ohne Zusatzinformationen
E6	Studie ist im Volltext publiziert und beschaffbar
E7	Referenz wurde in bisheriger Leitlinie noch nicht berücksichtigt
E8	Studie kann einer konkreten Empfehlung oder vorab festgelegten Fragestellung (nach PICO-Schema) zugeordnet werden

2.9 Becken

E1	Studienpopulation: Erwachsene Patienten (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung
E2	Intervention: Behandlung / Diagnostik eines Beckentraumas in Präklinik / Schockraum / 1. OP-Phase
E3	Studientyp: • Vergleichende, prospektive Studien *oder* • vergleichende Registerdaten[19] (inkl. Fall-Kontroll-Studien; keine non-comparative studies) *oder* • Querschnittstudien (nur bei diagnostischen Fragestellungen) *oder* • Systematic Reviews auf Basis der genannten Primärstudientypen, die jeweils relevante (klinische) Endpunkte berichten.
E4	Publikationssprache: Englisch oder Deutsch
E5	Keine Mehrfachpublikation ohne Zusatzinformationen
E6	Studie ist im Volltext publiziert und beschaffbar
E7	Referenz wurde in bisheriger Leitlinie noch nicht berücksichtigt

[18] Nur multizentrische Register nach Registerdefinition der AHRQ, siehe Fußnote 7 auf Seite 87.
[19] Nur multizentrische Register nach Registerdefinition der AHRQ, siehe Fußnote 7 auf Seite 87.

E8	Studie kann einer konkreten Empfehlung oder vorab festgelegten Fragestellung (nach PICO-Schema) zugeordnet werden

2.10 Schädel-Hirn-Trauma

E1	Studienpopulation: Erwachsene Patienten (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung
E2	Intervention: Behandlung / Diagnostik eines Schädel-Hirn-Traumas im Schockraum
E3	Studientyp: • Vergleichende, prospektive Studien *oder* • vergleichende Registerdaten[20] (inkl. Fall-Kontroll-Studien; keine non-comparative studies) *oder* • Querschnittstudien (nur bei diagnostischen Fragestellungen) *oder* • Systematic Reviews auf Basis der genannten Primärstudientypen, die jeweils relevante (klinische) Endpunkte berichten.
E4	Publikationssprache: Englisch oder Deutsch
E5	Keine Mehrfachpublikation ohne Zusatzinformationen
E6	Studie ist im Volltext publiziert und beschaffbar
E7	Referenz wurde in bisheriger Leitlinie noch nicht berücksichtigt
E8	Studie kann einer konkreten Empfehlung oder vorab festgelegten Fragestellung (nach PICO-Schema) zugeordnet werden

2.12 Unterkiefer und Mittelgesicht

E1	Studienpopulation: Erwachsene Patienten (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung
E2	Intervention: Diagnostik und klinische Untersuchung von Unterkiefer- und Mittelgesichtsverletzungen
E3	Studientyp: • Vergleichende, prospektive Studien *oder* • vergleichende Registerdaten[21] (inkl. Fall-Kontroll-Studien; keine non-comparative studies) *oder* • Querschnittstudien (nur bei diagnostischen Fragestellungen) *oder* • Systematic Reviews auf Basis der genannten Primärstudientypen, die jeweils relevante (klinische) Endpunkte berichten.
E4	Publikationssprache: Englisch oder Deutsch
E5	Keine Mehrfachpublikation ohne Zusatzinformationen
E6	Studie ist im Volltext publiziert und beschaffbar
E7	Referenz wurde in bisheriger Leitlinie noch nicht berücksichtigt
E8	Studie kann einer konkreten Empfehlung oder vorab festgelegten Fragestellung (nach PICO-Schema) zugeordnet werden

[20] Nur multizentrische Register nach Registerdefinition der AHRQ, siehe Fußnote 7 auf Seite 87.
[21] Nur multizentrische Register nach Registerdefinition der AHRQ, siehe Fußnote 7 auf Seite 87.

2.13 Hals

E1 Studienpopulation: Erwachsene Patienten (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung

E2 Intervention: Sicherung der Atemwege, Diagnostik oder Therapie bei Halstrauma

E3 Studientyp:
- Vergleichende, prospektive Studien *oder*
- vergleichende Registerdaten[22] (inkl. Fall-Kontroll-Studien; keine non-comparative studies) *oder*
- Querschnittstudien (nur bei diagnostischen Fragestellungen) *oder*
- Systematic Reviews auf Basis der genannten Primärstudientypen,

die jeweils relevante (klinische) Endpunkte berichten.

E4 Publikationssprache: Englisch oder Deutsch

E5 Keine Mehrfachpublikation ohne Zusatzinformationen

E6 Studie ist im Volltext publiziert und beschaffbar

E7 Referenz wurde in bisheriger Leitlinie noch nicht berücksichtigt

E8 Studie kann einer konkreten Empfehlung oder vorab festgelegten Fragestellung (nach PICO-Schema) zugeordnet werden

3 Erste OP-Phase

3.1 Thorax

E1 Studienpopulation: Erwachsene Patienten (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung

E2 Intervention: Behandlung eines Spannungspneumothorax‘ / einer Thoraxverletzung in der 1. OP-Phase

E3 Studientyp:
- Vergleichende, prospektive Studien *oder*
- vergleichende Registerdaten[23] (inkl. Fall-Kontroll-Studien; keine non-comparative studies) *oder*
- Querschnittstudien (nur bei diagnostischen Fragestellungen) *oder*
- Systematic Reviews auf Basis der genannten Primärstudientypen,

die jeweils relevante (klinische) Endpunkte berichten.

E4 Publikationssprache: Englisch oder Deutsch

E5 Keine Mehrfachpublikation ohne Zusatzinformationen

E6 Studie ist im Volltext publiziert und beschaffbar

E7 Referenz wurde in bisheriger Leitlinie noch nicht berücksichtigt

E8 Studie kann einer konkreten Empfehlung oder vorab festgelegten Fragestellung (nach PICO-Schema) zugeordnet werden

3.3 Abdomen

E1 Studienpopulation: Erwachsene Patienten (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung

[22] Nur multizentrische Register nach Registerdefinition der AHRQ, siehe Fußnote 7 auf Seite 87.
[23] Nur multizentrische Register nach Registerdefinition der AHRQ, siehe Fußnote 7 auf Seite 87.

E2 Intervention: Therapie abdomineller Verletzung in der ersten OP-Phase

E3 Studientyp:
- Vergleichende, prospektive Studien *oder*
- vergleichende Registerdaten[24] (inkl. Fall-Kontroll-Studien; keine non-comparative studies) *oder*
- Querschnittstudien (nur bei diagnostischen Fragestellungen) *oder*
- Systematic Reviews auf Basis der genannten Primärstudientypen,

die jeweils relevante (klinische) Endpunkte berichten.

E4 Publikationssprache: Englisch oder Deutsch

E5 Keine Mehrfachpublikation ohne Zusatzinformationen

E6 Studie ist im Volltext publiziert und beschaffbar

E7 Referenz wurde in bisheriger Leitlinie noch nicht berücksichtigt

E8 Studie kann einer konkreten Empfehlung oder vorab festgelegten Fragestellung (nach PICO-Schema) zugeordnet werden

3.4 Schädel-Hirn-Trauma

E1 Studienpopulation: Erwachsene Patienten (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung

E2 Intervention: Chirurgische Maßnahmen (z.B. Entlastungskraniektomie/ Kraniotomie, Dekompression, Liquordrainage, intrakranielle Blutung, / Diagnostisch-chirurgische Maßnahmen (z.B. Ventrikeldrainage, Druckmessung) bei SHT in der 1. OP-Phase

E3 Studientyp:
- Vergleichende, prospektive Studien *oder*
- vergleichende Registerdaten[25] (inkl. Fall-Kontroll-Studien; keine non-comparative studies) *oder*
- Querschnittstudien (nur bei diagnostischen Fragestellungen) *oder*
- Systematic Reviews auf Basis der genannten Primärstudientypen,

die jeweils relevante (klinische) Endpunkte berichten.

E4 Publikationssprache: Englisch oder Deutsch

E5 Keine Mehrfachpublikation ohne Zusatzinformationen

E6 Studie ist im Volltext publiziert und beschaffbar

E7 Referenz wurde in bisheriger Leitlinie noch nicht berücksichtigt

E8 Studie kann einer konkreten Empfehlung oder vorab festgelegten Fragestellung (nach PICO-Schema) zugeordnet werden

3.5 Wirbelsäule

E1 Studienpopulation: Erwachsene Patienten (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung

E2 Intervention: Therapie von Wirbelsäulenverletzungen in der ersten OP-Phase

E3 Studientyp:
- Vergleichende, prospektive Studien *oder*

[24] Nur multizentrische Register nach Registerdefinition der AHRQ, siehe Fußnote 7 auf Seite 87.
[25] Nur multizentrische Register nach Registerdefinition der AHRQ, siehe Fußnote 7 auf Seite 87.

- vergleichende Registerdaten[26] (inkl. Fall-Kontroll-Studien; keine non-comparative studies) *oder*
- Querschnittstudien (nur bei diagnostischen Fragestellungen) *oder*
- Systematic Reviews auf Basis der genannten Primärstudientypen,

die jeweils relevante (klinische) Endpunkte berichten.

E4 Publikationssprache: Englisch oder Deutsch

E5 Keine Mehrfachpublikation ohne Zusatzinformationen

E6 Studie ist im Volltext publiziert und beschaffbar

E7 Referenz wurde in bisheriger Leitlinie noch nicht berücksichtigt

E8 Studie kann einer konkreten Empfehlung oder vorab festgelegten Fragestellung (nach PICO-Schema) zugeordnet werden

3.10 Untere Extremitäten

E1 Studienpopulation: Erwachsene Patienten (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung

E2 Intervention: (operative) Behandlung von Frakturen, Luxationen und Gefäßverletzungen der unteren Extremitäten (nicht Becken)

E3 Studientyp:

- Vergleichende, prospektive Studien *oder*
- vergleichende Registerdaten[27] (inkl. Fall-Kontroll-Studien; keine non-comparative studies) *oder*
- Querschnittstudien (nur bei diagnostischen Fragestellungen) *oder*
- Systematic Reviews auf Basis der genannten Primärstudientypen,

die jeweils relevante (klinische) Endpunkte berichten.

E4 Publikationssprache: Englisch oder Deutsch

E5 Keine Mehrfachpublikation ohne Zusatzinformationen

E6 Studie ist im Volltext publiziert und beschaffbar

E7 Referenz wurde in bisheriger Leitlinie noch nicht berücksichtigt

E8 Studie kann einer konkreten Empfehlung oder vorab festgelegten Fragestellung (nach PICO-Schema) zugeordnet werden

3.12 Urogenitaltrakt

E1 Studienpopulation: Erwachsene Patienten (≥14 Jahre) mit Polytrauma oder traumabedingter Schwerverletzung

E2 Intervention: Chirurgische/interventionelle Maßnahmen bei Urogenitalverletzungen

E3 Studientyp:

- Vergleichende, prospektive Studien *oder*
- vergleichende Registerdaten[28] (inkl. Fall-Kontroll-Studien; keine non-comparative studies) *oder*
- Querschnittstudien (nur bei diagnostischen Fragestellungen) *oder*
- Systematic Reviews auf Basis der genannten Primärstudientypen,

die jeweils relevante (klinische) Endpunkte berichten.

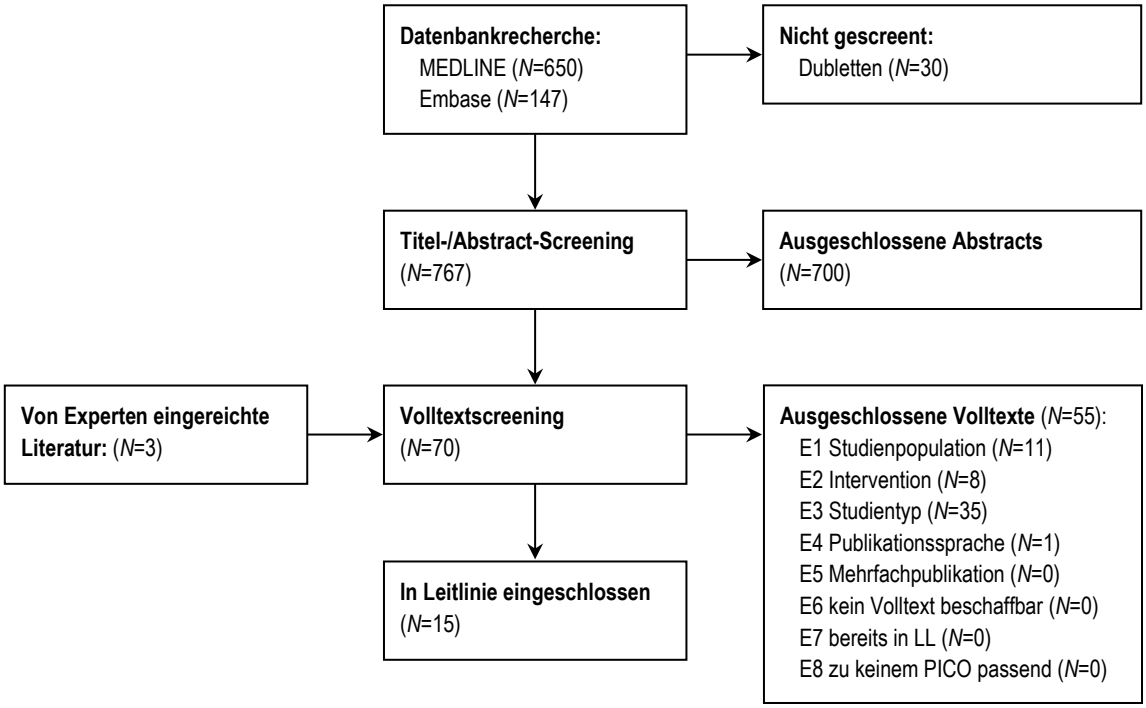
[26] Nur multizentrische Register nach Registerdefinition der AHRQ, siehe Fußnote 7 auf Seite 87.
[27] Nur multizentrische Register nach Registerdefinition der AHRQ, siehe Fußnote 7 auf Seite 87.
[28] Nur multizentrische Register nach Registerdefinition der AHRQ, siehe Fußnote 7 auf Seite 87.

E4	Publikationssprache: Englisch oder Deutsch
E5	Keine Mehrfachpublikation ohne Zusatzinformationen
E6	Studie ist im Volltext publiziert und beschaffbar
E7	Referenz wurde in bisheriger Leitlinie noch nicht berücksichtigt
E8	Studie kann einer konkreten Empfehlung oder vorab festgelegten Fragestellung (nach PICO-Schema) zugeordnet werden

Appendix A4. Flowcharts

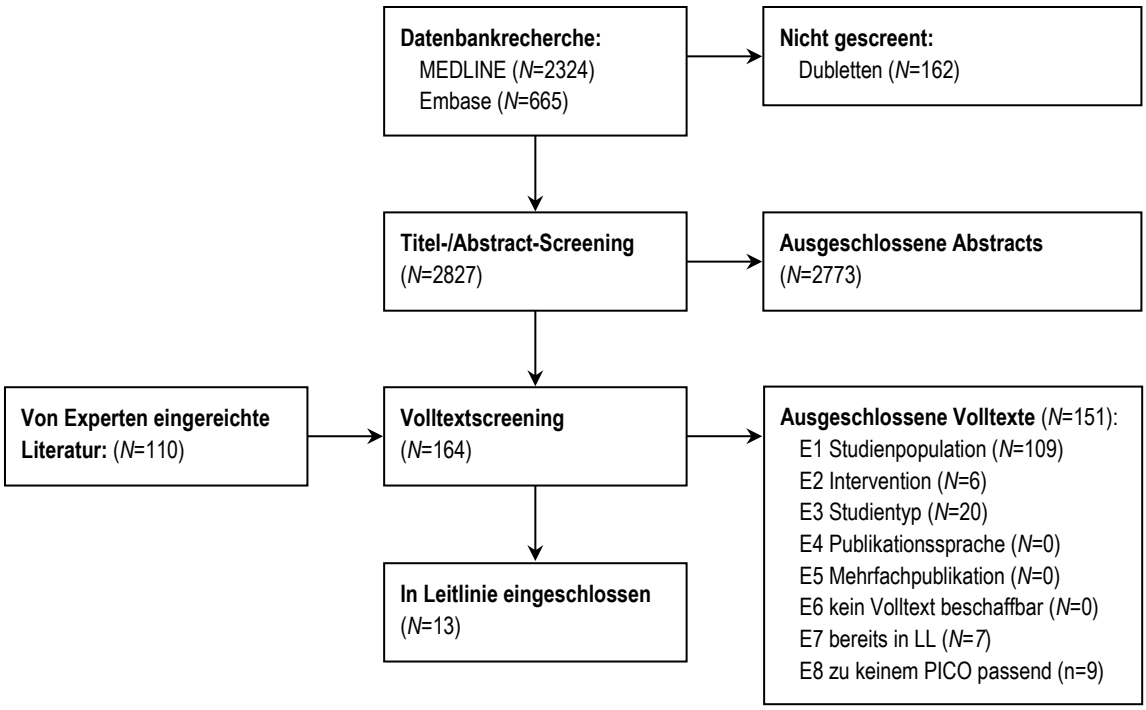
1 Präklinik

1.1 Stop the bleeding

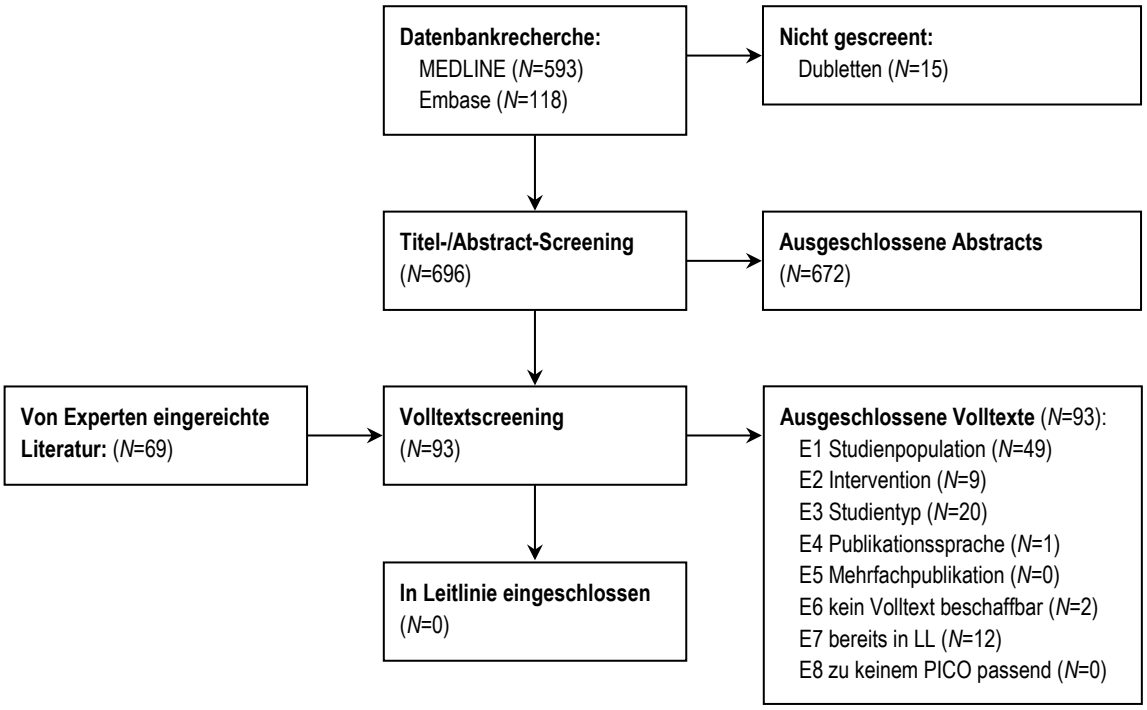


1.2 Atemwegsmanagement, Beatmung und Notfallnarkose

Hauptrecherche

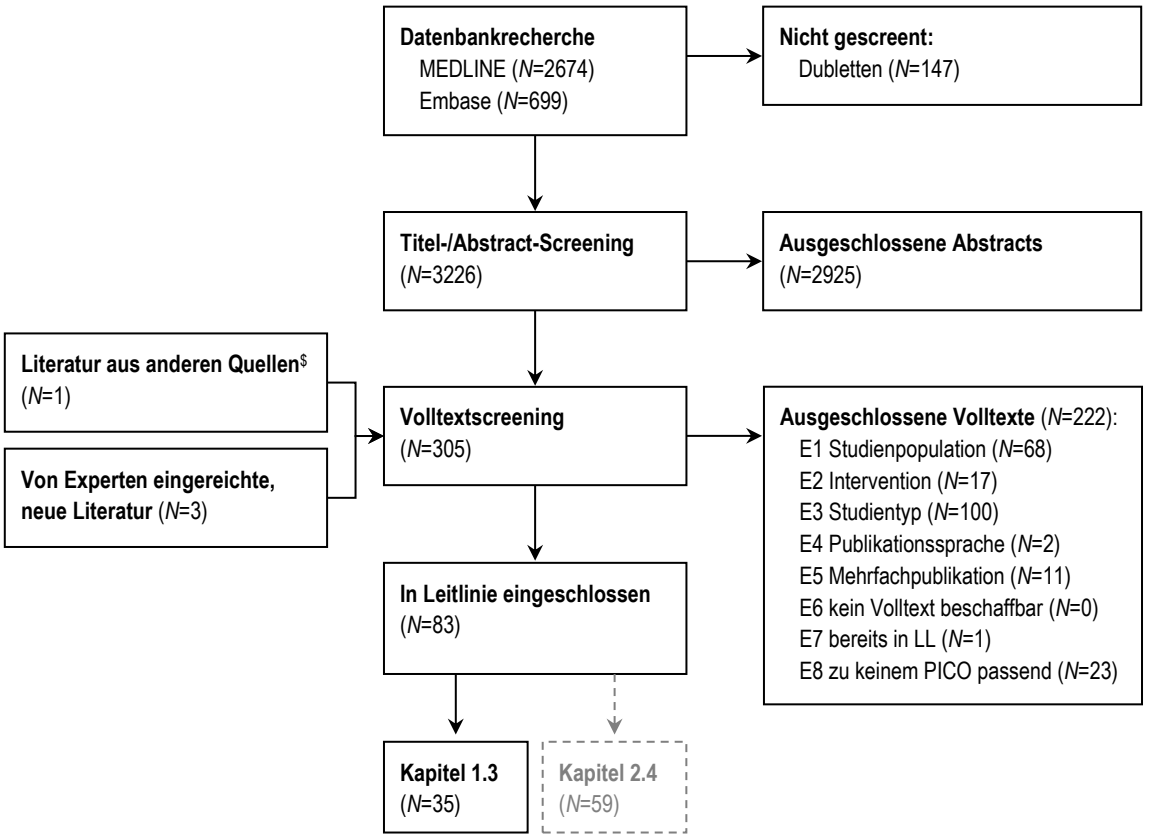


Recherche Zusatzfragen



1.3 Gerinnungsmanagement und Volumentherapie

Die Recherche für dieses Kapitel wurde gemeinsam mit 2.4 Gerinnungsmanagement und Volumentherapie durchgeführt.



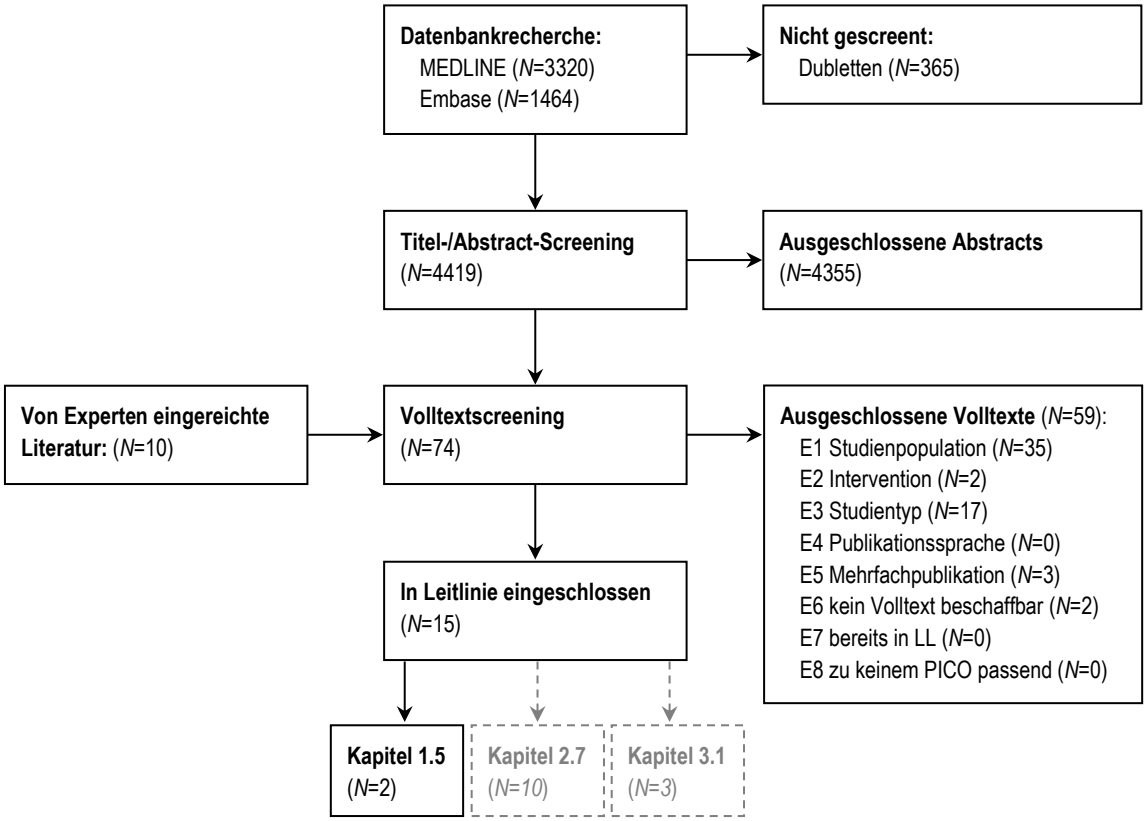
$ in Methoden zitierte Hauptstudie zu eingeschlossener Sekundäranalyse

1.4 Analgesie

Das PRISMA-Diagramm ist Referenz [5] zu entnehmen.

1.5 Thorax

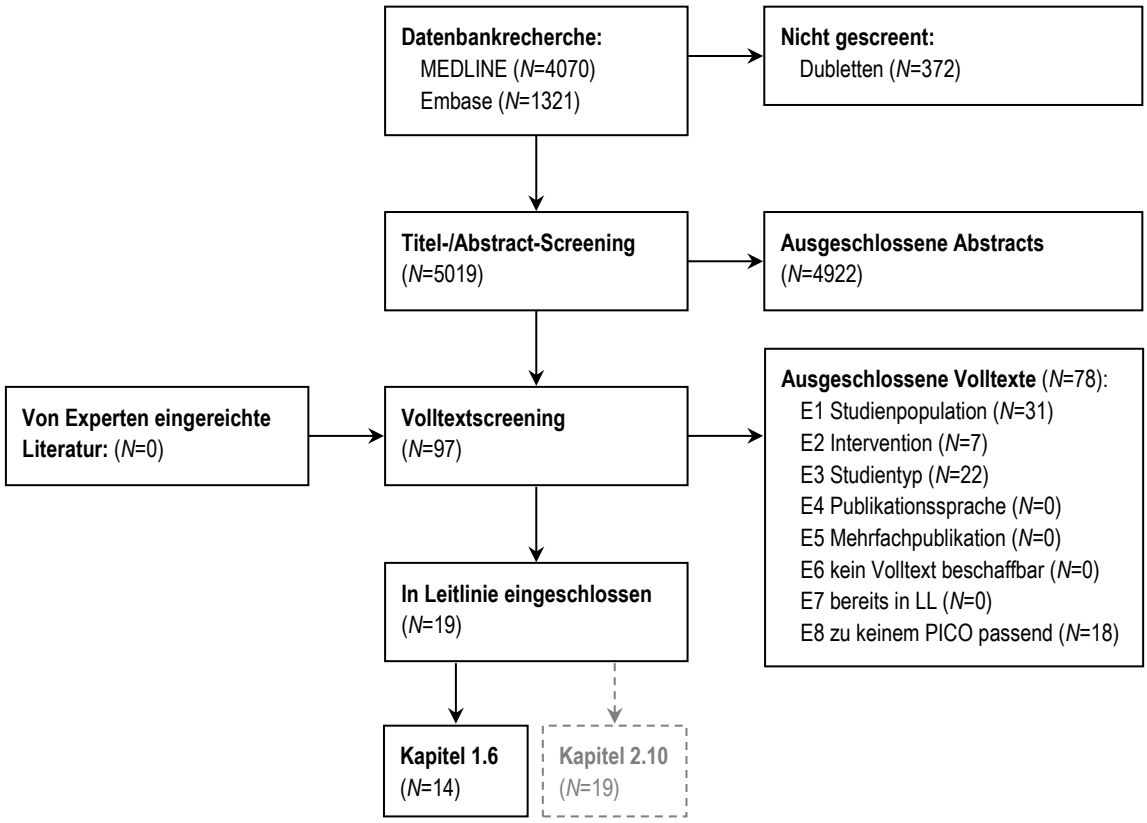
Die Recherche für dieses Kapitel wurde gemeinsam mit 2.7 Thorax und 3.1 Thorax durchgeführt.



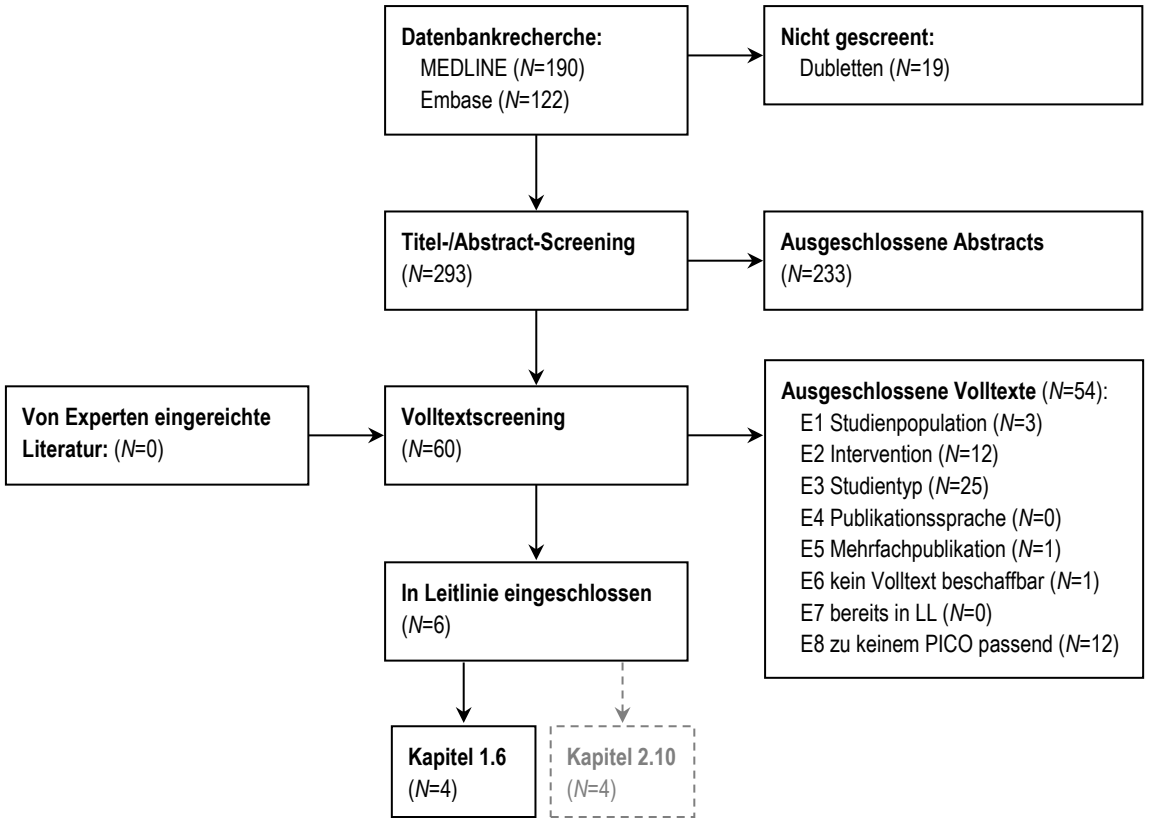
1.6 Schädel-Hirn-Trauma

Die Recherchen für dieses Kapitel wurden gemeinsam mit 2.10 Schädel-Hirn-Trauma durchgeführt.

Hauptrecherche

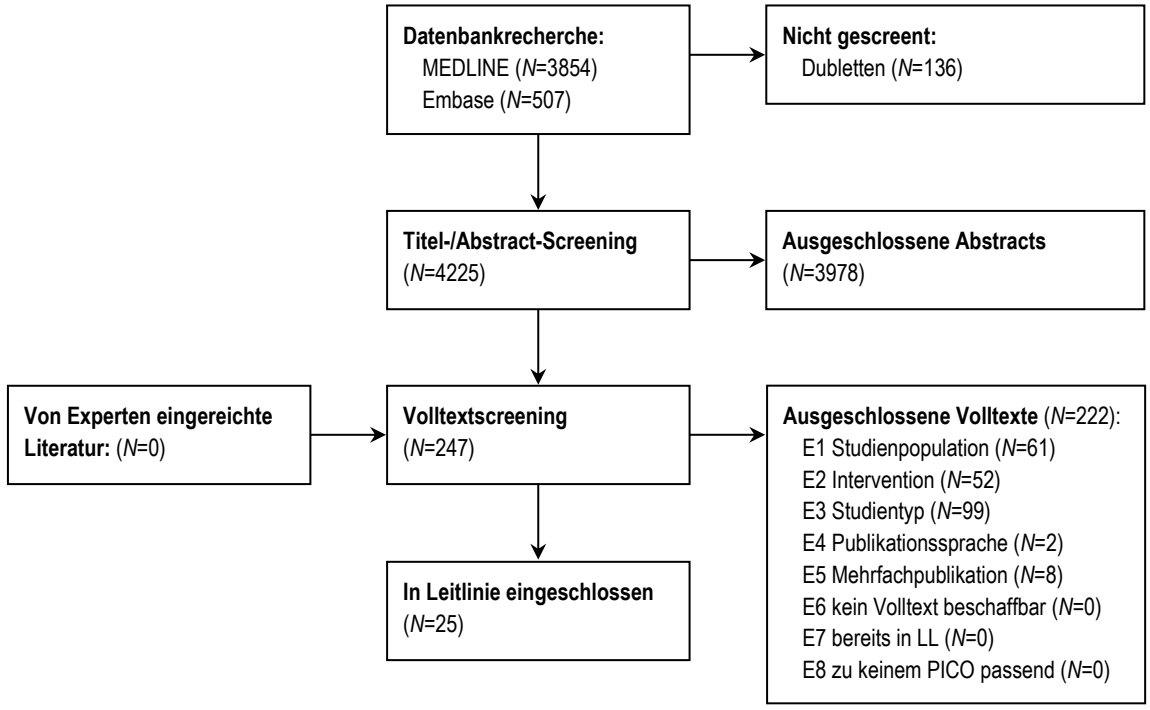


Recherche Bachelorarbeit[$]



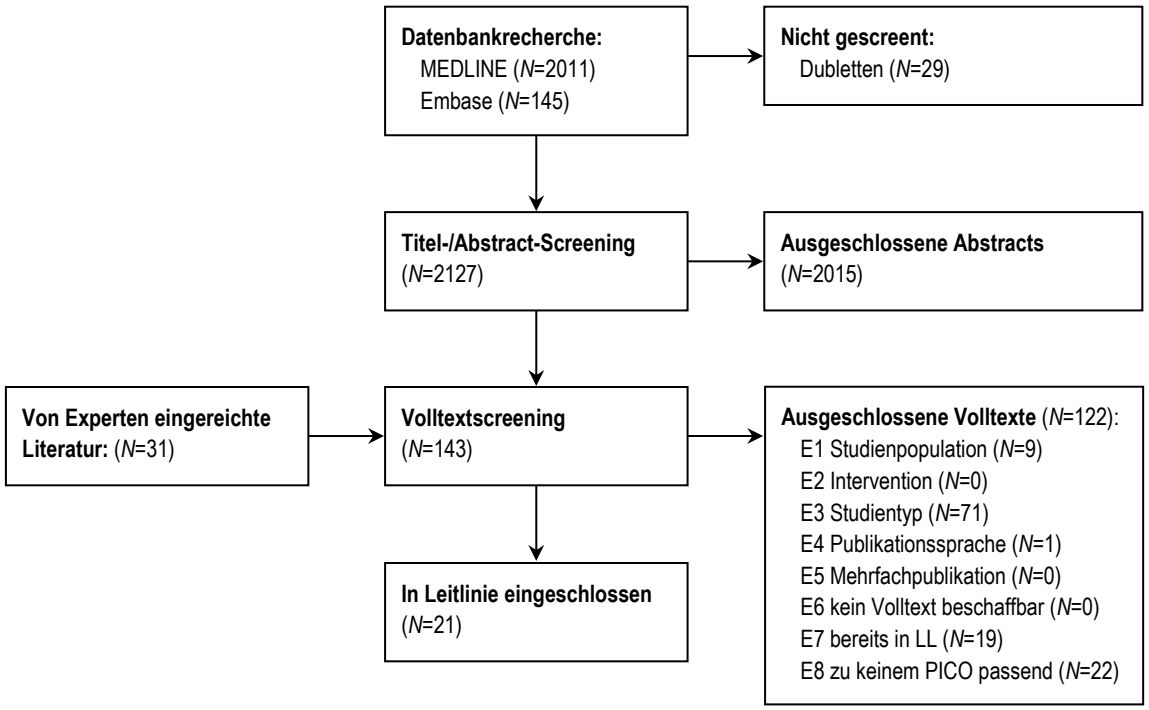
[$] Der Teilbereich zu Hyperventilierung, Mannitol und hypertonen Kochsalzlösungen wurde getrennt recherchiert und im Rahmen einer Bachelorarbeit bearbeitet.

1.10 Massenanfall von Verletzten

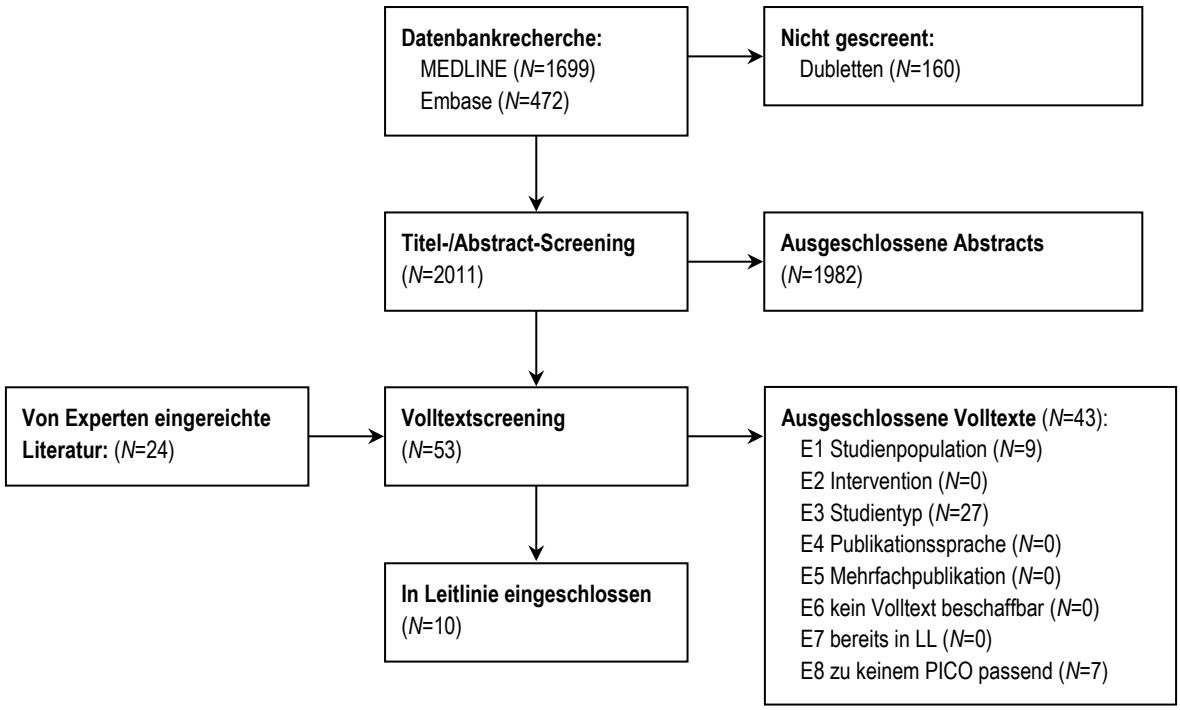


2 Schockraum

2.3 Schockraum – Team und Alarmierung

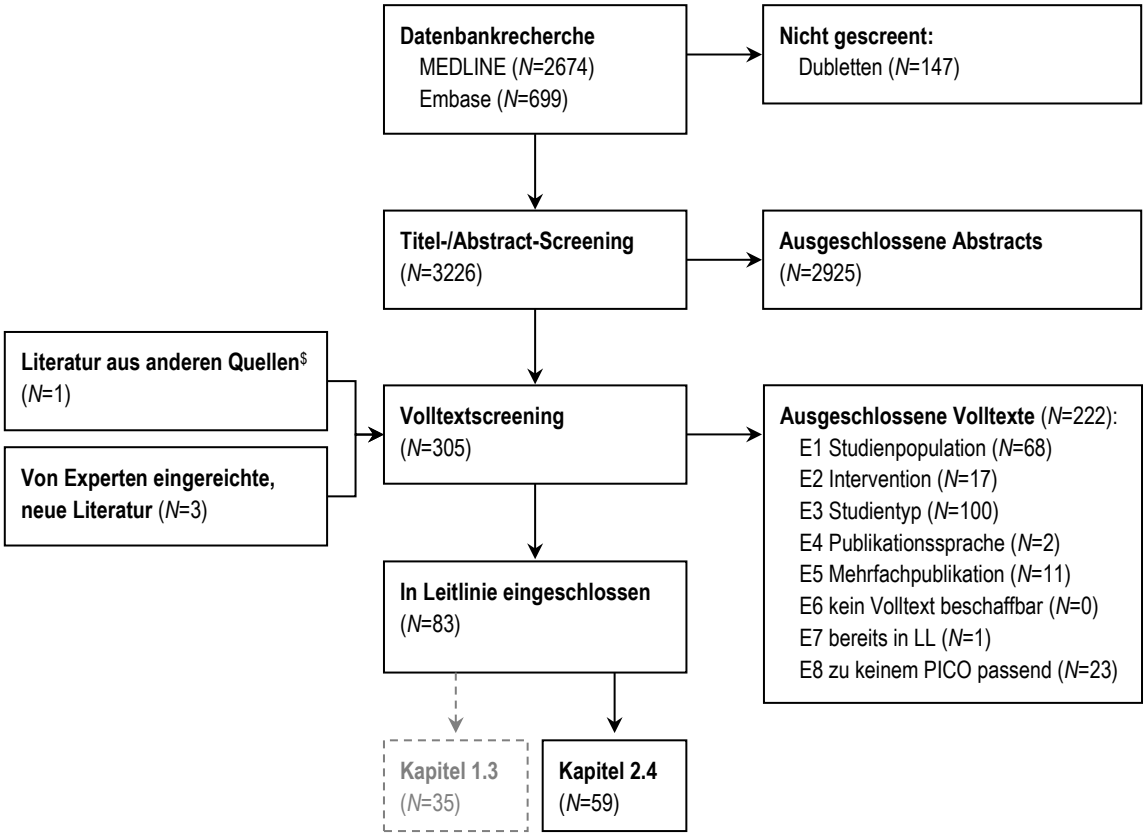


2.3 Reanimation



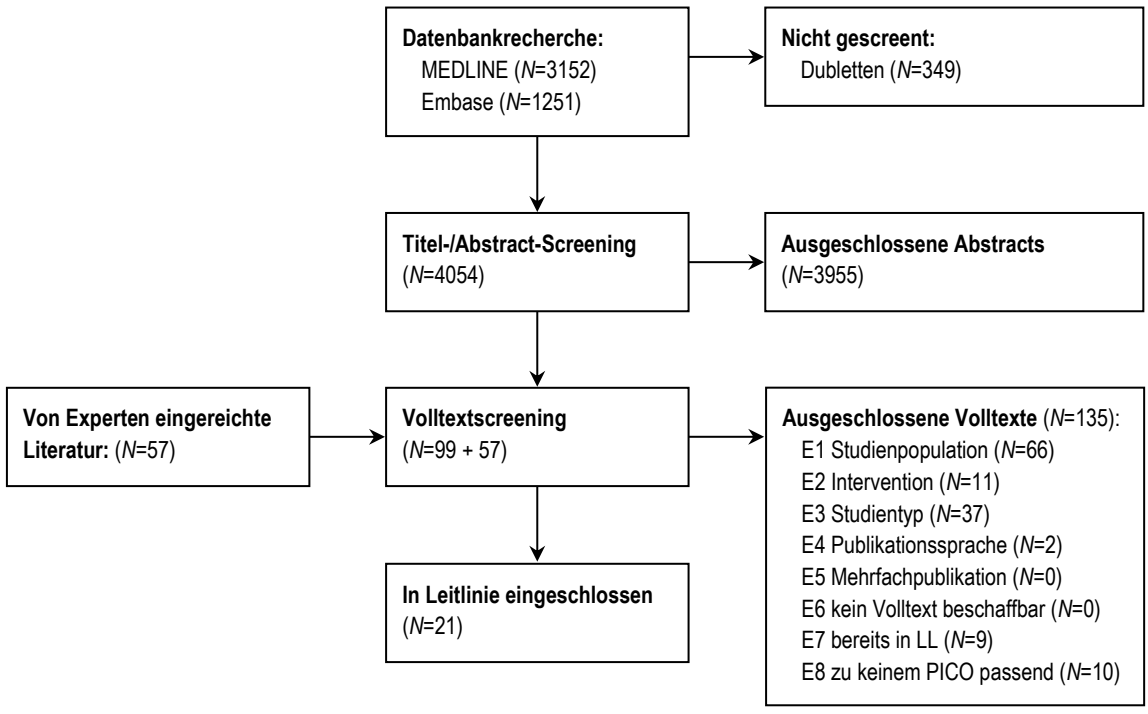
2.4 Gerinnungsmanagement und Volumentherapie

Die Recherche für dieses Kapitel wurde gemeinsam mit 1.3 Gerinnungsmanagement und Volumentherapie durchgeführt.

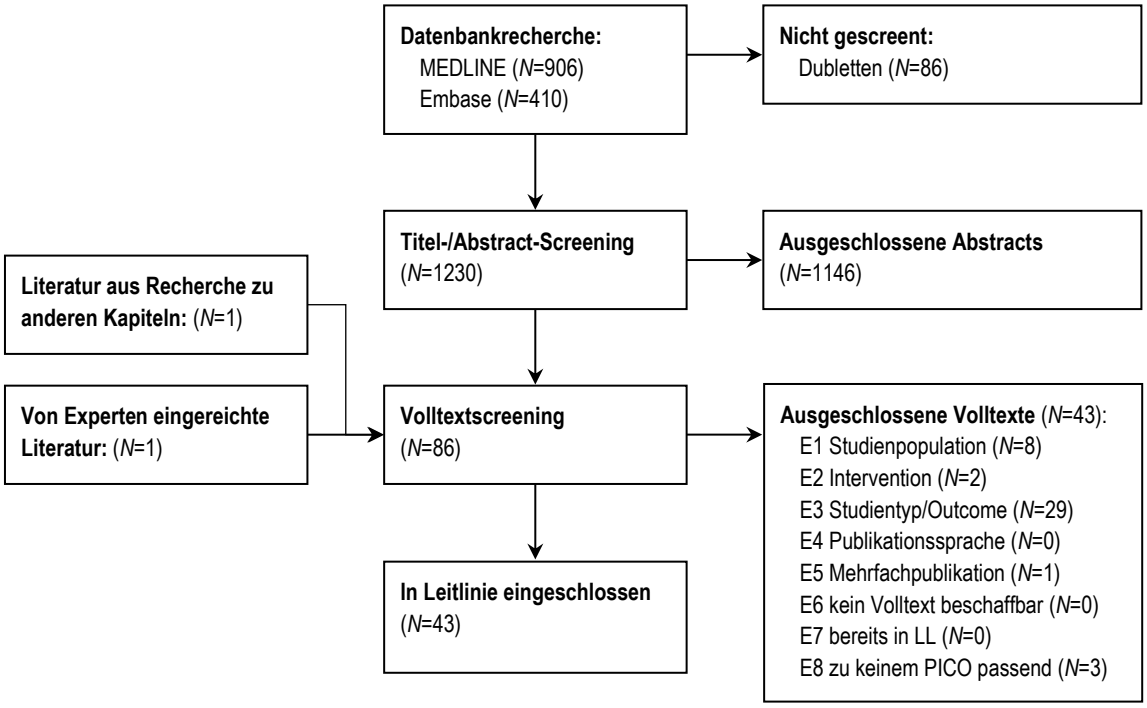


$ in Methoden zitierte Hauptstudie zu eingeschlossener Sekundäranalyse

2.5 Bildgebung

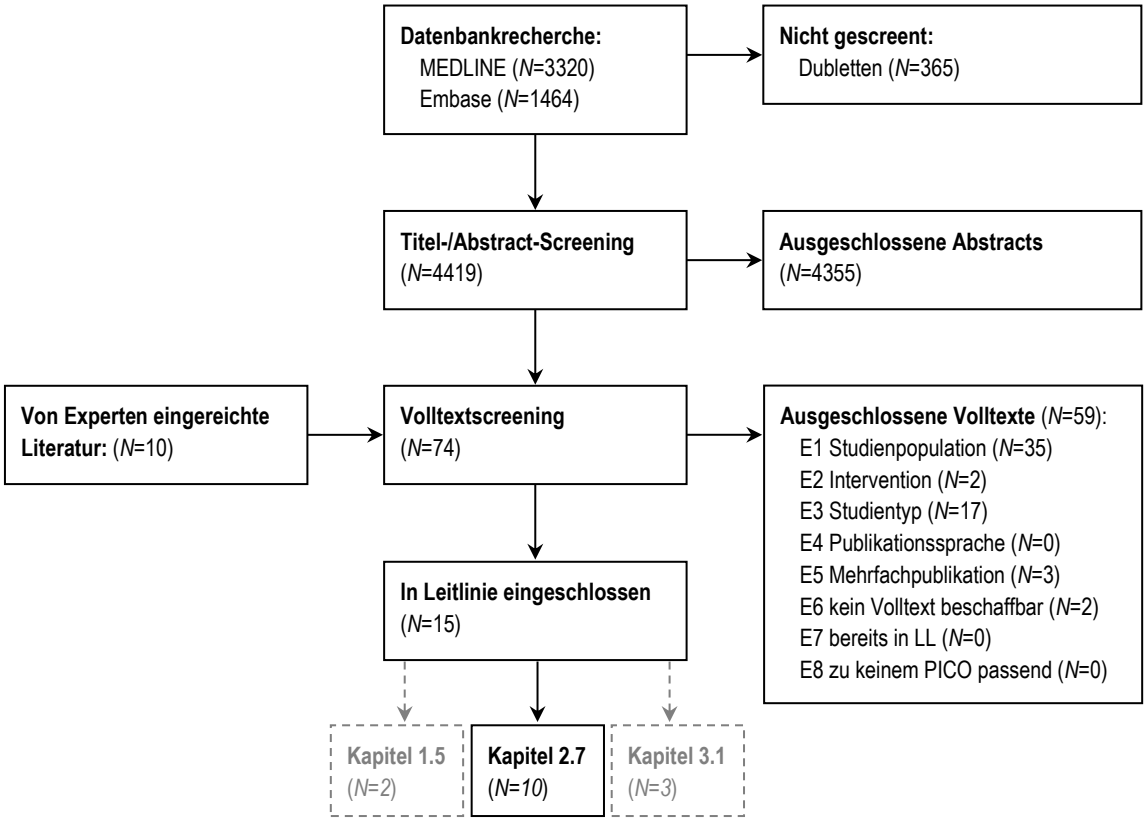


2.6 Endovaskuläre Therapie von Blutungen und Gefäßläsionen



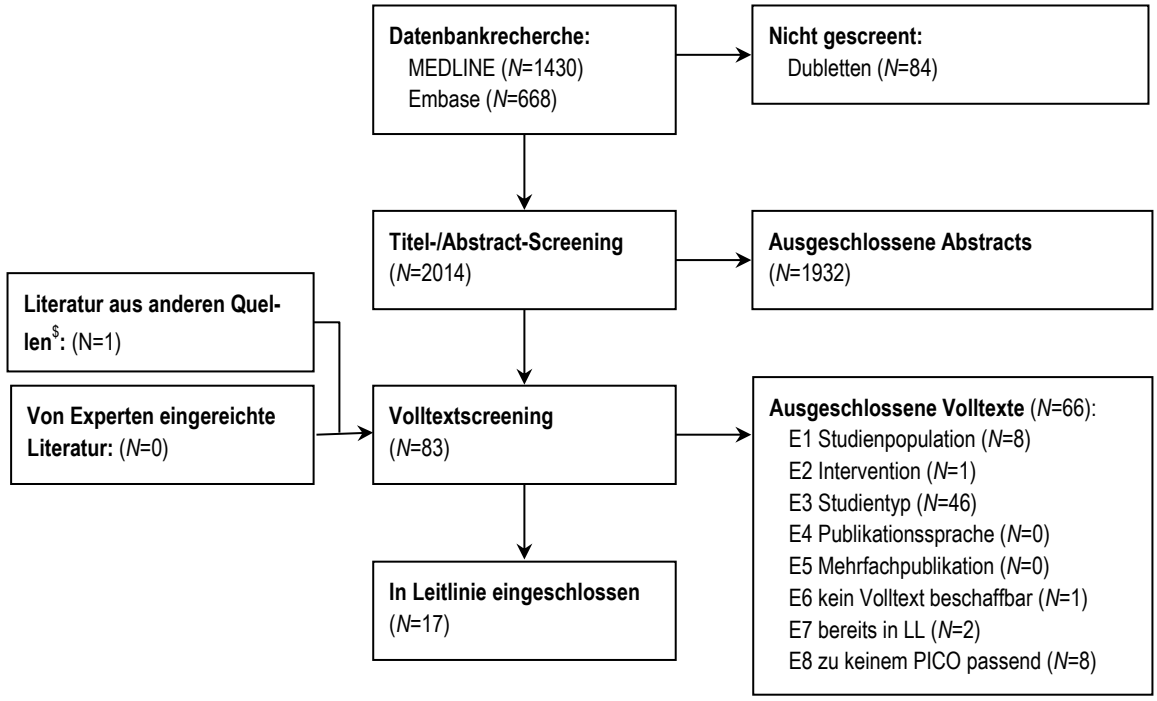
2.7 Thorax

Die Recherche für dieses Kapitel wurde gemeinsam mit 1.5 Thorax und 3.1 Thorax durchgeführt.



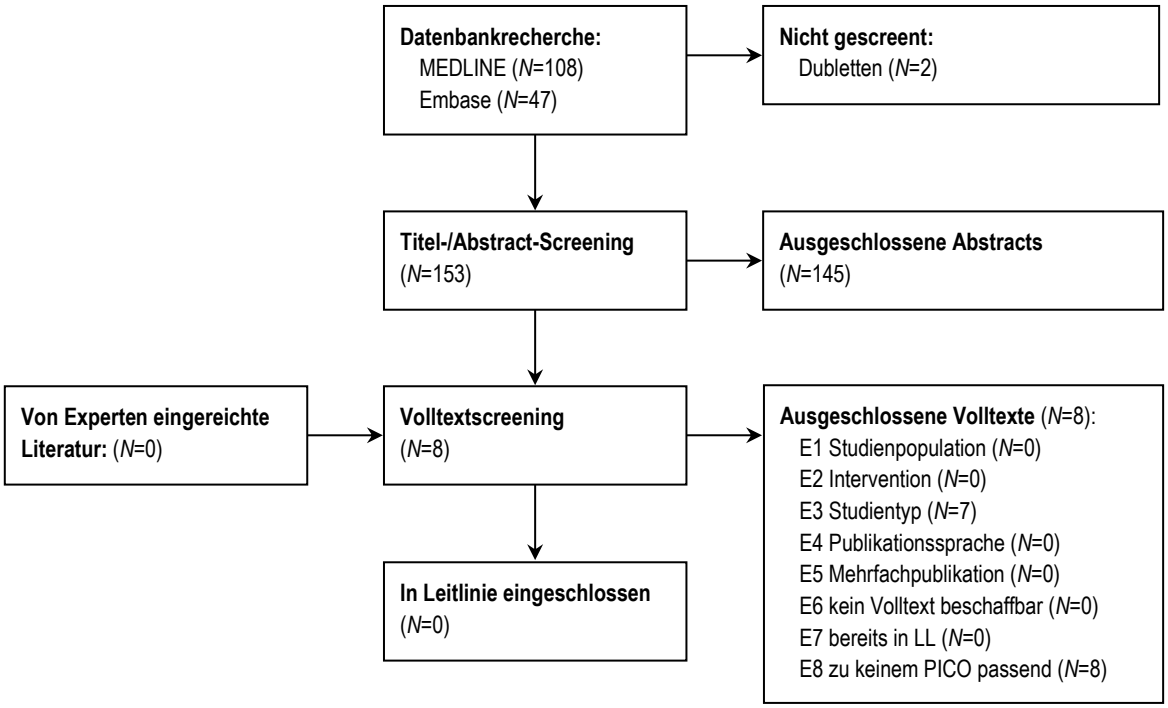
2.9 Becken

Hauptrecherche



$ in Methoden zitierte Hauptstudie zu eingeschlossener Sekundäranalyse

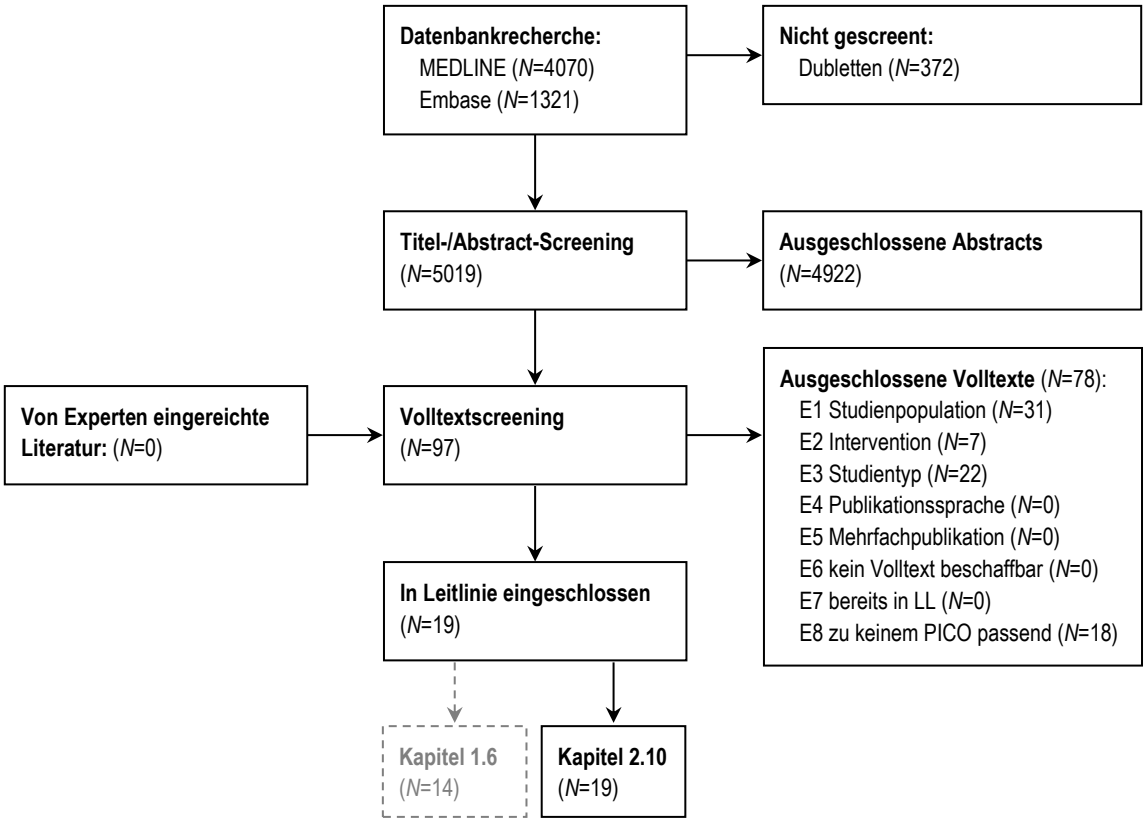
Recherche Zusatzfrage transurethrale Katheterisierung



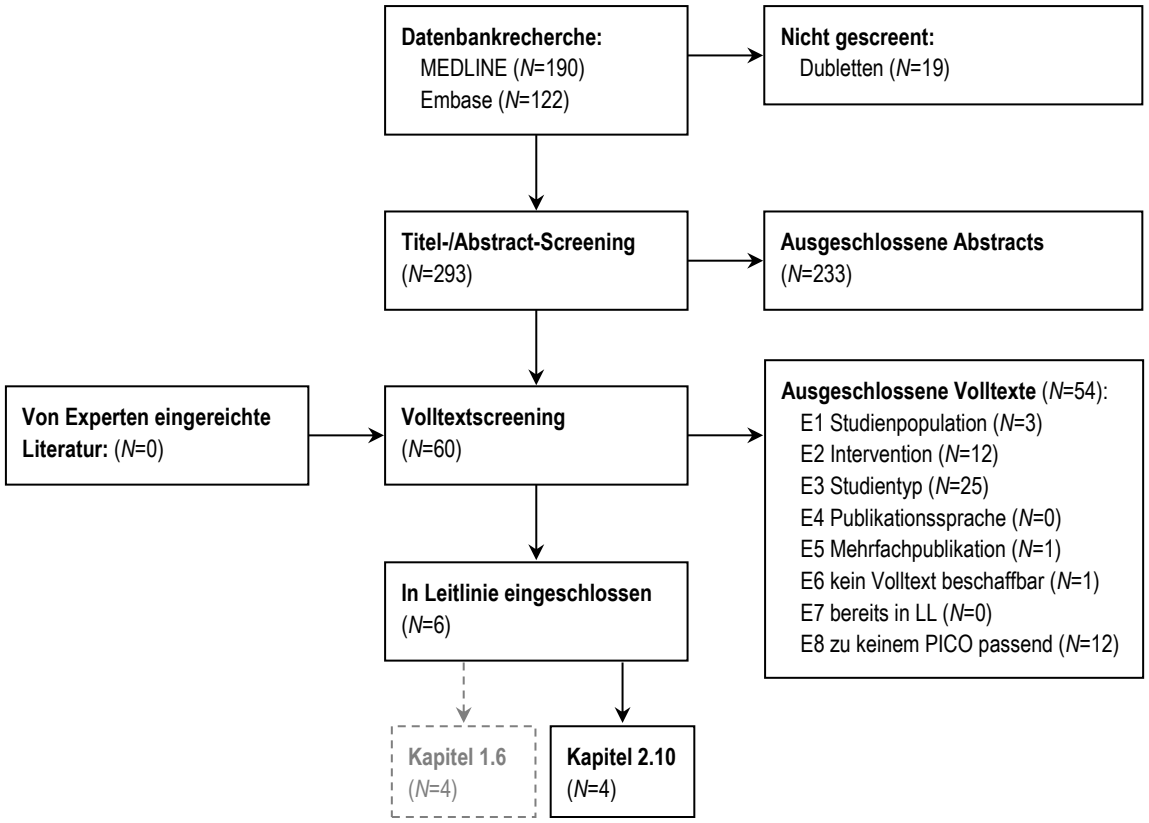
2.10 Schädel-Hirn-Trauma

Die Recherchen für dieses Kapitel wurden gemeinsam mit 1.6 Schädel-Hirn-Trauma durchgeführt.

Hauptrecherche

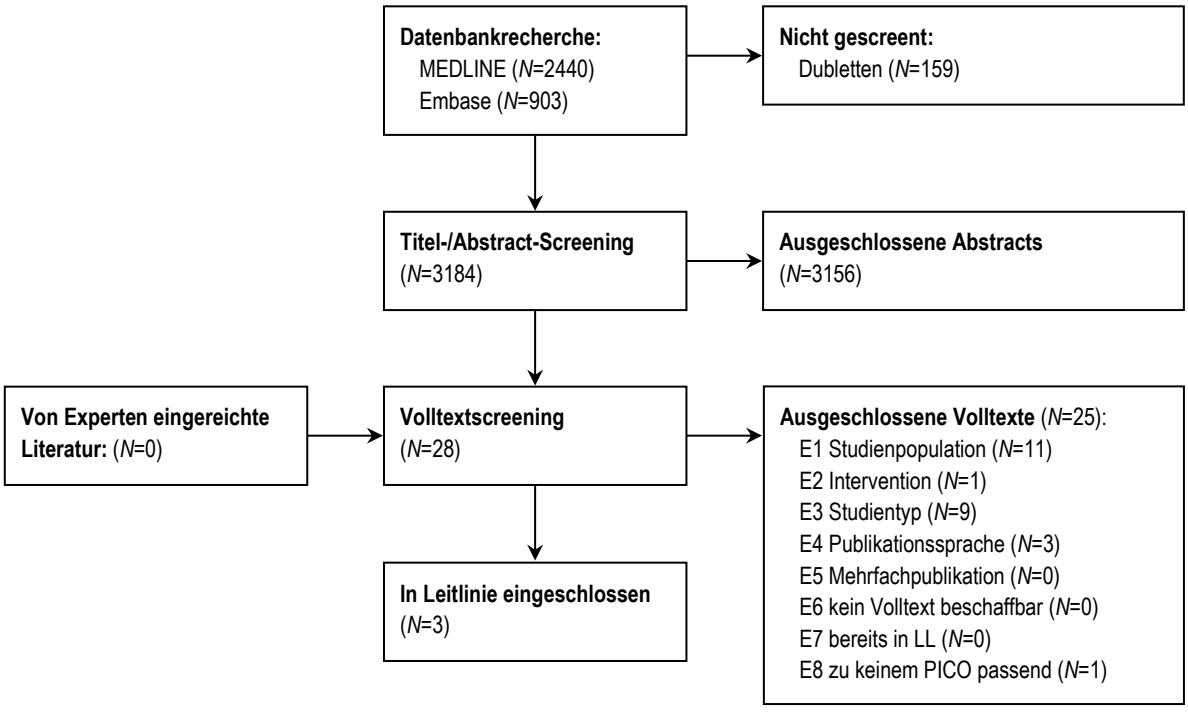


Recherche Bachelorarbeit[$]

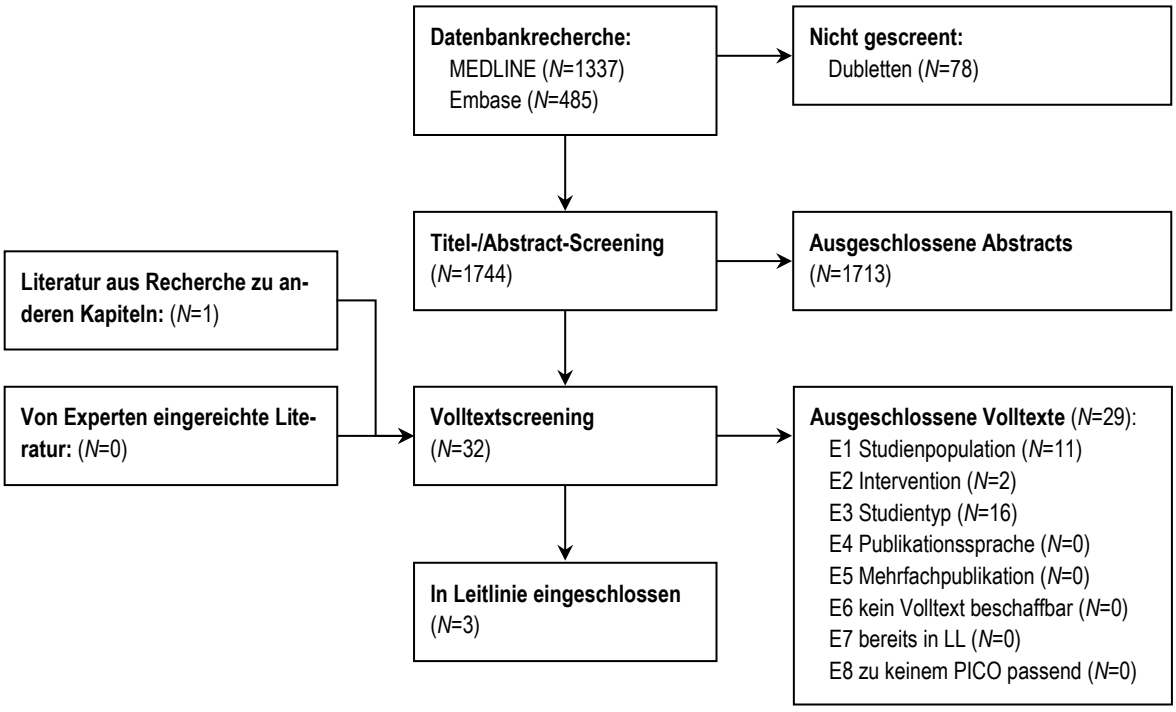


[$] Der Teilbereich zu Hyperventilierung, Mannitol und hypertonen Kochsalzlösungen wurde getrennt recherchiert und im Rahmen einer Bachelorarbeit bearbeitet.

2.12 Unterkiefer und Mittelgesicht



2.13 Hals

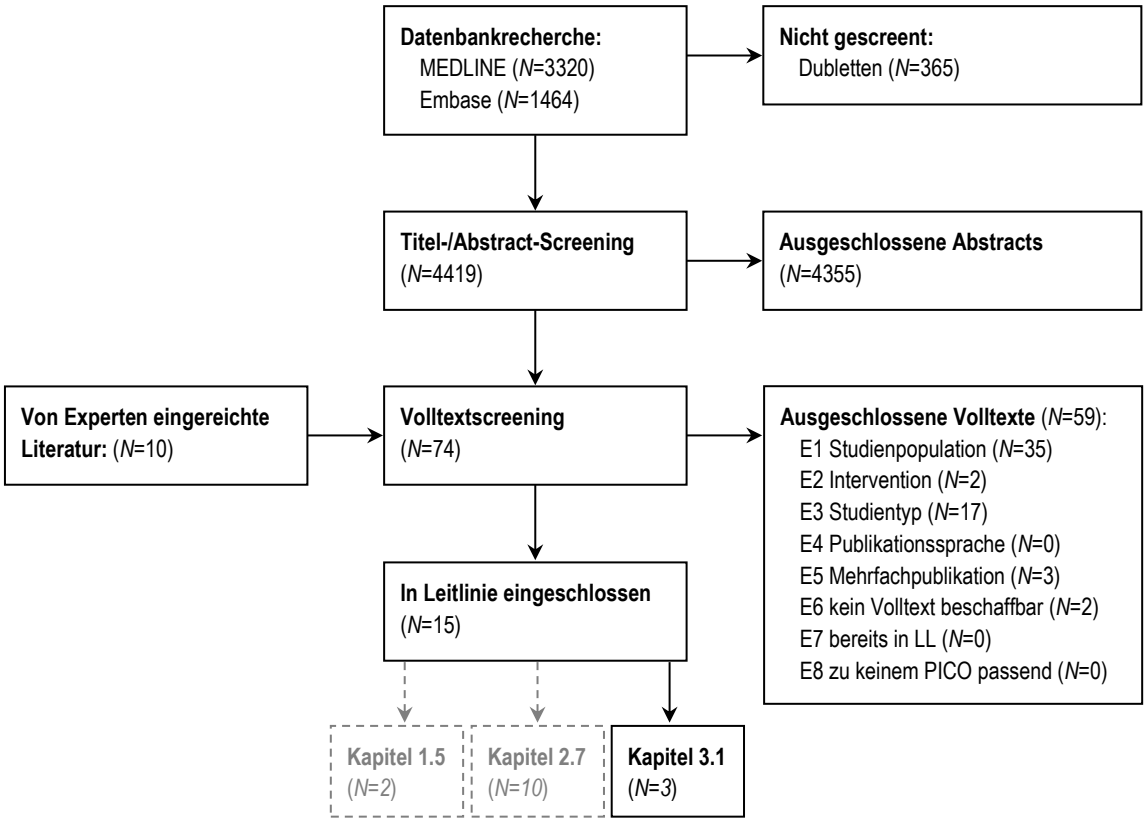


3 Erste OP-Phase

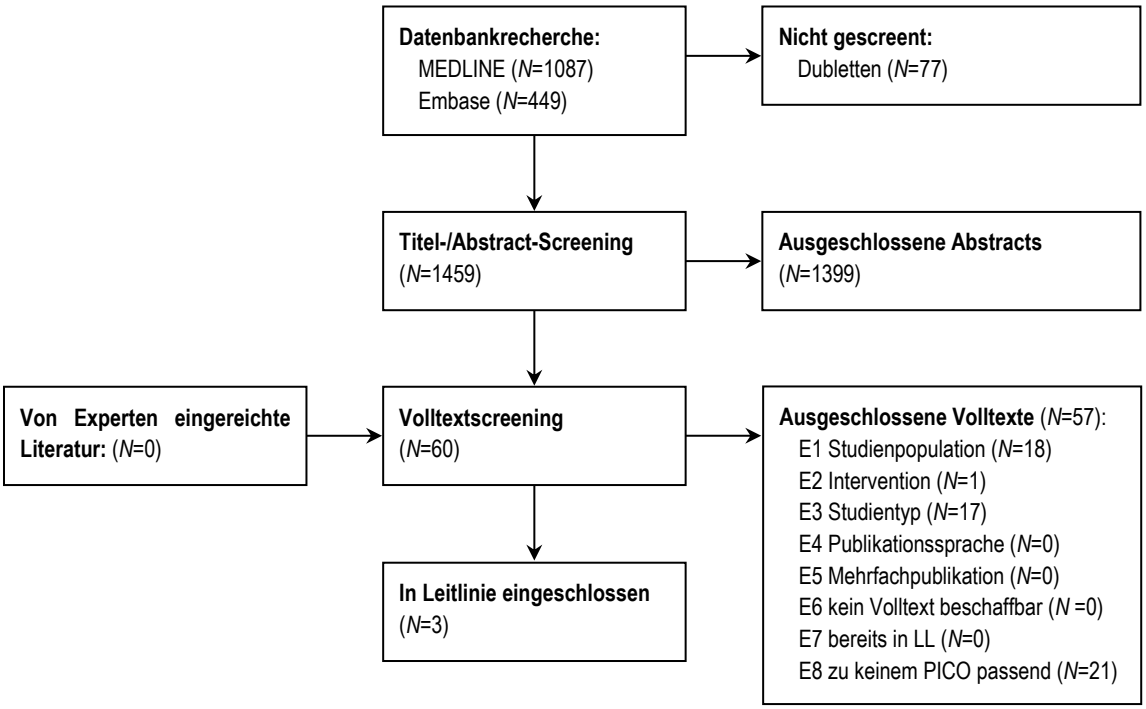
3.1 Thorax

Die Hauptrecherche für dieses Kapitel wurde gemeinsam mit 1.5 Thorax und 2.7 Thorax durchgeführt.

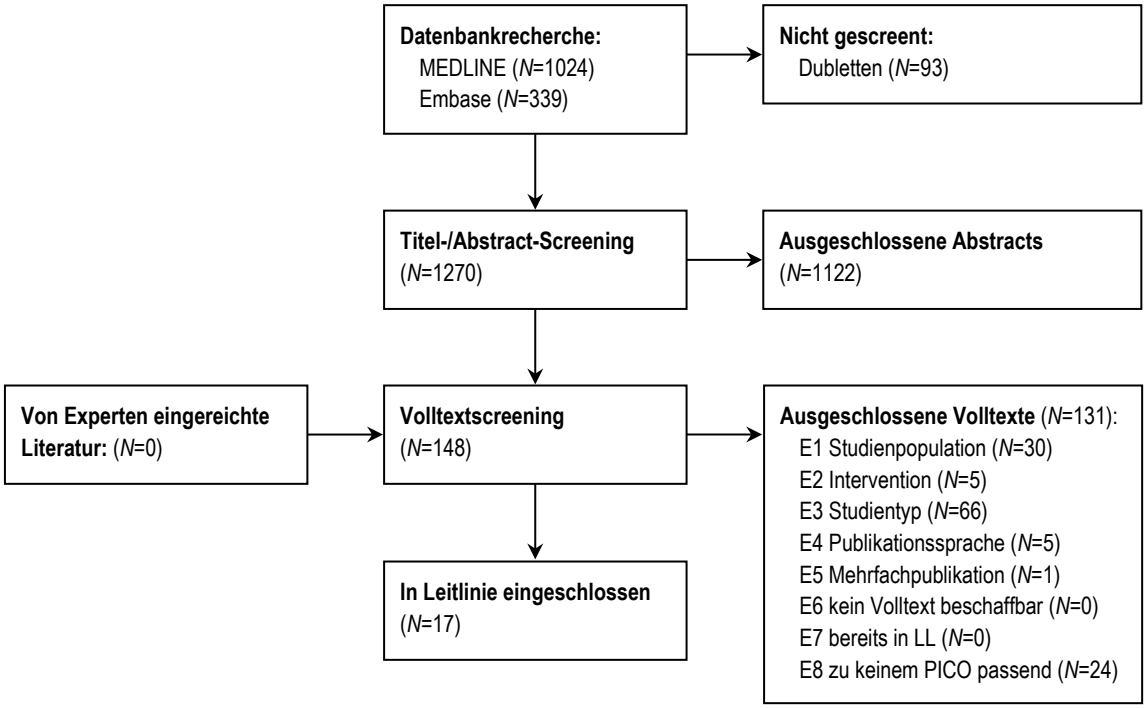
Hauptrecherche



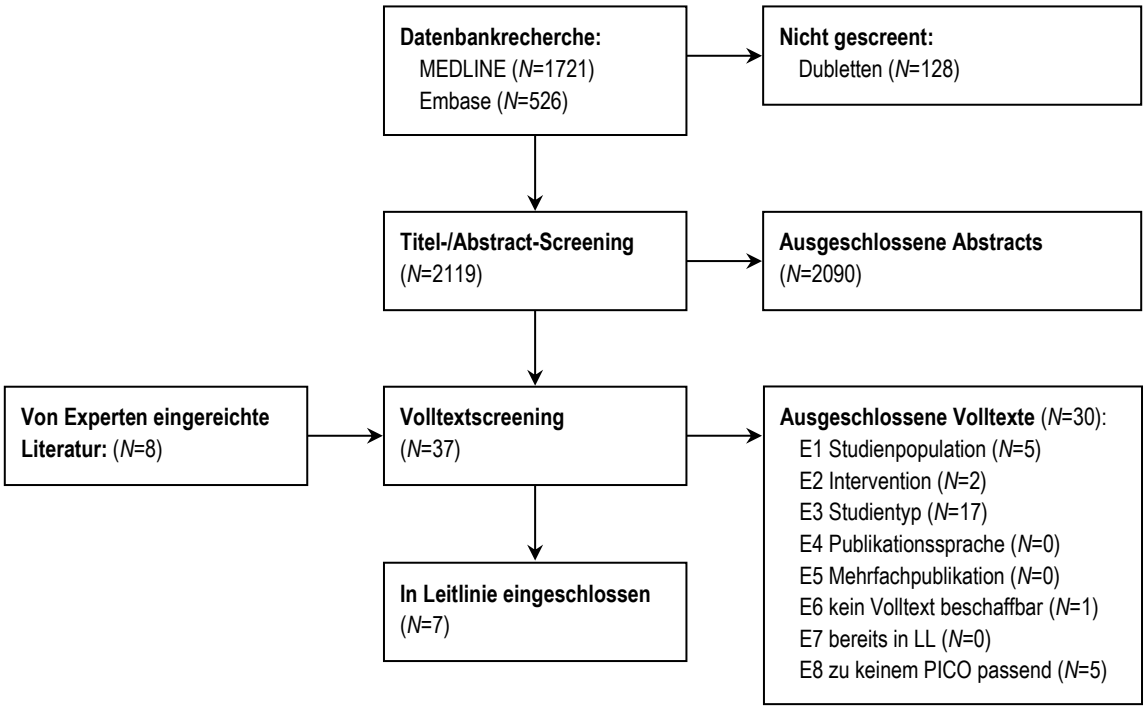
3.3 Abdomen



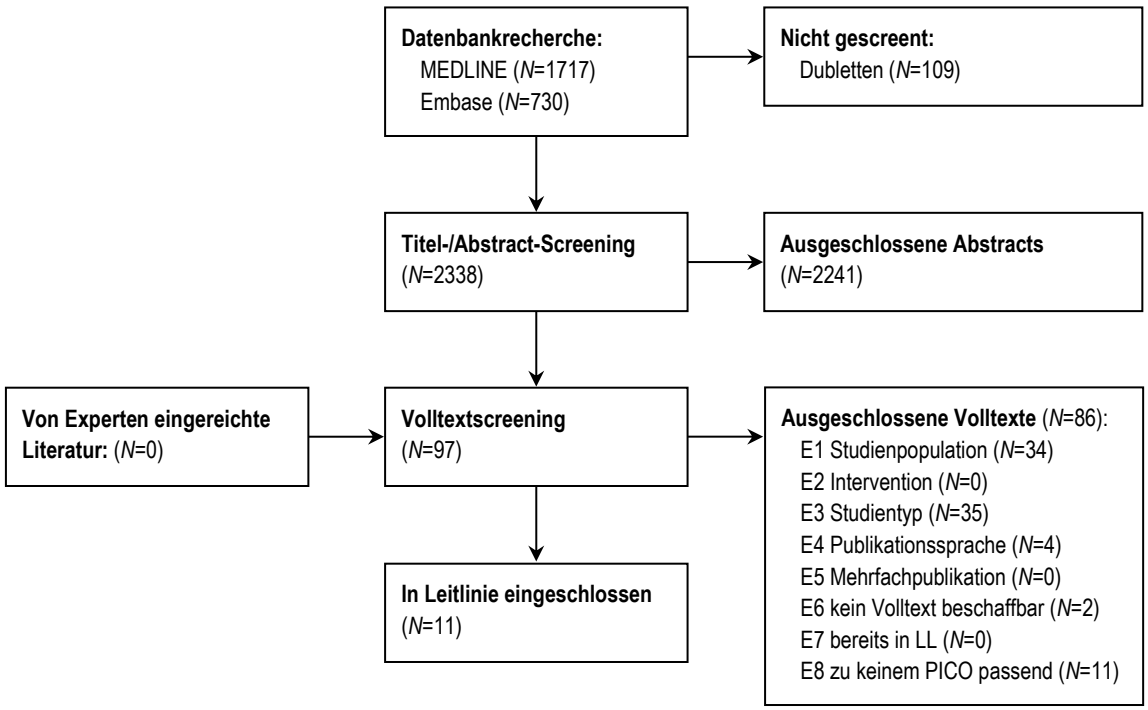
3.4 Schädel-Hirn-Trauma



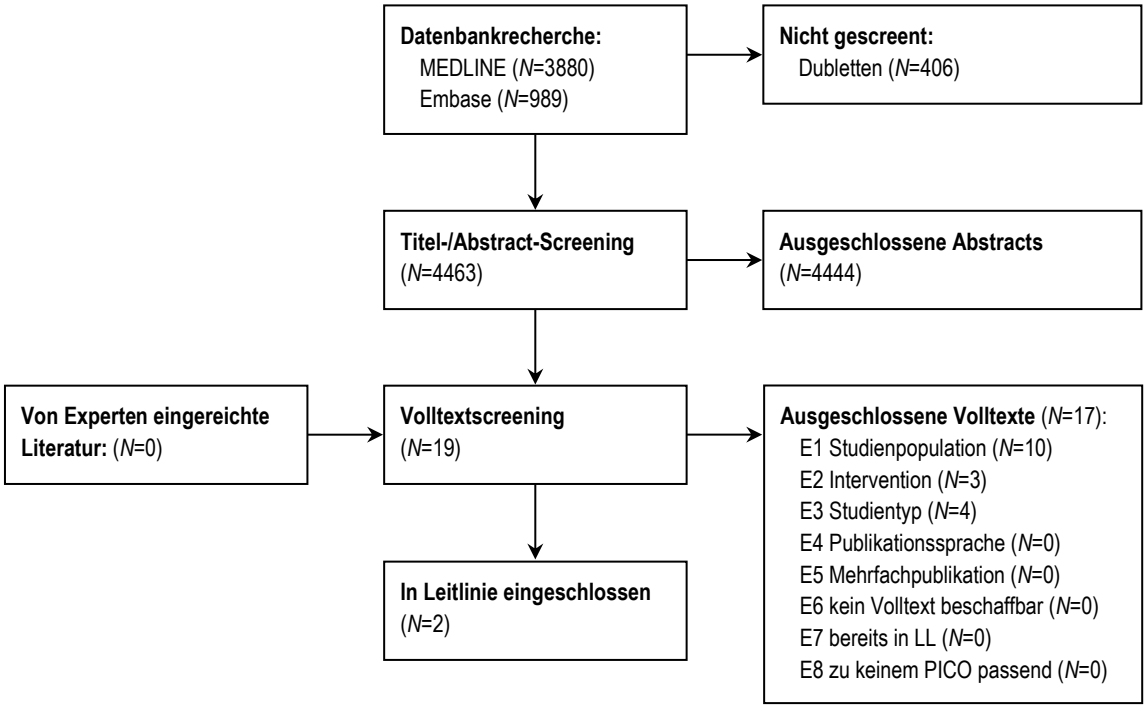
3.5 Wirbelsäule



3.10 Untere Extremitäten



3.12 Urogenitaltrakt



Appendix A5. Evidenztabellen

1 Präklinik

1.1 Stop the bleeding

Beckengurt

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Berger-Groch (2021) "Evaluation of pelvic circular compression devices in severely injured trauma patients with pelvic fractures" DOI: 10.1080/10903127.2021.1945717 **Study design** Comparative registry study (TraumaRegister DGU®) **Aim of the study** "The purpose of the current investigation is to determine whether patients with significant pelvic trauma, treated with a PCCD, have decreased mortality and a lower risk for blood loss." **Setting** Germany 2015-2016	**Inclusion criteria** • patients suffering from a relevant pelvic trauma (AIS severity 3-5; unstable fractures with or without relevant blood loss or open fracture) • ISS ≥9 • age ≥16 years • directly admitted from the scene of the accident to the participating hospital • complete outcome documentation (survival to hospital discharge or death) **Exclusion criteria** • patients transferred from another hospital (no prehospital data available) • patients transferred to another hospital within 48 h (outcome unknown) • no information about the use of PCCD, either prehospital or in the ED **Characteristics** Age [y], mean ± SD no PCCD: 51.3 ± 20.6 PH-PCCD:46.9 ± 19.3 ED-PCCD: 53.0 ± 19.0, p=0.001 Male, n (%)	**Participants** N=1103 patients **Study groups** no PCCD: patients without PCCD stabilization (N=649) PH-PCCD: patients receiving PCCD stabilization in the prehospital phase (N=284) ED-PCCD: patients receiving PCCD stabilization in the resuscitation phase in the emergency department (N=170) No information on the type of PCCD used, no confirmation that it had been properly fitted. Missing data for pelvic binder were not replaced; 11% of patients had missing data for PH PCCD, and 8% of cases had missing data for ED PCCD. **Adjusting variables in multivariable logistic regression** • age (8 categories) • sex • prehospital shock • shock on admission • cardio-pulmonary resuscitation (CPR)	**Adjusted outcomes** In-hospital mortality, adjusted OR (95% CI) no PCCD: reference PH-PCCD: 1.493 (0.802-2.780), p=0.206 ED-PCCD: 1.453 (0.709-2.974), p=0.307 In-hospital mortality, O/E ratio (95% CI)§ no PCCD: 0.910 (0.721-1.100) PH-PCCD: 1.033 (0.815-1.251) ED-PCCD: 1.161 (0.875-1.448) Transfusion, adjusted OR (95% CI) no PCCD: reference PH-PCCD: 1.607 (1.049-2.464), p=0.029 ED-PCCD: 1.423 (0.847-2.389), p=0.182 **Unadjusted outcomes** In-hospital mortality, n/N (%) no PCCD: 78/649 (12) PH-PCCD: 66/284 (23.2) ED-PCCD: 46/170 (27.1), p<0.001 24h mortality, n/N (%) no PCCD: 34/649 (5.2) PH-PCCD: 37/284 (13) ED-PCCD: 30/170 (17.6), p<0.001	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Even after subsequent adjustment in this study, the postulated beneficial effect of PCCDs in terms of decreased mortality and lower needs for blood transfusion could not be confirmed. Application of PCCDs in patients with a severe pelvic trauma is a general indicator for a critical patient with increased mortality." **Reviewers' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	no PCCD: 385 (59.3) PH-PCCD: 181 (63.7) ED-PCCD: 99 (58.2), p=0.37 ISS, mean ± SD no PCCD: 27.9 ± 13.8 PH-PCCD: 34.12 ± 16.4 ED-PCCD: 35.9 ± 5.5, p<0.001 GCS, median / mean ± SD no PCCD: 15 / 12.6 ± 4.1 PH-PCCD: 14 / 11.3 ± 4.7 ED-PCCD: 14 / 11.6 ± 4.4, p<0.001 Pelvic Injury Severity, p<0.001: AIS_{pelvis} = 3, n (%) no PCCD: 332 (51.2) PH-PCCD: 94 (33.2) ED-PCCD: 44 (25.9) AIS_{pelvis} = 4, n (%) no PCCD: 244 (37.6) PH-PCCD: 121 (42.6) ED-PCCD: 67 (39.4) AIS_{pelvis} = 5, n (%) no PCCD: 73 (11.2) PH-PCCD: 69 (24.3) ED-PCCD: 59 (34.7) AIS_{Head} ≥3 no PCCD: 160 (24.7) PH-PCCD: 68 (23.9) ED-PCCD: 45 (26.5) AIS_{Thorax}≥3	• unconsciousness (GCS≤8) • prehospital intubation • prehospital catecholamines • ISS • severe pelvic trauma (AIS 4-5) • relevant injuries (AIS 3+) to the head, the thorax, and the abdomen	ICU stay [d], median / mean SD no PCCD: 4.0 / 9.3 ± 12.5 PH-PCCD: 5.0 / 11.1 ± 15.0 ED-PCCD: 6.0 / 12.4 ± 16.0, p=0.064 Hospital stay [d], median / mean SD no PCCD: 20.0 / 24.01 ± 18.3 PH-PCCD: 21.5 / 25.7 ± 24.8 ED-PCCD: 20.5 / 24.6 ± 24.1, p=0.78 § observed/expected ratio; expected mortality calculated using the RISC prognosis in %	The study conclusions account for the retrospective study design and substantial risk of selection bias. The groups were not balanced at baseline, but the analysis was adjusted for important confounders.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	no PCCD: 307 (47.3) PH-PCCD: 168 (59.2) ED-PCCD: 103 (60.6) $\underline{AIS_{Abdomen} \geq 3}$ no PCCD: 102 (15.7) PH-PCCD: 77 (27.1) ED-PCCD: 43 (25.3) Shock (SBP ≤90 prehospital), n (%) no PCCD: 70 (11.9) PH-PCCD: 69 (27.2) ED-PCCD: 31 (21.7), p<0.001			
Pierrie (2021) "Pilot randomized trial of pre-hospital advanced therapies for the control of hemorrhage (PATCH) using pelvic binders". *Am J Emergency Med* 2021; 42: 43-48. **Study design** Randomised controlled trial (PATCH trial) **Aim of the study** "To determine if prehospital placement of pelvic binders is feasible (even among patients with diagnoses other than pelvic fracture) and to pilot the feasibility of conducting a	**Inclusion criteria** • ≥18 years of age • high-energy traumatic injury other than a ground-level fall • either had clinical signs and symptoms of pelvic ring injury (PRI, such as pelvic, hip, or groin pain, deformity, ecchymosis, or crepitus) or were hypotensive (SBP <90 mmHg) **Exclusion criteria** • ground-level fall • penetrating pelvic injury without obvious evidence of fracture • obviously pregnant • body habitus larger than could be accommodated by a commercial pelvic binder • going to be transferred to a facility other than the level-one trauma center conducting this study **Characteristics**	**Participants** N=50 patients enrolled, N=43 consented to participate in the outcomes analysis **Study groups** IG: pelvic binder (N=20 in outcomes analysis) CG: current standard of care (N=23 in outcomes analysis) SAM Pelvic Sling II (SAM Medical Products, Wilsonville, OR, USA) used for all pelvic binders in this study.	30-d mortality, n/N (%) IG: 0/20 (0) vs. CG: 1/23 (2.3), p=0.99 Blood product transfusion, n/N (%) IG: 1/20 (5) vs. CG: 5/23 (21.7), p=0.19 Surgical control of pelvic hemorrhage, n/N (%) IG: 0/20 (0) vs. CG: 0/23 (0) Angioembolization for pelvic hemorrhage, n/N (%) IG: 2/20 (10) vs. CG: 3/23 (13.0), p=0.99 30-d readmission, n/N (%) IG: 1/20 (5.0) vs. CG: 2/23 (8.7), p=0.99	**Level of evidence** 2b↓ **Risk of bias** Selection bias: + Performance bias: – Attrition bias: ? Detection bias: + **Authors' conclusion** "80% of binders were placed appropriately without secondary injury to any patient. Further, the model for conducting a prospective, randomized efficacy trial in a prehospital setting was successfully piloted. However, identifying the impact of prehospital pelvic

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
randomized trial evaluating the efficacy of pelvic binder placement in the prehospital setting." **Setting** USA, two-year period, years n.r.	98% blast and gunshot wounds Age [y], median IG: 33.5 vs. CG: 36.0, p=0.97 Male, n/N (%) IG: 15/20 (75.0) vs. CG: 15/23 (65.2), p=0.53 BMI, median IG: 26.9 vs. CG: 23.8, p=0.02 ISS ≥16, n/N (%) IG: 6 (30.0) vs. CG: 12 (52.2), p=0.22 Pelvic injury, n/N (%) IG: 2 (10.0) vs. CG: 7 (30.4), p=0.14 Met inclusion criteria, n/N (%) IG: 8 (36.4) vs. CG: 17 (60.7), p=0.09			compression device placement on morbidity and mortality would require a much larger patient cohort." **Reviewers' conclusion** The study was a small pilot RCT, and seriously underpowered to draw any meaningful efficacy or safety conclusions. Only 20% of patients had a pelvic injury.
Pizanis (2013) "Emergency stabilization of the pelvic ring: Clinical comparison between three different techniques". *Injury, Int. J. Care Injured* 2013; 44: 1760-1764. **Study design** Comparative registry study (German Pelvic Trauma Registry) **Aim of the study**	**Inclusion criteria** • patients with fractures or disruptions of the pelvic ring • treated by circumferential sheets, binders, or c-clamps **Exclusion criteria** • patients who received a combination of different emergency stabilization measures **Characteristics** Age [y], median	**Participants** N=192 patients **Study groups** sheet: circumferential sheets; time of application unclear (N=31) binder: circumferential binders; time of application unclear (N=28) c-clamp: c-clamps; time of application unclear (N=133) Fifteen patients who received a combination of different emergency stabilization measures were excluded from the analysis.	**Adjusted outcomes** Mortality, OR (95% CI) sheet: 3.26 (1.15-9.26), p=0.03 c-clamp: reference **Unadjusted outcomes** Mortality, %[$] sheet: 40 binder: 22 c-clamp: 21, p=0.08 Lethal bleeding from the pelvic region, %[$] sheet: 23 binder: 4 c-clamp: 8, p=0.02	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Our data suggest that emergency stabilization of the pelvic ring by c-clamps in younger patients with

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"The aim of the present study was to compare (i) demography, (ii) pattern and severity of injuries, (iii) time between admission and procedure, (iv) additional emergency measures, (v) transfusion requirement of packed red blood cells, (vi) length of hospital stay, (vii) mortality, and (viii) incidence of lethal pelvic bleeding between patients, which were treated by circumferential sheets, binders, and c-clamps for emergency stabilization of the pelvic ring." **Setting** Germany, 2004-2012	sheet: 47 binder: 26 c-clamp: 42, p=0.01 <u>Female, n (%)</u> sheet: 5 (16) binder: 10 (36) c-clamp: 46 (35), p=0.12 <u>ISS, median (IQR)</u> sheet: 34 (29-50) binder: 34 (22-41) c-clamp: 36 (29-48), p=0.30 <u>SBP [mmHg], median (IQR)</u> sheet: 80 (60-110) binder: 90 (80-120) c-clamp: 90 (75-100), p=0.43	**Adjusting variables in multivariate logistic regression** • age (by year) • additional packing (yes vs. no) • ISS (by ISS point)	$ extracted graphically	lower ISS is associated with less mortality. Unadjusted analyses showed a lower rate of lethal pelvic bleeding for binders and c-clamps in comparison with sheet wrapping. Circumferential sheets and binders seem to be, however, faster applicable than the c-clamp." **Reviewers' conclusion** The study results need to be interpreted with caution due to the retrospective study design. The groups were not balanced at baseline, but the analysis was adjusted for important confounders. An adjusted analysis for mortality is not reported for circumferential binders.
Schweigkofler (2021) "Is there any benefit in the pre-hospital application of pelvic binders in patients with suspected pelvic injuries?" *European Journal of Trauma and Emergency Surgery* 2021; 47: 493-498. **Study design**	**Inclusion criteria** • all patients admitted to the emergency room of the BG Unfallklinik Frankfurt am Main • radiologically confirmed type B or C (according to Tile) pelvic ring fracture • blood requirement in the first 72 h after admission **Exclusion criteria** • patients transferred from another hospital	**Participants** N=64 patients with B/C pelvic ring fracture, 35 patients with pRBC requirement **Study groups** IG: pelvic binder applied during prehospital treatment (N=37 overall, N=20 with pRBC requirement) CG: no pelvic binder (N=27 overall, N=15 with pRBC requirement)	**Adjusted outcomes** <u>Mortality, SMR§</u> IG: 1.06 vs. CG: 1.35, p=0.500 **Unadjusted outcomes** <u>Mortality, n/N (%)</u> IG: 4/20 (20) CG: 2/15 (13.33), p=0.452 <u>pRBC in 72h [units], mean ± SD (range)</u>	**Level of evidence** 3b↓ **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Prospective observational multi-center study (sub-group analysis) **Aim of the study** "The aim of this study was to evaluate the clinical effect of an early pelvic binder application in multiple trauma patients with suspected pelvic fracture (as a potential bleeding source) on patients outcome and transfusion requirements." **Setting** Germany, 2013-2014	**Characteristics of patients with pRBC req.** Age [y], mean ± SD (range) IG: 51 ± 19.6 (16–88) CG: 48 ± 21.0 (17–78), p=0.402 Sex, male, n (%) IG: 12 (60) CG: 9 (60), p=0.637 ISS, mean ± SD IG: 29.7 ± 12.3 CG: 24.4 ± 9.0, p=0.082 NISS, mean ± SD IG: 35.2 ± 14.1 CG: 31.3 ± 10.2, p=0.323 TASH on admission, mean ± SD IG: 10.1 ± 5.7 CG: 6.2 ± 3.9, p=0.690 RISC II survival probability [%], mean ± SD IG: 81.2 ± 22.9 CG: 89.2 ± 15.2, p=0.525 Rate of abdominal injury, AIS>3, n (%) IG: 6 (16.2) CG: 2 (7.4) Severe TBI, AIS>3, n (%) IG: 5 (13.5) CG: 5 (18.5), p=0.589 Isolated pelvic injury, n (%) IG: 2 (5.4) CG: 2 (7.4), p=0.759		IG: 10.5 ± 7.8 (1–30) CG: 7.5 ± 8.4 (1–35), p=0.457 Mass transfusion (≥10 pRBC/24 h), n/N (%) IG: 7/20 (35) CG: 3/15 (20), p=0.247 § standardized mortality rate (SMR): observed divided by expected mortality, using the Revised Injury Severity Classification Score II (RISC-II) to estimate probability of survival	"We were unable to identify blood-saving effects with application of a pelvic binder to patients with instable pelvic ring fractures in terms of RPBC requirements. Nevertheless, some salutary effect of prehospital pelvic binder application may be assumed." **Reviewers' conclusion** This was a post-hoc subgroup analysis with very small sample size, and probably underpowered to detect differences in either baseline characteristics or outcomes.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
+: low risk; –: high risk; ?: unclear risk; AIS: Abbreviated Injury Scale; BMI: body mass index; CI: Confidence Interval; GCS: Glasgow Coma Scale; ED: emergency department; HR: Hazard Ratio; ICU: intensive care unit; IQR: interquartile range; ISS: injury severity score; ITT: Intention to Treat; NISS: new injury severity score; OR: Odds Ratio; PCCD: pelvic circumferential compression device; PH: prehospital; pRBC: packed red blood cells; req.: requirement; RISC-II: Revised Injury Severity Classification Score II; RR: Relative Risk; SBP: systolic blood pressure; SD: Standard Deviation; SEM: Standard Error of Mean; SMR: standardized mortality rate; TASH: Trauma Associated Severe Hemorrhage Score; TBI: traumatic brain injury. adj.: adjusted; d: days; m: months; y: years; n.r.: not reported				

Kompressionsverband

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Taghavi (2021) "An Eastern Association for the Surgery of Trauma multicenter trial examining prehospital procedures in penetrating trauma patients" *J Trauma Acute Care Surg* 2021; 91(1): 130-140. **Study design** Prospective cohort study (Eastern Association for the Surgery of Trauma) **Aim of the study** "The goal of this study was to evaluate the influence of PHPs on outcomes in penetrating trauma patients in urban locations." **Setting** USA (urban), 2019-2020	**Inclusion criteria** • adults (≥18 y) with penetrating trauma • gunshot or stab wound to the torso and/or proximal extremity • torso and/or proximal extremity penetrating injury combined with distal extremity penetrating injury • penetrating torso and/or proximal extremity injury combined with a blunt injury **Exclusion criteria** • patients with isolated injury above the clavicle (including head or neck [including TBI]), • distal extremity injury only (distal to elbows or knees), • isolated blunt mechanism of injury • patients transferred from outside institutions • known age ≤17 y **Characteristics**§ Age [y], mean ± SD	**Participants** N=2,284 patients **Study groups** IG: pressure dressing application (N=409) applied on-scene (N=325) and/or during transport (N=161) CG: no prehospital procedures (N=898) PHP: prehospital procedures including IV access, intraosseous access, fluid administration, bladder catheterization, endotracheal intubation, cervical spine immobilization, pleural decompression, tourniquet placement, pressure dressing application, cricothyrotomy, and pelvic stabilization (N=1,386) **Adjusting variables in multivariate logistic regression** • Age • NISS • gunshot wound • chest injury • higher PH SBP • PH intubation	**Adjusted outcomes** In-hospital mortality, adj. OR (95% CI) IG: 0.80 (0.34–1.87), p=0.60 CG: reference **Unadjusted outcomes** In-hospital mortality, OR (95% CI) IG: 0.58 (0.38–0.90), p=0.01 CG: reference	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Prehospital use of tourniquets and pressure dressings were not associated with benefit on adjusted analysis." **Reviewers' conclusion** The study results need to be interpreted with caution due to the retrospective study design and risk of selection bias. No information on baseline characteristics is provided in the pressure

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	PHP: 33.3 ± 12.9 CG: 31.2 ± 11.6, p<0.001 Male, n (%) PHP: 1,183 (86.1) CG: 803 (89.5), p=0.02 NISS, mean ± SD PHP: 16 ± 18 CG: 12 ± 16, p<0.001 GCS, mean ± SD PHP: 13.7 ± 3.5 CG: 14.3 ± 2.6, p=0.02 Shock index (HR/SBP) PHP: 0.8 ± 0.4 CG: 0.7 ± 0.2, p=0.02 § characteristics not reported for IG (pressure dressings) separately from other PH procedures	• PH IO access • PH IV placement • PH fluids • PH C-spine immobilization • PH tourniquet • PH pleural decompression		dressing group. The analysis was adjusted for important confounders.
+: low risk; –: high risk; ?: unclear risk; CI: Confidence Interval; HR: Hazard Ratio; IO: intraosseous; IQR: Interquartile Range; ISS: injury severity score; ITT: Intention to Treat; NISS: new injury severity score; OR: Odds Ratio; PH: prehospital; pRBC: packed red blood cells; RISC-II: Revised Injury Severity Classification Score II; RR: Relative Risk; SBP: systolic blood pressure; SD: Standard Deviation; SEM: Standard Error of Mean; SMR: standardized mortality rate; TASH: Trauma Associated Severe Hemorrhage Score; TBI: traumatic brain injury. adj.: adjusted; d: days; m: months; y: years				

Tourniquet

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Clasper (2009) "Limb complications following pre-hospital tourniquet use". *J R Army Med*	**Inclusion criteria** • AIS >1 in the lower limbs • lower limb injury with fracture **Exclusion criteria**	**Participants** N=58 limbs **Study groups** IG: tourniquet used (N=23 limbs, N=22 after matching)	Total number of limbs with any complication, n/N IG: 19/22 vs. CG: 15/22, p=0.13 Superficial wound infection, n IG: 11/22 vs. CG: 11/22, NS	**Level of evidence** 3b↓ **Risk of bias** Selection bias: –

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Corps. 2009; 155(3): 200-202. **Study design** Comparative registry study (Joint Theatre Trauma Register) **Aim of the study** "The aim of this study was to investigate if the pre-hospital application of a tourniquet resulted in an increase in morbidity following significant ballistic limb injury." **Setting** UK military: Afghanistan / Iraq, 2003-2008	n.r. **Characteristics** Age [y], mean (range) IG: 26.6 (19-37) vs. CG: 25.7 (19-37) ISS, median IG: 10 vs. CG: 10 MESS, median IG: 5 vs. CG: 5 Time to initial surgery >6 h from injury, n IG: 4 vs. CG: 4 Bone involved, n *Femur* IG: 6 vs. CG: 7 *Patella* IG: 1 vs. CG: 1 *Tibia* IG: 10 vs. CG: 11 *Isolated fibula* IG: 1 vs. CG: 1 *Ankle + Hindfoot* IG: 2 vs. CG: 1 Hindfoot/Midfoot IG: 2 vs. CG: 1	19 tourniquets were applied for a median of 60 min [range 19-150 min], for 3 it was impossible to determine accurately the applied tourniquet time. 3 were applied for ≥120 min (currently recommended maximum time). CG: no tourniquet used (N=35 limbs, N=22 after matching) **Matching** An experienced military orthopaedic surgeon blinded to the study (PH) matched each casualty from the pre-hospital tourniquet group with a casualty from the pre-hospital non-tourniquet group; all data was anonymised and identifiable by JTTR number only. Although the exact details of the matching were left to the surgeon, each casualty was only used once and matched for anatomical location, severity of the bony injury, initial surgical management, ISS and MESS as much as possible.	Major complications, n IG: 10/22 vs. CG: 4/22, p=0.045 Failed salvage [amputation required], n IG: 3/22 vs. CG: 3/22, NS Deep infection [osteomyelitis], n IG: 7/22 [4/22] vs. CG: 1/22 [0/22], p<0.05 Flap failure, n IG: 1/22 vs. CG: 0/22, NS	Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion** "Ultimately the use of the tourniquet may have saved lives, and did not increase the amputation rate in this small study, and so despite the increased deep infection rate the use of pre-hospital tourniquets cannot be decried as a result of this study." **Reviewers' conclusion** The study results need to be interpreted with caution due to risk of selection and performance bias. The study is very small and details of matching were left to the surgeon. Only 43% of patients were severely injured.
Henry (2021) "Increased Use of Pre-hospital Tourniquet and Patient Survival: Los Angeles Countywide Study" *J Am Coll Surg,* 2021; 233(2): 233-239.e2.	**Inclusion criteria** • Patients with peripheral arterial injuries • transported by EMS to 1 of 15 Level I or II trauma centers **Exclusion criteria** NR	**Participants** N=944 patients **Study groups** IG: prehospital tourniquet used (N=97) CG: no prehospital tourniquet used (N=847)	**Adjusted outcomes** In-hospital mortality, adj. OR (95% CI)* 0.32 (0.16 to 0.85), p=0.032 Delayed amputation, adjusted OR (95% CI)* 1.07 (0.21 to 10.88), p=0.097 ICU LOS [d], (95% CI)*	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: – Attrition bias: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Study design Comparative registry study (LA County Department of Health Services EMS provider registry and trauma registry) **Aim of the study** "to determine whether the use of tourniquets in Los Angeles County (LAC) has been increasing over time and whether prehospital tourniquet use is associated with improved patient outcomes without complications." **Setting** USA, 2015-2019	**Characteristics** Age [y], mean ± SD IG: 34.8 ± 13.3 vs. CG: 36.8 ± 12.4, p=0.201 Male, n (%) IG: 83 (85.6) vs. CG: 712 (84.1), p=0.674 ISS, mean ± SD IG: 13.4 ± 8.1 vs. CG: 13.7 ± 7.3, p=0.104 GCS, mean ± SD IG: 13 ± 1.9 vs. CG: 13 ± 2.3, p=0.753 SBP [mmHg], mean ± SD IG: 113 ± 45.4 vs. CG: 119 ± 33.2, p=0.055 Extremity AIS ≥4, n (%) IG: 24 (24.7) vs. CG: 86 (10.2), p=0.004 Traumatic amputation, n (%) IG: 1 (1.0) vs. CG: 27 (3.2), p=0.087	The decision to place a tourniquet was made by the prehospital EMS provider and is not standardized across the county. **Adjusting variables in multivariable regression analysis** • penetrating mechanism • traumatic amputations • ISS • prehospital transport time • prehospital heart rate >100 beats/min • prehospital SBP <90 mmHg • prehospital GCS <9	-0.18 (-1.74 to 0.11), p=0.799 PRBC transfusion 4-h volume (mL), (95% CI)* -547.76 (-762.73 to -283.49), p<0.001 PRBC transfusion 24-h volume [mL] (95% CI)* -1,389.82 (-1,824.88 to -920.97), p<0.001 * prehospital tourniquet vs no prehospital tourniquet **Unadjusted outcomes** In-hospital mortality, n (%) IG: 1 (1.0) vs. CG: 75 (8.9), p=0.027 Delayed amputation, n (%) IG: 6 (0.7) vs. CG: 1 (1.0), p=0.727 ICU LOS [d], median (IQR) IG: 4.2 (1.9-6.2) vs. CG: 3.9 (2.2-7.1), p=0.868 Transfusion 4-h PRBC volume [mL], median (IQR) IG: 462.8 (107.3-749.7) vs. CG: 1041.3 (682.2-2674.9), p<0.001 Transfusion 24-h PRBC volume [mL], median (IQR) IG: 994.6 (559.4-1304.1) vs. CG: 2469.1 (981.2-5117.5), p<0.001	Detection bias: + **Authors' conclusion** "The use of prehospital tourniquets for patients with extremity vascular injuries is significantly associated with improved survival and decreased blood transfusion requirement, without an increased risk of delayed amputation." **Reviewers' conclusion** The study results need to be interpreted with caution due to risk of selection and performance bias. Patients in the tourniquet group had significantly higher extremity AIS. Patients did not fulfil the criteria of polytrauma (ISS≥15, multiple injuries).
Kauvar (2018) "Tourniquet use is not associated with limb loss following military lower extremity arterial trauma". *J Trauma Acute Care Surg.* 2018; 85(3): 495-499.	**Inclusion criteria** • limbs sustaining at least one arterial injury to the common, superficial, or deep femoral, popliteal, or tibial arteries • undergoing at least one limb salvage procedure in the OIF or OEF theaters of operations	**Participants** N=455 limbs **Study groups** IG: extremity tourniquet use (N=254 limbs) CG: no extremity tourniquet use (N=201 limbs)	**Systemic outcomes, unadjusted** Mortality, n (%) IG: 8 (3.2) vs. CG: 8 (4.0), NS Rhabdomyolysis, n (%) IG: 26 (10) vs. CG: 18 (9.0), NS Pulmonary embolism, n (%)	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: – Attrition bias: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Study design Comparative registry study (Department of Defense Trauma Registry) **Aim of the study** "The purpose of this study was to use a military lower extremity vascular injury database with long-term follow-up to study the influence of tourniquet use on long-term limb outcomes following arterial injury." **Setting** US military/Iraq, 2004-2012	**Exclusion criteria** • Casualties sustaining traumatic amputations and those with vascular injuries managed with amputation at the index operation **Characteristics** Age [y], mean ± SD IG: 27 ± 7 vs. CG: 26 ± 6, NS ISS, mean ± SD IG: 17 ± 9 vs. CG 16 ± 10, NS AIS extremity, median (range) IG: 3 (3–4) vs. CG: 3 (3–3.5), p=0.02 MESS, median (range) IG: 6 (5–7) vs. CG: 6 (5–7), p=0.006 Fracture, n (%) IG: 153 (60) vs. CG: 112 (56), NS Nerve injury, n (%) IG: 144 (57) vs. CG: 91 (45), p=0.015 Vascular injury above the knee, n (%) IG: 145 (57) vs. CG: 109 (54), NS Venous injury, n (%) IG: 50 (20) vs. CG: 43 (21), NS	**Co-interventions** Recombinant factor VIIa and/or TXA, n (%) IG:48 (19) vs. CG: 22 (11), p=0.02	IG: 18 (7.1) vs. CG: 5 (2.5), p=0.026 Whole blood + PRBC, mean ± SD IG: 31 ± 26 vs. CG: 25 ± 19, NS Arterial shunt, n (%) IG: 54 (21) vs. CG: 30 (15), p=0.08 Arterial bypass, n (%) IG: 122 (48) vs. CG: 92 (46), p=NS Fasciotomy, n (%) IG: 195 (77) vs. CG: 134 (67), p=0.02 **Limb complications, unadjusted** Amputation, n (%) IG: 63 (25) vs. CG: 40 (19), NS Amputation above the knee, n (%) IG: 28 (11), vs. CG: 11 (5.4), p=0.11 Vascular repair, n (%) IG: 51 (20) vs. CG: 27 (13), p=0.06 Wound infection, n (%) IG: 79 (31) vs. CG: 41 (20), p=0.01 Contracture, n (%) IG: 21 (8.3) vs. CG: 11 (5.5), NS Foot drop, n (%) IG: 70 (28) vs. CG: 35 (17), p=0.011 Sensory deficit, n (%) IG: 67 (26) vs. CG: 63 (31), NS Severe edema, n (%)	Detection bias: + **Authors' conclusion** "In combat-related lower extremity trauma with arterial injury, tourniquet use before initial surgical care was not associated with early or eventual limb loss despite increased limb injury severity. Tourniquet use was associated with some eventual adverse limb outcomes, however, indicating that tourniquets should continue to be used for well-defined indications and rapid surgical control of limb hemorrhage should remain a priority during modern military operations." **Reviewers' conclusion** There is a risk of performance bias as less patients in the intervention group were treated in a role 2 (level of surgical care) institution. Moreover, the authors state that they are unaware of the initial treatment except for the tourniquet. The groups differ with respect to important risk factors, and the results are unadjusted.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			IG: 108 (43) vs. CG: 70 (35), NS Deep venous thrombosis, n (%) IG: 21 (8.3) vs. CG: 12 (6.0), NS	
Kragh (2015) "U.S. Military use of tourniquets from 2001 to 2010". *Prehospital Emergency Care* 2015; 19(2): 184–190. **Study design** Comparative registry study (Department of Defense Trauma Registry) **Aim of the study** "The purpose of the present study is to associate tourniquet use and survival in casualty care over a decade in order to provide evidence to emergency medical personnel for the implementation and efficacy of tourniquet use in a large trauma system." **Setting** US military: Afghanistan / Iraq, 2001-2010	**Inclusion criteria** • active-duty casualties at any U.S. military hospital in either Afghanistan or Iraq • major limb trauma, extremity AIS ≥3 • extremity AIS 1 to 5 if paired with an associated external AIS ≥3 **Exclusion criteria** • casualties killed prior to reaching hospital, or who arrive without vital signs (and are not regained) **Characteristics** Age, median (range) 24 (18-60) Male, n (%) IG: 1,250 (98.2) vs. CG: 2,948 (97.5)	**Participants** N=4,297 patients **Study groups** IG: extremity tourniquet used (N=1,272) CG: no extremity tourniquet used (N=3,025)	Mortality, n/N (%) IG: 102/1272 (8.0) CG: 112/3025 (3.7), p<0.0001	**Level of evidence** 3b↓ **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "In summary, the present survey of war casualties with extremity injury shows that survival rates are increased in those casualties with injuries amenable to tourniquet use, despite an increased injury severity. The findings of the present study are 1) tourniquet use rates have risen in recent years; 2), survival rates of those casualties with injuries amenable to tourniquet use rose concurrently; 3) those with injuries that were not amenable to tourniquet use decreased; and 4) tourniquet requirement

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
				rates are opportunities for improvement." **Reviewers' conclusion** There is a high risk of selection bias due to the exclusion of casualties who arrived dead at the hospital and unclear timing of tourniquet placement. No information is provided on injury severity by group. The results are unadjusted and groups may differ regarding important confounders. The population may partially overlap with Kauvar (2018).
Kragh (2015) "Transfusion for Shock in US Military War Casualties With and Without Tourniquet Use". *Ann Emerg Med.* 2015; 65(3): 290-296. **Study design** Comparative registry study (Department of Defense Trauma Registry) **Aim of the study** "The purpose of the present study of transfused	**Inclusion criteria** • active-duty casualties who arrived alive at any US military hospital • major limb trauma AIS (upper/lower extremities) >2 • transfusion of a blood product • tourniquet use **Exclusion criteria** • detainees, prisoners • died on arrival or before arrival to the first military hospital **Characteristics** <u>Age [y], mean ± SD</u> IG: 26 ± 6.1 vs. CG: 26 ± 6.1	**Participants** N=1,413 patients, 502 after propensity matching **Study groups** IG: extremity tourniquet used (N=720 total, N=251 after matching) CG: no extremity tourniquet used (N=693 total, N=251 after matching) **Matching criteria** • admission hemoglobin, pulse rate, adjusted ISS, extremity AIS score • casualties who had only minor or no injuries of the head, face, chest, and abdomen; this second propensity matching was intended to remove casualties with	**Outcomes after propensity matching** <u>Mortality, %, MD; OR (95% CI)</u> IG: 6.8 vs. CG: 8.8, MD 2, p=0.40 OR 0.916 (0.450-1.865) Casualties who had only minor or no injuries of the head, face, chest, and abdomen: <u>Mortality, %, MD</u> IG: 3.4 (N=207) CG: 5.5 (N=207), MD 2.1, p=0.40 **Outcomes, unadjusted** <u>Survival, n/N (%)</u> IG: 632/720 (88) vs. CG: 614/693 (89), p=0.62 <u>Red blood cells [units], mean ± SD, MD (95% CI)</u>	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: + Attrition bias: + Detection bias: + **Authors' conclusion** "Given the data available to us today, we see no design option that alters the likelihood of detecting a survival benefit with tourniquet use

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
war casualties admitted to US military hospitals is to determine whether there were any associations among severities of injury, tourniquet use, and survival to better understand the effect of tourniquet use on outcomes in hemorrhagic shock." **Setting** US military, Afghanistan / Iraq, 2001-2008	ISS, mean ± SD; MD (95% CI) IG: 19 ± 10.6 vs. CG 21 ± 11.8 MD 2 (0.65-2.99) SBP [mmHg], mean ± SD IG: 111 ± 37 vs. CG: 112 ± 33.7 AIS extremity, n (%) Serious: IG: 465 (64.6) vs. CG: 555 (80.1) Severe: IG: 248 (34.4) vs. CG: 111 (16) Critical: IG: 7 (1) vs. CG: 27 (3.9) GCS, mean ± SD IG: 13 ± 4.3 vs. CG: 13 ± 4.3	major injuries that would not benefit from tourniquet use.	IG: 12 ± 11.4 vs. CG: 9 ± 8.8, MD -3 (-4.97 to -2.85) Platelets [units], mean ± SD, MD (95% CI) IG: 1 ± 2.0 vs. CG: 0.5 ± 1.9, MD -0.5 (-0.71 to -0.31) Cryoprecipitate [units], mean ± SD, MD (95% CI) IG: 0.4 ± 1.07 vs. CG: 0.3 ± 0.9, MD -0.1 (-0.21 to 0) Whole blood [units], mean ± SD, MD (95% CI) IG: 2 ± 5.3 vs. CG: 1 ± 3.9, MD -1 (-0.86 to 0.11) Plasma [units], mean ± SD, MD (95% CI) IG: 7 ± 9.2 vs. CG: 5 ± 7.2, MD -2 (-3.40 to -1.68) Sum of blood products, mean ± SD, MD (95% CI) IG: 14 ± 14.4 vs. CG: 10 ± 10.8, MD -4 (-5.60 to -2.96) Total ICU length of stay [d], mean ± SD, MD (95% CI) IG: 7 ± 13.8 vs. CG 8 ± 13.7, MD 1 (-0.45 to 2.42) Total length of stay [d], mean ± SD, MD (95% CI) G: 34 ± 31.4 vs. CG 33 ± 35.6, MD 1 (-4.15 to 2.87)IG: 6.8 vs.CG: 8.8, MD 2, p=0.	in a registry that excludes out-of-hospital deaths. Although tourniquets may appear to be a proven solution for hemorrhage control, the science is limited and research needs to be conducted." **Reviewers' conclusion** The authors' conclusions account for the high risk of selection bias due to the exclusion of casualties who arrived dead at the hospital. The mortality outcome, though adjusted for measured confounders, may be strongly biased favouring the control group without tourniquet placement. The population likely overlaps with Kragh (2015) and Kauvar (2018).
Taghavi (2021) "An Eastern Association for the Surgery of Trauma multicenter trial examining prehospital procedures in penetrating trauma patients" *J Trauma Acute Care Surg* 2021; 91(1): 130-140.	**Inclusion criteria** • adults (≥18 y) with penetrating trauma • gunshot or stab wound to the torso and/or proximal extremity • torso and/or proximal extremity penetrating injury combined with distal extremity penetrating injury	**Participants** N=2,284 patients **Study groups** IG: tourniquet placement (N=108) applied on-scene (N=86) and/or during transport (N=29) CG: no prehospital procedures (N=898)	**Adjusted outcomes** In-hospital mortality, adj. OR (95% CI) IG: 0.70 (0.14–3.93), p=0.65 CG: reference **Unadjusted outcomes** In-hospital mortality, OR (95% CI)	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Study design Prospective cohort study (Eastern Association for the Surgery of Trauma) **Aim of the study** "The goal of this study was to evaluate the influence of PHPs on outcomes in penetrating trauma patients in urban locations." **Setting** USA (urban), 2019-2020	• penetrating torso and/or proximal extremity injury combined with a blunt injury **Exclusion criteria** • patients with isolated injury above the clavicle (including head or neck [including TBI]), • distal extremity injury only (distal to elbows or knees), • isolated blunt mechanism of injury • patients transferred from outside institutions • known age ≤17 y **Characteristics**§ Age [y], mean ± SD PHP: 33.3 ± 12.9 CG: 31.2 ± 11.6, p<0.001 Male, n (%) PHP: 1,183 (86.1) CG: 803 (89.5), p=0.02 NISS, mean ± SD PHP: 16 ± 18 CG: 12 ± 16, p<0.001 GCS, mean ± SD PHP: 13.7 ± 3.5 CG: 14.3 ± 2.6, p=0.02 Shock index (HR/SBP) PHP: 0.8 ± 0.4 CG: 0.7 ± 0.2, p=0.02	PHP: prehospital procedures including IV access, intraosseous access, fluid administration, bladder catheterization, endotracheal intubation, cervical spine immobilization, pleural decompression, tourniquet placement, pressure dressing application, cricothyrotomy, and pelvic stabilization (N=1,386) **Adjusting variables in multivariate logistic regression** • Age • NISS • gunshot wound • chest injury • higher PH SBP • PH intubation • PH IO access • PH IV placement • PH fluids • PH C-spine immobilization • PH pressure dressing • PH pleural decompression	IG: 0.66 (0.30–1.44), p=0.30 CG: reference	Detection bias: + **Authors' conclusion** "Prehospital use of tourniquets and pressure dressings were not associated with benefit on adjusted analysis." **Reviewers' conclusion** The study results need to be interpreted with caution due to the retrospective study design and risk of selection bias. No information on baseline characteristics is provided in the tourniquet group. The analysis was adjusted for important confounders.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	§ characteristics not reported for IG (tourniquets) separately from other PH procedures			

+: low risk; –: high risk; ?: unclear risk; AIS: Abbreviated Injury Scale; CI: Confidence Interval; GCS: Glasgow Coma Scale; ED: emergency department; HR: Hazard Ratio; ICU: intensive care unit; IQR: Interquartile Range; ISS: Injury Severity Score; ITT: Intention to Treat; IV: Intravenous; LOS: length of stay; MD: Mean Difference; MESS: Mangled Extremity Severity Score; NISS: new injury severity score; NS: not significant; OR: Odds Ratio; PH: prehospital; PRBC: packed red blood cells; RR: Relative Risk; SBP: systolic blood pressure; SD: Standard Deviation; SEM: Standard Error of Mean; TBI: traumatic brain injury; TXA: tranexamic acid; adj.: adjusted; d: days; m: months; y: years; n.r.: not reported.

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Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Irajpour (2012) "A comparison between the effects of simple and traction splints on pain intensity in patients with femur fractures". *Iranian J Nursing Midwifery Res* 2012; 17(7): 530-533. **Study design** Prospective, quasi-experimental study **Aim of the study** "To determine and compare the impacts of using simple and traction splints on pain intensity of patients with femoral fracture immediately and at the 1st, 6th and 12th h after splinting."	**Inclusion criteria** • diagnosed with a closed femoral shaft fracture • aged 15-65 years • not addicted to any drugs • had full consciousness when completing the questionnaires • maintaining the splint on the injured organ for ≥12 h after splinting • using morphine sulfate as a painkiller **Exclusion criteria** • unwilling to continue participation • developed any problems incompatible with the inclusion criteria • did not have the splint on the injured organ for 12 h **Characteristics** Age [y], mean ± SD IG: 31 ± 14.8 vs. CG: 29 ± 14.1, p=0.547	**Participants** N=64 patients **Study groups** IG: traction splint (N=32) CG: simple splint (N=32) **Co-interventions** 5 mg of morphine sulfate was used for all patients immediately before splinting.	**Unadjusted outcomes** Pain intensity immediately after splinting [VAS], mean ± SD IG: 6.4 ± 1.2 vs. CG: 6.7 ± 1.4, p=0.441 Pain intensity 1h after splinting [VAS], mean ± SD IG: 4.8 ± 1.0 vs. CG: 6.0 ± 1.3, p=0.0001 Pain intensity 6h after splinting [VAS], mean ± SD IG: 4.2 ± 1.0 vs. CG: 5.4 ± 0.9, p=0.0001 Pain intensity 12h after splinting [VAS], mean ± SD IG: 4.0 ± 1.0 vs. CG: 5.1 ± 1.2, p=0.020	**Level of evidence** 2b↓ **Risk of bias** Selection bias: – Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion** "The significant difference in pain reduction between the simple and traction splint groups at the 1st, 6th, and 12th hour after splinting emphasizes the superiority of traction splints." **Reviewers' conclusion** The study results need to be interpreted with care

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Setting Iran, study years n.r.	Male, n (%) IG: 29 (90.6) vs. CG: 28 (87.5), p=0.698			considering the substantial risk of selection and performance bias as well as poor reporting. Treatment was in-hospital, and there is no indication of severe injury or polytrauma, so that important considerations in the population of severely injured patients are not accounted for.
+: low risk; –: high risk; ?: unclear risk; n.r.: not reported; SD: Standard Deviation; VAS: visual analogue scale. adj.: adjusted; d: days; m: months; y: years				

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Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Hatamabadi (2015) "Celox-Coated Gauze for the Treatment of Civilian Penetrating Trauma: A Randomized Clinical Trial". *Trauma Mon.* 2015; 20(1): e23862 **Study design** Randomised controlled trial **Aim of the study** "This trial aimed to evaluate the role of celox in the management of civilian penetrating trauma."	**Inclusion criteria** • age 18-50 years • stab injury to a limb • minimal wound length of 3 cm • bleeding was a concern regardless of the source **Exclusion criteria** • foreign body retained in the wound • history of anticoagulation • required blood products for resuscitation • other hemostatic products used for the control of bleeding in the prehospital setting **Characteristics**	**Participants** N=160 patients **Study groups** IG: celox-coated gauze (N=80) CG: regular gauze (N=80) The control group was treated with pressure bandage using a regular 10 × 10 cm gauze, while a celox-coated gauze was used in the intervention group.	Time to control, by strata, n (%) *<5 min* IG: 41 (61.19) vs. CG: 26 (38.81) *5 to 10 min* IG: 20 (47.62) vs. CG: 22 (52.38) *≥10 min* IG: 19 (37.25) vs. CG: 32 (62.75) p=0.010 Number of blood-soaked 10×10 cm gauzes, mean IG: 2.63 vs. CG: 3.06, p=0.049 **Subgroup analyses** • Stronger association favouring celox-coated gauze in relation to hemostasis among dermal wounds and among wounds with size over 10 cm (p=0.01 and p=0.04, respectively). • no significant association among fascial, muscular, and smaller (<10 cm) wounds	**Level of evidence** 2b↓ **Risk of bias** Selection bias: + Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion** "The results showed that the use of celox-coated gauze reduces the time needed to achieve hemostasis and the amount of blood loss after initiation of

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Setting Iran, 2014	Age [y], mean ± SD IG: 29.99 ± 9.68 vs. CG: 31.01 ± 10.16, p=0.52 Male, n (%) IG: 73 (91.25) vs. CG: 72 (90), p=0.786 Wound length, n (%) *>10 cm* IG: 14 (17.5) vs. CG: 16 (20) *<10 cm* IG: 66 (83.5) vs. CG 64 (80) p=0.685 Wound depth, n (%) *Dermis* IG: 27 (33.75) vs. CG: 33 (41.25) *Facia* IG: 18 (22.5) vs. CG: 25 (31.25) *Muscle* IG: 35 (43.75) vs. CG: 22 (27.5) p=0.095 Prehospital pressure dressing, n (%) *By Medics* IG: 28 (35) vs. CG: 34 (42.5) *By Patient* IG: 8 (10) vs. CG: 5 (6.25) *None* IG: 44 (55) vs. CG: 41 (51.25) p=0.28 SBP [cmHg], mean ± SD IG: 11.64 ± 1.13 vs. CG: 11.44 ± 1.32 p=0.30		• The role of celox in the management of civilian stab wounds in foot seems more efficient (p=0.001)	the treatment. The challenge is to select patients who gain the most benefit from it." **Reviewers' conclusion** The study results need to be interpreted with caution due to the small number of participants and risk of performance bias. Patients did not fulfil the criteria of polytrauma (ISS≥15, multiple injuries).
Kabeer (2019) "Pre-hospital Hemorrhagic Control Effectiveness of Axiostat® Dressing Versus Conventional Method in	**Inclusion criteria** • age ≥18 years • bleeding wounds over the scalp • wound size should be covered by a single available size of study device	**Participants** N=104 **Study groups**	Time to achieve haemostasis [min], mean ± SD IG: 4.68 ± 1.04 vs. CG: 18.56 ± 5.04, p<0.0001 Blood loss [g], mean ± SD IG: 5.41 ± 2.53 vs. CG: 11.16 ± 4.96, p<0.0001	**Level of evidence** 3b↓ **Risk of bias** Selection bias: –

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Acute Hemorrhage Due to Trauma". *Cureus* 2019; 11(8): e5527 **Study design** Prospective cohort study **Aim of the study** "The objective of this study was to evaluate the safety and efficacy of the chitosan dressing, Axiostat®, in comparison with conventional cotton gauze as a pre-hospital dressing to stop bleeding from scalp wounds." **Setting** India, 2012-2013	**Exclusion criteria** • prior diagnosis of disease or medical condition affecting the ability of blood to clot (e.g., hemophilia) • a non-survivable injury as per the investigator's discretion • patients who, in the opinion of the investigator, may not complete the study for any reason (e.g., patients requiring immediate suturing) • grossly infected wounds which may require multiple debridement procedures prior to clearance of bacteria, and non-viable tissue from the wound • patients currently participating in an investigational drug or device study that had not yet completed its primary endpoint or interfered with procedure and assessments in this study • patients with a surgical/iatrogenic wound • patients with a major head injury, spinal injury, neck injury, abdominal injury, deep wound injury, fracture, haemorrhagic shock, or foreign materials inside the wound **Characteristics** Age [y], mean ± SD IG: 42.2 ± 11.7 vs. CG: 40.1 ± 12.8, p=0.41 Male, n (%) IG: 32 (68) vs. CG: 41 (72), p=0.67 Wound duration, n (%) *<1 hour* IG: 46 (97.9) vs. CG: 52 (91.2)	IG: Axiostat cauted gauze (N=47) Axiostat® is a sterile, single-use, 100% chitosan dressing designed to stop bleeding instantly. CG: conventional cotton gauze (N=57) The size of the dressing was 8 cm x 5 cm in both groups. If the bleeding was persistent, a second application of the respective dressing was applied.	Patients with two dressing applications, n/N (%) IG: 8/47 (17) vs. CG: 20/57 (35), p=0.039 Number of patients with haemostasis, n/N (%) IG: 44/47 (94) vs. CG: 42/57 (74), p=0.007 Side effects (difficulties removing the dressing, tissue loss, rebleeding), n/N IG: 0/47 vs. CG: 3/57 Allergic reaction, n/N IG: 1/47 vs. CG: 4/57	Performance bias: – Attrition bias: + Detection bias: – **Authors' conclusion** "(in trauma cases with bleeding scalp injuries) Axiostat®, significantly reduced time to haemostasis and reduced blood loss during emergency and trauma as compared to conventional cotton gauze. Additionally, it is easy to apply and shows negligible side effects." **Reviewers' conclusion** The study results need to be interpreted with caution due to the small number of participants and risk of selection, performance and detection bias. Accuracy in the measurement of blood loss was doubtful. Patients did not fulfil the criteria of polytrauma (ISS≥15, multiple injuries).

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	1-3 hours IG: 1 (2.1) vs. CG 5 (8.8), p=0.15			
Winstanley (2019) "Catastrophic haemorrhage in military major trauma patients: a retrospective database analysis of haemostatic agents used on the battlefield". *J R Army Med Corps* 2019; 165 :405-409. **Study design** Comparative registry study (UK Joint Theatre Trauma Registry) **Aim of the study** "The aim of this study was to provide a descriptive analysis of the use of haemostatics in major trauma patients on the battlefield. We examined patient demographics, levels of injury severity and associated rates of survival." **Setting** UK military, Iraq / Afghanistan, 2003-2014	**Inclusion criteria** • NISS ≥15 • injured in the Iraq or Afghanistan conflicts **Exclusion criteria** • NISS not reported • multiple haemostatic agents used **Characteristics** 98% blast and gunshot wounds Age [y], mean ± SD IG: 25.1 ± 7.6 vs. CG: 24.7 ± 8.6, p=0.52 Male, n (%) IG: 313 (99) vs. CG: 3,372 (97) NISS, mean ± SD MD (95% CI) IG: 43.4 ± 20.8 vs. CG: 42.4 ± 22.2, p=0.39	**Participants** N=3,792 patients **Study groups** IG: haemostatic agent used (N=317) CG: no haemostatic agent used (N=3,475) Hemcon and Quickclot were most commonly used, since 2010, the most common agent used has been Celox.	**Survival, all cases** Survival, % IG: 71.3 vs. CG: 64.0, p=0.01 Celox vs. no haemostatic agent, %-difference 14, p<0.00 (N=212 used Celox) Quickclot vs. no haemostatic agent, %-difference -6, p=0.63 (N=18 used Quickclot) Hemcon vs. no haemostatic agent, %-difference -8, p=0.13 (N=87 used Hemcon) **Survival stratified by NISS** Celox vs. no haemostatic agent, %-difference NISS 15–35: 6, p=0.28 NISS 36–55: 14, p=0.03 NISS 56–75: 24, p<0.00 Quickclot vs. no haemostatic agent, %-difference NISS 15–35: 4, p=0.33 NISS 36–55: 9, p=1.00 NISS 56–75: −8, p=1.00 Hemcon vs. no haemostatic agent, %-difference NISS 15–35: −11, p=0.42 NISS 36–55: 27, p=0.56 NISS 56–75: 1, p=0.13	Level of evidence 2b Risk of bias Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "There is an association between the use of haemostatic agents and improved survival, mostly in those with more severe injuries, which is particularly evident in those administered Celox." **Reviewers' conclusion** The study results need to be interpreted with caution due to the retrospective study design and risk of selection bias. The results are unadjusted and groups may differ regarding important unmeasured confounders.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
+: low risk; –: high risk; ?: unclear risk; AIS: Abbreviated Injury Scale; CI: Confidence Interval; HR: Hazard Ratio; IQR: Interquartile Range; ISS: Injury Severity Score; ITT: Intention to Treat; MD: Mean Difference; MESS: Mangled Extremity Severity Score; NISS: new injury severity score; OR: Odds Ratio; RR: Relative Risk; SBP: Systolic blood pressure; SD: Standard Deviation; SEM: Standard Error of Mean; adj.: adjusted; d: days; g: grams, m: months; min: minute; y: years				

Nasale Ballonkatheter

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
García Callejo (2010) "Nasal packing in posterior epistaxis. Comparison of two methods". *Acta Otorrinolaringol Esp.* 2010; 61(3): 196–201. **Study design** Prospective cohort study **Aim of the study** "The objective of this study was to assess the reliability of the two most commonly used types of posterior packing in terms of tolerance, comfort and capacity of terminating the haemorrhage." **Setting** Spain, 2003-2008	**Inclusion criteria** • posterior epistaxis that required packing • patients in whom conventional alternatives such as anterior packing with cotton, gauze or cellulose pads were ineffective in the first attempt or in repeated ER visits **Exclusion criteria** none reported **Characteristics**§ Age [y], mean ± SD (range) IG: 51.2 ± 11.8 (37-74) CG: 54.8 ± 9.9 (40-68) Male:female ratio IG: 2.2:1 CG: 3.2:1 There were more cases assisted with pneumatic packing, with a statistically significant difference, among those patients *with clotting or platelet aggregation disorders*.	**Participants** N=140 patients, 152 packings **Study groups** IG: Pneumatic packing device (105 packings in N=96 patients) Pneumatic packing device with a length of 12cm coated in tetracaine paste with 2 chambers and anterior introduction; it accepts a maximum inflation with saline solution of 10 cc in the posterior compartment and up to 30 cc in the anterior. The intravenous preparation of the patient is similar to the control group. CG: Classic posterior packing (47 packings in 44 patients) Classic posterior packing with gauze soaked in tetracaine paste and impacted into the cavum and choana, introduced through the mouth using traction probe from the nostril involved. The packing is completed by adding gauze through the nostril until the maximum possible area of the nasal segment is filled. The patient is systematically administered 5 mg of diazepam and 2 g of metamizole intravenously 30 s before plugging.	**Unadjusted outcomes** Control with a single packing IG: 71 (67.6%) vs. CG: 37 (78.7%), p<0.001 Need for embolisation/ligation, n/N (%) IG: 12 (11.4) vs. CG: 2 (4.2) , p<0.001 Need for RBC concentrate transfusion, n/N (%) IG: 19/105 (18.1) vs. CG: 7/47 (14.8), p<0.001 Rebleeding with packing placed, n/N (%) IG: 28/105 (26.6) vs. CG: 8/47 (17), p<0.001 Rebleeding just after removal, n/N (%) IG: 11/105 (10.5) vs. CG: 1/47 (2.1), p<0.001 Pain during placement [VAS], mean ± SD IG: 6.7 ± 1.7 vs. CG: 8.3 ± 1.5, p<0.001 Pain at 3rd day [VAS], mean ± SD IG: 3.4 ± 2.2 vs. CG: 5.7 ± 2.7, p<0.001 Pain at removal [VAS], mean ± SD IG: 1.3 ± 1.8 vs. CG: 2.1 ± 2.2, NS Duration of placement [s], mean ± SD IG: 36±19 vs. CG: 228 ± 102, p<0.001	**Level of evidence** 3b↓ **Risk of bias** Selection bias: – Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion** "The classic posterior packing with gauze is less rapid and comfortable to adapt, but it ensures a higher success rate in the control of epistaxis, produces fewer local injuries and reduces health costs in comparison with inflatable balloon packing." **Reviewers' conclusion** The study results need to be interpreted with great caution due to the risk of

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	§ p-value not reported	Treatment assignment chosen by the doctor on duty accordance to the emergency considerations suggested by the situation in each case.	Hospital stay [d], mean ± SD IG: 5.2±1.3 vs. CG: 4.2±0.9, p<0.001 Definitive structural complications IG: 8 (7.6) vs. CG: 2 (4.2), p<0.001	selection and performance bias. Important confounders were not reported, and the analysis is unadjusted. Treatment was in-hospital, and epistaxis was due to trauma in less than 10% of patients, so that the results may not apply to the prehospital treatment of severely injured patients.
+: low risk; –: high risk; ?: unclear risk; ER: emergency room; NS: not significant; RBC: red blood cells; SD: Standard Deviation; VAS: visual analogue scale. adj.: adjusted; d: days; m: months; y: years				

Junktionale Blutungen

No studies identified.

1.2 Atemwegsmanagement, Beatmung und Notfallnarkose

Notfallnarkose, endotracheale Intubation und Beatmung

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Chou (2016) "Field intubation in civilian patients with hemorrhagic shock is associated with higher mortality." *The Journal of Trauma and Acute Care Surgery*, 2016. 80(2): p. 278-82.	**Inclusion criteria** • Patients with hemorrhagic shock. Hemorrhagic shock was defined by the need for massive transfusion of six or more units of packed red blood cells (PRBCs) within 24 hours of hospital admission. **Exclusion criteria**	**Participants** N=552 patients **Study groups** IG: Field intubation (N=63) CG: no field intubation (N=489)	Mortality, % (n/N) IG: 82.5 (52/63) CG: 43.1 (211/489), adjusted OR 2.89 (1.08-7.78), p=0.035 Length of hospital stay [d] median (IQR) IG: 1.0 (1.0-4.0) CG: 9.0 (2.0-25.5), adjusted MD 13.11 (6.10-20.13), p=0.256	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Study design Comparative registry study (The Los Angeles County Trauma System Database) **Aim of the study** "The aim of this study was to assess the association between FI and in-hospital mortality in trauma patients experiencing hemorrhagic shock, defined by the use of massive transfusion within the first 24 hours after arrival to the trauma center." **Setting** USA, 2012-2014	• Patients who were missing intubation data or were younger than 16 years were excluded from the analysis. **Characteristics** Age [y], median (IQR) IG: 29.0 (21.0-49.0) CG: 35.0 (24.0-51.0), p=0.084 Male, % (n/N) IG: 87.3 (55/63) CG: 82.4 (403/489), p=0.0331 ISS median (IQR) IG: 41.0 (27.0-50.0) CG: 29.0 (20.0-41.0), p<0.001 Field GCS score median (IQR) IG: 3.0 (3.0-3.0) CG: 14.0 (4.0-15.0), p<0.001 Field SBP median (IQR) [mmHg] IG: 86.0 (0-127.0) CG: 103.5 (82.0-130.0), p<0.001 Field heart rate median (IQR), [beats/min] IG: 89.0 (1.0-120.0) CG: 108.0 (88.0-120.0), p<0.001 Field respiratory rate, median (IQR), [breaths/min] IG: 6.0 (0-12.0) CG: 18.5 (16.0-24.0), p<0.001	FI was defined as endotracheal tube insertion, laryngeal tube insertion, or surgical airway placement (cricothyroidotomy). *Adjusted for age, sex, ISS, field GCS score, field vital signs (heart rate, respiratory rate, and SBP), blunt (vs. penetrating) injury, total field time, and units of blood products administered in the first 24 hours of hospital admission.	Length of ICU stay [d] median (IQR) IG: 3.0 (2.0-15.3) CG: 6.0 (3.0-14.0), adjusted MD 11.13 (4.97-17.30), p=0.002 Ventilation [d] median (IQR) IG: 2.0 (1.0-6.8) CG: 4.0 (1.0-9.0), adjusted MD 5.95 (1.67-10.22), p=0.316 FI as a predictor of mortality, adjusted OR (95% CI) 3.41 (1.35-8.59), p=0.009	Detection bias: + **Authors' conclusion** "FI may be associated with increased mortality in trauma patients with hemorrhagic shock requiring massive transfusion. Noninvasive airway maneuvers should be considered to facilitate rapid transport of patients in this population." **Reviewers' conclusion** The results of the study need to be interpreted carefully due to selection bias (IG had significantly higher ISS and lower GCS). As hemorrhagic shock was defined by the need for massive transfusion after hospital admission, identification in the field was not possible. According to the authors, identification in the field by hypotension (SBP<90 mm Hg) would have let to 67% less cases of hemorrhagic shock.
Denninghoff (2017) "Prehospital Intubation is Associated with Favorable	**Inclusion criteria**	**Participants** N=882 patients	Mortality at 6 months after randomization, n (%)	**Level of evidence** 2b

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Outcomes and Lower Mortality in ProTECT III." *Prehospital Emergency Care*, 2017. 21(5): p. 539-544. **Study design** Secondary analysis of an RCT (ProTECT III) **Aim of the study** "We evaluated the relationship between prehospital intubation, functional outcomes, and mortality using high quality data on clinical practice collected prospectively during a randomized multicenter clinical trial." **Setting** USA, 2010-2013	• adults with severe, moderate-to-severe, or moderate TBI due to blunt trauma • GCS 4 to 12 • Patients who met inclusion criteria were enrolled if the study treatment could be initiated within 4 hours of injury **Exclusion criteria** • before enrolment, treatment team determined clinically injury was nonsurvivable; bilateral dilated, unresponsive pupils; cardio-pulmonary resuscitation was performed; or the patient had physiological findings of hypoxemia, hypotension, spinal cord injury, or status epilepticus. • pregnancy, status as a prisoner or ward of the state, severe intoxication (ethanol level, >249 mg per deciliter), and a known history of reproductive cancer, allergy to progesterone or a fat-emulsion vehicle, or a blood-clotting disorder. • active myocardial infarction, ischemic stroke, pulmonary embolism, or deep-vein thrombosis. • wearing an opt-out bracelet or were listed in a registry of persons preemptively requesting not to participate in this trial. **Characteristics** <u>Age [y], median (range)</u> IG: 36 (17–85) CG: 35 (17–94), p=n.r.	**Study groups** IG: Prehospital intubation (N=349) CG: no prehospital intubation (N=533) * adjusted for transport method, index GCS score at randomization, age, and race/ethnicity	IG: 48 (13.8) CG: 104 (19.5), p=n.r. adjusted OR 0.7 (0.37-1.31) <u>Functional recovery determined by the use of GOS-E at 6 months after randomization</u> Favorable outcome n (%), OR(CI) IG: 200 (57.3) CG: 245 (46.0), p=n.r., adjusted OR 1.10 (0.69-1.76) <u>Missing data</u> IG: 20 (5.7) CG: 32 (6.0), p=n.r.	**Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Prehospital intubation and air medical transport together were associated with favourable outcomes and lower mortality. Prehospital intubation was not associated with increased morbidity or mortality regardless of transport method or severity of injury." **Reviewers' conclusion** The study results need to be interpreted with caution due to the retrospective study design. It is unclear if performance bias occurred.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Male n (%) IG: 264 (75.6) CG: 386 (72.4), p=n.r. ISS n.r. (n.r.) IG: 24.8 (± 11.8) CG: 24.2 (± 11.1), p=n.r. **Index GCS score at randomization n (%)** Moderate IG: 70 (20.1) CG: 184 (34.5), p=n.r. Moderate to severe IG: 183 (52.4) CG: 289 (54.2), p=n.r. Severe IG: 96 (27.5) CG: 60 (11.3), p=n.r. AIS head score indication no injury n (%) IG: 14 (4.0) CG: 17(3.2), p=n.r.			
Gravesteijn (2020) "Tracheal intubation in traumatic brain injury: a multicentre prospective observational study." *British Journal of Anaesthesia*, 2020. 125(4): p. 505-517. **Study design** Comparative registry study	**Inclusion criteria** • patients with traumatic brain injury who had been intubated **Exclusion criteria** • excluded patients in whom intubation could not have been considered • For PHI, we therefore excluded patients who arrived to the study hospital without activating emergency medical services (self-presenters)	**Participants** N=1350 patients **Study groups** IG: Prehospital intubation (N=890) CG1: Non-prehospital intubation (N=2,846) CG2: inhospital intubation (N=460) Prehospital intubationwas defined as intubation at the scene of injury. Inhospital intubation was defined as intubation at the ED	Effect of prehospital (PHI) and in-hospital intubation (IHI) on lower functional outcome GOS-E Adjusted OR (CI) IG vs. CG1: Prehosptial intubation 1.01 (0.79-1.28), p=0.96 IG vs. CG2: Prehosptial intubation vs. Hospital intubation 0.90 (0.65-1.23), p=n.r. **Subgroup analysis for prehospital intubation**	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
(Collaborative European NeuroTrauma Effectiveness Research for Traumatic Brain Injury, CENTER-TBI) **Aim of the study** "We aimed to study the associations between pre- and in-hospital tracheal intubation and outcomes in traumatic brain injury (TBI), and whether the association varied according to injury severity." **Setting** 59 centres in Europe, 2014-2018	• For the IHI analysis, we excluded patients whose tracheas were already intubated on scene **Characteristics** <u>Age [y], median (IQR)</u> IG: 44 (25, 60) CG1: 52 (33, 68) p<0.001 CG2: 52 (31, 67), p=n.r. <u>Male n (%)</u> IG: 657 (73.8) CG1: 1,895 (66.6) p<0.001 CG2 334 (72.6), p=n.r. <u>GCS score baseline median (IQR)</u> IG: 4 (3, 8) CG1: 15 (13, 15), p<0.001 CG2: 8 (5, 13), p=n.r. <u>GCS score prehospital median (IQR)</u> IG: 6 (3, 9) CG1: 14 (13, 15), p<0.001 CG2: 10 (6, 14), p=n.r. <u>GCS score at ED median (IQR)</u> IG: 3 (3, 3) CG1: 15 (14, 15), p<0.001 CG2: 8 (5, 12), p=n.r. <u>Major head injury, n (%)</u> IG: 851 (95.6) CG1: 1,960 (68.9), p<0.001 CG2: 441 (95.9) p=n.r. <u>Major chest/spine injury, n (%)</u>	of the study hospital, or intubation at the referring hospital if the patient was transferred. Intubation could include intubation with and without sedation. Adjustment including age, sex, baseline GCS, pupil reactivity, heart rate/systolic blood pressure/saturation at arrival, AIS scores of head/spine/abdominal/face regions, traumatic subarachnoid haemorrhage, epidural haematoma, CT class, hypoxia/hypotension at the emergency department.	Prehospital intubation was associated with better functional outcome in patients with • higher thorax AIS scores (p=0.009) • higher abdominal AIS scores (p=0.02) • but not with lower GCS score (p=0.32)	"After adjustment for possible confounders, there was no evidence for an overall effect of intubation on functional outcome in TBI patients. Although higher or lower GCS scores did not influence the effect of intubation in the prehospital setting, intubation at the ED seemed to have a more beneficial effect in patients with lower GCS scores." **Reviewers' conclusion** The study results need to be interpreted with caution due to the retrospective study design. Selection bias (GCS scores differ) can be assumed and there is a risk for performance bias.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG: 408 (45.8) CG1: 436 (15.3), p<0.001 CG2: 135 (29.3) p=n.r. Major face injury, n (%) IG: 261 (29.3) CG1: 341 (12.0), p<0.001 CG2: 106 (23.0) p=n.r. Major abdominal injury, n (%) IG: 139 (15.6) CG1: 148 (5.2), p<0.001 CG2: 40 (8.7) p=n.r. Major external injury, n (%) IG: 40 (4.5) CG1: 45 (1.6), p<0.001 CG2: 12 (2.6) p=n.r. Major extremity injury, n (%) IG: 235 (26.4 CG1: 356 (12.5), p<0.001 CG2: 80 (17.4) p=n.r. Heart rate at ED arrival mean (SD) IG: 89 (24) CG1: 83 (18), p<0.001 CG2: 84 (21), p=n.r. SBP at ED arrival mean (SD) IG: 129 (31) CG1: 141 (26), p<0.001 CG2: 140 (32), p=n.r. SpO2 at ED arrival median (IQR) IG: 100 (98, 100) CG1: 141 (26), p<0.001 CG2: 98 (96, 100), p=n.r.			

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Hypoxia at ED (%) IG: 175 (20.6) CG1: 105 (3.9), p<0.001 CG2: 62 (14.9), p=n.r. Hypotension at ED (%) IG: 189 (22.2) CG1: 94 (3.4), p<0.001 CG2: 44 (10.4), p=n.r.			
Haltmeier (2017) "Prehospital intubation for isolated severe blunt traumatic brain injury: worse outcomes and higher mortality ". *European Journal of Trauma & Emergency Surgery* 2017; 43(6): 731-739 **Study design** Comparative registry study (National Trauma Data Bank) **Aim of the study** "The aim of this study was to investigate the effect of prehospital endotracheal intubation (ETI) in patients with traumatic brain injury (TBI)." **Setting** USA, 2008-2012	**Inclusion criteria** • Patients with isolated severe blunt TBI and a GCS ≤8 **Exclusion criteria** n.r. **Characteristics (after matching, equal for both groups)** Age [y], median (IQR) 42.0 (35.0) Male, n (%) 6,133 (75.4) GCS in the field, median (IQR) 3.0 (5.0)5.0), p=1.0 AIS head, median (IQR) 4.0 (1) Field hypotension (SBP <90 mmHg), n (%) 296 (3.6)	**Participants** N=16,278 patients **Study groups** IG: patients undergoing prehospital ETI (before Emergency Department (ED) admission); N=8139 CG: no prehospital ETI; N=8139 • Isolated TBI was defined as an AIS head score 3 and an AIS chest and abdomen score <3. • A 1:1 cohort matching of patients with and without prehospital ETI was performed. **Matching criteria** • Age (±5 years) • Sex • exact field GCS score • exact AIS head score • field hypotension • field cardiac arrest • brain injury type (contusion, epidural hematoma, subdural hematoma, subarachnoid haemorrhage, intraparenchymal	Mortality, n (%) IG: 2,553 (31.4) CG: 2,235 (27.5) p<0.001 Hospital Length of Stay [d], median (IQR) IG: 10.0 (17.0) CG: 9.0 (18.0) p<0.001 ICU Length of Stay [d], median (IQR) IG: 6.0 (11.0) CG: 5.0 (11.0) p<0.001 Ventilator days [d], median (IQR) IG: 4.0 (8.0) CG: 4.0 (9.0) p=0.006	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "In this large matched cohort study including patients with isolated severe blunt TBI, prehospital ETI was independently associated with lower ED GCS scores and higher inhospital mortality." **Reviewers' conclusion** The study results need to be interpreted with caution due to the retrospective study design. It was unclear

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
		haemorrhage, intraventricular haemorrhage, diffuse axonal injury, brain swelling, brain laceration, pneumocephalus).		if there was a potential of performance bias.
Hoffmann (2017) "The Impact of Prehospital Intubation With and Without Sedation on Outcome in Trauma Patients With a GCS of 8 or Less". *Journal of Neurosurgical Anesthesiology* 2017; 29(29): 161-167 **Study design** Comparative registry study (TraumaRegister DGU®) **Aim of the study** "The purpose of this study is to evaluate the impact of prehospital intubation with and without sedation on mortality and early neurological outcome in trauma patients with a GCS of 3 to 8 based on a large registry." **Setting** Europe, 2002- 2013	**Inclusion criteria** • European patients with complete documentation of intubation and GCS recorded prehospital by an emergency physician at the scene before resuscitation • Complete outcome documentation in terms of survival to hospital discharge or death. • Injury Severity Score (ISS) was ≥9 • patients directly from the scene to the participating hospital **Exclusion criteria** • patients transferred in from another hospital • patients transferred out to another hospital within 48 hours **Characteristics** Age [y], mean (SD) IG: 46.2 (22.6) CG: 52.6 (23.4) Male, n (%) IG: 13,480 (71.4) CG: 1564 (69.2) ISS, mean (SD) IG: 32.1 (16.0) CG: 24.0 (12.3) GCS=3 at scene, n (%)	**Participants** N=21,242 trauma patients with a prehospital GCS of 3 to 8 **Study groups** IG: Intubated patients (n=18,975) CG: Nonintubated patients (n=2,267) • TBI was defined as a head abbreviated injury scale (AIS) score of ≥3. Severe injuries were defined as an AIS of ≥3 for any body region • Intubated patients were classified into 2 subgroups: patients that received sedation before intubation and patients being intubated without sedation.	24h mortality, n (%) IG: 4,954 (26.1) CG: 348 (15.4) Observed hospital mortality, n (%) (95% CI) IG: 8,016 (42.2) (41.5-42.9) CG: 680 (30.0) (28.1-31.9) Predicted mortality = RISC II prognosis, % IG: 41.4 CG: 26.6 Standardized Mortality Ratio (95% CI) IG: 1.020 (1.003-1.037) CG: 1.128 (1.057-1.199) The difference between observed and predicted mortality rates were lower in intubated patients Prediction of Mortality in intubated patients* (not intubated as reference) Coefficient: 0.14 OR (95% CI): 1.15 (1.00-1.32); p=0.04 * by Multivariate Logistic Regression Analysis **Subgroup Age 60+** Observed Mortality, % IG: 60.4 CG: 50.7 p=n.r. Predicted mortality = RISC II prognosis, % IG: 58.2 CG: 42.9	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + no tool available for prognostic studies **Authors' conclusion** "Observed outcome of prehospital intubated patients with a GCS of ≤8 seems less poor than predicted compared with nonintubated patients. Sedation before intubation might potentially decrease mortality and improve early neurological outcome. Further studies are required to clarify this and other issues, such as the influence of drugs used for intubation, the effect of the experience of the intubating physician, and also the effect of other airway devices which could

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG: 11,185 (58.9) CG: 591 (26.1) Sedation, n (%) IG: 12,448 (87.6) CG: 498 (34.0) Combined TBI, n (%) IG: 12,238 (64.5) CG: 1073 (47.3) Isolated TBI, n (%) IG: 4166 (22.0) CG: 863 (38.1) AISHead ≥3, n (%) IG: 15,541 (81.9) CG: 1790 (79.0) AISThorax ≥3, n (%) IG: 9258 (48.8) CG: 678 (29.9) AISAbdomen ≥3, n (%) IG: 2655 (14.0) CG: 170 (7.5) AISExtremities ≥3, n (%) IG: 5044 (26.6) CG: 330 (14.6) Prehospital shock (BPr90mm Hg) (n [%]) IG: 5271 (31.5) CG: 253 (12.4) HR on scene, mean (SD) IG: 89.7 (33.4) CG: 89.1 (24.0)		p=n.r. Standardized Mortality Ratio (95% CI) IG: 1.04 (1.02-1.06) CG: 1.18 (1.11-1.26) P<0.001 **Subgroup Age <60** Observed Mortality, % IG: 34.0 CG: 14.6 Predicted mortality = RISC II prognosis, % IG: 33.8 CG: 14.4 p=n.r. Standardized Mortality Ratio (95% CI) IG: 1.01 (0.98-1.03) CG: 1.01 (0.88-1.14) p=n.r. **Subgroup ISS 9-15** Observed Mortality, % IG: 16.4 CG: 6.8 Predicted mortality = RISC II prognosis, % IG: 13.2 CG: 6.1 p=n.r. Standardized Mortality Ratio (95% CI) IG: 1.24 (1.12-1.36) CG: 1.11 (0.74-1.47) p=n.r.	not have been answered using the TR-DGU data set." **Reviewers' conclusion** There is a risk of selection bias due to the fact that not intubated patients had lower ISS than intubated patients. Furthermore provided information differ, partially p-values and Confidence intervals are given, partially not, which reduces the studies expressiveness. The authors state that in selected comparisons, statistical tests, or alternatively a 95% CI, have been calculated.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	SpO2 (%)* on scene, mean (SD) IG: 86.7 (20.1) CG: 93.2 (8.9)		**Subgroup ISS 16-24** Observed Mortality, % IG: 19.3 CG: 15.1 Predicted mortality = RISC II prognosis, % IG: 17.8 CG: 14.4 p=n.r. Standardized Mortality Ratio (95% CI) IG: 1.09 (1.02-1.16) CG: 1.05 (0.86-1.24) p=n.r. **Subgroup ISS>24** Observed Mortality, % IG: 52.6 CG: 48.5 Predicted mortality = RISC II prognosis, % IG: 52.3 CG: 42.5 p=n.r. Standardized Mortality Ratio (95% CI) IG: 1.005 (0.99-1.02) CG: 1.14 (1.07-1.21) P<0.001 **Subgroup Sedation vs. no sedation for intubated patients** Prediction of Mortality (reference status un-known)	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Sedation: coefficient -0.41; OR (95% CI): 0.66 (0.60-0.73); p<0.001 No Sedation: coefficient -0.03; OR (95% CI): 0.97 (0.84-1.11); p=0.64 Observed mortality, % (95% CI) Sedation: 37.7 (36.7-38.7) No sedation: 64.8 (62.6-67.1) p<0.001 RISC-II prognosis, % Sedation: 39.0 No Sedation: 61.1 Rates of good early neurological outcome (GOS 4+5), % Sedation: 38.9 No Sedation: 17.8 Standardized Mortality Ratio (95% CI) Sedation: 0.967 (0.951-0.983) No Sedation: 1.061 (1.025-1.098)	
Schauer (2018) "Prehospital Airway Management in Iraq and Afghanistan: A Descriptive Analysis". Southern Medical Journal 2018; 111(12): 707-713 **Study design** Comparative registry study (The Department of Defense Trauma Registry, formerly known as the Joint Theater Trauma Registry)	**Inclusion criteria** • Adult trauma patients • Patients who had a documented oropharyngeal airway (OPA), NPA, unspecified airway adjunct, endotracheal intubation (ETI), CRIC, or supraglottic airway (SGA) in the prehospital setting. • Patients with documented predefined ICD 9 codes (see Study interventions for details) **Exclusion criteria** • casualties who died in the prehospital setting or were killed in action **Characteristics**	**Participants** N=28,222 patients identified according to trauma and ICD9 codes; N=1379 patients with documented prehospital airway intervention **Study groups** IG -I: Patients with airway intervention Iraq, N=279 CG -I: Baseline population Iraq, without airway intervention, N=8,354 IG-A: Patients with airway intervention Afghanistan, N=1,100	Survival rate/ Discharged alive, n (%) IG-I: 181 (64.8) CG-I: 7,948 (95.5); p<0.001 IG-A: 833 (75.7) CG-A: 17,969 (97.2); p<0.001	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: ? **Authors' conclusion** „Patients undergoing airway intervention were most frequently injured by explosive or gunshot wound. Intubations and

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Aim of the study „Our objective was to describe the population requiring airway management in the prehospital, combat setting; currently used methods; and outcomes within this population." **Setting** Iraq & Afghanistan, 2007-2016	Age [y], median (IQR) IG-I: 22 (21–29) CG-I: 25 (21–32); p<0.001 IG-A: 25 (21–30) CG-A: 25 (21–30); p=0.346 Male, n (%) IG-I: 265 (94.9) CG-I: 7947 (95.1); p=0.911 IG-A: 1,084 (98.5) CG-A: 18,063 (97.8); p=0.080 ISS, median (IQR) IG-I: 22 (13–29) CG-I: 9 (4–16); p<0.001 IG-A: 20 (13–29) CG-A: 8 (4–14); p<0.001 AIS head/neck, median (IQR) IG-I: 3 (0–5) CG-I: 0 (0–2); p<0.001 IG-A: 2 (0–4) CG-A: 0 (0–2); p<0.001 AIS face, median (IQR) IG-I: 0 (0–2) CG-I: 0 (0–0); p<0.001 IG-A: 0 (0–2) CG-A: 0 (0–1); p<0.001 AIS thorax, median (IQR) IG-I: 0 (0–2) CG-I: 0 (0–0); p<0.001 IG-A: 0 (0–2) CG-A: 0 (0–0); p<0.001 AISBR4 (abdomen), median (IQR) IG-I: 0 (0–0)	CG-A: Baseline population Afghanistan, without airway intervention, N=18,479 **Study interventions** • The DODTR comprises all of the patients admitted to a Role 3 (fixed facility) or forward surgical team (FST) with an injury diagnosis using the International Classification of Diseases, Ninth Edition (ICD-9)codes 800–959.9, near-drowning/drowning with associated injury (ICD-9 994.1), or inhalational injury (ICD-9 987.9) and trauma occurring within 72 hours from injury • For airway interventions the following categorizations were made: Combitubes (Moore Medical, Farmington, CT), Laryngeal Mask Airways (LMA, TeleflexMedical Europe,Westmeath, Ireland), and King Laryngeal Tracheal (KingLT, Ambu, Ballerup, Denmark) as SGA devices.		CRICs were the most frequent airway interventions performed. Patients undergoing interventions were more critically injured with higher mortality rates." **Reviewers' conclusion** The study has several limitations and unclear risks of selection, performance and detection bias. The explanation for choosing the predefined ICD9 codes could be more detailed to understand underlying thoughts of the authors. Adjusting for confounding factors and calculating Odds is missing.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	CG-I 0 (0–0); p=0.901 IG-A: 0 (0–2) CG-A: 0 (0–0); p<0.001 AISBR5 (extremity), median (IQR) IG-I: 0 (0–2) CG-I: 0 (0–2), p=0.119 IG-A: 2 (0–3) CG-A: 0 (0–0); p<0.001 AISBR6 (external), median (IQR) IG-I: 1 (0–2) CG-I: 1 (0–1), p=0.094 IG-A: 1 (0–1) CG-A: 1 (0–1), p=0.194			
Schauer (2019) „A Comparison of Prehospital Versus Emergency Department Intubations in Iraq and Afghanistan*". Journal of Special Operations Medicine* 2019; 19(2): 87-90 **Study design** Comparative registry study (The Department of Defense Trauma Registry, formerly known as the Joint Theater Trauma Registry) **Aim of the study** "We sought to compare the outcomes of combat casualties intubated in the	**Inclusion criteria** • all subjects with a documented prehospital or ED intubation • subjects must arrive at the FST or fixed facility alive or with ongoing interventions **Exclusion criteria** n.r. **Characteristics** Age [y], median (IQR) IG: 24 (21–30) CG: 25 (21–30) p<0.001 Male, n (%) IG: 1,091 (97.7) CG: 3,122 (96.9) p=0.183	**Participants** N=4341 intubations **Study groups** IG: prehospital intubation cohort; N=1,117 CG: intubation in the ED cohort, N=3,224 • A subgroup analysis of patients with significant head injuries was performed. *Adjustment for: injury severity score, military operation, patient category (US military, coalition, etc.), mechanism of injury, sex, and age §Adjustment for: age, sex, mechanism of injury, theater of operation and AIS face, chest, abdomen, extremities, and external)	Survival rate, n (%); OR (95% CI)* IG: 853 (76.4) CG: 2,717 (84.3) p<0.001 Survival rate, adjusted* OR (95% CI) IG: 0.59, (0.50–0.71). **Subgroup head AIS ≥3 , N=1486** Number of patients intubated IG: 449 CG: 1,037 Survival rate, n (%) IG: 278 (61.9) CG: 783 (75.5) p<0.001 Survival rate, adjusted§ OR (95% CI) IG: 0.59, (0.50–0.71)	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Patients intubated in the prehospital setting had lower survival than those intubated in the ED. This finding persisted after controlling for measurable confounders." **Reviewers' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
prehospital setting (Role 1 and Role 2 without FST augmentation) versus the emergency department (forward surgical team or combat support hospital)." **Setting** Iraq & Afghanistan, 2007-2016	<u>ISS, median (IQR)</u> IG: 20 (12–27) CG: 18 (11–27) p=0.045 <u>AIS head/neck, median (IQR)</u> IG: 1 (0–4) CG: 1 (0–3) p<0.001 <u>AIS face, median (IQR)</u> IG: 0 (0–1) CG: 0 (0–1) p=0.286 <u>AIS thorax, median (IQR)</u> IG: 0 (0–2) CG: 0 (0–3) p=0.006 <u>AIS abdomen, median (IQR)</u> IG: 0 (0–2) CG: 0 (0–2) P=0.396 <u>AIS extremity , median (IQR)</u> IG: 2 (0–3) CG: 2 (0–3) P=0.033			The study results need to be interpreted with caution due to the retrospective study design. There is a potential risk of performance bias. Results obtained from patients in a combat environment are only partially transferable to civilian settings, as the population and injuries can differ a lot. CAVE: The population of this articles might overlap with Schauer (2019) "Survival of Casualties Undergoing Prehospital Supraglottic Airway Placement Versus Cricothyrotomy"

+: low risk; –: high risk; ?: unclear risk; adj.: adjusted; AIS: abbreviated injury severity; CG: control group; CI: Confidence Interval; CT: Computer tomography; d: days; ED: Emergency Department; FI: Field intubation; GCS: Glasgow Coma Scale; GOS-E: Glasgow Outcome Scale – Extended; HR: Hazard Ratio; IG: intervention group; IHI: In-hospital intubation; IQR: Interquartile Range; ISS: injury severity score; ITT: Intention to Treat; LoE: level of evidence; m: months; MD: mean difference; mg: milligram; mmHg: millimeter of mercury; n: number; n.a.: not applicable;; n.r.: not reported; OR: Odds Ratio; PHI: Prehospital intubation; PRBCs: packed red blood cells; RISC: Revised Injury Severity Classification; RR: Relative Risk; SBP: Systolic Blood Pressure; SD: Standard Deviation; TBI: Traumatic brain injury; y: years

Schwieriger Atemweg

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Burns (2016) "Difficult Intubation Factors in Prehospital Rapid Sequence Intubation by an Australian Helicopter Emergency Medical Service." Air Medical Journal, 2016. 35(1): p. 28-32. **Study design** Prognostic case-control study (data from Greater Sydney Area Helicopter Emergency Medical Service) **Aim of the study** "The objective of this study was to describe the factors associated with difficult intubation in prehospital rapid sequence intubation (RSI) as defined by more than a single look at laryngoscopy to achieve tracheal intubation." **Setting** Australia, 2009-2013	**Inclusion criteria** • Patients undergoing prehospital RSI by the service. **Exclusion criteria** n.r. **Characteristics** <u>Age [y], median (IQR)</u> Case: 41 (32) Control: 33 (32) <u>Male, n (%)</u> Case: 58 (82) Control: 272 (73) <u>Traumatic injury, n (%)</u> Case: 63 (89) Control: 336 (90) <u>Reason for intubation, n (%)</u> *Traumatic cardiac arrest* Case: 4 (6) Control: 33 (9) *Head injury threatened airway* Case: 37 (52) Control: 181 (49) *Head injury airway not patent* Case: 6 (8) Control: 47 (13) *Combative agitated*	**Participants** N=443 patients **Study groups** Case: Difficult Intubation, N=71 Control: Nondifficult intubation, N=372 • A single look at laryngoscopy was defined as a single passage of the laryngoscope blade past the lips by 1 operator. • A first-pass intubation was defined as a single passage of a tracheal tube past the lips leading to successful tracheal intubation. • Difficult intubation was defined as one that required more than a single look at laryngoscopy to achieve successful TI. • A failed airway was defined as one in which the initial method chosen for airway management, usually oral TI, was not successful and an alternative method needed to be undertaken. • Airway rescue maneuvers were defined as bag valve mask ventilation after induction for RSI, insertion of oro/nasopharyngeal airway after induction, or laryngeal mask airway insertion.	<u>Success rate single-look laryngoscopy, n (%); 95% CI</u> 372 (84); 80.3 – 87.1 <u>Success rate first-pass intubation, n (%)</u> 394 (88.9) <u>Overall successful intubation, n (%); 95% CI</u> 438 (98.9); 97.4 – 99.5 <u>Complications, n (%)</u> 116 (26.2) **Prognostic factors associated with difficult or nondifficult intubation** **Univariate Analysis** <u>Paramedic as first operator, n (%)</u> Case: 57 (80) Control: 233 (63) p=0.0051 <u>Blood/vomitus in airway, n (%)</u> Case: 35 (49) Control: 123 (33) p=0.0097 <u>Limited mouth opening, n (%)</u> Case: 12 (17) Control: 22 (6) p=0.0023 <u>Limited neck movement, n (%)</u> Case: 7 (10) Control: 7 (2)	**Level of evidence** 3b **Risk of bias** (Internal validity) Selection of participants: ? Assessment: ? Confounding factors: + Statistical analysis: + **Authors' conclusion** "RSI success was comparable or better than the majority of published data for prehospital services as well as ED, ICU, and pediatric intensive care unit intubations and indicate the procedure can be performed safely and effectively in the prehospital setting by experienced teams operating under strict operating procedures using pre-RSI checklists and routine audit of practice with a detailed airway registry of all intubations. Factors associated with more than a single attempt included a paramedic operator and the presence of blood/vomitus in airway, limited mouth

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Case: 26 (37) Control: 109 (29) *Shock* Case: 7 (10) Control: 39 (10) *Burn/inhalation* Case: 4 (6) Control: 24 (6)		p=0.0016 Night mission, n (%) Case: 29 (41) Control: 108 (29) p=0.05 Nil difficult airway indicators, n (%) Case: 4 (6) Control: 76 (20) p=0.0060 Trauma to face/neck, n (%) Case: 14 (20) Control: 81 (22) p=0.6991 C-spine precautions, n (%) Case: 48 (68) Control: 229 (62) p=0.3357 Obese body habitus, n (%) Case: 11 (15) Control: 33 (9) p=0.0916 Cricoid pressure, n (%) Case: 31 (44) Control: 134 (36) p=0.2235 Midline inline stabilization, n (%) Case: 45 (63) Control: 223 (60) p=0.5878 Intubated on ground, n (%)	opening, facial/neck trauma, C-spine precautions, obesity, or neck extension limited by anatomy." **Reviewers' conclusion** The study has limited transferability, caused by its case-control design. Due to missing information there is unclear risk of bias for patient selection and assessment. The identified factors were associated with difficult intubation, but outcomes like mortality are not reported.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Case: 13 (18) Control: 60 (16) p=0.6501 **Multivariate Analysis§** Paramedic as first operator, OR (95% CI) 3.295 (1.666-6.517) p=0.0006 Blood/vomitus in airway, OR (95% CI) 1.864 (1.054-3.297) p=0.0324 Limited mouth opening, OR (95% CI) 3.057 (1.341-6.968) P=0.0078 Limited neck movement, OR (95% CI) 4.610 (1.476-14.402) P=0.0086 Night mission, OR (95% CI) 3.295 (1.666-6.517) P=0.0006 § OR >1, increased odds of a difficult intubation; Hosmer and Lemeshow goodness-of-fit test, $\chi^2 7$ = 0.8396, p>9970.	
+: low risk; –: high risk; ?: unclear risk; adj.: adjusted; CG: control group; CI: Confidence Interval; C-Spine: cervical spine; d: days; ED: Emergency Department; HEMS: Helicopter Emergency Medical Service; ICU: Intensive Care Unit; IG: intervention group; IQR: Interquartile Range; LoE: level of evidence; m: months; MD: mean difference; n: number; n.r.: not reported; OR: Odds Ratio; RSI: Rapid Sequence Intubation; SD: Standard Deviation; TI: Tracheal intubation; y: years				

Alternative Methoden zur Atemwegssicherung

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Schauer (2019) "Survival of Casualties Undergoing Prehospital Supraglottic Airway Placement Versus Cricothyrotomy". *Journal of Special Operations Medicine* 2019; 19(2): 91-94 **Study design** Comparative registry study (The Department of Defense Trauma Registry, formerly known as the Joint Theater Trauma Registry) **Aim of the study** "We seek to compare outcomes of casualties undergoing cricothyrotomy versus supraglottic airway placement in the prehospital, combat setting." **Setting** Iraq & Afghanistan, .2007-2016	**Inclusion criteria** • all subjects who had a documented supraglottic airway device or cricothyrotomy performed as the sole documented airway intervention before reaching the emergency department at a combat support hospital (CSH) or forward surgical team (FST) **Exclusion criteria** • subjects if they had more than one airway intervention documented. • casualties who died in the prehospital setting or were killed in action **Characteristics** <u>Age [y], median (IQR)</u> IG: 24 (21–29) CG: 28 (22.75–35) p=0.022 <u>Male, n (%)</u> IG: 191 (98.5) CG: 21 (95.5) p=0.323 <u>prehospital GCS, median (IQR)</u> IG: 3 [IQR 3–6] CG: 3 [IQR 3–7.5 p=0.591 <u>GCS at ED arrival, median (IQR)</u> IG: 3 [3–5.5] CG: 3 [3–5.25] p=0.469	**Participants** N=216 documented airway interventions **Study groups** IG: cricothyrotomy prehospital, N=194 CG: supraglottic airway placement prehospital, N=22	<u>Survival Rate, n (%); OR (95% CI)*</u> CT: 106 (54.6) SGA: 13 (59.1); 1.20 (0.49–2.94) p=0.691 *univariable analysis <u>Adj. OR's after multivariable analysis, OR (95% CI)</u> controlling for injury scores by body region: 1.14 (0.42–3.10) controlling for the presence of a serious head injury: 1.06 (0.43–2.65) controlling for the mechanism of injury: 1.12 (0.45–2.76) controlling for ED GCS: 1.64 (0.62–4.30)	**Level of evidence** 2b **Risk of bias** Selection bias: ? Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** „We found no difference in short-term outcomes between combat casualties who received an SGA versus cricothyrotomy. Military prehospital personnel rarely used either advanced airway intervention during the recent conflicts in Afghanistan and Iraq." **Reviewers' conclusion** There is an unclear risk of selection bias as the exclusion of patients receiving more than one airway intervention was performed. This limits the studies expressiveness. Results should be interpreted with caution as SGA and cricothyrotomy are not used for the same situation. When deciding for cricothyrotomy

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	ISS, median (IQR) IG: 25 (14–33) CG: 27.5 (16.75–41.5) p=0.168 Serious head injuries (AIS ≥3), n (%) IG: 131 (67.5) CG: 10 (45.5) p=.0393 AIS (head), median (IQR) IG: 3 (1–5) CG: 2 (0–4.25) p=0.102 AIS (face), median (IQR) IG: 1 (0–2) CG: 0 (0–1.25) p=0.086 AIS (thorax), median (IQR) IG: 0 (0–2.25) CG: 3 (0–3) p=0.019 AIS (abdomen), median (IQR) IG: 0 (0–0) CG: 0 (0–3) P=0.077 AIS (extremity), median (IQR) IG: 0 (0–3) CG: 1 (0–3.25) P=0.151 AIS (superficial), median (IQR) IG: 1 (0–1)			EMS personnel faces a “cannot ventilate, cannot intubate” situation – which normally already included the try to use an SGA device before. CAVE: The population of this articles might overlap with Schauer (2019) „A Comparison of Prehospital Versus Emergency Department Intubations in Iraq and Afghanistan”!

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	CG: 1 (0–1) P=0.901			
Schauer (2018) "Prehospital Airway Management in Iraq and Afghanistan: A Descriptive Analysis". Southern Medical Journal 2018; 111(12): 707-713 Already extracted under 1.2, here we present only relevant outcomes concerning 1.8 **Study design** Comparative registry study (The Department of Defense Trauma Registry, formerly known as the Joint Theater Trauma Registry) **Aim of the study** „Our objective was to describe the population requiring airway management in the prehospital, combat setting; currently used methods; and outcomes within this population." **Setting** Iraq & Afghanistan, 2007-2016	**Inclusion criteria** • Adult trauma patients • Patients who had a documented oropharyngeal airway (OPA), NPA, unspecified airway adjunct, endotracheal intubation (ETI), CRIC, or supraglottic airway (SGA) in the prehospital setting. • Patients with documented predefined ICD 9 codes (see Study interventions for details) **Exclusion criteria** • casualties who died in the prehospital setting or were killed in action **Characteristics** **Afghanistan population** Age [y], median (IQR) IG1: 26 (21–35.5) IG2: 25 (21–30) IG3: 25 (21–30) IG4: 30 (23–40) CG: 25 (21–30) Male, n (%) IG1: 100 (17) IG2: 98.5 (870) IG3: 98.8 (176) IG4: 96.3 (26) CG: 97.8 (18,063) ISS, median (IQR) IG1: 14 (5.5–30) IG2: 19 (12–26)	**Participants** N=28,222 patients identified according to trauma and ICD9 codes **Study groups** **Aufghanistan population** IG1: nasopharyngeal airway, N=17 IG2: Intubation, N=883 IG3: Cricothyrotomy , n=178 IG4: Supraglottic airway, n=27 CG: no airway, N=18,479 **Iraq population** IG1: nasopharyngeal airway, N=0 IG2: Intubation, N=234 IG3: Cricothyrotomy , N=52 IG4: Supraglottic airway, N=0 CG: no airway, N=8,354 **Study interventions** • The DODTR comprises all of the patients admitted to a Role 3 (fixed facility) or forward surgical team (FST) with an injury diagnosis using the International Classification of Diseases, Ninth Edition (ICD-9)codes 800–959.9, near-drowning/drowning with associated injury (ICD-9 994.1), or inhalational injury (ICD-9 987.9) and trauma occurring within 72 hours from injury	Survival rate/ Discharged alive Afghanistan population based on different interventions, n (%) IG1: 14 (82.4) IG2: 692 (78.4) IG3: 104 (58.4) IG4: 12 (44.4) CG: 97.2 (17,969) Survival rate/ Discharged alive Iraq population based on different interventions, n (%) IG1 : NA IG2: 161 (68.8) IG3: 24 (46.1) IG4: NA CG: 95.5 (7,948)	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: ? **Authors' conclusion** „Patients undergoing airway intervention were most frequently injured by explosive or gunshot wound. Intubations and CRICs were the most frequent airway interventions performed. Patients undergoing interventions were more critically injured with higher mortality rates." **Reviewers' conclusion** The results should be interpreted with caution as the study is a descriptive study. The study has several limitations and unclear risks of selection, performance and detection bias. The explanation for choosing the predefined ICD9 codes could

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG3: 24 (14–33.25) IG4: 25 (14–38) CG: 8 (4–14) <u>AIS head/neck, median (IQR)</u> IG1: 0 (0–3) IG2: 1 (0–3) IG3: 3 (2–5) IG4: 3 (0–4) CG: 0 (0 – 2) <u>AIS face, median (IQR)</u> IG1: 0 (0–1.5) IG2: 0 (0–1) IG3: 2 (0–2) IG4: 1 (0–2) CG: 0 (0–1) <u>AIS thorax, median (IQR)</u> IG1: 0 (0–2.5) IG2: 0 (0–2) IG3: 0 (0–3) IG4: 2 (0–3) CG: 0 (0 – 0) <u>AIS abdomen, median (IQR)</u> IG1: 0 (0–2) IG2: 0 (0–2) IG3: 0 (0–0) IG4: 0 (0–2) CG: 0 (0–0) <u>AIS extremity, median (IQR)</u> IG1: 1 (0–3) IG2: 2 (0–3) IG3: 0 (0–3) IG4: 1 (0–3) CG: 0 (0–0)	• For airway interventions the following categorizations were made: Combitubes (Moore Medical, Farmington, CT), Laryngeal Mask Airways (LMA, TeleflexMedical Europe,Westmeath, Ireland), and King Laryngeal Tracheal (KingLT, Ambu, Ballerup, Denmark) as SGA devices.		be more detailed to understand underlying thoughts of the authors. Adjusting for confounding factors and calculating Odds is missing.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	AISB external, median (IQR) IG1: 1 (1–2) IG2: 1 (0–1) IG3: 1 (0–1) IG4: 1 (0–1) CG: 1 (0–1) **Iraq population** Age [y], median (IQR) IG1: NA IG2: 23 (21–29.25) IG3: 21.5 (21–27) IG4: NA CG: 25 (21–32) Male, n (%) IG1: NA IG2: 94.4 (221) IG3: 96.1 (50) IG4: NA CG: 95.1 (7947) ISS, median (IQR) IG1: NA IG2: 22 (13–29) IG3: 25 (14.5–29) IG4: NA CG: 9 (4–16) AIS head/neck, median (IQR) IG1: NA IG2: 2 (0–4.25) IG3: 3 (0–5) IG4: NA CG: 0 (0–2) AIS face, median (IQR)			

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG1: NA IG2: 0 (0–2) IG3: 0.5 (0–2) IG4: NA CG: 0 (0–0) AIS thorax, median (IQR) IG1: NA IG2: 0 (0–3) IG3: 0 (0–2) IG4: NA CG: 0 (0–0) AISBR4 (abdomen), median (IQR) IG1: NA IG2: 0 (0–0) IG3: 0 (0–0) IG4: NA CG: 0 (0–0) AISBR5 (extremity), median (IQR) IG1: NA IG2: 0 (0–2) IG3: 0 (0–2) IG4: NA CG: 0 (0–2) AISBR6 (external), median (IQR) IG1: NA IG2: 1 (0–2) IG3: 1 (0–2) IG4: NA CG: 1 (0–1)			
Schauer (2020) "Outcomes of Casualties Without Airway Trauma Undergoing Prehospital	**Inclusion criteria** • Patients with specific emergency department procedure codes	**Participants** N=28,222 patients identified, N=409 patients with airway intervention without apparent airway trauma	**Primary outcome** Survival rate/ Survival to discharge, n (%) ANY: 326 (80) NPA: 5 (71)	**Level of evidence** 2b **Risk of bias**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Airway Interventions: A Department of Defense Trauma Registry Study". *Military Medicine* 2020; 185(3-4): e352-e357 **Study design** Comparative registry study (The Department of Defense Trauma Registry, formerly known as the Joint Theater Trauma Registry) **Aim of the study** „Our primary objective in the present analysis is to perform a hypothesis-generating descriptive analysis of the incidence of airway interventions among the subset of casualties without reported upper airway trauma. Secondarily, we report survival among this unique subset of casualties." **Setting** Iraq & Afghanistan,2007-2016	• Patients with prehospital airway intervention • Patients must have arrived at a forward surgical team or fixed facility with signs of life or with ongoing interventions (e.g. cardiopulmonary resuscitation in progress). **Exclusion criteria** • n.r. **Characteristics** Age [y], median (IQR) ANY: 24 (21–30) NPA: 26 (23–30) CRI: 24 (21–37) IN: 24 (21–30) SU: 23 (20–34) Male, n (%) ANY: 255 (98) NPA: 7 (100) CRI: 24 (100) IN: 353 (97.8) SU: 7 (87.5) ISS, median (IQR) ANY: 17 (10–26) NPA: 13 (4–34) CRI: 17 (9–28) IN: 17 (10–25) SU: 17 (10–22) AIS thorax ≥3, n (%) ANY: 118 (29) NPA:2 (29) CRI:5 (21) IN: 105 (29)	**Study groups** ANY: patients with any airway intervention, baseline, N=409 NPA: nasopharyngeal airway, N=7 CRI: cricothyrotomy, N=24 IN: intubation, N=363 SU: supraglottic airway, N=8 **Note** • In this secondary analysis of that previously published dataset, we performed a subgroup analysis of subjects without apparent upper airway trauma as defined by abbreviated injury scale (AIS) of 0 for body region 1 (AISBR, head/neck) and body region 2 (face).	CRI: 13 (54) IN: 298 (82) SU: 3 (38)	Selection bias: ? Performance bias: ? Attrition bias: + Detection bias: ? **Authors' conclusion** "In this subgroup analysis of casualties without apparent upper airway trauma, survival rates were lower when compared to our previous report. Higher quality data are necessary to better understand the resuscitation needs of this critically ill subset of combat casualties." **Reviewers' conclusion** There is an unclear risk of selection, performance and detection bias. The study has a descriptive character and no p-values were provided to check for significance. The results have a questionable expressiveness and should therefore interpreted with caution. **CAVE:** overlapping population with Schauer (2018), secondary analysis of the same sample

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	SU: 3 (38) Abdomen ≥3, n (%) ANY: 215 (53) NPA: 2 (29) CRI: 4 (17) IN: 82 (23) SU: 1 (13) Extremity ≥3, n (%) ANY: 91 (22) NPA: 4 (57) CRI: 11 (46) IN: 195 (54) SU: 2 (25) Superficial ≥3, n (%) ANY: 45 (11) NPA: 1 (14) CRI: 6 (25) IN: 36 (10) SU: 1 (13)			
+: low risk; –: high risk; ?: unclear risk; adj.: adjusted; AIS: abbreviated injury severity; CG: control group; CI: Confidence Interval; CT: Computer tomography; d: days; ED: Emergency Department; GCS: Glasgow Coma Scale; IG: intervention group; IQR: Interquartile Range; ISS: injury severity score; LoE: level of evidence; m: months; n: number; n.r.: not reported; OR: Odds Ratio; SD: Standard Deviation; y: years				

Überwachung mittels EKG, Blutdruckmessung, Pulsoxymetrie und Kapnometrie/-grafie

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Wilharm (2019) Prehospital capnometry as quality indicator for trauma patients – Initial	**Inclusion criteria** • Admission via the shock room • Complete information on airway management	**Participants** N=5667 patients with airway management analyzed **Study groups**	Lethality observed IG, % IG: 30.3 CG: 30.7 Lethality predicted (RISC)CG, % IG: 30.1	**Level of evidence** 3b↓ **Risk of bias** Selection bias: –

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
analysis from the TraumaRegister DGU® Anasthesiologie und Intensivmedizin 2019; 60(9): 419-432 **Study design** Comparative registry study (TraumaRegister DGU®) **Aim of the study** "The aim of this study is to explore application and effects of prehospital capnometry." **Setting** Europe, 2016-2017	**Exclusion criteria** • Patients treated outside the European union • Patients transferred to other hospitals secondarily • Patients with missing data about airway management **Characteristics** <u>Age [y] median, (SD)</u> IG: 49.6 (± 22.8) CG: 50.4 (± 22.5) <u>Male, %</u> IG: 70.9 CG: 70.5 <u>ISS, median (±SD)</u> IG: 26.8 (± 15.2) CG: 24.1 (± 14.2) <u>AIS Head ≤3, %</u> IG: 63.0 CG: 56.5 <u>AIS Thorax ≤3, %</u> IG: 45.6 CG: 42.1	IG: airway management with capnometry documented, N=4,435 CG: airway management without capnometry documented, N=1,232	CG: 28.5 Difference not significant, p=0.23 <u>SMR, (95% CI)</u> IG: 1.008 (0.961–1.054) CG: 1.078 (0.969–1.187) p=n.r. **Subgroup analysis (patients with severe thorax and head injuries)** <u>SMR for AIS thorax ≥3</u> IG: 0.96 CG: 0.97 p=0.92 <u>SMR for AIS head ≥3 (95% CI)</u> CAP: 1,0 (0,96 – 1,05) NO: 1,11 (0,99 – 1,23) p=0.077	Performance bias: – Attrition bias: ? Detection bias: ? **Authors' conclusion** "Although current guidelines recommend capnometry for the monitoring of ventilated trauma patients, it has to be stated that capnometry has either not been documented or not been performed in a relevant percentage of patients, especially when alternative methods of airway management were applied. The degree of fulfilment of this important indicator of care quality and patient safety should be further increased. Their importance must continue to be emphasised in education and training." **Reviewers' conclusion** Due to the descriptive character of the study results are not adjusted for confounding factors, furthermore, observed differences between the study groups were not significant. Results should therefore interpreted with caution.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
+: low risk; –: high risk; ?: unclear risk; adj.: adjusted; AIS: Abbreviated Injury Scale; CG: control group; CI: Confidence Interval; d: days;; HR: Hazard Ratio; IG: intervention group; IQR: Interquartile Range; ISS: injury severity score; LoE: level of evidence; m: months; n: number; n.r.: not reported; OR: Odds Ratio; RISC: Revised Injury Severity Classification RR: Relative Risk; SD: Standard Deviation; SMR: Standardized Mortality Rate; y: years				

Einleitungshypnotikum

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Gasler (2019) "Pre-hospital emergent intubation in trauma patients: the influence of etomidate on mortality, morbidity and healthcare resource utilization." *Scandinavian Journal of Trauma, Resuscitation & Emergency Medicine*, 2019. 27(1): p. 61. **Study design** Comparative registry study (ADAC Air Rescue database and TraumaRegister DGU®) **Aim of the study** "The aim of this study is to address the issue of a single-dose of etomidate in pre-hospital trauma anes-	**Inclusion criteria** • Trauma patients with prehospital emergent intubation • documented ISS ≥9 **Exclusion criteria** • Transferred in secondarily • Transferred out early (no outcome) • Missing data induction agent **Characteristics** Age [y], mean (SD) IG: 46 (±20) CG: 43 (±21) p<0.001 Male, n (%) IG: 551(72.3) CG: 711(76.0), p=0.083 ISS, mean (SD) IG: 27 (±13) CG: 26 (±13), p=0.41 GCS score, mean (SD)/n IG: 10 (±5)/701 CG: 10 (±5)/839, p=0.97	**Participants** N=1,697 patients **Study groups** IG: etomidate during prehospital intubation (N=762) CG: any other intravenous anesthetic (N=935) (ketamine, thiopental, propofol, and midazolam) Adjusting for age, sex, unconsciousness (Glasgow Coma Scale ≤8), systolic blood pressure at scene, injury severity, trauma mechanism, hospital level of care (two categories), and year of trauma.	In-hospital mortality overall, n (%) IG: 144 (18.9) CG: 170 (18.2), p=0.71 Multivariable logistic regression analysis of risk factors for in-hospital mortality, OR(CI) IG: 1.10 (0.77-1.57), p=0.60 24-h mortality, n (%) IG: 71 (9.3) CG: 88 (9.4), p=1.00 ICU-LOS [d], mean (SD)/median IG:12.9 (±15.2)/8 CG: 11.2 (±13.3)/ 6, p=0.002 ICU length of ventilation [d], mean (SD) IG: 8.0 (±12.8) CG:6.8 (±9.7), p=0.005 HOS-LOS [d], mean (SD)/median IG: 27.9 (±28.7)/22 CG: 24.7 (±25.7)/19, p=0.014	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion** "The use of etomidate did not affect mortality. The influence on morbidity and health care resource utilization remains unclear. (…) The present study and one subgroup analysis revealed a prolonged use of healthcare resource utilization. We found no correlation to any organ failure for this result, though data is incomplete with respect to morbidity (organ failure, sepsis). Overall, the available data is limited due to

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
thesia by providing outcome data in a large multicentre approach." **Setting** Germany, 2008-2012	AIS Head ≥3, n (%) IG: 356 (46.7) CG: 462 (49.4) p=0.28 AIS Thorax ≥3, n (%) IG: 440 (57.7) CG: 504 (53.9) p=0.12 AIS Abdomen ≥3, n (%) IG: 111 (14.6) CG: 144 (15.4) p=0.68 AIS extremities ≥3, n (%) IG: 338 (44.4) CG: 389 (41.6) p=0.26 Blunt trauma n/N (%) IG: 663/712 (93.1) CG: 837/876 (95.5), p=0.037 SBP scene [mmHg], mean (SD)/n IG: 118 (±34)/689 CG: 119 (±35)/834, p=0.29 HR scene [1/min] mean (SD)/n IG:98 (±24)/458 CG: 99 (±24)/571, p=0.19			retrospective nature, small and inhomogeneous sample sizes or subgroup analysis." **Reviewers' conclusion** The results of the study need to be interpreted carefully due to performance bias. Furthermore, control group includes patients receiving several different anesthetic agents (thiopental, propofol, ketamine, midazolam).

+: low risk; –: high risk; ?: unclear risk; AIS: Abbreviated Injury Scale; CG: control group; CI: Confidence Interval; d: days; GCS: Glasgow Coma Scale; HR: Hazard Ratio; ICU: Intensive Care Unit; IG: intervention group; ISS: injury severity score; LoE: level of evidence; n: number; OR: Odds Ratio; SBP: Systolic Blood Pressure; SD: Standard Deviation; y: years

Videolaryngoskopie

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Goksu (2016) "Comparison of the C-MAC video laryngoscope to the Macintosh laryngo-scope for intubation of blunt trauma patients in the ED." Turkish Journal of Emergency Medicine, 2016. 16(2): p. 53-56. **Study design** Randomised controlled trial **Aim of the study** "We aimed to compare the performance of the C-MAC video laryngoscope (C-MAC) to the Macintosh laryngoscope for intuba-tion of blunt trauma pa-tients in the ED." **Setting** Turkey, 2013-2014	**Inclusion criteria** • >16 years • arriving at the ED due to blunt trauma requiring endotracheal intubation to secure the airway **Exclusion criteria** • intubated before ED arrival **Characteristics** Age [y], mean (SD) IG: 39 (±19) CG: 35 (±15.5), p=0.185 Male, n (%) IG: 70 (93.3) CG 73 (97.3), p=n.r. BMI, median (IQR) IG: 24 (23-29) CG 24 (22-26), p=0.2 **Indication for intubation n (%)** Head Trauma IG:30 (40) CG: 20 (26.7) Airway control IG: 14 (19) CG:13 (17.3) Low GCS	**Participants** N=150 patients **Study groups** IG: C-MAC video laryngoscope (N=75) CG: Macintosh laryngoscope (N=75)	Overall success n (%) IG: 69 (92) CG: 72 (96), p=n.r. First attempt success n (%) IG: 56 (62.7) CG: 44 (58.7), p=0.61 Second attempt success n (%) IG: 13 (17.3) CG: 21 (28), p=n.r. Time to successful intubation, [s] mean (SD) IG: 33.4 (±25) CG: 42.4 (±51), p=n.r. **The reasons for failed intubation at first attempt, n (%)** Inability to visualize cords IG:3 (4) CG: 16 (23, 1), p=0.002 Failure to direct the ET tube IG: 6 (8) CG: 8 (10.7), p=0.83 ET tube could not be passed between the vocal cords IG: 2 (2.7) CG:6 (8), p=0.36 Esophageal intubation	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: ? **Authors' conclusion** "In conclusion, in this study in the ED, although overall success rates were similar between the study devices, we demonstrated improved glottic view and a decrease in esophageal intubation rate with the C-MAC. First attempt and overall success rates, as well as the dura-tion of intubation with the C-MAC were at least equal to the DL in trauma patient population treatment in the ED. **Reviewers' conclusion** The study results need to be interpreted with caution due to the retrospective study design. The results of

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG: 4 (5.3) CG: 5 (6.7) Multiple Trauma IG: 3 (4) CG: 5 (6.7) Cardiac arrest IG: 11 (14.7) CG: 16 (21.3)		IG:0 (0) CG: 7 (9.3), p=0.013 Secretions IG: 7 (9.3) CG: 11 (14.7), p=0.26 Switch to another airway device IG: 6 (8) CG: 3 (4), p=0.25 Switch to another operator IG: 8 (10.7) CG: 20 (26.7), p=0.013	the study need to be interpreted carefully due to unclear detection bias.
+: low risk; –: high risk; ?: unclear risk; adj.: adjusted; BMI: Body-Mass-Index; CG: control group; ED: Emergency Department; ET: endotracheal; GCS: Glasgow Coma Scale; HR: Hazard Ratio; IG: intervention group; IQR: Interquartile Range; ISS: injury severity score; ITT: Intention to Treat; LoE: level of evidence; n: number; n.r.: not reported; SD: Standard Deviation; y: years				

1.3 Gerinnungsmanagement und Volumentherapie

Volumentherapie

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Heuer (2015) "Prehospital fluid management of abdominal organ trauma patients—a matched pair analysis." *Langenbeck's Archives of Surgery* 2015; 400(3): 371-379.	**Inclusion criteria** • Primary admission to a trauma center (no transfers) • Injury Severity Score (ISS) ≥16 • Age ≥16 years • Infusion of at least one unit of pRBCs • Systolic blood pressure ≥20 mmHg at the accident site	**Participants** N=136 patients **Study groups** IG: 0-1000 mL prehospital fluid replacement volume (N=68) CG: ≥1500 mL prehospital fluid replacement volume (N=68)	**Outcomes after matching** Died in hospital: n (%) IG: 8 (11.8) vs. CG: 13 (19.1), p=0.089 Died within the first 24 h: n (%) IG: 6 (8.8) vs. CG: 12 (17.6), p=0.129 ICU stay (days): mean ± SD	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Study design Comparative registry study (TraumaRegister DGU®) **Aim of the study** "We conducted a retrospective matched pair analysis to assess the influence of prehospital fluid replacement volume on the clinical course of patients with solid abdominal organ trauma." **Setting** Germany and Austria, 1993-2009	• Data available for the administered prehospital fluid replacement volume, hemoglobin concentration upon hospital admission, and blood pressure at the accident site and upon hospital admission **Exclusion criteria** • prehospital fluid replacement volume between >1000–1500 were not included **Characteristics** Age [y], mean ± SD IG: 34.25 (14.96) vs. CG: 36.37 (15.41), p=0.35 Male, n (%) IG: 59 (86.8) vs. CG: 59 (86.8), p=1.0 Glasgow coma scale (GCS) mean ± SD IG: 12.46 (3.76) vs. CG 12.32 (3.67), p=0.68 Injury severity score (ISS) IG: 34.97 (12.36) vs CG: 34.65 (11.17), p=0.99 Blunt abdominal trauma (%) IG: 86.8 vs. CG: 90.9, p=0.45 Fluid volume replaced prehospital [ml], mean ± SD IG: 818.38 (244.93), CG: 2101.84 (809.46)	**Co-interventions** Prehospital fluid replacement: crystalloids and colloids **Matching criteria** • The pattern of injury for the following abdominal organs: liver, spleen, kidney, and pancreas, where matching criteria were AIS severity ≥3points • The date of the injury (to account for changes in treatment over time): (I) 2002–2005, (II) 2006–2009, and (III) 2010–2012 • Systolic blood pressure at the accident site, which had to be at least 20mmHg: (I) 20–60mmHg, (II) 61–90mmHg, and (III) ≥91 mmHg • Age: (I) 16–54, (II) 55–69, and (III) ≥70 years • Intubation (yes/no) • Method of rescue transport (air vs. ground transportation) Time from injury to hospital ±30 min (i.e., the difference in the time from injury to hospital in matched patients did not exceed 30 min)	IG: 15.13 (22.32) vs. CG: 13.90 (14.32), p=0.91 Intubation at accident site: n (%) IG: 28 (41.2) vs. 28 (41.2), p=1.0 Days intubated: mean ± SD IG: 6.94 (8.79) vs. CG: 8.37 (10.38), p=0.5 Organ failure (%) IG: 56.5 vs. CG: 67.4, p=0.283 Multiple organ failure reported data unclear (no statistically significant difference between groups) RISC (revised injury severity classification) prognosis: n (%) IG: 10.44 (17.72) vs. CG: 13.85 (18.69), p=0.089 Days of hospitalization: mean ± SD IG: 31.37 (28.19) vs. CG: 31.79 (27.71), p=0.99	Detection bias: + **Authors' conclusion** "… aggressive volume replacement may lead by trend to increased mortality and could be related to early traumatic coagulopathy. The results of this study show that permissive hypotension and limited volume replacement during rescue have a positive impact on patients suffering from trauma and severe bleeding." **Reviewers' conclusion** The results of the study need to be interpreted with caution due to small group sizes and unclear performance bias. (CAVE: overlapping population with Leenen 2014)
Hussmann (2019)	**Inclusion criteria**	**Participants**	**Outcomes after matching**	**Level of evidence**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"Enhanced prehospital volume therapy does not lead to improved outcomes in severely injured patients with severe traumatic brain injury ". *BMC Emergency Medicine* 2019, 19(13): 1-9 **Study design** Comparative registry study (TraumaRegister DGU®) **Aim of the study** The aim of this study was to investigate the influence of prehospital volume therapy on the clinical course of severely injured patients with severe traumatic brain injury (TBI). **Setting** Germany and Austria, 2002-2012	• patients from Germany and Austria; all of the patients were attended by a physician before hospital admission • Primary admission to the hospital (no transfers) • Injury Severity Score (ISS) ≥16 • Age ≥16 years • Abbreviated Injury Scale (AIS) head ≥3 • Infusion of at least one unit of packed red blood cells (pRBCs) • Data available for prehospital administered fluid volume, hemoglobin concentration on hospital admission, and blood pressure at the accident site • and at the time of hospital admission **Characteristics** <u>Age strata [y] (% in each group):</u> 16-54: 76.9 55-69: 8.3 ≥70: 14.8 <u>Male gender (% in each group)</u> 82.2 <u>Glasgow Coma Scale (mean ±SD)</u> IG: 6.6 ± 4.2 CG:5.8 ± 3.8 (p=0.11) <u>Glasgow Coma Scale ≤8 (%§)</u> IG: 70.1 CG: 78.0 (p=0.10) <u>Injury Severity Score (ISS), mean ± SD</u> IG: 41.4 ± 13.7 CG: 42.3 ± 13.6 (p=0.37)	N=338 patients **Study groups** IG: "Low-volume"- group: ≤1000 mL (N=169) CG: "High-volume"-group: ≥1501 mL (N=169) prehospital administered fluid volume (crystalloids plus colloids) **Matching criteria** • AIS head 3, 4 and 5 inclusive 6 • Pattern of injury for the following three body regions: thorax, abdomen, and extremities, including the pelvis, where the matching criteria were AIS severity ≥3 points or <3 points; the AIS head score had to be greater than that in the other body regions • To account for treatment changes that may have been established over the years, the date of injury was divided into three groups: (1) 2002-2005, (2) 2006-2009, (3) 2010-2012. • Systolic blood pressure at the accident site had to be at least 20 mmHg and was subdivided into three groups with the following values: (1) 20-60 mmHg, (2) 61-90 mmHg and (3) ≥91 mmHg • Age categories were divided into three subgroups: (1) 16-54 years, (2) 55-69 years and (3) ≥70 years. • Intubation (yes/no) • Method of rescue transport (air vs. ground transport)	<u>Emergency surgery (%§):</u> IG: 6.2 vs. CG: 6.8 (p=1.0) <u>ICU stay (days): mean ± SD</u> IG: 16.2 (16.3) vs. CG: 14.5 (14.4) (p=0.4) <u>Days intubated, mean ± SD</u> IG: 11.9 (14.4) vs. CG: 11.4 (12.3) (p=0.97) <u>Organ failure (%§):</u> IG: 77.1 vs. CG: 83.8 (p=0.21) <u>Multi-organ failure (%§):</u> IG: 61.1 vs. CG: 67.7 (p=0.3) <u>Sepsis (%§):</u> IG: 13.5 vs. CG: 9.3 (p=0.33) <u>Died in hospital (%§):</u> IG: 45.6 vs. CG: 45.6 (p=1.0) <u>Glasgow Outcome Scale (%§):</u> dead: IG: 46.1 vs. CG: 47.0 (p=0.7) apallic: IG: 9.0 vs. 7.9 (p=0.7) strongly handicapped: IG: 17.4 vs. CG: 22.6 (p=0.7) mildly handicapped: IG: 17.4 vs. CG: 12.8 (p=0.7) recovered well: IG: 10.2 vs. CG: 9.8 (p=0.7) § N=number of patients with event not reported	2b **Risk of bias** Selection bias: ? Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "The present study does not support aggressive volume replacement after trauma and bleeding in patients with severe TBI. There were no improvements of outcome or mortality due to increased prehospital volume administration. On the contrary, coagulation was worsened." **Reviewers' conclusion** The results of the study need to be interpreted with caution due to small group sizes and unclear performance bias.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	New Injury Severity Score (NISS), mean ± SD IG: 51.1 ± 14.8 CG:51.9 ± 14.4 (p=0.64) BP at accident site [mmHg], mean ± SD IG: 121 ± 30 CG: 116 ± 26 (p=0.09) § N=number of patients with event not reported	• Time from injury to hospital ±30 min (differences in the time from injury to hospital admission in matched patients did not exceed 10 min) • Gender (male/female). **Fluid administration, group specific data** Fluid volume, prehospital [mL], mean ± SD IG: 808 ± 293.5 CG: 2098 ± 818 Fluid volume, ED [mL], mean ± SD IG: 3536 ± 2615 CG: 3116 ± 2232, p=0.12		
Hußmann (2015) "Prehospital Volume Therapy as an Independent Risk Factor after Trauma". *Biomed Res Int* 2015; 2015: 354367. **Study design** Comparative registry study (TraumaRegister DGU®) **Aim of the study** "The hypothesis of this study was that extensive prehospital volume replacement has a negative impact on patient mortality and represents an independent risk factor."	**Inclusion criteria** • Primary admission to the hospital (no transfers). • Injury Severity Score (ISS) ≥16. • Age ≥16 years. • Data available for prehospital and hospital volume therapy, GCS, hemoglobin concentration, base excess, one coagulation parameter (e.g., prothrombin time), blood pressure at the accident site, blunt trauma, therapeutic measures (resuscitation, intubation, insertion of chest tube), and prehospital time. **Characteristics** Male (%) IG1: 69.9 IG2: 72.1 IG3: 71.4	**Participants** N=7641 patients **Study groups** IG1: 0–500 mL of prehospital volume therapy (N=1597) IG2: 501–1000 mL (N=2047) IG3: 1001–1500 mL (N=1530) IG4: 1501–2000 mL (N=1161) IG5: ≥2001 mL (N=1306)	**Overall mortality, OR (95% CI)**§ Full patient set IG1: Reference IG2: 0.91 (0.73–1.14) IG3: 0.91 (0.71–1.12) IG4: 1.10 (0.79–1.35) IG5: 1.34 (1.02–1.73) Patients *without* severe TBI IG1: Reference IG2: 1.44 (0.89–2.35) IG3: 1.77 (1.08–2.92) IG4: 2.24 (1.32–3.80) IG5: 2.71 (1.62–4.52) Patients *with* severe TBI IG1: Reference IG2: 0.79 (0.61–1.04) IG3: 0.71 (0.52–0.94) IG4: 0.82 (0.56–1.07) IG5: 1.12 (0.72–1.39)	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion** "Prehospital volume therapy in patients without severe traumatic brain injury represents an independent risk factor for mortality. In such cases, respiratory and circulatory conditions should be stabilized and permissive hypotension should be accepted, and

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Setting Germany and Austria, 2002-2010	IG4: 74.2 IG5: 76.9, p<0.001 Age [y], mean ± SD IG1: 52.6 ± 20.3 IG2: 46.3 ± 19.7 IG3: 43.4 ± 19.1 IG4: 40.1 ± 18.1 IG5: 39.9 ± 17.3, p<0.001 ISS, mean ± SD IG1: 26.8 ± 10.9 IG2: 28.6 ± 12 IG3: 30.1 ± 12.2 IG4: 31.5 ± 13.3 IG5: 33.2 ± 13.4, p<0.001		$ Stepwise multivariate regression analysis; included variables: prehospital volume replacement, in-hospital volume replacement, age, Revised Trauma Score, blood pressure at the accident site, ISS, New- ISS, AIS (head, thorax, abdomen, and extremities, including pelvis), blunt trauma, penetrating trauma, resuscitation at the accident site, time from accident to hospital admission, prehospital intubation, prehospital chest tube, base excess at admission, hemoglobin concentration at admission, cause of accident, prothrombin time in hospital, and prehospital catecholamines.	patient transfer should not be delayed. In patients with severe traumatic brain injury, modest prehospital volume therapy can have protective effects." **Reviewers' conclusion** There is a substantial risk of selection and performance bias (due to imbalance of risk factors and co-interventions), partially mitigated by the chosen analysis.
Leenen (2014) "Limited volume resuscitation in hypotensive elderly multiple trauma is safe and prevents early clinical dilutive coagulopathy–A matched pair analysis from TraumaRegister DGU®." *Injury* 2014, 45: S59-S63. **Study design** Comparative registry study (TraumaRegister DGU®) **Aim of the study** "The aim of the study was to examine whether preclinical administration of	**Inclusion criteria** • Primary admission to the hospital (no transfers). • Injury Severity Score (ISS) ≥16. • Age ≥60 years. • Abbreviated Injury Scale Head ≤3. • Systolic blood pressure at the accident site between 60 and 100 mmHg. • Data available for prehospitally administered fluid volume, haemoglobin concentration on hospital admission and blood pressure at the accident site and upon hospital admission. **Characteristics** Age [y], mean ± SD IG: 70.9 ± 7.7 vs. CG 70.5 ± 7.8, p=0.173 Gender male n (%)	**Participants** N=352 patients after matching **Study groups** IG: 0-1000 ml prehospitally administered fluid volume [crystalloids plus colloids] (N=176) CG: >1000 ml prehospitally administered fluid volume [crystalloids plus colloids] (N=176) **Matching criteria** • Pattern of injury for the following five body regions: head, thorax, abdomen, face, and extremities, including the pelvis, where matching criteria were Abbreviated Injury Scale (AIS) • severity ≥3 points.	Days in hospital, mean ± SD IG: 27.6 ± 27.4 vs. CG 30.4 ± 29.1, p=0.368 ICU days, mean ± SD IG: 13.2 ± 14.3 vs.C: 16.2 ± 19.2, p=0.096 Days intubated, mean ± SD IG: 8.7 ± 11.8 vs. CG: 11.0 ± 15.9, p=0.119 Mortality, n (%) IG: 52 ± 29.5 vs. CG: 54 ± 30.7, p=0.890 Incidence of MOF, % IG: 41.2 vs. CG: 35.9, p=0.708	**Level of evidence** 2b **Risk of bias** Selection bias: ? Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "In spite of some limitations such as low number of matched pairs, we draw the cautious conclusion that a restrictive preclinical volume therapy is safe and also indicated in elderly patients."

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
restrictive volume therapy in the elderly patient can be safe." **Setting** Hospitals primarily located in Germany (90%), data from hospitals of other countries (Austria, Belgium, China, Finland, Luxembourg, Slovenia, Switzerland, The Netherlands, and the United Arab Emirates); timeframe n.r.	IG: 118 (67) vs. CG 118 (67) ISS, mean ± SD IG: 27.9 ± 9.4 vs. CG: 28.2 ± 9.9, p=0.395 GCS, mean ± SD IG: 12.2 ± 3.8 vs. IG: 12.4 ± 3.6, p=0.254 GCS <8, n (%) IG: 28 (15.9) vs. CG: 28 (15.9) Prehospital fluid volume [ml], mean ± SD IG: 808.6 ± 241.1, CG: 1871.8 ± 570.7	• Total ISS groups were matched with the following range: (1) 16–24; (2) 25–34; (3) 35–49; (4) ≥50. • Systolic blood pressure at the accident site had to be between 60 and 100 mmHg and was subdivided into two groups that matched the following values: (1) 60–89 mmHg and (2) 90–100 mmHg. • Ground or air transport. • Gender. • Intubation (yes/no) • Glasgow Coma Scale (GCS). • Percentage (%) of patient with GCS <8. • Number of preclinical procedures (intubation, venous access, sedation, reanimation, vasopressor support).		**Reviewers' conclusion** In agreement with the authors' conclusion the results of the study need to be interpreted with caution. (CAVE: overlapping population with Heuer 2015)
Schreiber (2015) "A controlled resuscitation strategy is feasible and safe in hypotensive trauma patients: results of a prospective randomized pilot trial". *The Journal of Trauma and Acute Care Surgery*; 78(4):687-95; discussion 95-7 **Study design** Randomised controlled trial **Aim of the study** to assess the feasibility and safety of controlled resuscitation (CR) for the	**Inclusion criteria** • Blunt or penetrating trauma • ≥15 years or estimated ≥50 kg if age was unknown • out-of hospital SBP ≤90 mmHg • absence of evidence of a severe head injury or a Glasgow Coma Scale score >8 **Exclusion criteria** • receipt of >250 cc of fluid prior to randomization • out-of-hospital cardiopulmonary resuscitation by EMS • drowning or asphyxia due to hanging • burns >20% total body surface area • time of call received at dispatch to study intervention >4 hours • prisoner status	**Participants** N=292 patients **Study groups** IG: **c**ontrolled **r**esuscitation (N=97) 2x 250 cc bags of normal saline and 500 cc bottle of water, patients received 250 cc bolus of fluid only if their SBP was <70mmHg or they had no palpable radial pulse. These patients received additional 250 cc boluses to maintain a SBP of 70 mmHg or a palpable pulse as needed. If the patient had a SBP 70 mmHg and/or a palpable pulse, fluid was administered only to keep the vein open CG: **s**tandard **r**esuscitation (N=95)	**Primary feasibility endpoint** Early crystalloid volume, adjusted difference of the means (95% CI)[1] **Overall:** *CG vs. IG* 0.92 (0.54 to 1.31) **ISS >15:** 0 *CG vs. IG*.64 (−0.35 to 1.64) **Blunt trauma**: *CG vs. IG* 0.84 (0.48 to 1.21) **Penetrating trauma**: *CG vs. IG* 1.27 (0.35 to 2.20) [1]adjusting variables: regional site, age, penetrating mechanism, ISS **Safety endpoints** 24-h mortality n/N (%) IG: 5/96 (5.2) vs. CG: 14/95 (14.7) Adj. OR (95% CI)[2]: 0.39 (0.12-1.25)	**Level of evidence** 2b↓ **Risk of bias** Selection bias: + Performance bias: – Attrition bias: + Detection bias: ? **Authors' conclusion** "Controlled resuscitation is feasible and safe for the initial resuscitation of hypotensive trauma patients. (…) Despite the smaller volume of fluid delivered, there were no clinically rel-

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
early resuscitation of patients with traumatic shock due to blunt or penetrating mechanisms. **Setting** USA & Canada, 2012-2013	• evidence of pregnancy • ground level falls (added during the study) • bilateral paralysis (added during the study) CAVE: no other inclusion criteria than SBP ≤90 mmHg for shock, therefore the majority of the population has an ISS<15 **Characteristics** Age, years, mean ± SD IG: 41.9 ± 20.2 CG: 41.8 ± 19.2 Male sex, n (%) IG: 72 (75.0) CG: 74 (77.9) ISS, median (IQR) IG: 9.5 (1.8-19.2) CG: 9 (2-24.2) ISS>15, n (%) IG: 33 (34.4) CG: 32 (34.0) Initial SBP, median (IQR), mmHg IG: 81.5 (72-92) CG: 84 (74.5-94)	1000 cc bag of normal saline; 2 liters of fluid as an initial bolus. Following the initial bolus, additional fluid was given as needed to maintain a SBP of 110 mmHg Study period: out-of-hospital enrollment until two hours into the hospital stay or until hemorrhage control was achieved	[2]adjusting variables: age, penetrating mechanism, ISS Systolic blood pressure [mmHg] at admission: mean ± SD IG: 98.7 ± 32.5 vs. CG: 105.0 ± 34.1 Heart rate [beats/m] at admission: mean ± SD IG: 92.9 ± 26.1 vs. CG: 86.9 ± 24.7 Glasgow Coma Scale at admission: mean ± SD IG: 13.1 ± 3.7 vs. CG: 13.0 ± 3.8 Hemoglobin [g/dL] at admission: mean ± SD IG: 12.3 ± 2.3 vs. CG: 12.6 ± 2.1 Prothrombin time [s] at admission: mean ± SD IG: 14.0 ± 2.9 vs. CG: 14.4 ± 2.7 Partial thromboplastin time [s] at admission: mean ± SD IG: 27.4 ± 8.5 vs. CG: 32.0 ± 25.0 INR at admission: mean ± SD IG: 1.16 ± 0.25 vs. CG: 1.18 ± 0.26 Platelets [10^9/L] at admission: mean ± SD IG: 239.9 ± 82.4 vs. CG: 219.5 ± 61.8 Base deficit [mmol/L] at admission: mean ± SD IG: 6.2 ± 5.7 vs. 6.4 ± 5.2 ICU free days at 28 days: mean ± SD IG: 23.6 ± 9.8 vs. CG: 23.0 ± 10.7 Days out of hospital at 28 days: mean ± SD IG: 18.5 ± 10.5 vs. 18.6 ± 10.3	evant differences in admission vital signs, GCS, hematologic labs or base deficit." **Reviewers' conclusion** The study was powered for the primary feasibility endpoint, early crystalloid volume (ECV), but had little power to detect all but large differences in survival. There is a risk for performance bias since the care teams were not blinded to the interventions once patients were randomized. A large proportion of patients discontinued the intervention in both groups (20%).

Infusionslösungen

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Rowell (2016) "The impact of pre-hospital administration of lactated Ringer's solution versus normal saline in patients with traumatic brain injury". *Journal of Neurotrauma*; 33(11): 1054-1059. **Study design** secondary analysis of a prospective cohort study (PROMMTT) **Aim of the study** The purpose of this study was to compare the effects of pre-hospital administration of lactated Ringer's (LR) and normal saline (NS) on outcomes in patients with and without significant traumatic brain injury (TBI). **Setting** USA, date n.r.	**Inclusion criteria** • patients who required the highest level activation at one of 10 level 1 trauma centers • subsequently received one or more units of red blood cells (RBC) within 6 hours of hospital admission **Exclusion criteria** • age <16 years • transfer from another hospital • pregnancy • >20% burn injury • inhalation injury • incarceration • death within 30 minutes of hospital admission • received any other type of fluid or blood products and those who received both LR and NS • Patients receiving a small volume of pre-hospital fluid (<200 mL) and those with minor injuries (ISS <9) **Characteristics** <u>Injury Severity Score, median</u> **AIS_{head} ≥3** IG: 42 (32-57) vs. CG 34 (26-43), p<0.001 **AIS_{head} <3** IG: 26 (17–35) vs. CG 19 (13–29), p<0.001 <u>Abbreviated Injury Scale head, median</u> **AIS_{head} ≥3** IG: 5 (4-5) vs. CG 4 (3-5), p<0.001	**Participants** N=308 patients with TBI N=483 patients without TBI **Study groups** IG: lactated Ringer's (**AIS_{head} ≥3** N=52, **AIS_{head} <3** N=65) CG: normal saline (**AIS_{head} ≥3** N=256, **AIS_{head} <3** N=418)	<u>Overall mortality at 30 days: n (%), adjusted</u> **AIS_{head} ≥3** IG vs. CG: HR 1.78, CI 1.04–3.04, p=0.035 **AIS_{head} <3** IG vs. CG: HR 1.49, CI 0.757–2.95, p=0.247 <u>Overall mortality at 30 days: (%), unadjusted</u> **AIS_{head} ≥3** IG: 50 vs. CG: 28 **AIS_{head} <3** IG: 25 vs. CG: 11 **Secondary outcomes for patients with AIS_{head} ≥3§** <u>Systolic blood pressure [mmHg]*</u> **AIS_{head} ≥3** IG: 120 ± 32 vs. CG: 107 ± 29, p=0.264 **AIS_{head} <3** IG: 118 ± 28 vs. CG: 104 ± 28, p=0.271 <u>Heart rate*</u> **AIS_{head} ≥3** IG: 105 ± 30 vs. CG: 103 ± 28, p=0.827 **AIS_{head} <3** IG: 112 ± 26 vs. CG: 107 ± 2827, p=0.392 <u>INR</u> **AIS_{head} ≥3** IG: 1.9 ± 1.7 vs. CG: 1.4 ± 1.1, p=0.559 **AIS_{head} <3** IG: 1.6 ± 0.7 vs. CG: 1.4 ± 1.3, p=0.976 Base deficit **AIS_{head} ≥3** IG: 6.5 ± 5.0 vs. CG: 7.3 ± 5.7, p=0.406 **AIS_{head} <3** IG: 7.7 ± 6.1 vs. CG: 7.0 ± 5.4, p=0.401 <u>pH</u> **AIS_{head} ≥3** IG: 7.26 ± 0.14 vs. CG: 7.24 ± 0.14, p=0.142 **AIS_{head} <3** IG: 7.24 ± 0.17 vs. CG: 7.25 ± 0.13, p=0.921	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: – Attrition bias: + Detection bias: ? **Authors' conclusion** "Administration of pre-hospital LR was associated with increased adjusted mortality compared with NS in patients with significant TBI. These findings justify the need for a randomized clinical trial comparing pre-hospital administration of LR and NS in patients with TBI." **Reviewers' conclusion** The intervention and control groups were not balanced with respect to several important baseline characteristics and co-interventions. However, the analyses were adjusted for this imbalance.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	AIS_{head} <3 IG: 0 (0–1) vs. CG 0 (0–0), p<0.001 Age [y], mean ± SD **AIS_{head} ≥3** IG: 45.2 ± 20.8 vs. IG 42.8 ± 18.4, p=0.453 **AIS_{head} <3** IG: 41.1 ± 20.1 vs. CG 38.8 ± 17.8, p=0.492 Male n (%) **AIS_{head} ≥3** IG: 34 (65.4) vs. CG 184 (71.9), p=0.348 **AIS_{head} <3** IG: 73.8 vs. CG 77.3, p=0.543 Mechanism blunt (%) **AIS_{head} ≥3** IG: 44 (84.6) vs. CG: 215 (84.0), p=0.509 **AIS_{head} <3** IG: 56.9 vs. CG 56.5, p=0.944 Mechanism penetrating n (%) **AIS_{head} ≥3** IG: 8 (15.4) vs. CG: 41 (16.0) **AIS_{head} <3** IG: 43.1 vs. CG 43.5, p – Prehospital intubation n (%) **AIS_{head} ≥3** IG: 56 (92.3) vs. CG: 146 (57), p<0.001 **AIS_{head} <3** IG: 70.8 vs. CG 20.7, p<0.001 Prehospital transport time (min), mean ± SD **AIS_{head} ≥3** IG: 57 ± 21 vs. CG: 69±62, p=0.599 **AIS_{head} <3** IG: 57 ± 34 vs. CG 51 ± 29, p=0.283 Prehospital fluid volume (ml), mean ± SD **AIS_{head} ≥3** IG: 1540 ± 1030 vs. CG: 970 ± 770, p<0.001		Hemoglobin (g/dL) **AIS_{head} ≥3** IG: 10.5 ± 2.6 vs. CG: 11.7 ± 2.1, p=0.113 **AIS_{head} <3** IG: 10.5 ± 2.8 vs. CG: 11.6 ± 2.2, p=0.998 Lactate (mEq/L) **AIS_{head} ≥3** IG: 5.7 ± 3.5 vs. CG: 4.5 ± 2.8, p=0.753 **AIS_{head} <3** IG: 4.8 ± 3.0 vs. CG: 7.1 ± 4.9, p=0.100 6-h fluid requirement (L) **AIS_{head} ≥3** IG: 5.4 ± 2.9 vs. CG: 3.8 ± 3.1, p=0.256 **AIS_{head} <3** IG: 6.7 ± 4.1 vs. CG: 4.1 ± 3.3, p=0.368 6-h RBC requirement (units) **AIS_{head} ≥3** IG: 4.5 ± 3.7 vs. CG: 5.8 ± 7.0, p=0.161 **AIS_{head} <3** IG: 8.3 ± 8.7 vs. CG: 7.3 ± 9.7, p=0.287 § mean ± SD ? (not reported) *SBP and HR: Initial value measured on arrival to the emergency department	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	AIS_{head} <3 IG: 1520 ± 1280 vs. CG 890 ± 650, p<0.001			

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Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Delano (2015) "Prehospital resuscitation of traumatic hemorrhagic shock with hypertonic solutions worsens hypocoagulation and hyperfibrinolysis." *Shock* 44(1): 25. **Study design** *a priori* subgroup analysis of a randomized controlled, trial (Bulger 2011) **Aim of the study** "This study explores the impact of resuscitation with various hypertonic solutions on early coagulopathy after trauma. As part of a larger prospective clinical trial evaluating prehospital resuscitation of severely injured trauma patients in hypovolemic shock, the aim of this ancillary laboratory study was to determine the impact of a single-bolus (250 mL) infusion of hypertonic	**Inclusion criteria** • patients in hypovolemic shock enrolled in two centers (Toronto and Seattle) • had additional laboratory tests done during the initial 24 h of hospitalization. • hypovolemic shock defined as out-of-hospital systolic blood pressure (SBP) of 70 mmHg or less or SBP 71 to 90 mmHg with a heart rate of 108 beats/min or more. **Exclusion criteria** • pregnancy, • younger than 15 years, • more than 2,000 mL of intravenous fluids or blood before enrollment, • hypothermia (<28°C), • drowning, • asphyxia, • burns, • isolated penetrating head injury, • time of call received by dispatch to study intervention longer than 4 h, • known prisoners, • and transfer from another hospital **Characteristics**	**Participants** N=34 patients **Study groups** IG1: out-of-hospital single bolus of 250 mL of 7.5% hypertonic saline (HS) (N=9) IG2: out-of-hospital single bolus of 250 mL of 7.5% hypertonic saline/6% Dextran 70 (HSD) (N=8) CG: out-of-hospital single bolus of 250 mL of standard 0.9% normal saline(NS) (N=17) **Co-interventions** Additional fluids were allowed after study fluid, as guided by local protocols	Admission SBP, mmHg mean ± SD IG1: 141 (30.7) vs. CG 112.1 (26.8), p<0.05 IG2: 126 (24.6) vs. CG 112.1 (26.8), not significant **Admission biochemistry and coagulation** Base deficit, mEq/L, mean (SEM) IG1: −9.2 (5.6) vs. CG: −9.4 (6.7), not significant IG2: −13.1 (12.2) vs. CG: −9.4 (6.7), not significant Lactate, mmol/l, mean (SEM) IG1: 5.3 (3.5) vs. CG: 5.3 (4.3), not significant IG2: 4.8 (1.1) vs. CG: 5.3 (4.3), not significant International normalized ratio (INR), mean (SEM) IG1: 1.3 (0.3) vs. CG: 1.2 (0.1), not significant IG2:1.6 (1.2) vs. CG: 1.2 (0.1), not significant Coagulopathic, n (%) IG1: 5 (55.6) vs. CG: 8 (47.1), not significant IG2: 5 (62.5) vs. CG: 8 (47.1), not significant INR ≥1.3, n (%) IG1: 3 (33.3) vs. CG: 7 (41.2), not significant IG2: 4 (50.0) vs. CG: 7 (41.2), not significant **Coagulation marker at admission** Thrombin-antithrombin complex (TAT) [1–4 ng/mL], mean (SEM)	**Level of evidence** 2b↓ **Risk of bias** Selection bias: ? Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "In conclusion, hypertonic solutions, particularly when combined with Dextran, seem to worsen the hypocoagulability and hyperfibrinolysis that occur after hemorrhagic shock in the cohort of trauma patients evaluated in our study. Although HS and HSD increased the SBP above that of NS, they may not have corrected the shock because acidosis persisted despite the BP normalization."

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
fluids on the risk of acute traumatic coagulopathy." **Setting** USA, Canada	Age, years mean ± SD IG1: 43.2 (22.8) IG2: 42.9 (18.5) CG: 42 (21) Male sex, n (%) IG1: 8 (88.9) IG2: 5 (62.5) CG:12 (70.6) ISS, mean ± SD IG1: 24.5 (16.8) IG2: 21.3 (9) CG: 21.2 (10.6)		IG1: 27.2 (1.9) vs. IG2: 14.6 (2.1), not significant IG1: 27.2 (1.9) vs. CG: 39.6 (3.1), not significant IG2: 14.6 (2.1 vs. CG: 39.6 (3.1), p<0.05 All groups vs. age-matched healthy controls p<0.05 Tissue factor (TF) [ND], mean (SEM) IG1: 109.6 (14.2) vs. IG2: 70.3 (10.4), not significant IG1: 109.6 (14.2) vs. CG: 192.6 (29), not significant IG2: 70.3 (10.4) vs. CG: 192.6 (29), p<0.05 IG2 vs. age-matched healthy controls p<0.05 Tissue factor pathway inhibitor [7.5–41.2 ng/mL], mean (SEM) IG1: 24.6 (3.1) vs. IG2: 28.8 (3.7), not significant IG1: 24.6 (3.1) vs. CG: 22.1 (2.5), not significant IG2: 28.8 (3.7) vs. CG: 22.1 (2.5), not significant IG2 vs. age-matched healthy controls p<0.05 Thrombomodulin [2.7–5.4 ng/mL], mean (SEM) IG1: 4.8 (0.6) vs. IG2: 5.2 (0.9), not significant IG1: 4.8 (0.6) vs. CG: 6.5 (1.2) , not significant IG2: 5.2 (0.9) vs. CG: 6.5 (1.2), not significant **Fibrinolysis marker at admission** Tissue plasminogen activator (tPA) [3–12 ng/mL], mean (SEM) IG1: 19.7 (2.5) vs. IG2: 25.2 (3.1), not significant IG1: 19.7 (2.5) vs. CG: 15.4 (1.9), not significant IG2: 25.2 (3.1) vs. CG: 15.4 (1.9), p<0.05 All groups vs. age-matched healthy controls p<0.05 Plasminogen activator inhibitor type 1 (PAI-1) [4–40 ng/mL] mean (SEM)	**Reviewers' conclusion** Small group sizes may limit the interpretation of the results. Surrogate outcomes are reported, but no patient-relevant outcomes.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			IG1: 38.7 (4.1) vs. IG2: 19.6 (3.4), not significant IG1: 38.7 (4.1) vs. CG: 46.3 (6.5), not significant IG2: 19.6 (3.4) vs. CG: 46.3 (6.5), p<0.05 All groups vs. age-matched healthy controls p<0.05 <u>Thrombin-activatable fibrinolysis inhibitor (TAFI) [40%–250%], mean (SEM)</u> IG1: 95.2 (10.2) vs. IG2: 80.5 (11.4), not significant IG1: 95.2 (10.2) vs. CG: 104.6 (6.3), not significant IG2: 80.5 (11.4) vs. CG: 104.6 (6.3), p<0.05 IG2 vs. age-matched healthy controls p<0.05 <u>D-dimer [0–400 ng/mL], mean (SEM)</u> IG1: 8.023 (1.205) vs. IG2: 10.786 (1.359), p<0.05 IG1: 8.023 (1.205) vs. CG: 6.375 (997), p<0.05 IG2: 10.786 (.,359) vs. CG: 6,375 (997), p<0.05 All groups vs. age-matched healthy controls p<0.05	
Han (2015) "Comparison of 3% And 7.5% Hypertonic Saline in Resuscitation after Traumatic Hypovolemic Shock". *Shock* 43(3), 244-249 **Study design** Randomised controlled trial **Aim of the study** The aim of this study was to evaluate the resuscitative effects and safety of	**Inclusion criteria** • trauma victims • prehospital systolic blood pressure (SBP) of ≤70 mmHg • or SBP 70 to 90 mmHg and heart rate (HR) ≥108 beats/min • aged 15 years or older **Exclusion criteria** • younger than 15 years • injury during previous 4 h • hypothermia (<28°C) • administration of dopamine or other vasoactive agents • administration of more than 2,000 mL of crystalloid before the study fluid	**Patients** N=246 patients **Study groups** IG1: 3% HSS (Hypertonic saline solution) (N=82) IG2: 7.5% HSS (Hypertonic saline solution) (N=80) CG: LRS (standard fluid, Lactated Ringer's solution) (N=84)	<u>Mortality, n (%)</u> Total deaths: 37 (15.4) Deaths within first 24 h: 30 (81.1) 24-h survival in IG1 and IG2 better than CG, but no statistically significant difference **Postinfusion complications, n (%)** <u>Tachycardia</u> IG1: 5 (6.1) IG2: 22 (27.5) (vs. IG1 and CG, p<0.05) CG: 4 (4.8) <u>Coagulopathy</u>	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: + Attrition bias: ? Detection bias: ? **Authors' conclusion** "In summary, administration of 3% HSS offered hemodynamic benefits equivalent to those of 7.5% HSS

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
3% Hypertonic saline solution (HSS) and to compare the risks of complications caused by HSS and standard fluid treatments. **Setting** China, 2008-2012	• ongoing cardiopulmonary resuscitation • severe cardio-respiratory dysfunction • known or suspected pregnancy • traumatic brain injury (TBI) • death within 1 h after intervention **Characteristics** Age, years (mean ± SD) IG1: 45 ± 0.5 IG2: 48 ± 3.1 CG: 43 ± 9.5 Sex (male, n (%)) IG1: 61 (74.4) IG2: 65 (81.3) CG: 63 (75.0) ISS (mean ± SD) IG1: 18.5 ± 2.5 IG2: 15.6 ± 3.1 CG: 16.5 ± 3.4 Shock index (mean ± SD) IG1: 1.5 ± 0.2 IG2: 1.6 ± 0.3 CG: 1.5 ± 0.2 Preinfusion MAP, mmHg (mean ± SD) IG1: 49 ± 6.6 IG2: 51 ± 9.7 CG: 52 ± 4.7 Infusion volume, 1 h, L (mean ± SD) IG1: 1.1 ± 0.2 IG2: 1.0 ± 0.2 CG: 2.1 ± 0.3 (CG vs. IG1 and IG2, p<0.05)		IG1: 0 IG2: 2 (2.5) CG: 9 (10.7) (vs. IG1 and IG2, p<0.001) Acute renal failure IG1: 0 IG2: 0 CG: 5 (6.0) (vs. IG1 and IG2, p<0.001) Pulmonary edema IG1: 0 IG2: 0 CG: 4 (4.8) vs. IG1 and IG2, p<0.001) Heart failure IG1: 1 (1.2) IG2: 1 (1.3) CG: 2 (2.4) Transient Hypotension IG1: 0 IG2: 4 (5.0) (vs. IG1 and CG p<0.05) CG: 0 ARDS IG1: 1 (1.2) IG2: 1 (1.3) CG: 3 (3.6) MODS IG1: 2 (2.4) IG2: 1 (1.3) CG: 3 (3.6)	infusion with lower degrees of hypernatremia and hyperchloremia and lower risks of cardiac dysrhythmia and transient hypotension. In addition, higher incidences of pulmonary edema, renal failure, and coagulopathy occurred in the LRS group." **Reviewers' conclusion** There might be a risk of attrition bias as information regarding length of follow-up regarding adverse events and the availability of outcome data are lacking.

Prähospitale Transfusion

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Brown (2015) "Pretrauma Center Red Blood Cell Transfusion Is Associated With Reduced Mortality and Coagulopathy in Severely Injured Patients With Blunt Trauma". *Annals of Surgery* 261(5): 997–1005. **Study design** Secondary analysis of a prospective cohort study (Host Response to Injury Collaborative) **Aim of the study** The aim of the study was to evaluate the association of PTC RBC (Pretrauma Center Red Blood Cell) transfusion with mortality and trauma-induced coagulopathy (TIC) in severely injured patients with blunt trauma **Setting** United States, 2003-2010	**Inclusion criteria** • Blunt injured patients in shock • Arriving at the study trauma center within 2 hours of injury **Characteristics (matched cohort)** Age (median, IQR) IG: 36 (28 - 52) CG: 37 (24 - 55) (p=0.63) Sex (male, %) IG: 60 CG: 72 (p=0.28) ISS (median, IQR) IG: 34 (18 - 43) CG: 30 (23 - 43) (p=0.81) Initial haemoglobin [g/dL], median, IQR) IG: 11.0 (8.8 - 13) CG: 11.1 (9.3 - 12.6) (p=0.90) PTC hypotension§ (%) IG: 71 CG: 53 (p=0.14) Admission hypotension§ (%) IG: 60 CG: 74 (p=0.02) 24-h RBC trauma center [units], median (IQR) IG: 14.0 (7.0 - 21.7) CG: 8.3 (3.4 - 18.5) (p=0.03)	**Participants** N=113 patients, 3:1 matching **Study groups** IG: PTC RBC (N=35) transfusion of RBCs at any time before the subject's arrival at the study trauma center CG: No PTC RBC (N=78)	Mortality: 24-hour mortality PTC RBC is independently associated with a 98% reduction in odds of 24-hour mortality: OR = 0.02; 95% CI, 0.01 - 0.69 (p=0.04) 30-day mortality: PTC RBC is independently associated with a 88% reduction in the risk of 30-day-mortality: HR = 0.12; 95% CI, 0.03 - 0.61 (p=0.01) Trauma-Induced Coagulopathy (TIC): PTC RBC is independently associated with a 99% reduction in odds of TIC: OR = 0.01; 95% CI, 0.01 - 0.95 (p=0.05) CAVE: Results regarding the matched cohort only	**Level of evidence** 3b↓ **Risk of bias** Selection bias: ? Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "PTC RBC administration was associated with a lower risk of 24-hour mortality, 30-day mortality, and TIC in severely injured patients with blunt trauma, warranting further prospective study." **Reviewers' conclusion** The analysis has some limitations as the original cohort study was not designed to address the specific question. There might be a performance bias as pretrauma center care was not standardized.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	§ N=number of patients with event not reported			
Gruen (2020) "Association of Prehospital Plasma With Survival in Patients With Traumatic Brain Injury A Secondary Analysis of the PAMPer Cluster Randomized Clinical Trial". *JAMA Network Open* 3(10), 1-15. **Study design** Predefined subgroup analysis of a randomised controlled trial (PAMPer trial) **Aim of the study** The aim of the study was to characterize the survival benefit associated with prehospital plasma among patients with traumatic brain injury (TBI) using data derived from a recently completed prehospital plasma clinical trial. **Setting** United States, 2014 – 2017 (Same as in original PAMPer trial (Sperry, 2018))	**Inclusion criteria** • Same as in original PAMPer trial (Sperry, 2018, see below) • For subgroup analysis: • Patients with TBI (assessed imaging results and defined TBI as brain injury documented by CT scan. TBI was defined as any finding consistent with TBI as defined by a radiologist at initial head CT) **Exclusion criteria** • Same as in original PAMPer trial (Sperry, 2018) **Characteristics** Age [y], median (IQR) IG: 42.50 (25.25 - 60.25) CG: 44.00 (25.00 - 59.25) (p=0.80) Sex (male), n (%) IG: 50 (67.6) CG: 75 (81.5) (p=0.06) ISS, median (IQR) IG: 29 (20 - 41) CG: 29 (22 - 37) (p=0.92) Prehospital GCS <8, n (%) IG: 52 (70.3) CG: 71 (79.8) Prehospital GCS 8-12, n (%)	**Participants** N=166 TBI patients (predefined subgroup) **Study groups** IG: Plasma (2 units of thawed plasma followed by standard care fluid resuscitation) (N=74) CG: Standard Care (crystalloid or crystalloid and packed red blood cells) (N=92)	Mortality: 30-d mortality (n (%)) IG: 26 (35.1) vs. CG: 51 (55.4), p=0.01 24-hour mortality (n (%)) IG: 12 (16.2) vs. CG: 33 (35.9), p=0.008 Analysis of 30-d survival, Hazard Ratio for patients with TBI (HR, 95% CI)* IG vs. CG: HR 0.55 (0.33-0.94) (p=0.03) **Others** Multiple organ failure, n (%) IG: 57 (77.0) vs. CG: 52 (56.5), p=0.009 Intensive care unit length of stay [d], median (IQR) IG: 8 (3 - 15) vs. CG: 6 (1 - 12), p=0.04 Hospital length of stay [d], median (IQR) IG: 13 (6 - 20) vs. CG: 8 (1 - 19), p=0.05 Ventilator duration [d], median (IQR) IG: 5 (2 - 11) CG: 4 (1 - 9), p=0.12 * After adjustment for multiple confounders and assessment of the degree of brain injury with clinical variables and biomarker	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion** "Early administration of prehospital plasma to patients with TBI is associated with improved survival, particularly among those with polytrauma and risk of hemorrhagic shock. Future studies are needed to confirm the clinical benefits of early plasma resuscitation. Our results are exploratory, but the prehospital setting may be a critical time to intervene in the care of patients with TBI." **Reviewers' conclusion** There is a risk of performance bias due to lack of blinding of study staff and variability in prehospital and hospital care.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG: 7 (9.5) CG: 6 (6.7) Prehospital GCS 13-15, n (%) IG: 15 (20.3) CG: 12 (13.5) Blunt injury, (n (%) IG: 74 (100.0) CG: 92 (100.0) Crystalloid fluid, mL (median (IQR)) IG: 700.00 (0.00 - 1287.50) CG: 1000.00 (0.00 - 1500.00) (p=0.20) INR (median, IQR) IG: 1.20 (1.10 - 1.40) CG: 1.40 (1.20 - 1.80) (p=0.001)			
Guyette (2021) "Prehospital Blood Product and Crystalloid Resuscitation in the Severely Injured Patient A Secondary Analysis of the Prehospital Air Medical Plasma Trial". A*nnals of Surgery* 273(2), 358-364. **Study design** Comparative registry study: secondary analysis of a randomised controlled trial (PAMPer trial) **Aim of the study**	**Inclusion criteria** • Same as in original PAMPer trial (Sperry, 2018, see below) **Exclusion criteria** • Patients transferred from referring facilities from the originally reported trial population (excluded, as they could receive both crystalloid and blood products at the outside facility before HEMS transport and potentially bias the outcomes of the prehospital resuscitation groups) **Characteristics** Age (median, IQR) PRBC (prehospital red blood cells)+Plasma: 45 (32 - 58)	**Participants** N=407 patients **Study groups** PRBC+Plasma (N=38, 10%) Plasma (N=147, 36%) PRBC only (N=83, 20%) Crystalloid only (N=139, 34%)	30-day Mortality, n (%), unadjusted (p=0.05) PRBC+Plasma: 10 (26) Plasma: 31 (23) PRBC only: 30 (36) Crystalloid only: 47 (37) **Cause of death, unadjusted (overall p=0.18)** Hemorrhage, n (%) PRBC+Plasma: 4 (40) Plasma: 9 (29) PRBC only: 15 (50) Crystalloid only: 10 (21) Traumatic Brain Injury, n (%) PRBC+Plasma: 2 (20) Plasma: 8 (26) PRBC only: 9 (30) Crystalloid only: 17 (36)	**Level of evidence** 2b **Risk of bias** Selection bias: ? Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion** "Patients receiving prehospital PRBC+plasma had the greatest mortality benefit. Crystalloid only had the worst survival. Patients with hemorrhagic shock should receive prehospital

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
The aim of the study was to determine whether prehospital blood products reduce 30-day mortality in patients at risk for hemorrhagic shock compared with crystalloid only resuscitation. **Setting** United States, 2014 – 2017 (Same as in original PAMPer trial (Sperry, 2018))	Plasma: 43 (30 - 55) PRBC only: 40 (25 - 55) Crystalloid only: 47 (28 - 65), p=0.25 Sex (male), n (%) PRBC+Plasma: 26 (68.4) Plasma: 108 (73.5) PRBC only: 64 (77.1) Crystalloid only: 100 (71.9), p=0.75 Prehospital SBP [mmHg], median (IQR) PRBC+Plasma: 69 (61 - 82) Plasma: 72.5 (63 - 81) PRBC only: 69 (60 - 80) Crystalloid only: 72 (63 - 81), p=0.79 Prehospital GCS (median, IQR) PRBC+Plasma: 12.5 (3 - 15) Plasma: 12 (3 - 15) PRBC only: 13 (3 - 15) Crystalloid only: 7 (3 - 15), p=0.56 ISS (median, IQR) PRBC+Plasma: 24 (17 - 34) Plasma: 22 (14 - 34) PRBC only: 22 (16 - 29) Crystalloid only: 21 (12 - 33), p=0.57		Cox proportional Hazard Regression Treatment Effect Estimates (HR (95% CI)* PRBC+Plasma: 0.38 (0.26 – 0.55) (p<0.001) Plasma: 0.57 (0.36 – 0.91) (p=0.017) PRBC: 0.68 (0.49 – 0.95) (p=0.025) Crystalloid only: Reference * Adjusted for age, injury, ISS, severe prehospital hypotension (SBP <70 mm Hg), prehospital time, prehospital crystalloid volume, emergent procedure within 24hours of admission, INR, 24-hour total PRBC and plasma transfusion requirements, development of multiple organ failure, nosocomial infection, AIS for head, chest, and abdomen.	blood products when available, preferably PRBC+plasma. Prehospital whole blood may be ideal in this population." **Reviewers' conclusion** There is a risk of performance bias due to lack of blinding of study staff and variability in prehospital and hospital care. Further, as the study was not designed to address the specific question, the results should be interpreted with caution.
Henriksen (2016) "Pre-hospital transfusion of plasma in hemorrhaging trauma patients independently improves hemostatic competence and acidosis*". Scandinavian*	**Inclusion criteria** • adult trauma patients (≥16 years) • met criteria for full trauma team activation • received blood before arrival at ED or after hospital admittance within 6 h of ED arrival **Exclusion criteria** • pregnancy	**Participants** N=257 patients **Study groups** IG: pre-hospital plasma and/or RBCs (PH) (N=75, 29%) CG: in-hospital RBCs, plasma and platelets (IH) (N=182, 71%)	**Mortality** 6-h mortality, n (%) IG: 10 (13.3) vs. CG: 15 (8.2), p=0.210 24-h mortality, n (%) IG: 12 (16) vs. CG: 19 (10.4), p=0.213 In-hospital mortality, n (%) IG: 20 (26.7) vs. CG: 38 (20.9), p=0.313	**Level of evidence** 3b↓ **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: ? Detection bias: ?

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Journal of Trauma, Resuscitation and Emergency Medicine 24(145), 1-6. **Study design** Prospective cohort study **Aim of the study** The aim of the study was to investigate the association between pre-hospital administered RBCs and plasma and hemostatic function as evaluated by whole blood thrombelastography (TEG) on arrival at the trauma center as compared to that of patients not receiving pre-hospital blood transfusions. **Setting** United States, 2012-2013	• prisoner • burned body surface area >20% • enrolled in another study **Characteristics** Age [y], median (IQR) IG: 34 (23 - 53) CG: 39 (26 - 53), p=0.259 Sex male, n (%) IG: 62 (82.7) CG: 146 (80.2), p=0.650 ISS, median (IQR) IG: 29 (17 - 41) CG: 26 (17 - 34), p=0.106 GCS, median (IQR) IG: 3 (3 - 15) CG: 12 (3 - 15), p=0.022 Penetrating injury, n (%) IG: 34 (45.3) CG: 46 (25.3), p=0.002 SBP [mmHg], median (IQR) IG: 90 (77 - 113) CG: 100 (80 - 125), p=0.044 Platelet count [x103/µL], median (IQR) IG: 193 (152 - 223) CG: 225 (174 - 257), p=0.001 pH, median (IQR) IG: 7.21 (7.06 - 7.32) CG: 7.27 (7.18 - 7.33), p=0.002 **Admission to 6 h total transfusions**		**Rapid thombelastography (rTEG) at hospital admission (median)** MA IG vs. CG: 62 vs. 64 (p=0.020) G-value IG vs. CG: 8.1 vs. 8.69 (p=0.009) Multivariate linear regression with adjusting for pH, hemoglobin, platelet count, SBP, and in IG patients PH-RBC and PH-Plasma: higher pH and higher platelet count were independent predictors of rTEG MA in CG patients and higher pH, higher platelet count and PH-Plasma were associated with higher rTEG MA in IG patients (all p<0.05, data not shown).	**Authors' conclusion** "Overall, these data imply that early administration of plasma may have beneficial effects on improving hemostasis, which may potentially translate into improved patient survival in future studies with larger sample sizes." **Reviewers' conclusion** There is a risk of selection bias as, for example, the IG had a higher incidence of penetrating injuries and lower GCS score than CG.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	RBC [units], median (IQR) IG: 8 (4 - 14) CG: 3 (1 - 8), p<0.001 Plasma [units], median (IQR) IG: 6 (3 - 12) CG: 3(2 - 7), p<0.001 Platelets [packs], median (IQR) IG: 6 (0 - 12) CG: 0 (0 - 6), p<0.001			
Holcomb (2017) "Multicenter observational prehospital resuscitation on helicopter study (PROHS)". *The Journal of Trauma and Acute Care Surgery* 83(1): S83-S91. **Study design** Multicenter, prospective cohort study **Aim of the study** The hypothesis of this study was that patients with severe traumatic injuries evacuated to level 1 trauma centers on air ambulances who received prehospital red blood cells and/or plasma would have lower in-hospital mortality compared to patients	**Inclusion criteria** • Estimated to be ≥15 years or ≥50 kg • Traumatic injury • Transported by helicopter directly from the scene of injury to one of nine Level I trauma centers • Highest risk population including at least one of the following criteria • heart rate ≥120 bpm • systolic blood pressure ≤90mmHg • penetrating truncal injury • tourniquet applied • pelvic binder applied • intubated prehospital • received blood products during transport. **Exclusion criteria** • prisoners • any transfers between hospitals **Characteristics (after matching)** Age, years, median (IQR)	**Participants** N=109 patients (1,058 prior to matching) **Study groups** IG: prehospital transfusion (plasma and/or red blood cells) (5 helicopters with blood available) (N=43; N=142 prior to matching) CG: crystalloid resuscitation (4 helicopters without blood available) (N=66; N=473 prior to matching) **Matching criteria** Matching according to the following criteria (2:1 ratio of CG vs. IG): • age • gender • race (white, black, other) • injury severity score (ISS) • prehospital vital signs (systolic blood pressure, diastolic blood pressure, pulse) • whether or not patients satisfied more than one of the highest risk criteria (yes/no)	Mortality 3h: n (%): IG: 4 (9.3) vs. CG: 8 (12.1) adjusted OR (95% CI) 0.74 (0.24–2.26) p=0.60 Mortality 24h: IG: 5 (11.6) vs. 10 (15.2) Adj OR (95% CI): 0.74 (0.25–2.17), p=0.58 Mortality 30 days: IG: 8 (18.6) vs. 14 (21.2) Adj OR (95% CI): 0.85 (0.32–2.28), p=0.75	**Level of evidence** 3b↓ **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: – Detection bias: + **Authors' conclusion** "In the primary analysis, prehospital blood product use was not significantly associated with 3 hour, 24 hour or 30 day mortality. However, the unexpected and significant differences in injury severity score, GCS and SBP resulted in lower power and therefore, the results are inconclusive." **Reviewers' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
transferred by air ambulance who received only crystalloid. **Setting** USA, 2015	IG: 48 (27-62) CG: 39 (26-56) Male, n (%) IG: 29 (67.4) CG: 48 (72.7) ISS, median (IQR) IG: 24 (10-34) CG: 22 (10-34) Systolic (mmHg) Blood Pressure, median (IQR) IG: 110 (88-133) CG: 105 (88-128)	• presence of any penetrating injury (yes/no) • use of a prehospital lifesaving intervention (yes/no) • time from the air team call to arrival to the ED (in minutes) • whether the bleeding source was identified prehospital (yes/no) site volume (the total number of trauma patients arriving via helicopter)		Power was low. More than 2/3 of cases were not available for analysis after matching because of systematic differences before matching. Therefore, the results need to be interpreted with caution.
Holcomb (2015) "Transfusion of Plasma, Platelets, and Red Blood Cells in a 1:1:1 vs a 1:1:2 Ratio and Mortality in Patients With Severe Trauma - The PROPPR Randomized Clinical Trial". *Journal of the American Medical Association* 313(5):471-482 **Study design** Randomised controlled trial **Aim of the study** The aim of the study was to address the effectiveness and safety of a 1:1:1 transfusion ratio compared with a 1:1:2 transfusion ratio in patients with	**Inclusion criteria** • Highest trauma level activation • Estimated age of 15 years or older or weight of 50 kg or greater if age unknown • Received directly from the injury scene • Initiated transfusion of at least 1 U of blood component within the first hour of arrival or during prehospital transport • Predicted to receive a massive transfusion by exceeding the threshold score of either the Assessment of Blood Consumption score of 2 or greater or based on the attending trauma physician's judgment **Exclusion criteria** • Received lifesaving intervention from an outside hospital or health care facility	**Participants** N=680 patients **Study groups** IG: Transfusion ratio 1:1:1 (N=338) (Plasma, Platelets, Red Blood Cells (RBCs) CG: Transfusion ratio 1:1:2 (N=342) (Plasma, Platelets, Red Blood Cells (RBCs)	**Mortality (primary endpoint)** 24-h Mortality, n (%) IG: 43 (12.7) CG: 58 (17.0) Difference, % (95% CI): IG vs. CG −4.2% (−9.6 - 1.1) Adjusted RR (95% CI): IG vs. CG 0.75 (0.52 - 1.08) 30-d Mortality, n (%) IG: 75 (22.4) CG: 89 (26.1) Difference (% (95% CI)): IG vs. CG −3.7 (−10.2 - 2.7) Adjusted RR (95% CI): IG vs. CG 0.86 (0.65 - 1.12) **Others** Achieved hemostasis, n (%) IG: 291 (86.1) vs. CG: 267 (78.1), p=0.006	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** **"**Among patients with severe trauma and major bleeding, early administration of plasma, platelets, and RBCs in a 1:1:1 ratio compared with a 1:1:2 ratio did not result in significant differences in mortality at 24 hours or 30 days. However, more patients in the

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
trauma who were predicted to receive a massive transfusion. **Setting** 12 Level 1 trauma centers, North America, 2012-2013	• Had devastating injuries and expected to die within 1 hour of admission • Directly admitted from a correctional facility • Required thoracotomy prior to receiving randomized blood products in the emergency department • Younger than 15 years or weighed less than 50 kg if age unknown • Known pregnancy • burns covering greater than 20% total body surface area • Suspected inhalation injury • Received greater than 5 consecutive minutes of cardiopulmonary resuscitation (with chest compressions) prior to arriving at the hospital or within the emergency department • Known do-not-resuscitate order prior to randomization • Enrolled in a concurrent, ongoing, interventional, randomized clinical trial • Activated the opt-out process for the PROPPR trial (usually by wearing a bracelet given out at a community consent presentation) • More than 3 U of red blood cells given before randomization **Characteristics** Age, years (median, IQR) IG: 34.5 (25 – 51) CG: 34 (24 – 50) Sex (male, n (%)) IG: 263 (77.8) CG: 283 (82.7)		Hospital-free days (median (IQR) IG: 1 (0 – 17) vs. CG: 0 (0 – 16), p=0.83 Ventilator-free days (Median, IQR) IG: 8 (0 – 16) vs. CG: 7 (0 – 14), p=0.14 ICU-free days (Median, IQR) IG: 5 (0 – 11) vs. CG: 4 (0 – 10), p=0.10 **Cause of death, n (%)** Exsanguination 24-h: IG: 31 (9.2) vs. CG: 50 (14.6), p=0.03 30-day: IG: 36 (10.7) vs. CG: 50 (14.7) Traumatic Brain Injury 24-h: IG: 11 (3.3) vs. CG: 12 (3.5) 30-day: IG: 27 (8.1) vs. CG: 35 (10.3) No differences in complications (such as acute respiratory distress syndrome, multiple organ failure, sepsis) at 30 days.	1:1:1 group achieved hemostasis and fewer experienced death due to exsanguination by 24 hours. Even though there was an increased use of plasma and platelets transfused in the 1:1:1 group, no other safety differences were identified between the 2 groups." **Reviewers' conclusion** There might be a risk of performance bias as could not be blinded and the care apart from the intervention was not standardized.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	GCS (median, IQR) IG: 14 (3 – 15) CG: 14 (3 – 15) ISS (median, IQR) IG: 26.5 (17 – 41) CG: 26 (17 – 38) Systolic blood pressure, mmHg (median, IQR) IG: 102 (81 – 126) CG: 102 (80 – 125) INR (median, IQR) IG: 1.3 (1.2 – 1.5) CG: 1.3 (1.2 – 1.5) Massive Transfusion (n (%)) IG: 153 (45.3) CG: 160 (46.8)			
Moore (2018) "Plasma-first resuscitation to treat haemorrhagic shock during emergency ground transportation in an urban area: a random-ised trial". *Lancet* 392(10144): 283-291. **Study design** Randomised controlled trial (COMBAT trial) **Aim of the study**	**Inclusion criteria** • injured adults (age >18 years) • systolic blood pressure (SBP)≤70 mm Hg • or SBP 71–90 mm Hg and heart rate 108 beats per min thought to be due to acute blood loss. **Exclusion criteria** • prisoner status • known pregnancy • isolated gunshot to the head • asystole or cardiopulmonary resuscita-tion before randomization • known objection to blood products • opt-out bracelets or necklaces	**Participants** Randomized N=144 patients As treated N=125 patients **Study groups** IG: prehospital 2 U AB plasma (universal do-nor, ~250 mL each) in prepacked coolers (randomized N=75; as treated N=65) CG: standard of care (normal saline 0.9%, volume based on haemodynamic need) (randomised N=69; as treated N=60)	**Primary endpoint** Mortality (28 days), n (%) As treated: IG: 10 (15) vs. CG: 6 (10), p=0.37 Relative risk (95% CI): 1.54 (0.60 - 3.98) ITT: IG: 12 (16) vs. CG: 6 (9), p=0.19 Mortality (24h) (as treated): n (%) IG: 8 (12) vs. CG: 6 (10), p=0.68 Relative risk (95% CI): 1.23 (0.45 – 3.34)	**Level of evidence** 2b↓ **Risk of bias** Selection bias: + Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion** "Our findings indicate that plasma does not improve outcomes after injury when given within 30 min during

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
We tested the hypothesis that mortality would be lower among patients who received plasma before arrival at a level 1 trauma facility than among those who received standard care with normal saline. **Setting** USA, 2014-2017	• family objection to the patient's enrolment. **Characteristics** Age, years, median (IQR) IG: 33.0 (25.0-51.0) CG: 32.5 (25.5-42.0) Male sex, n (%) IG: 52 (80) CG: 51 (85) NISS, median (IQR) IG: 27.0 (10.0–41.0) CG: 27.0 (11.5–36.0) INR (at scene of injury): median (IQR) IG: 1.1 (1.0-1.2) CG: 1.1 (1.0-1.1)		Multiple organ failure (28 days) (Denver score >3) (as treated): n (%) IG: 4 (6) vs. CG: 1 (2), p=0.37 Relative risk (95% CI): 3.69 (0.42 – 32.11) **Secondary endpoints (as treated)** Composite outcome (multiple organ failure or death) at 28 days, n (%) IG: 14 (21) vs. CG: 7 (12), p=0.14 Relative risk (95% CI): 1.85 (0.80 - 4.26) Base deficit on arrival (mEq/L): median (IQR) IG: 9.0 (5.5 – 13.0) vs. CG: 8.8 (6.0 – 13-0), p=0.8 Median difference (95% CI): 0 (−2.70 – 2.00) Lactic acid concentration on arrival (mg/dL): median (IQR) IG: 5.5 (3.9 – 8-5) vs. CG: 4.9 (3.2 – 7.0), p=0.3 Median difference (95% CI): 0.60 (−0.60 – 1.80) INR on arrival at hospital, median (IQR) IG: 1.27 (1.11 – 1.40) vs. CG: 1.15 (1.08 – 1.29), p=0.1 Median difference (95% CI): 0.60 (−0.01 – 0.14)	rapid ground transportation to mature, level 1 trauma centres." **Reviewers' conclusion** The study has wide confidence intervals and was powered to detect a 19% difference in mortality. There may be a performance bias because masking of the care team was not possible and because patients in both groups did not receive similar volumes of plasma and placebo. LoE downgraded due to post-hoc analysis.
Pusateri (2020) "Association of Prehospital Plasma Transfusion With Survival in Trauma Patients With Hemorrhagic Shock When Transport Times Are Longer Than 20 Minutes: A Post Hoc Analysis of the	**For inclusion and exclusion criteria see PAMPer (Sperry 2018) & COMBAT trial (Moore 2018)** **Characteristics** Age, years, median (IQR) Total: 42 (27-52)	**Participants** N=626 patients (N=125 COMBAT, N=501 PAMPer) **Study groups** IG: prehospital plasma (N=297) CG: standard care (crystalloid) (N=329)	I**nfluence of prehospital transport time** (subgroup analysis of PAMPer & COMBAT) Mortality (28 days, 1ary outcome): HR (95% CI)§ ≤20 min transport time IG vs. CG: 1.71 (0.70-4.16), p=0.24 >20 min transport time IG vs. CG: 0.56 (0.40-0.80) p=0.001	**Level of evidence** 2b↓ **Risk of bias** Selection bias: + Performance bias: – Attrition bias: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
PAMPer and COMBAT Clinical Trials". *JAMA Surgery* 155(2):e195085 **Study design** Post-hoc subgroup analysis of data from 2 RCTs (PAMPer & COMBAT) **Aim of the study** Examine the combined data set to address the post hoc hypothesis that the benefits of prehospital administration of plasma are influenced by prehospital transport time. **Setting** USA, 2014-2019	IG: 43 (29-56) CG: 42 (26-57) Male sex, n (%) Total: 467 (84.6) IG: 216 (72.7) CG: 251 (76.3) ISS, median (IQR) Total: 22 (12-34) IG: 22 (12-34) CG: 22 (12-33)		Mortality (24 h): Hazard ratio (95% CI)[§] ≤20 min transport time IG vs. CG: 1.89 (0.65-5.40), p=0.25 >20 min transport time IG vs. CG: 0.53 (0.34-0.82) p=0.004 [§]Patients with event not reported per group, analyses adjusted for age and ISS	Detection bias: + **Authors' conclusion** "These data suggest that prehospital plasma is associated with a survival benefit when transport times are longer than 20 minutes and that the benefit-risk ratio is favorable for use of prehospital plasma." **Reviewers' conclusion** This is post-hoc subgroup analysis of harmonized data from the PAMPer and COMBAT trial. There may be a performance bias because masking of the care team was not possible and because patients in both groups did not receive similar volumes of plasma and placebo. LoE downgraded due to post-hoc analysis.
Reitz (2020) "Prehospital plasma in injured patients is associated with survival principally in blunt injury: Results from two randomized prehospital plasma trials". *The Journal of Trauma and Acute Care Surgery*. 88(1):33-41	**For inclusion and exclusion criteria see PAMPer (Sperry 2018) & COMBAT trial (Moore 2018)** **Characteristics** Age, years, median (IQR) Blunt trauma: 45 (28-61) Penetrating trauma: 35 (26-49) (p<0.001)	**Participants** N=626 patients (N=501 PAMPer, N=125 COMBAT) **Study groups** IG: prehospital plasma (N=not reported) CG: standard care (crystalloid) (N=not reported)	**Mechanism of injury** (subgroup analysis of PAMPer & COMBAT) 28-day mortality (primary endpoint): n (%) *Blunt trauma* IG: 50 (23.5) vs CG: 86 (34.1), p=0.012 Multivariate Cox-hazard regression HR (95% CI): HR: 0.68 (0.472-0.965), p=0.031	**Level of evidence** 2b↓ **Risk of bias** Selection bias: + Performance bias: – Attrition bias: + Detection bias: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Study design Post-hoc subgroup analysis of data from 2 randomised controlled trials (PAMPer & COMBAT) **Aim of the study** Our overall objective was to characterize prehospital plasma outcomes across mechanism of injury using harmonized data obtained from these two recently completed prehospital plasma clinical trials. We hypothesized that the safety and beneficial effects of prehospital plasma would be consistent across blunt and penetrating mechanism of injury. **Setting** USA, 2014-2019	Male sex, n (%) Blunt trauma: 326 (70.1) Penetrating trauma: 141 (87.6) (p<0.001) ISS, median (IQR) Total: 22 (12-34) Blunt trauma: 24 (17-34) Penetrating trauma: 14 (6-25) (p<0.001) GCS: median (IQR) Total: 6 (3-15) Blunt trauma: 3 (3-15) Penetrating trauma: 14 (3-15) (p=0.004)	**Subgroup analysis mechanism of injury** Blunt: n=465, 75%, (including 10 suffering from blunt and penetrating trauma) (n=406 PAMPer, n=59 COMBAT) Penetrating: n=161, 25% (n=95 PAMPer, n=66 COMBAT)	*Penetrating trauma* IG: 12 (14.3) vs. CG. 8 (10.4), p=0.454 Multivariate Cox-hazard regression HR (95% CI): HR: 1.16 (0.430 – 3.103), p=0.775 24h mortality: n (%) *Blunt trauma* IG: 29 (15.2) vs. CG: 58 (25.8), p=0.010 Multivariate Cox-hazard regression HR (95% CI): HR: 0.59 (0.370-0.947), p=0.029 *Penetrating trauma* IG: 8 (10.4) vs. CG: 11 (13.23), p=0.595 Multivariate Cox-hazard regression HR (95% CI): HR: 1.16 (0.430 – 3.103), p=0.775	**Authors' conclusion** "A survival benefit associated with prehospital plasma at 24 hours and 28 days exists primarily in blunt injured patients with no benefit shown in penetrating trauma patients" **Reviewers' conclusion** This is post-hoc subgroup analysis of harmonized data from the PAMPer and COMBAT trial. There may be a performance bias because masking of the care team was not possible and because patients in both groups did not receive similar volumes of plasma and placebo. LoE downgraded due to post-hoc analysis.
Robinson (2018) "Risk Factors for the Development Of Acute Respiratory Distress Syndrome Following Hemorrhage". *Shock* 50(3): 258-264. **Study desgin**	**Inclusion criteria** • Same as in PROPPR trial **Exclusion criteria** • Same as in PROPPR trial, additionally: • patients with survival ≤24 hours • lack of intensive care unit admission • lack of recorded PaO2 to FiO2 (P/F) ratio during days 1-7	**Participants** N=454 patients, subset of the original 680 patients **Study groups** IG: Transfusion ratio 1:1:1 (N=230) (Plasma, Platelets, Red Blood Cells (RBCs) CG: Transfusion ratio 1:1:2 (N=224) (Plasma, Platelets, Red Blood Cells (RBCs)	**Pulmonary outcomes** ARDS, n (%) IG: 34 (14.8), p=0.35 CG: 41 (18.3) Hospital day ARDS occurred, during hospital day 1-7, median (IQR) IG: 3.5 (1 - 6), p=0.06 CG: 2 (1 - 4)	**Level of evidence** 2b↓ **Risk of bias** Same as in PROPPR trial **Authors' conclusion** "Acute crystalloid exposure, but not blood products, emerges as a modifia-

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
secondary analysis of the PROPPR randomised controlled trial **Aim of the study** The aim of this secondary analysis was to clarify pulmonary outcomes in high-risk patients following severe injury with active hemorrhage after exposure to damage control resuscitation practices **Setting** North America, same as PROPPR trial	• naturally or synthetically derived colloids (e.g. albumin, hetastarch) **Characteristics** Age (median, IQR) IG: 34.5 (25 - 49) (p=0.65) CG: 33 (24 - 50) Sex (male), n (%) IG: 179 (77.8) (p=0.37) CG: 182 (81.3) ISS (median, IQR) IG: 29 (19 - 41) (p=0.31) CG: 28 (18 - 38) ED GCS (median, IQR) IG: 14 (3 - 15) (p=0.32) CG: 14 (3 - 15) ED SBP<90 (mmHg, n (%)) IG: 76 (33.3) (p=0.53) CG: 66 (30.6) Massive Transfusion (n (%)) IG: 108 (47.0) (p=0.52) CG: 112 (50.0)		Ventilator days, median (IQR) IG: 5 (2 - 13), p=0.98 CG: 4.5 (2 - 14) Ventilator-free days in 30, median (IQR IG: 24 (9 - 27), p=0.90 CG: 24 (9.5 - 28) **Mortality** 7-day mortality, n (%) IG: 18 (7.8), p=0.60 CG: 14 (6.3) 30-day mortality, n (%) IG: 28 (12.3), p=0.91 CG: 28 (12.5) Risk factors for ARDS (entire study group, multivariate analysis), OR (95% CI) Blunt mechanism: 3.61 (1.53 - 8.51), p<0.01 Chest AIS: 1.40 (1.15 - 1.71), p<0.01 IVFs given (by 500 mL units) in hours 0-6: 1.09 (1.04 - 1.14), p<0.01	ble risk factor for the prevention of ARDS following hemorrhage. Relatively small volumes of crystalloid fluids given during the acute period of resuscitation appear to be associated with the development of lung injury." **Reviewers' conclusion** Post-hoc analysis of RCT data. The intervention and control groups were balanced with respect to baseline characteristics.
Sperry (2018) "Prehospital Plasma during Air Medical Transport in Trauma Patients at Risk for Hemorrhagic Shock ", *The New England Journal of Medicine* 379(4),315-26.	**Inclusion criteria** • Patients transported from scene of injury to a participating trauma center or who were transferred from an outside referral emergency department to a participating trauma center • at least one episode of hypotension (systolic blood pressure <90 mm Hg) and tachycardia (heart rate >108 bpm)	**Participants** N=501 patients **Study groups** IG: prehospital thawed plasma (N=230) 2 units of either group AB or group A with a low anti-B antibody titer (<1:100) thawed plasma infused to completion	**Mortality** Primary outcome: 30-day mortality§: n (%) IG: 53 (23.2), CG: 89 (33.0) Difference in % (95% CI): −9.8% (−18.6 to −1.0); p=0.03 Risk of death within 30 days, OR (95% CI)	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: – Attrition bias: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Study design cluster-randomised clinical trial (PAMPer trial) **Aim of the study** The aim of the study was to determine the efficacy and safety of prehospital plasma resuscitation as compared with standard-care resuscitation in severely injured patients at risk for hemorrhagic shock. **Setting** United States, 2014-2017	• OR any severe hypotension (systolic blood pressure <70 mm Hg), either before the arrival of air medical transport or any time before arrival at the trauma center **Exclusion criteria** • Aged >90 years or <18 years • intravenous or intraosseous access could not be established • isolated fall from standing • a documented cervical cord injury • known to be a prisoner • known pregnancy • traumatic cardiac arrest lasting >5 minutes • penetrating brain injury • injury due to isolated drowning or hanging • burns >20% of total body- surface area • admitted as an inpatient at an outside referral hospital • if patient or family member voiced an objection to participation in the trial at the scene of the injury • wearing an "opt-out" bracelet, indicating to opt out of the PAMPer trial **Characteristics** <u>Age (median, IQR)</u> IG: 44 (31–59) CG: 46 (28–60) <u>Male sex, n (%)</u> IG: 164 (71.3) CG: 200 (73.8)	CG: Standard-care resuscitation (N=271) infusion of a crystalloid solution as the primary resuscitative fluid Note: 13 of 27 air medical bases also carried 2 units of infusion of **universal donor red cells** which were allowed to be administered to IG (after plasma) or placebo	IG vs. CG (adj.): 0.61 (0.40 - 0.91), p=0.02 <u>24-hour mortality, n (%), % difference (95% CI)*</u> IG: 32 (13.9), −8.2% (−14.9 to −1.6), adj. p=0.55 CG: 60 (22.1) <u>In-hospital mortality, n (%), % difference (95% CI)*</u> IG: 51 (22.2), −10.3% (−18.0 to −2.6), p=0.33 CG: 88 (32.5) **Others** <u>Multiorgan failure, n (%)</u> IG: 145 (63.0), 5.4% (−3.1 to 14.1), p>0.99* CG: 156 (57.6) <u>Acute lung injury–acute respiratory distress syndrome, n (%)*</u> IG: 48 (20.9), 2.4% (−4.8 to 9.4), p>0.99 CG: 50 (18.5) <u>initial prothrombin-time ratio; median (IQR)*</u> IG: 1.2 (1.1 - 1.4), p<0.001 CG: 1.3 (1.1 - 1.6) *Significance levels were adjusted with the use of a Bonferroni correction to account for multiple comparisons. §after multiple imputation	Detection bias: + **Authors' conclusion** "In injured patients at risk for hemorrhagic shock, the administration of thawed plasma during prehospital air medical transport was safe and resulted in lower 30-day mortality and a lower median prothrombin-time ratio than standard-care resuscitation." **Reviewers' conclusion** There may be a risk of performance bias since the staff was not masked to the intervention because the trial intervention was a blood product, which requires full traceability.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	GCS <8, n (%) IG: 103 (44.8) CG: 129 (47.6) ISS (median, IQR) IG: 22 (14–33) CG: 21 (12–29) prehospital systolic blood pressure [mmHg], median (IQR) IG: 71 (64–81) CG: 69 (61–81)			

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Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Bossers (2021) "Association between prehospital tranexamic acid administration and outcomes of severe traumatic brain injury." *JAMA Neurology* 78.3: 338-345. **Study design** Comparative registry study (BRAIN-PROTECT) **Aim of the study** "In this cohort study, we aimed to assess whether prehospital administration	**Inclusion criteria** • patients with suspected severe traumatic brain injury (TBI) (based on a trauma mechanism or clinical findings suggestive of severe TBI and a prehospital GlasgowComa Scale [GCS] score of 8 or lower) • treated by 1 of the 4 Dutch physician-staffed Helicopter Emergency Medical Services (HEMS) **Exclusion criteria** • not transported to a participating trauma center (no follow-up data were available)	**Participants** N=1827 patients **Study groups** IG: Patients who received tranexamic acid (N=693)* CG: Patient who did not receive tranexamic acid (N=1134) *in 680 patients, tranexamic dose was documented, 90% received a dose of 1g	**Primary outcomes** 30-day mortality n (%) IG: 241 (37) vs. CG: 322 (30), p=0.005 (missing data: N=113/1827) Confounder-adjusted logistic regression, original data set, OR (95% CI) Full cohort: 1.18 (0.73-1.90), p=0.51 Confirmed TBI cohort: 1.27 (0.68-2.35) p=0.45 Isolated TBI cohort: 4.49 (1.57-12.87), p=0.005 Confounder-adjusted logistic regression, after multiple imputations, OR (95% CI) Full cohort: 1.17 (0.84-1.65), p=0.35 Confirmed TBI cohort: 1.19 (0.92-1.53), p=0.19	**Level of evidence** 2b **Risk of bias** Selection bias: ? Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "This study found that prehospital tranexamic acid administration was associated with increased mortality in patients with isolated severe TBI, suggesting the judicious use of the drug

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
of tranexamic acid is associated with mortality and functional outcomes in a group of patients with severe TBI." **Setting** Netherlands, 2012-2018	• patients who were undergoing prehospital traumatic cardiopulmonary resuscitation (inherently very high mortality, regardless of treatment) **Characteristics** Age, years, median (IQR) IG: 47 (25-66) vs. CG: 45 (22-65), p=0.03 (missing data: N=20 / 1827) Male sex, n (%) IG: 486 (70) vs. CG: 797 (70), p=0.94 (missing data: N=3 / 1827) ISS, median (IQR) IG: 27 (21-38) vs. CG: 26 (17-34), p<0.001 (missing data: N=208 / 1827) GCS score, median (IQR) IG: 4 (3-6) vs. CG: 5 (3-7), p<0.001 Confirmed TBI (Head AIS ≥3) Overall: n=1375 Isolated TBI (Head AIS ≥3, with neck, spine, thorax, abdomen, extremities, and external AIS ≤2) Overall: n=719		Isolated TBI cohort: 2.05 (1.22-3.45), p=007 Sensitivity analyses - Confounder-adjusted survival analysis, original data set, HR (95% CI): Full cohort: 1.10 (0.92-1.31), p=0.30 Confirmed TBI cohort: 1.10 (0.90-1.35), p=0.35 Isolated TBI cohort: 1.66 (1.08-2.54), p=0.02 - Confounder-adjusted survival analysis, after multiple imputations, HR (95% CI): Full cohort: 1.01 (0.90-1.14), p=0.81 Confirmed TBI cohort: 1.00 (0.91-1.11), p=0.97 Isolated TBI cohort: 1.34 (1.16-1.55), p<0.001 **Secondary outcomes** Hospital Length of Stay, median (IQR) IG: 17 (7.5-35) vs. CG: 15 (5-31) p=0.007 (missing data: N=11 / 1827) Adjusted analyses, original data set, incidence rate ratio (IRR) (95% CI) Full cohort: 0.92 (0.81-1.04), p=0.17 Confirmed TBI cohort: 0.89 (0.77-1.03), p=0.11 Isolated TBI cohort: 0.71 (0.54-0.95), p=0.02 Adjusted analyses, after multiple imputations, IRR (95% CI) Full cohort: 1.05 (0.92-1.20), p=0.44 Confirmed TBI cohort: 1.04 (0.88-1.22), p=0.65 Isolated TBI cohort: 0.88 (0.69-1.11), p=0.27	when no evidence for extracranial hemorrhage is present." **Reviewers' conclusion** There might be a risk of selection bias as the groups differ in baseline factors, such as age and injury severity, and due to missing data. However, several adjustments for confounders and sensitivity analyses were done, showing consistent results.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Glasgow Outcome Scale (GOS) score at discharge, n (%), p=0.001 (missing data: N=170 / 1827) - Death, IG: 250 (39) vs. CG: 323 (32) - Vegetative state, IG: 19 (3) vs. CG: 19 (2) - Severe disability, IG: 214 (34) vs. CG: 385 (38) - Moderate disability, IG: 70 (11) vs. CG: 107 (10) - Good recovery, IG: 80 (13) vs. CG: 190 (19) Adjusted analyses, original data set, OR (95% CI) Full cohort: 1.05 (0.81-1.37), p=0.71 Confirmed TBI cohort: 0.97 (0.72-1.30), p=0.83 Isolated TBI cohort: 0.68 (0.25-1.90), p=0.47 Adjusted analyses, after multiple imputations, OR (95% CI) Full cohort: 0.97 (0.78-1.21), p=0.79 Confirmed TBI cohort: 0.86 (0.72-1.04), p=0.13 Isolated TBI cohort: 0.69 (0.42-1.14) 0 .15 **12-month Mortality** Adjusted analyses, original data set, OR (95% CI) Full cohort: 1.08 (0.66-1.76), p=0.76 Confirmed TBI cohort: 1.04 (0.60-1.79), p=0.89 Isolated TBI cohort: 3.31 (1.20-9.16), p=0.02 Adjusted analyses, after multiple imputations, OR (95% CI) Full cohort: 0.99 (0.77-1.29), p=0.96 Confirmed TBI cohort: 0.99 (0.75-1.30), p=0.93	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Isolated TBI cohort: 1.78 (1.13-2.80), p=0.01	
Brenner (2020) "Understanding the neuroprotective effect of tranexamic acid: an exploratory analysis of the CRASH-3 randomised trial." *Critical Care* 24.1: 1-10. **Study design** Exploratory analysis of a randomised controlled trial (CRASH-3) **Aim of the study** To explore the mechanism of action of TXA in TBI, we examined the timing of its effect on death. **Setting** 29 countries, 2012-2019	**Inclusion criteria** • Adults with traumatic brain injury (TBI) ≤3 h of injury • GCS score ≤12 or intracranial bleeding on CT • no significant extra-cranial bleeding **Exclusion criteria** • GCS score of 3 • Bilateral unreactive pupils **Characteristics** Patient characteristics for all patients with TBI within 3 h of injury: see CRASH-3	**Participants** N=7637 patients (after excluding patients with GCS score of 3 or bilateral unreactive pupils); exclusion of 98 patients with missing outcome data **Study groups** IG: TXA 1 g of tranexamic acid infused over 10 min, started immediately after randomisation, followed by an intravenous infusion of 1 g over 8 h (four ampules of TXA 500 mg) CG: 100 mL bag of 0.9% sodium chloride (Number of patients per group not reported)	**Effect of tranexamic acid on early deaths (within 24 h)** All patients, n (%), RR (95% CI) IG: 112 (2.9) vs. CG: 147 (3.9), 0.74 (0.58-0.94) Severity n (%), RR (95% CI) *Mild/moderate (GCS 9-15):* IG: 25 (0.9) vs. CG: 37 (1.3), 0.66 (0.40-1.09) *Severe (GCS 3-8):* IG: 87 (8.5) vs. CG: 110 (11.3), 0.75 (0.58-0.98) Country income, n (%), RR (95% CI) *LMIC:* IG: 98 (3.3) vs. CG: 126 (4.4), 0.75 (0.58–0.98) *HIC:* IG: 14 (1.5) vs. CG: 21 (2.4), 0.65 (0.33–1.26) **Effect of tranexamic acid on deaths after 24 h** All patients, n (%), RR (95% CI) IG: 432 (11.5) vs. CG: 421 (11.7), 0.98 (0.69–1.12) Severity n (%), RR (95% CI) *Mild/moderate (GCS 9-15):* IG: 163 (5.8) vs. CG: 186 (6.9), 0.85 (0.69–1.04) *Severe (GCS 3-8):* IG: 269 (28.7) vs. CG: 235 (27.2), 1.05 (0.91–1.22) Country income, n (%), RR (95% CI) *LMIC:*	**Level of evidence** 2b↓ **Risk of bias** See CRASH-3 (below) **Authors' conclusion** "Tranexamic acid reduces early deaths in non-moribund TBI patients regardless of TBI severity or country income. The effect of tranexamic acid in patients with isolated TBI is similar to that in polytrauma. Treatment is safe and even severely injured patients appear to benefit when treated soon after injury." **Reviewers' conclusion** The exploratory analysis of the CRASH-3 trial is of good quality indicating reliable results. Downgraded due to post-hoc analysis.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			IG: 363 (12.6) vs. CG: 344 (12.5), 1.01 (0.88–1.16) *HIC:* IG: 69 (7.7) vs. CG: 77 (9.0), 0.86 (0633–1.18) **Effect of tranexamic acid on deaths at 28 days** All patients, n (%), RR (95% CI) IG: 544 (14.0) v. CG: 568 (15.1), 0.93 (0.83–1.03) Severity n (%), RR (95% CI) *Mild/ moderate (GCS 9-15):* IG: 188 (6.7) vs. CG: 223 (8.1), 0.82 (0.68–0.99) *Severe (GCS 3-8):* IG: 356 (34.7) vs. CG: 345 (35.4), 0.98 (0.87–1.10) Country income, n (%), RR (95% CI) *LMIC:* IG: 461 (15.5) vs. CG: 470 (16.3), 0.95 (0.84–1.07) *HIC:* IG: 83 (9.2) vs. CG: 98 (11.1), 0.82 (0.62–1.08) **Effects of tranexamic acid on vascular occlusive events (fatal and non-fatal) in all patients irrespective of time to treatment** Severe (GCS 3-8), n/N (%), RR (95% CI): IG: 60/2264 (2.7) vs. CG: 50/2247 (2.2), 1.19 (0.82–1.73) Pooled data from the CRASH-2 and CRASH-3 trials were not reported separately for severe TBI.	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
CRASH-3 collaborators (2019). "Effects of tranexamic acid on death, disability, vascular occlusive events and other morbidities in patients with acute traumatic brain injury (CRASH-3): a randomised, placebo-controlled trial". *Lancet* 394(10210): 1713-23 **Study design** Randomised controlled trial **Aim of the study** The CRASH-3 trial aimed to quantify the effects of tranexamic acid on head injury-related death, disability, and adverse events in patients with TBI. **Setting** 29 countries, 2012-2019	**Inclusion criteria** • Adults with traumatic brain injury (TBI) ≤3 h of injury (at the beginning ≤8 h) • Glasgow Coma Scale (GCS) score ≤12 • OR any intracranial bleeding on CT scan, • no major extracranial bleeding • responsible clinician was substantially uncertain as to the appropriateness of tranexamic acid treatment **Baseline characteristics of those randomly assigned within 3 h of injury** Age, years, mean ± SD IG: 41.7 (19.0) CG: 41.9 (19.0) Male sex, n (%) IG: 3,742 (80) CG: 3,660 (80) Glagow Coma Scale Scores, n (%) GCS 3: IG: 495 (11) vs. CG: 506 (11) GCS 4: IG: 213 (5) vs. CG: 213 (5) GCS 5: IG: 163 (4) vs. CG: 172 (4) GSC 6: IG: 221 (5) vs. CG: 232 (5) GCS 7: IG: 311 (7) vs. CG: 294 (6) GCS 8: IG: 354 (8) vs. CG: 315 (7) GCS 9: IG: 335 (7) vs. CG: 292 (6) GCS 10: IG: 371 (8) vs. CG: 364 (8) GCS 11: IG: 375 (8) vs. CG: 390 (9)	**Participants** N=12,737 patients, out of whom 9,202 (72.2%) patients within 3 h of injury. **Study groups** IG: TXA (N=6,406; 4,649 ≤3 h) 1 g of tranexamic acid infused over 10 min, started immediately after randomisation, followed by an intravenous infusion of 1 g over 8 h (four ampules of TXA 500 mg) CG: 100 mL bag of 0.9% sodium chloride (N=6,331; 4,553 ≤3 h)	All results for patients randomly assigned within 3h: **Head injury-related death in hospital (28 days): n/N (%)** overall: IG: 855/4,613 (18.5) vs. CG: 892/4514 (19.8) Risk ratio (95% CI): 0.94 (0.86–1.02) GCS severe (3-8) IG: 689/1,739 (39.6) vs. GC: 685/1,710 (40.1) Risk ratio (95% CI): 0.99 (0.91–1.07) no obvious effect of time to treatment in patients with severe head injury (p=0·73). **Stratification by time** Early treatment was more effective than later treatment in patients with mild and moderate head injury (p=0·005) but we found no obvious effect of time to treatment in patients with severe head injury (p=0·73). Other endpoints were not reported separately for severe TBI.	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: + Attrition bias: + Detection bias: + **Authors' conclusion** "We found a substantial reduction in head injury-related deaths with tranexamic acid in patients with mild and moderate head injuries but no apparent reduction in those with severe head injury." **Reviewers' conclusion** CRASH-3 is a randomised controlled trial of good quality with large sample size, indicating reliable results.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	GCS 12: IG: 476 (10) vs. CG: 478 (10) GCS 13: IG: 297 (6) vs. CG: 312 (7) GCS 14: IG: 526 (11) vs. CG: 458 (10) GCS 15: IG: 484 (10) vs. CG: 492 (11) Unknown: IG: 28 (1) vs. CG: 35 (1)			
Guyette (2020) "Tranexamic Acid During Prehospital Transport in Patients at Risk for Hemorrhage After Injury: A Double-blind, Placebo-Controlled, Randomized Clinical Trial". *JAMA Surgery* (2021); 156(1): 11-20 **Study design** Randomised controlled trial (STAAMP) **Aim of the study** To assess the effectiveness and safety of tranexamic acid administered before hospitalization compared with placebo in injured patients at risk for hemorrhage. **Setting** USA, 2015-2019	**Inclusion criteria** • injured patients at risk for hemorrhage transported from the scene or transferred from an outside emergency department • at least 1 episode of hypotension (systolic blood pressure ≤90 mmHg) or tachycardia (heart rate ≥110 beats per minute) before arrival at a participating center **Exclusion criteria** • age >90 years, <18 years • lack of intravenous or intraosseous access • isolated fall from standing • documented cervical cord injury • known prisoner or pregnancy • traumatic arrest of >5 minutes • penetrating brain injury • isolated drowning or hanging • objection to study voiced at scene • wearing a STAAMP study opt-out bracelet. **Characteristics** Age, years, mean ± SD Overall: 42 ± 18	**Participants** N=903 patients **Study groups** IG: TXA (N=477) The treatment arms received a 1-g bolus of tranexamic acid (for 10 minutes) en route to the hospital. • TXA abbreviated: 1g TXA + placebo + placebo (N=151) • TXA standard: 1g TXA +1g TXA + placebo (N=141) • TXA repeat: 1g TXA + 1g TXA + 1g TXA (N=150) CG: placebo bolus + placebo bolus + placebo infusion (N=456) **Co-interventions** Phase A (prehospital): infusion over 10 min • 1 g of TXA 10mL of solution + 100-mL bag of 0.9% saline • 10 mL of sterile water + 100-mL bag of 0.9% saline.	**Mortality (30 days): n/N (%)** Overall IG: 36/442 (8.1) vs. 45/452 (10.0) (9 missing) Risk ratio (95% CI) 0.82 (0.60-1.11) By dosing regimen *TXA abbreviated* 14/150 (9.3) vs. CG: 45/452 (10.0) Risk ratio (95% CI): 0.94 (0.65-1.36), p=0.74 *TXA standard* 11/141 (7.8) vs. CG: 45/452 (10.0) Risk ratio (95% CI): 0.78 (0.50-1.24), p=0.30 *TXA repeat* 11/151 (7.3) vs. CG: 45/452 (10.0) Risk ratio (95% CI): 0.73 (0.54-0.99), p=0.04 **By TBI severity** No severe TBI (head AIS≤2) IG: 17/352 (4.8) vs. CG: 25/374 (6.7) Risk ratio (95% CI): 0.72 (0.46-1.14) Severe TBI (head AIS>2) IG: 19/90 (21.1) vs. 20/78 (25.6) Risk ratio (95% CI): 0.82 (0.55-1.24) Adjusted p=0.86 for interaction	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: + Attrition bias: + Detection bias: + **Authors' conclusion** "Patients with severe shock (systolic blood pressure ≤70mmHg) who received tranexamic acid demonstrated lower 30-day mortality compared with placebo." **Reviewers' conclusion** The study has a low risk of bias. The subgroup of severe shock patients (SBP ≤70mmHg) contains a small number of patients (N=58).

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG: 41 ± 17 CG: 42 ± 18 <u>Male sex, n (%)</u> Overall: 686 (74.0) IG: 327 (73.2) CG: 341 (74.8) ISS, median (IQR) Overall: 12 (5-22) IG: 13 (5-22) CG: 11 (4-22) <u>Initial GCS<8: n (%)</u> IG: 89 (19.9) CG: 107 (23.5)	Phase B intervention (hospital): infusion over 10 min • 1g TXA in 10 mL of solution • 10 mL of placebo (sterile water) added to a 100 mL bag of 0.9% saline Phase C intervention (hospital): infusion over 8h • 1 g of TXA in 10 mL of solution 10 mL of placebo + 100-mL bag of 0.9% saline	**By transfusion received** <u>No transfusion received</u> IG: 10/289 (3.5) vs. CG: 10/295 (3.4) Risk ratio (95% CI): 1.02 (0.49-2.15) <u>Transfusion received</u> IG: 26/153 (17.0) vs. 35/157 (22.3) Risk ratio (95% CI): 0.76 (0.57-1.01) Adjusted p=0.32 for interaction **By shock severity** (post-hoc analysis) <u>Tachycardia only</u> IG: 18/316 (5.7) vs. CG: 21/320 (6.6) Risk ratio (95% CI): 0.87 (0.56-1.34), p=0.52 <u>SBP <90 mm Hg</u> IG: 13/99 (13.1) vs. CG: 13/101 (12.9) Risk ratio (95% CI): 1.02 (0.55-1.90), p=0.95 <u>SBP <70 mm Hg</u> IG: 5/27 (18.5) vs. CG: 11/31 (35.5) Risk ratio (95% CI): 0.52 (0.34-0.80), p=0.003 **By time from injury** (post-hoc analysis) <u>≤1h</u> IG: 10/219 (4.6) vs. CG: 18/238 (7.6) Risk ratio (95% CI): 0.60 (0.44-0.83) <u>>1h</u> IG: 26/223 (11.7) vs. 27/214 (12.6) Risk ratio (95% CI): 0.92 (0.52-1.64) §only percentage reported	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Khan (2018) „Severely Injured Trauma Patients With Admission Hyperfibrinolysis; Is There A Role Of Tranexemic Acid? Findings From The PROPPR Trial", *Journal of Trauma and Acute Care Surgery, 85(5): 851–857* **Study design** Comparative registry trial (secondary analysis of PROPPR database) **Aim of the study** The aim of the study was to analyze the role of TXA in severely injured trauma patients with admission hyperfibrinolysis. **Setting** North America, PROPPR Trial 2012-2013	In Addition to PROPPR **Inclusion criteria** • trauma patients with hyperfibrinolysis on admission measured via thromboelastography. Hyperfibrinolysis was defined as Ly30 ≥3% on thromboelastography **Exclusion criteria** • all patients who received TXA >3 hours of injury **Characteristics** Age: mean, ± SD IG: 42.5 ± 20 (p=0.33) CG: 38.7 ± 17 Male gender: % § IG: 66% (p=0.84) CG: 68% Injury Severity Score (ISS): median (IQR) IG: 38 (23 - 45) (p=0.56) CG: 35 (21 - 45) GCS: median, IQR) IG: 6 (3 - 15) (p=0.34) CG: 8 (3 - 15) SBP: median (IQR) IG: 90 (70 - 126) (p=0.28) CG: 101 (80 - 131) Lactate: median (IQR) IG: 8.3 (5.1 - 11.7) (p=0.83) CG: 9.5 (5.1 - 12.7)	**Participants** N=93 patients, matched in 1:2 ratio (117 patients pre-matching) **Study groups** IG: TXA (N=31) CG: no TXA (N=62) **Matching criteria** Propensity score matching according to age, gender, race, ED SBP, ED HR, mechanism of injury, ISS, head-AIS, GCS, and PROPPR intervention groups (1:1:1 or 1:1:2 transfusion ratios).	**Mortality§** - *primary outcomes* 6-hour: %§ IG: 13 (p=0.04) CG: 34 24-hour: %§ IG: 26 (p=0.25) CG: 39 30-day: %§ IG: 45 (p=0.82) CG: 50 **Cause of death§** Exsanguination/Hemorrhagic shock: %§ IG: 26 (p=0.39) CG: 32 TBI: %§ IG: 10 (p=0.62) CG: 13 Respiratory: %§ IG: 6.4 (p=0.26) CG: 1.6 Other: %§ IG: 3.2 (p=1.00) CG: 3.2 **Complications§ -** *Secondary outcomes* Deep venous thrombosis: % IG: 6.5 (p=0.59) CG: 3.2	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: + Attrition bias: + Detection bias: + **Authors' conclusion** "Tranexamic acid (TXA) was associated with increased 6 hour survival but does not improve long term outcomes in severely injured trauma patients with hemorrhage who develop hyperfibrinolysis." **Reviewers' conclusion** There may be a risk of performance bias because TXA use was not prescribed in the PROPPR study protocol and left to the discretion of the trauma attending. However, patients received the same care apart from TXA use and cohorts were matched according to confounders and transfusion ratios showing consistent results.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Transfusion ratio (1:1:1): %§ IG: 55% CG: 47% § n=total number of patients not reported		Acute Kidney Injury (AKI): % IG: 45 (p=0.01) CG: 19 Sepsis: % IG: 35 (p=0.04) CG: 16 Multiple organ failure: % IG: 19 (p=0.01) CG: 6.4 ICU free days: median (IQR) IG: 0 (0 – 3) (p=0.22) CG: 0 (0–5) § n=number of patients with event not reported	
Meizoso (2018) "Increased risk of fibrinolysis shutdown among severely injured trauma patients receiving tranexamic acid". *Journal of Trauma and Acute Care Surgery* 84(3), 426 - 432. **Study design** Prospective cohort study (subanalysis) **Aim of the study** "The aim of this study was to test the hypothesis that TXA administration is associated with fibrinolysis shutdown in a group of	**Inclusion criteria** • Adult trauma patients [1] • enrolled in a prospective observational trial of postinjury coagulation changes in severely injured patients in the trauma intensive care unit (ICU) • thromboelastography (TEG) drawn upon ICU admission **Exclusion criteria** • burn injury • pregnancy • incarceration **Characteristics** Age (years, mean ± SD) IG: 46 ± 15 vs. CG: 46 ± 19 (p=0.892) Sex (male / female, n (%))	**Participants** N=218 patients **Study groups** IG: Tranexamic acid (TXA) (N=35, 16%): 1-g bolus over 10 minutes followed by 1 g infusion over 8 hours at the discretion of the trauma surgeons and anesthesiologists within 3 hours after injury. CG: No TXA (N=183, 84%)	**ICU-free days, median (IQR)** IG: 16 (4–55) vs. CG: 10 (4–19) (p=0.060) Hospital LOS (days), median (IQR) IG: 41 (23–92) vs. CG: 25 (15–44) (p=0.015) Mortality, n (%) IG: 6 (17.1) vs. CG: 27 (14.8) (p=0.718) **Fibrinolysis phenotype, n (%)** Shutdown IG: 32 (91.4) vs. CG: 107 (58.5) (p<0.0001) Physiologic IG: 3 (8.6) vs. CG: 68 (37.2) (p=0.001) Hyperfibrinolysis IG: 0 (0) vs. CG: 8 (4.4) (p=0.208)	**Level of evidence** 3b↓ **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Patients who received TXA were at increased risk of fibrinolysis shutdown compared with patients who did not receive TXA. We recommend that administration of TXA be limited to severely injured patients

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
high-risk trauma patients." **Setting** USA, 2011-2015	IG: 27 (77.1) / 8 (22.9) vs. CG: 148 (81.3) / 34 (18.7) (p=0.567) Admission SBP (mmHg, mean ± SD) IG: 98 ± 32 vs. CG: 123 ± 41 (p=0.001) Admission Shock Index (mean ± SD) IG: 1.23 ± 0.60 vs. CG: 0.90 ± 0.41 (p<0.0001) Admission GCS (median, IQR) IG: 9 (4–15) vs. CG: 14 (6–15) (p=0.074) ISS (mean ±SD) IG: 30 ± 15 vs. CG: 28 ± 13 (p=0.377) ISS >15[1] (n (%)) IG: 30 (85.7) vs. CG: 150 (82.0) (p=0.592) Massive Transfusion , n (%) IG: 23 (65.7) vs. CG: 31 (18.9) (p<0.0001) [1] CAVE: 14.3% / 18% are ISS <15		**Regression analysis** Independent predictors of fibrinolysis shutdown (adjusted RR, 95% CI) TXA: 1.35 (1.10–1.64) (p=0.004) Cryoprecipitate: 1.29 (1.07–1.56) (p=0.007)	with evidence of hyperfibrinolysis and recommend caution in those with evidence of fibrinolysis shutdown." **Reviewers' conclusion** There may be a high risk of selection bias. The groups differ in baseline factors.
Moore (2017) "Tranexamic acid is associated with increased mortality in patients with physiological fibrinolysis ", *Journal of Surgical Research* 2017; 220: 438-443. **Study design** Prospective cohort study **Aim of the study**	**Inclusion criteria** • Adult trauma patients (aged >18 years) • highest level of activation at level I trauma center • new injury severity score (NISS) >15 **Characteristics** Age [y], median (IQR) IG: 27 (24-54), p=0.214 CG: 34 (27-49) Male gender, %§	**Participants** N=232 patients **Study groups** IG: TXA (N=26) CG: no TXA (N=206)	**Mortality** Mortality (in-hospital): %§ IG: 50, p<0.001 CG: 17 *Mortality (in-hospital) by phenotype* Hyperfibrinolysis, % IG: 56, p=0.023 CG: 19 Shutdown, %	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"The aim of the study was to investigate if TXA in patients with a physiological level of fibrinolysis will have an increase in mortality compared with other fibrinolytic phenotypes." **Setting:** USA, 2014-2016	IG: 85, p=0.362 CG: 77 NISS, median (IQR) IG: 48 (29-57), p=0.001 CG: 29 (22-43) INR, median (IQR) IG: 1.4 (1.2-1.8), p<0.001 CG: 1.2 (1.1-1.3) **Fibrinolysis phenotype (n)** Hyperfibrinolysis, n (N=64) IG: 10 CG: 54 Shutdown, n (N=54) IG: 8 CG: 46 Physiologic, n (N=114) IG: 8 CG: 106 § n=number of patients with event not reported		IG: 38, p=0.604 CG: 28 Physiologic, % IG: 63, p<0.001 CG: 11 Death associated with haemorrhage§ (%) IG: 55% (p=0.060) CG: 23% TXA as predictor of mortality by fibrinolysis phenotype (adj. for NISS) Physiologic (p=0.018) Hyperfibrinolysis (p=0.116) Shutdown (p=0.597) Massive transfusion: %§ IG: 69, p<0.001 CG: 12 § n=number of patients with event not reported	"There was no clear benefit of receiving TXA in this study, and patients who present to the hospital with physiologic levels of fibrinolysis, who received TXA, had the highest mortality." **Reviewers' conclusion** There is a substantial risk of selection bias due to imbalance of NISS and INR. Blinding was unclear and co-interventions were different (patients in the TXA group tended to receive more blood products), so that there is a risk for performance bias. The risk of attrition bias is unclear because the numbers in the analyses were not reported.
Nishijima (2019) "The Effect of Tranexamic Acid on Functional Outcomes: An Exploratory Analysis of the CRASH-2 Randomized Controlled Trial". *Annals of Emergency Medicine.* 74(1), 79-87	**Inclusion criteria** • Same as in CRASH-2 trial and • only patients randomised 3 hours or less from the time of injury **Exclusion criteria** • patients who did not have modified Oxford Handicap Scale scores reported **Characteristics**	**Participants** N=13,432 patients, subset of CRASH-2 dataset **Study groups** IG: TXA (N=6,753) CG: Placebo (N=6,679)	**Modified Oxford Handicap Scale score (at discharge or at 28 days): n (%)** No symptoms IG: 1,052 (15.6) CG: 941 (13.9) Minor symptoms IG: 2,190 (32.4) CG: 2,140 (32.0)	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: + Attrition bias: + Detection bias: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Study design Randomised controlled trial (exploratory analysis of CRASH-2 trial data) **Aim of the study** The aim of the study was to evaluate whether tranexamic acid was associated with improved functional outcomes and, if so, which patients benefitted from tranexamic acid use. **Setting** 40 countries, 2005-2010	Age (mean ± SD) IG: 34.1 (± 13.8) CG: 34.1 (± 14.2) Male sex: n (%)) IG: 5,605 (83.0) CG: 5,606 (84.0) Initial GCS: median (IQR) IG: 12.7 (3.6) CG: 12.7 (3.6) **Baseline risk of mortality stratum: n %)§** <6 IG: 2,415 (35.8) CG: 2,325 (34.9) 6-20 IG: 2,410 (35.7) CG: 2,391 (35.9) 21- 50 IG: 1,171 (17.4) CG: 1,201 (18.0) >50 IG: 753 (11.2) CG: 752 (11.3) Days in hospital (median, IQR) IG: 7 (3–14) CG: 7 (3–14)		Some restrictions IG: 1,311 (19.4) CG: 1,324 (19.8) Dependent IG: 807 (11.9) CG: 779 (11.7) Fully dependent IG: 421 (6.2) CG: 396 (5.9) Dead IG: 972 (14.4) CG: 1,109 (16.6) mean utility-weighted modified Oxford Handicap Scale score: mean ± SD IG: 0.66 (± 0.33) CG: 0.64 (± 0.34) mean difference = 0.02 (95% CI 0.01 – 0.03) (p<0.001) 28-day mean utility-weighted modified Oxford Handicap Scale score (Area under the curve analysis): mean ± SD: IG: 0.55 (± 0.30) CG: 0.53 (± 0.31) mean difference = 0.02 (95% CI 0.01 – 0.03) **functional outcomes, stratified by CRASH-2 prognostic score: n (%) (95% CI) §** 0-6 % baseline risk Overall favorable outcome (no symptoms)	**Authors' conclusion** "In this exploratory analysis we found that adult trauma patients randomized to tranexamic acid within 3 hours of injury had better functional outcomes compared with patients randomized to placebo." **Reviewers' conclusion** The trial is of good quality indicating reliable results.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			IG: 534 (22.1) (95% CI 20.5 – 23.8) CG: 425 (18.3) (95% CI 16.7 – 19.9) IG vs. CG: adjusted OR for favorable outcome = 1.28 (95% CI 1.11 – 1.48) <u>6-20 % baseline risk</u> Overall favorable outcome (no or minor symptoms) IG: 1209 (50.2) (95% CI 48.1 – 52.2) CG: 1202 (50.3) (95% CI 48.2 – 52.3) IG vs. CG: adjusted OR for favorable outcome = 0.99 (95% CI 0.88 – 1.11) <u>21-50 % baseline risk</u> Overall favorable outcome (no or minor symptoms or some restrictions) IG: 611 (52.2) (95% CI 49.3 – 55.1) CG: 588 (49.0) (95% CI 46.1% - 51.8) IG vs. CG: adjusted OR for favorable outcome = 1.15 (95% CI 0.97 – 1.37) <u>>50 % baseline risk</u> Overall favorable outcome (no or minor symptoms or some restrictions or dependent) IG: 238 (31.6) (95% CI 28.3 – 35.1) CG: 217 (28.9) (95% CI 25.6 – 32.2) IG vs. CG: adjusted OR for favorable outcome = 1.24 (95% CI 0.97 – 1.57) <u>Overall proportion of patients with favorable outcomes: n (%) (95% CI):</u> IG: 5,360 (79.4) (95% CI 78.4% - 80.3) CG: 5,174 (77.) (95% CI 76.5% - 78.5) difference 1.9% (95% CI 0.5% - 3.3)	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			NNT = 52 (95% CI 30 – 196) § Favorable versus unfavorable outcomes were defined separately for each risk stratum	
Roberts (2014) "Mechanism of action of tranexamic acid in bleeding trauma patients: an exploratory analysis of data from the CRASH-2 trial." *Critical Care* 2014; 18(6): 1-5. **Study design** Randomised controlled trial (CRASH-2) **Aim of the study** "We conducted further analyses of the CRASH-2 trial data to examine the timing of the effect of TXA on mortality." **Setting** 40 countries, 2005-2010	Same as *CRASH-2:* **Inclusion criteria** • adult trauma patients with, or at risk of, significant bleeding, and • who were within 8 h of their injury **Characteristics** no patient characteristics reported	**Participants** N=20,211 patients **Study groups** IG: TXA (loading dose 1 g over 10 minutes followed by an infusion of 1 g over 8 h) (N=10,060 with outcome data) CG: matching placebo (N=10,067 with outcome data)	**All cause mortality (incl. non-bleeding patients!)** 0 days since injury, Hazard Ratio (95% CI) 0.83 (0.73, 0.93) 1 day since injury, Hazard Ratio (95% CI) 0.91 (0.79, 1.04) 2 days since injury, Hazard Ratio (95% CI) 0.96 (0.77, 1.19) 3 days since injury, Hazard Ratio (95% CI) 1.01 (0.76, 1.34) 4 days since injury, Hazard Ratio (95% CI) 0.96 (0.70, 1.36) **Mortality due to bleeding** 0 days since injury, Hazard Ratio (95% CI) 0.80 (0.68, 0.94) 1 day since injury, Hazard Ratio (95% CI) 0.89 (0.72, 1.11) 2 days since injury, Hazard Ratio (95% CI) 1.17 (0.74, 1.86) 3 days since injury, Hazard Ratio (95% CI) 0.66 (0.32, 1.37) 4 days since injury, Hazard Ratio (95% CI)	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: + Attrition bias: + Detection bias: + **Authors' conclusion** "Early administration of tranexamic acid appears to reduce mortality primarily by preventing exsanguination on the day of the injury." **Reviewers' conclusion** It is unclear if the analysis was predefined. Apart from that, this subgroup analyses of the CRASH-2 trial is of good quality indicating reliable results.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			0.77 (0.29, 2.06) **Non-bleeding mortality** 0 days since injury, Hazard Ratio (95% CI) 0.87 (0.71, 1.06) 1 day since injury, Hazard Ratio (95% CI) 0.92 (0.76, 1.11) 2 days since injury, Hazard Ratio (95% CI) 0.91 (0.71, 1.16) 3 days since injury, Hazard Ratio (95% CI) 1.09 (0.80, 1.48) 4 days since injury, Hazard Ratio (95% CI) 1.01 (0.71, 1.43) **All cause mortality, Time to treatment ≤3h (incl. non-bleeding patients!)** 0 days since injury, Hazard Ratio (95% CI) 0.78 (0.68, 0.90) 1 day since injury, Hazard Ratio (95% CI) 0.86 (0.72, 1.02) 2 days since injury, Hazard Ratio (95% CI) 0.86 (0.65, 1.13) 3 days since injury, Hazard Ratio (95% CI) 0.95 (0.66, 1.37) 4 days since injury, Hazard Ratio (95% CI) 0.94 (0.61, 1.45) **All cause mortality, time to treatment >3h (incl. non-bleeding patients!)**	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			<u>0 days since injury, Hazard Ratio (95% CI)</u> 1.02 (0.76, 1.36) <u>1 day since injury, Hazard Ratio (95% CI)</u> 1.02 (0.80, 1.31) <u>2 days since injury, Hazard Ratio (95% CI)</u> 1.16 (0.81, 1.66) <u>3 days since injury, Hazard Ratio (95% CI)</u> 1.11 (0.73, 1.71) <u>4 days since injury, Hazard Ratio (95% CI)</u> 1.04 (0.62, 1.75)	
Roberts (2017) "Tranexamic acid in bleeding trauma patients: an exploration of benefits and harms." *Trials* 18: 48 **Study design** Randomised controlled trial (predefined subgroup analysis of CRASH-2) **Aim of the study** We examine how patient characteristics vary by time to treatment in the CRASH-2 trial and explore whether any such variations explain the time-dependent treatment effect. **Setting**	Same as *CRASH-2:* **Inclusion criteria** • Adult trauma patients • with, or at risk of, significant bleeding within 8 h of their injury **Characteristics** no patient characteristics reported	**Participants** N=20,211 patients **Study groups** IG: TXA (loading dose 1 g over 10 min followed by an infusion of 1 g over 8 h) (N=10,093) CG: matching placebo (N=10,114)	**Subgroup analyses of CRASH-2** • SBP (≤75, 76–89, >89 mmHg) • GCS score (severe 3–8, moderate 9–12, mild 13–15) • type of injury (penetrating versus blunt) <u>1. Effects of **early** tranexamic acid (TXA) treatment stratified by systolic blood pressure on death due to bleeding: Risk Ratio (95% CI)</u> SBP ≤75 RR: 0.73 (0.61-0.86) SBP 76-89 RR: 0.86 (0.64-1.16) SBP>89 RR: 0.71 (0.54-0.92) SBP <100 mg and treatment initiated within 1h RR = 0.69 (0.58 - 0.83) SBP <100 mg and treatment between 1-3h RR = 0.84; 95% (0.67 - 1.04)	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: + Attrition bias: + Detection bias: + **Authors' conclusion** "When given within 3 h of injury, TXA reduces death due to bleeding regardless of injury type, GCS or blood pressure." **Reviewers' conclusion** This predefined subgroup analyses of the CRASH-2

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
40 countries, 2005-2010			Effects of **late** tranexamic acid (TXA) treatment stratified by **systolic blood pressure** (SBP) on death due to bleeding: Risk Ratio (95% CI) Systolic blood pressure (mm Hg) ≤75, 1.36 (0.92-2.01) 2. Effects of **early** tranexamic acid (TXA) treatment stratified by **Glasgow Coma Scale** (GCS) score on death due to bleeding: Risk Ratio (95% CI) GCS 3-8 RR: 0.82 (0.66-1.02) Effects of **late** tranexamic acid (TXA) treatment stratified by **Glasgow Coma Scale** (GCS) score on death due to bleeding: Risk Ratio (95% CI) GCS 3-8 1.42 (0.90-2.25) 3. Effects of **early** tranexamic acid (TXA) treatment stratified by **type of injury** on death due to bleeding: Risk Ratio (95% CI) Blunt 0.72 (0.60 - 0.86) Penetrating 0.73 (0.60 – 0.90) Effects of **late** tranexamic acid (TXA) treatment stratified by **type of injury** on death due to bleeding: Risk Ratio (95% CI) Blunt 1.48 (1.12 – 1.96) Penetrating 1.25 (0.74 – 2.12)	trial is of good quality indicating reliable results.
Shiraishi (2017) „Effectiveness of early administration of tranexamic acid in patients with se-	**Inclusion criteria** • patients aged ≥18 years • ISS ≥16 • Admitted to one of the study hospitals	**Participants** N=500 after matching **Study groups**	28-day mortality§ (%) (mean difference, (95% CI): IG: 10.0 (−8.4 (−14.5, −2.3)) CG: 18.4 Odds Ratio (95% CI) = 0.49 (0.29, 0.83)	**Level of evidence** 2b **Risk of bias** Selection bias: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
vere trauma". *British Journal of Surgery* 104: 710-717. **Study design** Comparative registry study (Japanese Observational Study for Coagulation and Thrombolysis in Early Trauma) **Aim of the study** The aims of the present study were to compare 28-day mortality and blood transfusion amounts among severely injured subjects who did or did not receive tranexamic acid within 3 h of injury, based on propensity score matching that balanced for background characteristics including ISS and indicators of coagulopathy and fibrinolysis. **Setting** Japan, 2012	**Exclusion criteria** • complications such as out-of-hospital cardiac arrest • burns • liver cirrhosis • isolated cervical spine injury not caused by a high-energy accident • pregnant **Characteristics (after matching)** Age (median, IQR) IG: 57 (36–72) (SMD = −0.038) CG: 56 (38–69) Gender (male, n (%)) IG: 181 (72.4) (SMD = −0.065) CG: 186 (74.4) Systolic BP (mmHg, median, IQR) IG: 136 (110 - 159) (SMD = 0.031) CG: 133 (110 - 157) GCS (median, IQR) IG: 13 (8 - 15) (SMD = −0.004) CG: 13 (8 - 15) Injury Severity Score (ISS) (median, IQR) IG: 25 (17 - 29) (SMD = −0.007) CG: 25 (17 - 29) Traumatic Brain Injury (n, (%)) IG: 188 (75.2) (SMD = −0.019) CG: 190 (76.0) Lactate (mmol/l, median, IQR)	IG: TXA (N=250), IV administration within 3h after injury CG: No TXA (N=250 propensity score-matched controls) **Matching criteria** 1:1 Propensity score matching Before matching: N=281 TXA, n=525 control patients. Logistic regression analysis was employed to compute the propensity score for the use of the study intervention in each subject from the known pretreatment variables that were considered to be associated clinically with the primary outcome of the study.	Cause-specific mortality§ (%): Primary brain injury IG: 6.0 (−7.2 (−12.3, −2.1)) CG: 13.2 Odds Ratio (95% CI) = 0.42 (0.22, 0.88)) Haemorrhage IG: 2.8 (−1.2 (−4.4, 2.0)) CG: 4.0 Odds Ratio (95% CI) = 0.69 (0.26, 1.85) Thromboembolic complications§ (%): IG: 1.2 (−0.8 (−3.0, 1.4)) CG: 2.0 Odds Ratio (95% CI) = 0.60 (0.14, 2.53) § N=number of patients with event not reported	Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Early tranexamic acid use was associated with reduced mortality in severely injured patients, in particular those with a primary brain injury." **Reviewers' conclusion** Precautions were taken to minimise biases. The intervention and control groups were comparable with respect to baseline characteristics; co-interventions are not reported.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG: 2.6 (1.7 - 4.0) (SMD = −0·007) CG: 2.6 (1.6 - 3.9) SMD = Standardized Mean Difference			
Spinella (2020) "The immunologic effect of early intravenous two and four gram bolus dosing of tranexamic acid compared to placebo in patients with severe traumatic bleeding (TAMPITI): A randomized, double-blind, placebo-controlled, single-center trial". *Frontiers in Immunology* 11: 2085. **Study design** Randomised controlled trial **Aim of the study** The hemostatic properties of tranexamic acid (TXA) are well described, but the immunological effects of TXA administration after traumatic injury have not been thoroughly examined. We hypothesized TXA would reduce monocyte activation in bleeding trauma patients with severe injury. **Setting**	**Inclusion criteria** • Age ≥18 • sustained a traumatic injury which required them to receive at least one unit of red blood cells (RBC) or required an emergent operation for possible bleeding control • were able to receive the study medication (TXA or placebo) within 2 h of time of injury **Exclusion criteria** • Suspected acute MI or stroke (thromboembolic and/or hemorrhagic) on admission • Known inherited coagulation disorders • Known past medical history of thromboembolic events (DVT, PE, MI, Thromboembolic Stroke) • Known history of seizures and/or seizure after injury/on admission related to this hospitalization • Suspected or known pregnancy • Futile care • Known current state of immunosuppression (i.e. on high dose steroids, chemotherapeutics, etc.) • Unknown estimated time of injury • Patients wearing an "Opt Out" TAMPITI Study bracelet • Known presence of subarachnoid hemorrhage	**Participants** N=150 patients **Study groups** TXA 2g: 2 g of TXA (N=49)* TXA 4g: 4 g of TXA (N=50) CG: placebo (N=50) each in 40 mL of normal saline i.v. over 10 min * 1 patient withdrawn (age <18 yrs)	<u>28-day mortality n/N, (%)</u> CG: 6/49 (12.2) vs. TXA 2g: 5/44 (11.4) vs. TXA 4g: 4/48 (8.33), p=0.8 <u>Thromboembolic event n/N, (%)</u> CG: 6/50 (12.0) vs. TXA 2g: 13/49 (26.5) vs. TXA 4g: 16/50 (32.0), p=0.05 <u>ICU admission n/N, (%)</u> CG: 37/50 (74.0) vs. TXA 2g: 36/49 (73.5) vs. TXA 4g: 38/50, p=0.96 <u>Mechanical ventilation n/N, (%)</u> CG: 30/50 (60.0) vs. TXA 2g: 28/48 (58.3) vs. TXA 4g: 30/49 (61.2), p=0.96 <u>ICU-free Days, [N] median (IQR)</u> CG: [50] 27.3 (17.4 – 28.6) vs. TXA 2g: [45] 27.1 (24.0 – 29.4) vs. TXA 4g: [49] 27.1 (24.3 – 29.0), p=0.77 <u>Max MODS in 7 days , [N] median (IQR)</u> CG: [49] 4.00 (1.00 – 7.00) vs. TXA 2g: [49] 4.00 (1.00 – 6.00) vs. TXA 4g: [50] 4.00 (1.00 – 8.00), p=0.79 <u>Seizure n/N, (%)</u>	**Level of evidence** 2b↓ **Risk of bias** Selection bias: + Performance bias: + Attrition bias: + Detection bias: + **Authors' conclusion** "In conclusion, in this RCT in patients with primarily penetrating traumatic injuries, 2 and 4 g i.v. bolus dosing of TXA had minimal immunomodulatory and hemostatic effects." **Reviewers' conclusion** The clinical outcomes (mortality, morbidity) were secondary outcomes. The RCT was not powered to detect differences in clinical outcomes.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
USA, 2016-2017	• Isolated injuries to hands and/or feet (distal) • Administration of antifibrinolytics pre-hospital and/or during this ED admission prior to enrollment **Characteristics** Age [y], median (IQR) CG: 27.0 (22.0 – 34.0) vs. TXA 2g: 26.0 (22.0 – 40.0) vs. TXA 4g: 31.0 (25.0 – 44.0), p=0.13 Male n (%) CG: 45 (90.0) vs. TXA 2g: 44 (90.0) vs. TXA 4g: 42 (84.0), p=0.58 GCS, [n] median (IQR) CG: 15.0 (12.0 – 15.0) vs. TXA 2g: 15.0 (11.0 – 15.0) vs. TXA 4g: 15.0 (14.0 – 15.0), p=0.26		CG: 0/49 (0.00) vs. TXA 2g: 1/44 (2.27) vs. TXA 4g 2/48 (4.17), p=0.42 MODS = multiple organ dysfunction score	
Wafaisade (2016) "Prehospital administration of tranexamic acid in trauma patients". *Critical Care* 20(1): 143. **Study design** Comparative registry study (TraumaRegister DGU®) **Aim of the study** the aim of the present study was to assess	**Inclusion criteria** ADAC Air Rescue Service database: • Primarily admitted trauma patient • Critical injury, defined as preclinically assessed NACA IV (potentially life-threatening), NACA V (acute danger) or NACA VI (respiratory and/or cardiac arrest) • Admission to a trauma centre participating in the TR-DGU TR-DGU database: • Primary admission	**Study groups** IG: prehospital TXA (N=258) CG: no prehospital TXA (N=258 propensity score-matched controls) **Matching criteria** Propensity score matching Multivariable analysis using a logistic regression model with prehospital administration of tranexamic acid as a dependent variable (N=5765)	Time to death, days, mean ± SD IG: 8.8 (13.4) vs. CG: 3.6 (4.9), p=0.001 6-h mortality, n (%) IG: 5/258 (1.9) vs. CG: 24/258 (9.3), p<0.001 12-h mortality, n (%) IG: 9/258 (3.5) vs. CG: 28/258 (10.9), p=0.002 24-h mortality, n (%) IG: 15/258 (5.8) vs. CG: 32/258 (12.4), p=0.01 30-day mortality, n (%) IG: 36/258 (14.0) vs. CG: 42/258 (16.3), p=0.54	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: + Attrition bias: + Detection bias: ? **Authors' conclusion** "In the present study of trauma patients, prehospi-

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
whether prehospital intravenous (i.v.) administration of TXA in trauma patients is associated with improved outcomes. **Setting** Germany, 2012-2014	• Treatment in a German trauma centre (i.e., exclusion of trauma centres from other countries) **Characteristics** Age, years, mean ± SD IG: 43 ± 19 vs. CG: 41 ± 18, p=0.48 Male, sex, n (%) IG: 187 (72.5) vs. CG: 187 (72.5), p=1.00 ISS, points, mean ± SD IG: 24 ± 14 vs. CG: 24 ± 16, p=0.46 SBP at scene ≤90 mmHg, n (%) IG: 55 (21.3) vs. CG: 54 (20.9), p=1.0 SBP at scene, mmHg, mean ± SD IG: 118 ± 34 vs. CG: 116 ± 33, p=0.36 GCS at scene ≤8, n (%) IG: 89 (34.5) vs. CG: 96 (37.2), p=0.58 GCS at scene, points, mean ± SD IG: 10.5 ± 4.9 vs. CG: 10.2 ± 5.0, p=0.69		In-hospital mortality overall, n (%) IG: 38/258 (14.7) vs. CG: 42/258 (16.3), p=0.72 Mortality prognosis in %, based on RISC 2 score (n) IG: 15.4% (258) vs. CG: 15.2% (258), p=0.38 ICU LOS, days, mean ± SD IG: 10.7 ± 12.6 vs. CG: 9.2 ± 11.4, p=0.03 Hospital LOS, days, mean ± SD IG: 25.5 ± 23.2 vs. CG: 22.3 ± 25.4, p=0.04 Thromboembolic event, n (%)[$] IG: 4/71 (5.6) vs. CG: 10/121 (8.3), p=0.58 Sepsis, n (%)[$] IG: 4/67 (6.0) vs. CG: 8/119 (6.7), p=1.00 Multiple organ failure, n (%)[$] IG: 27/74 (36.5) vs. CG: 35/121 (28.9), p=0.34 [$] As some values were missing, the respective population is documented in brackets for continuous variables and in the denominator for categorical variables.	tal use of TXA was associated with prolonged time to death and significantly improved early survival, suggesting benefits of TXA on haemostatic resuscitation. Until further evidence emerges, the results support the use of TXA during prehospital treatment of severely injured patients." **Reviewers' conclusion** Precautions were taken to minimise biases. The intervention and control groups were comparable with respect to both baseline characteristics and co-interventions. It is unclear how outcomes with missing values were determined.

Fibrinogen

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Ziegler (2021)	**Inclusion criteria** • Trauma patients • ≥18 years of either sex	**Participants** N=53 patients	FIBTEM maximum clot firmness (FIBTEM MCF) at emergency room admission, median difference (IQR)	**Level of evidence** 2b↓

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"Efficacy of prehospital administration of fibrinogen concentrate in trauma patients bleeding or presumed to bleed (FIinTIC): A multicentre, double-blind, placebo-controlled, randomised pilot study". *European Journal of Anaesthesiology* 38(4): 348. **Study design** Randomised controlled trial **Aim of the study** The aim of the study was to administer fibrinogen concentrate in the prehospital setting to improve blood clot stability in trauma patients bleeding or presumed to bleed. **Setting** Austria, Germany, Czech Republic, 2011-2015	• Major bleeding or occult bleeding • Need for volume replacement therapy • Patient admitted to one of the participating hospitals **Exclusion criteria** • Solely penetrating trauma • Solely head injury • In case of ongoing severe hemodynamic instability refractory to therapy (vasopressor, volume) • Patient with inevitable lethal course as evaluated by emergency physician • Need for CPR on the scene • Deep hypothermia (<30°C) • Obviously pregnant women • Patient with known recent history of thromboembolic events within the last 6 months • Patient known to be on anticoagulant therapy • Patient with known refusal of a participation in this clinical trial **Characteristics** Age [y], median (IQR) IG: 46 (34.5-58) vs. CG: 54 (37-56), p=0.4868 Sex Male, n (%) IG: 23/28 (82.1) vs. CG: 21/25 (84.0), p=1 ISS, median (IQR) IG: 25 (16-36) vs. CG: 16 (16-34), p=0.393 GCS, median (IQR) IG: 14.5 (6-15] vs. CG: 15 (13-15), p=0.574	**Study groups** IG: fibrinogen concentrate 1.5 g per 30 kg of estimated bodyweight (i.v., 20ml min-1) (N=37) CG: placebo (N=30) **Participants analysed/excluded from analysis** IG analysed (N=28) Excluded from analysis (*N*=9) • Transfer to non-study hospital (*N*=1) • Anticoagulant treatment (*N*=1) • Inevitably lethal course (*N*=2) • Primary endpoint missing (*N*=5) CG analysed (N=25) Excluded from analysis (*N*=5) • Transfer to non-study hospital (*N*=1) • Age <18 years (*N*=1) • Inevitably lethal course (*N*=1) • Primary endpoint missing (*N*=2)	CG vs. IG: -4, (-7 to -2), p<0.0026 FIBTEM maximum clot firmness (FIBTEM MCF) change from baseline to emergency room admission, median difference (IQR) CG vs. IG: -5 (-7 to -3), p<0.0001 EXTEM clotting time (EXTEM CT) at emergency room admission, median difference (IQR) CG vs. IG: 0 (-5 to 5), p<0.9858 EXTEM clotting time (EXTEM CT) change from baseline to emergency room admission, median difference (IQR) CG vs. IG: 6.8 (0 to 12), p<0.0509 EXTEM maximum clot firmness (EXTEM MCF) at emergency room admission, median difference (IQR) CG vs. IG: -5 (-9 to -2), p<0.0102 EXTEM maximum clot firmness (EXTEM MCF) change from baseline to emergency room admission, median difference (IQR) CG vs. IG: -5 (-8 to -2), p<0.0031 **Changes in FIBTEM maximum clot firmness (FIBTEM MCF) between baseline (T1) and 7 days posttrauma (T7)** T2: on arrival at the ED CG vs. IG:–4 (–7 to –2), p<0.0026 T3: 3 h after ED admission CG vs. IG:–3 (–6 to 0), p<0.0851 T4: 9 h after ED admission CG vs. IG: -2 (-5 to 1), p<0.1812	**Risk of bias** Selection bias: + Performance bias: + Attrition bias: – Detection bias: + **Authors' conclusion** "Early fibrinogen concentrate administration is feasible in the complex and time-sensitive environment of prehospital trauma care. It protects against early fibrinogen depletion, and promotes rapid blood clot initiation and clot stability." **Reviewers' conclusion** There is a risk of attrition bias as the primary endpoint is missing for more patients in the IG than then CG. The outcomes are surrogate outcomes; mortality, morbidity or transfusion requirements were not investigated.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			T5: 24 h after ED admission CG vs. IG: -2 (-5 to 1), p<0.102 T6: 48 h after ED admission CG vs. IG: -1 (-4 to 2), p<0.7328 T7: 7 days after ED admission CG vs. IG: -2 (-8 to 3), p<0.5084	

Intraossärer Zugang

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Chreiman (2018) "The IOs have it: a prospective observational study of vascular access success rates in patients in extremis using video review." *The Journal of Trauma and Acute Care Surgery* 84(4): 558-563. **Study design** Retrospective cohort study (study included because "The use of audiovisual recordings allowed us to collect data in a fashion similar to prospective real-time data collection […].") **Aim of the study**	**Inclusion criteria** • Hypovolemic trauma patients • Presenting to the hospital in extremis (absence of a palpable pulse or measureable blood pressure) • Vascular access: intraosseous (IO) (including tibial and humoral), peripheral IV (PIV), central venous catheter (CVC) (including internal jugular, subclavian, and femoral line) or intracardiac line (IC) **Characteristics** Male gender n (%) 35 (92) Age [y], median (IQR) 30 (25-38) Injury Mechanism, n (%)	**Participants** N=38 patients, 145 vascular access attempts **Study groups** IG: intraosseous access (52 attempts) CG 1: peripheral intravenous access (37 attempts) CG 2: central venous catheter access (52 attempts) CG 3: intracardiac line (4 attempts)	**Primary endpoint** Success rates by type of vascular access attempt: n/N (%) IG 48/52 (92) [tibial 38/38 (100), 2 with missing data; humeral 10/12 (83.3)] vs. CG 1: 12/37 (43.2) vs. CG 2: 23/52 (44.2) [Femoral: 11/ 24 (45.8), Subclavian: 11/24 (45.8), Internal Jugular 1/2 (50)] vs. CG 3: 3/4 (75) p<0.001 Success rates were not different between sites by access type (p=0.54 for tibia vs. humeral IO; p=0.99 for femoral vs. subclavian vs. internal jugular CVC) **Secondary endpoint** The time to completion of access attempts by type of vascular access, minutes: median (IQR) IG: 0.39 (0.13-0.65) vs.CG 1: 0.63 (0.35-0.96), adjusted p=0.03	**Level of evidence** 3b↓ **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: ? Detection bias: ? **Authors' conclusion** "Access attempts using IO are as fast as PIV attempts but are more than twice as likely to be successful. Attempts at CVC access in patients in extremis have high rates of failure and take a median of over 3 minutes. While IO access may not completely supplant PIVs and CVCs, IO access should

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
With the goal of informing guidelines for vascular access in hypovolemic trauma patients, we sought to study the real-time provision of vascular access in patients presenting to the hospital in extremis, defined for the purpose of this study as the absence of a palpable pulse or measurable blood pressure. **Setting** USA, 2016-2017	Gunshot wound 31 (82%) Stab wound 4 (10%) Other 3 (8%) <u>ISS, median (IQR)</u> 25 (16-25) All patients undergoing Emergency Department Thoracotomy.		Both IG and CG1 were faster than CG 2 [3.2 (1.72 – 5.23)], adjusted p<0.001	be considered as a first line therapy for trauma patients in extremis." **Reviewers' conclusion** Due to insufficient reporting it is unclear whether the groups are comparable. There may be a high risk of selection bias, and results need to be interpreted with caution.
Leidel (2012) "Comparison of intraosseous versus central venous vascular access in adults under resuscitation in the emergency department with inaccessible peripheral veins". *Resuscitation* 2012, 83: 40-45. **Study design** Prospective cohort study **Aim of the study** To compare the time required to establish IO access versus CVC in adult patients undergoing resuscitation who initially had unsuccessful attempts at peripheral IV access, as	**Inclusion criteria** • adults • all severely injured or critically ill patients under resuscitation • admitted to ED without at least 1 efficient 18-gauge peripheral IV access • indications for vascular access included blood drawing for serum analysis, delivery of drugs, antibiotics, fluids or blood products when no other access was available. **Exclusion criteria** • age <18 years • pregnancy • prisoners **Characteristics** <u>Gender male, n/N (%)</u>	**Participants** N=40 patients **Study groups** IG: intraosseous (IO) access (N=40) primarily proximal humerus CG: central venous catheter (CVC) (N=40) primarily subclavian vein (each patient received both IO and CVC, site depending on injury pattern) During initial resuscitation, peripheral IV access was attempted for ≤3 efforts or ≤2 min. If unsuccessful, IO access and CVC were performed in a standardised course of action by 2 independent operators. **IO devices** • battery driven EZ-IO system (Vidacare Corp.)	<u>Success rate on first attempt, n/N, % (95% CI)</u> IG: 34/40, 85 (74 to 96) CG: 24/40, 60 (45 to 75), p=0.024 <u>Procedure time [min], median (IQR)</u> IG: 2.0 (1.0 to 3.0) CG: 8.0 (5.5 to 10.0), p<0.001 <u>Unsuccessful attempts n/N</u> IG: 6/40 CG: 16/40 <u>Reasons for unsuccessful attempts</u> IG: cannula did not penetrate the bone cortex due to incorrect tibial insertion site (n=4) (BIG Bone Injection Gun); excessive humeral overlying soft tissue (n=2) (EZ-IO) CG: inability to insert or advance the guide wire into the vessel probably due to incorrect insertion site or technique	**Level of evidence** 3b↓ **Risk of bias** Selection bias: + Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion** "We found IO vascular access a safe, reliable and rapid option in adults under resuscitation in the emergency department with inaccessible peripheral veins. Compared to landmark-based CVC, IO cannulation

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
well as report on their complication rates. **Setting** Germany, 2007-2009	27/40 (68) Age [y], mean ± SD (range) 48 ± 21 (18-87) Obesity, BMI >30 kg/m^2, n/N (%) 7/40 (18) Trauma, n/N (%) *CAVE!* 29/40 (73)	• spring load driven Adult BIG Bone Injection Gun (WaisMed Ltd.)		was significantly more successful on first attempt and required significantly less time." **Reviewers' conclusion** The study was well conducted and reported. Study subjects were the same in both arms, and the study was sufficiently powered. Due to lack of blinding, there is a residual risk of performance bias. The relevance of the results for the severe trauma population is limited by the fact that a substantial fraction of the population (27%) were non-trauma patients, leading to downgrading.
+: low risk; –: high risk; ?: unclear risk; CI: Confidence Interval; HR: Hazard Ratio; IQR: Interquartile Range; ITT: Intention to Treat; OR: Odds Ratio; RR: Relative Risk; SD: Standard Deviation; SEM: Standard Error of Mean				

1.4 Analgesie

Es wurden keine Daten in Evidenztabellen extrahiert.

1.5 Thorax

In diesem Kapitel wurde das LoE nicht herabgestuft.

Verdachtsdiagnose Pneumo- und/oder Hämatothorax

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Press (2014) "Prospective Evaluation of Prehospital Trauma Ultrasound During Aeromedical Transport". *The Journal of Emergency Medicine* 2014, Vol. 47, No. 6, pp. 638–645. **Study design** Diagnostic cross-sectional study **Aim of the study** "The goal was to assess prehospital provider accuracy in performing the abdominal, cardiac, and lung components of EFAST." **Setting** USA, 7-month-study	**Inclusion criteria** • adult trauma patients (18 years or older) transferred directly from scene if time allowed after standard stabilization **Exclusion criteria** NR **Characteristics** Age [y], mean ± SD 41 ± 17 Male, n (%) 216 (74) ISS mean ± SD 16 ± 11 Trauma type, n (%) Blunt 252 (88.4) Penetrating 33 (11.6) Weight (kg), mean ± SD 82 ± 18 Scene systolic blood pressure (mm Hg), mean ± SD 130 ± 27	**Participants** Adult trauma patients from scene N=833 Patients with at least one HEMS ultrasound n=293 Number of lung HEMS ultrasound n=511 **Tests evaluated** Index text: In flight ultrasound. HEMS providers were trained to perform EFAST during a 2-month period. HEMS providers performed EFAST using the following views: hepatorenal, splenorenal, suprapubic, cardiac (subcostal or parasternal long-axis), right lung, and left lung. All views were standard and in accordance with imaging described by the American College of Emergency Physicians and American Institute of Ultrasound in Medicine (19). Abdominal and cardiac examinations were performed to evaluate for intraperitoneal and pericardial fluid, respectively. Lung ultrasound was performed to evaluate for lung slide to exclude or diagnose pneumothorax. Abdominal views were saved as still images, and cardiac and lung views as 4-s video clips. Reference standard: ED diagnostics and management including CT, chest radiography and clinical examination.	**Diagnostic test performance** Lung Pneumothorax true positive, n=8 false positive, n=2 true negative, n=444 false negative, n=35 sensitivity, % (95% CI), n/N 18.7 (8.9–33.9), 8/43 specificity, % (95% CI) , n/N 99.5 (98.2–99.9), 444/446 PPV, % (95% CI) , n/N 80 (44.2–96.5), 8/10 NPV, % (95% CI) , n/N 92.7 (89.9–94.8), 444/479 Lung Pneumothorax required intervention true positive, n=9 false positive, N=1 true negative, n=469 false negative, n=0	**Level of evidence** 2b **Risk of bias** Patient selection: + Index test: + Reference standard: + Flow and timing: + **Authors' conclusion** "Positive interpretations significantly raised the probability of injury, more reliably so for lung ultrasound. Negative interpretations were predictive, but low prevalence limited the value of these results. Sensitivity was not sufficient for ruling out injury. We believe further study is needed to elucidate accuracy as providers gain experience, and to explore clinical outcomes that may be affected by prehospital trauma ultrasound." **Reviewers' conclusion**

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	Scene heart rate (bpm), mean ± SD 94 ± 22 Base deficit, mean ± SD 3.1 ± 4.5 Transport time to ED (min), mean ± SD 20.9 ± 8.7 ED GCS 12 + 3/–4		sensitivity, % (95% CI) , n/N 50 (22.3–58.7), 9/9 specificity, % (95% CI) , n/N 99.8 (98.6–100), 469/470 PPV, % (95% CI) , n/N 90 (54.1–99.5), 9/10 NPV, % (95% CI) , n/N 98.1 (96.3–99.1), 469/478	HEMS providers were new to inflight ultrasound and received a training. The guidance from this training may have a high influence on current behaviour. Also all staff knew about the study which may have introduced a Hawthorne effect.
Quick (2016) "In-flight ultrasound identification of pneumothorax". *Emerg Radiol* (2016) 23:3–7. **Study design** Diagnostic cross-sectional study **Aim of the study** "Our study sought to demonstrate the accurate and timely detection of correctable thoracic pathology, specifically pneumothorax and improperly positioned endotracheal tubes by non-physician, prehospital flight crews trained in the use of thoracic ultrasound." **Setting**	**Inclusion criteria** • all adult trauma patients, • all intubated adult medical patients transported by one of University of Missouri's Staff for Life Helicopters **Exclusion criteria** NR **Characteristics** Age [y], mean (range) 44.4 (16-94) Male, n (%) 133 (69) ISS mean (range) 17.68 (1-75) Chest AIS mean (range) 2.93 (0-6) BMI mean (range)	**Participants** N=149 In-flight ultrasound N=116 CT scan **Tests evaluated** Index text: In-flight ultrasound. Twenty-six flight crew members were trained to perform and interpret thoracic ultrasound prior to the initiation of the study. Flight crews recorded their interpretations of radiographic findings using an evaluation form. Reference standard: CT scan. Routine clinical care was provided in accordance with ATLS methods to include the completion of an E-FAST by the trauma team. Further imaging was obtained as needed during patient evaluation. Computed tomography (CT) was considered the criterion standard and utilized to confirm either the presence or absence of pneumothorax and proper endotracheal tube placement. Patients that did not undergo CT evaluation had either clearly visible pneumothorax on chest X-ray	**Diagnostic test performance** Lung Pneumothorax true positive, n=16 false positive, n=1 true negative, n=129 false negative, n=3 sensitivity, % (95% CI) 68 (0.46–0.85) specificity, % (95% CI) 96% (CI 0.90–0.98) PPV, % (95% CI) NR NPV, % (95% CI) NR **Diagnostic accuracy, % (95% CI)** 91 (0.85–0.95)	**Level of evidence** 2b **Risk of bias** Patient selection: + Index test: + Reference standard: + Flow and timing: ? **Authors' conclusion** "Ultrasonography should be utilized to augment the diagnostic capabilities of all prehospital aeromedical providers. Routine use of in-flight ultrasound is one step closer to getting the right care to the right patient at the earliest possible instance and could lead to better outcomes. A multicenter trial is warranted to

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USA, 15-month	28.2 (15–50) 149 patients (136 trauma/13 medical) met inclusion criteria.	or definitive clinical signs of a pneumothorax.	Right lung ultrasound was more sensitive than left for both pneumothorax (18.7% vs. 8.7%) and required intervention (66.6% vs.33.3%).	further confirm this benefit." **Reviewers' conclusion** Providers were new to in-flight ultrasound and received a training. The guidance from this training may have a high influence on current behaviour. It is unclear how many patients received chest radiography as reference standard.
+: low risk; –: high risk; ?: unclear risk; adj.: adjusted; AIS: abbreviated injury score; ATLS: Advanced Trauma Life Support; BMI: body mass index; CG: control group; CI: Confidence Interval; CT: computed tomography; d: days; ED: emergency department; (e)FAST: extended version of the Focused Assessment with Sonography for Trauma; GCS: Glasgow coma scale; HR: Hazard Ratio; HEMS: helicopter emergency medical services; IG: intervention group; IQR: Interquartile Range; ISS: injurie severity score; ITT: Intention to Treat; LoE: level of evidence; m: months; NPV: negative predictive value; NR: not reported; OR: Odds Ratio; PPV: positive predictive value; RR: Relative Risk; SD: Standard Deviation; SEM: Standard Error of Mean; y: years				

1.6 Schädel-Hirn-Trauma

Arterielle Normotension

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Asmar (2021) "The ED Systolic Blood Pressure Relationship After Traumatic Brain Injury" *J Surg Res* 2021; 257: 493-500. **Study design**	**Inclusion criteria** • adult trauma patients aged ≥18 y • who had an isolated blunt TBI on presentation (AIS ≥1 and other body region AIS <2) **Exclusion criteria** • patients being dead on arrival • transferred from other institutions	**Participants** N=94411 patients overall N=12984 patients with severe TBI **Comparison groups (for GCS≤8)** ED SBP<70 (N=n.r.) ED SBP 70-89 (N=n.r.) ED SBP 90-109 (N=n.r.)	<u>Multivariate logistic regression for in-hospital mortality for subgroup analysis (severe TBI), OR (95% CI) (for GCS≤8)</u> ED SBP<70: 3.59 (3.01-4.29) ED SBP 70-89: 2.36 (2.07-2.069) ED SBP 90-109: 1.42 (1.28-1.59) ED SBP 110-129: Reference	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion**

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Prognostic cross-sectional study American College of Surgeons (ACS) Trauma Quality Improvement Program (TQIP) database) **Aim of the study** "to assess the association between ED SBP on presentation and mortality in patients with isolated TBI and to determine which range of ED SBP was associated with the lowest mortality." **Setting** USA, 2015-2016	• presenting with acute intoxication of alcohol or illicit substances In the following data from subgroup analysis for severe TBI (GCS≤8 was extracted) **Characteristics (for GCS≤8)** Age [y], mean ± SD 52 ± 22 Male, % 70.6 ISS, median (IQR) 25 (16-26) ED GCS, median (IQR) 3 (3-6) Head AIS, median (IQR) 5 (4-5) Epidural hematoma, % 3.4 Intraventricular haemorrhage, % 1.5 Intraparenchymal haemorrhage, % 21.7 Subdural hematoma, % 33.0	ED SBP 110-129 (N=n.r.) ED SBP 130-149 (N=n.r.) ED SBP 150-169 (N=n.r.) ED SBP 170-189 (N=n.r.) ED SBP ≥190 (N=n.r.) **Variables included in regression** • age • ED heart rate • GCS • Emergency department SBP • ISS • Head AIS	ED SBP 130-149: 0.93 (0.85-1.023) ED SBP 150-169: 1.11 (1.003-1.24) ED SBP 170-189: 1.24 (1.089-1.04) ED SBP ≥190: 1.38 (1.21-1.57)	"In severe TBI, only ED SBP 130-149 mmHg had no difference in mortality compared with ED SBP 110-129 mmHg, as both ED SBP <110 and ≥150mmHg were associated with increased risk of mortality" **Reviewers' conclusion** The results should be interpreted in view of the fact that there are no number of participants and characteristics for the different comparison groups provided. Furthermore, the authors stated that they could not adjust for all possible confounders such as interventions to normalize blood pressure.
Barmparas (2014) "Prehospital hypertension is predictive of traumatic	**Inclusion criteria** • blunt trauma patients	**Participants** N=45,732 patients	**Adjusted outcomes** Overall mortality, adjusted OR (95% CI)	**Level of evidence** 2b

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
brain injury and is associated with higher mortality" *J. Trauma Acute Care Surg*. (2014); 77(4): 592-598. **Study design** Prognostic cross-sectional study (National Trauma Data Bank) **Aim of the study** "to investigate the effect of early adrenergic hyperactivity as manifested by prehospital (emergency medical service [EMS]) hypertension on outcomes of TBI patients" **Setting** USA, 2007-2008	• head (AIS) score ≥3 (for the study aim of interest) • ≥15 years • with available EMS and ED vital signs **Exclusion criteria** • patients with missing demographics, vital signs • nonsurvivable injuries (any body region AIS score 6) • hospital disposition • outlier values for EMS BPS, EMS HR, ED BPS, ED HR **Characteristics** <u>Age [y], mean (SD)</u> 48.5 (22.6) <u>Male gender, %</u> 69.6	**Comparison groups** EMS SBP <100 mm Hg: N=2913 EMS SBP 100-150 mm Hg: N=32,505 EMS SBP 160-180 mm Hg: N=7826 EMS SBP 190-230 mm Hg: N=1821 **Adjustment criteria** • age • sex • ISS • EMS GCS • AIS for all body regions • isolated TBI	EMS SBP <100 mm Hg: 1.76 (1.58-1.95) EMS SBP 100-150 mm Hg: reference group EMS SBP 160-180 mm Hg: 1.33 (1.22-1.44) EMS SBP 190-230 mm Hg: 1.97 (1.76-2.21)	**Risk of bias** no tool available for prognostic studies **Authors' conclusion** "Prehospital hypertension in TBI is associated with a higher mortality risk." **Reviewers' conclusion** Some possible confounders (including medication) were not recorded in the database and could not be included in adjustment. A high percentage of patients was excluded because of missing data.
Becker (2020) "Hypotension on admission in patients with isolated traumatic brain injury: contemporary examination of the incidence and outcomes using a national registry" *Brain Inj*. (2020); 34(10): 1422-1426. **Study design**	**Inclusion criteria** • blunt trauma • TBI (presence of any type of intracranial bleeding, diffuse axonal injury, or brain edema) • ≥2 years **Exclusion criteria** • concomitant injuries to other body regions (AIS >2) • dead on arrival • incomplete data	**Participants (for >14y)** N=23571 patients **Comparison groups (for >14y)** IG: SBP <90 mmHg on admission (N=307) CG: SBP ≥90 mmHg on admission (N=23264)	<u>Mortality, n/N (%) (for >14y)</u> IG: 142/307 (46) vs. CG: 1715/23264 (7.4), p<0.0001 <u>ICU need, n/N (%) (for >14y)</u> IG: 156/307 (51) vs. CG: 6346/23264 (27), p<0.0001 <u>ICU days >3, n/N (%) (among admitted to ICU) (for >14y)</u> IG: 72 (46) vs. CG: 3048 (48), p=0.7 <u>LOS >7 days, n (%) (for >14y)</u>	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "Adult mortality in the hypotensive group reached 46% compared to 7.4%

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Prognostic cross-sectional study (Israeli National Trauma Registry) **Aim of the study** "to examine the incidence and impact of hypotension in contemporary trauma care; using a subset of patients with isolated TBI." **Setting** Israel, 1998-2017	In the following, only results for adults (>14y) were extracted **Characteristics (for >14y)** <u>Age, mean ± SD</u> 46.8 ± 19		IG: 84 (51) vs. CG: 6431 (30), p<0.0001 <u>Rehabilitation, n (%) (for >14y)</u> IG: 43 (26) vs. CG: 3492 (16.2), p=0.0006	among normotensive counterparts" **Reviewers' conclusion** The database does not include information regarding resuscitative interventions. Since our population of interest includes only a subgroup, characteristics are only scarcely reported. In the overall population, diffuse axonal injury was more often in patients with hypotension.
Berry (2012) "Redefining hypotension in traumatic brain injury" *Injury* (2012); 43(11): 1833-7. **Study design** Prognostic cross-sectional study (Los Angeles County Trauma System Database) **Aim of the study** "to determine the age-adjusted optimal SBP in patients with isolated moderate to severe TBI. We hypothesize, that similarly to non-TBI trauma patients, hypotension should	**Inclusion criteria** • all adults (≥15 years) • with blunt isolated moderate to severe TBI (head AIS ≥3, all other AIS ≤3) **Exclusion criteria** • age <15 • Head AIS >5 • dead on arrival • data missing on mortality, gender, ISS, GCS score, or admission SBP **Characteristics across different age groups** <u>Age [y], mean ± SD</u> 43.4 ± 20.8 <u>Male, %</u> 77.5	**Participants** N=15,733 patients (N=10,284 age 15-49; N=3093 age 50-69; N=2356 age ≥70) **Comparison groups** SBP <60: N=38 SBP <70: N=76 SBP <80: N=228 SBP <90: N=495 SBP <100: N=900 SBP <110: N=1714 SBP <120: N=3237 SBP <130: N=5412 SBP <140: N=8044 SBP <150: N=10,589	**Logistic regression for mortality rate stratified for different age groups, n/N (%)** <u>Age 15-49</u> SBP <60: 9/24 (37.5) SBP <70: 34/47 (47.9) SBP <80: 62/150 (41.3) SBP <90: 120/333 (36.0) SBP <100: 179/618 (29.0) SBP <110: 258/1205 (21.4)* SBP <120: 361/2375 (15.2) SBP <130: 484/4070 (11.9) SBP <140: 624/6062 (10.3) SBP <150: 759/7744 (9.8) Optimal SBP and mortality; AOR (95% CI)**	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "Patients with isolated moderate to severe TBI should be considered hypotensive for SBP <110 mm Hg." **Reviewers' conclusion** The authors stated that they were unable to record any effects of other potential interventions such medications which may have af-

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be defined at a higher SBP than 90 mm Hg." **Setting** USA, 1998-2005	ISS, mean ± SD 19.3 ± 8.2 GCS, mean ± SD 11.4 ± 4.5 Head AIS, mean ± SD 3.79 ± 0.81	**Covariates included in logistic regression** • age • sex • ISS ≥16 • GCS ≤8	1.98 (1.65–2.39), p<0.0001 Age 50-69 SBP <60: 4/8 (50.0) SBP <70: 10/17 (58.8) SBP <80: 21/45 (66.7) SBP <90: 34/94 (66.2) SBP <100: 49/168 (29.2)* SBP <110: 60/306 (19.6) SBP <120: 85/536 (15.9) SBP <130: 110/871 (12.6) SBP <140: 146/1312 (11.1) SBP <150: 183/1784 (10.3) Optimal SBP and mortality; AOR (95% CI)** 2.20 (1.46–3.31), p=0.0002 Age ≥70 SBP <60: 4/6 (66.7 SBP <70: 6/12 (50.0) SBP <80: 15/33 (45.5) SBP <90: 37/68 (54.4) SBP <100: 53/114 (46.5) SBP <110: 77/203 (37.9)* SBP <120: 104/326 (31.9) SBP <130: 138/471 (29.3) SBP <140: 177/670 (26.4) SBP <150: 239/961 (24.9)	fected outcomes. Furthermore, the measurement of the blood pressure was stated as a limitation (only one measurement and values were found to be depending on the device).

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			Optimal SBP and mortality; AOR (95% CI)** 1.92 (1.35–2.74), p=0.0003 * the greatest C-Statistic, and the smallest Akaike Information Criterion and Schwartz Criterion. p<0.0001 ** Optimal SBP is compared to SBP reference groups, adjusting for age, gender, ISS ≥16, and GCS ≤8; reference groups for age 15–49 (≥110 mm Hg); for age 50–69 (≥100 mm Hg), for age ≥70 (≥110 mm Hg)	
Ley (2011) "Elevated admission systolic blood pressure after blunt trauma predicts delayed pneumonia and mortality" *J Trauma Inj Infect Crit Care* (2011); 71(6): 1689-1693. **Study design** Prognostic cross-sectional study (Los Angeles County Trauma System Database) **Aim of the study** "to determine the association between elevated admission SBP and delayed outcomes after trauma" **Setting** USA, 2003-2008	**Inclusion criteria** • blunt trauma patients • age ≥14 years **Exclusion criteria** • LOS <2 days • dead on arrival • AIS >5 for any body region • missing data on age, sex, or AIS In the following, only results for the subgroup of patients with Head AIS ≥3 were extracted **Characteristics (for Head AIS ≥3)** Age, mean ± SD 41.6 ± 18.2 Male, n (%) 2071 (79.6) ISS, mean ± SD 21.5 ± 10.7 ISS ≥16; n (%)	**Participants (for Head AIS ≥3)** N=2601 patients **Comparison groups (for Head AIS ≥3)** SBP ≥160 mm Hg (N=445) SBP ≥170 mm Hg (N=278) SBP ≥180 mm Hg (N=173) SBP ≥190 mm Hg (N=111) SBP ≥200 mm Hg (N=54) SBP ≥210 mm Hg (N=35) SBP ≥220 mm Hg (N=21) Variables included in multivariable regression modeling • age • gender • ISS ≥16 • GCS ≤8 • blood alcohol level positive • SBP <90 mm Hg • SBP ≥160 mm Hg	**Adjusted outcomes (for Head AIS ≥3)** Multivariable Regression Modeling Determined Predictors of in-hospital mortality, adjusted OR (95% CI) SBP <90 mm Hg 1.62 (0.81–3.28), p=0.17 SBP ≥160 mm Hg 1.59 (1.10–2.29), p=0.03 Multivariable Regression Modeling Determined Predictors of pneumonia, adjusted OR (95% CI) SBP <90 mm Hg 1.84 (1.00–3.36), p=0.05 SBP ≥160 mm Hg 1.79 (1.30–2.46), p=0.0004 Unadjusted outcomes (for Head AIS ≥3) In-hospital mortality, n/N (%); RR (95% CI) SBP ≥160 56/445 (12.6) vs. SBP <160 129/2156 (6.0); 2.10 (1.56–2.83) SBP ≥170 39/278 (14.0) vs. SBP <170 146/2323 (6.3); 2.23 (1.60–3.11) SBP ≥180 29/173 (16.8) vs. SBP <180 156/2428 (6.4); 2.61 (1.81–3.76)	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "In conclusion, elevated admission SBP after trauma may affect delayed outcomes." **Reviewers' conclusion** The low number of patients with SBP at higher levels should be kept in mind when interpreting the results. The multivariable modeling did not control for related comorbidities or medications so patients with high blood pressure before trauma may have

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	1887 (72.5) GCS, mean ± SD 11.5 ± 4.3 GCS ≤8, n (%) 735 (28.3) Head AIS, mean ± SD 3.75 ± 0.78		SBP ≥190 22/111 (19.8) vs. SBP <190 163/2490 (6.6); 3.03 (2.02–4.53) SBP ≥200 17/54 (31.5) vs. SBP <200 168/2547 (6.6); 4.77 (3.14–7.26) SBP ≥210 11/35 (31.4) vs. SBP <210 174/2566 (6.8); 4.63 (2.78–7.72) SBP ≥220 7/21 (33.3) vs. SBP <220 178/2580 (6.9); 4.83 (2.60–8.99) Pneumonia, n/N (%); RR (95% CI) SBP ≥160 70/445 (15.7) vs. SBP <160 177/2156 (8.2); 1.92 (1.48–2.48) SBP ≥170 47/278 (16.9) vs. SBP <170 200/2323 (8.6); 1.96 (1.47–2.63) SBP ≥180 26/173 (15.0) vs. SBP <180 221/2428 (9.1); 1.65 (1.13–2.40) SBP ≥190 21/111 (18.9) vs. SBP <190 226/2490 (9.1); 2.08 (1.39–3.12) SBP ≥200 13/54 (24.1) vs. SBP <200 224/2547 (9.2); 2.62 (1.61–4.27) SBP ≥210 11/35 (31.4) vs. SBP <210 236/2566 (9.2); 3.42 (2.06–5.66) SBP ≥220 8/21 (38.1) vs. SBP <220 239/2580 (9.3); 4.11 (2.35–7.19)	associated worse outcomes.
Shibahashi (2018) "Defining Hypotension in Patients with Severe Traumatic Brain Injury" *World Neurosurg* (2018); 120: e667-e674. **Study design**	**Inclusion criteria** • adult (≥18 years) patients • with severe TBI (admission GCS≤8) after blunt injury **Exclusion criteria** • SBP<60 [mmHg]	**Participants** N=12,537 patients **Comparison groups** SBP 60-69: N=n.r. SBP 70-79: N=n.r.	Multiple Logistic Regression Analysis for in-hospital mortality, OR (95% CI) SBP 60-69: 2.94 (2.20-3.92), p<0.001 SBP 70-79: 2.71 (2.10-3.49), p<0.001 SBP 80-89: 2.06 (1.61-2.63), p<0.001 SBP 90-99: 1.51 (1.20-1.90), p<0.001	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Prognostic cross-sectional study (Japan Trauma Data Bank) **Aim of the study** "to redefine hypotension and determine its optimal threshold in patients with TBI." **Setting** Japan, 2004-2015	• unknown in-hospital mortality **Characteristics (overall)** <u>Male, n (%)</u> 8798 (70.2)	SBP 80-89: N=n.r. SBP 90-99: N=n.r. SBP 100-109: N=n.r. SBP 110-119: N=n.r. SBP 120-129: N=n.r. SBP 130-139: N=n.r. SBP 140-149: N=n.r. SBP 150-159: N=n.r. SBP 160-169: N=n.r. SBP 170-179: N=n.r. SBP 180-189: N=n.r. SBP 190-199: N=n.r. SBP ≥200: N=n.r. **Covariates included in regression** • age • sex • year of hospital admittance • GCS on arrival • major extracranial injury • maximum AIS in the head • ISS	SBP 100-109: 1.40 (1.13-1.73), p=0.0023 SBP 110-119: 1.19 (0.97-1.46), p=0.094 SBP 120-129: 1.03 (0.84-1.24), p=0.80 SBP 130-139: Reference SBP 140-149: 1.06 (0.88-1.28), p=0.53 SBP 150-159: 1.15 (0.95-1.39), p=0.14 SBP 160-169: 1.15 (0.95-1.40), p=0.15 SBP 170-179: 1.39 (1.12-1.72), p=0.0024 SBP 180-189: 1.35 (1.08-1.69), p=0.0093 SBP 190-199: 1.58 (1.24-2.00), p<0.001 SBP ≥200: 1.72 (1.41-2.09), p<0.001	**Authors' conclusion** "In the overall analyses, SBP of 130-139 mm Hg was associated with the lowest odds for mortality. SBP of 60-109 mm Hg on admission was significantly associated with mortality, even after adjusting for possible confounders. These findings suggest an optimal threshold of 110 mm Hg for hypotension." **Reviewers' conclusion** The authors stated that they could not adjust for all possible confounders such as pupillary reactions to light. Neither are the patient characteristics across all age groups reported, nor the case numbers per study group. Because only 1 measurement was assessed, no conclusion on effects of interventions on hypotension could be made.
Shibahashi (2021) "Acceptable Blood Pressure Levels in the Prehospital Setting for Patients with Traumatic Brain Injury: A Multicenter Observational Study"	**Inclusion criteria** • adult patients (age ≥18 years) • with severe TBI (maximum head AIS score ≥3)	**Participants** N=34,175 patients **Comparison groups** Prehospital SBP 60-69 N=348 Prehospital SBP 70-79 N=595	**Adjusted outcomes** <u>Logistic regression analysis for in-hospital mortality, adjusted OR (95% CI) (N=32702)</u> Prehospital SBP 60-69: 2.68 (2.02-3.55), significant	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
World Neurosurg 2021; 6:6. **Study design** Prognostic cross-sectional study (Japan Trauma Data Bank) **Aim of the study** "To investigate the association between prehospital blood pressure and the outcomes pf patients with TBI to determine optimal threshold for hypotension that could be considered in the prehospital setting" **Setting** Japan, 2004-2019	• transported directly from the scene of the blunt trauma occurrence to the hospital **Exclusion criteria** • prehospital SBP <60 and ≥160 mm Hg • unknown prehospital SBP and final outcome information • AIS of 6 in the head region • non-blunt injury • not transported by ambulance from the scene **Characteristics (overall)** Age, median (IQR) 61 (41-75) Male, n (%) 23607 (69)	Prehospital SBP 80-89 N=1142 Prehospital SBP 90-99 N=1972 Prehospital SBP 100-109 N=3082 Prehospital SBP 110-119 N=4323 Prehospital SBP 120-129 N=5437 Prehospital SBP 130-139 N=5868 Prehospital SBP 140-149 N=6029 Prehospital SBP 150-159 N=5379 **Covariates included in regression** • Age • sex • year of hospital admission • time of day • nature of the injury • prehospital Japan Coma Scale • maximum head AIS score • ISS	Prehospital SBP 70-79: 2.55 (2.02-3.22), significant Prehospital SBP 80-89: 1.91 (1.57-2.31), significant Prehospital SBP 90-99: 1.59 (1.35-1.89), significant Prehospital SBP 100-109: 1.18 (1.01-1.38), significant Prehospital SBP 110-119: 1.30 (0.88-1.19) Prehospital SBP 120-129: 1.10 (0.96-1.27) Prehospital SBP 130-139: Reference Prehospital SBP 140-149: 1.06 (0.92-1.21) Prehospital SBP 150-159: 1.10 (0.96-1.26) Prehospital SBP<110: 1.52 (1.39-1.65)	**Authors' conclusion** "An SBP of <110 mm Hg in the prehospital setting was found to be significantly associated with in-hospital mortality" **Reviewers' conclusion** The authors stated that they could not adjust for all possible confounders such as pupillary reaction to light. Since only single one-time measurements were assessed, no conclusion could be drawn about the effect of therapeutic interventions. Furthermore, the authors state that the absence of an inflection point might indicate that the threshold is an arbitrary value depending on the sample size.
Zafar (2011) "Presenting blood pressure in traumatic brain injury: a bimodal distribution of death" *J TRAUMA* (2011); 71(5): 1179-84. **Study design** Prognostic cross-sectional study	**Inclusion criteria** • patients ≥16 years old • with isolated moderate to severe blunt TBI (defined by an AIS head severity score of 3 to 6) **Exclusion criteria** • penetrating injuries • patients who were dead on arrival • injuries to other body regions of AIS severity ≥3	**Participants** N=7238 patients **Comparison groups** Emergency department SBP <120: N=1177 Emergency department SBP 120-140: N=1931 Emergency department SBP ≥140: N=4130 **Variables included in regression** • age	**Adjusted outcomes** Multivariate Logistic Regression Analysis for in-hospital mortality, OR (95% CI) Emergency department SBP <120 vs. 120–140: 2.7 (2.13–3.48), p<0.001 Emergency department SBP ≥140 vs. 120–140: 1.6 (1.32–1.96), p<0.001 **Unadjusted outcomes** Length of stay (of survivors), mean	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "Even though our data have many limitations and we cannot be precise about

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
(National Trauma Data Bank) **Aim of the study** "to evaluate the relationship of the initial emergency department systolic blood pressure with outcome." **Setting** USA, n.r.	• missing or invalid emergency department SBP values **Characteristics** <u>Male, n (%)</u> 4,626 (64)	• gender • race • insurance category • emergency department SBP • injury severity	Emergency department SBP <120: 5.0 Emergency department SBP 120-140: 4.9 Emergency department SBP ≥140: 6.6, p<0.001 <u>Length of ICU stay (of survivors), mean</u> Emergency department SBP <120: 2.1 Emergency department SBP 120-140: 2.2 Emergency department SBP ≥140: 3.0, p<0.001	the threshold value for hypotension in patients with moderate to severe TBI, we can be sure that is much higher than 90 mm Hg." **Reviewers' conclusion** The authors stated that it was not possible to determine whether extremes of blood pressure are causally associated with mortality or whether blood pressure is simply a predictor with no contribution to cellular processes that lead to death. Furthermore, a lack of data on possible confounders for adjustment was mentioned.
AIS: Abbreviated Injury Scale; CG: Control group; CI: Confidence interval; CT: Computer tomography; GCS: Glasgow Coma Scale; ICH: Intracranial haemorrhage; ICU: Intensive care unit; IG: Intervention group; IQR: Interquartile range; ISS: Injury Severity Score; LoE: Level of evidence; n: number; n.r.: not reported; OR: Odds ratio; RR: Relative risk; SBP: Systolic Blood Pressure; SD: Standard deviation; TBI: Traumatic brain injury; y: years * For underpowered studies, the LoE was downgraded and marked with an arrow				

Arterielle Sauerstoffsättigung

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Baekgaard (2020) "Early hyperoxemia is associated with lower adjusted mortality after severe trauma: results from	**Inclusion criteria** • Trauma patients • >17 years • with a PaO_2 measured and registered in the TraumaBase® registry	**Participants (for GCS ≤8)** N=n.r. **Study groups (for GCS ≤8)**	**Adjusted outcomes (for GCS ≤8)** <u>In-hospital mortality, OR (95% CI)</u> Normoxemia: reference Hyperoxemia: 0.69 (0.53–0.89), p=0.005	**Level of evidence** 2b **Risk of bias**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
a French registry" *Crit. Care* (2020); 24(1): 604. **Study design** Prognostic cross-sectional study (TraumaBase) **Aim of the study** "to assess the association between early hyperoxemia and in-hospital mortality after severe trauma" **Setting** France, 2016-2019	**Exclusion criteria** • hypoxemic patients (PaO_2 <60 mmHg on arrival) • patients withdrawn from life-sustaining therapy *In the following, only results for the subgroup of GCS ≤8 were extracted* **Characteristics (for GCS ≤8)** n.r.	Normoxemia (PaO_2 60 -150 mmHg) at hospital admission (N=n.r.) Hyperoxemia PaO_2 ≥150 mmHg at hospital admission (N=n.r.) **Adjustment criteria** • age • sex • prehospital heart rate • SBP • Temperature • Hemoglobin • Lactate • Airway management • TBI • Initial GCS • ASA>1 • Presence of hemorrhagic shock	**Unadjusted outcomes (for GCS <8)** In-hospital mortality, OR (95% CI) Normoxemia: reference Hyperoxemia: 0.55 (0.43–0.71), p<0.0001	no tool available for prognostic studies **Authors' conclusion** "In accordance with several of the above studies, we found a clinical benefit of early hyperoxemia in the current study. Of note, however, all the latter studies focus solely on trauma patients with TBI, whereas we chose to include all trauma patients to present a broader and more pragmatic perspective, as isolated TBI may not always be evident in the acute phase. Nonetheless, in our subgroup analysis of patients with GCS <8, our results were unchanged." **Reviewers' conclusion** Since our population of interest only refers to a subgroup, no patient characteristics were reported. Furthermore, the authors report that in-hospital mortality was missing in 18% and that the PaO_2 value was missing in a substantial proportion of patients, which might have biased the results.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
CG: Control group; CI: Confidence interval; GCS: Glasgow Coma Scale; IG: Intervention group; LoE: Level of evidence; n: number; n.r.: not reported; OR: Odds ratio; SBP: Systolic Blood Pressure; TBI: Traumatic brain injury *For underpowered studies, the LoE was downgraded and marked with an arrow				

(Wiederholte) Erfassung und Dokumentation von Bewusstseinslage, Pupillenfunktion und Glasgow Coma Scale

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Grote (2011) "Diagnostic value of the Glasgow Coma Scale for traumatic brain injury in 18,002 patients with severe multiple injuries*" J. Neurotrauma* (2011); 28(4): 527-534. **Study design** Diagnostic cross-sectional study (Trauma Register of the German Society for Trauma Surgery) **Aim of the study** "we investigated the diagnostic value of GCS to identify severe TBI in multiple-injured patients" **Setting** Germany, 1993-2007	**Inclusion criteria** • adult patients • admitted primarily with ISS ≥16 **Exclusion criteria** • secondarily admitted to trauma centers • age <16 • missing ISS data • missing age data • incomplete GCS data **Characteristics** Age [y], mean ± SD 43 ± 20 Male gender, % 73.7 ISS, mean ± SD 30 ± 12	**Participants** N=18,002 patients **Tests evaluated** Index test: GCS Reference test: Head AIS	Sensitivity of GCS ≤8 to predict severe TBI, n/N; % (95% CI) 4903/8746; 56.1 (55.0–57.1) Specificity of GCS ≤8 to predict severe TBI, n/N; % (95% CI) 7613/9256; 82.2 (81.5–83.0) Positive predictive value of GCS ≤8 to predict severe TBI, n/N; % (95% CI) 4903/6546; 74.9 (73.9–76.0) Negative predictive value of GCS ≤8 to predict severe TBI, n/N; % (95% CI) 7613/11456; 66.5 (65.6–67.3) Correlation between AIS head and GCS ≤8, Spearman's rank correlation - 0.52, p<0.001	**Level of evidence** 2b **Risk of bias** Patient selection: + Index test: + Reference standard: ? Flow and timing: ? **Authors' conclusion** "Our study indicates that the GCS (as defined ≤8) in unconsciousness patients with multiple injuries shows only a moderate correlation with the diagnosis of severe TBI. TBI must always be considered in patients with multiple injuries even with GCS 15" **Reviewers' conclusion** Head AIS was used as a reference test.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Hoffmann (2012) "Introduction of a novel trauma score" *J. Trauma Acute Care Surg*. (2012); 73(6): 1607-1613. **Study design** Diagnostic/prognostic cross-sectional study (Trauma Register of the German Society for Trauma Surgery) **Aim of the study** "to introduce a novel trauma score to predict TBI presence and outcome. It was hypothesized that the complete GCS evaluation is unnecessarily complex and that the modified GCS motor component in combination with pupil reactivity and size might perform better in the prediction of TBI and outcome." **Setting** Europe, mainly Germany, 1993-2010	**Inclusion criteria** • complete GCS documentation (motor, coded 1-6; verbal, coded 1-5; eye, coded 1-4), pupil size (coded 1-3), and pupil reactivity (coded 1-3) • recorded by an emergency physician at the scene before resuscitation and on hospital admission by a different emergency physician • complete outcome documentation in terms of survival to hospital discharge or death • ISS ≥9 • admitted from the scene directly to the participating hospital **Exclusion criteria** • interhospital-transferred patients • patients with missing data Characteristics Age [y], mean ± SD 42.8 ± 20.7 Male, n (%) 20463 (72.3) ISS, mean ± SD 24.9 ± 13.7 ISS ≥16, n (%) 21137 (74.7) GCS, mean ± SD 11 ± 4.6	**Participants** N=28,305 patients **Tests evaluated** Index test 1: GCS Index test 2: ECS Reference test: Head AIS	**Prognostic part** Prediction of mortality, AUROC (95% CI) GCS: 0.811 (0.804-0.818) ECS: 0.824 (0.817-0.831) Spearman's rank correlation: 0.887, p<0.001 **Diagnostic part** Prediction of head AIS ≥3, AUROC (95% CI) GCS: 0.777 (0.768-0.786) ECS: 0.813 (0.805-0.822) Spearman's rank correlation: 0.889, p<0.001	**Level of evidence** 2b **Risk of bias** Diagnostic part: Patient selection: + Index test: + Reference standard: ? Flow and timing: ? Prognostic part: no tool available for prognostic studies **Authors' conclusion** "The present study demonstrated that the ECS exhibits significantly more accuracy for prediction of TBI prevalence and outcome compared with the GCS and provides a simple, yet reliable, stratification tool." **Reviewers' conclusion** When interpreting the results, it should be kept in mind that the motor component of the novel score has been modified on the basis of existing data of the GCS motor component. Furthermore, head AIS was used as a reference test.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
	GCS ≤8, n (%) 8,238 (29.1)			
Hoffmann (2012) "Pupil evaluation in addition to Glasgow Coma Scale components in prediction of traumatic brain injury and mortality" *Br. J. Surg*. (2012); 99: 122-130. **Study design** Prognostic/diagnostic cross-sectional study (Trauma Registry of the German Society for Trauma Surgery) **Aim of the study** "to assess the mortality prediction value of the GCS, its components, and pupil size and reactivity" **Setting** Europe (mainly Germany), 1993-2009	**Inclusion criteria** • ISS ≥9 • directly admitted patients • alive on admission • complete data on GCS recorded at the scene before resuscitation and on hospital admission • complete data on pupil size and pupil reactivity • complete outcome documentation in terms of survival to hospital discharge or death **Exclusion criteria** • minor injuries and burns **Characteristics** Age [y], mean ± SD 42.3 ± 20.5 Male, n (%) 17482 (72.5) ISS, median (IQR) 22 (16–32) GCS, median (IQR) 14 (7–15) GCS ≤8, n (%) 7141 (29.6) Head AIS ≥3, n (%)	**Participants** N=24,115 patients **Model components (index tests)** Pupil reactivity Pupil size Motor (GCS) Verbal (GCS) Eye (GCS) GCS Reference test: Head AIS	**Prognostic part** Area under the curve for the prediction of mortality (95% CI) Pupil size: 0.686 (0.675 – 0.696) Pupil reactivity: 0.770 (0.761 – 0.779) GCS motor component: 0.797 (0.788 – 0.805) GCS verbal component: 0.791 (0.783 – 0.798) GCS eye component: 0.770 (0.761 – 0.778) Pupil reactivity & motor (GCS): 0.822 (0.814 – 0.830) Pupil reactivity & pupil size: 0.778 (0.769 – 0.787) Pupil reactivity & pupil size & motor (GCS): 0.824 (0.816 – 0.832) Pupil reactivity & pupil size & motor (GCS) & verbal (GCS): 0.829 (0.821- 0.837) Pupil reactivity & pupil size & motor (GCS) & verbal (GCS) & eye (GCS): 0.830 (0.822 – 0.838) Pupil reactivity & GCS: 0.827 (0.820 – 0.835) Motor (GCS) & verbal (GCS) & eye (GCS): 0.808 (0.800 – 0.815) Predictive value of change in status at scene and after initial resuscitation in terms of mortality, n (%) Pupil reactivity: identical 81.1 (15.1) Pupil reactivity: worse 13.9 (24.5)	**Level of evidence** 2b **Risk of bias** Prognostic part: no tool available for prognostic studies Diagnostic part: Patient selection: + Index test: + Reference standard: ? Flow and timing: + **Authors' conclusion** "The present study has demonstrated that prediction of outcome using pupil reactivity and the GCS motor component provides a simple yet reliable stratification tool when assessing patients with TBI." **Reviewers' conclusion** Not all patients had polytrauma even though minor injuries and burns were excluded, (ISS ≥9 included). Furthermore, head AIS was used as a reference test.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
	11601 (48.1)		Pupil reactivity: improved 5.0 (21.4) Pupil size: identical 91.1 (14.7) Pupil size: worse 3.7 (54.5) Pupil size: improved 5.2 (25.0) **Diagnostic part** <u>Area under the curve for the prediction of Head AIS ≥3 (95% CI)</u> Pupil size: 0.598 (0.591-0.605) Pupil reactivity: 0.669 (0.662 – 0.676) GCS motor component: 0.748 (0.741 – 0.754) GCS verbal component: 0.775 (0.769 – 0.781) GCS eye component: 0.746 (0.739 – 0.752) Combined model using all five predictor variables: 0.784 (0.778 – 0.790)	
Hoffmann (2017) "Prospective evaluation of the Eppendorf-Cologne Scale" *Eur J Emerg Med* 2017; 24(2): 120-25. **Study design** Prognostic cross-sectional study (Trauma Registry of the German Society for Trauma Surgery) **Aim of the study**	**Inclusion criteria** • patients supplying a complete status documentation of the ECS (pupil reactivity, coded 0–3; pupil size, coded 0–2; motor, coded 0–3) and the GCS (motor, coded 1–6; verbal, coded 1–5; eye, coded 1–4) • recorded by an emergency physician at the scene before resuscitation and on hospital admission by a different emergency physician • complete outcome documentation in terms of survival to hospital discharge or death • ISS ≥9	**Participants** N=12,146 patients **Comparison groups** GCS N=12,146 ECS N=12,146	<u>Mortality prediction, AUROC (05% CI)</u> GCS 0.836 (0.825-0.848) ECS 0.853 (0.831-0.854), p=0.062	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "The ECS had higher accuracy in terms of mortality prediction compared with the GCS" **Reviewers' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
"to re-evaluate the ECS as a predictor for TBI presence and outcome on the basis of a prospective data set." **Setting** Europe (mainly Germany), 2012-2013	• patient admitted from the scene directly to the participating hospital **Exclusion criteria** • Patients with missing data • Interhospital transferals **Characteristics (overall)** Age [y], mean ± SD 47.7 ± 21.5 Male, n (%) 8711 (71.9) ISS, mean ± SD 22.9 ± 13.1 New ISS, mean ± SD 28.5 ± 15.5			The study could not account for inter-rater variability which was found for GCS and ECS. Furthermore, there was no information on experience or grade of prehospital physicians.

+: low risk; ?: unclear risk; AIS: Abbreviated Injury Scale; AUROC: Area under the receiver operating curve; CG: Control group; CI: Confidence interval; ECS: Eppendorf-Cologne-Scale; GCS: Glasgow Coma Scale; IQR: Interquartile range; ISS: Injury Severity Score; LoE: Level of evidence; n: number; SD: Standard deviation; TBI: Traumatic brain injury; y: years

*For underpowered studies, the LoE was downgraded and marked with an arrow

Glukokortikoide

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Asehnoune (2014) "Hydrocortisone and fludrocortisone for prevention of hospital-acquired pneumonia in patients with severe traumatic brain injury (Corti-	**Inclusion criteria** • 15-65 years • severe TBI (GCS score ≤8 and trauma-associated lesion on brain CT scan) • enrolment within 24 h of trauma **Exclusion criteria**	**Participants** N=368 participants enrolled **Study groups** IG: hydrocortisone (i.v. continuous infusion of 200 mg per day for 7 days starting on day 1, 100 mg on days 8 and 9, and 50 mg on	**Adjusted outcomes** Hospital-acquired pneumonia at day 28, Hazard ratio (95% CI) (N=271) IG: 0.75 (0.55–1.03) vs. CG: reference, p=0.07 **Unadjusted outcomes**	**Level of evidence** 2b↓ **Risk of bias** Selection bias: + Performance bias: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
TC): a double-blind, multi-centre phase 3, randomised placebo-controlled trial" *Lancet Respir Med* (2014); 2(9): 706716. **Study design** RCT (Corti-TC) **Aim of the study** "We tested the efficacy of low-dose hydrocortisone with fludrocortisone for the prevention of hospital-acquired pneumonia" **Setting** France, 2010-2012	• treatment with corticosteroids in the previous 6 months • immunosuppression • tetraplegia • or antibiotic treatment at the time of inclusion • enrolment in another study **Characteristics** Age [y], median (IQR) IG: 36 (24–49) vs. CG: 31 (22–47) Male gender, n (%) IG: 138 (84) vs. CG: 136 (83) ISS, median (IQR) IG: 20 (10–27) vs. CG: 22 (13–30) GCS, median (IQR) IG: 6 (3–7) vs. CG: 6 (4–7)	day 10) and fludrocortisone (50 µg tablet once per day) for 10 days (N=168 enrolled; N=165 included in intention to treat analysis) CG: placebo for 10 days (N=368 enrolled; N=163 included in intention to treat analysis) **Co-interventions** After randomisation, there was no significant difference in terms of interventions for prevention of hospital-acquired pneumonia or the management of TBI between the study groups	Kaplan-Meier-estimator for number of hospital-acquired pneumonia at day 28, absolute risk reduction (95% CI) –7% (–19 to 5) Death in ICU, n (%) IG: 23 (14) vs. CG: 19 (12), p=0.52 Survival, median (IQR) IG: 9 (8–11) vs. CG: 7 (5–17), p=0.56 Death at 6 months, n (%) (N=247) IG: 27 (16) vs. CG: 21 (13), p=0.38 Cases of hospital acquired pneumonia per patient, median (IQR) IG: 0 (0–1) vs. CG: 1 (0–1), p=0.07 **Other infections** Surgical site infection, n (%) IG: 3 (2) vs. CG: 4 (2), p=1.00 Meningitis, n (%) IG: 3 (2) vs. CG: 2 (1), p=1.00 Bacteraemia, n (%) IG: 10 (6) vs. CG: 11 (7), p=0.82 Urinary tract infection, n (%) IG: 19 (12) vs. CG: 22 (14), p=0.62 Antibiotic-free days at day 28, median (IQR) IG: 20 (15–24) vs. CG: 19 (12–22), p=0.15 Duration of mechanical ventilation [d], mean (SD) IG: 15 (11) vs. CG: 16 (13), p=0.31	Attrition bias: + Detection bias: + **Authors' conclusion** "Low-dose hydrocortisone with fludrocortisone did not improve the outcome of patients with traumatic brain injury. However, the study was underpowered because the proportion of patients with hospital-acquired pneumonia in the placebo group was lower than expected. The results were close to statistical significance for efficacy, meaning that further studies are therefore needed." **Reviewers' conclusion** Even though we found no risk of bias in this multicenter RCT, the study could not show any difference because it was underpowered. Only results for hospital-acquired pneumonia are adjusted.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
			Duration of intensive care [d], mean (SD) IG: 20 (14) vs. CG: 22 (17), p=0.35 SOFA Score at day 1, median (IQR) IG: 9 (7-10) vs. CG: 9 (7-10), p=0.33 SOFA Score at day 3, median (IQR) IG: 8 (5-9) vs. CG: 8 (6-10), p=0.38 SOFA Score at day 7, median (IQR) IG: 5 (2-7) vs. CG: 5 (3-7), p=0.97 Serious adverse events Serious adverse events did not differ greatly between the groups (table 5)	
+: low risk; CG: Control group; CI: Confidence interval; CT: Computer tomography; GCS: Glasgow Coma Scale; ICU: Intensive care unit; IG: Intervention group; IQR: Interquartile range; ISS: Injury Severity Score; i.v.: Intravenous; LoE: Level of evidence; n: number; RCT: Randomised controlled trial; SD: Standard deviation; SOFA: Sequential Organ Failure Assessment; TBI: Traumatic brain injury; y: years *For underpowered studies, the LoE was downgraded and marked with an arrow				

Hyperventilation / hypertone Kochsalzlösung / Mannitol

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Hendoui (2013) "Reliability of calcium-binding protein S100B measurement toward optimization of hyperosmolar therapy in traumatic brain injury." *Eur. Rev. Med. Pharmacol. Sci.* 2013: 17(4): 477-485	**Inclusion criteria** • age 18 - 65 years • GCS ≤12 and evidence of brain edema on head Computed Tomography (CT) scan **Exclusion criteria** • Patients with penetrating head trauma • serum sodium >160 meq/l or <130 meq/l	**Participants** N=33 patients **Study groups** IG1: N=10 MTL 20%, 1 g/kg was administered over 20 minutes via central venous catheter and repeated with a dose of 0.25-0.5 g/kg every 6 hours based on patient response (defined by GCS and CT improvement) for 3 days	60 days survival: mean ± standard error (%) (95% CI): IG1: 28.9 ± 8.5 (21%) (12.06-45.7) IG2: 40.2 ± 4.9 (82%) (30.5-49.9) CG: 46.8 ± 9.2 (65.5%) (28.7-64.8) Overall: 41.9 ± 5.9 (48%) (30.4-53.5) no significant difference between different groups (p=0.1) GCS: mean ± SD	**Level of evidence** 1b **Risk of bias** Selection bias: ? Performance bias: ? Attrition bias: + Detection bias: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Study design RCT **Aim of the study** "In this study we are going to compare both administration methods of HTS delivering (bolus and continuous infusion) versus mannitol and evaluate the role of S100B as a therapeutic tool for monitoring treatment." **Setting** Iran, ICU, 2009- 2011	• serum osmolarity >350 mOsmol/kg • acute renal failure (an abrupt (within 48 hours) absolute increase in the serum creatinine concentration of ≥0.3 mg/dl from baseline, a percentage increase in the serum creatinine concentration of ≥50 percent, or oliguria of less than 0.5 ml/kg per hour for more than six hours) during the study • hepatic failure (ALT, AST >5 upper limit normal or cirrhosis) before or during the study • shock (MAP ≤60 mmHg) • heart failure (EF <40%) • pulmonary edema (CVP >15 mmHg) • BMI >25 kg/m2 • psychiatric and neurologic disorders history • pregnant women **Characteristics** <u>Age [y], mean ± SD:</u> IG1: 34.2±9 IG2: 33.6 ± 13.05 CG: 40.58 ± 16, p=0.1 <u>Male, n (%):</u> IG1: 6 (60) IG2: 11 (100) CG: 11 (92), p=0.002 <u>Initial GCS, mean ± SD:</u> IG1: 6.5 ± 3.3 IG2: 8.1 ± 2.1 CG: 6.4 ± 1.5, p=0.1 <u>Initial SOFA, mean ± SD:</u>	IG2: N=11 125 mL HTS 5%, over an hour via central venous catheter every 6 hours for 3 days CG: N=12 500 ml HTS 5% was continuously infused over 24 hours for 3 days **(Co)-interventions** • All patients were intubated • received mechanically ventilation with a head elevation of 30° • Volume resuscitation was achieved with 0.9% normal saline for a target CVP of 8-12 mmHg • after adequate fluid resuscitation, MAP was kept above 90 mmHg • Sedation and analgesia were provided for all patients, using continuous infusion of midazolam and morphine to maintain good analgesic control and sedation • Insulin treatment was administered to maintain glucose at <200 mg/dl	GCS level increased significantly during study period (p=0.047). The evaluation of each group showed that this elevation was significant only for infusion part (p=0.002). The p value comparing between groups was 0.1. *IG1:* 1st day: 5.9 ± 3.3 2nd day: 7±2.7 3rd day: 6.6 ± 3.5, p=0.7 *IG2:* 1st day: 7.9 ± 2.02 2nd day: 8.3 ± 2.1 3rd day: 9±2.3, p=0.2 *CG:* 1st day: 6.7 ± 1.5 2nd day: 7±1.8 3rd day: 7.6 ± 1.9, p=0.002 <u>SOFA: mean ± SD</u> Our intervention reduced SOFA score significantly (p=0.018), and the evaluation of each group showed that this reduction was significant only in bolus group (p=0.002). The p value between groups was 0.9. *IG1:* 1st day: 6.4 ± 2.2 2nd day: 6.7 ± 2.5 3rd day: 6 ± 1.8, p=0.4 *IG2:* 1st day: 7 ± 1.9 2nd day: 5.7 ± 2 3rd day: 5.3 ± 1.5, p=0.002	**Authors' conclusion** "Our data suggest that osmotherapy with HTS and mannitol improves GCS- and SOFA score." **Reviewers' conclusion** The risk of selection and performance bias is unclear because there is no information on the blinding and the concealment of allocation.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
	IG1: 6.7 ± 2.2 IG2: 6.5 ± 1.5 CG: 6.5 ± 2.4, p=0.9 Initial MAP (mmHg), mean ± SD: IG1: 85 ± 7.2 IG2: 85.45 ± 14.5 CG: 84.16 ± 5.4, p=0.9 Initial APACHE II, mean ± SD: IG1: 14.6 ± 5.4 IG2: 12.18 ± 5.9 CG: 17.08 ± 4.6, p=0.1 Mechanism of injury, n (%) *Car accident* IG1: 4 (40) IG2: 5 (45.5) CG: 5 (41.7), p=0.6 *Motor accident* IG1: 5 (50) IG2: 4 (36.4) CG: 3 (25) *Falling* IG1: 1 (10) IG2: 1 (9.1) CG: 4 (33.3) *Electricity insult* IG1: 0 (0) IG2: 1 (9.1) CG: 0 (0)		*CG:* 1st day: 6.7 ± 2.4 2nd day: 6.2 ± 2.4 3rd day: 6.2 ± 2.09, p=0.5 Length of ICU stay (day): mean ± SD IG1: 16.9 ± 9 IG2: 14.2 ± 12 CG: 11.17 ± 7.7, p=0.5 Length of hospital stay (day): mean ± SD IG1: 20.7 ± 21.25 IG2: 18.18 ± 12.4 CG: 18.09 ± 1.84, p=0.9 Morbidity, n (%) *Sepsis:* IG1: 3 (30) vs. IG2:0 (0) vs. CG: 2 (17) *MOF:* IG1: 3 (30) vs. IG2:0 (0) vs. CG: 1 (8) *Seizure:* IG1: 1 (10) vs. IG2:0 (0) vs. CG: 0 (0)	
Jagannatha (2016)	**Inclusion criteria** • patients with severe TBI	**Participants**	In-hospital mortality, n (%)	**Level of evidence**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
"An equiosmolar study on early intracranial physiology and long term outcome in severe traumatic brain injury comparing mannitol and hypertonic saline." *J. Clin. Neurosci.* 2016*; 27: 68-73* **Study design** RCT **Aim of the study** "In the current study, we aimed to compare the effect of equiosmolar doses of 3% HTS and 20% mannitol on the treatment of post-traumatic ICH over 6 days." **Setting** India, ICU, n.r.	• aged between 15 and 70 years • within 24 hours of injury **Exclusion criteria** • Patients with a GCS score of 3 and absent brainstem reflexes • Pregnant women • patients with spinal cord injury • patients with multiple systemic injuries **Characteristics** Age [y], mean ± SD IG: 31 ± 13 CG: 27 ± 8, p=0.24 Male, n (%) IG: 18 (90) CG: 16 (89), p=0.91 Admission GCS score post-resuscitation, median (IQR) IG: 5 (4–6) CG: 4 (4–5), p=0.654 GCS score (Eye + Motor) at inclusion to study (IQR), median (IQR) IG: 5 (3–7) CG: 4 (3–7), p=0.317 Duration of monitoring, hours, mean ± SD IG: 130 ± 54 CG: 131 ± 42, p=0.94 Mode of injury, n (%) *Road traffic accident*	N=38 patients **Study groups** IG: 20% MTL (N=20) CG: 3% HTS (N=18) Both infused as a bolus through a central venous catheter over 5 minutes. Both were administered as 2.5 ml/kg doses (equiosmolar dose). If the first dose of the osmotic agent failed to decrease the ICP to below 20 mmHg, a maximum of three doses of the same drug were administered. **(Co)-interventions** • surgically treatable lesions were immediately operated upon • placement of an external ventricular drain catheter on the • more severely injured side through a frontal twist drill craniotomy • All patients were sedated with morphine or fentanyl in combi- nation with midazolam or diazepam to facilitate mechanical ventilation • Glycemic levels were targeted to around 150 mg/dl by administering insulin • The head-end of the patient's bed was elevated by 15–30°. • All patients received 1 mg/kg of i.v. lignocaine before tracheal suction and chest-physiotherapy • If an ICH episode occurred despite adequacy of sedation, ventilation and head position, CSF was drained until it stopped flowing spontaneously as a first line intervention. If the ICP remained elevated (>20 mmHg for >10 minutes) in spite of	IG: 10 (50%) CG: 3 (16,7%), p=0.07 Mortality at 6 months, n (%) IG: 10 (50) CG: 6 (33,3), p=0.41 Median GCS score at ICU discharge, median (IQR) IG: 8.5 (8–10) CG: 9 (8–10), p=0.98 Median GCS score at hospital discharge, median (IQR) IG: 9.5 (8–12) CG: 9 (8–12), p=0.98 Length of ICU stay, days, mean ± SD IG: 17 ± 6 CG: 16 ± 7, p=0.6 Length of hospital stay, days, mean ± SD: IG: 26 ± 10 CG: 30 ± 11, p=0.38 Favourable GOS score at 6 months, n IG: 0 CG: 2 Unfavourable GOS score at 6 months, n IG: 16 CG: 12, p=0.21	1b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "To conclude, immediate physiological advantages seen with HTS over mannitol did not translate into long term benefit on ICP/CPP control or mortality of patients with TBI." **Reviewers' conclusion** There is an unclear risk of attrition and selection bias and there is only a small sample size of patients.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
	IG: 12 (60) CG: 12 (67) *Fall from height* IG: 4 (20) CG: 4 (22) *Others* IG: 4 (20) CG: 2 (11), p=0.54 <u>Injury to hospital duration (hours) mean ± SD</u> IG: 4.3 ± 3.6 CG: 4.5 ± 3.2, p=0.88 <u>Injury to surgery duration (hours) mean ± SD</u> IG: 6.7 ± 5.2 CG: 6.1 ± 5.5, p=0.73 <u>Predominant lesion on CT scan, n (%)</u> **Extradural haematoma:** IG: 3 (15) CG: 7 (39) Subdural haematoma: IG 15 (75) CG: 7 (39) Contusion: IG: 2 (10) CG: 2 (11) Diffuse: IG: 0 (0) CG: 2 (11), p=0.67	CSF drainage (until the CSF egress ceased), patients received osmotic therapy. • If the ICH persisted, hyperosmolar therapy was considered a failure and thiopentone, propofol, or moderate hyperventilation (PaCO2= 30 mmHg) were instituted • Decompressive craniectomy was considered after exhausting general measures, CSF drainage, osmotic therapy and metabolic suppression • Hyperosmolar therapy was temporarily suspended if serum sodium increased to >160 mmol/dl or if serum osmolality increased to >320 mOsm/kg • Inotropes/vasopressors (dopamine, adrenaline and noradrenaline) were administered as and when required to maintain CPP. • A CT scan of the head was repeated at 24 hours and 5 days post-trauma, and whenever the patient suffered a neurological deterioration. • The ICP catheter was left in situ for 6 days but was removed earlier if the patient started obeying commands or the ICP was maintained <20 mmHg for 24 hours.		

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Junger (2013) "Prehospital hypertonic saline resuscitation attenuates the activation and promotes apoptosis of neutrophils in patients with severe traumatic brain injury." *Shock* 2013; 40(5): 366-374 **Study design** Subgroup analysis of an RCT **Aim of the study** "we investigated whether prehospital hypertonic fluid resuscitation using HS, with or without dextran, can help to reduce trauma-induced alterations of PMN responses in TBI patients." **Setting** Canada, USA, prehospital, 2006-2009	**Inclusion criteria** • severe TBI with head trauma • GCS score ≤8 **Exclusion criteria** • age <15 y • pregnancy • received i.v. fluid therapy in the field with more than 1,000 mL of isotonic crystalloid fluids, any colloids, or any blood products before treatment with study fluids • more than 4 h had passed after injury • prehospital cardiopulmonary resuscitation • severe hypothermia (body core temperature <28°C) • drowning or asphyxia due to hanging • burns >20% of the total body surface area • isolated penetrating head injury • inability to obtain i.v. access • prisoner **Characteristics** <u>Age [y], mean (SD)</u> IG 1: 39.1 (17.7) IG 2: 37.2 (21.0) IG 3: 36.2 (19.1) <u>Male, n (%)</u> IG 1: 19 (86.4) IG 2: 13 (59.1) IG 3: 29 (74.4) <u>Worst MODS, mean (SD)</u>	**Participants** N=83 patients **Study groups** IG 1: N=22; 7.5% HTS without dextran IG 2: N=22; 7.5% HTS + 6% dextran-70 (HSD; RescueFlow) IG 3: N=39; 0.9% NaCl (normal saline) All fluids were provided in identical 250-ml infusion bags. All infusions were infused as bolus.	<u>Overall mortality, n (%)</u> IG 1: 5 (22.7) IG 2: 7 (31.8) IG 3: 11 (28.2) no statistical significance (p-value n.r.) <u>Length of stay, mean (SD), days n (%)</u> IG 1: 30.8 (22.8) IG 2: 21.9 (27.8) IG 3: 28.7 (29.3) no statistical significance (p-value n.r.) <u>ARDS-free survival to 28 days, n (%)</u> IG 1: 18 (81.8) IG 2: 15 (68.2) IG 3: 28 (71.8) no statistical significance (p-value n.r.) <u>GOSE 6 months, median (IQR)</u> IG 1: 3.5 (2-6) IG 2: 3.5 (1-6) IG 3: 4.0 (1-6) no statistical significance (p-value n.r.) <u>DRS, 6 months, median (IQR)</u> IG 1: 5.5 (3-6) IG 2: 6 (2-6) IG 3: 5 (3-6) no statistical significance (p-value n.r.) <u>≥1 Infections, n (%)</u> IG 1: 8 (36.4) IG 2: 7 (31.8) IG 3: 10 (25.6) no statistical significance (p-value n.r.)	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: + Attrition bias: + Detection bias: + **Authors' conclusion** "Our current results suggest that prehospital hypertonic immunomodulation with HS can reduce excessive PMN activation, but that this does not translate into better clinical outcome in TBI patients. However, it is possible that HS resuscitation combined with subsequent hyperosmotic fluid therapy to attenuate intracranial hypertension in TBI patients during their stay in the ICU could be a feasible strategy to improve longer-term neurological outcome after TBI" **Reviewers' conclusion** P-values for clinical outcomes were not reported.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
	IG 1: 7.5 (8.3) IG 2: 9.3 (8.9) IG 3: 8.6 (9.0) ISS, median (IQR) IG 1: 25.5 (17.5-35) IG 2: 29 (17-38) IG 3: 29 (16-35) GCS score at entry, median (IQR) IG 1: 5.0 (3-7) IG 2: 5.5 (3-7) IG 3: 5.0 (3-7) Type of injury, n (%) *Blunt / Penetrating:* IG 1: 21 (95.5) / 1 (4.5) IG 2: 21 (95.5) / 1 (4.5) IG 3: 39 (100) / 0(0) Head AIS, mean (SD): IG 1: 4.1 (1.0) IG 2: 4.0 (1.2) IG 3: 3.8 (1.1)			
Rhind (2010) "Prehospital resuscitation with hypertonic saline-dextran modulates inflammatory, coagulation and endothelial activation marker profiles in severe traumatic brain injured patients." *J. Neuroinflammation* 2010; 7(5): 1-17 **Study design**	**Inclusion criteria** • loss of consciousness at any time during prehospital care they experienced due to isolated blunt head trauma • GCS score ≤8 **Exclusion criteria** • primary penetrating injury • patients had suffered severe life-threatening injury to organs other than the brain	**Participants** N=65 patients **Study groups** IG: 250ml 7.5% HTS admixed with 6% dextran-70 (HSD) (N=30) CG: 250ml 0,9% Normal Saline (NS) (N=35) both groups receive a single prehospital bolus infusion	Mortality, n (%) IG: 4 (13.3) CG: 6 (17.1), p=0.67 GOS at hospital discharge or ≤30 days), mean ± SD IG: 3.7 ± 1.3 CG: 3.5 ± 1.5, p=0.81 Length of stay, days, mean ± SD IG: 14.1 ± 13.6 CG: 14.7 ± 12.5, p=0.90	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: ? **Authors' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Subgroup analysis of an RCT **Aim of the study** "We hypothesized that prehospital resuscitation of head injury patients using 7.5% hypertonic saline with 6% dextran- 70 (HSD) would attenuate the expression of selected cellular and soluble inflammatory/coagulation markers related to secondary brain injury cascades." **Setting** Canada, ICU, n.r.	• received previous i.v. fluid therapy ≥50 ml • a time interval between arrival at scene and vascular access which exceeded 4 hours • age <16 • pregnancy • patients had vital signs absent prior to randomization **Characteristics** Age [y], mean ± SD IG: 41.8 ± 17.4 CG: 42.8 ± 18.8, p=0.85 Male, n (%) IG: 19 (63) CG: 25 (71), p=0.79 GCS on admission, mean ± SD IG: 5.6 ± 2.8 CG: 5.9 ± 2.6, p=0.53 ISS, mean ± SD IG: 34.9 ± 9.5 CG: 31.7 ± 14.6, p=0.19 APACHE II, mean ± SD IG: 12.5 ± 5.9 CG: 14.8 ± 5.1, p=0.24 SOFA, mean ± SD IG: 4.9 ± 1.7 CG: 4.9 ± 2.5, p=0.72 MODS, mean ± SD		Mechanical Ventilation, days, mean ± SD IG: 6.6 ± 5.2 CG: 9.1 ± 5.8, p=0.71	- **Reviewers' conclusion** The results of the study need to be interpreted carefully because of the unclear risk of performance and detection bias.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
	IG: 3.8 ± 1.5 CG: 5.0 ± 3.3, p=0.64			

+: low risk; ?: unclear risk; AIS: Abbreviated Injury Scale; ALT: Alanin-Aminotransferase; APACHE II: Acute Physiologic and Chronic Health Evaluation; ARDS: Acute respiratory distress syndrome; AST: Aspartat-Aminotransferase; BMI: Body mass index; CG: Control group; CI: Confidence interval; CPP: Cerebral perfusion pressure; CSF: Cerebrospinal fluid; CT: Computer tomography; CVP: Central venous pressure; DRS: Disability Rating Scale; EF: Ejection fraction; GCS: Glasgow Coma Scale; GOS: Glasgow Outcome Scale; GOSE: extended Glasgow Outcome Scale; HTS: Hypertonic saline; HSD: Hypertonic saline solution with dextran; ICH: Intracranial haemorrhage; ICP: Intracranial pressure; ICU: Intensive care unit; IG: Intervention group; IQR: Interquartile range; ISS: Injury Severity Score; i.v.: Intravenous; LoE: Level of evidence; MAP: Mean arterial pressure; MODS: Multiple organ dysfunction syndrome; MOF: Multi Organ Failure; MTL: Mannitol; NaCl: Sodium chloride; n: number; n.r.: not reported; PMN: Polymorphonuclear neutrophil; RCT: Randomised controlled trial; SD: Standard deviation; SOFA: Sequential Organ Failure Assessment; TBI: Traumatic brain injury; y: years

*For underpowered studies, the LoE was downgraded and marked with an arrow

1.10 Massenanfall von Verletzten

Ausbildung/Training

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Andreatta (2010) "Virtual reality triage training provides a viable solution for disaster-pre-paredness". *Acad Emerg Med* 2010; 17(8): 870-6. **Study design** Randomised controlled trial **Aim of the study** "The purpose of this study was to determine if a fully immersive virtual reality (VR) disaster drill is as effective as a comparable live disaster drill using	**Inclusion criteria** • post-graduate year 1–4 residents from the University of Michigan Emergency Medicine Residency Program **Exclusion criteria** • previous training in START triage **Characteristics (participants)** n.r. **Characteristics (simulated casualties)** n.r.	**Participants** N=15 emergency medicine residents N=14 simulated casualties **Study groups** VR: full immersion virtual reality training (n=7) SP: standardized simulated patient disaster drill (n=8) **Summary of interventions** • 1h lecture about the principles of disas-ter triage and application of START • pre-test to assess the baseline level of cognitive knowledge • disaster drills with SP and VR (otherwise identical)	<u>Triage performance rating, mean ± SD</u> 32-item, 5-point rating scale (5=best, 1=worst) VR: 3.55 ± 0.17 SP: 3.47 ± 0.41 comparison between means: Cohen's d = 0.25 (small difference) <u>Correctly triaged patients [n], mean ± SD (%)</u> VR: 11.86 ± 1.57 (85%) SP: 11.38 ± 1.92 (81%) comparison between means: Cohen's d = 0.27 (small difference)	**Level of evidence** 2b↓ **Risk of bias** Selection bias: ? Performance bias: + Attrition bias: + Detection bias: + **Authors' conclusion** "The results of our study and those of others suggest that a carefully designed VR environment can provide a simulated disaster environ-ment that is comparable to

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
standardized patients (SPs) in teaching and assessing START triage knowledge and skills for emergency medicine (EM) residents." **Setting** US, year n.r.		• simulated disaster scenarios involved an explosion in an office building, multiple diversely injured victims • SP drill: victims wore costumes and received cosmetically rendered wounds • VR space included the same office layout, facilities, and furnishings and the same locations, personal characteristics, and injuries of the victims. • Each resident responsible for triaging 14 victims without the support of reference materials. • performances were monitored, timed, and assessed using the triage rating scale by one of the researchers who has advanced training in START (JF) • post-test 2 weeks after the disaster drills		those created using SPs. The VR disaster drill did not have a differential impact on learning based on pre-/posttest analysis, and we found no significant difference between the triage performance of those clinicians who performed START during an SP disaster drill and those who performed START using a VR disaster drill." **Reviewers' conclusion** There is an unclear risk of selection bias as no information about participants' characteristics is provided. The results should be interpreted with caution because of the small sample size, large standard deviations, and missing number of participants at follow-up. The effect of training on important outcomes such as under- and over-triage rates was not measured.
Cicero (2017) "60 seconds to survival: A pilot study of a disaster triage video game for prehospital providers". *Am J Disaster Med* 2017; 12(2): 75-83.	**Inclusion criteria** • EMS providers including paramedics, paramedic students, and EMTs at a single EMS training facility affiliated with a medical school **Exclusion criteria**	**Participants** N=62 EMS providers randomised, N=47 analysed N=10 simulated paediatric casualties Participants excluded from analysis because they did not complete second session (IG:	<u>Triage accuracy at baseline [%], median (IQR)</u> IG: 80 (60 to 90), p=0.457 CG: 80 (70 to 80) <u>Triage accuracy at time 2 [%], median (IQR)</u> IG: 90 (80 to 90) CG: 80 (70 to 80)	**Level of evidence** 2b↓ **Risk of bias** Selection bias: ? Performance bias: –

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Study design Randomised controlled trial **Aim of the study** "In this work, we aimed to assess the efficacy of the serious video game "60 Seconds to Survival" (60S) for EMS disaster triage learning. We hypothesized that participants who played 60S would demonstrate greater improvement in triage accuracy over time than EMS providers who had no formal disaster triage training during the study period. Secondary outcomes included associations between the game and decreased instances of over- and under-triage for 60S playing EMS providers." **Setting** USA, year n.r.	n.r. **Characteristics (participants)** <u>Male, n (%)</u> IG: 19 (73) CG: 17 (81) <u>Experience [y], median (IQR)</u> IG: 3.5 (0 - 9.3) CG: 5.5 (0 - 10.5) **Characteristics (simulated casualties)** <u>Age group, n (%)</u> children: 6 (60) adults: 4 (49)	n=8, CG: n=2) or did not play game ≥3 times (IG: n=5) **Study groups** IG: weekly triage training using the 60S video game for 13 weeks, 3 levels with 12-victim MCI scenarios, weekly email reminders to play (n=39 randomised, n=26 analysed) CG: no formal disaster triage training during 13-week study period (n=23 randomised, n=21 analysed) **Study interventions** • live simulation at baseline (school shooting) • Participants individually assessed and triaged the patients; no feedback • In the game, possibility given of checking vital signs and performing interventions. Players performed START/JumpSTART to triage the victims • At time 2, 13 weeks after the onset, all participants returned to the same simulation center and completed the same live simulation as at the onset of the study.	<u>Median improvement, baseline vs. time 2, % (IQR)</u> IG: 10 (0 to 20) CG: 0 (−5 to 20) median difference 10; p=0.335 <u>Mean improvement, baseline vs. time 2, %</u> IG: 13; p=0.005 CG: 6; p=0.174 mean difference 6.5; p=0.279	Attrition bias: – Detection bias: + **Authors' conclusion** "Participants who played 60S demonstrated improved triage accuracy from the beginning to the end of the study, and the control group did not. However, there was no significant difference in triage performance at the end of the study between the intervention and control groups. These results may be due to small sample size, the Hawthorne effect or lack of variation in patient presentation in this iteration of 60S." **Reviewers' conclusion** The results of the study should be interpreted with caution due to the high attrition rate in the intervention group, and unclear risk of selection and performance bias. The study was underpowered, and relevant effects may not have been detected. In addition, all participants performed the same live simulation at

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
				baseline and time 2, resulting in possible learning effects and bias towards the null (no difference). Finally, the video game was not fully developed in terms of maintaining novelty, limiting generalisability of the findings. The effect of training on important outcomes such as under- and over-triage rates was not measured.
Dittmar (2016) "Mass casualty incident triage: Substantial decrease in triage ability of EMS personnel one year after initial training". *Notfall und Rettungsmedizin* 2016; 19(2): 108-114. **Study design** Prospective cohort study **Aim of the study** "To answer the question at which intervals retraining must be attended, we examined the triage ability of EMS personnel 1 year after primary triage certification." **Setting** Germany, year n.r.	**Inclusion criteria** • All EMS professionals who attended training after implementation of the Amberg-Schwandorf algorithm (ASAV) 1 year prior to the study **Exclusion criteria** • Refusing participation • Participants in the follow-up trial with no matching data available from initial validation study **Characteristics (participants)** Full-time EMS, n (%)§ Initial: 55 (72) Follow up: 13 (59) Voluntary EMS, n (%)§ Initial: 21 (28) Follow up: 9 (41) **Characteristics (simulated casualties)**	**Participants** N=76 EMS providers pool of n=40 simulated cases, n=20 manikins randomly selected for each triage session **Study groups** IN: initial assessment following initial ASAV training and certification (n=76 EMS providers, 780 triage decisions) FU: follow up assessment ≥12 months after initial testing (median 15.5m, range 13–20m) (n=22 EMS providers, 280 triage decisions) **Study interventions** • initial assessment: 3-hour educational training with subsequent triage exercise using manikins • follow up assessment: triage exercise in teams of two, triage of 20 manikins with	Triage accuracy, % (95% CI) proportion of cases classified as intended‡ IN: 84 (81-87) FU: 77 (70-85), p=0.028 Sensitivity for triage level RED, % (95 CI) IN: 87 (84-91) FU: 77 (69-85), p=0.006 Specificity for triage level RED, % (95 CI) IN: 91 (88-94) FU: 85 (78-90), p=0.030 Under-triage, % (95% CI) proportion of all cases classified into a lower category than intended‡ IN: 10 (8-12) FU: 19 (13-29), p<0.01 Critical under-triage, % (95% CI) IN: 5 (3-6) FU: 13 (7-21), p<0.01	**Level of evidence** 2b **Risk of bias** Selection bias: ? Performance bias: + Attrition bias: + Detection bias: + **Authors' conclusion** „The results indicate that in professional EMS systems, triage concepts should be retrained at 1 year intervals. Examinations for recertification without prior teaching do not seem to be promising." **Reviewers' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	n.r. § differences not significant	the help of a printed version of ASAV triage algorithm • During the exercise one team member was assigned as team leader, the other as assistant, after 10 triaged manikins, roles were switched • Correct triage level was set a priori by expert consent	Over-triage, % (95% CI) proportion of all cases classified into a higher category than intended‡ IN: 6 (5-8) FU: 13 (7-21), p<0.05 Critical over-triage, % (95% CI) IN: 4 (3-6) FU: 12 (6-20), p<0.01 Accuracy of airway management decisions, % (95% CI) IN: 90 (88-92) FU: 81 (76-86) Accuracy of bleeding control decisions, % (95% CI) IN: 93 (91-95) FU: 84 (80-89) ‡ definitions obtained from ref. [5]	The study has an unclear risk of selection bias because it is unclear how participants were selected for inclusion in the follow-up evaluation. The follow up assessment included less participants than the initial assessment, leading to wider confidence intervals. The calculation of under- and over-triage (full population as denominator) differs from other studies (denominator: all severe cases for under-triage; all cases identified as "red" for over-triage), leading to lower rates than in other studies. This needs to be taken into account when interpreting the results. The population overlaps with Dittmar (2018), so the studies need to be assessed jointly.
Dittmar (2018) "Primary mass casualty incident triage: evidence for the benefit of yearly brief re-training from a simulation study". *Scandinavian J Trauma, Resusc Emerg Med* 2018; 26(1): 35.	**Inclusion criteria** • EMS personnel, professionals or volunteers who participated during the earlier parts of the study **Exclusion criteria**	**Participants** N=80 EMS providers, n=1280 triage decisions recorded N=51 EMS providers, n=990 triage decisions pool of n=40 casualty vignettes, n=20 randomly selected for each triage session **Study groups**	Triage accuracy, % (95% CI) IN: 84 (80–87) 2nd: 77 (69–85) 3rd: 86 (82–91) IN vs. 2nd: p=0.159 3rd vs. IN: p=1.000 2nd vs. 3rd: p=0.069	**Level of evidence** 2b **Risk of bias** Selection bias: ? Performance bias: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Study design Prospective cohort study, follow up of Dittmar (2016) **Aim of the study** "In this study, the authors investigated the changes of triage performance over time subsequent to initial training, as well as the effect of a brief re-training session. The Amberg-Schwandorf Algorithm for Primary Triage (ASAV, Amberg-Schwandorf-Algorithmus für die Vorsichtung) served as triage algorithm for this purpose." **Setting** Germany, n.r.	• none of the two team members participated in the baseline evaluation and ≥1 follow-up session **Characteristics (participants)** <u>Fulltime EMS, n (%)</u> IN: 24 (72.7)* 2nd: 13 (59.1) 3rd: 19 (100) <u>Voluntary EMS, n (%)</u> IN: 9 (27.3)* 2nd: 9 (40.9) 3rd: 0 (0) **Characteristics (simulated casualties)** <u>Triage category, %</u> red: 20 yellow: 20 green: 60 * data for 33 out of 51 EMS providers	IN: initial triage assessment (N=51 EMS providers, n=490 triage decisions) 1Y: triage assessment after a mean of 14.6 (14.0–15.3) months (N=22 EMS providers, n=280 triage decisions) 3rd: triage assessment after a mean of 25.1 (22.9–27.3) months + re-training (N=19 EMS providers, n=220 triage decisions) **Study interventions** • participants recruited separately for each assessment session; some missed one of the follow up assessments • patient dummies had written description cards displaying the relevant vital data as well as additional information • triage performed in teams of two • re-training: 45 min didactical lecture refreshing triage knowledge	<u>Sensitivity for triage level RED, % (95 CI)</u> IN: 86 (82–91) 2nd: 77 (69–85) 3rd: 92 (86–98) IN vs. 2nd: p=0.058 3rd vs. IN: p=0.707 2nd vs. 3rd: p=0.012 <u>Specificity for triage level RED, % (95 CI)</u> IN: 91 (87–94) 2nd: 85 (79–90) 3rd: 89 (84–94) IN vs. 2nd: p=0.182 3rd vs. IN: p=1.000 2nd vs. 3rd: p=0.767 <u>Under-triage, % (95% CI)</u> IN: 10 (8–13) 2nd: 19 (12–27) 3rd: 5 (2–8) IN vs. 2nd: p=0.012 3rd vs. IN: p=0.360 2nd vs. 3rd: p=0.000 <u>Critical under-triage, % (95% CI)</u> IN: 6 (4–8) 2nd: 13 (6–20) 3rd: 3 (1–5) IN vs. 2nd: p=0.026 3rd vs. IN: p=1.000 2nd vs. 3rd: p=0.007 <u>Over-triage, % (95% CI)</u>	Attrition bias: – Detection bias: + **Authors' conclusion** "Primary triage represents an important component of MCI management. However, many aspects thereof still lack scientific foundation. It is demonstrated, that triage skills deteriorate significantly and relevantly within the first year after initial training. A brief, 45-min re-training session is capable of restoring the practical triage capabilities of professional EMS personnel. Thus, triage education should be refreshed on a yearly basis." **Reviewers' conclusion** The risk of attrition bias is high, because the population at the 3rd assessment is composed differently to the initial group (no EMS volunteers). The study has an unclear risk of selection bias because it is unclear how participants were selected for inclusion in the follow-up evaluation. The calculation of under- and over-triage (full popu-

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			IN: 6 (4–8) 2nd: 13 (6–20) 3rd: 9 (5–13) IN vs. 2nd: p=0.049 3rd vs. IN: p=1.000 2nd vs. 3rd: p=0.726 <u>Critical over-triage, % (95% CI)</u> IN: 4 (3–6) 2nd: 12 (5–19) 3rd: 7 (4–11) IN vs. 2nd: p=0.022 3rd vs. IN: p=0.982 2nd vs. 3rd: p=0.535 <u>Accuracy of airway management decisions, % (95% CI)</u> IN: 91 (88–93) 2nd: 81 (76–86) 3rd: 97 (95–99) IN vs. 2nd: p=0.000 3rd vs. IN: p=0.025 2nd vs. 3rd: p=0.000 <u>Accuracy of bleeding control decisions, % (95% CI)</u> IN: 93 (91–96) 2nd: 84 (80–89) 3rd: 94 (90–97) IN vs. 2nd: p=0.000 3rd vs. IN: p=1.000 2nd vs. 3rd: p=0.001	lation as denominator) differs from other studies (denominator: all severe cases for under-triage; all cases identified as “red” for over-triage), leading to lower rates than in other studies. This needs to be taken into account when interpreting the results. The population overlaps with Dittmar (2016), so the studies need to be assessed jointly.
Knight 2010 „Serious gaming technology in major incident triage training: a pragmatic	**Inclusion criteria** • Attendees of 4 MIMMS courses (doctors, nurses and paramedics)	**Participants** N=91 clinicians; N=8 simulated casualties **Study groups**	<u>Tagging accuracy, n (%)</u> n participants who correctly tagged 8/8 victims	**Level of evidence** 3b↓ **Risk of bias**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
controlled trial". *Resuscitation* 2010; 81(9): 1175-9. **Study design** Prospective cohort study **Aim of the study** "The aim of this study was to evaluate the effectiveness of this serious game (Triage Trainer) in supporting the teaching and development of basic major incident triage skills. The objective was to compare triage performance after practicing the triage process using the Triage Trainer or by other, more traditional learning methods." **Setting** UK, 2007-2008	**Exclusion criteria** n.r. **Characteristics (participants)** <u>Age [y], n (%)</u> 20-29: TT: 4 (9) vs. CS: 6 (14) 30-39: TT: 26 (55) vs. CS: 18 (41) 40+: TT: 14 (30) vs. CS: 10 (23) missing data: TT: 14 (30) vs. CS: 3 (6) <u>Male, n (%)</u> TT: 31 (66) vs. CS: 30 (68) missing data: TT: 0 (0) vs. CS: 4 (9) **Characteristics (simulated casualties)** n.r.	TT: Triage Trainer video game: initial 15-min tutorial on gameplay procedure followed by a gameplay period of 60 min. (n=47) CS: card-sort exercise: tasked to document patient priorities on cards based on written physiological and mobility findings; 60 min. exercise (n=44) **Study interventions** • upfront MIMMS course: face-to-face educational training about triage methodologies • feedback given either through the game (TT) or through instructor (CS) • triage ability assessed in a simulated mass casualty situation (2–3 h after learning); gas explosion accident, 8 actors simulated injuries • triage sieve of the eight casualties and assign each of them a priority tag	TT: 34 (72), p=0.02 CS: 24 (55) <u>Step accuracy, n (%)</u> n participants who triaged 8/8 casualties without a step error TT: 13 (28) CS: 3 (7) p>0.05 across all eight accuracy groups percentage of casualties triaged without a step error TT: 68, n.s. CS: 57 <u>Time to complete exercise [s], mean ± SD</u> TT: 456 ± 62, p=0.155 CS: 435 ± 74	Selection bias: – Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion** „This study has demonstrated that serious gaming technology can be used to teach major incident triage, that it improves the accuracy of the triage process when this process is assessed immediately after training and suggests that it may have a role to play in the future if these promising early results are maintained." **Reviewers' conclusion** The risk of selection bias is high, because participants were allocated by the course coordinator and important confounders (previous triage experience) were not accounted for. Due to lack of blinding, there is a risk of performance bias. The results should be interpreted with great caution because (1) the sample size is very small, (2) the usual measures of triage accuracy

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
				are not provided, (3) no information on the casualties is given, (4) the authors did not analyse study limitations, and (5) they have a direct financial conflict of interest.
Mills 2020 „Virtual Reality Triage Training Can Provide Comparable Simulation Efficacy for Paramedicine Students Compared to Live Simulation-Based Scenarios". *Prehosp Emerg Care* 2020; 24(4): 525-536. **Study design** Randomised cross-over study **Aim of the study** „given the logistic and financial opportunities associated with VR compared to live simulation training, we aimed to compare the simulation efficacy of a bespoke VR MCI triage training simulation against a comparable live simulation scenario." **Setting** Australia, year n.r.	**Inclusion criteria** • students enrolled in a Bachelor of Science (Paramedical Science) at ECU with previous table-top didactic MCI discussion/workshop session • enrolled into 3rd-year practical-unit "Advanced Paramedical Practice 2" **Exclusion criteria** n.r. **Characteristics (participants)** n.r. **Characteristics (simulated casualties)** <u>Triage colour, n/N (%)</u> black: 2/10 (20) red: 3/10 (30) yellow: 3/10 (30) green: 2/10 (20)	**Participants** N=29 students; N=10 simulated casualties **Study groups** VR: virtual reality MCI simulation (completed first by n=15, second by n=14) LS: live MCI simulation (completed first by n=14, second by n=15) **Study interventions** • START triage • VR simulation filmed on a single day using moulaged actors to simulate victims injuries, giving stereoscopic 360-degree spherical video and sound • user interaction with the 360-degree film possible (click on designated icons attached to each patient to gather basic clinical information, i.e. airway, respiratory rate and pulse rate; allocate an appropriate triage card) • software provided feedback to users regarding correct versus incorrect triage assignment of patients, as well as the order and timeliness of their triage assignments Live simulation scenarios: controlled outside area of the university campus, same actors	<u>Cards allocated correctly [n], mean ± SD</u> VR: 7.97 ± 1.81, p=1.000 LS: 8.52 ± 1.66 <u>Time taken to complete scenario [s], mean ± SD</u> VR: 210.55 ± 35.14, p<0.001 LS: 360.14 ± 74.47 Note: data extraction limited to clinically relevant outcomes	**Level of evidence** 2b↓ **Risk of bias** Selection bias: + Performance bias: + Attrition bias: + Detection bias: + **Authors' conclusion** „given the catastrophic nature of real-world MCIs, and their potential threat to life and long-term injuries, the ability of VR to provide realistic education and training is a significant benefit. Moreover, the highly programable and structured format training provided via a VR platform could work to standardize training across providers, as well as improve the accessibility and feedback poten-

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
		utilized during filming, same patients, identical injuries; an actor with a paramedic clinical background provided basic clinical information matching that provided in the VR group		tial for MCI response training, without overly sacrificing scenario authenticity." **Reviewers' conclusion** There is low risk of bias in this study. The results should be interpreted with great caution as (1) no standardised test was used to compare groups, so that comparative evaluation of training methods on time taken is not justified; (2) the number of simulated casualties was very small, so the study may be underpowered to detect clinically meaningful differences; (3) the effect of training on important outcomes such as under- and over-triage rates was not measured; (4) the generalisability is limited because the training population consisted of paramedic students only; (5) the authors report a financial conflict of interest of their institution. The simulated casualties were identical, though bias from sequence effects was avoided by the randomised cross-over design.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Risavi 2013 „Prehospital mass-casualty triage training-written versus moulage scenarios: how much do EMS providers retain?" *Prehosp Disaster Med* 2013; 28(3): 251-6. **Study design** Prospective cross-over study **Aim of the study** „The purpose of this study was to compare the effectiveness of training prehospital providers to master mass-casualty triage skills through video instruction with subsequent application in both written and moulage scenarios. Independent variables included type of instructional design (written scenarios or moulage), time-dependent knowledge retention (measured initially and at six months), and level of prior training (emergency medical technicians (EMTs) and emergency medical technician paramedics (EMT-Ps)." **Setting**	**Inclusion criteria** • certified emergency medical technicians (EMTs) and emergency medical technician paramedics (EMT-Ps) **Exclusion criteria** none **Characteristics (participants)** <u>Profession, n (%)</u> EMT: 28 (62) EMT-P: 17 (38) **Characteristics (simulated casualties)** n.r.	**Participants** N=45 prehospital providers **Study groups** WR: written scenario exercise, 12 patients MG: moulage scenario exercise, 12 patients **Study interventions** • both groups trained in the START method using a video presentation • each participant completed both a written and moulage scenario • To minimize selection bias, 28 subjects completed the written scenario prior to the moulage, and 17 completed the moulage first. This was repeated six months later to assess learning retention. Data not extracted due to risk of sequence effects.	**Outcomes immediately after training**[$] <u>Triage accuracy for triage level RED, n/N (%)</u> WR: 166/180 (92.2) MG: 163/180 (90.5) <u>Under-triage for triage level RED, n/N (%)</u> WR: 14/180 (7.7) MG: 17/180 (9.4) <u>Overtriage for triage level RED, n/N (%)</u> WR: 0/180 (0) MG: 0/180 (0) <u>Triage accuracy for triage level YELLOW, n/N (%)</u> WR: 182/315 (57.7) MG: 141/315 (44.7) <u>Under-triage for triage level YELLOW, n/N (%)</u> WR: 107/315 (33.9) MG: 105/315 (33.3) <u>Over-triage for triage level YELLOW, n/N (%)</u> WR: 26/315 (8.2) MG: 69/315 (21.9) <u>Triage accuracy for triage level GREEN, n/N (%)</u> WR: 43/45 (95.5) MG:42/45 (93.3) <u>Under-triage for triage level GREEN, n/N (%)</u> WR: 0/45 (0) MG: 0/45 (0) <u>Over-triage for triage level GREEN, n/N (%)</u> WR: 2/45 (4.4) MG: 3/45 (6.6)	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: + Attrition bias: + Detection bias: + **Authors' conclusion** „In summary, these data confirm the skill deterioration associated with an infrequently used triage method. Mass-casualty triage trainees frequently do not get the opportunity to practice and perform trained skills after formal training and after an extensive period of non-use, they may find themselves in need of these skills." **Reviewers' conclusion** There is a low risk of bias in this study. The number of simulated casualties was very small, so the study may be underpowered to detect clinically meaningful differences.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
USA, year n.r.			[$] all rates calculated from counts provided in Figures 2-4 Test scores (clinical non-relevant outcome) were not extracted.	
+: low risk; –: high risk; ?: unclear risk; CI: Confidence Interval; HR: Hazard Ratio; IQR: Interquartile Range; ITT: Intention to Treat; LS: live simulation; MD: mean difference; OR: Odds Ratio; RR: Relative Risk; SD: Standard Deviation; SEM: Standard Error of Mean; VR: virtual reality; adj.: adjusted; d: days; m: months; s: seconds; y: years				

Prehospital Triage

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Cross (2013) "Head-to-Head Comparison of Disaster Triage Methods in Pediatric, Adult, and Geriatric Patients". *Ann Emerg Med* 2013; 61(6): 668-676.e7. **Study design** Prognostic cross-sectional study (National Trauma Data Base) **Aim of the study** "The study objective was to determine the accuracy of several disaster triage methods when predicting	**Inclusion criteria** • valid age • reported patient outcomes at both ED disposition and final hospital discharge **Exclusion criteria** • interfacility transfer • any of several data irregularities, such as a total hospital length of stay that was shorter than the ED length of stay or a final hospital discharge outcome that was inconsistent with the ED disposition • no report of the initial/scene vital signs of pulse, respirations, and Glasgow Coma Scale (GCS) score • reported only vital signs obtained after arrival at a hospital ED • records without Injury Severity Score **Characteristics**	**Dataset** N=530,695 patient records **Triage tools evaluated** START: categories black (dead), red (immediate), yellow (delayed), green (minor); START for adults and JumpSTART for victims aged <9 years FDNY: categories black (dead), red (immediate), orange (urgent), yellow (delayed, green (minor); based on START but inclusion of GCS for assigning category CareFlight: categories black (dead), red (immediate), yellow (delayed), green (minor); simpler than START and does not have pediatric rules GCS: Scores from 3 (coma) to 15 (awake and orientated); was not initially created for triage, but it is familiar to medical providers; scene-reported GCS was used for triage	**Prognostic test performance: mortality at hospital disposition** AUC (95% CI) START: 0.846 (0.843 to 0.849) FDNY: 0.851 (0.848 to 0.853) CareFlight: 0.852 (0.850 to 0.855) GCS: 0.825 (0.822 to 0.829) Sacco: 0.883 (0.880 to 0.885) Unadjusted Sacco: 0.824 (0.821 to 0.828) **Prognostic test performance: deaths in the ED** AUC (95% CI) START: 0.950 (0.946 to 0.954) FDNY: 0.951 (0.947 to 0.955) CareFlight: 0.955 (0.951 to 0.959) GCS: 0.952 (0.947 to 0.957) Sacco: 0.967 (0.963 to 0.971) Unadjusted Sacco: 0.970 (0.965 to 0.974) **Prognostic test performance: any ventilator use**	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "Among 6 disaster triage methods compared against outcomes in trauma registry patients, the Sacco Score tended to predict mortality most accurately. This analysis highlights comparative strengths and weakness of START/ JumpSTART, FDNY, CareFlight, the GCS, and the Sacco Score, suggesting areas in which each triage

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
clinically important outcomes in a large cohort of trauma victims." **Setting** US, 2007-2009	Age, median [y], (IQR) 42 (24–61) Age strata [y], n (%) 0-8y 15,114 (2.8) 9-15: 21,781 (4.1) 16-64: 379,144 (71.4) ≥65: 114,656 (21.6) Male, n (%) 344,421 (64.8) ISS, median (IQR) 9 (4–14) ISS >15, % 24.4 Mortality at hospital disposition, n (%) 21,887 (4.1) Death in the ED, n (%) 2,198 (0.4) Ventilator support, n (%) 68,925 (13.0)	Sacco: Respirations, pulse, and motor response (similar to the GCS motor subscore) used for a primary score totaling 0 to 12 points, then adjusted for patient age, yielding a final Sacco Score from –2 (dead) to 14 (healthy) Unadjusted Sacco: calculated like the regular Sacco Score, simply omitting the age adjustment term. For victims of all ages, results in scores ranging from 0 (dead) to 12 (healthy) **Summary of intervention** • Each patient retroactively assigned a triage level with each of 6 disaster triage methods • EMS/disaster management experts vetted the methods used to approximate the disaster triage strategies with the NTDB data • In case triage algorithms use data that are not available in the NTDB, approximations based on available surrogate information were used	AUC (95% CI) START: 0.799 (0.797 to 0.801) FDNY: 0.805 (0.803 to 0.807) CareFlight: 0.801 (0.799 to 0.803) GCS: 0.744 (0.742 to 0.746) Sacco: 0.714 (0.711 to 0.716) Unadjusted Sacco: 0.735 (0.733 to 0.738) **Subgroup analysis by age strata‡** **Prognostic test performance: Mortality at hospital discharge** Age 16-64 years AUC (95% CI) START: 0.888 (0.885–0.890) FDNY: 0.894 (0.892–0.897) CareFlight: 0.897 (0.894–0.899) GCS: 0.880 (0.876–0.883) Sacco: 0.900 (0.896–0.903) Unadjusted Sacco: 0.892 (0.889–0.896) Age ≥65 years AUC (95% CI) START: 0.791 (0.785–0.797) FDNY: 0.797 (0.791–0.803) CareFlight: 0.791 (0.785–0.797) GCS: 0.733 (0.726–0.740) Sacco: 0.733 (0.727–0.740) Unadjusted Sacco: 0.713 (0.706–0.720) ‡ age subgroups 0-8 and 9-15 were analysed in Cicero (2021) and are presented there	method might be further improved." **Reviewers' conclusion** The results of the study need to be interpreted with caution. Analysis was based on trauma cases treated individually, rather than those treated under MCI conditions. Investigators performed all triage assignments themselves, and results may differ under real-MCI conditions. Surrogates based on ISS hat to be used for the ability to ambulate for START, FDNY, and CareFlight, which may have affected triage performance estimates. The study design was not suitable to evaluate time taken for triage.
Cross (2015)	**Inclusion criteria*** • complete, internally consistent data	**Dataset**	**Primary Outcomes**	**Level of evidence** 2b

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
„A better START for low-acuity victims: data-driven refinement of mass casualty triage". *Prehosp Emerg Care* 2015; 19(2): 272-278. **Study design** Diagnostic & prognostic cohort study (National Trauma Database, secondary analysis of Cross 2013) **Aim of the study** „The objective of this project was to assess errors and weakness of the currently widely used Simple Triage and Rapid Transport (START) algorithm. Particularly, we concentrated on the Minor/Green triage category, wherein previous work shows a small but real risk of mortality. We developed and tested evidence-based improvements to START triage, and assessed the likely impact on overall performance if those improvements were implemented." **Setting**	• valid age • reported patient outcomes at both ED disposition and final hospital discharge **Exclusion criteria*** • interfacility transfer • any of several data irregularities, such as a total hospital length of stay that was shorter than the ED length of stay or a final hospital discharge outcome that was inconsistent with the ED disposition • no report of the initial/scene vital signs of pulse, respirations, and Glasgow Coma Scale (GCS) score • reported only vital signs obtained after arrival at a hospital ED • records without Injury Severity Score Characteristics Age [y], median (IQR) 42 (24–61) Death in the ED, n (%) 2,198 (0.4) Any ventilator use, n (%) 68,925 (13%) ≥1 Baxt criteria, n (%) 113,526 (21%) Mortality by triage level, n died (%) START Dead/Black: 2,089 (90.6) Immediate/Red: 13,422 (16.8)	N=530,695 patients (all triage levels), N=322,162 assigned to Minor/Green Triage tools evaluated StartOver60: patients with age >60 triage category changed from green to yellow; n=91,163 StartOver75: patients with age >75 changed from green to yellow; n=53,195 Reference standard: START triage **Study interventions** • START triage assignments compared to recorded patient mortality outcomes • Subjects assigned to the Minor/Green level who died prior to hospital discharge were considered mistriaged. • Demographic and clinical attributes associated with mistriage (most discriminating cutoff values) organized into a hierarchical prediction tree • Age ≥60 years was the primary predictor of undertriage by START • Age with a cutoff of 75 years was the second most useful predictor of undertriage	**Prognostic test performance: mortality at hospital discharge** AUC START: 0.846 StartOver60: 0.855* StartOver75: 0.858* **Secondary Outcomes** **Prognostic test performance: any ventilator use** AUC START: 0.799 StartOver60: 0.773* StartOver75: 0.783* **Diagnostic test performance: presence of one or more Baxt criteria**$ AUC: START: 0.717 StartOver60: 0.676* StartOver75: 0.692* * 95% CI do not overlap with the reference method (START) $ Baxt criteria: Glasgow Coma Motor Score <5; systl. Blood pressure <85 mmHg; potential penetrating injury of the head neck, or trunk; presence of major trauma	**Risk of bias (QUADAS)** Patient selection: – Index test: – Reference standard: ? Flow and timing: + no tool available for prognostic studies **Authors' conclusion** "In this research model using trauma registry data, most START undertriage errors occurred in elderly patients. Overall START accuracy was improved by placing elderly, but otherwise minimally injured mass casualty victims into a higher risk triage level. Alternatively, such patients would be candidates for closer monitoring at the scene or expedited transport ahead of other, younger Minor/Green victims." **Reviewers' conclusion** The results are derived from the same population as Cross (2013). Therefore, adjusted START results may be directly compared with the other triage algorithms presented therein.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
USA, 2007-2009	Delayed/Yellow: 4,330 (3.4) Minor/Green: 2,046 (0.6) StartOver60 Dead/Black: 2089 (90.6) Immediate/Red: 13,422 (16.8) Delayed/Yellow: 6,072 (2.8) Minor/Green: 304 (0.1) StartOver75 Dead/Black: 2089 (90.6) Immediate/Red: 13,422 (16.8) Delayed/Yellow: 5,699 (3.2) Minor/Green: 677 (0.3) * criteria extracted from Cross (2013)			There is a risk of bias related to the index and reference triage tools. The triage tools may be biased because actual triage decisions were approximated by physiological thresholds. The results of the age-modified START algorithms are yet to be validated using an independent sample. Only AUC values are presented for the triage algorithms, so that no comparison of sensitivity/specificity is possible. Analysis was based on trauma cases treated individually, rather than those treated under MCI conditions. Investigators performed all triage assignments themselves, and results may differ under real-MCI conditions. The study design was not suitable to evaluate the effects on time taken for triage. Systolic blood pressure <109 mmHg was identified as another highly discriminating factor associated with increased mortality in the 60-74 age group, but no AUC result is provided that includes this factor.
Cicero (2021)	**Inclusion criteria**	**Dataset**	**Diagnostic test performance: triage category**	**Level of evidence**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"Prehospital Disaster Triage Does Not Predict Pediatric Outcomes: Comparing the Criteria Outcomes Tool to Three Mass-Casualty Incident Triage Algorithms". *Prehosp Disaster Med* 2021; 36(5), 503-510. **Study design** Diagnostic cross-sectional study (National Trauma Data Bank, subgroup analysis of Cross 2013) **Aim of the study** „The primary objective of this study was to compare triage outcomes of Simple Triage and Rapid Treatment (START), modified START, and CareFlight in pediatric patients to an outcomes-based gold standard using the Criteria Outcomes Tool (COT). The secondary outcomes were sensitivity, specificity, under-triage, over-triage, and overall accuracy at each level for each MCI triage algorithm." **Setting** USA, 2007-2009	• age: 0-15 years at the time of the trauma • transported from the scene of injury • internally consistent data **Exclusion criteria** • transferred from outlying facility • age or outcomes not reported • data irregularities • scene vital signs or GCS not reported • ISS not reported **Characteristics** COT-based triage levels, n (%) BLACK: 601 (1.9) RED: 1,572 (5.1) YELLOW: 11,587 (37.3) GREEN: 17,333 (55.7)	N=31,093 pediatric casualties **Triage tools** evaluated START: Simple Triage and Rapid Treatment; categories black (dead), red (immediate), yellow (delayed), green (minor) adjusted for children under 9y: JumpSTART CareFlight: categories black (dead), red (immediate), yellow (delayed), green (minor); simpler than START; no pediatric assessment rules FDNY: Fire Department of New York algorithm; categories black (dead), red (immediate), orange (urgent), yellow (delayed, green (minor); based on START, inclusion of GCS Reference standard: Criteria Outcome Tool (COT) Expected Triage Level, a consensus-based gold standard based on outcomes, including mortality, injury type, admission to the hospital, and surgical procedures. Developed specifically to test the inherent capability of MCI triage algorithms to correctly triage the pediatric population using outcomes data **Study intervention** • COT triage levels (BLACK/RED/YELLOW/GREEN) assigned to each patient • START, FDNY, CareFlight applied according to their published algorithms • JumpSTART utilized in children ≤8 years; START for children >8 years of age • ORANGE and YELLOW triage categories of FDNY triage collapsed into one category and compared to COT YELLOW	COT level BLACK Sensitivity, % (95% CI) START: 39 (35 – 43) CareFlight: 83 (80 – 86) FDNY: 39 (35 – 43) Specificity, % (95% CI) START: 100 (99 – 100) CareFlight: 100 (99 – 100) FDNY: 100 (99 – 100) Patients under-triaged, % START: 61 CareFlight: 17 FDNY: 61 COT level RED Sensitivity, % (95% CI) START: 54 (51 – 56) CareFlight: 50 (48 – 53) FDNY: 56 (54 – 59) Specificity, % (95% CI) START: 85 (84 – 86) CareFlight: 89 (89 – 90) FDNY: 80 (79 – 80) Patients over-triaged, % START: 0 CareFlight: 0 FDNY: 0 Patients under-triaged, % START: 46 CareFlight: 50 FDNY: 56	2b **Risk of bias (QUADAS)** Patient selection: – Index test: – Reference standard: + Flow and timing: + **Authors' conclusion** „When pediatric trauma patients aged 0-15 years are triaged using START, FDNY triage, or CareFlight, comparison with the COT standard shows that CareFlight has the relative best performance for predicting patient outcomes. All of START, FDNY triage, and CareFlight algorithms do not appear to accurately predict pediatric patient care needs at a receiving facility. The COT can be used to evaluate the correlation between the sorting outcomes of a triage strategy and the short- and long-term outcomes for a population of disaster victims." **Reviewers' conclusion** There is an unclear risk of selection bias because a substantial proportion of patients were excluded due

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			COT level YELLOW Sensitivity, % (95% CI) START: 21 (20 – 22) CareFlight: 22 (21 – 23) FDNY: 20 (19 – 21) Specificity, % (95% CI) START: 88 (87 – 89) CareFlight: 87 (87 – 88) FDNY: 88 (87 – 88) Patients over-triaged, % START: 16 CareFlight: 14 FDNY: 19 Patients under-triaged, % START: 63 CareFlight: 65 FDNY: 60 COT level GREEN Sensitivity, % (95% CI) START: 77 (76 – 77) CareFlight: 79 (79 – 80) FDNY: 69 (68 – 69) Specificity, % (95% CI) START: 44 (43 – 45) CareFlight: 43 (42 – 44) FDNY: 47 (46 – 48) Patients over-triaged, % START: 23 CareFlight: 21 FDNY: 31	to missing or irregular data. The triage tools may be biased because actual triage decisions were approximated by physiological thresholds, and ability to walk was estimated based on ISS in all algorithms, which may have affected triage performance estimates. Analysis was based on trauma cases treated individually, rather than those treated under MCI conditions. Investigators performed all triage assignments themselves, and results may differ under real-MCI conditions. The study design was not suitable to evaluate the effects on time taken for triage. The expected triage level used as reference standard is based on consensus between two independent experts. START and JumpSTART were analysed as one triage algorithm. Subgroup analysis might gave given more insight into usefulness of pediatric adapted triage.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Malik (2020) "The BCD Triage Sieve outperforms all existing major incident triage tools: Comparative analysis using the UK national trauma registry population". *EClinicalMedicine* 2021; 36: 100888. **Study design** Prognostic and diagnostic cross-sectional study (Trauma Audit and Research Network Registry) **Aim of the study** „In order to inform major incident triage practice in the UK civilian setting, this study aimed to compare the performance of major incident triage tools applicable at the scene of injury in predicting P1 casualty status amongst adults using the UK trauma registry database." **Setting** UK, 2008 –2017	**Inclusion criteria** • patients aged 16+ years **Exclusion criteria** • incomplete pre-hospital physiological data required to apply the triage tools (respiratory rate, heart rate, capillary refill time, Glasgow Coma Score (GCS), and GCS Motor Component) **Characteristics** Age (y) median (IQR) 66.2 (47.3 to 83) Age groups n (%) 16-64: 95,306 (48.7) 65+: 100,403 (51.3) Male n (%) 104,019 (53.1) ISS (median) n (IQR) 9 (9-17) Mortality n (%) 13,601 (7)	**Dataset** N=195,709 patient records **Triage tools evaluated** BCD: Battlefield Casualty Drills (BCD) Triage Sieve, current UK military tool for use in adults CareFlight: Australian tool used in adults and children START: Simple Triage and Rapid Treatment, United States, used in several states JumpSTART: START modified for children mSTART: modification of START, capillary refill replaced by absence of radial pulse MIMMS: Major Incident Medical Management and Support (MIMMS) Triage Sieve, former UK military adult triage tool MPTT: Modified Physiological Triage Tool, UK-based tool modelled in a military cohort MPTT-24: modification of MPTT, inclusion of relevant hemorrhage and application of tourniquet NARU: National Ambulance and Resilience Unit (NARU) Triage Sieve, Current UK civilian adult tool, adapted from MIMMS RAMP: Rapid Assessment of Mentation and Pulse, United States, used by the Rocky Mountain Fire Department, Colorado Reference standard: intervention-based criteria with categories Priority 1 (P1, defined	**Prognostic test performance: mortality, age group 16-64y*** Sensitivity, % (95% CI) BCD: 85.2 (83.8 – 86.6) CareFlight: 69.6 (67.8 – 71.4) START: 75.3 (73.6 – 77.0) JumpSTART: 70.0 (68.2 – 71.8) mSTART: 77.3 (75.6 – 78.9) MIMMS: 63.3 (61.4 – 65.2) MPTT: 34.2 (32.3 – 36.1) MPTT-24: 33.4 (31.6 – 35.3) NARU: 72.7 (70.9 – 74.4) RAMP: 50.6 (48.6 – 52.6) Specificity, % (95% CI) BCD: 60.9 (60.5 – 61.2) CareFlight: 88.3 (88.1 – 88.6) START: 85.1 (84.8 – 85.3) JumpSTART: 84.7 (84.5 – 84.9) mSTART: 82.9 (82.7 – 83.2) MIMMS: 88.9 (88.7 – 89.1) MPTT: 57.4 (57.0 – 57.7) MPTT-24: 61.0 (60.6 – 61.3) NARU: 84.3 (84.1 – 84.6) RAMP: 88.9 (88.7 – 89.1) PPV, % (95% CI) BCD: 5.6 (5.4 – 5.8) CareFlight: 14.0 (13.4 – 14.6) START: 12.1 (11.6 – 12.6) JumpSTART: 11.1 (10.6 – 11.6) mSTART: 11.0 (10.5 – 11.5) MIMMS: 13.5 (12.9 – 14.2) MPTT: 2.1 (2.0 – 2.3) MPTT-24: 2.3 (2.1 – 2.4)	**Level of evidence** 2b **Risk of bias (QUADAS)** Patient selection: + Index test: + Reference test: + Flow and timing: + no tool available for prognostic studies **Authors' conclusion** "In conclusion, based on current available evidence and the findings of this study, the NARU Triage Sieve used currently in UK civilian practice is not the optimal tool for major incident triage. We recommend its replacement by the BCD Triage Sieve, which may afford a 24-26% improvement in detecting patients in need of time-critical, life-saving intervention at the scene of a major incident, thus facilitating their immediate transfer to the highest tier of trauma care and maximising chances of survival." **Reviewers' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
		as need for time-critical lifesaving intervention(s)), P2, P3, Expectant or Dead **Summary of interventions** • time-critical interventions from a pre-defined list, allowing assignment of "actual" triage categories (P1, P2, P3, Expectant or Dead) • Tool performance assessed by comparing tool-predicted and intervention-based P1 status	NARU: 11.2 (10.8 – 11.7) RAMP: 11.1 (10.5 – 11.7) <u>NPV, % (95% CI)</u> BCD: 99.3 (99.3 – 99.4) CareFlight: 99.1 (99.0 – 99.1) START: 99.2 (99.1 – 99.3) JumpSTART: 99.0 (99.0 – 99.1) mSTART: 99.3 (99.2 – 99.3) MIMMS: 98.9 (98.8 – 99.0) MPTT: 97.0 (96.8 – 97.1) MPTT-24: 97.1 (97.0 – 97.2) NARU: 99.1 (99.1 – 99.2) RAMP: 98.5 (98.4 – 98.6) <u>Undertriage (1-sensitivity), % (95% CI)</u> BCD: 14.8 (13.4 – 16.2) CareFlight: 30.4 (28.6 – 32.2) START: 24.7 (23.0 – 26.4) JumpSTART: 30.0 (28.2 – 31.8) mSTART: 22.7 (21.1 – 24.4) MIMMS: 36.7 (34.8 – 38.6) MPTT: 65.8 (63.9 – 67.7) MPTT-24: 66.6 (64.7 – 68.4) NARU: 27.3 (25.6 – 29.1) RAMP: 49.4 (47.4 – 51.4) <u>Overtriage (1-PPV), % (95% CI)</u> BCD: 94.4 (94.2 – 94.6) CareFlight: 86.0 (85.4 – 86.6) START: 87.9 (87.4 – 88.4) JumpSTART: 88.9 (88.4 – 89.4) mSTART: 89.0 (88.5 – 89.5) MIMMS: 86.5 (85.8 – 87.1) MPTT: 97.9 (97.7 – 98.0) MPTT-24: 97.7 (97.6 – 97.9) NARU: 88.8 (88.3 – 89.2) RAMP: 88.9 (88.3 – 89.5)	The study has a low risk of bias. The results of the study still need to be interpreted with caution: Analysis was based on trauma cases treated individually, rather than those treated under MCI conditions. Investigators performed all triage assignments themselves, and results may differ under real-MCI conditions. All patients in the TARN database were assumed to be non-ambulatory, which is different to many MCI scenarios. The study design was not suitable to evaluate the effects on time taken for triage. Missing information about knowledge of reference test results during triage performance lead to an unclear risk of bias for the index test.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			AUC (95% CI) BCD: 0.730 (0.723 – 0.738) CareFlight: 0.790 (0.781 – 0.799) START: 0.802 (0.794 – 0.810) JumpSTART: 0.774 (0.765 – 0.783) mSTART: 0.801 (0.793 – 0.809) MIMMS: 0.761 (0.752 – 0.771) MPTT: 0.458 (0.448 – 0.467) MPTT-24: 0.472 (0.463 – 0.481) NARU: 0.785 (0.776 – 0.794) RAMP: 0.698 (0.688 – 0.707) **Diagnostic test performance: P1 status, age group 16-64y*** Sensitivity, % (95% CI) BCD: 70.4 (69.7 – 71.1) CareFlight: 43.3 (42.6 – 44.1) START: 53.7 (52.9 – 54.5) JumpSTART: 46.8 (46.1 – 47.6) mSTART: 57.2 (56.5 – 58.0) MIMMS: 41.8 (41.0 – 42.5) MPTT: 49.9 (49.1 – 50.7) MPTT-24: 47.9 (47.1 – 48.7) NARU: 44.9 (44.1 – 45.7) RAMP: 39.4 (38.6 – 40.1) Specificity, % (95% CI) BCD: 65.6 (65.3 – 66.0) CareFlight: 92.8 (92.7 – 93.0) START: 90.9 (90.7 – 91.1) JumpSTART: 89.3 (89.0 – 89.5) mSTART: 89.0 (88.8 – 89.3) MIMMS: 93.4 (93.3 – 93.6) MPTT: 59.1 (58.7 – 59.4) MPTT-24: 62.9 (62.6 – 63.2) NARU: 88.4 (88.2 – 88.6) RAMP: 93.3 (93.1 – 93.5)	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			PPV, % (95% CI) BCD: 29.1 (28.6 – 29.6) CareFlight: 54.8 (53.9 – 55.7) START: 54.2 (53.4 – 55.0) JumpSTART: 46.6 (45.8 – 47.4) mSTART: 51.1 (50.4 – 51.9) MIMMS: 56.0 (55.1 – 56.9) MPTT: 19.6 (19.2 – 20.0) MPTT-24: 20.6 (20.1 – 21.0) NARU: 43.6 (42.9 – 44.4) RAMP: 54.1 (53.2 – 55.0) NPV, % (95% CI) BCD: 91.7 (91.5 – 91.9) CareFlight: 89.1 (88.9 – 89.3) START: 90.7 (90.5 – 90.9) JumpSTART: 89.3 (89.1 – 89.6) mSTART: 91.2 (91.0 – 91.4) MIMMS: 88.9 (88.7 – 89.1) MPTT: 85.5 (85.2 – 85.8) MPTT-24: 85.8 (85.5 – 86.1) NARU: 88.9 (88.7 – 89.1) RAMP: 88.5 (88.3 – 88.7) Undertriage (1-sensitivity), % (95% CI) BCD: 29.6 (28.9 – 30.3) CareFlight: 56.7 (55.9 – 57.4) START: 46.3 (45.5 – 47.1) JumpSTART: 53.2 (52.4 – 53.9) mSTART: 42.8 (42.0 – 43.5) MIMMS: 58.2 (57.5 – 59.0) MPTT: 50.1 (49.3 – 50.9) MPTT-24: 52.1 (51.3 – 52.9) NARU: 55.1 (54.3 – 55.9) RAMP: 60.6 (59.9 – 61.4) Overtriage (1-PPV), % (95% CI)	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			BCD: 70.9 (70.4 – 71.4) CareFlight: 45.2 (44.3 – 46.1) START: 45.8 (45.0 – 46.6) JumpSTART: 53.4 (52.6 – 54.2) mSTART: 48.9 (48.1 – 49.6) MIMMS: 44.0 (43.1 – 44.9) MPTT: 80.4 (80.0 – 80.8) MPTT-24: 79.4 (79.0 – 79.9) NARU: 56.4 (55.6 – 57.1) RAMP: 45.9 (45.0 – 46.8) AUC (95% CI) BCD: 0.680 (0.676 – 0.684) CareFlight: 0.681 (0.677 – 0.685) START: 0.723 [0.719 – 0.727] JumpSTART: 0.681 [0.676 – 0.685] mSTART: 0.731 (0.727 – 0.735) MIMMS: 0.676 (0.672 – 0.680) MPTT: 0.545 (0.541 – 0.549) MPTT-24: 0.554 (0.550 – 0.558) NARU: 0.666 (0.662 – 0.670) RAMP: 0.663 (0.660 – 0.667) **Prognostic test performance: mortality, age group 65+*** Sensitivity, % (95% CI) BCD: 49.7 (48.8 – 50.7) CareFlight: 26.9 (26.1 – 27.8) START: 33.5 (32.7 – 34.4) JumpSTART: 23.5 (22.7 – 24.3) mSTART: 35.7 (34.8 – 36.6) MIMMS: 21.5 (20.8 – 22.3) MPTT: 48.6 (47.7 – 49.5) MPTT-24: 45.9 (44.9 – 46.8) NARU: 29.4 (28.6- 30.3) RAMP: 25.0 (24.2 – 25.9) Specificity, % (95% CI)	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			BCD: 73.4 (73.1 – 73.7) CareFlight: 94.1 (93.9 – 94.2) START: 90.3 (90.1 – 90.5) JumpSTART: 90.6 (90.4 – 90.8) mSTART: 88.9 (88.7 – 89.1) MIMMS: 92.7 (92.5 – 92.9) MPTT: 67.5 (67.2 – 67.8) MPTT-24: 71.0 (70.7 – 71.3) NARU: 90.4 (90.2 – 90.6) RAMP: 94.3 (94.1 – 94.4) PPV, % (95% CI) BCD: 18.8 (18.4 – 19.3) CareFlight: 36.1 (35.0 – 37.1) START: 30.1 (29.3 – 30.9) JumpSTART: 23.6 (22.9 – 24.5) mSTART: 28.4 (27.7 – 29.2) MIMMS: 26.8 (25.8 – 27.7) MPTT: 15.6 (15.2 – 16.0) MPTT-24: 16.4 (16.0 – 16.8) NARU: 27.5 (26.7 – 28.4) RAMP: 35.1 (34.1 – 36.2) NPV, % (95% CI) BCD: 92.2 (92.0 – 92.4) CareFlight: 91.2 (91.0 – 91.4) START: 91.6 (91.5 – 91.8) JumpSTART: 90.5 (90.3 – 90.7) mSTART: 91.8 (91.6 – 92.0) MIMMS: 90.5 (90.3 – 90.7) MPTT: 91.4 (91.2 – 91.6) MPTT-24: 91.4 (91.2 – 91.6) NARU: 91.2 (91.0 – 91.4) RAMP: 91.0 (90.8 – 91.2) Undertriage (1-sensitivity), % (95% CI) BCD: 50.3 (49.3 – 51.2) CareFlight: 73.1 (72.2 – 73.9)	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			START: 66.5 (65.6 – 67.3) JumpSTART: 76.5 (75.7 – 77.3) mSTART: 64.3 (63.4 – 65.2) MIMMS: 78.5 (77.7 – 79.2) MPTT: 51.4 (50.5 – 52.3) MPTT-24: 54.1 (53.2 – 55.1) NARU: 70.6 (69.7 – 71.4) RAMP: 75.0 (74.1 – 75.8) Overtriage (1-PPV), % (95% CI) BCD: 81.2 (80.7 – 81.6) CareFlight: 63.9 (62.9 – 65.0) START: 69.9 (69.1 – 70.7) JumpSTART: 76.4 (75.5 – 77.1) mSTART: 71.6 (70.8 – 72.3) MIMMS: 73.2 (72.3 – 74.2) MPTT: 84.4 (84.0 – 84.8) MPTT-24: 83.6 (83.2 – 84.0) NARU: 72.5 (71.6 – 73.3) RAMP: 64.9 (63.8 – 65.9) AUC (95% CI) BCD: 0.616 (0.611 – 0.621) CareFlight: 0.605 (0.601 – 0.609) START: 0.619 (0.615 – 0.624) JumpSTART: 0.571 (0.566 – 0.575) mSTART: 0.623 (0.618 – 0.627) MIMMS: 0.571 (0.567 – 0.575) MPTT: 0.580 (0.575 – 0.585) MPTT-24: 0.584 (0.579 – 0.589) NARU: 0.599 (0.595 – 0.604) RAMP: 0.597 (0.592 – 0.601) **Diagnostic test performance: P1 status, age group 65+**[*] Sensitivity, % (95% CI) BCD: 56.7 (55.5 – 57.9) CareFlight: 33.5 (32.3 – 34.7)	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			START: 45.9 (44.7 – 47.2) JumpSTART: 36.1 (34.9 – 37.3) mSTART: 48.6 (47.4 – 49.9) MIMMS: 34.7 (33.5 – 35.9) MPTT: 45.4 (44.1 – 46.6) MPTT-24: 43.1 (41.9 – 44.3) NARU: 33.2 (32.1 – 34.4) RAMP: 31.3 (30.1 – 32.4) Specificity, % (95% CI) BCD: 72.7 (72.4 – 73) CareFlight: 93.4 (93.3 – 93.6) START: 89.9 (89.7 – 90.1) JumpSTART: 90.7 (90.5 – 90.9) mSTART: 88.5 (88.3 – 88.7) MIMMS: 92.8 (92.7 – 93.0) MPTT: 66.4 (66.1 – 66.7) MPTT-24: 69.9 (69.6 – 70.2) NARU: 89.6 (89.4 – 89.8) RAMP: 93.7 (93.5 – 93.9) PPV, % (95% CI) BCD: 12.1 (11.7 – 12.5) CareFlight: 25.3 (24.4 – 26.3) START: 23.2 (22.5 – 24.0) JumpSTART: 20.5 (19.7 – 21.2) mSTART: 21.8 (21.2 – 22.5) MIMMS: 24.3 (23.4 – 25.2) MPTT: 8.2 (7.9 – 8.5) MPTT-24: 8.7 (8.4 – 9.0) NARU: 17.5 (16.9 – 18.2) RAMP: 24.7 (23.8 – 25.7) NPV, % (95% CI) BCD: 96.2 (96.1 – 96.3) CareFlight: 95.5 (95.4 – 95.6) START: 96.2 (96.0 – 96.3) JumpSTART: 95.5 (95.4 – 95.7)	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			mSTART: 96.3 (96.2 – 96.4) MIMMS: 95.5 (95.4 – 95.7) MPTT: 94.8 (94.7 – 95.0) MPTT-24: 94.9 (94.7 – 95.0) NARU: 95.3 (95.2 – 95.4) RAMP: 95.4 (95.2 – 95.5) <u>Undertriage (1-sensitivity), % (95% CI)</u> BCD: 43.3 (42.1 – 44.5) CareFlight: 66.5 (65.3 – 67.7) START: 54.1 (52.8 – 55.3) JumpSTART: 63.9 (62.7 – 65.1) mSTART: 51.4 (50.1 – 52.6) MIMMS: 65.3 (64.1 – 66.5) MPTT: 54.6 (53.4 – 55.9) MPTT-24: 56.9 (55.7 – 58.1) NARU: 66.8 (65.6 – 67.9) RAMP: 68.7 (67.6 – 69.9) <u>Overtriage (1-PPV), % (95% CI)</u> BCD: 87.9 (87.5 – 88.3) CareFlight: 74.7 (73.7 – 75.6) START: 76.8 (76.0 – 77.5) JumpSTART: 79.5 (78.8 – 80.3) mSTART: 78.2 (77.5 – 78.8) MIMMS: 75.7 (74.8 – 76.6) MPTT: 91.8 (91.5 – 92.1) MPTT-24: 91.3 (91.0 – 91.6) NARU: 82.5 (81.8 – 83.1) RAMP: 75.3 (74.3 – 76.2) <u>AUC (95% CI)</u> BCD: 0.647 (0.641 – 0.653) CareFlight: 0.635 (0.629 – 0.641) START: 0.679 (0.673 – 0.686) JumpSTART: 0.634 (0.628 – 0.640) mSTART: 0.686 (0.679 – 0.692) MIMMS: 0.638 (0.632 – 0.644)	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			MPTT: 0.559 (0.553 – 0.565) MPTT-24: 0.565 (0.559 – 0.571) NARU: 0.614 (0.609 – 0.620) RAMP: 0.625 (0.619 – 0.631) * all triage performance measures compared to reference standard	
Martin-Rodrigues (2019) „Accuracy of National Early Warning Score 2 (NEWS2) in Prehospital Triage on In-Hospital Early Mortality: A Multi-Center Observational Prospective Cohort Study" *Prehosp Disaster Med* 2019; 34(6): 610-618. **Study design** Prognostic cross-sectional study **Aim of the study** „The objective of this study was to evaluate the capacity of different prehospital triage systems based on physiological parameters (SI, GAP, RTS, and NEWS2) to predict early mortality (within 48 hours) from the index event for use in MCIs." **Setting** Spain, 2018-2019	**Inclusion criteria** • patients over 18 years of age • attended by ALS and transferred to the emergency department (ED) **Exclusion criteria** • age below 18 years • social problems or acute psychiatric pathology • cardiorespiratory arrest • death before or during the transfer • pregnancy • terminal stages of disease (in treatment by palliative care units) • arrival time >45 min., evacuated by other means of transport or discharged in situ • could not be followed-up on through the electronic medical record **Characteristics (trauma and medical patients)** <u>Age [y], mean, (IQR)</u> 68 (53-81) <u>Male, n (5)</u> 766 (59.5) <u>48h-Mortality, n (%)</u>	**Dataset** N=1492 patients included, N=1288 analysed, N=262 trauma patients **Triage tools evaluated** SI: Shock index, physiological parameters measured are heart rate (bpm) and systolic blood pressure (mmHg) GAP: Glasgow Coma Scale-Age-Pressure Score, physiological parameters measured are systolic blood pressure (mmHg), AVPU score / GCS and age (years) RTS: Revised Trauma Score, physiological parameters measured are Respiratory Rate (per minute), systolic blood pressure (mmHg) and AVPU score / GCS NEWS2: National Early Warning Score 2, physiological parameters measured are respiratory rate (per minute), oxygen saturation (%), supplemental oxygen heart rate (bpm), systolic blood pressure (mmHg), body temperature (°C) and AVPU score / GCS **Summary of intervention** • During MCIs the Prehospital Emergency Medical System (PhEMS) performs first	**Prognostic test performance: early mortality (48h)**[§] <u>AUC (95% CI)</u> SI: 0.481 (0.32 – 0.64) GAP: 0.975 (0.91 – 1.0) RTS: 0.957 (0.88 – 1.0) NEWS2: 0.961 (0.88 – 1.0) Test performance using the following cut-offs, calculated using Youden's index to maximise sensitivity & specificity: SI: 1.05 GAP: 7 RTS: 2 NEWS2: 10 <u>Sensitivity % (95% CI)</u> SI: 23.1 (8.2–50.3) GAP: 100 (77.2–100) RTS: 100 (77.2–100) NEWS2: 100 (77.2–100) <u>Specificity % (95% CI)</u> SI: 95.2 (91.8–97.2) GAP: 92.0 (87.9–94.7) RTS: 81.1 (75.8–85.5) NEWS2: 89.6 (85.1–92.8) <u>PPV % (95% CI)</u>	**Level of evidence** 3b↓ **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "The use of the NEWS2 as a prehospital triage system presents a very high AUROC, both globally and specifically for trauma and injuries by external agents and other types of medical pathology. This triage system can help selecting the order of referral and the most appropriate hospital center depending on the patient's situation. Thus, PhEMS should evaluate the employment of the NEWS2 as a triage system, especially for the second triage (evacuation priority)." **Reviewers' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	69 (5.4) **Characteristics (trauma patients)** 48h-Mortality, n (%) 13 (5.0)	triage to determine the priority of attention for each patient, tools used for this are: START, Sacco, META etc. • In the second triage, once the Basic Life Support (BLS) and/or Advanced Life Support (ALS) maneuvers have been applied, the objective is to identify which casualties have the least chance of surviving if they are not referred to a center that is suitable to their pathology, and have therefore a higher priority of evacuation. Tools used for this are based on physiological parameters: Revised Trauma Score (RTS), Shock Index (SI), Glasgow Coma Scale-Age-Pressure Score (GAP). • During first patient contact the BLS and/or ALS teams collected demographic data, times of arrival, assistance and evacuation, vital parameters (respiratory rate, oxygen saturation, heart rate, systolic blood pressure, and body temperature), and clinical observations (AVPU [Alert, Verbal, Pain, Unresponsive] scale or Glasgow Coma Scale, and use of supplemental oxygen). • The data obtained the values of SI, GAP, RTS, and NEWS2 for each participant. • Data on hospital mortality were obtained through a review of the electronic medical records of the patients three days after prehospital care, including early mortality (within 48 hours of the index event) from any cause within the hospital.	SI: 20.0 (7.0–45.2) GAP: 39.4 (24.7–56.3) RTS: 21.7 (13.1–33.6) NEWS2: 33.3 (20.6–49.0) NPV % (95% CI) SI: 96.0 (92.7–97.8) GAP: 100 (98.4–100) RTS: 100 (98.1–100) NEWS2: 100 (98.3–100) LR (+) % (95% CI) SI: 4.79 (1.54–14.91) GAP: 12.45 (8.18–18.95) RTS: 5.30 (4.10–6.85) NEWS2: 9.58 (6.66–13.78) LR (–) % (95% CI) SI: 0.81 (0.59–1.11) GAP: 0 (0–3120.11) RTS: 0 (0–1500.87) NEWS2: 0 (0–2563.20) Prognostic OR (95% CI) SI: 5.93 (1.44–24.38) GAP: ∞ (30.95–∞) RTS: ∞ (12.36–∞) NEWS2: ∞ (23.78–∞) Prognostic accuracy % (95% CI) SI: 91.6 (87.6–94.4) GAP: 92.4 (88.5–95.0) RTS: 82.1 (77.0–86.2) NEWS2: 90.1 (85.9–93.1) § Data for trauma patients	All data required for triage assessment were collected prospectively. The results for trauma patients are based on a small number of cases, and confidence intervals are very wide. The study should be interpreted with caution as the analysis was based on trauma cases treated individually, rather than those treated under MCI conditions. Investigators performed all triage assignments themselves, and results may differ under real-MCI conditions. Time taken to collect data and perform triage decisions was not evaluated.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Vassallo (2017) "Major incident triage: Derivation and comparative analysis of the Modified Physiological Triage Tool (MPTT)". *Injury, Int. J. Care Injured* 2017; 48(5): 992-999. **Study design** Diagnostic cross-sectional study (Joint Theatre Trauma Registry) **Aim of the study** "With lack of evidence to support existing major incident triage tools, this study aims to derive a triage tool, using observed physiological measurements that shows an improved performance at predicting the need for life-saving intervention in a military population when compared to existing methods." **Setting** UK Military (Afghanistan), 2006-2013	**Inclusion criteria** • adult trauma patients (>18 years) • presenting to the Emergency Department at Camp Bastion, Afghanistan • complete recordings of physiological parameters on arrival at hospital (SBP, HR, GCS, RR) **Exclusion criteria** n.r. **Characteristics (participants)** Age, [y] median (IQR) 24 (21-19) Male, n (%) 3593 (98.3) Patients with Priority 1, n (%) 1738 (47.6) Fatalities, n (%) 75 (2.1) ISS, median (IQR) 5 (2-16)	**Dataset** N=3645 patients (after exclusion of 39.3% with incomplete physiological data) **Triage tools evaluated** MPTT: Modified Physiological Triage Tool, defined as RR<12 or RR≥22 or HR≥100 or GCS<14 MS: Military Sieve, RR<10, RR>30, HR>120, GCS<13 MMS: Modified Military Sieve, RR<12, RR>24, HR<40, HR>120, GCS<13 TS: Triage Sieve, RR<10, RR>30, HR>120 START: Simple Triage and Rapid Treatment, RR≥30, SBP<90, GCS<13 CareFlight: SBP<90, GCS<13 Reference standard: P1 status defined as having received one or more life-saving interventions from a predefined list **Summary of intervention** • The JTTR does not record presence of a radial pulse as a variable, therefore for the purposes of prioritisation using START and CareFlight, a surrogate systolic blood pressure of 90 mmHg was taken to represent the presence of a radial pulse and absence of hypotension • With available data patients were assigned a triage category using the different triage algorithms	**Diagnostic test performance: Priority 1 status** Sensitivity, % (95% CI) MPTT: 69.9 (67.7–72.0) MS: 43.8 (41.5–46.2) MMS: 50.9 (48.6–53.3) TS: 24.8 (22.8–26.9) START: 38.7 (36.5–41.1) CareFlight: 33.5 (31.3–35.8) Specificity, % (95% CI) MPTT: 65.3 (63.2–67.5) MS: 93.6 (92.4–94.6) MMS: 87.5 (85.9–88.9) TS: 94.7 (93.6–95.7) START: 96.9 (96.0–97.6) CareFlight: 98.4 (97.7–98.9) Undertriage (1-sensitivity), % MPTT: 30.1 MS: 56.2 MMS: 49.1 TS: 75.2 START: 61.3 CareFlight: 66.5 Overtriage (1-PPV), % MPTT: 35.2 MS: 13.8 MMS: 21.2 TS: 18.8 START: 8.1 CareFlight: 5.0	**Level of evidence** 2b **Risk of bias (QUADAS)** Patient selection: ? Index tests: – Reference standard: + Flow and timing: + **Authors' conclusion** "Our findings show that the modified physiological triage tool demonstrates good performance at predicting need for life-saving intervention within a military setting. It is superior to all existing major incident triage tools with respect to its rates of under-triage, and has an acceptable level of over-triage." **Reviewers' conclusion** The risk of patient selection bias is unclear because of missing information about exclusion criteria and exclusion of around 40% of patients due to missing physiological data. The triage tools may be biased because actual triage decisions were approximated by physiological thresholds,

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
				and it is unclear whether P1 status classification was known to those performing triage. The results of the study should also be interpreted with caution, because of (1) the military setting, resulting in a mainly young, male population not representative for a civilian population; (2) non-inclusion of P3 patients in the registry, which is different to many MCI scenarios; (3) evaluation of the performance of the MPTT on the same dataset in which it was derived, which may lead to overestimation of effect. The study design was not suitable to evaluate time taken for triage.
+: low risk; –: high risk; ?: unclear risk; CI: Confidence Interval; GCS: Glasgow Coma Scale; HR: Hazard Ratio; IQR: Interquartile Range; ISS: Injury Severity Score; ITT: Intention to Treat; OR: Odds Ratio; RR: Relative Risk; SD: Standard Deviation; SEM: Standard Error of Mean; adj.: adjusted; d: days; m: months; y: years				

Secondary Triage

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Muguruma (2019) "Validation of the Pediatric Physiological and Anatomical Triage Score in Injured Pediatric Patients".	**Inclusion criteria** • <16 years of age • admitted to the hospital	**Dataset** N=2005 patient data records (after exclusion of 30.2% patients with missing data) **Triage tools evaluated**	**Diagnostic test performance: ICU admission** AUC (95% CI) PPTAS: 0.61 (0.59-0.63) TRTS: 0.57 (0.56-0.59), p<0.001	**Level of evidence** 2b **Risk of bias (QUADAS)**

Prehosp Disaster Med 2019; 34(4): 363-369. **Study design** Diagnostic cross-sectional study (Japan Trauma Data Bank) **Aim of the study** "A Pediatric Physiological and Anatomical Triage Score (PPATS) was developed as a new secondary triage method. This study aimed to validate the accuracy of the PPATS in identifying injured pediatric patients who are admitted at a high frequency and require immediate treatment in a disaster setting." **Setting** Japan, 2012-2016	• availability of vital sign data for calculation of the PPATS and TRTS **Exclusion criteria** • out-of-hospital cardiac arrest • missing data necessary for evaluation **Characteristics** Age [y], median (IQR) 9 (6–13) Male, n (%) 1,439 (72) ISS, median (IQR) 9 (8–17) ICU admission, n (%) 1002 (49.9) Mortality during hospitalization, n (%) 30 (1.5)	PPTAS: Pediatric Physiological and Anatomical Triage Score, calculated based on respiratory rate, heart rate, systolic blood pressure, GCS, anatomical abnormalities, and the need for life-saving interventions TRTS: Triage Revised Trauma Score, calculated based on respiratory rate, systolic blood pressure and GCS Reference: need of immediate treatment, approximated by ICU admission **Summary of interventions** • primary analysis: prediction of immediate triage priority • secondary analysis: predicted survival rate	Test performance using a cut-off of 6 points for PPTAS: Sensitivity, % PPTAS: 78.6 TRTS: 18.4 Specificity, % PPTAS: 43.7 TRTS: 96.5 PPV, % PPTAS: 58.2 TRTS: 84.0 NPV, % PPTAS: 67.2 TRTS: 54.2	Patient selection: ? Index test: ? Reference standard: ? Flow and timing: + **Authors' conclusion** "The accuracy of PPATS, a new secondary triage method for injured pediatric patients, was superior to that of the current method (TRTS). The PPATS method is useful not only for identifying high-priority patients, but also for determining the priority ranking for medical treatment and evacuation." **Reviewers' conclusion** The risk of patient selection bias is unclear because around 30% of patients were excluded due to missing data. The triage tools may be biased because it is unclear whether ICU admisison was known to those performing triage. ICU admission was used as a surrogate for need of immediate treatment but may have other causes. The study compares a pediatric specific tool with a general tool not developed for children. Analysis was based on trauma cases treated individually, rather

				than those treated under MCI conditions. Investigators performed all triage assignments themselves, and results may differ under real-MCI conditions.
Vassallo (2015) "Usefulness of the Shock Index as a secondary triage tool". *R Army Med Corps* 2015; 161: 53–57. **Study design** Diagnostic cross-sectional study **Aim of the study** "The aim of this study was to identify whether the SI was a suitable alternative to the TSO for the purposes of *secondary* triage. The objectives were to identify the sensitivities and specificities of various cut-offs of SI, allowing for the identification of the optimum SI cut-off, and to compare this against the TSO at predicting need for LSI." **Setting** UK Military (Afghanistan), 2011	**Inclusion criteria** • adult (>18 years) trauma patients • presenting to the ED at Camp Bastion, Afghanistan • met trauma team activation criteria • data available for interventions undertaken (including 'none') **Exclusion criteria** n.r. **Characteristics (participants)** <u>SI, median (IQR)</u> P1 patients: 0.93 (0.71–1.26) Non P1 patients: 0.61 (0.52–0.75)	**Participants** N=482 patients presenting to ED Camp Bastion, N=345 analysed **Triage tools evaluated** TSO: Triage Sort, Score calculated based on Glasgow Coma score, Respiratory Rate and Systolic Blood Pressure SI: Shock Index (Heart Rate/Systolic Blood Pressure) <u>Reference standard</u>: Priority One (P1) defined as requirement of one or more LSI from a predefined list or death within the department **Summary of interventions** • the Major Incident Medical Management and Support course, MIMMS (UK standard), has a two-stage approach: primary triage using the Triage Sieve is conducted at the incident scene; secondary triage, performed at the casualty clearing station, or in a safe environment, uses the Triage Sort (TSO). • Physiological data (prehospital when available, and on arrival in hospital), and interventions performed within the emergency department (ED) and operating theatre, prospectively collected for trauma patients	**Diagnostic test performance: Priority 1 Status** <u>Sensitivity, % (95% CI)</u> TSO: 58.6 (51.8 – 65.4) SI§: 70 (63.6 – 76.3) <u>Specificity, % (95% CI)</u> TSO: 88.7 (83.5 – 93.9) SI§: 74.7 (67.5 – 81.8) §Cut-off >0.75	**Level of evidence** 2b **Risk of bias (QUADAS)** Patient selection: ? Index test: + Reference standard: + Flow and timing: + **Authors' conclusion** "These findings show that in a military population, the SI is a more appropriate secondary triage tool than the existing UK method, the TSO. A cut-off of 0.75 predicts the need for a LSI with a sensitivity of 70.0%, vs 58.6% for the TSO." **Reviewers' conclusion** All data required for triage assessment were collected prospectively. The risk of patient selection bias is unclear due to missing exclusion criteria and because around 30% of patients were excluded due to missing data. The results should also be interpreted

		• All patients receiving a LSI, or who died in department, were classified as P1, and all others as non-P1. • TSO applied to in-hospital physiology, dividing casualties into P1 and non-P1 • the SI, using in-hospital physiology again, used to categorise patients as either P1 or non-P1, using a range of SI cut-off values (0.4 to 1.0 in 0.05 increments) Triage of patients using the TSO and the SI compared with the gold standard		with caution because of the limitation to military patients; the study population is therefore not representative for civilian settings.
+: low risk; –: high risk; ?: unclear risk; CI: Confidence Interval; GCS: Glasgow Coma Scale; HR: Hazard Ratio; IQR: Interquartile Range; ISS: Injury Severity Score; ITT: Intention to Treat; OR: Odds Ratio; RR: Relative Risk; SD: Standard Deviation; SEM: Standard Error of Mean; adj.: adjusted; d: days; m: months; y: years				

Transport/Logistik

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Cheng (2020) "Going vertical: triage flags improve extraction times for priority patients". *J Am Coll Emerg Physicians Open* 2020; 1(6): 1185-1193 **Study design** Prospective crossover study **Aim of the study** "Our study aims to further investigate if the time required to identify and extract the highest priority patients from an MCI field to a casualty collection	**Inclusion criteria** • First-year medical students • had completed training in basic disaster life support (BDLS) • consent to participate during Medical First Responder Capstone Day course **Exclusion criteria** n.r. **Characteristics (participants)** Age [y], range 20-40 Male, n (%) 43 (51) **Characteristics (manikin casualties)**	**Participants** N=84 medical students participated, N=82 analysed **Study groups** IG: Flags and Tags (triage wrist tags attached to each manikin with their corresponding color, and commercially available utility marking field flags inserted into the ground next to each manikin; N=44) CG: Tags only (triage wrist tags attached to each manikin with their corresponding color; N=38) **Summary of intervention** • 2 physically separated outdoor fields for IG and CG, split into 32 7×7 ft squares • 1 manikin randomly placed in each square	Completion time [s], mean difference (95% CI) IG: –24.42 (–21.11 to –27.73); 28.5% reduction CG: reference Accuracy§, n/N (%) IG: 54 (64.3) vs. CG: 49 (58.3) **Subgroup 1** flags and tags first, tags only second Completion time [s], mean ± SD IG: 75.91 ± 13.44 vs. CG: 92.06 ± 26.31 **Subgroup 2** tags only first, flags and tags second Completion time [s], mean ± SD IG: 64.76 ± 10.25 vs. CG: 97.67 ± 15.90	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion** "Using a vertical cue decreased the time required to identify high-priority patients. This suggests that a rapidly deployable and visually apparent triage marker may allow faster

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point can be significantly shortened with the use of a color-coded vertical marker, a "triage flag."" **Setting** USA, year n.r.	<u>Triage tag colour, n/N (%)</u> IG: red 10/32 (31), yellow 17/32 (53), black 5/32 (15) CG: red 10/32 (31), yellow 17/32 (53), black 5/32 (15)	• each manikin randomly assigned a red, yellow, or black tag • Each participant started on 1 of the 2 fields and crossed over to the other upon completion • identify all the red manikins, read the triage tag barcode numbers and report via radio	§successfully identified all 10 reds without any duplicates	identification and extraction of patients across a field of victims with varying injury severities than a flat horizontal triage tag, thereby potentially improving patient outcomes." **Reviewers' conclusion** The study results need to be interpreted with caution because both the MCI event and the patients were simulated. The scope of the study was limited to victim identification. There is a risk of performance bias due to lack of blinding. The cross-over study was probably not limited by carryover or sequence effects. A learning effect ('period effect') was observed for both groups equally.
Cuttance (2017) "Paramedic Application of a Triage Sieve: A Paper-Based Exercise". *Prehosp Disaster Med* 2017; 32(1): 3-13. **Study design** Prospective cohort study§ **Aim of the study**	**Inclusion criteria** • Participants of the SAAS annual Professional Development Workshop (PDW) days • Operational clinical staff either in training to become a paramedic, or have the clinical authority to practice at a paramedic level or higher, who respond either as part of an emergency ambulance crew or solo responder	**Participants** N=292 workshop participants N=20 simulated casualties (n=19 evaluated, 1 subsequently removed as pediatric) **Study groups** IG1: With aide-memoir while performing the exercise (n=73)	<u>Accuracy rate [%], mean ± SD§</u> IG1: 90 ± 6.7 IG2: 76 ± 6.6 IG3: 89 ± 7.3 CG: 47 ± 6.2 <u>Mean differences in triage accuracy vs. CG§</u> IG1: 43, p<0.001 IG2: 29, p<0.001 IG3: 42, p<0.001	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: + Attrition bias: + Detection bias: +

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"Using a paper-based exercise (questionnaire), the purpose of this study was to assess operational career paramedics' baseline ability to perform a triage sieve accurately (without any intervention/assistance) and compare this to accuracy rates following theoretical knowledge acquisition (via an educational refresher) and/or provision of an aide-memoir." **Setting** Australia, 2014 § randomisation mentioned in abstract but not in main article text	within SA Ambulance Service, who would undertake a triage sieve. **Exclusion criteria** n.r. **Characteristics (participants)** <u>Age strata overall [y], n (%)</u> 20 to 30: 99 (33.9) 31 to 40: 88 (30.1) 41 to 50: 75 (25.7) 51 to 60: 26 (8.9) 61+: 4 (1.4) (data for each group, see publication) <u>Male, n/N (%)</u> IG1: 39/73 (53.4) IG2: 38/74 (51.4) IG3: 35/74 (47.3) CG: 43/71 (60.6) <u>Formal Triage Sieve Training, n (%)</u> IG1: 70/73 (94.6) IG2: 67/74 (90.5) IG3: 71/74 (95.9) CG: 65/71 (91.5) <u>Undertaken a Triage Sieve, n (%)</u> IG1: 45/73 (61.6) IG2: 44/74 (59.5) IG3: 42/74 (56.8) CG: 41/71 (57.7) **Characteristics (simulated casualties)** <u>Triage category, n (%)</u>	IG2: Educational refresher before performing the exercise, no aide-memoir for support (n=74) IG3: Educational refresher before performing the exercise, with aide-memoir for support (n=74) CG: No supporting documentation for performing a paper-based triage exercise (triage 20 victims of a bus crash) (n=71) **Summary of study intervention** • data collection pack: part 1, a written consent form, a demographics questionnaire, and baseline triage knowledge questionnaire; part 2, the triage sieve questionnaire 10 minutes assigned for the completion of the triage sieve questionnaire	§ numbers calculated from those in text p. 7 (by dividing by n in each group) to match those in abstract other results not extracted due to data inconsistencies	**Authors' conclusion** "This study has shown that when paramedics from a state-based ambulance service utilized an aide-memoir to triage sieve 20 casualties from a questionnaire, there was a significantly higher correct triage accuracy rate with a concomitant reduction in under- and over-triage rates compared to those paramedics who did not utilize an aide-memoir. Although a "just-in-time" educational refresher was provided to two sub-groups of this study, the overall usefulness in terms of results and practical application is questionable, as it did not produce a significant statistical difference between these two sub-groups and the sub-group of paramedics who only utilized the aid-memoir. The use of an aide-memoir when conducting a triage sieve is strongly recommended." **Reviewers' conclusion** There is low risk of bias in this study. The data reliability of the is unclear due to inconsistencies between

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	dead: 2 (10) Priority P(1): 6 (30) P2: 6 (30) P3: 6 (30)			text and abstract, and between reported and theoretically possible numbers. The study was conducted in the controlled environment of a paper-based exercise with simulated casualties and may not be fully applicable to a real MCI scenario.
Homier (2018) "A Randomized Trial Comparing Telephone Tree, Text Messaging, and Instant Messaging App for Emergency Department Staff Recall for Disaster Response". *Prehosp Disaster Med* 2018; 33(5): 471-477. **Study design** Randomised controlled trial **Aim of the study** "With the objective of identifying the most reliable and efficient staff recall method, an unannounced, randomized, ED staff recall drill was conducted using three different communication tools: manual phone tree, SMS, and IMA."	**Inclusion criteria** • emergency physicians, emergency medicine residents, nurses, patient attendants, pharmacists, clerks, and administrative personnel working in the departments of emergency medicine of the McGill University Health Centre (MUHC) hospitals • Participants consented to save the MUHC Call Centre numbers in their contacts and authorize visual and sound effects for messages sent by the MUHC Call Centre and the instant messaging application (IMA) • Consent to let member of the study team arrange the settings on their cell phone (to ensure that SMS messages from the MUHC Call Centre would produce the same type of notification at night) **Exclusion criteria** • Staff members not owning a smart phone with SMS messaging capabilities	**Participants** N=132 emergency department staff **Study groups** SMS: short message service (participants contacted during the night via SMS; n=44) IMA: instant messaging application (participants contacted during the night via Instant messenger; n=44) CG: manual phone tree (participants contacted during the night via phone; n=44) **Summary of intervention** • The communication drill message was considered to have been received once the participant was reached over the phone or when replied to the staff recall message by sending an SMS or a message on the IMA, as per the instructions received. • Participants in the phone tree arm were recorded whether or not the participant was reached and how that person was reached (cell phone or landline)	<u>Respondents at 45 min, n/N (%)</u> SMS: 7/44 (16) IMA: 11/44 (25) CG: 18/44 (41), p=0.029 <u>Respondents at 45 min, % difference (95% CI)§</u> CG vs. SMS 25 (4.6 to 45.0), p=0.018 CG vs. IMA 16 (–5.7 to 38.0), p=0.17 <u>Response time [min], median (range)</u> SMS: 152 (2.0 to 336) IMA: 104 (1.0 to 458) CG: 8.5 (2.0 to 8.5) § calculated using the proportion test to evaluate the difference between the best group and the others	**Level of evidence** 2b↓ **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Both the phone tree and IMA groups had a significantly higher response than the SMS group. There was no significant difference between the proportion of responses at 45 minutes in the phone tree group and the IMA group. The distribution of response times was different in the three groups. This study suggests that an IMA may be as effective as a manual phone

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Setting Canada, 2017	• Staff on leave of absence or maternity leave **Characteristics** Age [y], mean ± SD SMS: 41.0 ±1 1.7 IMA: 34.6 ± 8.1 CG: 38.5 ± 11.1 Male, n (%) SMS: 17 (39) IMA: 14 (32) CG: 17 (39)	• Participants in the SMS arm were directed to respond by text message to a specific cell phone number • Participants in the IMA group had to respond directly on the "This Is It" group.		tree in reaching ED staff members within 45 minutes." **Reviewers' conclusion** There is an unclear risk of performance bias as no further information was provided. Although a significant difference between phone tree arm and SMS arm was identified, the confidence intervals were large. Results of the study should be interpreted with caution.
+: low risk; –: high risk; ?: unclear risk; CI: Confidence Interval; HR: Hazard Ratio; IQR: Interquartile Range; IMA: instant messaging application; ITT: Intention to Treat; OR: Odds Ratio; RR: Relative Risk; SD: Standard Deviation; SEM: Standard Error of Mean; adj.: adjusted; d: days; min: minutes; m: months; y: years				

Therapie

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Ophir (2014) "Airway control in case of a mass toxicological event: superiority of second-generation supraglottic airway devices". *Am J Emerg Med* 2014; 32(12): 1445-1449. **Study design** Randomised cross-over trial	**Inclusion criteria** • military medics, military paramedics, military general practitioners (GPs), residents from varying specialties, and board-certified anesthesiologists **Exclusion criteria** n.r. **Characteristics (participants)** Age [y], mean ± SD	**Participants** N=117 medical staff **Study groups** LMAU: first-generation SAD laryngeal mask AW unique (n=117 participants, 6 procedures each) LTS-D: second-generation SAD laryngeal tube suction disposable (n=117 participants, 6 procedures each)	**Overall sample** Procedure failure, n defined as 3 sequential unsuccessful attempts LMAU: 0 LTS-D: 0 SLMA: 0 CG: 9 Number of attempts, mean§ up to 3 device insertion attempts / procedure	**Level of evidence** 2b↓ **Risk of bias** Selection bias: ? Performance bias: + Attrition bias: + Detection bias: + **Authors' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Aim of the study "The aim of this study is to evaluate the efficiency of Airway (AW) control by using second-generation supraglottic AW devices (SADs) as compared with endotracheal intubation (ETI) and first-generation SAD while wearing chemical personal protective equipment (C-PPE)." **Setting** Israel, year n.r.	24.7 ± 7.2 Male, n (%) n.r.	SLMA: second-generation SAD supreme laryngeal mask AW (n=117 participants, 6 procedures each) CG: endotracheal tube (ETT) size 8 with direct laryngoscopy (n=117 participants, 6 procedures each) Each subject practiced each of the 4 study devices on an AW management trainer (AW management trainer; Laerdal, Stavanger, Norway) in a randomised order, 3 procedures while wearing C-PPE and 3 while wearing standard clothing. Correct device insertion was determined by visualization of lung expansion of the AW management trainer using bag valve ventilation. Each participant inserted a lubricated gastric tube size 16 through the gastric channel of the SLMA and LTS-D and through the nostril of the simulator with the ETT. A gastric tube was not used in conjunction with the LMAU, as this is not possible with this device. **Co-intervention** Participants attended an airway control workshop before the beginning of the trial to optimize familiarity with the different devices	LMAU: 1.00, p≤0.05 LTS-D: 1.01, p≤0.05 SLMA: 1.01, p≤0.05 CG: 1.11 Time to successful AW control [s], mean§ LMAU: 17.2, p<0.0001 LTS-D: 18.1, p<0.0001 SLMA: 17.7, p<0.0001 CG: 31.7 **Subgroup analysis: Participants wearing C-PPE** Time to successful AW control [s], mean§ LMAU: 19.0, p<0.01 LTS-D: 19.5, p<0.01 SLMA: 18.6, p<0.01 CG: 34.7 § p-values for t-test comparison with CG	"(…) we demonstrated that using SADs significantly shortens the time to AW control while wearing C-PPE compared with ETI. (…) Unless other solutions to personal protection or AW management are available, second generation SADs may be an important additive to the AW management "toolbox." This may be especially critical in cases of mass toxicology events (MTEs), preferably as a bridge, until definite AW is achievable." **Reviewers' conclusion** The study results need to be interpreted with caution as airway control was performed using manikins in a training environment. Insufficient details are provided to assess the risk of selection bias.
Shimonovich (2016) "Intranasal ketamine for acute traumatic pain in the Emergency Department: a prospective, ran-	**Inclusion criteria** • Patients aged 18–70 years • mild to moderate blunt trauma (sustained in road, workplace and home accidents) causing moderate to severe pain (≥80 mm score on a 100 mm VAS) • Glasgow Coma Score (GCS) of 15	**Participants** N=90 patients randomised, N=75 analysed **Study groups** IN KET: intranasal ketamine 1.0 mg/kg (n=34 randomised, n=24 analysed)	**Efficacy outcomes** Time to onset [min], mean (95% CI)‡ the first timepoint at which the patient reported 15 mm of pain reduction or more	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: –

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domised clinical trial of efficacy and safety". *BMC Emerg Med* 2016; 16: 43. **Study design** Randomised controlled trial **Aim of the study** "The objective of this study was to elucidate the efficacy and adverse effects of a sub-dissociative dose of intranasal (IN) Ketamine compared to intravenous (IV) and intramuscular (IM) morphine." **Setting** Israel, 2012-2014	• body weight of 50–110 kg • systolic blood pressure of 90–160 mmHg, heart rate <100 bpm • American Society of Anaesthesiologists (ASA) score of 1 or 2 • denying head injury • denying regular use of opiates **Exclusion criteria** • any analgesia received within the prior 3 h • allergic sensitivity to morphine or ketamine • large meal ingested within the previous hour • pregnancy • deviated nasal septum or trauma to the nose • history of a psychiatric condition • head trauma or head injury with loss of consciousness, dizziness, vomiting, or nausea **Characteristics** Age [y], mean (95% CI) IN KET: 37.9 (32.3–43.5) IV MO: 42.9 (38.0–47.8) IM MO: 37.7 (32.8–42.6) Male, n (%) IN KET: 17 (70.8) IV MO: 18 (75.0) IM MO: 16 (59.3) Pre-analgesic VAS score [mm], mean (95% CI)	IV MO: intravenous morphine 0.10 mg/kg (n=26 randomised, n=24 analysed) IM MO: muscle injection of morphine 0.15 mg/kg (n=30 randomised, n=27 analysed) **Summary of intervention** • Vital signs (blood pressure, heart rate, respiratory rate, oxygen saturation) were obtained, and an initial VAS reading was obtained immediately prior to administration of analgesia • Patients were then given either 1 mg/kg IN ketamine (spray in 0.1–0.2 mL aliquots into each nare from a 1cc syringe at intervals of 10–30 s), 0.15 mg/kg IM morphine (gluteal injection), or 0.1 mg/kg slow IV bolus of morphine. • Vital signs and VAS measurements were obtained at 5 min intervals for 60 min. • Adverse effects were recorded at the end of 1 h using the 'Opiate Related Symptom Distress Scale'	IN KET: 14.3 (9.8–18.8) IV MO: 8.9 (6.6–11.2), p=0.300 IM MO: 26.0 (20.3–31.7), p=0.003 Maximal pain reduction on 100mm VAS [mm]‡ the lowest VAS score reported by the patient over the course of follow-up IN KET: 56 IV MO: 59, n.s. IM MO: 48, p=0.300 Time to maximal pain reduction [min] (95% CI)‡ IN KET: 40.4 (33.9–46.9) IV MO: 33.4 (26.2–40.6), p=0.441 IM MO: 46.7 (41.1–52.3), p=0.386 IV MO vs. IM MO: p=0.019 Non-responders, n (%)‡ IN KET: 1 (4) IV MO: 1 (4), n.s. IM MO: 3 (11), p=0.611 **Safety outcomes (selection)§** Systolic BP increase [mmHg], mean (95% CI) IN KET: 23.5 (17-30) vs. IV MO: 12.8 (8.2-17.4) vs. IM MO: 14.1 (9.6-18.6), n.s. Systolic BP decrease [mmHg], mean (95% CI) IN KET: 6.8 (1.4-12.2) vs. IV MO: 13.5 (9.4-17.5) vs. IM MO: 10.0 (4.7-15.2), n.s. Respiratory rate decrease [Resp/min], mean (95% CI) IN KET: 3.5 (2.4-4.6) vs. IV MO: 4.5 (3.4-5.6) vs. IM MO: 3.5 (2.3-4.7), n.s.	Attrition bias: – Detection bias: + **Authors' conclusion** "IN ketamine showed efficacy and safety comparable to the current standard-of-care for acute traumatic pain in the ED, IM and IV morphine. IN ketamine provided rapid pain relief without causing hemodynamic instability or respiratory side-effects, was easy to administer and may thus be an important option for ED settings, pre-hospital trauma management, as well as in battlefield and disaster medicine." **Reviewers' conclusion** The study included only low-risk patients, which limits generalisability and the possibility to detect hemodynamic and respiratory side effects. Furthermore, the study was probably not powered to detect meaningful differences in safety outcomes like hemodynamics and respiratory rates, which were not significant. Because the trial was open label, there is a risk of performance bias. The drop-out rate was substantially

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	IN KET: 90 (89.7–90.3) IV MO: 92 (91.7–92.3) IM MO: 91 (90.7–91.3)		‡ p-value for comparison with IN KET § no significant differences between groups for hemodynamic and respiratory data	higher in the IN ketamine group, indicating possible attrition bias.
+: low risk; –: high risk; ?: unclear risk; C-PPE: chemical personal protective equipment; CI: Confidence Interval; ETI: endotracheal intubation; ETT: endotracheal tube; HR: Hazard Ratio; IM: intramuscular; IN: intranasal; IV: intravenous; IQR: Interquartile Range; ITT: Intention to Treat; KET: ketamine; MO: morphine; n.r.: not reported; n.s.: not significant; OR: Odds Ratio; RR: Relative Risk; SAD: supraglottic airway device; SD: Standard Deviation; SEM: Standard Error of Mean; adj.: adjusted; d: days; m: months; y: years				

Dekontamination

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Amlot (2010) "Comparative Analysis of Showering Protocols for Mass-Casualty Decontamination". *Prehosp Disaster Med* 2010; 25(5): 435-9. **Study design** Randomised controlled trial **Aim of the study** "The purpose of this study was to evaluate three empirical strategies designed to optimize existing decontamination procedures: (1) instructions in the form of a pictorial aid prior to decontamination; (2) provision of a washcloth within the shower-	**Inclusion criteria** • volunteers who completed a health questionnaire that was reviewed by a registered health professional **Exclusion criteria** • adults or children with pre-existing skin conditions or other health issues that could potentially affect their safety during the trial **Characteristics (participants)** Age [y], mean (range) 44 (7-81) Male, n (%) n.r.	**Participants** N=90 volunteers randomised, N=89 analysed **Study groups** IG 1: standard UK protocol with shower duration 3 min.: 2-minute delivery of detergent solution followed by a water-only rinse for a further minute. The temperature and flow rate of the water leaving the pump were 37°C and ~6,000 L h^{-1}, respectively. This equated to a flow of ~10 L min^{-1} per person (n=15) IG 2: shower duration 3 min. with additional washcloth (n=15) IG 3: shower duration 3 min. with additional pictorial instructions during showering (n=13) IG 4: shower duration 3 min. with additional washcloth and with additional instructions during showering (n=20)	Relative efficacy, p-value$ % Efficacy = 100 - ((Qpre - Qpost)/Qpre) x 100, with Q: amount of fluorophore on the skin surface IG 1: p<0.05 IG 2: p<0.05 IG 3: p<0.05 IG 4: p<0.05 IG 5: p<0.05 CG: reference only the use of a washcloth (IG 2) on ventral surfaces led to a statistically significant (~20%) improvement in decontamination efficiency when compared against the current UK procedure $ p-values calculated by one-way, parametric ANOVA	**Level of evidence** 2b↓ **Risk of bias** Selection bias: ? Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "The provision of a washcloth significantly improved the efficacy of fluorophore removal by -20% in comparison to the current UK protocol (shower duration 3 min). Provision of pictorial instructions and extension of shower duration failed to produce any statistically significant improvement."

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ing facility; and (3) an extended showering period." **Setting** UK, years n.r.		IG 5: extended shower duration 6 min. (n=11) CG: no decontamination (n=15) **Summary of intervention** • Dark clothing was provided to all volunteers to limit interference from exogenous sources of fluorescent (brightening) agents. • Volunteers were initially (baseline) photographed in a lightproofed horsebox (Space-TrekaM, Equitrek) with 12 UV fluorescent tubes (model F36W/BLB-T8, Sylvania), standing 2 m from the UV array in the centre of an internal doorway • Stock Solution of the fluorophore was applied to 12 skin sites on the front of each volunteer (forehead, both cheeks, both shoulders, both ante-cubital fossae, both hands, abdomen and both legs). Diluted Solutions were applied to five sites on the back of each volunteer. • After "contamination" volunteers were photographed a second time under UV illumination. The volunteers then underwent their respective decontamination treatment • Volunteers were photographed for a third time after decontamination treatment.		**Reviewers' conclusion** Little information on randomisation and blinding is provided, leading to an unclear risk of selection and performance bias. Data is provided mainly in pictorial but not numerical form. The generalisability of the findings is limited by the use of a simulant substance, whose physicochemical properties, skin penetration, and metabolism may not be comparable to actual hazardous contaminants. Systemic exposure, a critical patient-relevant outcome in the context of chemical decontamination, was not analysed.
Amlot (2017) "Volunteer trials of a novel improvised dry decontamination protocol for use during mass casualty incidents as part of	**Inclusion criteria** • volunteers **Exclusion criteria**	**Participants** Study 1: N=20 volunteers randomised, N=12 analysed Study 2: N=21 volunteers	**Study 1** Spread of simulant [cm^2], mean difference ± SD mean difference of spread between experimental arm and control arm; spread defined as the skin	**Level of evidence** 2b↓ (Study 1); 3b↓ (Study 2) **Risk of bias: Study 1** Selection bias: ?

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the UK'S Initial Operational Response (IOR)". *PLOS One* 2017; 12(6): e0179309. **Study design** Study 1: Randomised cross-over trial Study 2: Prospective cohort study **Aim of the study** "The main objective was to confirm the most effective method for improvised dry decontamination using materials widely available in ambulance and hospital settings. Study 1 assessed the most efficacious method of use (blotting, rubbing, or blotting and rubbing) for the two products identified (blue roll and incontinence pad). (…) Study 2 had two aims. The new draft dry decontamination guidance was tested by asking two groups of participants to perform dry decontamination, with one group receiving the guidance and the other group receiving no guidance. (…) Secondly, public perceptions of the accept-	• pre-existing health concerns that could affect participation in the study **Characteristics** Age [y] >18 Male, n (%) Study 1: 11 (55) Study 2: 16 (76)	**Study groups** Study 1 BR-B: dry decontamination with blue roll, blot the simulant application site (n=5) BR-R: dry decontamination with incontinence pad, rub the simulant application site (n=5) BR-BR: dry decontamination with blue roll, blot and rub (n=5) IP-B: dry decontamination with incontinence pad, blot (n=7) IP-R: dry decontamination with incontinence pad, rub (n=7) IP-BR: dry decontamination with incontinence pad, blot and rub (n=7) CG: no decontamination, control arm (all) Study 2 IG: guidance while performing dry decontamination with blue roll (n=10) CG: no guidance while performing dry decontamination with blue roll (n=11) **Summary of intervention** Study 1 • The simulant contaminant was a solution of 10 mg of curcumin per 1 mL of 99.9% methyl salicylate (MeS) • 10 µL MeS applied to each participant's forearms in each study session • Spread of the simulant measured by UV fluorescence	surface area of fluorescence post – pre decontamination BR-B: –4.64 ± 9.03 BR-R: 4.23 ± 4.08 BR-BR: 2.17 ± 1.39 IP-B: 3.85 ± 11.98 IP-R: 7.77 ± 6.20 IP-BR: 2.06 ± 4.89 blot vs. rub vs. blot&rub: p=0.06 blue roll vs. incontinence pad: p=0.14 MeS recovered post decontamination (µg/mL] data combined for blue roll and incontinence pad Blot vs. CG: p<0.05 Rub vs. CG: p>0.05 Blot&Rub vs. CG: p<0.05 blot vs. rub vs. blot&rub: p>0.05 blue roll vs. incontinence pad: p>0.05 **Study 2: Success in the key steps of dry decontamination** Whole body decontamination, n/N (%) IG: 10/10 (100) CG: 2/11 (18) Top-Down Decontamination, n/N (%) IG: 7/10 (70) CG: 1/11 (9) Sufficient blue role used, n/N (%) IG: 10/10 (100) CG: 0/11 (0)	Performance bias: + Attrition bias: – Detection bias: + **Risk of bias: Study 2** Selection bias: ? Performance bias: + Attrition bias: + Detection bias: + **Authors' conclusion** "These studies have shown that the provision of an absorbent material and some basic instructions is not enough; failure to provide effective instructions could lead to dry decontamination being carried out ineffectively, and may result in increased spread of a contaminant. Improvised dry decontamination is included as part of the UK Initial Operational Response Programme, and first responders will be instructed to use this as a default option prior to the commencement of any wet decontamination (unless a caustic or particulate agent is involved, or biological or radiological contamination is suspected)."

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ability of dry decontamination and participants' willingness to comply with the decontamination process were assessed." **Setting** UK, years n.r.		• 15 minutes after simulant application, participants were provided with one of the two dry decontamination products • asked to either just blot, just rub, or both blot and rub the simulant application site for 5 seconds • Each participant's dominant arm served as the control site • Each participant carried out all 3 methods in randomised order • A final UV illuminated image was captured following decontamination. • Additionally swabs were taken from both arms to measure quantity of simulant after decontamination Study 2 • Participants conducted dry decontamination using blue roll • Participants in the guidance group were instructed to use a separate piece of blue roll for their hands, their face and neck, their left arm, their right arm, their torso and back, their left leg and foot, and their right leg and foot. • A two-page guide on the dry decontamination process was developed, based on the outcomes from Study 1. • The participants in the no-guidance group were asked to clean themselves using the blue roll.		**Reviewers' conclusion** There is a high risk of attrition bias, with an unexplained drop-out rate of 40%. The risk of selection bias is unclear as insufficient detail is provided. Most results were not significant, and the study may be underpowered to detect meaningful differences. The generalisability of the findings is limited by the use of a simulant substance, whose physicochemical properties, skin penetration, and metabolism may not be comparable to actual hazardous contaminants. Systemic exposure, a critical patient-relevant outcome in the context of chemical decontamination, was not analysed.
Chilcott (2019) "Optimization of Nonambulant Mass Casualty Decontamination Protocols	**Inclusion criteria** n.r. **Exclusion criteria** • relevant pre-existing conditions	**Participants** Study 1: N=16 volunteers Study 2: N=18 volunteers **Study groups**	**Decontamination outcomes** recovery of MeS between controls (untreated) and decontamination treatment groups, p-values from nonpaired, single-tail Mann–Whitney U-test	**Level of evidence** 2b↓ **Risk of bias** Selection bias: +

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as Part of an Initial or Specialist Operational Response to Chemical Incidents". *Prehosp Emerg Care* 2019; 23(1): 32-43 **Study design** Randomised controlled trial **Aim of the study** "the aim of this study was to confirm the effectiveness of putatively optimized dry (IOR) and wet (SOR) protocols for nonambulant decontamination in human volunteers." **Setting** UK, year n.r.	**Characteristics** Age [y], mean (range) Study 1: 33.8 (19-59) Study 2: 34.1 (19-59) Male, n (%) Study 1: 8 (50) Study 2: 9 (50)	Study 1: Dry decontamination IG: dosed and subsequently treated with Blue Roll: subjected to disrobe and dry decontamination process (n=8) CG: dosed but not decontaminated: subjected to disrobe procedure and rolled between the stretchers only (n=8) Study 2: Wet decontamination IG: decontamination: 4-min. protocol for casualty decontamination, rinse & wash with absorbent cellulose sponges, roll, repeat; towelling after decontamination; swabbing (n=9) CG: no decontamination: same procedures (placement/movement on stretcher in decontamination unit, swabbing) but no decontamination and towelling (n=9) **Summary of interventions** Study 1 • whole-body fluorescent images: at baseline, prior to decontamination, and post decontamination • chemical warfare agent simulant dosing solution (CMX): methyl salicylate (MeS) containing 10 mg mL^{-1} curcumin as fluorescent dye • research team member applied 10 mL droplets of CMX to 12 areas of the hair or skin surfaces and 100 mL droplets of CMX to the surface of 6 clothed sites of all participants • disrobe and dry decontamination process was performed by 3 decontamination team members (DTMs) (including 9	Study 1: Dry decontamination, unclothed Left cheek p=0.0024 Right cheek p<0.0001 Front neck p=0.0005 Back neck p=0.0249 Left palm p=0.0003 Right palm p=0.0003 Left foot p=0.0010 Right foot p=0.0007 Left hand p=0.0016 Right hand p=0.0088 Top head p=0.1613 (n.s.) Back head p=0.3598 (n.s.) Study 1: Dry decontamination, clothed Mid-torso, front p=0.0758 (n.s.) Mid-torso, back p=0.0350 Right elbow (front) p=0.0464 Left elbow (back) p=0.1524 (n.s.) Left shin p=0.1615 (n.s.) Right calf p=0.4282 (n.s.) Study 2: Wet decontamination, unclothed Left cheek p<0.0001 Right cheek p<0.0001 Front neck p<0.0001 Back neck p=0.0001 Left palm p<0.0001 Right palm n.m. Left foot p<0.0001 Right foot p<0.0001 Left hand n.m. Right hand p<0.0001 Top head p=0.0070 Back head p=0.0050 Study 2: Wet decontamination, unclothed	Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "a protocol for disrobe and dry decontamination of nonambulant casualties has been developed and assessed: the new protocol is rapid (3-min duration), generally effective and establishes key principles for future implementation as part of the UK's IOR. However, it must be reiterated that dry decontamination is an emergency medical countermeasure that should normally be used in conjunction with subsequent wet (clinical) decontamination." **Reviewers' conclusion** There is an unclear risk of performance bias, as it is unclear whether participants or personnel were blinded. The study was conducted using a single mid-volatility chemical warfare agent simulant, which limits gen-

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		defined steps pictures and steps provided in the article) Study 2 • whole-body fluorescent images: at baseline, prior to decontamination, and post decontamination • research team member applied 10 mL droplets of a CMX to 16 areas of the hair or skin surfaces • standard NHS clinical decontamination unit with 4 team members • participants lie on a stretcher • Clinical decontamination according to a 4-min protocol (developed during a previous, unpublished study): initial (30 s) rinse of anterior skin and hair surfaces, followed by a 1.5 min wash with sponges (no soap), following partial (90°) roll of the volunteer on to his/her right, process was repeated (30 s rinse, 1.5 min wash). • After decontamination participants received a disposable towel	Mid-torso, front p<0.0001 Mid-torso, back p<0.0001 Right elbow (front) p<0.0001 Left elbow (back) p=0.0006 Left shin p<0.0001 Right calf p<0.0001	eralisability to contaminants with similar properties. Systemic exposure was not analysed, and there was an unaccounted fraction of 30–45% of the applied MeS dose from all experimental compartments. It remains unclear if the performing decontamination team members were professionals used to the protocols or not.
Collins (2021) „Evaluating the impact of decontamination interventions performed in sequence for mass casualty chemical incidents". *Sci Rep* 2021; 11(1): 14995. **Study design** Randomised cross-over trial **Aim of the study**	**Inclusion criteria** • informed consent **Exclusion criteria** n.r. **Characteristics (participants)** Age [y], mean ± SD (range) 35.83 ± 10.75 (23-56)	**Participants** N=11 volunteers **Study groups** IG1: improvised dry decontamination after 15 min. + Interim (high-volume showering corridor) after 25 min. (n=11) IG2: improvised wet: 'rinse wipe rinse' (RWR) after 15 min. + interim after 25 min. (n=11)	**MeS Decontamination** Decontamination efficacy, % % reduction in skin recovery vs. CG IG1: 93.1 IG2: 93.8 IG3: 92.8 IG4: 93.0 all p<0.1 vs. CG Systemic exposure after 80 min. quantity excreted via urine samples vs. baseline	**Level of evidence** 2b↓ **Risk of bias** Selection bias: + Performance bias: + Attrition bias: + Detection bias: + **Authors' conclusion**

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"We evaluate for the first time the efficacy of the UK Initial Operational Response (IOR) and Specialist Operational Response (SOR) decontamination protocols performed in sequence and at timescales to reflect UK response times in a human volunteer study, in the removal of methyl salicylate (MeS) and for the first-time benzyl salicylate (BeS), a simulant for less volatile chemical warfare agents such as Novichoks, from the skin of human volunteers." **Setting** UK, year n.r.		IG3: improvised dry after 15 min. + Interim after 25 min. + Specialist Operational Response (SOR) procedure in a mass decontamination unit after 60 min. with structured showering involving warm water, detergent and washing aids (n=11) IG4: RWR after 15 min. + Interim after 25 min. + SOR after 60 min. (n=11) CG: no decontamination (n=11) **Summary of interventions** • Participants' skin was dosed separately with MeS (1:1 mixture with vegetable oil) and BeS (each with 4 mg/ml of fluorescent marker Invisible Red S) at sites on both shoulders • for UV image analysis, 2µL of each simulant added to the wrists and calves • for urine analysis, 700µL MeS:vegetable oil and 300µL BeS applied without fluorescent markers. • Participants completed five randomised decontamination interventions on different study days at least 4 days apart • baseline and t = 80 min post-simulant application urine samples on day 1 and collected all subsequent urine for 24 h • MeS and BeS remaining on skin by skin sampling and UV image analysis	no significant differences <u>Systemic exposure after 24h</u> quantity excreted via urine samples vs. baseline no significant differences **BeS Decontamination** <u>Decontamination efficacy, %</u> % reduction in skin recovery vs. CG IG1: 76.4 IG2: 83.5 IG3: 91.6 IG4: 81.2 all p<0.001 vs. CG SOR vs. dry/wet + interim: p=0.0189 <u>Systemic exposure after 80 min.</u> quantity excreted via urine samples vs. baseline increase in IGs, p=0.057 <u>Systemic exposure after 24h</u> quantity excreted via urine samples vs. baseline downwards trend in the median BeS recovery with increasing interventions, n.s.	"Here, SOR provided additional benefits beyond improvised and interim decontamination for BeS but not MeS. This implies that for chemicals less well removed by IOR [improvised operational response] due to their physicochemical character, the addition of SOR is likely to be of greater importance, but further studies with simulants with divergent physicochemical characteristics are required." **Reviewers' conclusion** The risk of bias is low due to the randomised cross-over design with wash-out period. The generalisability of the findings is limited by the use of simulant substances, whose physicochemical properties, skin penetration, and metabolism may not be comparable to actual hazardous contaminants. When interpreting findings on systemic exposure, it is important to note that all skin decontamination procedures were performed at

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
				least 15 min. after exposure, when significant skin penetration may already have occurred.
Larner (2020) „Efficacy of Different Hair and Skin Decontamination Strategies with Identification of Associated Hazards to First Responders". *Prehosp Emerg Care* 2020; 24(3): 355-368. **Study design** Prospective cohort study **Aim of the study** „To investigate the effectiveness of various dry (DD) and wet decontamination strategies for removing a chemical warfare simulant (methyl salicylate; MS) from the hair and skin of human volunteers. (…) a secondary objective of this study was to evaluate the risk of contamination from casualties and materials used in the different decontamination processes, with a view to evaluating how individual and combined procedures may influence such risks on the scene	**Inclusion criteria** • Healthy adult volunteers, male or female, aged 18-60 y **Exclusion criteria** • individuals with pre-existing skin conditions • salicylate intolerance • pregnant or breastfeeding **Characteristics (participants)** Age [y], range 20-60 Male, n (%) 20 (41.6)	**Participants** N=48* volunteers * Several volunteers attended more than one session (no more than 6, each 1 week apart), resulting in a total N=115 participant sessions **Study groups** DD: Dry decontamination, using wound dressings 4 min. post dose (n=11) LPS: Ladder pipe system, a custom-built, static showering corridor (7.3m long) delivers water at 50 psi from each of 3 hoses (2 side, 1 overhead, total rate: 240 L min^{-1}) 8 min. post dose, no towel (n=10) TD: technical decontamination, a single-person decontamination tent fitted with 6 fixed nozzles (5 side, 1 overhead) 12 min. post dose (n=10) DD+LPS: dry decontamination + ladder pipe system (n=12) LPS+TD: ladder pipe system + technical decontamination (n=10) DD+TD: dry decontamination + technical decontamination (n=12) LPS+towel: ladder pipe system + disposable cotton towel (n=10)	**Skin decontamination outcomes** MeS recovery, back swabs, p-value§ (mean) DD: n.s. LPS: n.s. TD: n.s. DD+LPS: n.s. LPS+TD: n.s. DD+TD: p<0.05 LPS+towel: n.s. DD+LPS+towel: p<0.05 DD+LPS+TD (no towel): p<0.01 DD+LPS+TD+towel: p<0.001 (28.6 µg) Control: reference (445 µg) MeS recovery, hair swabs, p-value§ DD: n.s. LPS: n.s. TD: n.s. DD+LPS: n.s. LPS+TD: p<0.05 DD+TD: n.s. LPS+towel: n.s. DD+LPS+towel: n.s. DD+LPS+TD (no towel): p<0.0001 DD+LPS+TD+towel: n.s. Control: reference (1531 µg) MeS recovery, scalp swabs, p-value§ DD: n.s. LPS: n.s. TD: n.s. DD+LPS: n.s.	**Level of evidence** 2b **Risk of bias** Selection bias: ? Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** „The results of this study confirm the value of the "Triple Protocol" response for optimizing casualty treatment. Initial dry decontamination was associated with significantly lower levels of contaminant recovered from volunteers during subsequent stages of the response process. Furthermore, prompt initiation of dry decontamination is of clinical benefit in making more effective use of the time delay associated with the operational deployment of wet decontamination assets." **Reviewers' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
and during downstream processes." **Setting** UK, 2017		DD+LPS+towel: dry decontamination + ladder pipe system + towel (n=10) DD+LPS+TD (no towel): dry decontamination + technical decontamination + ladder pipe system without towel (n=10) DD+LPS+TD+towel: all decontamination methods combined + towel (n=10) Control: no decontamination (n=10) **Summary of interventions** • baseline urine sample (10–50 mL) • simulant: MeS + curcumin, concentrations 1100 and 9 mg mL^{-1} • dosing: enclosed dosing chamber (1.2mx1.2mx1.8 m), seated participants exposed to a metered, aerosolized spray of simulant (video-recorded) • fluorescence photography before / after dosing and after each decontamination • dry decontamination using a wound dressing for 1 minute: 10 s wipe their face, 10 s wipe their hands, 30 s to wipe their bodies, final 10 s to wipe their hair (video-recorded) • ladder pipe system (LPS) shower: each volunteer walking the length of the LPS corridor for 15 seconds, making a single 360° turn at the point where the 3 sprays converged (video-recorded) • towel: volunteers given a disposable cotton towel and instructed to dry themselves all over for 30 s; towel immediately photographed on both sides in the fluorescence imaging	LPS+TD: p<0.01 DD+TD: n.s. LPS+towel: n.s. DD+LPS+towel: n.s. DD+LPS+TD (no towel): p<0.001 DD+LPS+TD+towel: n.s. Control: reference (92.8 µg) **Systemic decontamination outcomes** <u>MeS metabolite recovery, 24h-urine samples</u> salicyluric acid detected in all samples differences across the treatment groups n.s. § all p-values vs. control group	There is an unclear risk of selection and performance bias, as information on randomisation is contradictory and no information about blinding is provided. The study was conducted using a single mid-volatility agent as simulant, which limits generalisability to contaminants with similar properties. When interpreting findings on systemic exposure, it is important to note that other sources of the MeS metabolite salicyluric acid (ingestion of salicylates via plant-based food, medication with aspirin) may bias results.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
		• technical decontamination: participants were handed cotton washcloths pre-impregnated with 10mL Johnson's Baby Shampoo and was instructed to enter the showering tent with warmed water (35°C). Participants were instructed to wash themselves all over for 90 seconds using the washcloth (video-recorded) • swab samples taken at 18 min. post dose, from 28 sites on each volunteer (15 on front and 11 on rear of body, 1 on scalp, 1 on hair), quantitative LC-DAD analysis • all urine collected for 24 h • Baseline and 24 h urine samples analysed by LC-MS for salicyluric acid, the primary metabolite of MeS		
+: low risk; –: high risk; ?: unclear risk; BeS: benzyl salicylate; CI: Confidence Interval; HR: Hazard Ratio; IQR: Interquartile Range; ITT: Intention to Treat; MeS: methyl salicylate; n.m.: not measured; n.s.: not significant; OR: Odds Ratio; RR: Relative Risk; SD: Standard Deviation; SEM: Standard Error of Mean; adj.: adjusted; d: days; m: months; y: years				

2 Schockraum

2.2 Schockraum – Team und Alarmierung

Kriterien für die Schockraumaktivierung

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Bieler (2021) "Evaluation of a standardized instrument for post hoc analysis of trauma-team-activa-	**Inclusion criteria** • Adults (age ≥16) • Maximum AIS ≥2 **Exclusion criteria**	**Participants** N=75,613 patients **(Potential) activation criteria** 1: Cardio-pulmonary resuscitation (N=3162)	**Mortality, n/N (%)** 1: 2409/3162 (76.2) 2: 2033/8823 (23.0) 3: 4692/13,150 (35.7)	**Level of evidence** 2b **Risk of bias**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
tion-criteria in 75,613 injured patients an analysis of the TraumaRegister DGU®". *Eur J Trauma Emerg Surg*, 1-9. **Study design** Prognostic cross-sectional study (TraumaRegister DGU®) **Aim of the study** „to examine whether the catalogue can identify severely injured patients with an increased mortality risk to evaluate in the future especially with regard to the positive predictive value of new and existing activation criteria for trauma teams." **Setting** Germany, 2007-2016	• Patients transferred in as well as patients transferred out within 48 h **Characteristics** n.r.	2: Insertion of a chest tube (N=8823) 3: Administration of catecholamine (N=13,150) 4: Drop in GCS ≥2 points (N=3706) 5: Saturation of peripheral oxygen<90% (N=9484) 6: Hypothermia <35 °C (N=3040) 7: Shock index >0.9 (N=17,720) 8: Respiratory rate <9 or >29 (N=3207) 9: Advanced Airway (N=22771) 10: GCS score <9 (N=15099) 11: SBP <90 (N=11212)	4: 477/3706 (12.9) 5: 2989/9484 (31.5) 6: 880/3040 (28.9) 7: 3165/17,720 (17.9) 8: 1452/3207 (45.3) 9: 6154/22771 (27.0) 10: 5660/15099 (37.5) 11: 3322/11212 (29.6) **Mortality when only a single criterion was fulfilled, n/N (%)** 1: 0/14 (0.0) 2: 0/263 (0.0) 3: 0/94 (0.0) 4: 6/420 (1.4) 5: 7/514 (1.4) 6: 1/88 (1.1) 7: 3/1639 (0.2) 8: 1/45 (2.2) 9: 3/592 (0.5) 10: 0/166 (0.0) 11: 0/186 (0.0)	no tool available for prognostic studies **Authors' conclusion** n.r. for comparison of interest **Reviewers' conclusion** The primary aim of the study was to evaluate a post hoc criteria catalogue for trauma-team-activation and not to examine the criteria catalogue as activation criteria themselves. According to the authors data availability was unsatisfactory for temperature and respiratory rate. No patient characteristics were reported for the overall population.
Brown (2016) "Systolic blood pressure criteria in the National Trauma Triage Protocol for geriatric trauma: 110 is	**Inclusion criteria** • age >15 y • transported from the scene of injury **Exclusion criteria**	**Participants** N=1,555,944 patients overall; N=438,828 geriatric cohort (age >65 y); N=1,117,116 adult cohort (age 16-65 y)	**Results for primary outcome (trauma center need)*** <u>Sensitivity for geriatrics, %</u> 1: 13 2: 5	**Level of evidence** 2b **Risk of bias**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
the new 90". *J Trauma Acute Care Surg* 2015; 78(2):352-359. **Study design** Prognostic cross-sectional study (National Trauma Data Bank) **Aim of the study** "to evaluate the impact of substituting an SBP of less than 110 mm Hg for the current SBP of less than 90 mm Hg criterion within the NTTP on triage performance and mortality." **Setting** USA, 2010-2012	• interfacility transfer • death on arrival **Characteristics (for different age groups)** Age [y], median (IQR) Geriatric: 80 (73–86) Adult: 37 (25–50), p<0.01 Male gender, % Geriatric: 39 Adult: 71, p<0.01 Blunt injury, % Geriatric: 99 Adult: 85, p<0.01 Prehospital SBP [mmHg], median (IQR) Geriatric: 144 (128–164) Adult: 131 (118–146), p<0.01 ISS, median (IQR) Geriatric: 9 (4–10) Adult: 6 (4–13), p<0.01	**(Potential) activation criteria** • 1: SBP <110 mmHg • 2: SBP <90 mmHg • 3: presence of physiologic Step 1 NTTP criteria (GCS score ≤13, SBP <90 mm Hg, respiratory rate (RR) <10 or RR >29) or presence of anatomic Step 2 NTTP criteria (penetrating injury, flail chest, open skull fracture, ≥2 proximal long bone fractures, pelvic fracture, crush injury, amputation, paralysis) using SBP <110 mmHg • 4: presence of physiologic Step 1 NTTP criteria (GCS score ≤13, SBP <90 mm Hg, respiratory rate (RR) <10 or RR >29) or presence of anatomic Step 2 NTTP criteria (penetrating injury, flail chest, open skull fracture, ≥2 proximal long bone fractures, pelvic fracture, crush injury, amputation, paralysis) using SBP <90 mmHg **Variables included in logistic regression to calculate ROC** • Sex • Race • Mechanism • Pre-hospital time • Transportation mode • prehospital and admission vital signs • ISS • urgent surgery • ICU admission • trauma center level	3: 44 4: 40 Sensitivity for adults, % 1: 23 2: 10 3: 67 4: 62 Specificity for geriatrics, % 1: 93 2: 99 3: 71 4: 75 Specificity for adults, % 1: 90 2: 98 3: 62 4: 67 Positive predictive value for geriatrics, % 1: 50 2: 66 3: 44 4: 45 Positive predictive value for adults, % 1: 63 2: 79 3: 58 4: 59 Negative predictive value for geriatrics, % 1: 68 2: 67	no tool available for prognostic studies **Authors' conclusion** "Substituting an SBP of less than 110 mm Hg criterion in geriatric patients results in discrimination as good as the current SBP of less than 90 mm Hg criterion, with superior improvements in undertriage relative to overtriage. Geriatric patients who would be newly triaged positive under this change have a risk of mortality similar to those under the current SBP triage criterion, warranting transport to a trauma center." **Reviewers' conclusion** A large amount of data was missing. Authors used multiple imputation methods, but state that the amount of missing data was larger than suitable to avoid risk of bias. However, sensitivity analyses for complete data and best-case scenarios revealed comparable results. Only data for the first two steps in activation were provided in the database excluding trauma activations for mechanism of injury (step 3) and special

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			3: 71 4: 71 <u>Negative predictive value for adults, %</u> 1: 61 2: 59 3: 70 4: 69 <u>ROC AUC (95% CI), AIC for geriatrics</u> 1: 0.532 (0.530 to 0.534), 364865 2: 0.519(0.517 to 0.522), 365258 3: 0.575 (0.572 to 0.577), 361316 4: 0.574 (0.571 to 0.576), 363319 <u>ROC AUC (95% CI), AIC for adults</u> 1: 0.564 (0.563 to 0.566), 980176 2: 0.539 (0.538 to 0.541), 979913 3: 0.641 (0.640 to 0.642), 1022308 4: 0.646 (0.645 to 0.647), 1013075 <u>Undertriage** reduction by substituting an SBP <110 mmHg, %</u> Geriatric: 4.4 Adult: 4.3 **defined as a subject who did not have any Step 1 or Step 2 NTTP criteria present but met the definition of TCN <u>Overtriage*** increase by substituting an SBP <110 mmHg, %</u> Geriatric: 4.3 Adult: 5.3 ***defined as a subject who did have at least one Step 1 or Step 2 NTTP criteria present but did not meet the definition of TCN	considerations (step 4). Furthermore, the authors state that it is possible that a group of patients with no other activation criteria who would have been captured by the SBP of less than 110 mm Hg criterion were not taken to a trauma center under the current SBP of less than 90 mm Hg criterion and thus would not be represented in the database. If this group is substantial and ultimately does not require trauma center care, a significantly greater increase in overtriage from that reported here is possible, with the attendant problems highlighted earlier. The authors could not account for this scenario. In this study, the overtriage rate represents the false positive patients and the undertriage rate represents the false negative patients.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Optimal SBP for geriatrics (<122 mmHg), sensitivity [%], specificity [%] 22, 83 Optimal SBP for adults (<118 mmHg), sensitivity [%], specificity [%] 32, 73 *trauma center need defined as a composite of ISS <15, ICU admission ≥24 h, need for urgent surgery (defined as ED disposition to the operating room), or death in the ED **Results for secondary outcome (mortality)** Optimal SBP for geriatrics (<118 mmHg), sensitivity [%], specificity [%] 29, 86 Optimal SBP for adults (<106 mmHg), sensitivity [%], specificity [%] 49, 88 Mortality of patients newly triaged because of substituting SBP value compared to regular SBP, AOR (95% CI); model c statistics (95% CI) Geriatric: 1.03 (0.88–1.20), p=0.76; 0.910 (0.904–0.915)	
Cull (2019) "Development of Trauma Level Prediction Models Using Emergency Medical Service Vital Signs to Reduce Over- and Undertriage Rates in Penetrating Wounds and Falls of the	**Inclusion criteria** for geriatric fall: • blunt trauma • E-code fall on the same level - other • age ≥65 y • transported via ground ambulance • vitals sign type EMS	**Participants** N=157,164 patients **(Potential) Activation criteria** 1: Falls (N=92780); equation for predictive model = 0.286 + 0.00267 x SBP – 0.00538 x PR + 0.00656 x RR + 0.0444 x GCS + 0.000006 x SBP^2 – 0.003209 x GCS^2 –	Overtriage*, n/N (%) 1: 34418/92780 (37.10) 2: 14512/32440 (44.73) 3: 6885/31944 (21.55) *coded trauma level indicated no trauma activation, but predictive model indicated activation Undertriage**, n/N (%)	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Elderly". *Am Surg* 2019; 85(5): 524-529. **Study design** Prognostic cross-sectional study (National Trauma Data Bank) **Aim of the study** "analyzes the influence of EMS vital signs on injury severity and triage level for use in developing a predictive model when assessing GF [geriatric falls], GSW [gunshot wounds], and SW [stab wound] patients." **Setting** USA, 2013-2015	<u>for firearm:</u> • penetrating injury • E-code all listed firearm mechanism • Age >0 y [data were filtered for patients >14 years] • Transported via ground ambulance • vitals sign type EMS <u>cut/pierce:</u> • penetrating injury • E-code all listed cut/pierce mechanism • Age >0 [data were filtered for patients >14 years] • Transported via ground ambulance • vitals sign type EMS **Exclusion criteria** • missing vital data • vital data not in required ranges (60≤SBP≤240; 0<PR≤200; 0<RR≤40; GCS≤15) **Characteristics** n.r.	0.000297 x SBP x GCS + 0.000357 x PR x GCS – 0.000593 x RR x GCS 2: Gunshot wounds (N=32440); equation for predictive model= 0.861 – 0.00134 x SBP + 0.00075 x PR – 0.02778 x RR + 0.0844 x GCS + 0.000020 x SBP^2 + 0.000014 x PR^2 + 0.000583 x RR^2 – 0.006277 x GCS^2 – 0.000035 x SBP x PR + 0.000083 x SBP x RR – 0.000282 x SBP x GCS + 0.000108 x PR x GCS 3: Stab wounds (N=31944); equation for predictive model= 0.587 – 0.00276 x SBP – 0.00128 x PR + 0.01023 x RR – 0.02529 x GCS + 0.000018 x SBP^2 + 0.000024 x PR^2 + 0.000255 x RR^2 – 0.000015 x SBP x PR – 0.000064 x SBP x RR – 0.000078 x PR x RR	1: 3245/92780 (3.50) 2: 1191/32440 (3.67) 3: 1171/31944 (3.67) ** coded trauma level indicated trauma activation, but predictive model indicated no activation <u>Accuracy***, n/N (%)</u> 1: 55117/92780 (59.41) 2: 16737/32440 (51.59) 3: 23888/31944 (74.78) ***coded trauma level matches predictive model	"Our developed trauma level prediction models enable health providers to predict trauma activation levels that result in OT and UT rates within the recommended ranges by the Committee on Trauma." **Reviewers' conclusion** The cribari method was used to calculate over-and undertriage, but there are concerns regarding the validity of this method for calculation of undertriage. Over- und undertriage are calculated solely based on ISS. No patient characteristics were reported.
Damme (2016) "Isolated prehospital hypotension correlates with injury severity and outcomes in patients with trauma". *Trauma Surg Acute Care Open* 2016; 1(1): e000013. **Study design**	**Inclusion criteria** n.r. **Exclusion criteria** • Patients who remained hypotensive on admission • Who were transferred by a non-EMS service and thus had no prehospital SBP documentation • With incomplete data	**Participants** N=287 patients **(Potential) activation criteria** Hypotension defined as SBP ≤110 mm Hg (n=81 patients) Normotension defined as SBP >110 mm Hg (n=206 patients)	<u>ICU admission, %</u> hypotension: 56.79 normotension: 22.82, p<0.0001 <u>ICU LOS [d], mean ± standard error</u> hypotension: 3.23±0.71 normotension: 0.71±0.17, p<0.0001 <u>Ventilator days, mean ± standard error</u> hypotension: 3.38±1.20 normotension: 0.27±0.08, p=0.0001	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "Isolated prehospital hypotension in patients in the

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Prognostic cross-sectional study **Aim of the study** "to determine whether isolated prehospital hypotension portends poor outcomes and correlates with injury severity" **Setting** USA, 2014	**Characteristics** Male gender, % hypotension: 59 normotension: 60, p=0.77 Age [y], mean ± standard error hypotension: 38.8±2.7 normotension: 51.1±1.6, p<0.0001 Mechanism of injury (%) Blunt: hypotension: 90 normotension: 92 Burn: hypotension: 1 normotension: 1 Penetrating: hypotension: 9 normotension: 7, p overall=0.7593 SBP [mmHg], mean ± standard error Pre-hospital: hypotension: 99.11±1.75 normotension: 143.44±1.59, p<0.0001 ED: hypotension: 132.65±1.39 normotension: 148.47±1.69, p<0.0001 GCS, mean± standard error Pre-hospital: hypotension: 12.81±0.44 normotension: 14.38±0.13, p<0.0001 ED: hypotension: 12.78±0.47 normotension: 14.37±0.14, p<0.0001		Packed red blood cells [first 24 h], % hypotension: 22±8 normotension: 6±2, p=0.0114 CAVE: It is uncertain, whether data for PRBC reflect proportions or mean (SE) ISS, mean± standard error hypotension: 12.27±1.12 normotension: 9.22±0.49, p<0.0001	trauma and emergency department correlates with increased injury severity and portends worse outcomes despite a normal blood pressure reading at admission. Prehospital hypotension must be given heavy consideration in triage, as these patients may be transiently hypotensive and appear less critical than their true status." **Reviewers' conclusion** This was a prospective single center study. Information on the study's inclusion criteria are missing. Both patient groups differed significantly in age and pre-hospital and ED-GCS.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Dehli (2016) "Evaluation of a trauma team activation protocol revision: a prospective cohort study". *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine* 2016; 24(1): 105. **Study design** Prognostic cross-sectional study **Aim of the study** "we evaluated the protocol revision by comparing over- and undertriage in the former and present set of criteria" **Setting** Norway, 2013-2014	**Inclusion criteria** • severely injured patients (ISS >15) with our without a TTA • patients admitted with TTA **Exclusion criteria** • patients transferred >24 h after injury In the following, only data since the implementation of the new protocol were extracted **Characteristics (overall)** <u>Male gender, n (%)</u> 226 (69.8%) <u>Age [y[, mean (range)</u> 41 (0–101) <u>ISS, median (IQR)</u> 10 (2, 20) <u>Predominant mechanism of injury (%)</u> Penetrating 3.4% Blunt 96.6%	**Participants** N=324 patients **(Potential) activation criteria** <u>Vital parameters:</u> • 1. Airway obstruction, stridor N=4 • 2. Tachypnoe (adults, respiratory rate >30) N=14 • 3. Heart rate >130 (adults) N=3 • 4. Systolic BP <90 mmHg N=9 • 5. Lowered level of consciousness (GCS <13) N=87 <u>Extent of injuries:</u> • 6. Flail chest N=2 • 7. Unstable fracture of the pelvis. Fracture in two or more long bones N=5 • 8. Traumatic amputation or crush injury above wrist/ankle N=1 • 9. Injury in two or more body regions (head/neck/chest/abdomen/pelvis/ femur/back) N=61 • 10. Paralysis N=10 • 11. Penetrating injury of the head/neck/chest/abdomen/pelvis/ groin/back N=5 • 12. 2. or 3. degree burn injury >15 % body surface (children >10 %) N=5 • 13. Burn injury with inhalation injury N=5 • 14. Hypothermia (core temperature <32 °C) N=11 <u>Mechanism of injury</u> • 15. Ejected from vehicle N=6 • 16. Co-passenger dead N=5 • 17. Trapped in wreck N=9	**<u>Accuracy, n/N (%)</u>** <u>fraction of patients correctly classified as severely injured (ISS >15), with N=all patients meeting the activation criterion</u> 1: 2/4 (50) 2: 10/14 (71) 3: 0/3 (0) 4: 5/9 (56) 5: 33/87 (38) 6: 1/2 (50) 7: 2/5 (40) 8: 0/1 (0) 9: 9/61 (15) 10: 8/10 (80) 11: 0/5 (0) 12: 2/5 (40) 13: 2/5 (40) 14: 3/11 (27) 15: 4/6 (67) 16: 2/5 (40) 17: 3/9 (33) 18: 2/15 (13) 19: 10/20 (50) 20: 0/1 (0) 21: 0/8 (0)	**Level of evidence** 3b↓ **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "The low number of patients makes it difficult to draw conclusions about individual criteria for TTA, and even though some criteria were seldom used, the proportion of correctly triaged patients was high. However, based on the findings in the present study, we suggest that further changes in the present TTA criteria will not help to reduce overtriage. Another way to limit unnecessary use of limited resources may be to introduce a two-tiered TTA, with a low threshold for mobilizing a smaller team based on MOI information from the prehospital services, and the full team only when alarming vital signs or anatomical injuries are reported." **Reviewers' conclusion** This was a prospective single center study. The study

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
		• 18. Pedestrian or cyclist hit by motor vehicle N=15 • 19. Fall from >5 m N=20 • 20. Avalanche accident N=1 Unknown criteria: • 21. Estimated time from arrival<15 min N=8 • 22. Trauma team leader requested TTA N=5 • 23. Anesthesiologist in ambulance helicopter requested TTA N=6 • 24. Unknown/undocumented reason for TTA N=20	22: 0/5 (0) 23: 0/6 (0) 24: 0/20 (0) fraction of patients correctly classified as severely injured (need for emergency procedure*), with N=all patients meeting the activation criterion 1: 3/4 (75) 2: 3/14 (21) 3: 2/3 (67) 4: 4/9 (44) 5: 28/87 (32) 6: 0/2 (0) 7: 0/5 (0) 8: 1/1 (100) 9: 8/61 (13) 10: 1/10 (10) 11: 3/5 (60) 12: 3/5 (60) 13: 2/5 (40) 14: 2/11 (18) 15: 0/6 (0) 16: 0/5 (0) 17: 1/9 (11) 18: 2/15 (13) 19: 3/20 (15)	was downgraded, because it was underpowered to show a difference for the individual activation criteria. The low number of patients should be kept in mind when interpreting the results for individual TTA criteria. Furthermore, not all criteria are assessed for every admission since there is no difference if one or more criteria are fulfilled.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			20: 0/1 (0) 21: 0/8 (0) 22: 0/5 (0) 23: 0/6 (0) 24: 0/20 (0) *emergency procedures were endotracheal intubation, damage control thoracotomy, damage control laparotomy, extraperitoneal pelvic packing, intervention radiology, craniotomy, insertion of intracranial pressure bolt, chest tube insertion, external fracture stabilization, other procedures to stabilize airways, respiration or circulation	
Guyette (2015) "A comparison of prehospital lactate and systolic blood pressure for predicting the need for resuscitative care in trauma transported by ground". *J Trauma Acute Care Surg* 2015; 78(3): 600-606. **Study design** Prognostic cross-sectional study **Aim of the study** "to compare prehospital point-of-care lactate (P-LAC) with systolic blood pressure (SBP) for predicting the need for resuscitative care (RC) in trauma patients transported by	**Inclusion criteria** • Prehospital SBP ≤100 mm Hg • Blunt or penetrating trauma • Transported by emergency medical services to a Level I or II trauma center • Valid lactate measurement **Exclusion criteria** • age <15 years • obvious isolated penetrating head injury • drowning • asphyxia caused by hanging • burns on >20% of total body surface area • prisoner status • SBP ≤70 mm Hg **Characteristics** n.r. for comparison of interest	**Participants** N=387 patients **(Potential) activation criteria** • Point-of-care lactate • SBP • Shock index (heart rate/SBP) • GCS score • Any airway/bag valve mask attempted **Variables included in multivariable logistic regression** • Age • Sex • mechanism of injury • prehospital vital signs (SBP, SI, GCS score) • airway status • and regional site	**Adjusted outcomes** <u>Logistic regression analysis for need for resuscitative care*, OR (95% CI)</u> Point-of-care lactate**: 1 mmol/L difference in point-of-care lactate within the range of <2.5: 1.76 (0.41-12.93) 1 mmol/L difference in point-of-care lactate within the range of 2.5-3.9: 3.61 (1.67-8.35) 1 mmol/L difference in point-of-care lactate within the range of ≥4.0: 0.97 (0.87-1.07) SBP (per 5 mm Hg): 0.92 (0.73-1.15) Shock index (per increment of 0.1): 1.21 (1.06-1.38) Initial GCS score (per increment of 1): 1.01 (0.90-1.13) Any airway/bag valve mask attempted: 4.55 (1.40-15.43)	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "P-LAC obtained at the scene of injury is strongly associated with the need for RC. P-LAC is superior to other early surrogates for hypoperfusion (SBP and SI) in predicting the need for RC in trauma patients with 70 mm Hg G SBP e 100 mm Hg." **Reviewers' conclusion** There was a large proportion of patients for whom

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ground emergency medical services" **Setting** North America, 2011-2012			**Unadjusted outcomes** **Accuracy, n/N (%)** fraction of patients correctly classified as severely injured (need for resuscitative care), with N=all patient meeting the activation criterion: Point-of-Care-Lactate ≥2.5 mmol/L: 65/228 (28.5) SBP ≤90 mm Hg: 47/213 (22.1) Point-of-Care-Lactate ≥2.5 mmol/L and SBP 91-100 mm Hg: 21/93 (22.6) Sensitivity for detection of patients with need of resuscitative care*, % (95% CI) Point-of-care lactate ≥2.5mmol/L: 93 (84-98) SBP ≤90 mm Hg 67 (55-78), p<0.001 for difference Negative predictive value for detection of patients with need of resuscitative care*, % (95% CI) Point-of-care lactate <2.5mmol/L: 97(93-99) SBP >90 mm Hg 87 (81-91) Area under the receiver operating characteristic curve, % (95% CI) Point-of-care lactate 0.78 (0.73-0.83), statistically significant superior to SBP 0.59 (0.53-0.66) and Shock index 0.66 (0.60-0.74) *need for resuscitative care defined as any of the following within 6 hours of emergency department arrival: • blood transfusion of 5 U or greater	no (valid) lactate measure could be performed. Emergency service personnel as well as receiving personnel in the hospital was blinded to the point-of-care lactate value. Sensitivity analyses using two alternative definitions of resuscitative care found no differences in results. The authors state that the cutoff points are not intended to be clinical decision points and may result in overtriage if they are extended to a patient population that does not meet their eligibility criteria.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			• intervention for haemorrhage including thoracotomy, laparotomy, pelvic fixation, or interventional radiology embolization • death (including death before hospital arrival) **Modeled as linear spline with knots at 2.5 mmol/L and 4.0 mmol/L. The estimate for a given lactate range is the ratio of odds for the need for resuscitative care between two patients who both have lactate levels within the same range (e.g., 2.5-3.9) and have the same covariate data except that their lactate levels differ by 1 mmol/L.	
Hasler (2011) "Systolic blood pressure below 110 mmHg is associated with increased mortality in blunt major trauma patients: Multicentre cohort study". *Resuscitation* 2011; 82(9): 1202-7. **Study design** Prognostic cross-sectional study (Trauma Audit and Research Network) **Aim of the study** "to examine the association of SBP with mortality in blunt trauma patients." **Setting** Europe, 2000-2009	**Inclusion criteria** • Injured patients • Adults ≥16 y **Exclusion criteria** • penetrating injuries • concomitant head trauma (AIS 3+) • transferals from a non-TARN hospital • referrals to a non-TARN hospital • missing data for SBP or GCS **Characteristics (overall)** Age [y], median (IQR) 51.1 (32.8 to 67.4) Male gender, n (%) 28,694 (60) ISS, median (IQR) 9 (8 to 10) GCS, median (IQR) 15 (15 to 15)	**Participants** N=47,927 patients **(Potential) activation criteria** SBP at ED arrival <70 (N=346) SBP at ED arrival 70–79 (N=327) SBP at ED arrival 80–89 (N=761) SBP at ED arrival 90–99 (N=1584) SBP at ED arrival 100–109 (N=3191) SBP at ED arrival 110–119 (N=5380) SBP at ED arrival 120–129 (N=7393) SBP at ED arrival 130–139 (N=7971) SBP at ED arrival 140–149 (N=7347) SBP at ED arrival 150–159 (N=5394) SBP at ED arrival 160–169 (N=3258) SBP at ED arrival 170–179 (N=1953) SBP at ED arrival 180–189 (N=1299)	Multivariate analysis for mortality, OR (95% CI) SBP <70: 5.98 (4.42 to 8.09) SBP <90: 2.90 (2.20 to 3.84) SBP <100: 2.11 (1.65 to 2.70) SBP <110: 1.69 (1.35 to 2.12) SBP <130 mmHg: reference category ROC curve = 0.89 and AIC = 10811.15	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "We recommend triaging adult blunt trauma patients with a SBP <110 mmHg to resuscitation areas within dedicated trauma units for close monitoring and appropriate management." **Reviewers' conclusion** This study included a high number of patients and performed several adjusted analyses for assessing the impact of SBP on mortality. The authors could not adjust for other possible con-

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	SBP, median (IQR) 135 (120 to 152)	SBP at ED arrival 190–199 (N=816) SBP at ED arrival ≥200 (N=907) **Adjustment criteria in multivariate analysis using mixed effect logistic regression** • age • gender • ISS • GCS		founders such as base excess, lactate levels, body temperature or co-morbidities, but the analysis showed a good model fit. SBP was measured using either automated or manual non-invasive blood pressure measurements, which might bias the results. Further, SBP measures were performed at arrival in the emergency department. When interpreting the results, one should keep in mind that the study population includes patients with severe traumatic injuries more frequently due to the definition of trauma according to the TARN registry.
Hasler (2012) "Systolic blood pressure below 110 mmHg is associated with increased mortality in penetrating major trauma patients: Multicentre cohort study". *Resuscitation* 2012; 83(4): 476-81. **Study design** Prognostic cross-sectional study	**Inclusion criteria** • Adults ≥16 y • With penetrating trauma **Exclusion criteria** • blunt injuries • concomitant head trauma (AIS 3+) • transferals from a non-TARN hospital • referrals to a non-TARN hospital **Patient characteristics (overall)** Age [y], median (IQR) 30.0 (22.5 to 41.4)	**Participants** N=3444 patients **(Potential) activation criteria** ED SBP <70 (N=153) ED SBP 70–89 (N=276) ED SBP 90–109 (N=520) ED SBP 110–129 (N=941) ED SBP 130–149 (N=946) ED BP 150–169 (N=444) ED SBP ≥170 (N=164)	Multivariate analysis for mortality [30d], OR (95% CI) SBP <70: 10.3 (4.76 to 22.2) SBP 70–89 : 4.01 (2.02 to 7.95) SBP 90–109: 2.22 (1.09 to 4.50) SBP 110–129 1.00 (reference) SBP 130–149: n.r. SBP 150–169: 0.65 (0.22 to 1.91) SBP ≥170: 0.20 (0.03 to 1.17), p for linear trend <0.001	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "We recommend that penetrating trauma patients with a SBP <110 mmHg are triaged to resuscitation areas within dedicated, appropriately specialised,

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
(Trauma Audit and Research Network) **Aim of the study** "to determine the association between different SBP cut-offs and overall mortality at 30 days after admission in patients with penetrating trauma." **Setting** Europe, 2000-2009	Male gender, n (%) 2991 (86.9) ISS, median (IQR) 9 (9 to 14) GCS, median (IQR) 15 (15 to 15) SBP, median (IQR) 126 (107 to 142)	**Adjustment criteria in multivariate analysis using mixed effect logistic regression** • age • gender • ISS • GCS	AUROC= 0.91 and AIC = 580	high-level care trauma centres." **Reviewers' conclusion** The authors could not adjust for other possible confounders such as base excess, lactate levels, body temperature or co-morbidities. SBP was measured using either automated oscillometry or manual sphygmanometry, which might bias the results. SBP was measured on admission to ED. When interpreting the results, one should keep in mind that the study population includes patients with severe traumatic injuries more frequently due to the definition of trauma according to the TARN registry.
Heindl (2021) "Emergency intervention rate in the emergency room depending on the alerting criteria. Prospective data analysis of a supraregional trauma center". *Unfallchirurg* 2021; 4: 40. **Study design**	**Inclusion criteria** • Patients who were primarily admitted by ground ambulance or air ambulance after an accident and were admitted via the shock room • Patients admitted to the shock room under resuscitation **Exclusion criteria**	**Participants** N=164 patients **(Potential) activation criteria** A-criteria (abnormal vital signs, obvious severe injury, prehospital intervention) N=32 B-criteria (mechanism of injury) N=84 Null criteria (Criteria not mentioned in the criteria catalog of the S3 guideline; activations generally based on the assessment of the emergency physician alone) N=48	Mortality (%) A: 31.3 B: 2.4 Null: 2.1, p<0.001 Mechanism of injury - multiple injuries, (%) A: 59 B: 67 Null: 29 Mechanism of injury - single injury, (%)	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "Differentiation according to the TTA criteria results in patient collectives with different injury severity and emergency intervention

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Prognostic cross-sectional study **Aim of the study** "to describe ER patients according to the TTA criteria and to collect the corresponding emergency intervention rates in ER." **Setting** Germany, 2017	• Patients treated as self-referrals in the shock room without a previous accident or without treatment by the ambulance service • Patients referred secondarily after primary care at another clinic **Characteristics** <u>Age [y], mean ± SD</u> A-criteria: 48.3± 28.8 B-criteria: 48.7± 22.9 Null criteria: 66± 19.7 p significant for comparison between A and Null and B and Null <u>ISS mean ± SD</u> A-criteria: 20.6± 21.3 B-criteria: 8.0± 7.2, p significant compared to A Null criteria: 5.6± 8.2, p significant compared to A <u>Admission GCS mean ± SD</u> A-criteria: 7.8± 5.5 B-criteria: 14.2± 1.8 p significant compared to A Null criteria: 13.8± 1.7 p significant compared to A <u>Systolic blood pressure at admission [mm Hg] mean ± SD</u> A-criteria: 99.7± 56.7 B-criteria 143.7± 25.4, p significant compared to A Null criteria: 141.7± 26.6, p significant compared to A		A: 41 B: 31 Null: 54 <u>Mechanism of injury - no injury, (%)</u> A: 0 B: 2 Null: 17 <u>Emergency intervention, (%)</u> A: 75 B: 6 Null: 2.1 <u>Intubation, (%)</u> A: 71.9 B: 5.9 Null: 2 <u>Chest tube, (%)</u> A: 34.4 B: 1.2 Null: 0 <u>Cardiopulmonary resuscitation, (%)</u> A: 31.3 B: 0 Null: 0 <u>Transfusion, (%)</u> A: 6.3 B: 0 Null: 0 <u>Coagulation substitution, (%)</u> A: 15.6 B: 0 Null: 0	rates. This result justifies considerations to adjust team composition based on TTA criteria, as long as it is ensured that critical conditions can be identified and remedied by adapted teams" **Reviewers' conclusion** This was a prospective single center study. Except for the mortality rate there are no p values available for the outcome variables. Therefore, statements on the significance of these results are not possible.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			External pelvic stabilization, (%) A: 9.4 B: 0 Null: 0 Surgical hemostasis, (%) A: 0 B: 0 Null: 0	
Hranjec (2012) "Mortality Factors in Geriatric Blunt Trauma Patients: Creation of a Highly Predictive Statistical Model for Mortality Using 50,765 Consecutive Elderly Trauma Admissions from the National Sample Project" *Am Surg*. 2012; 78(12): 1369–1375. **Study design** Prognostic cross-sectional study (National Trauma Database) **Aim of the study** "to create a geriatric-specific model that would accurately predict in-hospital mortality in injured elderly trauma patients while adjusting for multiple covariates."	**Inclusion criteria** • Age ≥65 • known outcome variable mortality/survival to discharge • hospital length of stay of at least 24 hours • ISS >0 **Exclusion criteria** n.r. **Patient characteristics (overall)** Male gender, n (%) 24,603 (42.4)	**Participants** N=57,973 patients **(Potential) activation criteria** 1: Age 2: Gender 3: Motor GCS 4: SBP 5: Temperature 6: Mechanical ventilation **Variables included in logistic regression** • Age • gender • ISS motor GCS • SBP • Temperature • Presence of mechanical ventilation	**Adjusted outcomes** Logistic regression for prediction of mortality, OR (95% CI) 1: Age >85 y: 2 (1.8–2.2) 65–75 y: 1.86 (1.7–2.0) 65 y: reference 2: Gender Female: 0.77 (0.7–0.8) Male: reference 3: motor GCS 1: 4.49 (4.0–5.0) 2–5: 2.82 (2.5–3.2) 6: reference 4: SBP 0–60: 1.69 (1.1–2.7) 60–90: 1.3 (1.1–1.6) 90-120: reference 120–150: 0.62 (0.6–0.7) 150–180: 0.67 (0.6–0.8) 5: Temperature	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "Clearly, a separate geriatric model for predicting outcomes is not only warranted, but necessary." **Reviewers' conclusion** Because of the high share of missing data on some items such as SBP and mechanical ventilator, an additional analysis of patients with complete data was performed, which revealed comparable results. Some important variables affecting mortality such as respiratory rate could not be included in the predictive model.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Setting USA, 2003-2006			65–97.7: 1.23 (1.1–1.4) 97.7–101.3: reference >101.3: 1.24 (0.5–2.5) 6: mechanical ventilation Yes: 5.1 (4.6–5.6) No: reference	
Ichwan (2014) "Geriatric-Specific Triage Criteria Are More Sensitive Than Standard Adult Criteria in Identifying Need for Trauma Center Care in Injured Older Adults". *Ann Emerg Med*. 2014; 65(1): 1-9. **Study design** Prognostic cross-sectional study (Ohio Trauma Registry) **Aim of the study** "to evaluate the sensitivity of the Ohio geriatric trauma triage criteria compared with the adult triage criteria in identifying need for trauma center care among injured older adults." **Setting** USA, 2006-2011	**Inclusion criteria** • injured patients • age ≥16 y • initially transported from the scene by emergency medical service personnel **Exclusion criteria** • absent data for ISS **Patient characteristics** Age [y], mean ± SD Adults: 42 ± 16 Geriatrics: 82 ± 7 Male gender, n (%) Adults: 45589 (66.9) Geriatrics: 10407 (31.2) Blunt mechanism of injury, n (%) Adults: 58449 (86) Geriatrics: 32965 (99) Penetrating mechanism of injury, n (%) Adults: 8445 (12) Geriatrics: 252 (0.8) Burns mechanism of injury, n (%)	**Participants** N=101,577 patients overall; N=33,379 geriatrics (age ≥70 y); N=68,198 adults (age 16-69 y) **(Potential) activation criteria** 1: Geriatric triage criteria: • Systolic blood pressure <100 mm Hg, or absent radial pulse with carotid pulse present • GCS score ≤14 in trauma patient with a known or suspected traumatic brain injury • Fracture of 1 proximal long bone sustained from motor vehicle crash • Injury sustained in 2 or more body regions • Pedestrian struck by motor vehicle • Fall from any height, including standing falls, with evidence of a traumatic brain injury 2: Adult triage criteria • Systolic blood pressure <90 mm Hg, or absent radial pulse with carotid pulse present • GCS score ≤13 • Fractures of 2 or more proximal long bones	**Prediction of ISS >15** Sensitivity of geriatric criteria, % (95% CI) Geriatrics: 93 (92 to 93) Adults: 94 (94 to 95) Sensitivity of adult criteria, % (95% CI) Geriatrics: 61 (60 to 62) Adults: 87 (86 to 87) Specificity of geriatric criteria, % (95% CI) Geriatrics: 49 (48 to 49) Adults: 35 (35 to 35) Specificity of adult criteria, % (95% CI) Geriatrics: 61 (61 to 62) Adults: 44 (44 to 45) AUC of geriatric criteria, % (95% CI) Geriatrics: 0.71 Adults: 0.65 AUC of adult criteria, % (95% CI) Geriatrics: 0.61 Adults: 0.65 Difference in sensitivity between criteria, % (95% CI) Geriatrics: 32 (30 to 33) Adults: 8 (7 to 8)	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "we demonstrated that application of Ohio's geriatric trauma triage guidelines to the older adult population would result in improved sensitivity, with acceptable decreases in specificity for older adults. We showed that current standard adult triage guidelines provide poor sensitivity in identifying older adults with moderate to severe injury who need trauma center care. In addition, we found that using the geriatric trauma triage guidelines in younger adults provides minimal appreciable increase in sensitivity, but substantial decreases in specificity"

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Adults: 952 (1.4) Geriatrics: 139 (0.4) Asphyxial mechanism of injury, n (%) Adults: 352 (0.5) Geriatrics: 23 (0.1) ISS, mean ± SD Adults: 12 ± 11 Geriatrics: 8 ± 7		Difference in specificity between criteria, % (95% CI) Geriatrics: -12 (-12 to -13) Adults: -9 (-9 to -9) **Prediction of Operating Room Visit within 48h of injury** Sensitivity of geriatric criteria, % (95% CI) Geriatrics: 47 (46 to 49) Adults: 73 (72 to 73) Sensitivity of adult criteria, % (95% CI) Geriatrics: 35 (34 to 37) Adults: 65 (64 to 65) Specificity of geriatric criteria, % (95% CI) Geriatrics: 42 (41 to 42) Adults: 27 (26 to 27) Specificity of adult criteria, % (95% CI) Geriatrics: 57 (56 to 58) Adults: 36 (35 to 36) AUC of geriatric criteria h, % (95% CI) Geriatrics: 0.44 Adults: 0.5 AUC of adult criteria, % (95% CI) Geriatrics: 0.46 Adults: 0.5 Difference in sensitivity between criteria, % (95% CI) Geriatrics: 12 (11 to 13) Adults: 8 (8 to 8)	**Reviewers' conclusion** Four different common outcome measures were used to assess the need for trauma center care. The results need to be interpreted in the context of a study population with high severity of injury which might affect the test characteristics. Since the trauma registry was not designed to capture the presence of geriatric criteria, a coding scheme had to be used to identify patients who meet either of these criteria. Multiple imputation methods were used to account for a high amount of missing data. Sensitivity analyses for complete data and a restriction to 2009-2011 patients revealed comparable results.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Difference in specificity between criteria, % (95% CI) Geriatrics: -16 (-15 to -16) Adults: -9 (-9 to -9) **Prediction of ICU stay of 1 day or longer during the hospitalization** Sensitivity of geriatric criteria, % (95% CI) Geriatrics: 81 (80 to 82) Adults: 91 (90 to 91) Sensitivity of adult criteria, % (95% CI) Geriatrics: 56 (55 to 57) Adults: 82 (82 to 83) Specificity of geriatric criteria, % (95% CI) Geriatrics: 48 (47 to 48) Adults: 34 (33 to 34) Specificity of adult criteria, % (95% CI) Geriatrics: 61 (60 to 62) Adults: 42 (42 to 43) AUC of geriatric criteria, % (95% CI) Geriatrics: 0.64 Adults: 0.62 AUC of adult criteria, % (95% CI) Geriatrics: 0.58 Adults: 0.62 Difference in sensitivity between criteria, % (95% CI) Geriatrics: 25 (24 to 26) Adults: 8 (8 to 9)	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Difference in specificity between criteria, % (95% CI) Geriatrics: -13 (-13 to -13) Adults: -9 (-9 to -9) **Prediction of inhospital mortality** Sensitivity of geriatric criteria, % (95% CI) Geriatrics: 90 (89 to 91) Adults: 99 (99 to 100) Sensitivity of adult criteria, % (95% CI) Geriatrics: 74 (72 to 76) Adults: 98 (97 to 98) Specificity of geriatric criteria, % (95% CI) Geriatrics: 45 (45 to 46) Adults: 30 (29 to 30) Specificity of adult criteria, % (95% CI) Geriatrics: 60 (60 to 61) Adults: 39 (39 to 39) AUC of geriatric criteria, % (95% CI) Geriatrics: 0.68 Adults: 0.64 AUC of adult criteria, % (95% CI) Geriatrics: 0.67 Adults: 0.68 Difference in sensitivity between criteria, % (95% CI) Geriatrics: 16 (14 to 17) Adults: 2 (0 to 2) Difference in specificity between criteria, % (95% CI)	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Geriatrics: -15 (-15 to -15) Adults: -9 (-9 to -10)	
Kalkwarf (2021) "Prehospital ABC score accurately forecasts patients who will require immediate resource utilization". South Med J 2021; 114($): 193-198. **Study design** Prognostic cross-sectional study **Aim of the study** "to evaluate the ability of the Prehospital ABC Score to predict blood transfusions and the need for emergent laparotomy" **Setting** USA, 2010	**Inclusion criteria** • Trauma patients • who arrived via the institution's aeromedical transport service • underwent in-flight pFAST by a Life Flight nurse or paramedic **Exclusion criteria** n.r. **Characteristics** <u>Age [y], median (IQR)</u> Prehospital ABC+: 30 (21-48) Prehospital ABC-: 40 (27-52), p=0.081 <u>Male gender, %</u> Prehospital ABC+: 61 Prehospital ABC-:72, p=0.257 <u>ISS, median (IQR)</u> Prehospital ABC+: 24 (14-30) Prehospital ABC-: 15 (9 to 22), p=0.023	**Participants** N=291 patients **(Potential) activation criteria** Prehospital ABC* + [positive] (N=25) Prehospital ABC* - [negative] (N=266) *≥2 of the following present during aeromedical transport: • Penetrating trauma • Heart rate >120 bpm • SBP <90 mmHg • Positive abdominal pFAST	<u>Sensitivity, %</u> Emergent laparotomy*: 46 Massive transfusion**: 33 Substantial bleeding: 41 <u>Specificity, %</u> Emergent laparotomy*: 96 Massive transfusion**: 93 Substantial bleeding: 94 <u>Positive predictive value, %</u> Emergent laparotomy*: 48 Massive transfusion**: 28 Substantial bleeding: 34 <u>Negative predictive value *, %</u> Emergent laparotomy*: 95 Massive transfusion**: 94 Substantial bleeding: 96 <u>AUROC</u> Emergent laparotomy*: 0.836 Massive transfusion**: 0.771 Substantial bleeding: 0.849 <u>RBC [units] in ED, median (IQR)</u> Prehospital ABC+: 0 (0 to 1) Prehospital ABC-: 0 (0 to 0), p<0.001 <u>ED plasma [units], median (IQR)</u> Prehospital ABC+: 0 (0 to 1) Prehospital ABC-: 0 (0 to 0), p=0.002 <u>RBC [units] after 0-3 h, median (IQR)</u>	**Level of evidence** 3b↓ **Risk of bias** no tool available for prognostic studies **Authors' conclusions** "The prehospital ABC score effectively predicts in-hospital resource utilization. It […] is helpful to improve trauma team activation, mobilize blood products, and prepare the operating room." **Reviewers' conclusion** The study was downgraded, because it was a posthoc analysis of a single-center study. The high false positive rate resulted in a relatively low sensitivity and positive predictive value. Only 25% of transported patients received a complete examination. Reasons for non-performance are unknown.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Prehospital ABC+: 0 (0 to 3) Prehospital ABC-: 0 (0 to 0), p<0.001 <u>Plasma after 0-3 h, median (IQR)</u> Prehospital ABC+: 0 (0 to 3) Prehospital ABC-: 0 (0 to 0), p<0.001 <u>In-hospital mortality</u> Prehospital ABC+: 22 Prehospital ABC-: 2, p<0.001 Cave: It is unclear whether data for mortality were reported as proportions or absolute numbers * defined as taken to the OR within 2 h of admission ** defined as transfusion of ≥10 u of packed RBCs in the first 24h after admission	
Lehmann (2009) "A Simplified Set of Trauma Triage Criteria to Safely Reduce Overtriage". *Arch Surg* 2009; 144(9): 853-858. **Study design** Prognostic cross-sectional study **Aim of the study** "To prospectively evaluate the performance of our institution's current triage system compared with a simplified system using	**Inclusion criteria** • trauma patients • age >15 y **Exclusion criteria** n.r. **Characteristics (overall)** <u>Age [y], mean</u> 40 <u>Blunt injury mechanism, %</u> 95	**Participants** N=244 patients **(Potential) activation criteria** <u>1: institution's current triage system including 3 steps:</u> Step 1) Assess vital signs and level of consciousness: • Systolic blood pressure <90 mm Hg • Heart rate >120 beats/min • For pediatric patients (aged <15 years), use blood pressure <90 mm Hg or cap refill >2 seconds • For pediatric patients (aged <15 years), use heart rate <60 or >120 beats/min	<u>Accuracy (%)</u> <u>fraction of patients correctly classified as severely injured (need for emergency intervention*)</u> Current system: 21 (overall) Simplified system: 58 (overall), p<0.05 step 1) of the current system: 36 step 2) of the current system: 31 step 3) of the current system: 7 p<0.05 for step 1 or 2 vs step 3) *requiring an urgent procedure in the ED (intubation, tube thoracostomy, blood transfusion, resuscitative thoracotomy) and/or emergent transfer to the OR (laparotomy, craniotomy, vascular procedure, angioembolization) for a lifesaving procedure	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion** „Using a simplified triage system can safely reduce the rate of overtriage. This could conserve resources, reduce mistriage from misunderstood guidelines, and improve specificity by including only those variables with high predictive value."

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
only 4 highly predictive variables" **Setting** USA, 2007-2008		• Any of the above vital signs associated with signs and symptoms of shock AND/OR • Respiratory rate <10 or >29 breaths/min associated with evidence of distress AND/OR • Altered mental status (altered neuron examination results ranging from completely unconscious to responding to painful stimuli only, or a verbal response that is confused, or an abnormal motor response) Step 2) Assess anatomy of injury • Penetrating injury of head, neck, torso, groin OR • Combination of burns >20% or involving face or airway OR • Amputation above wrist or ankle OR • Spinal cord injury OR • Flail chest OR • ≥2 Obvious proximal long bone fractures Step 3) Assess biomechanics of injury and other risk factors • Death of same-car occupant OR • Ejection of patient from enclosed vehicle OR • Falls >20 feet OR • Pedestrian hit at >20 mph or thrown 15 feet • High energy transfer situation (rollover, motorcycle/all-terrain vehicle/bicycle accident, extrication time >20 minutes • Extremes of age, <15 or >60 years • Hostile environment (extremes of heat or cold)	Negative predictive value [Sensitivity according to the authors]**, % Current system: 99.6 Simplified system: 96 **The authors seem to have confuse sensitivity and negative predictive value. This is the negative predictive value, according to the description of their calculations. Positive predictive value [Specificity according to the authors]***, % Current system: 21 Simplified system: 58*** The authors seem to have confuse specificity and positive predictive value. This is the positive predictive value, according to the description of their calculations. Univariate analysis for association between individual criteria and need for urgent intervention Significant association for all step 1 criteria of the current system and all criteria of the simplified system (p<0.05) Penetrating truncal injury was the only criterion of level 2 and level 3 criteria with a significant association	**Reviewers' conclusion** This was a prospective single center study. Only few inclusion criteria and patient characteristics were reported. Results for regression analysis were only reported narratively without reporting any data. Missing information on the study population should also be kept in mind when interpreting the results. Negative predictive value [sensitivity according to the authors] and positive predictive value [specificity according to the authors] were extracted instead of over- and undertriage rates, because it was not possible to judge the appropriateness of the calculation technique due to missing information.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
		• Medical illness (chronic obstructive pulmonary disease, congestive heart failure, renal failure etc.) • Second or third trimester of pregnancy • Gut feeling of medic 2: simplified triage protocol using 4 variables • hypotension [<100 mm Hg in the field or ED] • mental status [GCS <14] • altered respirations • penetrating truncal wound		
Lin (2012) "Do pre-hospital trauma alert criteria predict the severity of injury and a need for an emergent surgical intervention?". *Injury* 2012; 43(9): 1381-5. **Study design** Prognostic cross-sectional study **Aim of the study** "to evaluate which pre-hospital parameters identify major trauma victims with an emphasis on a need for emergent surgical procedures" **Setting** USA, 2007	**Inclusion criteria** • patients admitted to a level one trauma center **Exclusion criteria** • age <15 y • thermal, chemical and electrical injuries • patients experiencing a cardiac arrest before any surgical procedure • transferals from another hospital • adequate prehospital data could not be obtained **Characteristics (overall)** Male gender, % 81.26 Age [y], mean ± SD 38.25 ± 18.43 Injury mechanism, %	**Participants** N=601 patients **(Potential) activation criteria** Category 1 (at least 1 criterion has to be fulfilled): • Airway: Active airway assistance beyond supplemental O_2 (N=40) • Consciousness: BMR <5, or paralysis, or suspicion of spinal cord injury, or loss of sensation, or GCS ≤12 (N=128) • Circulation: No radial pulse and sustained heart rate ≥120, or SBP ≤90 mmHg (N=63) • Fracture: 2 or more long bone fractures (humerus, radius, ulna, femur, tibia, fibula) (N=37) • Cutaneous: Deep penetrating injury to head, neck & torso, Amputation at or proximal to wrist or ankle (N=139) • Other: High index of suspicion (N=222)	Obvious overtriage* n/N (%) Category 1 airway: 0/40 (0) Category 1 consciousness: 16/128 (12.5) Category 1 circulation: 13/63 (20.6) Category 1 fracture: 3/37 (8.1) Category 1 cutaneous: 26/139 (18.7) Category 1 suspicion: 96/222 (43.2) Category 1 two or more criteria: 2/81 (2.5) Category 2 two or more criteria: 21/44 (47.7) *With N=patients meeting the activation criterion and with a hospital stay <24h and N=all patients meeting the activation criterion overtriage**, n/N (%) Category 1 airway: 6/40 (15) Category 1 consciousness: 38/128 (29.7) Category 1 circulation: 20/63 (31.7) Category 1 fracture: 11/37 (29.7) Category 1 cutaneous: 73/139 (52.5) Category 1 suspicion: 175/222 (78.8) Category 1 two or more criteria: 13/81 (16) Category 2 two or more criteria: 32/44 (72.7)	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "Overall, the set of trauma alert criteria system can be further simplified and enable better utilisation of resources." **Reviewers' conclusion** This is a prospective single center study. The study reports results for overtriage and relative risks for the prediction of several aspects of major trauma. Undertriage was not addressed within this study.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Blunt: 69.38 Penetrating: 30.62 ISS, mean ± SD 14.32 ± 13.71	• Two or more category 1 criteria fulfilled N=81 Category 2 (at least 2 criteria have to be fulfilled; N=44 overall): • Age: >55 years old • Airway: Respiratory rate ≥30 • Consciousness: BMR =5 Best motor response of the GCS • Circulation: Sustained heart rate = 120 bpm • Fracture: Any long bone fracture sustained in a motor vehicle collision or fall ≥10 feet • Cutaneous: Major degloving injury, or major flap avulsion >5 inches, or gunshot wound to the extremities Mechanism of injury: Ejection from a closed motor vehicle, or steering wheel deformity	**with n=patients meeting the activation criterion, but not meeting the following criteria: ISS 16 or greater, need an emergent surgery, need ICU care and N=all patients meeting the activation criterion Prediction of major trauma***, RR (95% CI) Category 1 airway: 9.54 (3.94–23.12) Category 1 consciousness: 3.00 (1.98–4.53) Category 1 circulation: 4.60 (2.67–7.94) Category 1 fracture: 3.94 (1.92–8.11) Category 1 cutaneous: not significant Category 1 suspicion: not significant Category 1 two or more criteria: 10.31 (5.54–19.18) Category 2 two or more criteria: not significant ***Patients were classified as major trauma victims when their calculated ISS was 16 or greater, when they needed an emergent surgery and when they needed ICU care. Prediction of ISS ≥25, RR (95% CI) Category 1 airway: 11.02 (5.42–22.43) Category 1 consciousness: 6.97 (4.49–10.81) Category 1 circulation: 5.23 (3.12-8.75) Category 1 fracture: 2.35 (1.18-4.69) Category 1 cutaneous: not significant Category 1 suspicion: not significant Category 1 two or more criteria: 13.81 (7.98-23.91) Category 2 two or more criteria: not significant Prediction of emergent operation, RR (95% CI) Category 1 airway: 6.11 (2.73–13.71) Category 1 consciousness: 4.43 (2.28–8.58) Category 1 circulation: 11.69 (5.85–23.36) Category 1 fracture: 3.01 (1.18–7.71) Category 1 cutaneous: 3.92 (2.03–7.58)	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Category 1 suspicion: / Category 1 two or more criteria: 12.49 (6.24–24.99) Category 2 two or more criteria: /	
Matsushima (2016) "Should we still use motor vehicle intrusion as a sole triage criterion for the use of trauma center resources?". *Injury* 2016; 47(1): 235-8. **Study design** Prognostic cross-sectional study (Los Angeles County Trauma and Emergency Medicine Information System Trauma database) **Aim of the study** "to assess the validity of MVI [motor vehicle intrusion] with no other criterion in field triage following motor vehicle collision" **Setting** USA, 2002-2012	**Inclusion criteria** • patients involved in a motor vehicle accident • with associated motor vehicle intrusion **Exclusion criteria** • other trauma center triage criteria than motor vehicle intrusion **Characteristics** <u>Male gender, n (%)</u> ≤18 y: 271 (55.0) 19-64y: 1825 (56.7) ≥65: 163 (56.6), p=0.76 <u>Field SBP, median (IQR)</u> ≤18 y: 126 (24) 19-64y: 133 (27) ≥65y: 150 (35), p<0.001 <u>Field heart rate, median (IQR)</u> ≤18 y: 100 (20) 19-64y: 96 (23) ≥65y: 90 (20), p<0.001 <u>GCS <9 in Emergency Room, n (%)</u> ≤18 y: 0 (0) 19-64y: 4 (0.1) ≥65y: 0 (0), p=1.00 <u>Shoulder belt, n (%)</u>	**Participants** N=3998 patients overall; N=n.r. patients ≤18y old; N=n.r. patients 19-64y old N=n.r. patients ≥65y old **(Potential) activation criteria** Motor Vehicle Intrusion and one of the following: • Age ≥65 (N=288) • Male gender (N=2259) • Airbag not deployed (N=300) • Seatbelt (N=3254) • HR>100 (N=1175) • SBP<110 (N=251) **Variables included in logistic regression** n.r.	**Adjusted outcomes** <u>Logistic regression model for need of trauma center resource*, OR (95% CI)</u> Age ≥65: 3.36 (2.57 to 4.40), p<0.001 Male gender: 1.23 (1.02 to 1.48), p=0.03 Airbag not deployed: 1.13 (0.94 to 1.37), p=0.20 Seatbelt: 0.84 (0.66 to 1.06), p=0.15 HR >100: 1.37 (1.13 to 1.66), p=0.001 SBP <110: 2.41 (1.78 to 3.27), p<0.001 **Unadjusted outcomes** <u>In-hospital mortality, n (%)</u> <18 y: 0 (0) 19-64y: 10 (0.3) ≥65: 9 (3.1), p<0.001 <u>Intubation in Emergency room, n (%)</u> <18 y: 9 (1.8) 19-64y: 79 (2.5) ≥65: 8 (2.8), p=0.63 <u>Discharge from Emergency room, n (%)</u> <18 y: 284 (57.6) 19-64y: 1630 (50.7) ≥65: 86 (29.9), p<0.001 <u>ISS>15, n (%)</u>	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "Overall, MVI as a sole field triage criterion results in excessive overtriage. However, patients with additional risk factors including age, gender, or field vital signs might still need to be transported to the designated trauma centers" **Reviewers' conclusion** With regard to the study's aim, there seem to be no major limitations for adjusted outcomes. However, variables included in logistic regression were not reported. When interpreting unadjusted results, one should keep in mind that population characteristics varied significantly between age groups and that the youngest age group (≤18y) probably includes

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	≤18 y: 363 (73.6) 19-64y: 2640 (82.1) ≥65y:251 (87.2), p<0.001 Airbag not deployed, n (%) ≤18 y: 56 (11.4) 19-64y: 224 (7) ≥65y: 20 (6.9), p=0.002		<18 y: 46 (9.5) 19-64y: 278 (8.7) ≥65: 58 (20.2), p<0.001 LOS, median (IQR) <18 y: 2 (1) 19-64y: 2(2) ≥65: 3 (5), p<0.001 ICU admission, n (%) <18 y: 44 (8.9) 19-64y: 353 (11) ≥65: 89 (30.9), p<0.001 ICU LOS, median (IQR) <18 y: 2.5 (2) 19-64y: 3 (2) ≥65: 3 (5), p=0.008 Need for trauma center resource* <18 y: 53 (10.8) 19-64y: 435 (13.5) ≥65: 92 (31.8), p<0.001 *defined as: 1) intubation in the ER, 2) non-orthopedic surgical procedures (thoracic, abdominal, vascular, neurosurgical, obstetrics/gynecological, and neurosurgical), 3) ICU admission, and 4) in-hospital mortality	patients below the age of 14y.
Shawhan (2015) "A simplified trauma triage system safely reduces overtriage and improves provider satisfaction: a prospective study". *Am J Surg* 2015; 209(5): 856-62.	**Inclusion criteria** • Trauma patients who presented to the trauma center • Age >16 y **Exclusion criteria** n.r.	**Participants** N=460 patients **Activation criteria** Level 1 (N=89): • Hypotension (SBP ≤90) or age appropriate hypotension for pediatrics	**Accuracy, n/N (%)** fraction of patients correctly classified as severely injured (patients requiring ICU admission), with N=all patients meeting the activation level Level 1: 56/89 (63) Level 2: 26/146 (18) Level 3: n.r.	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Study design Prognostic cross-sectional study **Aim of the study** "to prospectively analyze the safety, efficacy, and surgeon satisfaction with the newly introduced triage system." **Setting** USA, 2010-2013	**Characteristics*** Age [y], mean ± SD Level 1: 37.1 ± 18.2 Level 2: 40.4 6 21.8 Male gender, n (%) Level 1: 61 (68) Level 2: 86 (58%) Blunt mechanism, n (%) Level 1: 72 (81) Level 2: 134 (92) Field GCS, mean ± SD Level 1: 11.1 ± 4.5 Level 2: 14.4 ± 1.2 ISS, mean ± SD Level 1: 13.7 ± 12.2 Level 2: 5.7 ± 6.9 Field heart rate, mean ± SD Level 1: 95.3 ± 28.0 Level 2: 98.1 ± 18.6 Field SBP, mean ± SD Level 1: 131.0 ± 34.9 Level 2: 135 ± 28.3*not reported for Level 3	• GCS <13 currently • Penetrating wound to neck, chest, or abdomen • Altered respirations or intubated in field • Proximal extremity amputation • Multiple severely injured patients incoming Level 2 (N=146): • GCS 13-14 • Pulse >120 (or age appropriate tachycardia for pediatrics) • Mangled extremity or distal amputations • Age >65 + mechanism (excludes ground level falls) • Neurologic deficit (paralysis, suspected spinal cord injury) • Burns >20% BSA or inhalation • Multiple long bone fractures or mangled extremity • Flail chest • Peritonitis on abdominal exam • Pregnancy Level 3/trauma consultation (N=225): • All other traumatic mechanisms • GCS 15 and normal vital signs	fraction of patients correctly classified as severely injured (requiring urgent intervention), with N=all patients meeting the activation level Any intervention Level 1: 50/89 (56) Level 2: 8/146 (5) Level 3: 7/225 (3) Intubation Level 1: 28/89 (31) Level 2: 1/146 (0.7) Level 3: 4/225 (1.8) Surgical airway Level 1: 1/89 (1) Level 2: 0/146 (0) Level 3: 0/225 (0) Chest tube Level 1: 14/89 (16) Level 2: 2/146 (1) Level 3: 1/225 (0.4) Central line Level 1: 11/89 (12) Level 2: 2/146 (1) Level 3: 0/225 (0) Blood products Level 1: 12/89 (13) Level 2: 5/146 (3) Level 3: 1/225 (0.4) Cardiopulmonary resuscitation	n.r. for comparison of interest **Reviewers' conclusion** This was a prospective single center study. The low number of patients for some outcomes to be predicted should be kept in mind when interpreting the results for individual TTA criteria. Data for the predictive value of level 3 activation criteria for ICU admission are missing.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Level 1: 5/89 (6) Level 2: 0/146 (0) Level 3: 0/225 (0) Urgent surgery Level 1: 12/89 (13) Level 2: 1/146 (0.7) Level 3: 2/225 (0.9)	
Singh (2014) "Correlation of Shock Index and Modified Shock Index with the Outcome of Adult Trauma Patients: A Prospective Study of 9860 Patients". *N Am J Med* 2014; 6(9): 450-2. **Study design** Prognostic cross-sectional study **Aim of the study** **"**to evaluate the predictive value of shock index (SI) and modified shock index (MSI) for hospital mortality among adult trauma patients." **Setting** India, 2013	**Inclusion criteria** • Adult patients • With trauma • Presenting to the Emergency Room **Exclusion criteria** • Referrals from another hospital after the first aid • death within the first six hours of arrival • patients <18 y • incomplete data **Characteristics (overall)** <u>Age [y], mean ± SD</u> 39 ± 11 <u>Male gender, %</u> 63 <u>HR [beats/minute], mean ± SD</u> 103 ± 17 <u>SBP [mmHg], mean ± SD</u> 126 ± 19 <u>DBP [mmHg], mean ± SD</u>	**Participants** N=9860 patients **(Potential) activation criteria** • Heart rate >120 • SBP <90 mmHg • Diastolic blood pressure <60 mmHg • Shock index (heart rate/SBP)<0.5 • Shock index (heart rate/SBP)>0.9 • Modified shock index (heart rate/mean arterial pressure) <0.7 • Modified shock index (heart rate/mean arterial pressure) >1.3 **Criteria included in logistic regression** • Heart rate • SBP • Diastolic blood pressure • Shock index • Modified shock index	<u>Prediction of mortality based on logistic regression, OR (95% CI)</u> HR >120: 2.5 (1.7 to 3.3) SBP <90: 2.6 (1.9 to 3.4) DBP <60: 1.9 (1.4 to 2.3) SI <0.5: 1.3 (0.8 to 1.6) SI >0.9: 1.1 (0.7 to 1.7) MSI <0.7: 3.5 (2.1 to 6.9) MSI >1.3: 4.5 (2.9 to 6.6)	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "MSI, as a potential marker for predicting the mortality rate and is significantly better than HR, SBP, diastolic blood pressure, and SI alone. Thus, MSI emerges as a better and improved predictor for prediction of hospital mortality in adult trauma patients in the emergency room" **Reviewers' conclusion** This was a prospective single center study. When interpreting the results, one should keep in mind that high number of patients (14.2%) where excluded

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	69 ± 15 SI, mean ± SD 0.69 ± 0.23 MSI, mean ± SD 1.08 ± 0.20			due to missing data. Moreover, 249 patients were excluded, because of death within six hours of hospital arrival. Clinical data (eg, heart rate, SBP) were collected at the time of admission and then hourly. Furthermore, MSI and SI were calculated at six hours. This might limit transferability of results to pre-clinical settings. Results on the predefined endpoints ICU stay and hospital stay are missing.
St. John (2018) "Prehospital Lactate Predicts Need for Resuscitative Care in Non-hypotensive Trauma Patients". *West J Med* 2018; 19(2): 224. **Study design** Secondary analysis of a prognostic cross-sectional study **Aim of the study** "to determine the test characteristics of prehospital lactate levels for predicting need for resuscitative care among a broad population of nor-	**Inclusion criteria** • patients who received intravenous access • and were transported to a Level I trauma center • valid prehospital lactate measurement **Exclusion criteria** • prehospital systolic blood pressure ≤100 mmHg • age <15 years • obvious isolated, penetrating head trauma • drowning • asphyxia caused by hanging • burns >20% body surface area • known prisoner status **Characteristics (overall)** Age [y], median (IQR)	**Participants** N=314 patients **(Potential) activation criteria** • Prehospital lactate • Shock index (heart rate/SBP) **Variables included in multivariable logistic regression** n.r.	**Adjusted outcomes** Logistic regression analysis for need for resuscitative care*, OR (95% CI) Prehospital lactate**: 1 mmol/L difference in prehospital lactate within the range of <2.5: 1.29 (0.40 – 4.12), p=0.666 1 mmol/L difference in prehospital lactate within the range of 2.5-4.0: 2.27 (1.10 – 4.68), p=0.027 1 mmol/L difference in prehospital lactate within the range of ≥4.0: 1.26 (1.05 – 1.50), p=0.011 **Unadjusted outcomes** AUROC for need for resuscitative care*, % (95% CI) Prehospital lactate 0.716 ([0.632 – 0.800) Shock index 0.631 (0.537 – 0.724), p=0.125	**Level of evidence** 3b↓ **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "In conjunction with previous studies on prehospital lactate in trauma patients, these findings suggest that prehospital lactate could improve overall triage for ALS patients, and we suggest that it should be investigated prospectively as a rapid test in the field to identify occult shock" **Reviewers' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
motensive trauma patients being transported by ground ALS units" **Setting** North America, 2011-2012	35.5 (25-51) Male, n (%) 228 (72.6) Mechanism of injury, n (%) Blunt 260 (82.8 Penetrating 54 (17.2) ISS, median (IQR) 9 (5-19)		Sensitivity for need for resuscitative care*, % (95% CI) Prehospital lactate level ≥2.5 mmol/L: 74.6 Prehospital lactate level ≥3.0 mmol/L: 70.9 Shock index ≥0.9: 30.8 Either prehospital lactate level ≥2.5 mmol/L or shock index ≥0.9: 77.6 Specificity for need for resuscitative care*, % (95% CI) Prehospital lactate level ≥2.5 mmol/L: 53.4 Prehospital lactate level ≥3.0 mmol/L: 66.9 Shock index ≥0.9: 89.9 Either prehospital lactate level ≥2.5 mmol/L or shock index ≥0.9: 49.8 *need for resuscitative care defined as either • death in the ED • disposition to operating room or interventional radiology within six hours • receipt of five units of blood within six hours of ED arrival. **a multivariate logistic regression was performed that included need for resuscitative care as its outcome and a linear spline of lactate with knots at 2.5 and 4 mmol/L as the predictor of interest.	The study was downgraded, because it was a secondary analysis. The authors stated that the impact of inclusion of prehospital lactate into any triage protocol would need to be investigated prospectively before it could be recommended for implementation.
Tignanelli (2018) "Noncompliance with American College of Surgeons Committee on	**Inclusion criteria** • Age ≥16 y • ISS ≥5 • At least one valid trauma International Classification of Diseases, 9th Revision,	**Participants** N=51,792 patients **Prognostic part**	Prognostic part Accuracy, n/N (%) fraction of correctly classified as severely injured (need for emergent intervention* and meeting	**Level of evidence** 2b **Risk of bias** Prognostic part:

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Trauma recommended criteria for full trauma team activation is associated with undertriage deaths". *J Trauma Acute Care Surg* 2018; 84(2): 287-294. **Study design** Prognostic cross-sectional study and comparative registry study (Michigan Trauma Quality Improvement Program) **Aim of the study** "we examined the compliance rate of ACS-COT–verified Level I and II trauma centers in Michigan with the ACS-6 triage criteria. We evaluated the association of these criteria with trauma patient mortality and rates of emergent intervention." **Setting** USA, 2014-2016	Clinical Modification code in the range of 800 to 959.9 • Primary mechanism of injury classified as either blunt or penetrating • ED discharge disposition and hospital discharge disposition known **Exclusion criteria** • Patients directly admitted • Missing data • no signs of life at initial evaluation (ED SBP, 0; pulse, 0; GCS score, 3) • late effects (905–909.9) • superficial injuries (910–924.9) • foreign bodies (930–930.9) **Characteristics** <u>Age 18-25 [y], %</u> 1: 14 2: 21 3: 40 4: 22 5: 24 6: 10 <u>Age 26-45 [y], %</u> 1: 22 2: 29 3: 44 4: 29 5: 31 6: 16 <u>Age 46-65 [y], %</u> 1: 32 2: 28 3: 13	**<u>(Potential) activation criteria</u>** 1: SBP ≤90 mmHg (N=1346) 2: Intubation (N=3459) 3: Central gunshot wound (N=1931) 4: GCS <9 (N=2475) 5: Any ACS-6 criterion including the 4 mentioned above + Transfer patients from other hospitals receiving blood to maintain vital signs & emergency physician's discretion (N=6080) Cave: It remains unclear, whether N=6080 includes all ACS-6 criteria or only criteria 1-4. 6: no ACS-6 criterion (N=45712) **Intervention comparison** N=1130 patients with full activation N=243 patients with partial activation N=379 patients with trauma consult only N=382 with no activation "Data collected reflect the highest tier of activation status and account for activation upgrades."	<u>the activation criterion), with N=all patients meeting the activation criterion, n/N (%)</u> 1: 848/1346 (63) 2: 3459/3459 (100) 3: 1285/1931 (67) 4: 2271/2475 (92) 5: 4781/6080 (79) 6: 6746/45712 (15) * defined as receiving one or more of the following: transfusion of greater than four units of blood within 4 hours of arrival, emergent central line insertion, emergent operation, emergent angiography, emergent intubation, emergent chest tube placement, or placement of a cerebral monitor. <u>Undertriage, n/N (%)**</u> 1: 157/1346 (12) 2: 514/3459 (15) 3: 42/1931 (2.2) 4: 274/2475 (11) 5: 728/6080 (12) 6: 5572/45712 (12) **major trauma (ISS >15) but no full TTA (due to non-compliance with the proposed activation criteria) <u>Mortality in the undertriaged population, n/N (%)</u> 1: 24/157 (15) 2: 179/514 (35) 3: 10/42 (24) 4: 130/274 (47) 5: 217/728 (30) 6: 216/5572 (4) **Intervention comparison**	no tool available for prognostic studies <u>Intervention comparison:</u> Selection bias: – Performance bias: ? Attrition bias: + Detection bias: ? **Authors' conclusion** n.r. for comparison of interest **Reviewers' conclusion** <u>Prognostic part:</u> Two out of 6 criteria (Transfer patients from other hospitals receiving blood to maintain vital signs & emergency physician's discretion) proposed by the American College of Surgeons Committee on Trauma could not be identified in the available database. Therefore, it remains unclear, whether criterion 5 includes all 6 ACS-criteria in an aggregated form or only criteria 1-4. This might have an impact on the results for criterion 5 and 6. When interpreting the undertriage rate and mortality in the undertriaged population one should keep in mind

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	4: 27 5: 25 6: 25 Age 66-75 [y], % 1: 12 2: 10 3: 2 4: 9 5: 8 6: 14 Age >75 [y], % 1: 20 2: 13 3: 1 4: 13 5: 12 6: 35 Male gender, % 1: 64 2: 74 3: 88 4: 73 5: 75 6: 53 GCS score 14-15, % 1: 66 2: 19 3: 77 4: 0 5: 45 6: 88 GCS score 9-13, %		Mortality for SBP ≤90 mmHg stratified for activation levels, n/N (%) Full activation:208/NR (30) Partial activation: 15/NR (6) trauma consult only: 24/NR (11) no activation: 18/NR (10) Mortality for intubation stratified for activation levels, n/N (%) Full activation: 915/NR (35) Partial activation: 96/ NR (19) trauma consult only: 82/NR (35) no activation: 47/NR (39) Mortality for Central gunshot wound stratified for activation levels, n/N (%) Full activation: 278/NR (19) Partial activation: 0/NR (0) trauma consult: 11/NR (11) no activation: 3/NR (5) Mortality for GCS<9 stratified for activation levels, n/N (%) Full activation: 852/NR (42) Partial activation: 54/NR (25) trauma consult: 67/NR (49) no activation: 36/NR (41) Mortality for any ACS-6 criterion stratified for activation levels, n/N (%) Full activation: 1057/NR (26) Partial activation: 110/NR (10) trauma consult: 119/NR (21) no activation: 72/NR (19)	that these patients did not receive full TTA due to non-compliance with the proposed activation criteria. Intervention comparison: There is a high risk of selection bias. The risk of bias remains unclear for this part of the study due to lack of information.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	1: 9 2: 15 3: 5 4: 0 5: 10 6: 3 GCS score 3-8, % 1: 21 2: 61 3: 15 4: 100 5: 41 6: 0 ISS 5-15, % 1: 52 2: 27 3: 62 4: 24 5: 45 6: 86 ISS 16-24, % 1: 21 2: 24 3: 18 4: 22 5: 21 6: 11 ISS 25-35, % 1: 17 2: 36 3: 18 4: 38 5: 26 6: 3		Mortality for no ACS-6 criterion stratified for activation levels, n/N (%) Full activation: 73/NR (3) Partial activation: 133/NR (1) trauma consult: 260/NR (2) no activation: 310/NR (2)	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	ISS >35, % 1: 11 2: 13 3: 2 4: 16 5: 9 6: 0.3 ED SBP≥91 [mmHg], % 1: 0 2: 84 3: 86 4: 83 5: 75 6: 97 ED SBP 61-90 [mmHg], % 1: 83 2: 9 3: 8 4: 8 5: 18 6: 0 ED SBP≤[mmHg], % 1: 17 2: 3 3: 3 4: 3 5: 4 6: 0			
Werman (2011) "Development of Statewide Geriatric Pa-	**Inclusion criteria** n.r. **Exclusion criteria** n.r.	**Participants** N=90,597 overall; N=n.r. for geriatrics (>70 y); N=n.r. for adults (16-69 y)	Prediction of mortality by different GCS levels % (95% CI) GCS 13: Geriatrics: 14.4 (11.1 to 18.5) Adults: 3.9 (2.8 to 5.0)	**Level of evidence** 3b↓ **Risk of bias**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
tients Trauma Triage Criteria". Prehosp Disaster Med 2011; 26(3): 170-179. **Study design** Prognostic cross-sectional study (Ohio Trauma Registry) **Aim of the study** "describes the development of geriatric- specific field destination criteria for the state of Ohio" **Setting** USA, 2003-2006	**Characteristics** n.r.	**(Potential) activation criteria** 1: GCS 2: SBP 3: falls associated with head, chest, abdominal or spinal injury 4: pedestrian struck 5: multiple body regions injured 6: motor vehicle collision with humerus/femur fracture	Geriatrics with a GCS=14 vs. adults with GCS=13, RR (95% CI): 1.65 (1.14–2.40),p=0.01 → "the Task Force recommended that a GCS of 14 or less for an elderly patient be used as a criterion for transport to a trauma center […] an additional qualifier was added to suggest that there must be some evidence of recent head trauma for triage to a trauma center." <u>Prediction of mortality by different SBP levels, % (95% CI)</u> SBP 81–90 mmHg: Geriatrics: 19.2 (15.1 to 23.2) Adults: 12.0 (10.1 to 14.0) Geriatrics with SBP 91–100 vs. adults with SBP of 81–90 mmHg, RR (95% CI) 0.98 (0.73–1.32),p=0.89 Geriatrics with SBP101–110 vs. adults with SBP81–90 mmHg, RR (95% CI) 0.69 (0.53–0.90),p=0.005 →"the Task Force proposed that elderly trauma patients with a SBP of <100 mmHg be evaluated in a trauma center." <u>Prediction of mortality for falls with traumatic brain injury, OR (95% CI)</u> 2.12 (1.88 to 2.39), p<0.001 <u>Prediction of mortality for falls with traumatic chest injury, OR (95% CI)</u> 1.22 (0.99 to 1.52), p=0.056 <u>Prediction of mortality for falls with traumatic pelvic/abdominal injury, OR (95% CI)</u>	no tool available for prognostic studies **Authors' conclusion** "As a result of this analysis, the Task Force recommended additional geriatric-specific criteria that are listed in Table 6. These include an increase in both the GCS score and SBP used to determine field destination for geriatric patients, as well as the addition of single long-bone fracture in motor vehicle collision and pedestrian struck as definitive destination criteria. These criteria represent changes or additions to the existing criteria for other adult trauma patients" **Reviewers' conclusion** The study was downgraded, because no inclusion and exclusion and no patient characteristics were provided. The authors state that the generalizability to other settings might be limited. Only results for mortality were reported even though the authors state they found conflicting findings for the adult and geriatric populations when total length of stay, ICU

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			0.98 (0.73 to 1.31), p=0.865 Prediction of mortality for falls with traumatic spinal cord injury, OR (95% CI) 1.22 (0.99 to 1.52), p=0.056 →"The Task Force proposed […] that geriatric trauma patients with falls and evidence of traumatic brain injury (regardless of GCS score) should be triaged to a trauma center." Prediction of mortality for pedestrian struck, OR (95% CI 2.39 (1.77 to 3.21), p=0.001 →"The Task Force proposed that geriatric pedestrians who are struck by a moving vehicle be triaged to a trauma center." Prediction of mortality for multiple body regions injured, OR (95% CI 1.29 (1.06 to 1.57), p=0.01 →"it was recommended that geriatric patients with injuries to more than one body system be included in the revised field destination guidelines and ultimately would be assessed in a trauma center." Prediction of mortality motor vehicle collision with humerus/femur fracture, OR (95% CI 2.41 (1.81 to 3.21), p=0.001 →"the presence of any proximal long-bone fracture following motor vehicle trauma would require an evaluation in a trauma center in the proposed triage scheme."	length of stay, and number of complications were investigated.

+: low risk; –: high risk; ?: unclear risk
ACS: American College of Surgeons Committee on Trauma; adj.: adjusted; AIC: Akaike information criterion; AIS: Abbreviated Injury Scale; AUROC: area under the ROC curve; BMR: Best motor response

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Activation criteria	Main outcomes	Assessment: LoE, risk of bias; Conclusions
of the GCS; bpm: beats per minute; BSA: body surface area; CI: Confidence Interval; d: days; DBP: Diastolic Blood Pressure; ED: Emergency Room; EMS: Emergency Medical Service; ER: Emergency Room; GCS: Glasgow Coma Scale; h: hours; HR: Hazard Ratio; HR: Heart Rate; ICU: Intensive Care Unit; IQR: Interquartile Range; ISS: Injury Severity Score; ITT: Intention to Treat; LOS: Length of Stay; m: months; MOI: Mechanism of Injury; MSI: Modified Shock Index; MVI: Motor Vehicle Injury; n.r.: not reported; NTTP: National Trauma Triage Protocol; OR: Odds Ratio; PR: pulse rate; RBC: Red Blood Cells; ROC: receiver operating characteristic; RPBC: Red Packed Blood Cells; RR: Relative Risk; RR: respiratory rate; SBP: Systolic Blood Pressure; SD: Standard Deviation; SEM: Standard Error of Mean; SI: Shock Index; TARN: Trauma Audit and Research Network; TTA: Trauma Team Activation; y: years;				

Polytraumaversorgung: Teams / Training

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention group (IG) vs. control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Daurka (2015) "A priority driven ABC approach to the emergency management of high energy pelvic trauma improves decision making in simulated patient scenarios". Injury 2015; 46(2): 340-3. **Study design** RCT **Aim of the study** "to assess whether trainees taught this ABC initialled aide memoire gave better priority driven care in simulated patient scenarios. They were compared directly to their colleagues that underwent the same pelvic training	**Inclusion criteria** • orthopaedic trainees • belonging to the same deanery teaching group with similar levels of training and experience in pelvic trauma **Exclusion criteria** • Those completing a post with a strong element of pelvic trauma or previously completed a pelvic trauma training course **Characteristics** Year of training, mean IG: 4.4 CG: 4.9, p=0.426 Number of high energy pelvic cases treated, mean IG: 3 CG: 1.4, p=0.347	**Participants** N=20 trainees **Study groups** IG: pelvic training afternoon (1h presentation of the principles of pelvic trauma patient management including classification, associated injuries, early and definitive management led by two experienced pelvic and acetabular surgeons)+ 5 slides covering the ABC concept (N=11) CG: pelvic training afternoon only (N=9)	Improved responses in assessment and management of possible coagulopathy*, % IG: 55 CG: 0, p<0.001 Improved responses in assessment and management of possible urological pathology*, % IG: 97 CG: 78, p=0.047 Improved responses in assessment and management of possible bowel injury/open fracture*, % IG: 60 CG: 26, p=0.007 improved responses for resuscitation*, % IG: 78 CG: 74, p=0.67 Improved responses for blood and blood products and in the initiation of antimicrobial therapy*, % IG: 33 CG: 15, p=0.09 Improved responses for CT scanning*, %	**Level of evidence** 2b↓ **Risk of bias** Selection bias: ? Performance bias: + Attrition bias: + Detection bias: + **Authors' conclusion** "This study has demonstrated that using an initialled ABC acronym as a teaching method improves both clinician's recall and prioritisation when discussing pelvic trauma in examination scenarios" **Reviewers' conclusion** This was an RCT which was downgraded because of a

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention group (IG) vs. control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
but without reference to the ABC concept." **Setting** UK, n.r.			IG: 45 CG: 81, p=0.004 <u>Number of appropriately prioritised management plans*, %</u> IG: 78 CG: 44, p=0.006 *assessed after 6 weeks using viva scenarios of pelvic trauma	small sample size. The outcomes were measured after 6 weeks. The study did not account for long term outcomes. The authors do not refer to a study protocol.
+: low risk; –: high risk; ?: unclear risk CG: Comparison group; CT: computed tomography; h: hours; IG: Intervention group; RCT: randomised controlled trial				

2.3 Reanimation

Thorakotomie

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Suzuki (2016) "Comparative Effectiveness of Emergency Resuscitative Thoracotomy versus Closed Chest Compressions among Patients with Critical Blunt Trauma: A Nationwide Cohort Study in Japan". *PLoS One* 2016; 11(1): e0145963. **Study design** Comparative registry study (Japan Trauma Data Bank)	**Inclusion criteria** • Patients that underwent ERT, defined as thoracotomy conducted within 24 h of ED arrival • Or received CCC **Exclusion criteria** • Patients with cardiac arrest and loss of signs of life on ED arrival, • without blunt trauma, • who underwent ERT more than 24 h after ED arrival, • who underwent ERT at the accident site • those with incomplete data	**Participants** N=1,377 patients **Study groups** IG: emergency resuscitative thoracotomy (ERT). The ERT group consisted of all patients who underwent ERT within 24h regardless of receiving prior closed-chest compressions (CCC) (N=484) CG: CCC group consisted of patients who only received CCC during resuscitation (N=893) **Regression analysis**	<u>Unadj. 24h survival: n (%)</u> IG: 22 (4.5) vs. CG: 156 (17.5), p<0.001 <u>Unadj. survival to discharge: n (%)</u> IG: 9 (2) vs. CG: 84 (9), p<0.001 <u>Unadj. 28d survival: n (%)</u> IG: 6 (1.2) vs. CG: 54 (6), p<0.001 <u>Adj. 24h survival: OR (95% CI):</u> 3.78 (1.77–8.08), p<0.001 **Sensitivity analysis with propensity score matched dataset (N=852)**	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Emergency resuscitative thoracotomy was independently associated with

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Aim of the study "The overall aim of this study was to test the hypothesis that emergency resuscitative thoracotomy (ERT) is associated with favorable outcomes among critical blunt trauma patients by evaluating its effectiveness compared to that of manual closed-chest compressions (CCC), a conventional method of cardiopulmonary resuscitation." **Setting** Japan, 2004-2012	**Characteristics (before adjustments)** Age [y], mean ± SD IG: 53 ± 22 vs. CG: 59 ± 23, p<0.001 Male, n (%) IG: 345 (71) vs. CG: 576 (65), p=0.011 Pre-hospital cardiopulmonary resuscitation, n (%) IG: 38 (7.9) vs. CG: 106 (11.8), p=0.021 Systolic blood pressure [mmHg], mean ± SD IG: 76 ± 37 vs. CG: 91 ± 43, p<0.001 Heat rate [bpm], mean ± SD IG: 106 ± 37 vs. CG: 99 ± 34, p<0.001 Respiratory rate [breaths/min], mean ± SD IG: 24 ± 14 vs. CG: 21 ± 13, p<0.001 ISS, mean ± SD IG: 38.4 ± 15.3 vs. CG: 34.9 ± 16.0, p<0.001 GCS, mean ± SD IG: 7.1 ± 4.3 vs. CG: 6.6 ± 4.4, p=0.053 FAST, positive, n (%) IG: 252 (52) vs. CG: 218 (24), p<0.001 FAST, negative, n (%) IG: 184 (38) vs. CG: 533 (60) Received blood transfusions, n (%) IG: 409 (85) vs. CG: 509 (57), p<0.001	Regression adjustment was used for the primary analysis, where potential confounders (covariates) were simultaneously included with the ERT or CCC variables in multivariable generalized mixed effects regression analysis. Covariates were selected a priori based on factors associated with mortality within a permissible number computed using the 10 events per variable rule.	Adj. 24h survival: OR (95% CI): 2.83 (1.57–5.12), p<0.001 **CAVE**: The ORs were probably calculated for mortality instead of survival considering the raw numbers and conclusion.	decreased odds of a favorable survival rate compared to closed-chest compressions." **Reviewers' conclusion** There might be a risk for performance bias because of co-interventions and unmasking. The intervention and control groups were not balanced with respect to several important baseline characteristics and co-interventions. However, the analyses were adjusted for this imbalance as subgroup analyses have shown. When interpreting the study, one should keep in mind that the indications for thoracotomy are unclear.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Intra-aortic balloon occlusion, n (%) IG: 85 (17.6) vs. CG: 99 (11.1), p=0.001 Resuscitative endovascular balloon occlusion of the aorta, n (%) IG: 212 (43.8) vs. CG: 9 (1.0), p<0.001			
Yamamoto (2020) "Resuscitative endovascular balloon occlusion of the aorta and traumatic out-of-hospital cardiac arrest: A nationwide study." *Journal of the American College of Emergency Physicians Open* 2020: *1*(4): 624-632. **Study design** Comparative registry study (Japan Trauma Data Bank) **Aim of the study** "To eventually ascertain whether REBOA might be a therapeutic option during the resuscitation of t-OHCA in a prospective study, we used a Japanese nationwide trauma database to examine the clinical outcomes of trauma victims with OHCA who had received aortic occlusion by RT or REBOA"	**Inclusion criteria** • patients with t-OHCA • aged 15 years or older • arrived without a palpable pulse and with GCS score of 3 • and received aortic occlusion by either cross-clamping through RT or REBOA **Exclusion criteria** • Patients with missing or invalid data on inhospital survival or transportation time • Patients with missing covariates were excluded from the propensity score calculation **Characteristics (after matching)** Age [y], median (IQR), standardized difference IG: 53 (30) vs. CG: 53 (33), 0.080 Male, n (%), standardized difference IG: 903 (69.2) vs. CG: 928 (69.1), 0.002 ISS, median (IQR), standardized difference IG: 36 (29) vs. CG: 38 (45), 0.120 Blunt injury, n (%), standardized difference	**Participants** N=1,342 in inverse probability analysis of 1,483 patients in analyses **Study groups** IG: resuscitative endovascular balloon occlusion of the aorta (N=129) CG: resuscitative thoracotomy (N=1,213) **Matching criteria for inverse probability weighting** • age, • sex, • mechanism of injury, • severity of injuries (Injury Severity Score), • presence of severe head and/or chest injury, • presence of signs of life at scene and/or on hospital arrival, • and transportation time	**Survival to discharge** Unadj. survival to discharge, n/N (%) IG: 5/144 (3.5) vs. CG: 10/1339 (0.7) Adj. survival to discharge, % (95% CI) IG: 3.0 (2.1–3.9) vs. CG: 0.8 (0.3–1.3), p<0.001 OR (95% CI): 3.73 (1.90–7.32) **Hospital-free days to 90 days** Unadj. Hospital-free days to 90 days, mean, median (IQR) IG: 1.3, 0(0) vs. 0.6, 0(0) Adj. hospital-free day to 90 days, mean, median (IQR) IG: 1.1, 0(0) vs. CG: 0.7, 0(0) OR (95% CI): 1.3 0.6–2.0	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "In summary, in patients with t-OHCA, REBOA was associated with improved survival to discharge instead of cross-clamping the aorta through RT." **Reviewers' conclusion** There might be a risk for performance bias because of unknown blinding. When interpreting results, one should be aware on a quite large proportion of patients excluded for missing data. **CAVE**: Patients that received both REBOA and resuscitative thoracotomy,

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Setting Japan, 2004-2019	IG: 122 (9.3) vs. CG: 112 (8.3), 0.036 <u>Signs of life at scene, n (%)</u> IG: 958 (73.4) vs. CG: 1,001 (74.5), 0.026 <u>Signs of life on arrival, n (%)</u> IG: 1,277 (97.9) vs. CG: 1,314 (97.8), 0.001			were included in IG or CG depending on the first treatment received. **Note**: The study is also included in chapter 2.17.
+: low risk; –: high risk; ?: unclear risk; CG: Control group; CI: Confidence Interval; IQR: Interquartile Range; IG: Intervention group; OR: Odds Ratio; RR: Relative Risk; SD: Standard Deviation; SEM: Standard Error of the Mean; adj.: adjusted; bpm: beats per minute; h: hours; d: days; m: months; y: years; ALS: advanced life support; CCC: closed-chest compressions; CPR: cardiopulmonary resuscitation; CPC: cerebral performance category; GCS: Glasgow Coma Scale; ED: Emergency department; ERT: emergency resuscitative thoracotomy; FAST: Focused Assessment with Sonography for Trauma; ISS: Injury severity score; JTDB: Japan Trauma Data Bank; REBOA: Resuscitative endovascular balloon occlusion of the aorta; ROSC: prehospital return of spontaneous circulation; RT: resuscitative thoracotomy; OHCA: out-of-hospital cardiac arrest; TCA: traumatic cardiac arrest; t-OHCA: traumatic out-of-hospital cardiac arrest				

Open-chest cardio-pulmonary resuscitation vs. closed-chest cardio-pulmonary resuscitation

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Bradley (2016) "Open chest cardiac massage offers no benefit over closed chest compressions in patients with traumatic cardiac arrest." *The Journal of Trauma and Acute Care Surgery* 2016: 81(5): 849-854. **Study design** Prospective cohort study **Aim of the study** "The purpose of this study was to prospectively compare OCCM versus CCC in our patients with both	**Inclusion criteria** • Patients with TCA and had CCC and/or OCCM **Exclusion criteria** • Patients determined to be dead on arrival • received a resuscitative endovascular balloon occlusion of the aorta (REBOA) device **Characteristics** <u>Male gender, n/N</u> IG: 16/16 vs. CG: 15/17, p=0.49 <u>Age [y], mean ± SD</u> IG: 31.4 ± 12.7 vs. CG: 42.5 ± 18.8, p=0.08	**Participants** N=33 patients **Intervention groups** IG: closed chest compressions (CCC) followed by open chest cardiac massage (OCCM) (N=16) CG: CCC-only (N=17)	<u>Mortality: n (%)</u> IG: 16 (100) vs. CG: 15 (88.2), p=0.49 <u>Return of spontaneous circulation (ROSC): %</u> IG: 23.5 vs. CG: 38.9 p=0.53	**Level of evidence** 3b↓ **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: ? **Authors' conclusion** "There was no improvement in ROSC with the institution of OCCM after CCC." **Reviewers' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
penetrating and blunt trauma presenting in extremis using ETCO2 as the surrogate for cardiac output (CO) and marker for adequacy of resuscitation." **Setting** USA, 2014	Penetrating injury, n/N (%) IG: 13/16 (81) vs. CG: 8/17 (47), p=0.05 Blunt injury, n/N (%) IG: 2/16 (13) vs. CG: 8/17 (47), p=0.04 Witnessed arrest (yes), n IG: 7 vs. CG: 9, p=0.54 Witnessed arrest (no), n IG: 8 vs. CG: 8, p=0.54			There is a high risk of selection bias. The groups differ in baseline factors. There may be a risk for performance bias due to missing information about concomitant treatments and blinding. There may also be a risk of detection bias due to unclear follow up time for mortality. When interpreting the study, one should be aware of the small study group and that the primary endpoint was a surrogate endpoint (End-tidal carbon dioxide, $ETCO_2$)
Endo (2020) "Open-chest versus closed-chest cardiopulmonary resuscitation in trauma patients with signs of life upon hospital arrival: a retrospective multicenter study." *Critical Care* 2020: *24:541* **Study design** Comparative registry study (Trauma Quality Improvement Program) **Aim of the study**	**Inclusion criteria** • Trauma patients with presence of signs of life (SOL) upon hospital arrival • Received OCCPR or CCCPR within 6h of hospital arrival **Exclusion criteria** • Age <16y • Patients who had nonsurvivable injury (AIS = 6 points) • Patients without exact information on injury mechanism • Patients without exact information on SOL upon ED arrival **Characteristics (after matching)** Age [y], median (IQR) IG: 39 (26,45) vs. CG: 40 (25,56)	**Participants** N=1,062 patients (N=2,682 before matching) **Study groups** IG: Open-chest cardiopulmonary resuscitation (OCCPR) (N=531 of N=1,032 before matching) CG: closed-chest cardiopulmonary resuscitation (CCCPR) (N=531 of N=1,650 before matching) Patients who had OCCPR and CCCPR were classified into the OCCPR group. **Variables for logistic regression analysis and propensity score matching** • age • gender	**Survival to hospital discharge** Adj. for PS matching survival to hospital discharge, n/N (%) IG: 89/531 (16.8) vs. CG: 58/531 (10.9) OR (95% CI): 1.66 (1.13-2.42), p=0.009 Adj. for selected variables survival to hospital discharge, n/N (%) IG: 157/1,032 (15.2) vs. CG: 293/1,650 (11.7), p=0.017 OR (95% CI): 1.99 (1.42-2.79), p<0.001 Length of hospital stay [d], (IQR percentiles) IG: 18 (6-35) vs. CG: 19 (10-32)	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Compared to CCCPR, OCCPR was associated with significantly higher survival at hospital discharge in severe trauma patients with SOL upon ED arrival" **Reviewers' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"to compare the effectiveness of Open-chest cardiopulmonary resuscitation (OCCPR) to closed-chest cardiopulmonary resuscitation (CCCPR) in severe trauma patients with SOL upon arrival at the emergency department (ED)." **Setting** USA, 2010-2016	Female, n (%) IG: 127 (23.9) vs. CG: 127 (23.9) Blunt injury, n (%) IG: 339 (63.8) vs. CG: 342 (64.4) Total prehospital transport time [min], median [IQR] IG: 44 (30-73) vs. CG: 39 (28-69) ISS, median (IQR) IG: 26 (19-35) vs. CG: 27 (20-38) Systolic blood pressure [mmHg], median (IQR) IG: 92 (67-127) vs. CG: 96 (69-130) Heart rate [bpm], median (IQR) IG: 107 (71-130) vs. CG: 106 (75-130) Respiratory rate [bpm], median (IQR) IG: 16 (0-22) vs. CG: 16 (8-24) GCS, median (IQR) IG: 3 (3-11) vs. CG: 3 (3-12)	• insurance type • year of injury • injury mechanism (i.e, penetrating or blunt) • vital signs upon ED arrival (systolic blood pressure, heart rate, respiratory rate) • GCS • Body temperature at ED arrival • Maximum AIS by body region • ISS • Total prehospital transport time • Hospital characteristics (American College of Surgeons verification level and teaching status)		Propensity score matching equalized baseline characteristics (e.g. age or injury severity) between the groups, probably leading to a low risk of selection bias. Sensitivity analyses based on the most optimistic and pessimistic scenarios demonstrated the robustness of results in context of missing outcome data. There may be a risk for performance bias due to missing information about concomitant treatments and blinding.
Endo (2017) "Open-chest versus closed-chest cardiopulmonary resuscitation in blunt trauma: analysis of a nationwide trauma registry" *Critical Care* (2017): 21:169 **Study design**	**Inclusion criteria** • Patient with blunt trauma who received CPR in an ED **Exclusion criteria** • Patients with an AIS score of 6 • Patients with a missing AIS score in any anatomical region • Patients transferred from other hospitals	**Participants** N=3,608 patients (N=6,510 before matching) **Study groups** IG: open-chest cardiopulmonary resuscitation (OCCPR) (N=1,804 of N=2,192 before matching)	Adj. survival to hospital discharge, n/N (%) IG: 22 (1.2) vs. CG: 60 (3.3) OR (95% CI): 0.41 (0.25-0.68), p<0.001 Adj. survival over 24 hours after ED arrival, n/N (%) IG: 89 (4.9) vs. CG: 147 (8.1) OR (95% CI): 0.59 (0.45-0.79), p<0.001	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Comparative registry study Japan Trauma Data Bank (JTDB) **Aim of the study** "to compare the effectiveness of OCCPR with that of closed-chest cardiopulmonary resuscitation (CCCPR) in an emergency department (ED)." **Setting** Japan, 2004-2015	**Characteristics (after matching)** <u>Age [y], median (IQR)</u> IG: 52 (34-68) vs, CG: 53 (34-71) <u>Sex male, n (%)</u> IG: 1,250 (69.3) vs. CG: 1,248 (69.2) <u>Vital signs at the scene of injury, median (IQR)</u> *Systolic blood pressure [mmHg]:* IG: 71 (0-107) vs. CG: 68 (0-104) *Heart rate [beats/min]:* IG: 53 (0-100) vs. 30 (0-100) *Respiratory rate [beats/min]:* IG: 6 (0-24) vs. 0 (0-24) <u>Cardiac arrest at scene of injury, n (%)</u> IG: 714 (39.6) vs. CG: 771 (42.7) <u>Prehospital treatment, n (%)</u> *Chest compression:* IG: 935 (51.8) vs. CG: 943 (52.3) *Defibrillation:* IG: 31 (1.7) vs. CG: 36 (2.0) <u>Vital signs on ED arrival, median (IQR)</u> *Systolic blood pressure [mmHg]:* IG: 0 (0-40) vs. CG: 0 (0-40) *Heart rate [beats/min]:* IG: 0 (0-75) vs. CG: 0 (0-72)	CG: closed-chest cardiopulmonary resuscitation (CCCPR) (N=1,804 of N=4,318 before matching) **Criteria for propensity score matching** • Year of injury • Age • Sex • Time from EMS dispatch to ED arrival • mean number of unexpected survivors per year in the treating hospital that the patients was transferred to • vitals signs at the scene of injury • whether or not cardiac arrest at the scene was observed • vital signs • GCS on ED arrival • Whether or not cardiac arrest was observed on ED arrival • AIS score of each region • ISS		"OCCPR was associated with reduced rates of survival to hospital discharge and of survival over 24 hours after ED arrival in patients with blunt trauma; and the study could not identify a specific subpopulation that would benefit from OCCPR." **Reviewers' conclusion** Propensity score matching equalized baseline characteristics (e.g. age or injury severity) between the groups, probably leading to a low risk of selection bias. There may be a risk for performance bias due to missing information about concomitant treatments and blinding.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Respiratory rate [beats/min]: IG: 0 (0-8) vs. CG: 0 (0-10) *Body temperature [°C]:* IG: 35.2 (34.2-36.0) vs. CG: 35.2 (34.2-36.0) GCS on ED arrival, median (IQR) IG: 3 (3-3) vs. CG: 3 (3-3) ISS, median (IQR) IG: 34 (25-43) vs. CG: 34 (25-43) Cardiac arrest on arrival, n (%) IG: 1,266 (70.2) vs. CG: 1,272 (70.5)			

+: low risk; –: high risk; ?: unclear risk; CG: Control group; CI: Confidence Interval; IQR: Interquartile Range; IG: Intervention group; NA: Not applicable; OR: Odds Ratio; RR: Relative Risk; SD: Standard Deviation; SEM: Standard Error of Mean; adj.: adjusted; bpm: beats per minute; sec: seconds; h: hours; d: days; m: months; y: years; AIS: abbreviated injury scale; CCC: closed chest compressions; CCCPR: closed-chest cardiopulmonary resuscitation; CRP: Cardiopulmonary resuscitation; GCS: Glasgow Coma Scale ED: emergency department; EMS: emergency medical service; $ETCO_2$: End-tidal carbon dioxide; ISS: Injury severity score; OCCM: open chest cardiac massage; OCCPR: Open-chest cardiopulmonary resuscitation; OHCA: out-of-hospital cardiac arrest; PM: Propensity Score Matching; REBOA: resuscitative endovascular balloon occlusion of the aorta; ROSC: Return of spontaneous circulation; SOL: Signs of Life; TQIP: Trauma Quality Improvement Program

Dauer der Wiederbelebung

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Beck (2017) "Resuscitation attempts and duration in traumatic out-of-hospital cardiac arrest" *Resuscitation* 2017: 111: 14-21. **Study design**	**Inclusion criteria** • Patients with traumatic out-of-hospital cardiac arrest (OHCA) **Exclusion criteria** • Age <16 • Cases with a mechanism of hanging or drowning	**Participants** N=471 patients (of 2,334 OHCA patients in total) **Study groups** 0-10 min (N=160) 11-20 min (N=93) 21-30 min (N=92)	ROSC at any time, n/N (%) 0-10 min: 0/160 (0.0) 11-20 min: 2/93 (5.9) 21-30 min: 8/92 (23.5) >30 min: 24/125 (70.6), p<0.001	**Level of evidence** 3b↓ **Risk of bias** Selection bias: – Performance bias: – Attrition bias: + Detection bias: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Comparative registry study (Victorian Ambulance Cardiac Arrest Registry) **Aim of the study** "to understand factors associated with paramedics' decision to attempt resuscitation in traumatic out-of-hospital cardiac arrest (OHCA) and to characterise resuscitation attempts ≤10 min in patients who die at the scene." **Setting** Australia, 2008-2014	**Characteristics** <u>Age [y], median (IQR)</u> 0-10 min: 38.0 (28.0-60.0) 11-20 min: 35.0 (24.0-56.0) 21-30 min: 41.4 (28.5-55.5) >30 min: 50.0 (32.0-64.5), p<0.008 <u>Gender (all patients), n (%)</u> Male: 1,581 (67.7) Female 509 (21.8) Indeterminate/Unknown: 244 (10.5) <u>Bystander CPR, n (%)</u> 0-10 min: 68 (36.0) 11-20 min: 38 (20.1) 21-30 min: 35 (18.5) >30 min: 48 (25.4), p=0.85 <u>CPR by fire first responders, n (%)</u> 0-10 min: 27 (33.8) 11-20 min: 12 (15.0) 21-30 min: 14 (17.5) >30 min: 27 (33.8), p=0.36 <u>Response time for non-EMS witnessed cases, median (IQR)</u> 0-10 min: 9.9 (7.7-14.0) 11-20 min: 10.3 (7.6-15.7) 21-30 min: 9.3 (7.5-14.0) >30 min: 10.1 (7.1-17.5), p=0.827 <u>Prolonged downtime, n (%)</u> 0-10 min: 945 (37.2) 11-20 min: 22 (18.2) 21-30 min: 21 (17.4) >30 min: 33 (27.3)), p=0.752	>30 min (N=125) **Definition resuscitation duration [min]** Time from CPR commencement by EMS to the withdrawal of all treatment following declaration of death at scene **Adjusting variables** • Age • Region • Witnessed • Bystander CPR • Rhythm • Prolonged downtime • Trauma type • Mechanism of injury		**Authors' conclusion** "Resuscitation attempts ≤10 min represented over one third of cases where resuscitation was attempted but the patient subsequently died at the scene. The inclusion of these cases in reporting outcomes from traumatic OHCA may under-represent survival rates in those patients that receive full resuscitation attempts." **Reviewers' conclusion** There is a risk for selection bias since groups significantly differ in terms of age and the method of allocation to resuscitation times may have been related to potential confounding factors. There is a risk for performance bias due to differences in bystander CRP and missing information between group differences regarding qualification und authorisation of personnel performing CPR. When interpreting the results, one should keep in mind, that ROSC is only a short term outcome.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Asystole, n (%) 0-10 min: 106 (47.5) 11-20 min: 35 (15.7) 21-30 min: 35 (15.7) >30 min: 47 (21.1) ROSC at any time, n (%) 0-10 min: 0 (0) 11-20 min: 2 (5.9) 21-30 min: 8 (23.5) >30 min: 24 (70.6), p<0.001			

+: low risk; –: high risk; ?: unclear risk; CG: Control group; CI: Confidence Interval; IQR: Interquartile Range; IG: Intervention group; OR: Odds Ratio; RR: Relative Risk; SD: Standard Deviation; SEM: Standard Error of Mean; adj.: adjusted; bpm: beats per minute; h: hours; d: days; m: months; y: years; CPR: cardiopulmonary resuscitation; EMS: emergency medical service; OHCA: out-of-hospital cardiac arrest; ROSC: Return of spontaneous circulation; VACAR: Victorian Ambulance Cardiac Arrest Registry

Vergleich zweier Entscheidungsregeln für den Abbruch von Reanimationsmaßnahmen

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Chiang (2017) "Performance of a simplified termination of resuscitation rule for adult traumatic cardiopulmonary arrest in the prehospital setting." *Emerg Med J* 2017: 34: 39-45. **Study design** Prospective cross-sectional study (Utstein-based registry system for patients with	**Inclusion criteria** • Patients with TCPA who activated EMS **Exclusion criteria** • Age <18 • Patients with obvious sings of death like decapitation or rigour mortis • Patients with an existing do-not-resuscitation order **Characteristics** Age [y], mean (SD) 50.7 (20.0) Male sex, n/N	**Participants** N=893 patients **Termination rules evaluated** Index rule: The simplified TOR rule comprises two criteria: (1) mechanism with blunt injury and (2) initial presenting rhythm of asystole determined by an AED. Patients with TCPA were viewed as having experienced a blunt injury if a registered mechanism such as a traffic accident, falling injury or crushing injury occurred. Non-blunt injuries included hanging, electric injury, penetrating injury (by knife or gun), foreign body airway obstruction or intoxication.	**Predictive performance of simplified TOR rule for TCPA** Tested criteria by patients with (1) blunt trauma and (2) asystole Sensitivity,% (95% CI): 17.2 (14.8-20.0) Specificity, % (95% CI): 100.0 (88.0-100.0) PPV, % (95% CI): 100.0 (96.8-100.0) NPV, % (95% CI): 5.2 (3.8-7.1) False positive, % (95% CI): 0 (0.0-3.2) False negative, % (95% CI): 94.8 (92.9-96.2) **Predictive performance of combined NAEMSP/ASCOT TOR criteria for TCPA**	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "The simplified TOR rule appears to accurately predict non-survivors in adults with TCPA in the prehospital setting" **Reviewers' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
OHCA from a Taipei emergency medical service) **Aim of the study** "we assessed the discriminatory ability of a simplified TOR rule for TCPA modified from NAEMSP/ACSCOT criteria, evaluated its predictive accuracy and calculated the impact of such a TOR rule on EMS system efficiency by decreasing unnecessary ambulance transport of non-salvageable patients with TCPA to the hospital" **Setting** Taiwan, 2009-2013	578/893 Bystander CPR, n/N 164/893 EMS scene time [min], mean (SD) 13.0 (9.7) Transportation time [min], mean (SD) 4.5 (6.2) Prehospital resuscitation time [min.], mean (SD) 24.2 (14.7) Unsuccessful resuscitation time ≥15 min, n/N 501/893 Injury mechanism, n/N Blunt: 459/893 Penetrating: 212/893 Uncertain mechanism: 222/893 Initial rhythm, n/N Schockable rhythm: 47/893 Non-shockable rhythm: 846/893 Pulseless electric activity (PEA): 253/893 Asystole: 384/893 Other: 209/893	Reference rule: The objective aspects of the TOR guidelines (NAEMSP/ ASCOT rules) that can be judged as present or not are as follows: (1) blunt injury, (2) penetrating injury without organised ECG activity (i.e., pulseless electric activity), (3) witnessed status with longer than 15 min of unsuccessful resuscitation or (4) transport time longer than 15 min after TCPA identified.	Tested criteria by patients with (1) blunt trauma, (2) asystole, (3) unwitnessed and (4) URT ≥15 min Sensitivity, % (95% CI): 6.7 (5.1-8.6) Specificity, % (95% CI): 100.0 (88.8-100.0) PPV, % (95% CI): 100.0 (92.1-100.0) NPV, % (95% CI): 4.7 (3.4-6.4) False positive, % (95% CI): 0.0 (0.0-7.6) False negative, % (95% CI): 95.3 (93.6-96.6)	According to the research question, whether a simplified TOR rule can accurately predict non-survivors in TCPA patients in the prehospital setting, the study results seem to be reliable.

+: low risk; –: high risk; ?: unclear risk; CG: Control group; CI: Confidence Interval; IQR: Interquartile Range; IG: Intervention group; NA: Not applicable; OR: Odds Ratio; RR: Relative Risk; SD: Standard Deviation; SEM: Standard Error of Mean; adj.: adjusted; bpm: beats per minute; h: hours; d: days; m: months; y: years; ACSCOT: American College of Surgeons Committee on Trauma; AED: automated external defibrillator; CPR: Cardiopulmonary resuscitation; EMS: emergency medical service; NAEMSP: National Association Emergency Medical Physicians; TCPA: traumatic cardiopulmonary arrest TOR: termination of resuscitation

Epinephrin vs. kein Epinephrin

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Aoki (2019) "Association of Prehospital Epinephrine Administration With Survival Among Patients With Traumatic Cardiac Arrest Caused By Traffic Collisions" *Scientific reports* 2019: *9(1)*: 9922 **Study design** Comparative registry study (All-Japan Utstein Registry) **Aim of the study** "The objective of the present study was to investigate the efficacy of prehospital epinephrine administration in blunt trauma patients with TCA" **Setting** Japan, 2012-2015	**Inclusion criteria** • TCA caused by traffic collisions **Exclusion criteria** • no resuscitation • ALS performed by a physician • Unknown adrenaline use • CPR duration time <1 min • CPR duration time >30 min • Prehospital return of spontaneous circulation within 10 min from CPR **Characteristics (after matching)** <u>Age [y], median (IQR)</u> IG: 67 (47–77) vs. CG: 65 (43–77) <u>Male, n (%)</u> IG: 230 (73) vs. CG: 232 (73) <u>Any CPR, n (%)</u> IG: 61 (19) vs. CG: 64 (20) <u>No CPR, n (%)</u> IG: 256 (81) vs. CG: 253 (80) <u>First rhythm, n (%)</u> *Ventricular fibrillation:* IG: 2 (0.6) vs. CG: 4 (1.3) *Pulseless ventricular tachycardia:* IG: 1 (0.3) vs. CG: 2 (0.6) *Pulseless electrical activity:*	**Participants** N=634 patients (N=5,204 before matching) **Study groups** IG: prehospital epinephrine (N=317 of N=758 before matching) CG: no prehospital epinephrine (N=317 of N=4,446 before matching) **Propensity score matching criteria** • Age • Gender • presence of a witness • bystander CPR • first rhythm • use of ALS devices • insertion of an intravenous line • and time from the call to arrival at the scene of the accident **Adjusting variables in multivariate regression** • Age • Gender • First rhythm • Time for the call to arrival at the scene of the accident	**1-month survival** <u>Adj. for selected variables, OR (95% CI)</u> 1.495 (0.758-2.946) <u>Adj. by PS matching, n/N (%)</u> IG: 7/317 (2.2) vs. CG: 3/317 (0.9), p=0.340 OR (95% CI): 2.363 (0.606-9.223) **Return to spontaneous recirculation (ROSC)** <u>Adj. for selected variables, OR (95% CI)</u> 11.553 (7.770 to 17.178) <u>Adj. by PS matching, n/N (%)</u> IG: 53/317 (16.7) vs. CG: 9/317 (2.8), p<0.001 OR (95% CI): 6.870 (3.326 to 14.192)	**Level of evidence** 2b **Risk of bias** Selection bias: ? Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Prehospital epinephrine administration in patients with TCA caused by traffic collisions was not associated with 1-month survival, but was beneficial in regards to prehospital ROSC. Currently, options for the prehospital treatment of trauma are limited" **Reviewers' conclusion** There might be a risk for selection bias as information about concomitant injuries und severity are missing and therefore not included adjustments. There might be a risk for performance bias for the primary endpoint (1-months survival) since

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG: 127 (40) vs. CG: 123 (39) *Asystole*: IG: 177 (56) vs. CG: 180 (57) *Other*: IG 10 (3.2) vs. CG: 8 (2.5) Life support emergency medical personnel Use of advanced life support devices IG: 185 (58) vs. CG: 188 (59%) Insertion of intravenous line, n (%) IG: 302 (95) vs. CG: 302 (95) Time firm call to arrival at scene, median (IQR) IG: 8 (6-10) vs. CG: 8 (6-11) Time from call to arrival at hospital, median (IQR) IG: 35 (28-44) vs. 34 (27-44)			treatments in the hospital are unknown. When interpreting the study results of ROSC one should keep in mind that those patients with prehospital ROSC within 10 min from CPR were excluded from the analysis. Though, a sensitivity analysis with patients who achieved prehospital ROSC within 10 min from CPR, confirmed the results.
Chiang (2015) "Prehospital intravenous epinephrine may boost survival of patients with traumatic cardiac arrest: a retrospective cohort study" *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine* 2015: 23:102 **Study design** Comparative registry study (Utstein-based registry system for patients with	**Inclusion criteria** • Adult patients with TCA **Exclusion criteria** • Age <18 • Patients with signs of obvious death like decapitation or rigor mortis **Characteristics** Age [y], median (IQR) IG: 46.0 (35.0-75.0) CG: 48.0 (30.0-63.0), p=0.36 Male, n (%) IG: 27 (62.8) vs. CG: 321 (68.2), p=0.50	**Participants** N=514 patients **Study groups** IG: Epinephrine (N=43) CG: No epinephrine (N=471)	Survival to discharge, n/N (%) IG: 6/43 (14.0) vs. CG: 14/471 (3.0), p<0.01 Prehospital ROSC, n/N (%) IG: 5/43 (11.6) vs. CG: 35/471 (7.4), p=0.37 Sustained ROSC, n/N (%) IG: 18/43 (41.9) vs. CG: 83/471 (17.6), p<0.01 Cerebral performance category 1 & 2, n/N (%) IG: 2/43 (4.7) vs. CG: 11/471 (2.3), p=0.30 **Subgroup analysis, stratified by prehospital time** Sustained ROSC, OR (95% CI)	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "In summary, among patients with TCA in an Asian metropolitan area, administration of intravenous epinephrine in the prehospital

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
OHCA from a Taipei emergency medical service) **Aim of the study** "This study evaluated the effectiveness of epinephrine in the prehospital setting for patients with TCA." **Setting** Taiwan, 2010-2013	Witnessed, n (%) IG: 8 (18.6) vs. CG: 186 (39.5), p<0.01 Bystander CPR, n (%) IG: 13 (30.2) vs. CG: 97 (20.6), p=0.17 Shockable rhythm, n (%) IG: 5 (11.6) vs. CG: 19 (4.0), p=0.04 Blunt injury, n (%) IG: 11 (25.6) vs. CG: 377 (80.0), p<0.01 Scene time, median (IQR) IG: 14.0 (12.0–17.0) vs. CG: 11.0 (8.0–14.0), p<0.01 Total prehospital time, median (IQR) IG: 23.0 (20.0–29.0) vs. CG: 20.0 (16.0–25.0), p<0.01 Advance airway, n (%) IG: 32 (74.4) vs. CG: 92 (19.5), p<0.01		10-20 min (N=266): 1.16 (0.23 to 0.76) 21-30 min (N=203): 3.73 (1.52 to 9.16) >30 min (N=60: 23.0 (3.76 to 140.88)	setting was associated with higher sustained ROSC and survival to discharge, especially for those with longer prehospital time." **Reviewers' conclusion** There is a risk for selection bias, because the results of the study are unadjusted to confounding variables. There might be a risk for performance bias due to unblinded treatment personnel and missing information regarding concomitant treatment.
Yamamoto (2019) „Epinephrine during resuscitation of traumatic cardiac arrest and increased mortality: a post hoc analysis of prospective observational study." *Scandinavian Journal of Trauma, Resuscitation & Emergency Medicine* 2019: 27(1):74. **Study design**	**SOS-KANTO 2012** **Inclusion criteria** • with OHCA following trauma based on clinical finding (drowning and hanging were not considered traumatic) • aged ≥15 years • available data on epinephrine administration during resuscitation after hospital arrival **Exclusion criteria** • missing or unknown survival data 7 days after injury	**Participants** N=356 patients (1,030 patients before matching) **Study groups** IG: Epinephrine during resuscitation at hospital (N=178; N=822 before matching) Epinephrine use for patients with spontaneous circulation and Epinephrine use prior to hospital arrival were not considered an intervention. CG: No Epinephrine (N=178; 208 before matching)	Survival rate 7 days after injury: n (%, 95% CI) IG: 1 (0.6%; 0.0–1.7%) CG: 9 (5.1%; 1.8–8.3%), p=0.02 OR (95% CI): 0.11 (0.01–0.85) ROSC rate at the hospital: n (%, 95% CI) IG: 32 (18.0%; 12.3–23.6%) CG: 16 (9.0%; 4.8–13.2%), p=0.01 OR (95% CI): 2.21 (1.16–4.19)	**Level of evidence** 3b↓ **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "The relationship between the use of epinephrine dur-

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Comparative registry study (post-hoc analysis of prospective multicentre observational study SOS-KANTO 2012) **Aim of the study** "to elucidate the potential undesirable effects of epinephrine during resuscitation of patients with traumatic OHCA, the OHCA mortality rate after a major trauma was examined." **Setting** Japan, 2012-2013	• patients with missing covariates were excluded from the propensity score calculation **Characteristics (after matching)** Age [y], median (IQR) IG: 55 (30) vs. CG: 54 (31) Male sex, n (%) IG: 124 (70.0) vs. CG: 109 (61.2) Witness, n (%) IG: 102 (57.3) vs. CG: 90 (50.6) Bystander CPR, n (%) IG: 26 (14.6) vs. CG: 1 8 (10.1) Signs of life at scene, n (%) IG: 12 (6.7) vs. CG: 6 (3.4) Asystole at scene, n (%) IG: 132 (74.2) vs. CG: 143 (80.3) Collapsed to CA during transportation, n (%) IG: 15 (8.4) vs. CG: 8 (4.5) Epinephrine prior to hospital arrival, n (%) IG: 15 (8.4) vs. CG: 10 (5.6) ROSC prior to hospital arrival, n (%) IG: 7 (3.9) vs. CG: 8 (4.5) Signs of life on hospital arrival, n (%) IG: 12 (6.7) vs. CG: 13 (7.3) Asystole on hospital arrival, n (%)	**Matching criteria** • age • presence of signs of life at the scene and/or upon hospital arrival • no electrical activity on cardiac rhythm (asystole) at the scene and/or upon hospital arrival • witness status • presence of bystander CPR • collapsed to CA during transportation • ROSC achieved prior to arrival • time from emergency call to ambulance arrival at the scene • CPR duration until hospital arrival • administration of epinephrine before hospital arrival		ing resuscitation and decreased 7-day survival was found in patients with OHCA following trauma, and the propensity score-matched analyses validated the results." **Reviewers' conclusion** There is a risk for selection bias because patient characteristics were still different after matching. There might also be a risk for performance bias since treatments after epinephrine administration were not reported.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG: 157 (88.2) vs. CG: 160 (89.9) Penetrating injury, n (%) IG: 9 (5.1) vs. CG: 9 (5.1) CPR duration before hospital arrival [min], median (IQR) IG: 21 (11) vs. 22 (10)			
+: low risk; –: high risk; ?: unclear risk; CG: Control group; CI: Confidence Interval; IQR: Interquartile Range; IG: Intervention group; NA: Not applicable; OR: Odds Ratio; RR: Relative Risk; SD: Standard Deviation; SEM: Standard Error of Mean; adj.: adjusted; bpm: beats per minute; h: hours; d: days; m: months; y: years; ALS: Advanced life support; CA: Cardiac arrest; CPR: cardiopulmonary resuscitation; EMS: Emergency medical service; OHCA: out-of-hospital cardiac arrest; PM: Propensity score matching; ROSC: Return of spontaneous circulation; SOS-KANTO: survey of survivors of out-of-hospital cardiac arrest in the Kanto region of Japan; TCA: Traumatic cardiac arrest				

2.4 Gerinnungsmanagement und Volumentherapie

Viskoelastische Testverfahren

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Albert (2019) „Efficacy of Thromboelastography (TEG) in Predicting Acute Trauma-Induced Coagulopathy (ATIC) in Isolated Severe Traumatic Brain Injury (iSTBI)". *Indian J Hematol Blood Transfus* 2019; 35(2): 325-331. **Study design** Diagnostic cross-sectional study	**Inclusion criteria** • Isolated TBI patients with GCS≤8 • age 16–65 years • blood withdrawn for analysis <12h of injury, prior to fluid/blood transfusion **Exclusion criteria** • associated extracranial injuries (n=22) • clinical evidence of brain death (n=3) • secondary admissions (n=24) **Characteristics (validation cohort)** Age [y], median (IQR) 35 (29–42)	**Participants** N=58 patients in the development cohort, N=39 patients in the validation cohort **Tests evaluated** Index text: TEG was performed using citrated whole blood and without any additional coagulation activator on TEM-A, automated thromboelastometer (Framar Biomedica, Rome) within 2 h of blood collection. All TEG parameters were recorded from a graphical tracing: r-time (1.8–14.2 min), κ-time (0.7–7.3 min), α-angle (27.3°–72.3°), maximum amplitude (32.1–87.9 mm; MA) and lysis at 30 min (LY30, %).	**TEG cut-offs for identification of ATIC in isolated severe TBI patients** κ-time ≥3.7 min α-angle ≤48.0° **Diagnostic test performance** true positive, n=20 false positive, n=12 true negative, n=3 false negative, n=4 Sensitivity, % (95% CI)	**Level of evidence** 2b **Risk of bias (QUADAS)** Patient selection: ? Index test: ? Reference standard: + Flow and timing: + **Authors' conclusion** "TEG's ability to assess the spectrum of different coagulopathies in whole blood renders it to be ideal for

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Aim of the study "to establish a clinically significant cut-off for TEG parameters to identify acute trauma-induced coagulopathy (ATIC) in isolated severe traumatic brain injury (TBI) patients and to validate the established TEG definition to determine whether TEG can replace traditional coagulation assays in the emergency department." **Setting** India, 16 months period* * study years n.r.	Male, %$ 87 Mean time from injury to admission [h] 2 $ n/N not reported	Hypocoagulability was defined as prolonged r & κ-time and shortened α-angle & MA. Hypercoagulability was defined as shortened r & κ-time and prolonged α-angle & MA Reference standard: conventional coagulation tests (CCT) using sodium citrate-anticoagulated blood **Comparison** (CCT-based definition) ATIC+: acute trauma-induced coagulopathy (N=24) (INR ≥1.27 and/or PT ≥16.7 s and/or aPTT ≥28.8 s at hospital admission) ATIC–: no acute trauma-induced coagulopathy (N=15)	κ-time: 64 (45.83–79.29) α-angle: 62 (44–77.31) κ-time and α-angle: 63 (45.25–77.07) Specificity, % (95% CI) κ-time: 46 (21.27–71.99) α-angle: 40 (16.82–68.73) κ-time and α-angle: 43 (15.82–74.95) PPV, % (95% CI) κ-time: 75 (55.1–88) α-angle: 75 (55.1–88) κ-time and α-angle: 83 (64.15–93.32) NPV, % (95% CI) κ-time: 33 (43.42–72.92) α-angle: 27 (10.9–51.95) κ-time and α-angle:20 (7.047–45.19) Diagnostic accuracy κ-time: 59 (43.42–72.92) α-angle: 56 (40.98–70.7) κ-time and α-angle: 59 (43.42–72.92)	rapidly identifying ATIC and transfusion guidance. However in our study, we observed low specificity, therefore TEG cannot replace the conventional coagulation assays for identifying ATIC but may potentially be clinically sensitive in depicting the underlying coagulopathy following brain trauma." **Reviewers' conclusion** The results should be interpreted with caution due to the split-sample design and small sample size. Because the population was isolated severe TBI patients and multiply injured patients were excluded, the applicability to the polytraumatised population is limited.
Baksaas-Aasen (2021) „Viscoelastic haemostatic assay augmented protocols for major trauma haemorrhage (ITACTIC): a randomized, controlled trial". *Intensive Care Med* 2021; 47: 49-59. **Study design** Randomised controlled trial	**Inclusion criteria** • clinical signs of bleeding activating the local MHP • RBC transfusion initiated • ≤3 h after injury • ≤1 h after ED admission **Exclusion criteria** • none **Characteristics** Age [y], median (IQR)	**Participants** N=411 patients randomised, 396 in ITT analysis* **Study groups** CCT: conventional coagulation test (CCT) in the laboratory (N=203 randomised, 195 in ITT analysis)* VHA: point-of-care viscoelastic haemostatic assay (VHA) (N=208 randomised, 201 in ITT analysis)*	**Primary outcome** Subjects alive and free of massive transfusion, 24h after injury, %; OR (95% CI) CCT: 64% vs. VHA: 67% OR 1.15 (0.76–1.73) **Secondary outcomes (ITT population)** Mortality at 6 h, n/N (%); OR (95% CI) CCT: 22/195 (11) vs. VHA: 22/201 (11) OR 0.97 (0.52–1.80), p=0.915	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
(ITACTIC trial) **Aim of the study** "hypothesized that VHA-augmented MHPs would improve mortality and reduce the need for massive transfusion (ten or more units of red blood cell (RBC) transfusions) in the first 24 h after injury." **Setting** International Trauma Research Network (Denmark, the Netherlands, Norway, Germany, UK), 2016-2018	VHA: 40 (26–54), N=197 CCT: 43 (28–59), N=194 Male, n/N (%) VHA: 145/198 (73) CCT: 159/194 (82) Prior oral anticoagulation, n/N (%) VHA: 12/198 (6%) CCT: 15/192 (8%) ISS, median (IQR) VHA 26 (17–37), N=196 CCT: 26 (16–35), N=191 GCS, median (IQR) VHA: 12 (3–15), N=194 CCT: 13 (3–15), N=191 Systolic BP [mmHg], median (IQR) VHA: 95 (73–120), N=178 CCT: 90 (74–110), N=170 Heart rate [beats/min], median (IQR) VHA: 103 (87–127), N=190 CCT: 105 (82–123), N=181 With PTr>1.2, n/N (%) VHA: 58/181 (32) CCT: 44/175 (25)	Haemostatic therapy was delivered based on results of these according to the TAC-TIC algorithms, which define triggers for additional administration of platelet, fibrinogen, plasma and antifibrinolytic therapies. **Co-interventions** All patients received their local hospital's standard MHP, based on the empiric delivery of tranexamic acid; blood components delivered in a 1:1:1 ratio of RBCs, plasma and platelet transfusions; and limited infusion of crystalloid fluids. In both groups, blood was drawn for coagulation analysis at baseline and after every four units of RBCs transfused, until haemostasis. * rest did not provide informed consent	Mortality at 24 h, n/N (%); OR (95% CI) CCT: 33/195 (17) vs. VHA: 29/201 (14) OR 0.83 (0.48–1.42), p=0.495 Mortality at 28 days, n/N (%); OR (95% CI) CCT: 55/194 (28) vs. VHA: 50/201 (25) OR 0.84 (0.54–1.31), p=0.435 Mortality at 90 days, n/N (%); OR (95% CI) CCT: 56/177 (31) vs. VHA: 53/179 (29) OR 0.91 (0.58–1.42), p=0.678 Death from exsanguination, n/N (%); OR (95% CI) CCT: 17/56 (30) vs. VHA: 13/51 (25) OR 0.78 (0.34–1.82), p=0.576 Died before haemostasis, n/N (%); OR (95% CI) CCT: 24/54 (44) vs. VHA: 19/50 (38) OR 0.77 (0.35–1.67), p=0.505 Massive transfusion at 24 h, n/N (%); OR (95% CI) CCT: 55/195 (28) vs. VHA: 53/201 (26) OR 0.91 (0.59–1.42), p=0.682 Patients with symptomatic thromboembolism, n/N (%); OR (95% CI) CCT: 27/195 (14) vs. VHA: 17/201 (9) OR 0.57 (0.31–1.08), p=0.088 Patients with MODS, n/N (%); OR (95% CI) CCT: 134/159 (84) vs. VHA: 141/164 (86) OR 1.14 (0.62–2.10), p=0.668 EQ-5D index at discharge / 28 days: median (IQR) CCT: 49 (25-60), N=86 vs. VHA: 40 (28-60), N=92, p=0.672 EQ-5D index at 90 days: median (IQR)	"There was no difference in overall outcomes between VHA- and CCT-augmented-major haemorrhage protocols." **Reviewers' conclusion** This was a well-conducted RCT, though lack of blinding the clinical team leads to a risk of performance bias. When interpreting the study results, one needs to be aware that the study was powered to detect a 15% reduction in death/MT.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			CCT: 60 (40–70), N=75 vs. VHA: 53 (40–70), N=72, p=0.718	
Balendran (2017) „Prothrombin time is predictive of low plasma prothrombin concentration and clinical outcome in patients with trauma hemorrhage: analyses of prospective observational cohort studies". *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine* 2017; 25: 30. **Study design** Prognostic cross-sectional study (data from prospective ACIT and DIA-TRE-TIC studies) **Aim of the study** "The aims of the study were, firstly, to investigate the consequence of admission prothrombin concentration on massive transfusion (more than 10 PRBC units) and mortality at 24 h. Secondly, to determine the relationship between admission biomarkers (PT, ROTEM EXTEM CT and MCF) and	**Inclusion criteria ACIT (UK)** • adult trauma patients (>15 y) • met the local criteria for full trauma team activation **Inclusion criteria DIA-TRE-TIC (Austria, A)** • adults • severe polytrauma patients (ISS≥15, injury of ≥2 body regions) or patients with isolated TBI (GCS≤14 after blunt head trauma, AIS<3 in any other body region) **Exclusion criteria ACIT (UK)** • ED arrival 2 h after injury • administration of 2000 mL of intravenous fluid before ED arrival • transfer from another hospital • burns covering 5% of the total body surface area • taking anticoagulant medications • moderate or severe liver disease • known bleeding diathesis **Exclusion criteria DIA-TRE-TIC (A)** • patients <18 y • penetrating injuries • admittance >12 h after trauma • pre-existing coagulopathy • burn injury • malignant disease • avalanche victims • exhibition of non-head single trauma	**Participants** N=689 patients (UK: N=358, A: N=331) **Tests evaluated** • admission prothrombin time (PT) • admission EXTEM CT • admission EXTEM MCF **Comparison** 24h survival (N=655/689, 95.1%)	**Prognostic test performance: Prediction of 24h-mortality** AUC (95% CI) **UK:** PT: 0.90 (0.82-0.97) EXTEM CT: 0.66 (0.48-0.82), p<0.001§ EXTEM MCF: 0.81 (0.66-0.96), p=0.04§ **A:** PT: 0.78 (0.68-0.89) EXTEM CT: 0.74 (0.62-0.86), p=0.44§ EXTEM MCF: 0.67 (0.54-0.81), p=0.05§ § null hypothesis: no difference in AUC between PT and EXTEM marker	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "Our analyses suggest that prothrombin concentration at admission is predictive of mortality and transfusion and indicates that prothrombin and fibrinogen are rate limiting in coagulopathy." **Reviewers' conclusion** The study is limited by its inhomogeneous sample and low event rate. In addition, and measurements were not standardised. Part of the population excluded a potentially relevant group of patients who were taking oral anticoagulant medications or with pre-existing coagulopathy.

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prothrombin concentration, and thirdly, to understand the ability of admission biomarkers to act as a surrogate for low prothrombin concentration and predict outcome." **Setting** UK, 2008-2013 and Austria, 2005-2008	**Characteristics** Age [y], median (IQR) UK: 35 (23–50), A: 43 (27–56) Male, n (%) UK: 288 (80), A: 259 (78) ISS, median (IQR) UK: 13 (5–27), A: 34 (24–45) SBP [mmHg], median (IQR) UK: 132 (110–150), A: 120 (100–140) GCS, median (IQR) UK: 15 (14–15), A: 11 (6–15)			
Barrett (2020) „Plasmin thrombelastography rapidly identifies trauma patients at risk for massive transfusion, mortality, and hyperfibrinolysis: A diagnostic tool to resolve an international debate on tranexamic acid?" *J Trauma Acute Care Surg* 2020; 89: 991-998. **Study design** Diagnostic/prognostic cross-sectional study **Aim of the study** "to develop an assay, plasmin TEG (P-TEG), to more expeditiously stratify	**Inclusion criteria** • adult patients (≥18 years old) • trauma activation • GCS <8 with presumed thoracic, abdominal, or pelvic injury, *or* • respiratory compromise, obstruction, and/or intubation with presumed thoracic, abdominal, or pelvic injury, *or* • blunt trauma with systolic blood pressure of <90 mmHg, *or* • mechanically unstable pelvic injury, *or* • penetrating injuries with injury to neck and/or torso with systolic blood pressure of <90 mmHg, gunshot wound penetrating the neck/torso, or stab wounds to the neck/torso that require endotracheal intubation, *or* • amputation proximal to the ankle or wrist, *or*	**Participants** N=167 patients in total, 148 analysed 19 excluded from analysis because of incomplete TEG assays (4 rTEG, 5 citrated native TEG, 10 tPA TEG) **Tests evaluated** Index test 1: plasmin TEG assay (P-TEG) The P-TEG was considered positive (P-TEG positive) when the P-TEG R time is greater than or equal to native TEG R time. Index test 2: tissue plasminogen activator challenged TEG (tPA TEG) Reference test: TEG assays without exogenous additives (rapid/native) **Indices obtained from TEG tracings** • R time (minutes)	Time to results [min], median (IQR) P-TEG positive: 4.7 (2.5–9.1) tPA TEG TMA positive: 12.7 (9.2–13.8), p<0.001 tPA TEG LY30: 47.1 (42.6–51.2), p<0.001 rTEG LY30: 54.2 (51.1–58.1), p<0.001 **Diagnostic test performance: hyperfibrinolysis** *reference test in brackets* Sensitivity, % (95% CI) P-TEG (rTEG LY30 >3%): 0.19 (0.08–0.37) P-TEG (rTEG LY30 >7.6%): 0.31 (0.14–0.56) tPA TEG TMA (rTEG LY30 >3%): 0.50 (0.31–0.69) tPA TEG TMA (rTEG LY30 >7.6%): 0.77 (0.50–0.92) Specificity, % (95% CI) P-TEG (rTEG LY30 >3%): 0.88 (0.81–0.92) P-TEG (rTEG LY30 >7.6%): 0.89 (0.82–0.93) tPA TEG TMA (rTEG LY30 >3%): 0.87 (0.79–0.92) tPA TEG TMA (rTEG LY30 >7.6%): 0.87 (0.80–0.92)	**Level of evidence** 2b **Risk of bias (QUADAS)** Patient selection: ? Index test: ? Reference standard: + Flow and timing: + no tool available for prognostic studies **Authors' conclusion** "we have developed a novel modified diagnostic assay for use on currently available commercial equipment commonly used

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
which trauma patients are highest risk for bleeding, hyperfibrinolysis, and death and may therefore benefit most from TXA." **Setting** USA, 2018-2019	• the emergency medicine attending or chief surgical resident suspects that the patient is likely to require urgent operative intervention **Exclusion criteria** • age <18 years • initial blood collected >1h post-injury • infusion of blood products before the collection of blood samples • patients presenting as consultations from external hospitals • documented chronic liver disease (total bilirubin >2.0mg/dL) or advanced cirrhosis discovered on laparotomy • known inherited defects of coagulation function (e.g., hemophilia or von Willebrand disease) • patients on anticoagulants at the time of their injury • subsequent downgrades from trauma activation to trauma alert or non-trauma status in the ED • patients who were pregnant • prisoners **Characteristics** Age [y], median (range) 35 (18–90) Male, n (%) 114 (77) ISS, median (IQR) 20 (9–30)	• angle (°) • maximum amplitude (MA, mm) • clot lysis 30 minutes after MA (LY30, %)	PPV, % (95% CI) P-TEG (rTEG LY30 >3%): 25 (11–47) P-TEG (rTEG LY30 >7.6%): 25 (11–47) tPA TEG TMA (rTEG LY30 >3%): 42 (26–0.61) tPA TEG TMA (rTEG LY30 >7.6%): 38 (22–57) NPV, % (95% CI) P-TEG (rTEG LY30 >3%): 83 (75–88) P-TEG (rTEG LY30 >7.6%): 91 (85–95) tPA TEG TMA (rTEG LY30 >3%): 90 (83–94) tPA TEG TMA (rTEG LY30 >7.6%): 97 (92–99) **Diagnostic test performance: depletion of fibrinolytic inhibitors (DFI)** reference test: DFI measured by rTEG Sensitivity, % (95% CI) P-TEG: 0.32 (0.19–0.49) tPA TEG TMA: 0.64 (0.47–0.78) Specificity, % (95% CI) P-TEG: 0.92 (0.86–0.96) tPA TEG TMA: 0.95 (0.89–0.98) PPV, % (95% CI) P-TEG: 58 (36–77) tPA TEG TMA: 81 (62–91) NPV, % (95% CI) P-TEG: 81 (73–87) tPA TEG TMA: 89 (82–94) **Prognostic test performance: prediction of patients in need of massive transfusion** Sensitivity, % (95% CI) P-TEG: 0.40 (0.20–0.64) tPA TEG TMA: 0.69 (0.42–0.87)	in trauma that can, in under 5 minutes, rapidly identify trauma patients at highest risk for MT (i.e., massive bleeding), death at both 24 hours and 30 days, and high risk for hyperfibrinolysis (DFI) and, potentially, with future improvements (with or without composite use of tPATEG TMA), may be able to help guide selective TXA dosing." **Reviewers' conclusion** The time outcome may be subject to detection bias, as no mention is made of assessor blinding. The risk of bias of the index test cannot be assessed because it is unclear whether the results were interpreted without knowledge of the reference test. The effect on patient-relevant outcomes of using these tests to take therapeutic decisions was not investigated. The population excluded a potentially relevant group of patients with bleeding disorders or who were taking oral anticoagulant medications.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Specificity, % (95% CI) P-TEG: 0.89 (0.83–0.94) tPA TEG TMA: 0.86 (0.79–0.91) PPV, % (95% CI) P-TEG: 30 (15–52) tPA TEG TMA: 35 (19–54) NPV, % (95% CI) P-TEG: 93 (87–96) tPA TEG TMA: 96 (91–99) **Prognostic test performance: prediction of patients likely to benefit from TXA** Sensitivity, % (95% CI) P-TEG: 0.36 (0.16–0.61) tPA TEG TMA: 0.77 (0.50–0.92) Specificity, % (95% CI) P-TEG: 0.89 (0.82–0.93) tPA TEG TMA: 0.87 (0.80–0.92) PPV, % (95% CI) P-TEG: 26 (12–49) tPA TEG TMA: 38 (22–57) NPV, % (95% CI) P-TEG: 93 (87–96) tPA TEG TMA: 97 (92–99)	
Cohen (2019) "A prospective evaluation of thromboelastometry (ROTEM) to identify acute traumatic coagulopathy and predict massive transfusion in military trauma	**Inclusion criteria** • trauma patients • injuries resulting in activation of DCR (based on clinical status at presentation)	**Participants** N=88 patients enrolled, N=40 analysed ("due to intermittent lack of reagent availability, not patient selection") **Tests evaluated**	**Prognostic test performance: prediction of patients in need of massive transfusion** Sensitivity: % Index test: 86 Reference test: 64	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
patients in Afghanistan". *Transfusion* 2019; 59: 1601-1607. **Study design** Prognostic cross-sectional study **Aim of the study** "to determine the relative capacities to identify coagulopathy and predict MT between 1) the established ATC definition using an INR cutoff of 1.2 and 2) an integrated ROTEM model that also includes EXTEM A5 35 mm or less and/or EXTEM LI30 less than 97%." **Setting** US military (Afghanistan), 2012-2013	**Exclusion criteria** n.r. **Characteristics** Age [y], median (95% CI) 26 (17–35) Male, n (%) 40 (100) ISS, median (95% CI) 22 (14–27) GCS, median (95% CI) 15 (11.5–15) SBP [mmHg], median (95% CI) 119 (110–130) Heart rate [beats/min], median (95% CI) 129 (103–144)	Index test: definition of acute traumatic coagulopathy (ATC) by an integrated ROTEM model, incl. INR >1.2, EXTEM A5 ≤35 mm and/or EXTEM LI30 <97% on admission. Reference test: established definition of ATC using INR >1.2 Blood was obtained upon admission and at 6 and 24 hours after admission by a designated research team and analyzed by ROTEM with multiple assays (EXTEM, FIBTEM, APTEM).	Specificity: % Index test: 38 Reference test: 50 Positive likelihood ratio: Index test: 1.4 Reference test: 1.3 Negative likelihood ratio: Index test: 0.4 Reference test: 0.7	**Authors' conclusion** "Our integrated ROTEM model of ATC demonstrated a 15% increased burden of coagulopathy above those captured by INR alone and increased the detection of those that required MT by 22%. The specificity, however, was poor, arguing for its use as an adjunct to clinical presentation in the ultimate decision to initiate MT in the combat setting." **Reviewers' conclusion** The cohort is small, and no measure of variance or significance is provided, so that only limited conclusions may be drawn. The effect on patient-relevant outcomes of using the index test to take therapeutic decisions was not investigated.
Connelly (2017) "Assessment of three point-of-care platelet function assays in adult trauma patients". *J Surg Res* 2017; 212: 260-269. **Study design**	**Inclusion criteria** • adult trauma patients • at risk for coagulopathy and hemorrhage • Glasgow Coma Scale <10 or • intracranial hemorrhage (ICH) on initial head CT scan or • systolic blood pressure <90 mmHg or • intubation or	**Participants** N=64 patients **Tests evaluated** MA: Multiplate aggregometry aspirin area under the platelet aggregation curve (ASPI AUC)	**Diagnostic test performance: detection of patients on any antiplatelet therapy** Area under ROC curve (AUC) MA: 0.90 TEG-PM: 0.77 VN: 0.90 Cut-offs:	**Level of evidence** 2b **Risk of bias (QUADAS)** Patient selection: ? Index test: – Reference standard: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Diagnostic and prognostic cross-sectional study **Aim of the study** "to assess the ability of each assay to identify AP medication use in trauma patients immediately on arrival. The secondary aims were to compare the ability of VerifyNow and TEG-PM with Multiplate aggregometry to identify platelet dysfunction and to determine if any of these tests were predictive of ICH progression." **Setting** USA, 2013-2015	• base deficit >6 mEq/L or • penetrating injury to the torso, groin, or neck or • amputation proximal to the ankle or wrist or • uncontrolled external hemorrhage or • two or more long bone fractures or • pelvic fracture or • combination trauma with burns (<20% total body surface area) **Exclusion criteria** • Children aged <15 y • patients with significant burns (>20% total body surface area) • prehospital cardiopulmonary resuscitation • prisoners • Patients on other anticoagulation medications (than anti-platelet) • transferred from another facility >6 h since injury **Characteristics** Age [y], mean ± SD AP: 35.9 (14.7) non-AP: 71.6 (10.8), p<0.001 Male, n (%) AP: 31 (79) non-AP: 20 (80), p=1.00 ISS by strata, n (%) p=0.56 ISS 0-8: AP: 3 (8) vs. non-AP: 2 (8) ISS 9-15: AP: 8 (21) vs. non-AP: 2 (8)	TEG-PM: Thrombelastography Platelet Mapping percent inhibition of arachidonic acid (TEG-PM AA) VN: The Verify Now Aspirin Reaction Units (ARU) **Study groups** Anti-platelet (AP) group: patients currently taking aspirin (ASA) or clopidogrel, verified by outpatient medication lists or medical records (N=25) non-AP group: not taking ASA or clopidogrel (N=39)	MA: 33.5 TEG-PM: 48.2 VN: 614 Sensitivity (%) MA: 80 TEG-PM: 56 VN: 100 Specificity (%) MA: 92 TEG-PM: 92 VN: 70 PPV (%) MA: 87 TEG-PM: 82 VN: 71 NPV (%) MA: 88 TEG-PM: 77 VN: 100 **Prognostic test performance: detection of patients at risk for intracranial haemorrhage progression** ICH progression defined based on attending radiologist interpretation of all initial and follow-up head CT scan images. Area under ROC curve (AUC) MA: 0.50 TEG-PM: 0.66 VN: 0.59 Cut-offs:	Flow and timing: ? no tool available for prognostic studies **Authors' conclusion** "Multiplate ASPI AUC, TEG-PM AA percent inhibition, and VerifyNow ARU accurately identified AP medication use and platelet dysfunction in trauma patients. In addition, admission TEG-PM AA percent inhibition in a trauma patient may be associated with ICH progression. However, additional larger, prospective confirmatory studies are needed to confirm these findings." **Reviewers' conclusion** The cohort is small, and no measure of variance or significance is provided, so that only limited conclusions may be drawn. There were unexplained missing data for the VerifyNow test. Cutoffs for the tests were developed in this study, and are not yet validated. The population excluded a potentially relevant group of patients who were taking oral anticoagulant medications.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	ISS 16-24: AP: 15 (38) vs. non-AP: 13 (52) ISS 27-75: AP: 13 (33) vs. non-AP: 8 (32) GCS p=0.35 GCS 13-15: AP: 26 (67) vs. non-AP: 20 (80) GCS 9-12: AP: 1 (3) vs. non-AP: 1 (4) GCS 3-8: AP: 12 (31) vs. non-AP: 4 (16)		MA: 11.0 TEG-PM: 31.9 VN: 592.5 Sensitivity (%) MA: 92 TEG-PM: 67 VN: 80 Specificity (%) MA: 24 TEG-PM: 71 VN: 47 PPV (%) MA: 46 TEG-PM: 62 VN: 47 NPV (%) MA: 80 TEG-PM: 75 VN: 80	
Gonzalez (2016) "Goal-directed Hemostatic Resuscitation of Trauma-induced Coagulopathy: A Pragmatic Randomized Clinical Trial Comparing a Viscoelastic Assay to Conventional Coagulation Assays". *Ann Surg* 2016; 263(6): 1051-1059. **Study design**	**Inclusion criteria** • ≥18 years of age • met criteria for MTP activation upon ED arrival (SBP <70 mmHg or SBP 70-90 mmHg with heart rate ≥108 bpm) • injured patients (penetrating torso wound, unstable pelvic fracture, or abdominal ultrasound suspicious of bleeding in more than one region) **Exclusion criteria** • prisoners • pregnant patients	**Participants** N=111 patients **Study groups** IG: massive transfusion protocol (MTP) goal directed by point-of-care thrombelastography (TEG) (N=56) CG: MTP goal directed by conventional coagulation assays, i.e. INR, PTT, fibrinogen, and D-dimer (N=55) Platelet counts were available to both groups as part of the complete blood cell count. Both groups had all tests performed	**Primary outcome** 28 d-mortality: n/N (%); HR (95% CI) IG: 11/56 (19.6) vs. CG: 20/55 (36.4), p=0.049 HR 2.17 (1.034–4.576); p=0.043 **Secondary outcomes** 6 h-mortality: n/N (%) IG: 4/56 (7.1) vs. CG: 12/55 (21.8), p=0.032 Time to death [h] from ED arrival, median (IQR) IG: 10.4 (4.5–200.3) vs. CG: 4.2 (2.4–9.9), p=0.181	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion** "This trial demonstrates that a goal-directed, TEG-

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Pragmatic randomised controlled trial **Aim of the study** "to compare the effect of an MTP goal directed by TEG to a standard MTP guided by CCA on the primary outcome of survival after injury." **Setting** USA, 2011-2014	**Characteristics** Age [y], median (IQR) IG: 41.0 (28–54) vs. CG: 38.0 (25–53) Male, n (%) IG: 37 (66.0) vs. 41 (74.5) ISS, median (IQR) IG: 29.5 (23–41) vs. CG: 33.0 (25–43) GCS, median (IQR) IG: 14.5 (6–15) vs. CG: 14.0 (3–15) SBP [mmHg], median (IQR) IG: 97.0 (78–120) vs. CG: 90.0 (76–110) Heart rate [beats/min], median (IQR) IG: 107.5 (90–123) vs. CG: 112.5 (94–134)	(INR, PTT, fibrinogen, D-dimer, and TEG); however, managing clinicians only had access to the test(s) assigned to the study group and were blinded to the other tests. **Co-interventions** The amounts of administered crystalloid and RBC units at 2, 4, 6, 12, and 24 hours from time of injury were similar between the 2 groups. RBC units during initial 2 h of resuscitation IG: 4.5 (2–8), CG: 5.0 (2–11), p=0.317 plasma units during initial 2 h IG: 0.0 (0–3), CG: 2.0 (0–4), p=0.022 platelets units during initial 2 h IG: 0.0 (0–0), CG: 0.0 (0–1), p=0.041 cryoprecipitate during initial 24h IG: 0.0 (0–2), CG: 1.0 (0–2), p=0.040	ICU-free time [d], value (95% CI) IG: 16 (0–22) vs. CG: 8.5 (0–19.5), p=0.091	guided MTP improves survival after injury and promotes appropriate use of hemostatic blood products while favourably impacting ICU stay and mechanical ventilation time." **Reviewers' conclusion** This is a pragmatic RCT limited by the constraints in the context of trauma care. Lack of blinding leads to a risk of performance bias, which needs to be accounted for when interpreting the results.
Hagemo (2015) "Detection of acute traumatic coagulopathy and massive transfusion requirements by means of rotational thromboelastometry: an international prospective validation study". *Critical Care* 2015; 19: 97. **Study design** Diagnostic/prognostic cross-sectional study	**Inclusion criteria** • patients ≥18 years • requiring full trauma team activation **Exclusion criteria** • patients who received ≥2,000 mL of fluids before arrival • who arrived in the ED ≥2h from time of injury • patients who were pregnant • known liver failure • bleeding disorders • taking oral anticoagulant medications other than acetylsalicylic acid	**Participants** N=808 patients **Tests evaluated** EXTEM: the citrated sample is recalcified before it is activated by tissue factor (TF) FIBTEM: the platelet inhibitor cytochalasin D was added for platelet inhibition, to isolate the fibrin component of the clot. CCT: conventional coagulation tests, incl. PT converted to international normalized ratio (INR), fibrinogen concentration and platelet count.	**Diagnostic test performance: acute traumatic coagulopathy (ATC)** Reference standard: laboratory INR >1.2 AUC value (95% CI) EXTEM CA5: 0.79 (0.76-0.81) FIBTEM CA5: 0.80 (0.77-0.83) Fibrinogen: 0.87* (0.84-0.89) Platelet count: 0.74 (0.70-0.77) analysis using new "optimum" thresholds, i.e. EXTEM CA5 ≤37 (34-39) mm FIBTEM CA5 ≤8 (5-8) mm	**Level of evidence** 2b **Risk of bias (QUADAS)** Patient selection: ? Index test: – Reference standard: + Flow and timing: + no tool available for prognostic studies **Authors' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
(part of the Activation of Coagulation and Inflammation in Trauma (ACIT) 3 study) **Aim of the study** "to identify the threshold values that most accurately identify ATC and the need for massive transfusion, using the EXTEM assay, as well as the platelet-inhibited FIBTEM assay." **Setting** UK, Denmark, Norway, 2007-2011	**Characteristics** Age [y], median (IQR) 38 (28) Male, %[$] 77.4 ISS, median (IQR) 16 (20) INR <1.2, n (%) 89 (11.0) [$] n/N not reported	Blood samples were collected within 20 minutes of arrival in hospital. ROTEM assays were performed within one hour by dedicated study personnel using the ROTEM Delta.	Fibrinogen concentration ≤1.61 (1.36-1.9) g/L Platelet count ≤199 (128-199) x 10^9/L Sensitivity (detection rate), % (95% CI) EXTEM CA5 ≤37 mm: 66.3 (55.1-76.3) FIBTEM CA5 ≤8 mm: 67.5 (55.9-77.8) Fibrinogen ≤1.61 g/L: 73.6 (63.0-82.4) Platelet count ≤199 x 10^9/L: 61.7 (46.4-75.5) False positive rate, % (95% CI) EXTEM CA5 ≤40mm: 18.8 (15.9-21.9) FIBTEM CA5 ≤8 mm: 20.7 (17.7-23.9) Fibrinogen ≤1.61 g/L: 11.5 (9.2-14.1) Platelet count ≤199 x 10^9/L: 29.9 (26.6-33.4) PPV, % (95% CI) EXTEM CA5 ≤40mm: 29.9 (23.4-37.1) FIBTEM CA5 ≤8 mm: 26.9 (20.8-33.8) Fibrinogen ≤1.61 g/L: 45.1 (36.7-53.6) Platelet count ≤199 x 10^9/L: 11.9 (8.1-16.7) NPV, % (95% CI) EXTEM CA5 ≤40mm: 95.2 (93.2-96.8) FIBTEM CA5 ≤8 mm: 95.6 (93.5-97.1) Fibrinogen ≤1.61 g/L: 96.3 (94.5-97.7) Platelet count ≤199 x 10^9/L: 96.5 (94.6-97.9) **Prognostic test performance: prediction of patients in need of massive transfusion** analysis using previous thresholds Sensitivity (detection rate), % (95% CI) INR >1.2: 51.1 (36.1-65.9) CT >94s: 28.9 (16.4-44.3) EXTEM CA5 <35 mm: 45.5 (30.4-61.2) α-angle <65°: 37.2 (23.0-53.3) False positive rate, % (95% CI)	"this study confirms the previous finding that the ROTEM CA5 value measured on arrival is a valid marker for ATC and predicts MT requirements. An EXTEM CA5 threshold value of ≤40 mm has a detection rate of 72.7%, whereas a FIBTEM CA5 threshold value of ≤9 mm detects MT requirements in 77.5% of cases. Fibrinogen concentration was significantly better than ROTEM assays in predicting ATC, and a fibrinogen concentration ≤1.90 g/L had a detection rate of 77.8% for MT requirement." **Reviewers' conclusion** Patients were non-consecutively recruited, which may lead to selection bias. Cut-offs for the tests were developed in this study, and are not yet validated. The population excluded a potentially relevant group of patients with bleeding disorders or who were taking oral anticoagulant medications.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			INR >1.2: 8.8 (6.8-11.0) CT >94s: 8.8 (6.9-11.2) EXTEM CA5 <35 mm: 16.1 (13.5-19.0) α-angle <65°: 12.2 (9.9-14.8) PPV, % (95% CI) INR >1.2: 27.3 (18.3-37.9) CT >94s: 16.5 (9.1-26.5) EXTEM CA5 <35 mm: 14.4 (9.0-21.3) α-angle <65°: 15.1 (8.9-23.4) NPV, % (95% CI) INR >1.2: 96.7 (95.0-97.9) CT >94s: 95.5 (93.7-96.9) EXTEM CA5 <35 mm: 96.3 (94.5-97.6) α-angle <65°: 96.0 (94.2-97.3) **ROC analyses, prediction of massive transfusion** AUC value (95% CI) EXTEM CA5: 0.75 (0.72-0.78) FIBTEM CA5: 0.78 (0.74-0.81) Fibrinogen: 0.81 (0.78-0.83) INR: 0.82 (0.79-0.84) Platelet count: 0.70 (0.66-0.73) analysis using new “optimum” thresholds: EXTEM CA5 ≤40 (32-40) mm FIBTEM CA5 ≤9 (6-9) mm Fibrinogen concentration ≤1.90 (1.39-2.18) g/L INR ≥1.13 (1.0-1.16) Platelet count ≤174 (159-182) x 10^9/L Sensitivity (detection rate), % (95% CI) EXTEM CA5 ≤40 mm: 72.7 (57.2-85.0) FIBTEM CA5 ≤9 mm: 77.5 (61.5-89.2) Fibrinogen ≤1.90 g/L: 77.8 (62.9-88.8)	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			INR ≥1.13: 70.2 (55.1-82.7) Platelet count ≤174 x 10^9/L: 52.8 (41.9-63.5) False positive rate, % (95% CI) EXTEM CA5 ≤40 mm: 31.3 (28.0-34.8) FIBTEM CA5 ≤9 mm: 32.8 (29.4-36.4) Fibrinogen ≤1.90 g/L: 29.7 (26.4-30.1) INR ≥1.13: 19.0 (16.2-22.1) Platelet count ≤174 x 10^9/L: 14.8 (12.2-17.7) PPV, % (95% CI) EXTEM CA5 ≤40 mm: 12.2 (8.5-16.8) FIBTEM CA5 ≤9 mm: 11.4 (7.9-15.8) Fibrinogen ≤1.90 g/L: 14.0 (9.9-18.9) INR ≥1.13: 19.2 (13.6-25.9) Platelet count ≤174 x 10^9/L: 32.2 (24.7-40.4) NPV, % (95% CI) EXTEM CA5 ≤40 mm: 97.7 (96.0-98.8) FIBTEM CA5 ≤9 mm: 98.2 (96.6-99.2) Fibrinogen ≤1.90 g/L: 98.1 (96.5-99.1) INR ≥1.13: 97.7 (96.2-98.7) Platelet count ≤174 x 10^9/L: 93.1 (90.8-95.0) * AUC is significantly larger than the AUC of the ROTEM parameters (p=0.002 for difference to FIBTEM CA5).	
Moore (2017) "Viscoelastic Tissue Plasminogen Activator Challenge Predicts Massive Transfusion in 15 Minutes". *J Am Coll Surg* 2017; 225(1): 138-147. **Study design**	**Inclusion criteria** • Consecutive adult trauma patients • meeting criteria for the highest level of activation **Exclusion criteria** • n.r. **Characteristics**	**Participants** N=324 patients **Study groups** R-TEG: rapid thrombelastogram (TEG) Reaction time (R-time min.), angle (°), maximum amplitude (MA [mm]), time to MA (TMA min.) and lysis 30 min after MA (LY30 [%]).	Time to result [min], median (IQR) Lt-LY30 >27%: 50 (47–53) Lt-TMA <23min: 19 (16–21) Ht-LY30 >71%: 42 (40–44) R-TEG MA <57mm: 23 (20–28) **Prognostic test performance: prediction of massive transfusion**	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "Using a high dose tPA TEG to help guide the activation

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Prognostic cross-sectional study **Aim of the study** "We hypothesize that a modified thrombelastogram (tPA-TEG) with the addition of exogenous tPA (tPA-TEG) predicts the patients' risk for requiring a MT more efficiently than current scoring systems." **Setting** USA, 2014-2016	Age [y], median (IQR?)* 33 (26–48) Male, %$ 81 ISS, median (IQR?)* 16 (5–27) GCS, median (IQR?)* 15 (7–15) Systolic blood pressure [mmHg], median (IQR?)* 112 (90–138) Heart rate, median [beats/min] (IQR?)* 102 (82–118) * measure of variance unclear $ n/N not reported	Lt-TEG: r-TEG assay with low dose of tissue plasminogen activator (tPA) Ht-TEG: TEG assay with high dose of tPA INR: international normalized ratio SI: shock index = heart rate/systolic blood pressure ABC: assessment of blood consumption score TASH: trauma associated severe hemorrhage score	Massive transfusion defined as >4 units of RBC per h or death attributed to hemorrhagic shock during the initial 6 h postinjury AUC (95% CI) Lt-LY30: 0.86 (0.79–0.93) Lt-TMA: 0.79 (0.71–0.87) Ht-LY30: 0.84 (0.77–0.91) Ht-TMA: 0.78 (0.71 – 8.5) R-TEG MA: 0.79 (0.73–0.85) INR: 0.86 (0.81–0.91) TASH: 0.84 (0.79–0.90) SI: 0.70 (0.61–0.80) ABC: 0.66 (0.58–0.74) Thresholds by Youden index Lt-LY30: 27% Lt-TMA: 23 min Ht-LY30: 71% Ht-TMA: 16 min R-TEG MA: 57mm INR: 1.1 TASH: 8 SI: 1.07 ABC: 1 Sensitivity, % (95% CI) Lt-LY30: 84 Lt-TMA: 67 Ht-LY30: 80 Ht-TMA: 84 R-TEG MA: 68 INR: 90 TASH: 87 SI: 63 ABC: 85 Specificity, % (95% CI)	of the massive transfusion protocol provides actionable results within 16 minutes. Combining this assay with an INR can raise its positive predictive value from 36% to 49% while excluding 97% of patients that did not require a massive transfusion." **Reviewers' conclusion** A non-standard definition for massive transfusion is used, limiting comparability with other studies. Cutoffs for the tests were developed in this study, and are not yet validated. No measure of variance or significance is provided, so that only limited conclusions may be drawn. The effect on patient-relevant outcomes of using these tests to take therapeutic decisions was not investigated.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Lt-LY30: 82 Lt-TMA: 85 Ht-LY30: 84 Ht-TMA: 70 R-TEG MA: 79 INR: 69 TASH: 76 SI: 77 ABC: 37 PPV, % (95% CI) Lt-LY30: 50 Lt-TMA: 45 Ht-LY30: 50 Ht-TMA: 36 R-TEG MA:41 INR: 33 TASH: 38 SI: 37 ABC: 22 NPV, % (95% CI) Lt-LY30: 96 Lt-TMA: 92 Ht-LY30: 95 Ht-TMA: 94 R-TEG MA:92 INR: 97 TASH: 97 SI: 92 ABC: 92	
Peng (2019) "A comparative study of viscoelastic hemostatic assays and conventional coagulation tests in trauma	**Inclusion criteria** • adults (age >18 y) • severe trauma patients • identified as being at risk for significant haemorrhage by hypotension (SBP	**Participants** N=45 patients **Tests evaluated** TEG FF MA: maximum amplitude or maximum clot strength (MA) determined by	**Diagnosis of hypofibrinogenemia** Reference test: 48h fibrinogen <1 g/L AUC (95% CI) TEG FF MA: 0.948 (0.886–1.000), p=0.002	**Level of evidence** 3b↓ **Risk of bias (QUADAS)** Patient selection: ?

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
patients receiving fibrinogen concentrate". *Clinica Chimica Acta* 2019; 495: 253-262. **Study design** Diagnostic cross-sectional study (substudy of the FiiRST RCT) **Aim of the study** "we conducted a comparative study of functional fibrinogen and coagulation assays using TEG and ROTEM and CCTs to determine their capability to monitor coagulation profiles, diagnose coagulopathy and predict blood transfusion requirements in trauma patients." **Setting** Canada, 2014-2015	≤100 mmHg) and need for uncross-matched RBC transfusion ≤30 min of arrival **Exclusion criteria** • received any blood or blood products before admission • presented >6 h after injury • estimated body weight < 50 kg • known or suspected pregnancy • catastrophic brain injury (any of: GCS of 3 as a result of brain injury; need of immediate neurosurgery, focal signs such as anisocoria or imaging evidence of intracranial bleeding with mass effect, transcranial gunshot wound, or open skull fracture with exposure/loss of brain tissue) • non-haemorrhagic shock (i.e. obstructive [cardiac tamponade, tension pneumothorax and massive pulmonary emboli], neurogenic, cardiogenic, or septic) • underlying hereditary or acquired coagulopathy • known or suspected use of anticoagulant medications such as warfarin, low-molecular weight heparin, and direct thrombin and factor Xa inhibitors • moribund and predicted to expire in a few h. **Characteristics** <u>Age [y], median (range)</u> FC: 48 (19–78) vs. placebo: 28 (19–88) <u>Male, %</u>[$]	standard functional fibrinogen (FF) thrombelastography (TEG) test TEG FIBTEM MA: MA determined by a cross-over test using ROTEM reagents on TEG with the same reagent:blood ratio as the ROTEM FIBTEM test ROTEM FIBTEM MCF: rotational thromboelastometry (ROTEM) FIBTEM was performed using 300 µL of citrated whole blood and 20 µL of ex-tem together with 20 µL of fib-tem following the procedure as recommended by the company. ROTEM EXTEM MCF: ROTEM EXTEM was conducted in parallel using 300 µL of the same blood sample and 20 µL of start-tem together with 20 µL of ex-tem. Reference tests: conventional coagulation tests (CCTs) including 48h fibrinogen (threshold <1 g/L) and 48h INR (threshold ≥1.2) TEG FF/FIBTEM, ROTEM FIBTEM/EXTEM tests and CCTs were simultaneously performed during hospital admission and 48-h hospitalization. **Co-interventions** N=21 allocated to fibrinogen concentrate (FC), N=24 allocated to placebo	ROTEM FIBTEM MCF: 0.962 (0.900–1.000), p<0.001 TEG FIBTEM MA: 0.945 (0.893–0.997), p<0.001 ROTEM EXTEM MCF: 0.920 (0.833–1.000), p<0.001 **Diagnosis of coagulopathy** Reference test: 48h INR ≥1.2 <u>AUC (95% CI)</u> TEG FF MA: 0.557 (0.480–0.634), p=0.15 ROTEM FIBTEM MCF: 0.564 (0.488–0.640), p=0.10 TEG FIBTEM MA: 0.533 (0.455–0.611), p=0.41 ROTEM EXTEM MCF: 0.609 (0.535–0.683), p=0.005	Index test: – Reference standard: + Flow and timing: + **Authors' conclusion** "all TEG MA and ROTEM MCF predicted hypofibrinogenemia with high accuracies. For the diagnosis of coagulopathy, only EXTEM MCF performed reasonably well" **Reviewers' conclusion** The population excluded a potentially relevant group of patients who were taking oral anticoagulant medications or with underlying hereditary or acquired coagulopathy. Only AUC values were evaluated, and no cut-offs were derived, which limits the applicability of the study results. It is unclear whether text results were interpreted without knowledge of the reference standard.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	FC: 77 vs. placebo: 87 ISS, median (IQR) FC: 25 (19–29) vs. placebo: 23 (18–29) GCS, median (IQR) FC: 15 (14–15) vs. placebo: 15 (12–15) Systolic blood pressure [mmHg], median (IQR) FC: 106 (80–144) vs. placebo: 99 (82–99) INR, mean (SD) FC: 1.2 (0.3) vs. placebo: 1.1 (0.2) $ n/N not reported			
Rizoli (2016) "In Trauma, Conventional ROTEM and TEG Results Are Not Interchangeable But Are Similar in Clinical Applicability". *Military Medicine* 2016; 181(5): 117. **Study design** Diagnostic and prognostic cross-sectional study **Aim of the study** "a study on the interchangeability of the conventionally performed TEG and ROTEM. We also investigated whether one test would be superior to	**Inclusion criteria** • adults (age >16 y) • severely injured (ISS >15) • patients admitted directly from the scene ≤1 h of the trauma • significant bleeding (expected to receive massive transfusion based on the ABC score ≥2 for massive transfusion) and probable coagulopathy (INR ≥1.2 and/or fibrinogen <1 g/L) **Exclusion criteria** • known acquired coagulopathy • not received directly from the injury scene • ≤15 years or ≤50 kg if age unknown • pregnancy **Characteristics**	**Participants** N=33 patients **Study groups** TEG MA: thrombelastography (TEG) maximum amplitude (MA) on a TEG 5000 Analyzer (Haemoscope, Niles, Illinois) using kaolin activation EXTEM MCF: maximum clot firmness (MCF) by EXTEM assay on a ROTEM delta system (TEM Systems, Durham, North Carolina) using tissue factor (conventional) FIBTEM MCF: maximum clot firmness (MCF) by FIBTEM assay on a ROTEM delta system (TEM Systems, Durham, North Carolina) using added cytochalasin D as a platelet inhibitor	**Diagnosis of hypofibrinogenemia** Reference test: fibrinogen <1 g/L AUC (95% CI)$ TEG MA: 0.743 (0.530–0.956) EXTEM MCF: 0.549 (0.285–0.812), p=0.09 FIBTEM MCF: 0.558 (0.348–0.769), p=0.12 **Diagnosis of coagulopathy** Reference test: INR ≥1.2 AUC (95% CI)$ TEG MA: 0.595 (0.452–0.738) EXTEM MCF: 0.566 (0.422–0.709), p=0.63 FIBTEM MCF: 0.595 (0.452–0.738), p=0.76 **Prediction of mortality** AUC (95% CI)$	**Level of evidence** 3b↓ **Risk of bias (QUADAS)** Patient selection: ? Index test: – Reference standard: + Flow and timing: + no tool available for prognostic studies **Authors' conclusion** "The results from TEG and ROTEM, when conventionally performed, failed to reach acceptable limits of agreement and thus are

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
the other in predicting mortality, the need for blood transfusion, and diagnosing early trauma coagulopathy." **Setting** Canada, 2012-2013	Age [y], mean ± SD 40.2 ± 20.1 Male, n (%) 26 (78.79) ISS, mean ± SD 23.5 ± 14.0 Admission Systolic blood pressure [mmHg], mean ± SD 123.4 ± 26.5 Admission heart rate [bpm], mean ± SD 99.6 ± 20.9 INR, mean ± SD 1.33 ± 0.4	Reference tests: International normalized ratio (INR) ≥1.2 or fibrinogen <1 g/L defined coagulopathy. ROTEM and TEG were performed simultaneously in the same patients within 30 minutes of admission and repeated when clinically indicated during the first 12 hours. The results of the VHA were not available to the clinicians and none of the clinical decisions made were based on the ROTEM or TEG results.	TEG MA: 0.709 (0.563–0.855) EXTEM MCF: 0.743 (0.607–0.880), p=0.59 FIBTEM MCF: 0.755 (0.563–0.947), p=0.59 **Prediction of massive RBC transfusion** replacement of ≥10 units of RBCs within 24 h AUC (95% CI)[$] TEG MA: 0.812 (0.706–0.918) EXTEM MCF: 0.830 (0.734–0.927), p=0.73 FIBTEM MCF: 0.783 (0.646–0.919), p=0.0001 [$] p-values compared to TEG MA	not interchangeable. (…) Although the results are not interchangeable, both VHA appear to have a similar clinical performance in predicting mortality, the need for blood transfusion, and diagnosing early trauma coagulopathy." **Reviewers' conclusion** Only AUC values were evaluated, and no cut-offs were derived, which limits the applicability of the study results. It is unclear whether text results were interpreted without knowledge of the reference standard. The population excluded a potentially relevant group of patients with acquired coagulopathy.
Spagnolello (2020) „Introduction of a ROTEM protocol for the management of trauma-induced coagulopathy". *Trauma* 2020; 1-14. **Study design** Prognostic cross-sectional study **Aim of the study**	**Inclusion criteria** • adult patient (≥16 y) • major trauma patients thought to be bleeding • underwent ROTEM testing **Exclusion criteria** • Patients on anticoagulant medication (local protocol suggests point-of-care INR testing followed by immediate reversal using Prothrombin Complex	**Participants** N=57 patients **Study groups** EXTEM A5 <35mm: clot firmness by rotational thromboelastometry at 5 minutes <35mm iTACTIC: the implementation treatment algorithms for the correction of trauma-induced coagulopathy (iTACTIC) ROTEM algorithm; for thresholds, see Hagemo (2015)	Time from ED admission to result [min], median (IQR) CCT: 83 (60-93) ROTEM A5: 51 (32–93), p=0.0006 vs. CCT ROTEM A10: 56 (37-98) **Prognostic test accuracy: prediction of massive transfusion** Sensitivity: % (95% CI) EXTEM A5 <35mm: 54.5 (23.3–83.2) iTACTIC: 100.0 (71.5–100.0) RIE A5: 36.3 (10.9–69.2)	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "In summary, we have developed and validated a simplified ROTEM algorithm for the management

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"The aims of this study were (a) to compare time to results for ROTEM testing versus laboratory conventional coagulation testing (CCT) and (b) to compare incidence of Trauma-induced coagulopathy (TIC) for our 5 and 10 minute ROTEM algorithms versus both the CCT-based European guideline algorithm and the ROTEM-based iTACTIC study algorithm, in both MT and non-MT patients." **Setting** UK, 2016-2019	Concentrate (PCC) prior to ROTEM testing) **Characteristics** Age [y], mean ± SD IG: 47.4 ± 19.3 Male, n (%) 44 (77.2) ISS, median (IQR) 25.0 (16.0–30.0) Ssystolic blood pressure [mmHg], median (IQR) 110.0 (90.0–120.00) TICCS, median (IQR) 7.0 (4.0–9.0) Time from admission to sampling [min], median (IQR) 20 (11-85)	RIE A5: Edinburgh ROTEM algorithm using only clot firmness 5 min. after the clot is first detected RIE A10: Edinburgh ROTEM algorithm using only clot firmness 10 min. after the clot is first detected CCT: conventional coagulation tests with INR >1.5; fibrinogen concentration ≤1.5 g/l; platelet count ≤50 or platelet count ≤100. sample for ROTEM testing drawn at the same time as the CCT **Full Edinburgh algorithm (considers three aspects of haemostasis)** • 1. clot firmness or strength (assessed from the A10 or A5, the clot firmness 10 or 5 mins after the clot is first detected) which is reduced by a low platelet count, a low plasma fibrinogen concentration and impaired fibrin polymerisation. • 2. the time taken until clot is first detected (assessed from the clotting time; CT) which is prolonged by a low fibrinogen concentration, low concentrations of other coagulation factors, anticoagulants and by thrombocytopenia (because in a whole blood test such as ROTEM, coagulation factors act on the surface of platelets). • 3. whether there is excessive clot lysis.	RIE A10: 45.4 (16.7–76.6) CCT: 54.5 (23.3–83.2) Specificity: % (95% CI) EXTEM A5 <35mm: 65.2 (49.7–78.6) iTACTIC: 23.9 (12.6–38.7) RIE A5: 93.4 (82.1–98.6) RIE A10: 93.5 (82.1–98.6) CCT: 82.6 (68.6–92.2) PPV: % (95% CI) EXTEM A5 <35mm: 27.2 (16.1–42.3) iTACTIC: 23.9 (21.1–27.0) RIE A5: 57.1 (25.8–83.6) RIE A10: 62.5 (31.8–85.6) CCT: 42.8 (24.6–63.2) NPV: % (95% CI) EXTEM A5 <35mm: 85.7 (75.2–92.2) iTACTIC: 100.0 (71.5–100.0) RIE A5: 86.0 (79.6–90.6) RIE A10: 87.7 (80.6–92.5) CCT: 88.3 (79.7–93.6) Test accuracy (ACC): % (95% CI) EXTEM A5 <35mm: 63.1 (49.3–75.5) iTACTIC: 38.6 (26.0–52.4) RIE A5: 82.4 (70.0–91.2) RIE A10: 84.2 (72.1–92.5) CCT: 77.2 (64.1–87.2)	of trauma patients using 5 and 10 minute EXTEM and FIBTEM thresholds which enables coagulation assessment to be obtained faster than laboratory CCT, identifies more patients with TIC, recommends fewer blood component transfusions to patients with a lesser degree of coagulation abnormality and predicts the need for MT better than other existing ROTEM algorithms." **Reviewers' conclusion** It is unclear whether the sample was consecutive because only patients with ROTEM data were included. The cohort is small, leading to wide confidence intervals. The effect of each treatment algorithm on patient-relevant outcomes was not investigated. The population excluded a potentially relevant group of patients on anticoagulant medication.

+: low risk; –: high risk; ?: unclear risk; A: Austria; A10: clot firmness by rotational thromboelastometry at 10 minutes; A5: clot firmness by rotational thromboelastometry at 5 minutes; ABC: assessment of blood consumption score; adj.: adjusted; AIS: Abbreviated Injury Scale; AP: anti-platelets; ARU: Aspirin Reaction Units; ASA: aspirin; ATC: acute traumatic coagulopathy; ATIC: Acute Trauma-Induced Coagulopathy; AUC: Area under the receiver operating characteristic curve; CCT: conventional coagulation tests; CG: control group; CI: Confidence Interval; CT: coagulation time; d: days; DFI: depletion of fibrinolytic inhibitors; ED: emergency department; GCS: Glasgow Coma Score; h: hours; HR: hazard ratio; Ht-TEG: thromboelastography assay with high dose of tissue plasminogen activator; IG: intervention group; INR: international normalized ratio; IQR: Interquartile Range; ISS: injury severity score; iSTBI: Isolated Severe Traumatic Brain Injury; iTACTIC: the implementation treatment algorithms for the correction of trauma-induced coagulopathy; L: litres; LoE: level of evidence; Lt-TEG rapid thromboelastography assay with low dose of tissue plasminogen activator; LY30; lysis at 30

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
min; m: months; MA: maximum amplitude; MAP: mean arterial pressure; MCF: Maximum Clot Firmness; MHP: major haemorrhage protocol; min: minutes; mmHg: millimetres of mercury; MODS: multiple organ dysfunction syndrome; MT: massive transfusion; MTP: massive transfusion protocol; n.r.: not reported; NPV: negative predictive value; PCC: prothrombin complex concentrate; PLT: platelets; PPV: positive predictive value; PT: prothrombin time; P-TEG: plasmin- thromboelastography; RBC: red blood cells; RIE: Edinburgh ROTEM algorithm; ROC: receiver operating curve; RR: Relative Risk; rTEG: rapid thromboelastography; s: seconds; SBP: systolic blood pressure; SD: Standard deviation; SI: shock index; TASH: trauma associated severe hemorrhage score; TBI: traumatic brain injury; TEG FF MA: maximum amplitude or maximum clot strength determined by standard functional fibrinogen thrombelastography test; TEG FIBTEM MA: maximum amplitude or maximum clot strength determined by a crossover test using ROTEM reagents on thrombelastography with the same reagent:blood ratio as the ROTEM FIBTEM test; TEG: Thromboelastography; TEG-PM AA: Thrombelastography Platelet Mapping percent inhibition of arachidonic acid; TEG-PM: Thrombelastography Platelet Mapping; TICCS: Trauma Induced Coagulopathy Clinical Score; TMA: time to maximum amplitude; tPA TEG: tissue plasminogen activator thromboelastography; tPA: tissue plasminogen activator; TXA: tranexamic acid; UK: United Kingdom; USA: United States of America; VHA: viscoelastic haemostatic assay; VN: Verify Now; y: years				

Volumentherapie, permissive Hypotension, MAP Ziele

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Carrick (2016) "Intraoperative hypotensive resuscitation for patients undergoing laparotomy or thoracotomy for trauma: Early termination of a randomized prospective clinical trial". *Journal of Trauma and Acute Care Surgery* 2016; 80(6): 886-896 **Study design** Randomised controlled trial **Aim of the study** "The aim of the study was to assess if intraoperative hypotensive resuscitation would improve survival for patients undergoing	**Inclusion criteria** • all penetrating trauma patients seen in Ben Taub Hospital Emergency Center (EC) • SBP ≤90 mmHg • In need of laparotomy or thoracotomy **Exclusion criteria** • blunt mechanism of injury • age of <14 years or >45 years (older patients could potentially have underlying cerebrovascular or cardiac disease) • known or suspected head injury • pregnant women • incarcerated individuals • patients with "opt-out" bracelets that signify their refusal of participation in the project **Characteristics**	**Participants** N=180 patients **Study groups** IG: LMAP (target MAP ≥50 mmHg) (N=89 total, N=86 analysed) CG: HMAP (target MAP ≥65 mmHg) (N=91 total, N=82 analysed) Methods for achieving the target blood pressure goals were left to the discretion of the treating anesthesiologist. If patients were able to spontaneously maintain a MAP greater than their assigned target, the blood pressure was not intentionally lowered.	**Primary Outcome** 30d Mortality, n/N (%) IG: 18/84 (21.4), p=0.47 CG: 21/80 (26.3) **Other Outcomes** Deaths due to exsanguination, n/N (% of deaths) IG: 10/18 (56) CG: 15/21 (71) Intraoperative MAP [mmHg], mean ± SD IG: 65.5 ± 11.6, p=0.07 CG: 69.1 ± 13.8 Percentage of time under target MAP (%) IG: 12.6, p<0.001 CG: 35.2 **Postoperative Complications** Acute renal injury, n/N (%)	**Level of evidence** 2b↓ **Risk of bias** Selection bias: + Performance bias: + Attrition bias: + Detection bias: + **Authors' conclusion** „The study was unable to demonstrate that hypotensive resuscitation at a target MAP of 50 mm Hg could significantly improve 30-day mortality. Further, the trial was terminated early because of temporal changes in processes of care, lack of equipoise,

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
operative control of hemorrhage following penetrating trauma." **Setting** USA, 2007-2013	Age [y], median (range) IG: 28 (16 - 54), p=0.24 CG: 32 (15 - 54) Male, n (%) IG: 79 (91.9), p=0.53 CG: 73 (89.0) ISS, median (range) IG: 17 (1 - 43), p=0.43 CG: 18 (4 - 75) GCS, median (range) IG: 15 (3 - 15), p=0.35 CG: 14 (3 - 15) SBP [mmHg], median (range) IG: 85 (11 - 161), p=0.16 CG: 79 (40 - 144)		IG: 10/75 (13.3), p=0.01 CG: 20/66 (30.3) Coagulopathy, n/N (%) IG: 21/75 (28.0), p=0.92 CG: 19/66 (28.8)	slow accrual, and futility and therefore was underpowered." **Reviewers' conclusion** Physicians and investigators were not/could not be blinded, but both groups received similar co-interventions. The study was underpowered to detect differences in mortality due to early termination.
Gu (2020) „Restricted fluid resuscitation improves the prognosis of patients with traumatic hemorrhagic shock". *International Journal of Clinical and Experimental Medicine* 2020; 13(7): 5319-5327 **Study design** Prospective randomised controlled trial **Aim of the study**	**Inclusion criteria** • Patients who met the diagnostic criteria of hemorrhagic shock in the "Chinese emergency medicine expert consensus on diagnosis and treatment of traumatic hemorrhagic shock" issued by the Chinese College of Emergency Physicians in 2017 • patients who were admitted to our hospital for the first time and who were admitted within 6 hours of their arrival and who had not been transferred • patients who were over 18 years old **Exclusion criteria**	**Participants** N=160 patients **Study groups** IG: restricted fluid resuscitation (N=80) • 500 - 1,500 mL of compound sodium chloride solution given within 30-60 min • Then 500 mL of hydroxyethyl starch given for the resuscitation • The total liquid infusion volume ranged from 1,500 mL to 2,000 mL • MAP 50-60 mmHg CG: routine fluid resuscitation (N=80)	MAP after resuscitation [mmHg]: mean ± SD IG: 61.3 ± 3.5 (p<0.001) CG: 71.1 ± 4.6 **Comparison of the prognosis** Death: n (%) IG: 5 (6.3) (p=0.045) CG: 13 (16.3) Acute Respiratory Distress Syndrome (ARDS): n (%) IG: 10 (12.5) (p=0.018) CG: 22 (27.5)	**Level of evidence** 1b **Risk of bias** Selection bias: ? Performance bias: ? Attrition bias: ? Detection bias: + **Authors' conclusion** „Compared with traditional aggressive fluid resuscitation, restricted fluid resuscitation can improve patient prognosis, effectively

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"To explore the effect of restricted fluid resuscitation on coagulation, the serum inflammatory factors, and the prognoses of patients with traumatic hemorrhagic shock." **Setting** China, 2018 – 2020	• Patients who had dysfunction of the vital organs including the liver and kidneys before their admission • patients who were admitted with MODS and ARDS • patients with incomplete clinical data **Characteristics** Age [years], mean ± SD IG: 36.8 ± 7.5 (p=0.313) CG: 38.1 ± 8.7 Gender, male / female, n (%) IG: 59 (73.8%) / 21 (26.2%) (p=0.301) CG: 53 (66.3%) / 27 (34.7%) Shock index, mean ± SD IG: 2.1 ± 0.4 (p=0.116) CG: 2.2 ± 0.4 Injury Severity Score (ISS), mean ± SD IG: 27.6 ± 3.2 (p=0.149) CG: 28.3 ± 2.9 Infusion volume during fluid resuscitation [mL], mean ± SD IG: 1526.4 ± 115.7 mL (p<0.001) CG: 2754.9 ± 153.8 mL MAP at time of admission [mmHg], mean ±SD IG: 59.3 ± 6.3 (p=0.222) CG: 58.6 ± 6.9	• 1,500 - 2,000 mL of compound sodium chloride solution given for volume expansion • Then 500 - 1,000 mL of hydroxyethyl starch given for the resuscitation • MAP 60-80 mmHg	Multiple Organ Dysfunction Syndrome (MODS): n (%) IG: 7 (8.8) (p=0.017) CG: 18 (22.5)	reducing the mortality and decreasing the incidences of ARDS and MODS." **Reviewers' conclusion** Because of incomplete reporting, the risk of selection, performance, and attrition bias cannot be assessed since no information on the randomization process, blinding and completeness of the data is available.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Lu 2018 "Controlled blood pressure elevation and limited fluid resuscitation in the treatment of multiple injuries in combination with shock ". *Pakistan Journal of Medical Sciences* 2018; 34(5): 1120-1124 **Study design** Randomised controlled trial **Aim of the study** "The aim of the study was to explore the effectiveness of controlled blood pressure elevation and limited fluid resuscitation in treating patients with multiple injuries in combination with shock in Intensive Care Unit (ICU). " **Setting** China, 2014-2017	**Inclusion criteria** • admission to ICU due to severe multiple injuries • injury severity score >16 • hemorrhagic shock • average arterial pressure <65 mmHg or systolic pressure <40 mmHg • undergone hemostatic treatment one or two hours after admission **Exclusion criteria** • death within 24 hours after admission to ICU • craniocerebral trauma, severe cardiopulmonary and hepatic and renal dysfunction or severe hypertension **Characteristics** Age [y], mean ± SD IG: 32.3 ± 4.2 (p<0.05) CG: 33.6 ± 4.2 Sex, n/N IG: 53/82 male, 29/82 female CG: 57/82 male, 25/82 female Shock, n/N *Severe* IG: 37/82 CG: 39/82 *Moderate* IG: 31/82 CG: 33/82	**Participants** N=164 patients **Study groups** IG: controlled blood pressure elevation and limited fluid resuscitation with 7.5% sodium chloride solution and plasma solution (N=82) • MAP: 40-50 mmHg CG: conventional fluid resuscitation and controlled blood pressure elevation (N=82) • MAP: 60-80 mmHg	**Primary outcomes** Recovery time [min], mean ± SD IG: 89.7 ± 25.2 (p=0.000) CG: 193.5 ± 38.7 Hemoglobin [g/L], mean ± SD IG: 102.5 ± 13.0 (p=0.006) CG: 84.6 ± 8.3 Prothrombin time [s], mean ± SD IG: 10.1±13.0 CG: 16.9±2.4 p=0.000 C-reactive protein level [mg/L], mean ± SD IG: 101.7±12.3 GC: 132.4±20.6, p=0.000 **Other outcomes** Fatality Rate, n/N (%) IG: 2/82 (2.4) (p=0.041) CG: 15/82 (18.3) Lactate Clearance [mmol/L], mean ± SD Blood lactic acid before resuscitation IG: 5.73 ± 1.29 (p=0.163) CG: 5.94 ± 1.61 Lactate Clearance Rate at 3h IG: 0.22 ± 0.01 (p=0.008) CG: 0.27 ± 0.03 Lactate Clearance Rate at 6h IG: 0.37 ± 0.06 (p=0.000) CG: 0.51 ± 0.08	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: ? Detection bias: ? **Authors' conclusion** "Controlled blood pressure elevation in combination with limited fluid resuscitation is more effective than conventional fluid resuscitation in the treatment of patients with multiple injuries and shock in ICU as it can shorten recovery time, improve microcirculation perfusion and prognosis, and reduce related complications and fatality rate." **Reviewers' conclusion** There might be a risk of performance and detection bias, as the study does not provide sufficient information on blinding and length of follow up.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Mild IG: 14/82 CG: 10/82		Lactate Clearance Rate at 24h IG: 0.77 ± 0.04 (p=0.179) CG: 0.76 ± 0.04 Complications, n/N (%) Disseminated intravascular coagulation IG: 2/82 (2.4) (p=0.039) CG: 14/82 (17.1) Respiratory distress syndrome IG: 10/82 (12.2) (p=0.006) CG: 25/82 (30.5) Multiple organ dysfunction syndrome IG: 10/82 (12.2) (p=0.027) CG: 24/82 (29.3)	
+: low risk; –: high risk; ?: unclear risk; adj.: adjusted; AIS: Abbreviated Injury Scale; ARDS: Acute Respiratory Distress Syndrome; BD: base deficit; CG: control group; CI: Confidence Interval; d: days; GCS: Glasgow Coma Score; h: hours; IG: intervention group; IQR: Interquartile Range; ISS: injury severity score; ITT: Intention to Treat analysis; L: litres; LoE: level of evidence; m: months; MAP: mean arterial pressure; min: minutes; mmHg: millimetres of mercury; MODS: multiple organ dysfunction syndrome; RR: Relative Risk; s: seconds; SBP: systolic blood pressure; SD: Standard Deviation; TBI: traumatic brain injury; y: years				

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Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Han (2015) "Comparison of 3% And 7.5% Hypertonic Saline in Resuscitation after Traumatic Hypovolemic Shock". *Shock* 2015; 43(3): 244-249 **Study design** Randomised controlled trial	**Inclusion criteria** • trauma victims with prehospital SBP≤70 mmHg or 70 to 90 mmHg • heart rate (HR) of ≥108 beats/min • aged 15 years or older **Exclusion criteria** • younger than 15 years • injury during previous 4 h • hypothermia (<28°C)	**Patients** N=246 patients **Study groups** IG1: 3% HSS (Hypertonic saline solution) (N=82) IG2: 7.5% HSS (Hypertonic saline solution) (N=80) • CG: LRS (standard fluid, LactDiated Ringer's solution) (N=84)	Mortality, n (%) Total deaths: 37 (15.4) Deaths within first 24 h: 30 (81.1) 24-h survival in IG1 and IG2 better than CG, but no statistically significant difference **Postinfusion complications, n (%)** Tachycardia	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: + Attrition bias: ? Detection bias: ? **Authors' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Aim of the study "The aim of this study was to evaluate the resuscitative effects and safety of 3% Hypertonic saline solution (HSS) and to compare the risks of complications caused by HSS and standard fluid treatments." **Setting** China, 2008-2012	• administration of dopamine or other vasoactive agents • administration of more than 2,000 mL of crystalloid before the study fluid • ongoing cardiopulmonary resuscitation • severe cardio-respiratory dysfunction • known or suspected pregnancy • traumatic brain injury (TBI) • death within 1 h after intervention **Characteristics** Age, years (mean ± SD) IG1: 45 ± 0.5 IG2: 48 ± 3.1 CG: 43 ± 9.5 Males, n (%)) IG1: 61 (74.4) IG2: 65 (81.3) CG: 63 (75.0) ISS (mean ± SD) IG1: 18.5 ± 2.5 IG2: 15.6 ± 3.1 CG: 16.5 ± 3.4 Shock index (mean ± SD) IG1: 1.5 ± 0.2 IG2: 1.6 ± 0.3 CG: 1.5 ± 0.2 Preinfusion MAP, mmHg (mean ± SD) IG1: 49 ± 6.6 IG2: 51 ± 9.7 CG: 52 ± 4.7 Infusion volume, 1 h, L (mean ± SD)		IG1: 5 (6.1) IG2: 22 (27.5) (vs. IG1 and CG, p<0.05) CG: 4 (4.8) Coagulopathy IG1: 0 IG2: 2 (2.5) CG: 9 (10.7) (vs. IG1 and IG2, p<0.001) Acute renal failure IG1: 0 IG2: 0 CG: 5 (6.0) (vs. IG1 and IG2, p<0.001) Pulmonary edema IG1: 0 IG2: 0 CG: 4 (4.8) vs. IG1 and IG2, p<0.001) Heart failure IG1: 1 (1.2) IG2: 1 (1.3) CG: 2 (2.4) Transient Hypotension IG1: 0 IG2: 4 (5.0) (vs. IG1 and CG p<0.05) CG: 0 ARDS IG1: 1 (1.2) IG2: 1 (1.3) CG: 3 (3.6) MODS IG1: 2 (2.4) IG2: 1 (1.3) CG: 3 (3.6)	"In summary, administration of 3% HSS offered hemodynamic benefits equivalent to those of 7.5% HSS infusion with lower degrees of hypernatremia and hyperchloremia and lower risks of cardiac dysrhythmia and transient hypotension. In addition, higher incidences of pulmonary edema, renal failure, and coagulopathy occurred in the LRS group." **Reviewers' conclusion** There might be a risk of attrition bias as information regarding length of follow-up regarding adverse events and the availability of outcome data are lacking.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG1: 1.1 ± 0.2 IG2: 1.0 ± 0.2 CG: 2.1 ± 0.3 (CG vs. IG1 and IG2, p<0.05)			

+: low risk; –: high risk; ?: unclear risk; adj.: adjusted; CG: control group; CI: Confidence Interval; d: days; g: grams; HR: Heart rate; HSS: Hypertonic saline solution; IG: intervention group; IQR: Interquartile Range; ISS: injury severity score; LoE: level of evidence; m: months; MAP: mean arterial pressure; min: minutes; mmHg: millimetres of mercury; mg: milligrams; MODS: multiple organ dysfunction syndrome; s: seconds; SBP: systolic blood pressure; SD: Standard Deviation; SOFA: Sequential Organ Failure Assessment; y: years

Basenüberschuss/Laktat

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Fligor (2017) Parathyroid hormone as a marker for hypoperfusion in trauma: A prospective observational study." *The Journal of Trauma and Acute Care Surgery* 2017; 83(6): 1142-1147. **Study design** Prognostic cross-sectional study **Aim of the study** "We hypothesized that early hyperparathyroidism predicts mortality and transfusion in trauma patients." **Setting** n.r. (authors from USA), 2016	**Inclusion criteria** • ≥18 years • received the highest level of trauma team activation **Exclusion criteria** • administration of blood products before phlebotomy • pregnancy • chronic kidney disease (stage III or worse) • primary or secondary bone malignancy • history of hyperparathyroidism or hypoparathyroidism • history of hypercalcemia or hypocalcemia • Labs incorrectly drawn • Did not speak English **Characteristics** Age [y], median (IQR) 47 (29-64)	**Participants** N=46 patients **Tests evaluated** Test 1: parathyroid hormone (PTH) Test 2: lactic acid Phlebotomists obtained specimens in the trauma bay before administration of blood products. The laboratory processed the samples according to normal laboratory procedures and recorded results in the medical record. The reference range for intact PTH is 9.2 pg/mL to 79.5 pg/mL, and the range for ionized calcium is 1.13 mmol/L to 1.32 mmol/L.	**Prediction of transfusions within 24h** AUC PTH: 0.876 vs. lactic acid: 0.793 Prognostic test performance with PTH≥100 pg/mL Sensitivity: 88% Specificity: 86% Positive predictive value: 79% Negative predictive value: 93% **Prediction of mortality** AUC PTH: 0.875 vs. lactic acid: 0.835 Prognostic test performance with PTH≥100 pg/mL Sensitivity: 90% Specificity: 72% Positive predictive value: 47%	**Level of evidence** 3b↓ **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "Hyperparathyroidism on hospital arrival in trauma patients predicts mortality and transfusion in the first 24 hours." **Reviewers' conclusion** The results should be interpreted with caution because the threshold was not pre-specified and test performance values of lactic acid are not presented. The majority of patients was not severely injured.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Male, %[$] 82.6 ISS, median (IQR) 12 (7-18) TRISS, median (IQR) 0.96 (0.80-0.99) Parathyroid hormone [pg/mL], median (IQR) 95.2 (63.3–149.4) Lactic acid [mmol/L], median (IQR) 2.8 (1.9–4.9) [$] n/N not reported		Negative predictive value: 96%	The effect on patient-relevant outcomes of using the index test to take therapeutic decisions was not investigated.
Gale (2016) "A comparison of initial lactate and initial base deficit as predictors of mortality after severe blunt trauma." *Journal of surgical research* 2017; 205(2): 446-455. **Study design** Prognostic cross-sectional study (Glue Grant Trauma-Related Database) **Aim of the study** "Our objective was to compare initial BD with	**Inclusion criteria** • Blunt trauma mechanism • Abbreviated Injury Scale (AIS) severity score >2 outside the head region • Emergency department (ED) arrival • SBP <90 mm Hg or BD >6 mEq/L (prehospital or within 60 min of arrival) • Blood transfusion within 12 h of injury • Intact cervical spinal cord • Records that contained both data points "Initial_Base_Deficit" and "ER_lactate" (ER = emergency room) **Exclusion criteria** • n.r. **Characteristics** Age [y], mean ± SD	**Participants** N=1,829 patients **Tests evaluated** Test 1: initial base deficit (BD) Test 2: initial lactate **Variables in multivariable logistic regression model** • age • gender • race • ISS • APACHE II	**Overall population** Inhospital mortality, multivariable adj. OR (95% CI) Initial BD: 1.04 (1.01-1.07), p<0.005 Initial lactate: 1.17 (1.12-1.23), p<0.00001 "for each 1 meq/L increase in BD, mortality risk increased by 4%; for each 1 mmol/L increase in lactate, mortality risk increased by 17%" AUC for prediction of total mortality Initial BD: 0.6135 Initial lactate: 0.7071 AUC for prediction of mortality after 24h Initial BD: 0.5749 Initial lactate: 0.6726 **Shock subgroup (lactate ≥4 mmol/L)**	**Level of evidence** 3b↓ **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "After severe blunt trauma, initial serum lactate is superior to initial BD in predicting inhospital survival in patients with and without shock. Initial BD does not predict mortality for patients whose survival is longer than 24 h." **Reviewers' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
lactate as predictors of in-hospital mortality in a large cohort of blunt trauma patients all presenting with hemorrhagic shock." **Setting** USA, 2002-2011	42.8 ± 18.7 Male, %[$] 66 GCS, mean ± SD 8.4 ± 5.6 ISS, mean ± SD 38.9 ± 14.0 Apache II, mean ± SD 29.1 ± 7.2 Initial base deficit [mEq/L], mean ± SD 8.81 ± 4.80 Initial lactate [mmol/L], mean ± SD 4.57 ± 2.86 [$] n/N not reported		Inhospital mortality, multivariable adj. OR (95% CI) Initial BD: 1.04 (1.01-1.08), p<0.03 Initial lactate: 1.15 (1.08-1.22), p<0.00001 AUC for prediction of total mortality Initial BD: 0.5975 Initial lactate: 0.6591 AUC for prediction of mortality after 24h Initial BD: 0.5410 Initial lactate: 0.6103 **TBI (head AIS>3) subgroup** Inhospital mortality, multivariable adj. OR (95% CI) Initial BD: 0.98 (0.93-1.04), p=0.55 Initial lactate: 1.11 (1.02-1.22), p<0.03 TBI (head AIS ≤3) subgroup Inhospital mortality, multivariable adj. OR (95% CI) Initial BD: 1.07 (1.03-1.10), p<0.0005 Initial lactate: 1.20 (1.13-1.27), p<0.00001	The results should be interpreted with caution because of the retrospective data analysis, unknown exclusion criteria, and unknown methods of testing. Only AUC values were evaluated, and no cut-offs were derived, which limits the applicability of the study results. The effect on patient-relevant outcomes of using the index test to take therapeutic decisions was not investigated. The study population was limited to blunt trauma patients in haemorrhagic shock.
Hutchings (2018) Microcirculatory Impairment Is Associated With Multiple Organ Dysfunction Following Traumatic Hemorrhagic Shock: The MICROSHOCK Study." *Critical Care Medicine* 2018; 46(9): e889-e896. **Study type**	**Inclusion criteria** • had been injured • had required blood product transfusion during resuscitation • lactate concentration ≥2 mmol/L at any stage prior to enrolment • were intubated and ventilated • enrolment as early as was feasible up to 12h after ICU admission **Exclusion criteria**	**Participants** N=60 patients (N=58 after 2 were excluded due to insufficient quality of microcirculatory video clips) **Tests evaluated** Microcirculatory measurements: An assessment was made of microcirculatory perfusion using incident dark field (IDF) videomicroscopy in the tongue. Videos are	**Prediction of MODS at day 7, AUC** Perfused vessel density: 0.87 (0.76–0.99) Microcirculatory flow index: 0.83 (0.71–0.95) Lactate: 0.69 (0.53–0.84)	**Level of evidence** 3b↓ **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "Microcirculatory hypoperfusion immediately

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Prognostic cross-sectional study **Aim of the study** "The aim of the present study was to examine the association between microcirculatory impairment and MODS (…) and to investigate whether there is a threshold of microcirculatory perfusion that might be predictive of MODS." **Setting** UK, 2014-2017	• unsurvivable injuries with a palliative focus of care • facial injuries that precluded hand-held videomicroscopy • insufficient quality of microcirculatory video clips **Characteristics** Age [y], mean ± SD 43 ± 19 Male, % 81 ISS, mean ± SD 29 ± 14 Blunt mechanism of injury, % 75 Highest lactate concentration prior to ICU admission [mmol/L], mean ± SD 7.3 ± 6.1 Lowest recorded SBP [mmHg], mean ± SD 69 ± 27	stored and analysed later. These video analyses give values for total vessel density (TVD), perfused vessel density (PVD), proportion of perfused vessels (PPV), microcirculatory flow index (MFI), and microcirculatory heterogeneity index (MHI) • D0: following bleeding control procedures, but less than 12 hours after admission to the ICU • D1: D0 + 24 hours • D2 D0 + 48 hours Lactate: Highest lactate prior to ICU admission multiple organ dysfunction syndrome (MODS) defined as Sequential Organ Failure Assessment (SOFA) Score ≥6 at day 7		following traumatic hemorrhagic shock and resuscitation is associated with increased multiple organ dysfunction syndrome. Microcirculatory variables are better prognostic indicators for the development of multiple organ dysfunction syndrome than more traditional indices." **Reviewers' conclusion** Only AUC values were evaluated, and no cut-offs were derived, which limits the applicability of the study results. The utility of video analysis for treatment decisions and patient outcomes has not yet been established.

+: low risk; –: high risk; ?: unclear risk; adj.: adjusted; AIS: Abbreviated Injury Scale; AUC: Area under the receiver operating characteristic curve; BD: base deficit; CG: control group; CI: Confidence Interval; d: days; ED: Emergency department; ER: emergency room; GCS: Glasgow Coma Score; h: hours; ICU: intensive care unit; IG: intervention group; IQR: Interquartile Range; ISS: injury severity score; ITT: Intention to treat analysis; L: litres; LoE: level of evidence; m: months; MAP: mean arterial pressure; min: minutes; mmHg: millimetres of mercury; MODS: multiple organ dysfunction syndrome; n.r.: not reported; OR: odds ratio; PTH: parathyroid hormone; RR: Relative Risk; s: seconds; SBP: systolic blood pressure; SD: Standard deviation; SOFA: Sequential Organ Failure Assessment; TBI: traumatic brain injury; TRISS: Trauma and Injury Severity Score; UK: United Kingdom; y: years

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Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Cooper (2018) "Effect of early sustained prophylactic hypothermia on neurologic outcomes among patients with severe traumatic brain injury: the POLAR randomized clinical trial." *JAMA* 2018; 320(21): 2211-2220. **Study design** Randomised controlled trial (POLAR-RCT) **Aim of the study** "To determine the effectiveness of early prophylactic hypothermia compared with normothermic management of patients after severe traumatic brain injury." **Setting** Australia, New Zealand, France, Switzerland, Saudi Arabia, and Qatar, 2010-2017	**Inclusion criteria** • Traumatic brain injury • Age: 18 to 60 y • GCS<9 • and had actual or imminent endotracheal intubation **Exclusion criteria** • significant bleeding suggested by systolic hypotension (<90mmHg) • or sustained tachycardia (>120/min), • suspected pregnancy, • possible uncontrolled bleeding, GCS≤3 and unreactive pupils, • or destination hospital not a study site **Characteristics** Age [y], mean ± SD IG: 35.0 ± 13.5 vs. CG: 34.1 ± 13.4 Male, n (%) IG: 207 (79.6) vs. CG: 194 (80.8) GCS, median (IQR) IG: 6 (4-7) vs. CG: 6 (4-7) Motor GCS, median (IQR) IG: 3 (1-4) vs. CG: 3 (2-5) ISS, median (IQRI IG: 26.0 (18-34) vs. CG: 20 (20.5-35)	**Participants** N=511 patients **Study groups** IG: hypothermia: 33°C ± 0.5°C (N=266 randomized, N=240 primary outcomes analyzed in ITT, N=256 secondary outcomes analyzed in ITT) • induced by a bolus of up to 2000 mL intravenous ice-cold (4°C) 0.9% saline and surface-cooling wraps once the patient was in the ED • targeting an initial core temperature of 35°C • once significant clinical risk for bleeding was excluded, target core temperature was 33°C • Hypothermia was maintained with Gymar Meditherm 3 console with surface-cooling wraps for at least 72h after randomization CG: Normothermia: 37°C ± 0.5°C (N=245 randomized, N=226 primary outcome analyzed in ITT, N=239 secondary outcome analyzed in ITT) **Co-interventions** Patients in both groups could receive other treatments for evaluated intracranial pressure as clinically indicated, and in both study groups care was recommended to be managed according to international traumatic brain injury guidelines	**Primary outcome** Favourable outcome (GOS-E score 5-8) at six months, n/N (%) IG: 117/240 (48.8) vs. CG: 111/226 (49.1) Absolute difference (95% CI): -0.4 (-9.4 to 8.7) RR (95% CI): 0.99 (0.82-1.19), p=0.94 Severity-adj. relative risk for favourable outcome (IMPACT-TBI) at six months (95% CI) 0.98 (0.87-1.11), p=0.75 **Secondary outcomes** Death in hospital, n/N (%) IG: 52/260 (20.0) vs. CG: 43/239 (18.0) Absolute difference (95% CI): 2.0 (−4.9 - 8.9) RR (95% CI): 1.11 (0.77-1.60), p=0.57 Death at 6 months, n/N (%) IG: 54/256 (21.1) vs.CG: 44/239 (18.4) Absolute difference (95% CI): 2.7 (−4.3 - 9.7) RR (95% C). 1.15 (0.80-1.64), p=0.45 Pneumonia, n/N (%) IG: 143/260 (55.0) vs. CG: 123/240 (51.3) Absolute difference (95% CI): 3.8 (−5.0 to 12.5) RR (95% CI): 1.07 (0.91-1.27), p=0.40 Bacteremia, n/N (%) IG: 19/260 (7.3) vs. CG: 12/240 (5.0)	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Among patients with severe traumatic brain injury, early prophylactic hypothermia compared with normothermia did not improve neurologic outcomes at 6 months. These findings do not support the use of early prophylactic hypothermia for patients with severe traumatic brain injury." **Reviewers' conclusion** Participants randomised to the intervention group had a higher median ISS but were comparable in other baseline characteristics. Due to non-blinded treating physicians, the study has a risk for performance bias.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Absolute difference (95% CI): 2.3 (−1.9 to 6.5) RR (95% CI): 1.46 (0.72-2.95), p=0.29 <u>Other infection, n/N (%)</u> IG: 36/260 (13.8) vs. CG: 38/240 (15.8) Absolute difference (95% CI): −2.0 (−8.2 - 4.3) RR (95% CI): 0.87 (0.57-1.33), p=0.53 <u>New or increased intracranial bleeding, n/N (%)</u> IG: 47/260 (18.1) vs. CG: 37/240 (15.4) Absolute difference (95% CI): 2.7 (−3.9 - 9.2) RR (95% CI): 1.23 (0.43-3.5), p=0.70 <u>New significant extracranial bleeding, n/N (%)</u> IG: 8/260 (3.1) vs. CG: 6/240 (2.5) Absolute difference (95% CI): 0.6 (−2.3 - 3.5) RR (95% CI): 1.17 (0.79-1.74), p=0.43	A treatment effect may have been concealed because 32% of patients in the hypothermia group never reached the target temperature of 33°C.
Hifumi (2017) "Therapeutic hypothermia in patients with coagulopathy following severe traumatic brain injury." *Scandinavian journal of trauma, resuscitation and emergency medicine* 2017; 25(1): 1-8. **Study design** Randomised controlled trial (secondary analysis of the B-HYPO trial)	**Inclusion criteria** • age 15–69 years • Glasgow Coma Scale (GCS) score of 4–8 • ability to initiate cooling within 2 h after the onset of TBI **Exclusion criteria (according to B-HYPO protocol)** • good motor response (GCS motor response=6) • SBP <90 mmHg after fluid and vasopressor resuscitation • platelet count <50,000 /mm^3 • severe pre-existing medical conditions (e.g., liver, kidney, or heart failure, or severe arrhythmia)	**Participants** N=132 patients in this post-hoc analysis (of N=150 in B-HYPO study) **Study groups** IG: mild therapeutic hypothermia (32.0-34.0°C)(N=79 of N=88 in B-HYPO study) • N=20 Coagulopathy • N=59 Non-coagulopathy CG: 35.5-37.0°C (N=40 of N=47 in B-HYPO study) • N=12 Coagulopathy • N=28 Non-coagulopathy	**Coagulopathy** <u>Favourable GOS outcome at 6 m[§]: n/N (%)</u> IG: 7/20 (35) vs. CG: 4/12 (33.3), p=1.00 <u>Survival rate at 6 m: n/N (%)</u> IG: 12/20 (60.0) vs. CG: 6/12 (50.0), p=0.72 <u>Overall complication rate during temperature management: n/N (%)</u> IG: 3/20 (15) vs. CG: 1/12 (8.3), p=1 **Non-Coagulopathy** <u>Favourable GOS outcome at 6 m[§]: n/N (%)</u> IG: 28/59 (47.5) vs. CG: 16/28, p=0.49	**Level of evidence** 2b↓ **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Our study suggests that in comparison to control, MTH does not worsen the outcome of patients with

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Aim of the study "The purpose of the present study was to examine the effect of coagulopathy on the safety of MTH compared to control in patients with severe TBI." **Setting** Japan, 2002-2008	• acute myocardial infarction, pregnancy • severe alcohol intoxication that prevented assessment of consciousness • penetrating brain injury • epidural hematoma without brain parenchymal injury • core body temperature <30°C • *in post-hoc analysis*: missing data activated partial thromboplastin time and fibrin/fibrinogen degradation products **Characteristics** **Coagulopathy subgroup** Age [y], median (SD) IG: 48 (25–58) vs. CG: 31 (21–55), p=0.34 Male, n (%) IG: 18 (90.0) vs. CG: 9 (81.8), p=0.60 GCS, median (IQR) IG: 6 (4–7) vs. CG: 6 (5–7), p=0.72 ISS, median (IQR) IG: 34 (22–36) vs. CG: 25 (21–25), p=0.08 **Non-coagulopathy subgroup** Age [y], median (SD) IG: 42 (20–55) vs. CG: 41 (23–57), p=0.93 Male, n (%) IG: 36 (62.1) vs. CG: 16 (59.3), p=0.82 GCS, median (IQR) IG: 6 (4–7) vs. CG: 6 (5–7), p=0.65 ISS, median (IQR) IG: 25 (17–34) vs. CG: 22 (16–29), p=0.36	The goal in each group was to achieve the targeted temperature within 6 h of the onset of TBI and to maintain this temperature for at least 72 h, predominantly using surface cooling blankets. After 72 h, the temperature was maintained at <38 °C until 7 days after the onset of TBI.	Survival rate at 6 m: n/N (%) IG: 38/59 (64.4) vs. CG: 25/28 (89.3), p=0.02 Overall complication rate during targeted temperature management: n/N (%) IG: 12/59 (20.3) vs. CG: 0/28 (0), p<0.01 §Good recovery and moderate disability according to the GOS scores at 6 months after injury were designated as a favourable neurological outcome.	coagulopathy following severe TBI." **Reviewers' conclusion** The results of this post-hoc analysis should be interpreted with caution due to the small subgroups and higher proportion of excluded patients in the CG due to missing data for coagulopathy markers. Patients with coagulopathy in the intervention group had a higher median ISS but were comparable in other baseline characteristics. In addition, there may be a risk for performance bias due to non-blinding of treatment personnel and patients.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Maekawa (2015) "Prolonged Mild Therapeutic Hypothermia versus Fever Control with Tight Hemodynamic Monitoring and Slow Rewarming in Patients with Severe Traumatic Brain Injury: A Randomized Controlled Trial." J Neurotrauma 2015; 32(7): 422–429. **Study design** Randomised controlled trial (Brain-Hypothermia (B-HYPO) Study) **Aim of the study** "to compare the neurological outcomes between TH (32–34°C) and fever control (35.5–37°C) for patients with TBI, and to clarify the clinical efficacy of mild therapeutic hypothermia." **Setting** Japan, 2002-2008	**Inclusion criteria** • age 15–69 years • Glasgow Coma Scale (GCS) score of 4–8 • ability to initiate cooling within 2 h after the onset of TBI **Exclusion criteria** • good motor response (GCS motor response=6) • SBP <90 mmHg after fluid and vasopressor resuscitation • platelet count <50,000/mm^3 • severe pre-existing medical conditions (e.g., liver, kidney, or heart failure, or severe arrhythmia) • acute myocardial infarction, pregnancy • severe alcohol intoxication that prevented assessment of consciousness • penetrating brain injury • epidural hematoma without brain parenchymal injury • core body temperature <30°C **Characteristics** Age [y], mean ± SD IG: 39 ± 19 vs. CG: 39 ± 18, p=0.940 Male, n (%) IG: 69 (70) vs. CG: 34 (68), p=0.763 ISS, mean ± SD IG: 27 ± 9 vs. CG: 24 ± 7, p=0.037 GCS, mean ± SD IG: 5.8 ± 1.4 vs. CG: 5.9 ± 1.3, p=0.513	**Participants** N=150 patients randomised, N=148 patients analysed Enrolment stopped before completion of sample size (300 cases) goals, because of concern about shortage of TBI patients (95 cases) and very small differences in neurological outcome between the two groups at the interim analysis in 2005. **Study groups** IG: mild therapeutic hypothermia (32.0-34.0°C) (N=99 randomised, N=98 analysed) CG: fever control (35.5-37.0°C) (N=51 randomised, N=50 analysed) Core body temperature was measured by a thermistor coupled to an internal jugular venous catheter. If the catheter could not be inserted, body temperature was measured in another site that was selected in the following order: pulmonary artery, bladder, rectum, and tympanic membrane. Cooling blankets, rapid cold fluid infusion (up to 1000 mL saline, human plasma products, or dextrose-free plasma expanders), and/or cold gastric lavage could be used during the induction phase in both groups. The aim was to achieve the target temperature within 6 h after the onset of TBI. The desired temperature was to be maintained for ≥72 h, mainly using surface cooling blankets, in each group. The patient was rewarmed at a rate of <1°C/day and core body temperature was maintained at <38°C for 7 days after the onset of TBI.	**Primary outcome** Poor GOS outcome at 6m[§]: n/N (%); RR (98% CI) IG: 50/94 (53) vs. CG: 23/48 (48) RR 1.24 (0.62–2.48), p=0.597 **Secondary outcomes** Mortality at 6m: n/N (%); RR (98% CI) IG: 33/94 (35) vs. CG: 11/48 (23) RR 1.82 (0.82–4.03), p=0.180 Complications, n/N (%) IG: 17/98 (17) vs CG: 1/50 (2), p=significant No significant differences in GOS or mortality subgroups stratified by GCS or age. [§] Severe disability (SD), persistent vegetative state (PVS), or death (D) were defined as poor neurological outcomes, whereas moderate disability (MD) or good recovery (GR) were defined as good neurological outcomes.	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Prolonged therapeutic hypothermia (≥72 h) for patients with severe TBI together with tight hemodynamic management and slow rewarming (<1.0°C/day) did not improve neurological outcomes or mortality compared with strict fever control. However, the CIs for the primary outcome were wide, and do not exclude either benefit or harm for MTH. Our results may indicate that TH may be harmful or should be applied more carefully in patients with TBI and a GCS of 6–8." **Reviewers' conclusion** This was a well-conducted RCT. There may be a risk for

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	SBP [mmHg], mean ± SD IG: 144 ± 34 vs. CG: 151 ± 39, p=0.222 Heart rate [beats/min], mean ± SD IG: 92 ± 28 vs. CG: 88 ± 24, p=0.431			performance bias as treating clinicians were not blinded. The study may have been underpowered to detect clinically significant differences in outcome, because recruitment was stopped for futility at 50% of target.
Quine (2021) "Thromboelastography to Assess Coagulopathy in Traumatic Brain Injury Patients Undergoing Therapeutic Hypothermia." *Therapeutic Hypothermia and Temperature Management* 2021; 11(1): 53-57. **Study design** Prospective cohort study (POLAR-TEG, nested within the POLAR-RCT) **Aim of the study** "Therefore, we conducted a nested cohort substudy of severe TBI patients enrolled in the prophylactic hypothermia to lessen traumatic brain injury (POLAR) trial to compare the TEG coagulation values of patients being treated	**Inclusion criteria** • Patients between 18 and 60 years • blunt trauma • severe TBI requiring intubation • enrolled in the POLAR trial in a single center **Exclusion criteria** • current anticoagulant treatment and • either clinically significant bleeding or • hemodynamic evidence suggestive of bleeding **Characteristics** Age [y], mean ± SD IG: 29 ± 9 vs. CG: 38 ± 14, p=0.19 Male, %§ IG: 80 vs. 90, p=0.53 GCS, median (IQR) IG: 4 (3-6) vs. CG 5 (3-7), p=0.96 Motor GCS, median (IQR) IG: 2 (1-3) vs. CG: 2 (1-4), p=0.58	**Participants** N=20 patients **Study groups** IG: induced hypothermia at 33°C (N=10) CG: patients tested at 37°C prior to induced hypothermia (N=10) Hypothermia was maintained for 72h. All patients had been returned to normothermia for their second TEG testing at 120 hours. **Co-interventions** Ten patients (five hypothermia and five control) were given blood products during the study. All received packed red blood cells with some receiving additional products. Two patients received 4% albumin solution (one hypothermia and one control) and two received fresh frozen plasma (FFP; both hypothermia). Both patients treated with FFP were given the product before their first TEG.	R time [seconds]: mean ± SD IG: 7.57 ± 2.6 vs. CG: 6.8 ± 1.7, p=0.41 α-Angle [degrees]: median (IQR) IG: 69.2 (63.5–69.9) vs. CG: 72.0 (68.7-73.5), p=0.02 MA [mm]: mean ± SD IG: 73.9 ± 3.5 vs. CG: 73.1 ± 4.4, p=0.79 LY30: median (IQR) IG: 0% (0–0.0%) vs. CG: 0.5% (0.1–5.3%), p<0.01 FF MA [mm]: mean ± SD IG: 32.8 ± 10.1 vs. CG: 29.6 ± 9.5, p=0.47 FLEV [mg/dL]: mean ± SD IG: 602 ± 186 vs. CG: 520 ± 178, p=0.33	**Level of evidence** 3b↓ **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "In patients with TBI receiving therapeutic hypothermia to 33°C as part of a randomized trial, we found on TEG that hypothermia was not associated with any clinically significant changes in bleeding tendency or platelet function. A small decrease in clot growth (decreased alpha angle) during hypothermia was within the normal reference range. (…) Hypothermia was associated

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with therapeutic hypothermia with controls." **Setting** Australia, 2013-2014	AIS-head, median (IQR) IG: 5 (4-5) vs. CG: 5 (5-5), p=0.30 ISS, median (IQR) IG:36 (21-50) vs. CG: 30 (28-34), 0.57 §only percentage reported			with decreased fibrinolysis and this finding requires further investigation" **Reviewers' conclusion** The study should be interpreted with caution due to the very small sample size and missing patient-relevant outcomes. However, it was nested with a RCT and therefore baseline characteristics were comparable within study groups. There may be a risk for performance bias as treating clinicians were not blinded.
Zhou (2018) "Influence of phased body temperature management for severe abdominal traumatic patients with hemorrhagic shock." *International Journal of clinical and experimental medicine* 2018; 11(4): 4056-4063. **Study design** Randomised controlled trial **Aim of the study** "In this study, phased body temperature management was employed	**Inclusion criteria** • ≤18 y • injury or rupture of abdominal parenchyma and cavity • bleeding in the abdomen • blood pressure lower than 90/60 mmHg • body temperature and blood pH lower than 35°C and 7.3 respectively, • ISS≥16 **Exclusion criteria** • patients with fever • abnormal body temperature regulation • thyroid dysfunction • diabetes • unwilling to participate in this study **Characteristics**	**Participants** N=90 patients **Study groups** IG: phased management group (N=45) • Room temperature 26-28°C • Wet clothes on patients were removed as soon as possible, then cotton wadding was used to cover the patient to keep them warm. • Intravenous infusion liquid warmed to 37-38°C • blood transfusion temperature 37-38°C • The independent air-conditioning surgery room, bed, and blanket (40°C) were prepared by the Emergency Operating Department in advance	Mortality: n (%) IG: 1 (2.22) vs. CG: 6 (13.33), p=0.049 Rate of complication: n (%) IG: 3 (6.67) vs. CG: 12 (26.67), p=0.011 Hospital stay [d]: mean ± SD IG: 21.689 ± 4.166 CG: 27.733 ± 6.166, p=0.000 Body temperature recovery§ [h]: mean ± SD IG: 4.244±1.401 vs. CG: 13.243±3.809, p=0.000 Lactate clearance§ [h]: mean ± SD IG: 12.600±2.683 vs. CG: 31.267±4.059, p=0.000 Prothrombin time recovery§ [h]: mean ± SD IG: 3.578±1.097 vs. 28.844±10.084, p=0.000	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: ? Detection bias: ? **Authors' conclusion** „Phased body temperature management could effectively improve treatment of severe abdominal traumatic patients with hemorrhagic shock, including correction of the risk of hypo-

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
for severe abdominal trauma patients with hemorrhagic shock in order to provide a clinical basis for its application in clinical settings." **Setting** China, 2015-2016	Age [y], mean ± SD IG: 43.978 ± 13.965 CG: 45.622 ± 14.767, p=0.589 Males, n IG: 32 vs. CG: 30, p=0.649 ISS, mean ± SD IG: 36.022 ± 7.018 CG: 36.533 ± 7.694, p=0.743	CG: routine body temperature treatment. (N=45) • wet clothes were removed and skin was dried. Clean patient' clothes were put on to keep the body dry. • Then the room temperature was maintained between 22 and 24°C.	Activated partial thromboplastin time recovery§ [h]: mean ± SD IG: 5.222±1.491 vs. CG: 26.956±10.540, p=0.000 §The time from admission to recovery of lactic acid, PT and APPT were referred to the lactic acid clearance time, and PT or APTT recovery time.	thermia, metabolic acidosis, and blood coagulation disorder, reducing rates of complications and death, and shortening the length of the hospital stay" **Reviewers' conclusion** The risk of performance, attrition and detection bias cannot be assessed due to unclear blinding, unclear completeness of data and unclear length of follow up.
+: low risk; –: high risk; ?: unclear risk; adj.: adjusted; APTT: activated partial thromboplastin time; AIS: Abbreviated Injury Scale; BD: base deficit; CG: control group; CI: Confidence Interval; d: days; F MA: Functional Fibrinogen maximum amplitude assay; FFP: fresh frozen plasma; FLEV: functional fibrinogen level; GCS: Glasgow Coma Score; GOS: Glasgow outcome scale; GOS-E: Glasgow outcome scale extended; h: hours; ICU: intensive care unit; IG: intervention group; IQR: Interquartile Range; ISS: injury severity score; ITT: Intention to Treat analysis; L: litres; LoE: level of evidence; LY30: percentage of clot lysed after 30 minutes; m: months; MA: maximal amplitude; MAP: mean arterial pressure; min: minutes; MTH: mild therapeutic hypothermia; mmHg: millimetres of mercury; mg: milligrams; PT: prothrombin time; RCT: randomised controlled trial; RR: Relative Risk; s: seconds; SBP: systolic blood pressure; SD: Standard Deviation; SOFA: Sequential Organ Failure Assessment; TBI: traumatic brain injury; TEG: Thromboelastography; y: years				

Azidämie

No studies identified

Hypokalzämie

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Moore (2020) "Forgot calcium? Admission ionized-calcium in two civilian randomized controlled trials of pre-	For inclusion and exclusion criteria see also PAMPer (Sperry 2018) & COMBAT trial (Moore 2018) **Inclusion criteria**	**Participants** N=160 patients **Study groups** IG: 2 Units of universal donor (AB) thawed plasma (N=76)	**Effect of interventions on hypocalcemia** Hypocalcemia§: n (%) IG: 40 (52.6) vs. CG: 30 (35.7),p=0.03 Adj. RR (95% CI): 1.48 (1.03-2.12), p=0.03	**Level of evidence** 2b↓ **Risk of bias** Selection bias: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
hospital plasma for traumatic hemorrhagic shock." *Journal of Trauma and Acute Care Surgery* 2020; 88(5), 588-596. **Study design** 2 Randomised controlled trials (analysis of the COMBAT and PAMPer RCTs) **Aim of the study** "We reviewed the experience of two recent prehospital plasma RCTs regarding admission ionized-calcium (i-Ca) blood levels and its impact on survival. We hypothesized that prehospital plasma is associated with hypocalcemia, which in turn is associated with lower survival." **Setting** USA, 2014-2019	• adults with traumatic hemorrhagic shock (SBP≤70mmHg or 71–90mmHg + heart rate [HR] ≥108 bpm) • i-Ca measured before Calciumsupplementation • Age>18 years [COMBAT]/ Age 18-90 years [PAMPer] **Exclusion criteria** • prisoner status • known pregnancy • isolated penetrating injury to the head • asystole or cardiopulmonary resuscitation before randomization • known objection to blood products • opt-out bracelets or necklaces, • family objection to the patient's enrolment • documented cervical cord injury [PAMPer] **Characteristics** <u>Age [y], median (IQR)</u> IG: 41 (29–54) vs. CG: 39.5 (26–52), p=0.72 <u>Female, n (%)</u> IG: 20 (26.3) vs. CG: 18 (21.4), p=0.58 <u>ISS, median (IQR).</u> IG: 22 (15–35) vs. CG: 23 (17–33), p=0.56 <u>GCS, median (IQR).</u> IG: 14 (3–15) vs. CG: 12 (3–15), p=0.32	CG: normal saline with or without RBCs if required (N=84) **Co-interventions** RBC units, Platelet units, cryoprecipitate units, crystalloids, tranexamic acid	**Effect of hypocalcemia on mortality, univariate Cox proportional hazards analysis** Hazard ratio: 1.07 (95% CI 1.02-1.13), p=0.01 §Hypocalcemia: i-Ca ≤1.0 mmol/L	Performance bias: – Attrition bias: ? Detection bias: + **Authors' conclusion** "Prehospital plasma in civilian trauma is associated with hypocalcemia, which in turn predicts lower survival and massive transfusion. These data underscore the need for explicit calcium supplementation guidelines in prehospital hemotherapy." **Reviewers' conclusion** There may be a performance bias because masking of the care team was not possible and because patients in both groups did not receive similar volumes of plasma and placebo. There is a risk of attrition bias because only 63/125 (50.4%) patients in the COMBAT trial had i-Ca measurement and the distribution between study groups is unclear. The effect of hypocalcemia on treatment decisions (supplementation) was not investigated. Its effect on patient-relevant outcomes

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
				followed a case-control design and no causality was demonstrated.

+: low risk; –: high risk; ?: unclear risk; adj.: adjusted; AIS: Abbreviated Injury Scale; BD: base deficit; CG: control group; CI: Confidence Interval; d: days; GCS: Glasgow Coma Score; h: hours; HR: heart rate; IG: intervention group; IQR: Interquartile Range; ISS: injury severity score; i-Ca: ionized-calcium; L: litres; LoE: level of evidence; m: months; MAP: mean arterial pressure; min: minutes; mmHg: millimetres of mercury; RBC: red blood cells; RCT: randomised controlled trial; RR: Relative Risk; s: seconds; SBP: systolic blood pressure; SD: Standard Deviation; y: years

Transfusion / Blutprodukte / Plasma

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Akbari (2018) "The effect of fibrinogen concentrate and fresh frozen plasma on the outcome of patients with acute traumatic coagulopathy: a quasi-experimental study." *The American journal of emergency medicine* 2018; 36(11): 1947-1950. **Study design** Randomised controlled trial **Aim of the study** "The present study is designed with the aim of comparing the outcome of ATC patients receiving fibrinogen and FFP." **Setting**	**Inclusion criteria** • patients with severe blunt multiple trauma (ISS >16) • age ≥18 y • in need of receiving concentrated red blood cells an • with a fibrinogen blood level <200 mg/dl **Exclusion criteria** • penetrating trauma, those with ISS <16 • patients with known history of liver dysfunction or coagulation disorders **Characteristics** Age [y], mean ± SD Fibrinogen: 34.93 ± 16.94 vs. FFP: 30.63 ± 13.21 vs. CG: 30.63 ± 13.21, p=0.572 Males, n (%) Fibrinogen: 26 (86.7) vs. FFP: 23 (76.7) vs. CG: 25 (83.3), p=0.587	**Participants** N=90 patients **Study groups** Fibrinogen: 2 g fibrinogen (N=30) FFP: at least 2 units of FFP was injected (N=30) CG: no product other than concentrated red blood cells was injected (N=30) **Co-interventions** Injection of concentrated red blood cells in all patients	Mortality during hospital stay, n (%) Fibrinogen: 3 (10.0) vs. FFP: 11 (36.7) vs. CG: 11 (36.7), p=0.029 Blood received in the initial 24h (unit), mean ±SD Fibrinogen: 2.04 ± 1.14 vs. FFP: 2.66 ± 0.65 vs. CG: 2.88 ± 0.88, p=0.044 Fluid received in the initial 24h (L), mean ± SD Fibrinogen: 3.4 ± 0.8 vs. FFP: 4.0 ± 1.1 vs. CG: 4.1 ± 1.0, p=0.022 Need for ICU admission, n (%) Fibrinogen: 19 (63.3) vs. FFP: 28 (93.3) vs. CG: 22 (73.3), p=0.020 Need for mechanical ventilation, n (%) Fibrinogen: 10 (33.3) vs. FFP: 14 (46.7) vs. CG: 17 (56.7), p=0.191 Multiple organ failure, n (%) Fibrinogen: 2 (6.7) vs. FFP: 8 (26.7) vs. CG: 7 (23.3), p=0.106 Sepsis, n (%)	**Level of evidence** 1b **Risk of bias** Selection bias: ? Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion** "Multiple trauma patients in need of blood transfusion who received fibrinogen along with concentrated red blood cells had a significantly better outcome regarding mortality, sepsis, need for intensive care unit admission, need for receiving packed cells, need for receiving intravenous fluids in the initial

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Iran, 2015-2016	Consciousness level (GCS), n (%) GSC ≥14: Fibrinogen: 2 (6.7) vs. FFP: 3 (10.0) vs. CG: 3 (10.0) GSC 8–14: Fibrinogen: 8 (26.7) vs. FFP: 10 (33.3) vs. CG: 16 (53.3) GSC <8: Fibrinogen: 20 (66.7) vs. FFP: 17 (56.7) vs. CG: 11 (36.7) p=0.204 Fibrinogen level [mg/dl], mean ± SD Fibrinogen: 106.4 ± 24.6 vs. FFP: 120.0 ± 22.4 vs. CG: 123.2 ± 24.4, p=0.018 ISS, mean ± SD Fibrinogen: 19.3 ± 4.4 vs. FFP: 17.2 ± 3.1 vs. CG: 19.0 ± 4.3, p=0.009 Fibrinogen level (mg/dl), mean ± SD Fibrinogen: 106.4 ± 24.6 vs. FFP: 120.0 ± 22.4 vs. CG: 123.2 ± 24.4, p=0.018		Fibrinogen: 5 (16.6) FFP: 16 (53.3) vs. CG: 4 (13.3), p=0.001 Duration of hospitalization [d], mean ± SD Fibrinogen: 11.0 ± 6.1 vs. FFP: 10.4 ± 8.2 vs. CG: 14.8 ± 7.6, p=0.045 Thrombosis, n Fibrinogen: 0 vs. FFP: 0 vs. CG: 0	24h, and duration of hospitalization. Although the rate of multiple organ failure and need for mechanical ventilation was lower in these patients, the difference was not statistically significant." **Reviewers' conclusion** The risk of selection bias is unclear since no information on allocation concealment is given. There may be a risk for performance and detection due to non-blinded treating staff and investigators.
Bui (2016) "The impact of increased plasma ratios in massively transfused trauma patients: a prospective analysis." *European Journal of Trauma and Emergency Surgery* 2016; 42(4): 519-525. **Study design** Prospective observational study	**Inclusion criteria** • Trauma patients who require a massive transfusion (defined as ≥10 units of PRBC in ≤24 h) **Exclusion criteria** • age <18 years • severe traumatic brain injury defined as the presence of head Abbreviated Injury Scale (AIS) score ≥3 • pregnancy • death in the emergency department or during the initial operative intervention	**Participants** N=103 patients **Study groups** IG: FFP:PRBC <1:1.5 (N=54) CG: FFP:PRBC ≥1:1.5 (N=49)	Mortality: n/N (%) IG: 17/54 (31.5) vs. CG: 7/49 (14.3), p=0.042 Hospital length of stay [d]: mean ± SD IG: 25.5 ± 7.3 vs. CG: 37.2 ± 4.9, p=0.191 Hospital length of stay [d] after exclusion of deaths: mean ± SD IG: 31.9 ± 5.7 vs. CG: 47.5 ± 7.5, p=0.107 ICU length of stay [d]: mean ± SD IG: 18.8 ± 5.4 vs. CG: 19.3 ± 2.4, p=0.914	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: ? **Authors' conclusion** "Achieving a ratio of FFP:PRBC ≥1:1.5 after the

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Aim of the study "The aim of our study was to prospectively analyze the effect of increasing ratios of fresh frozen plasma to packed red blood cells on the survival of massively transfused civilian trauma patients. Time elapsed to achieving the target FFP:PRBC ratio and its effect on mortality was also examined. Our hypothesis was that higher plasma to packed red blood cell ratios would improve survival." **Setting** USA, 2009-2011	• not receiving plasma **Characteristics** Age [y],mean ± SD IG: 34.6 ± 14 vs. CG: 35 ± 18.4, p=0.895 Males , n/N (%) IG: 49/54 (90.7) vs. CG: 42/49 (85.7), p=0.543 ISS; mean ± SD IG: 21.1 ± 13.2 vs. CG: 22.3 ± 10.9, p=0.621 ISS >25, n/N (%) IG: 18/54 (33.33) vs. CG: 20/49 (40.8), p=0.540 GCS ≤8, n/N (%) IG: 10/54 (18.5) vs. CG: 10/49 (20.4), p=0.801		ICU length of stay [d] after exclusion of deaths: mean ± SD IG: 17.5 ± 3.3 vs. CG: 21.9 ± 3.2, p=0.334 Ventilation days: mean ± SD IG: 3.7 ± 1.1 vs. CG: 7.9 ± 1.6, p=0.11 Ventilation days after exclusion of deaths: mean ± SD IG: 5.1 ± 1.3 vs. CG: 8.3 ± 1.6, p=0.14 Change of hematocrit at the end of resuscitation: mean ± SD IG: −3.20 ± 2.32 vs. CG: −2.83 ± 1.00, p=0.865 Change of INR at the end of resuscitation; mean ± SD IG: −0.07 ± 0.13 vs. 0.09 ± 0.05, p=0.378 Change of base deficit at the end of resuscitation; mean ± SD IG: 9.1 ± 1.87 vs. CG: 7.6 ± 0.86, p=0.401 Change of lactate at the end of resuscitation; mean ± SD IG: −2.92 ± 1.10 vs. CG: −3.29 ± 0.75, p=0.787	initial 24 h of resuscitation significantly improves survival in massively transfused trauma patients compared to patients that achieved a ratio <1:1.5." **Reviewers' conclusion** The risk of performance and detection bias cannot be assessed due to unclear blinding and unclear follow-up time. It should be noted that not only the ratios but also the total volume of PRBCs and plasma transfused was different between study groups.
Cardenas (2018) "Platelet transfusions improve hemostasis and survival in a substudy of the prospective, randomized PROPPR trial. *Blood advances* 2018; 2(14): 1696-1704. **Study design**	**Inclusion criteria** • ≥15 years of age, • were received directly from the injury scene, • had been transfused with at least 1 unit of blood product within the first hour of arrival or prehospital, • and were predicted to receive a massive transfusion	**Participants** N=261 patients **Study groups** IG: received platelets (1:1:1 group) (N=137) CG: did not receive platelets (1:1:2 group) (N=124) **Co-interventions**	24h mortality, n (%) IG: 8 (5.8) vs. CG: 21 (16.9), p_{adj}<0.01 30d mortality, n (%) IG: 13 (9.5) vs. CG: 25 (20.2), p_{adj}<0.01 Time to death [h], median (IQR) IG: 13.8 (0.9-69.5) vs. CG: 0.6 (0.3-5.7), p=0.02 Achieved homostasis, n (%)	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Comperative registry study (secondary analysis of the PROPPR trial) **Aim of the study** "The objective of this study was to examine the effect of platelet transfusions on mortality in severely injured trauma patients." **Setting** North America, 2012-2013	• patients who received only the first cooler of blood products during the randomized treatment phase and received no additional platelet transfusions post–randomized treatment. **Exclusion criteria** • transferred from another hospital, • had a lethal traumatic brain injury, • were prisoners, • were pregnant, were <15 years of age, • had received >5 minutes of cardiopulmonary resuscitation, • had a >20% total bodysurface area burn, • had an inhalation injury, • or had >3 units of RBCs transfused **Characteristics** Age [y], median (IQR) IG: 35 (25-50) vs. CG: 35 (26-49.5), p=0.82 Males, n (%) IG: 109 (79.6) vs. CG: 103 (83.1), p=0.53 ISS, median (IQR) IG: 22 (14-34) vs. CG: 21.5 (11-29.5), p=0.15 Revised Trauma Score, median (IQR) IG: 7.11 (4.09-7.84) vs. CG: 6.90 (4.09-7.84), p=0.28 INR, median (IQR) IG: 1.20 (1.10-1.32) vs. CG: 1.20 (1.14-1.40), p=0.18	• RBCs, Plasma, Cryoprecipitate, Colloids, Crystalloids, L • Randomization in PROPPR trial to receive 1:1:1 transfusion ratio of blood products compared with a 1:1:2 ratio (Plasma: Platelets: Red Blood Cells). **Adjustments** For adjustment purposes, total plasma received was categorized into 7 strata (0, 1, 2, 3, 4, 5, and ≥6 units). Stratification methods were used for comparing treatment groups, to adjust for different amounts of plasma in these 2 groups. p_{adj} for p-values adj. for plasma volume	IG: 130 (94.9) vs. CG: 91 (73.4), p_{adj}<0.01 Hospital free days, median (IQR) IG: 13 (0-22) vs. CG: 15 (0-22), p_{adj}=0.77 Ventilator-free days, median (IQR) IG: 28 (23-29) vs. CG: 28 (9-29), p_{adj}=0.03 ICU-free days, median (IQR) IG: 25 (15-27) vs. CG: 25 (7-27), p_{adj}=0.09 Cause of death (24 h) Exsanguination, n (%) IG: 2 (1.5) vs. CG: 16 (12.9), p=0.01 Traumatic brain injury n (%) IG: 4 (2.9) vs. CG: 5 (4.0), p=0.63 Respiratory, pulmonary contusion, or tension pneumothorax, n (%) IG: 0 (0) vs. CG: 0 (0) Multiple organ failure, n (%) IG: 0 (0) vs. CG: 0 (0) Myocardial infarction, n (%) IG: 1 (0.7) vs. CG: 1 (0.8), p=0.94 Pulmonary embolism, n (%) IG: 0 (0) vs. CG: 1 (0.8), p=0.32 **Cause of 30 day mortality** Exsanguination, n (%) IG: 2 (1.5) vs. CG: 16 (12.9), p<0.01 Traumatic brain injury, n (%) IG: 8 (5.8) vs. CG: 9 (7.3), p=0.64	**Authors' conclusion** "In this subgroup analysis of the PROPPR randomized trial, we have shown that transfusion of platelets in bleeding patients is associated with improved early and late survival, improved hemostasis, and reduced number of deaths resulting from exsanguination, without an increase in significant inflammatory complications like acute respiratory distress syndrome, multiorgan failure, and acute kidney injury." **Reviewers' conclusion** There might be a risk of performance bias as staff could not be blinded and the care apart from the intervention was not standardized. There is a risk of selection bias as the groups differ in the amount of plasma received. However, adjustments for this confounder were done to calculate adjusted p-values, showing consistent results.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Respiratory, pulmonary contusion, or tension pneumothorax, n (%) IG: 1 (0.7) vs. CG: 0 (0), p=0.32 Multiple organ failure, n (%) IG: 0 (0) vs. CG: 1 (0.8), p=0.32 Myocardial infarction, n (%) IG: 1 (0.7) vs. CG: 1 (0.8), p=0.94 Pulmonary embolism, n (%) IG: 0 (0) vs. CG:1 (0.8), p=0.32 Systemic inflammatory response syndrome, % IG: 65.0 vs. CG: 49.2, p=0.01	
Chehab (2021) "Never-Frozen Liquid Plasma Transfusion in Civilian Trauma: A Nationwide Propensity-Matched Analysis." *The Journal of Trauma and Acute Care Surgery* 2021; 91(1): 200-205. **Study design** Comparative registry study (Trauma Quality Improvement Program database) **Aim of the study** "This study aims to examine outcomes of trauma patients transfused with	**Inclusion criteria** • Adult (≥18 years) trauma patients • receiving early (≤4 hours) plasma transfusions **Exclusion criteria** • received both LQP and FFP within the initial 24-hour period of their presentation • Transfer patients • patients with a history of coagulation disorders, • patients with pre-hospital cardiac arrest **Characteristics (matched cohort)** Age [y], mean ± SD IG: 47±19 vs. CG: 48±19, P=0.641 Male, n (%)	**Participants** N=321 patients (N=12,958 pre-matching) **Study groups** IG: FFP within 24 hours of ED presentation (N=214) CG: Never-frozen liquid plasma (LQP) within 24 hours of ED presentation (N=107) **Co-interventions** PRBC, Platelets **Matching criteria (Propensity score matching)** • demographics • ED vitals • Injury characteristics • surgical intervention for hemorrhage control • blood product transfusions	24h-mortality: n (%) IG: 8 (3.7) vs. CG: 3 (2.8), p=0.664 Died in hospital: n (%) IG: 43 (20.1) vs. CG: 18 (16.8), p=0.481 Based on Cohen's effect size (h) calculation for proportions, h (0.201, 0.168) = 0.085 for in-hospital mortality Time to first plasma unit transfusion [min]: median (IQR) IG: 98 (59-133) vs. CG: 54 (28-79), p<0.001 Major complications: n (%) IG: 46 (21.5) vs. CG: 17 (15.9), p=0.233 Acute respiratory distress syndrome: n (%) IG: 14 (6.5) vs. CG: 2 (1.9), p=0.070 Unplanned intubation: n (%)	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Transfusion of LQP may be as safe and effective as transfusion of FFP for initial resuscitation after trauma. The immediate availability and longer shelf life of LQP units alongside the equivalent clinical outcomes in trauma patients receiving either form of plasma

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
LQP compared to thawed FFP." **Setting** USA, 2017	IG: 158 (74) vs. CG:77 (72), p=0.721 GCS, median (IQR) IG: 14 (9-15) vs. CG: 14 (8-15), p=0.661 ISS, median (IQR) IG: 27 (22-41) vs. CG: 27 (26-41), p=0.733	• ACS trauma center verification level	IG: 12 (5.6) vs. CG: 3 (2.8), p=0.262 Sepsis: n (%) IG: 8 (3.7) vs. CG: 5 (4.7), p=0.689 Acute kidney injury: n (%) IG: 21 (9.8) vs. CG: 5 (5.6), p=0.111 Deep vein thrombosis: n (%) IG: 13 (6.1) vs. CG: 2 (1.9), p=0.092 Pulmonary embolism: n (%) IG: 2 (0.9) vs. CG: 2 (1.9), p=0.477 Hospital length of stay, median (IQR) IG: 12 (6-23) vs. CG: 12 (6-21), p=0.826	makes LQP an important addition to blood banks in trauma centers across the United States." **Reviewers' conclusion** There might be a risk of performance bias due to unclear blinding. One should be aware that the selected (matched) cohort is much smaller than the total cohort fulfilling the inclusion criteria because most patients received FFP.
De Roulet (2020) "Group A emergency-release plasma in trauma patients requiring massive transfusion." *Journal of Trauma and Acute Care Surgery* 2020; 89(6): 1061-1067. **Study design** comparative registry trial (secondary analysis of the PROPPR trial) **Aim of the study** "This secondary analysis of the Pragmatic, Randomized, Optimal Platelet and Plasma Ratios trial examined whether exposure	**Inclusion criteria** • ≥15 years of age, • were received directly from the injury scene, • had been transfused with at least 1 unit of blood product within the first hour of arrival or prehospital, • and were predicted to receive a massive transfusion • at least one unit of ERP **Exclusion criteria** • transferred from another hospital, • had a lethal traumatic brain injury, • were prisoners, • were pregnant, were <15 years of age, • had received >5 minutes of cardiopulmonary resuscitation, • had a >20% total body surface area burn,	**Participants** N=584 patients **Study groups** IG: group A ERP (N=122) CG: group AB ERP (N=462) Emergency-release plasma (ERP) was defined as plasma delivered and infused before the patient's ABO group being known. **Co-interventions** RBC, Plasma, Platelets, and Crytalloids • Randomization in PROPPR trial to receive 1:1:1 transfusion ratio of blood products compared with a 1:1:2 ratio (Plasma: Platelets: Red Blood Cells). **Covariates for multivariate model** • Age	Mortality at 30 days after admission: n (%) IG: 30 (24.6) vs. CG: 111 (24.0), p=0.90 Adj. HR (95% CI)§:: 1.15 (0.91–1.45) Nonfatal complication: n (%) IG: 112 (91.8) vs. CG: 370 (80.1), p=0.002 Adj. HR (95% CI)§: 1.24 (0.87-1.77) Systemic inflammatory response syndrome: n (%) IG: 93 (76.2) vs. CG: 297 (64.3), p=0.01 Adj. HR (95% CI)§: 1.45 (0.89-2.97) Infection: n (%) IG: 56 (45.9) vs. CG: 201 (43.5), p=0.64 Adj. HR (95% CI)§: 1 (0.74-1.38) Acute kidney injury / acute renal failure: n (%) IG: 34 (27.9) vs. CG: 108 (23.4), p=0.30	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** **"**We conclude that the use of ERP is common in patients requiring massive transfusion. Providing group A ERP can facilitate the early and balanced resuscitation of patients requiring massive transfusion

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
to group A emergency-release plasma (ERP) was noninferior to group AB ERP. We also examined patients whose blood groups were compatible with group A ERP versus patients whose blood groups were incompatible with group A ERP." **Setting** North America, 2012-2013	• had an inhalation injury, • or had >3 units of RBCs transfused **Characteristics** Age [y], median (IQR) IG: 32 (24–51) vs. CG: 35 (25–51), p=0.62 Male, n (%) IG: 102 (83.6) vs. CG:362 (78.4), p=0.20 ISS, median (IQR) IG: 25 (17–34) vs. CG: 29 (18–41), p=0.02 SBP [mmHg], mean ± SD IG: 112.7 ± 33.8 vs. CG: 101.7 ± 31.6, p=0.001 Blunt injury mechanism, n (%) 55 (45.1) vs. 261 (56.5), p=0.02	• ISS>25 • GCS <9 • 3-hour RBC transfusion • and 3-hour crystalloid infusion • Variables not acting as a confounder and with p>0.05 were excluded from the final model.	Adj. HR (95% CI)§: 1.11 (0.65-1.94) Acute respiratory distress syndrome / acute lung injury: n (%) IG: 33 (27.1) vs. CG: 84 (18.2), p=0.03 Adj. HR (95% CI)§: 1.41 (0.83-2.4) Venous thromboembolism: n (%) IG: 12 (9.8) vs. CG: 79 (17.1), p=0.05 Thrombolytic events: HR (95% CI)§ Multivariate analysis: 0.52 (0.31–0.90) Deep vein thrombosis: n (%) IG: 3 (2.5) vs. IG: 41 (8.9) Pulmonary embolism: n (%) IG: 5 (4.1) vs. IG: 37 (8.0) Myocardial infarction: n (%) IG: 1 (0.8) vs. IG: 1 (0.2) Cerebral vascular accidents: n (%) IG: 4 (3.2) vs. CG: 16 (3.5) §HR: IG vs. CG	at trauma centers worldwide. (…) Group A ERP is an acceptable option for patients requiring massive transfusion, especially if group AB ERP is not readily available." **Reviewers' conclusion** There is a risk of selection bias because of unbalanced ISS and SPR but multivariate analyses controlled for confounding. There might be a risk of performance bias due to unknown blinding.
Innerhofer 2017 "Reversal of trauma-induced coagulopathy using first-line coagulation factor concentrates or fresh frozen plasma (RETIC): a single-centre, parallel-group, open-label, randomised trial". *The Lancet*	**Inclusion criteria** • Adult patients (aged 18–80 years) • trauma with Injury Severity Score (ISS) >15 • admitted to trauma center • clinical signs or risk of substantial haemorrhage	**Participants** N=100 patients (N=94 in modified ITT analysis) **Study groups** IG: CFC, coagulation factor concentrates (N=52, N=50 in modified ITT analysis)	**NOTE**: ORs and differences were calculated CG vs. IG! **Primary outcome** Multiple Organ Failure: n (%), OR (95% CI) IG: 25 (50) vs. CG: 29 (66) OR = 1.92 (0.78 - 4.86), p=0.15 **Other outcomes**	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: + Attrition bias: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Haematology 2017; 4: e258–71. **Study design** Randomised controlled trial (RETIC trial) **Aim of the study** "The aim of the study was to compare the efficacy of FFP and CFC for reversal of coagulopathy, blood loss-associated transfusion requirements, and the development of multiple organ failure as an overall clinical outcome parameter. " **Setting** Austria, 2012-2016	• screened for trauma-induced coagulopathy (defined as abnormally low fibrin polymerisation as measured with bedside rotational thromboelastometry (ROTEM) using the FibTEM assay (FibA10 <9 mm or prolonged initiation of coagulation in the ExTEM assay (ExCT >90 s) **Exclusion criteria** • injuries incompatible with survival • cardiopulmonary resuscitation on the scene • isolated brain injury • burn injury • avalanche injury • prehospital coagulation therapy other than tranexamic acid **Characteristics** Age [y], (median, IQR) IG: 42.5 (27.3 - 50.5) CG: 42.5 (24 - 56) Sex, n (%) IG: 38 (76%) male, 12 (24%) female CG: 32 (73%) male, 12 (27%) female ISS (median, IQR) IG: 35 (29 - 42) CG: 30 (24 - 45) GCS (median, IQR) IG: 12 (9 - 15) CG: 11 (7 - 15) Lactate (mmol/L, median, IQR)	CG: FFP, fresh frozen plasma (N=48, N=44 in modified ITT analysis) The trial was stopped early as the pre-planned interim analysis showed a significant difference in treatment failure combined with an increased risk of massive transfusion in patients in the FFP group.	In-hospital mortality: n (%), OR (95% CI) IG: 5 (10) vs. CG: 2 (5) OR = 0.43 (0.04 – 2.82), p=0.44 Ventilator-free days: median (IQR), difference IG: 23 (13 – 27) vs. CG: 21 (13 – 27) Difference = 0 (-2 to 3), p=0.99 Length of hospital stay [d]: median (IQR) difference IG: 28 (18 - 28) vs. CG: 27 (16 - 28) Difference = 0 (0 to 1), p=0.61 Reversal of coagulopathy after single-dose study drug (OR, 95% CI) IG vs. CG: OR = OR 8.22 (3.06 – 23.78) (p<0.0001) Massive Transfusion within 24 hours: n (%), OR (95% CI) IG: 6 (12) vs. CG: 13 (30) OR = 3.04 (0.95 to 10.87), p=0.042	Detection bias: + **Authors' conclusion** "CFC is superior to FFP. However, the trial was terminated early after randomization of 100 patients, as the a-priori planned interim analysis showed an unacceptably high incidence of treatment failure and increased risk for massive transfusion for patients randomly allocated to the FFP group" **Reviewers' conclusion** The study is of high quality. However, one should be aware that physicians were not blinded to the intervention as the difference in the process of study drug administration makes masking impossible.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG: 2.22 (1.55 – 3.22) CG: 2.28 (1.64 – 3.03) INR (median, IQR) IG: 1.3 (1.1 – 1.4) CG: 1.3 (1.2 – 1.5) Fibrinogen (mg/dL, median, IQR) IG: 196.5 (138.5 - 218.8) CG: 177.0 (140.5 - 222.3)			
Jones (2017) "Injury severity, sex, and transfusion volume, but not transfusion ratio, predict inflammatory complications after traumatic injury. *Heart & Lung* 2017; 46(2): 114-119. **Study design** Comparative registry trial (Glue Grant Inflammation and the Host Response to Injury Trauma-Related Database) **Aim of the study** "To evaluate the relationship among blood component ratios (1:1 vs other for PRBC:FFP and PRBC:PLT) and inflammatory complications (primary outcome) in patients with major trauma"	**Inclusion criteria** • aged 18-65 years • received blood component transfusion within the first 24 h following hospital admission for trauma, • and were severely injured (New Injury Severity Score [NISS] ≥15) **Exclusion criteria** • died within the 24 h following ED admission, as they were unlikely to develop inflammatory complications in that timeframe **Characteristics** Age [y], mean ± SD 39 ±14 Male, n (%) 1040 (68) New Injury Severity Score, mean ±SD 39 ±13	**Participants** N=643 patients in analysis of 1,538 patients in total **Study groups** IG: PRBC:FFP and PRBC:PLT ratios close to 1 (between 0.5-1.5) (N=n.r.) CG: ratios other than 0.5-1.5 (N=n.r.) §Number of patients per study group missing **Covariates for multivariable Cox model** • 24h total unit of PRBC and PLT • Comorbid burden • Age • Sex • NISS	Development of inflammatory complications during hospitalization: adj. HR (95% CI) **PRBC:FFP** 1.068 (0.900-1.267), p=0.451 **PRBC:PLT** 0.970 (0.809-1.164), p=0.746	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: – Detection bias: + **Authors' conclusion** "In conclusion, we found no relationship between the ratio of blood components transfused in the first 24 h following hospital admission and inflammatory complication development in patients with major trauma." **Reviewers' conclusion** The results of the study need to be interpreted with caution due to a large proportion of patients with

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Setting USA, 2003-2009				missing data (Attrition bias). The risk of performance bias is unclear.
Jones (2014) "Increased mortality in adult trauma patients transfused with blood components compared with whole blood." *Journal of trauma nursing* 2014; 21(1): 22-29. **Study design** Comparative registry trial (2009 National Trauma databank) **Aim of the study** "The aim of this study was to examine the association of type of blood transfusion, whole blood or blood components, with mortality in adult major trauma patients." **Setting** USA, 2009	**Inclusion criteria** • Aged 14-45 years • ISS >25 • admitted to the hospital after care in the ED • received blood transfusion, either whole blood or blood components, as part of their emergency care **Exclusion criteria** • dead on arrival to the emergency department or • were discharged to home after ED care and not admitted to the hospital • age>45 years **Characteristics** Age [y], mean ± SD IG: 27 ± 8 vs. CG: 29 ± 8, p=0.01 Male, n (%) IG: 69 (83) vs. CG: 1184 (71), p=0.02 ISS, mean ±SD IG: 39 ± 17 vs. CG: 35 ± 13, p=0.13	**Participants** N=1,745 patients **Study groups** IG: whole blood transfusion (N=83) CG: blood components transfusion (PRBCs and PLTs in combination) (N=1662) **Covariates for logistic regression** • Age • Gender • Ethnicity • ISS • Emergency medical system transfer time • Transfers from another facility	**Unadj. outcomes** Mortality during hospital stay: n (%) IG: 17 (21) vs. CG: 429 (26), p=0.27 **Adj. outcomes** Mortality during hospital stay: adj. OR (95% CI) CG vs. IG: 3.164 (1.314 – 7.618), p=0.010	**Level of evidence** 2b **Risk of bias** Selection bias: ? Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "We found that transfusion of whole blood rather than blood components produced superior survival in adult trauma patients from the NTDB." **Reviewers' conclusion** Although results were controlled for confounding factors, the results of the study need to be interpreted with caution due to a possible selection bias caused by unbalanced basic characteristics between study groups. The risk of performance bias is unclear.
Kutcher 2014	**Inclusion criteria**	**Participants**	Mortality (%)	**Level of evidence**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"The Natural History and Effect of Resuscitation Ratio on Coagulation After Trauma - A Prospective Cohort Study". *Annals of Surgery* 2014; 260(6): 1103–1111. **Study design** Prospective cohort study **Aim of the study** "The aim of the study was to investigate the natural history of coagulation factor perturbation after injury, and identify longitudinal differences in clotting factor repletion by RBC:FFP transfusion ratio." **Setting** USA, 2005-2011	• Adult patients requiring highest-level trauma activation and subsequent intensive care unit (ICU) admission, prespecified by physiologic (at least one pre-hospital or hospital SBP <90, heart rate >110, or Glasgow Coma Score 8) or anatomic criteria (penetrating torso trauma or evidence of high-energy blunt trauma) • also patients who died in the operating room or emergency department prior to ICU admission **Exclusion criteria** • age <18 years • incarceration • pregnancy • transfer from another hospital • administration of >2 liters of crystalloid prior to initial blood draw • Patients on warfarin • Patients possessing a preexisting bleeding diathesis at the time of injury **Characteristics** <u>Age [y], mean ± SD</u> IG: 38.7 ± 18.3, p=0.253 CG: 42.8 ± 21.5 <u>Sex (n.r.)</u> <u>ISS, mean ± SD</u> IG: 32.7 ± 16.2, p=0.164 CG: 36.6 ± 15.5 <u>GCS, median (IQR)</u>	N=143 patients **Study groups** IG: Low ratio RBC:FFP (RBC:FFP ≤1.5:1) (N=91) CG: High ratio RBC:FFP (RBC:FFP >1.5:1) (N=52) **Note** The original study population consisted of 336 patients who were divided into the groups "transfused" (N=143) and "non-transfused" (N=193). Those who received transfusions were further divided into the two groups "Low ratio" and "High ratio" RBC:FFP.	IG: 42.9 vs. CG: 55.8, p=0.165 <u>In-Hospital Mortality, Hazard Ratio (95% CI)</u> IG: HR 1.661 (0.943 – 2.925), p=0.079 CG: HR 3.402 (1.693 - 6.833), p=0.001 <u>Total hospital days, median (IQR)</u> IG: 11 (2 - 32) vs. CG: 6.5 (1.5 - 24), p=0.135 <u>Longitudinal factor levels</u> <u>Prothrombin time up to 72h [sec], median (IQR):</u> *0h:* IG: 16.7 (14.5 – 21.2) vs. CG: 16.2 (14.6 – 20.6) *6h:* IG: 15.3 (14.2 - 17.6) vs. CG: 16.2 (15.1 --18.3) *12h:* IG: 15.6 (14.6 - 16.9) vs. CG: 15.9 (15.0 - 17.0) *24h:* IG: 16.9 (15.5 - 19.1) vs. CG: 17.0 (15.8 - 17.7) *48h:* IG: 16.2 (14.9 - 18.8) vs. CG: 17.6 (15.6 - 18.8) *72h:* IG: 15.5 (14.1 - 17.8) vs. CG: 15.6 (15.2 - 17.3) <u>Activated partial thromboplastin time up to 72h [sec], median (IQR):</u> *0h:* IG: 32.5 (27.5 – 42.2) vs. CG: 32.5 (27.6 – 41.8) *6h:* IG: 33.2 (28.6 - 36.1)* vs. CG: 36.6 (32.5 - 41.7)* *12h:* IG: 33.7 (30.8 - 38.7)* vs. CG: 35.9 (32.8 - 40.4)* *24h:* IG: 38.2 (34.8 - 43.1) vs. CG: 39.8 (36.0 - 46.4) *48h:* IG: 39.2 (36.4 - 47.4) vs. CG: 47.0 (38.6 - 49.5) *72h:* IG: 38.5 (32.9 - 43.8) vs. CG: 41.5 (39.4 - 45.8) <u>Fibrinogen up to 72h [ng/mL], median (IQR):</u> *0h:* IG: 157 (106 – 200) vs. CG: 139 (125 – 205)	2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "[…] targeting ratios of RBC:FFP <=1.5:1 leads to earlier correction of PT and PTT, and earlier and prolonged repletion of specific clotting factor deficits compared to higher ratio transfusion strategies." **Reviewers' conclusion** There is a risk of selection bias because basic characteristic were not equal and the initial decision to transfuse and the specific array of blood products transfused were entirely at the discretion of the attending trauma surgeon. There might also be a risk of performance bias.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG: 6 (3 - 15), p=0.029 CG: 12 (4 - 15) RBC units / 24h, median (IQR) IG: 7 (4 - 14), p=0.001 CG: 10 (7 - 22) FFP units / 24h, median (IQR) IG: 7 (4 - 12), p=0.160 CG: 4.5 (3 - 11)		*6h:* IG: 142 (111 – 205) vs. CG: 139 (125 – 205) *12h:* IG: 180 (133 – 234) vs. CG: 183 (157 – 230) *24h:* IG: 288 (162 – 362) vs. CG: 258 (213 – 291) *48h:* IG: 325 (264 – 514) vs. CG: 547 (530 – 566) *72h:* IG: 494 (395 – 559) vs. CG: 668 (566 – 780) Factor II up to 72h [%], mean ± SD: *0h:* IG: 66.2 ± 21.3* vs. CG: 57.7 ± 18.3* *6h:* IG: 61.6 ± 17.1 vs. CG: 54.1 ± 14.9 *12h:* IG: 64.4 ± 17.5 vs. CG: 59.4 ± 12.1 *24h:* IG: 64.0 ± 18.5 vs. CG: 60.6 ± 12.4 *48h:* IG: 66.8 ± 20.2 vs. CG: 61.8 ± 14.2 *72h:* IG: 72.2 ± 14.4 vs. CG: 70.2 ± 15.4 Factor V up to 72h [%], mean ± SD: *0h:* IG: 38.7 ± 24.7 vs. CG: 38.0 ± 26.8 *6h:* IG: 43.2 ± 20.7* vs. CG: 33.3 ± 16.2* *12h:* IG: 43.7 ± 19.3 vs. CG: 39.7 ± 16.7 *24h:* IG: 45.3 ± 23.4 vs. CG: 43.2 ± 17.6 *48h:* IG: 58.8 ± 29.0 vs. CG: 43.2 ± 17.6 *72h:* IG: 79.6 ± 44.2 vs. CG: 61.0 ± 23.0 Factor VII up to 72h [%], mean ± SD: *0h:* IG: 72.3 ± 31.7 vs. CG: 73.9 ± 46.3 *6h:* IG: 107.0 ± 77.6 vs. CG: 86.3 ± 51.8 *12h:* IG: 100.3 ± 69.7 vs. CG: 101.1 ± 59.4 *24h:* IG: 48.2 ± 22.9 vs. CG: 61.1 ± 36.3 *48h:* IG: 61.8 ± 34.6 vs. CG: 52.9 ± 19.	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			72h: IG: 79.6 ± 29.8 vs. CG78.7 ± 32.7 <u>Factor VIII up to 72h [%], mean ± SD:</u> *0h:* IG: 188.1 ± 128.5* vs. CG: 266.6 ± 172.0* *6h:* IG: 115.3 ± 80.3 vs. CG: 106.4 ± 77.4 *12h:* IG: 105.2 ± 62.2 vs. CG: 106.2 ± 78.5 *24h:* IG: 110.6 ± 51.0 vs. CG: 112.5 ± 43.7 *48h:* IG: 179.3 ± 147.7 vs. CG: 114.1 ± 53.4 *72h:* IG: 192.9 ± 94.6 vs. CG: 152.6 ± 78.1 <u>Factor IX up to 72h [%], mean ± SD:</u> *0h:* IG: 101.2 ± 40.6 vs. CG: 96.5 ± 44.2 *6h:* IG: 116.3 ± 39.4* vs. CG: 86.5 ± 29.7* *12h:* IG: 114.0 ± 35.4* vs. CG: 100.7 ± 18.5* *24h:* IG: 114.6 ± 36.7 vs. CG: 107.1 ± 25.1 *48h:* IG: 151.6 ± 45.6 vs. CG: 142.9 ± 36.1 *72h:* IG: 184.4 ± 46.2 vs. CG: 179.0 ± 53.1 <u>Factor X up to 72h [%], mean ± SD:</u> *0h:* IG: 64.1 ± 23.9 vs. CG: 61.0 ± 23.1 *6h:* IG: 72.6 ± 33.4* vs. CG: 54.7 ± 16.9* *12h:* IG: 65.0 ± 19.9 vs. CG: 62.3 ± 20.9 *24h:* IG: 60.7 ± 17.9 vs. CG: 58.2 ± 10.4 *48h:* IG: 66.2 ± 16.8 vs. CG: 57.9 ± 12.9 *72h:* IG: 72.6 ± 15.7 vs. CG: 72.7 ± 13.0 <u>Antithrombin III up to 72h [%], mean ± SD:</u> *0h:* IG: 75.5 ± 24.9 vs. CG: 73.8 ± 23.4 *6h:* IG: 67.6 ± 18.9 vs. CG: 67.2 ± 19.7	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			12h: IG: 73.8 ± 17.6 vs. CG: 74.7 ± 16.7 *24h:* IG: 69.8 ± 16.7 vs. CG: 71.9 ± 20.0 *48h:* IG: 66.8 ± 21.0 vs. CG: 61.2 ± 18.9 *72h:* IG: 72.4 ± 22.6 vs. CG: 66.8 ± 24.1 <u>Protein C up to 72h [%], mean ± SD:</u> *0h:* IG: 77.4 ± 29.0 vs. CG: 79.5 ± 27.1 *6h:* IG: 66.8 ± 17.0 vs. CG: 63.9 ± 17.8 *12h:* IG: 72.0 ± 18.5 vs. CG: 69.7 ± 12.9 *24h:* IG: 64.5 ± 22.4 vs. CG: 64.4 ± 15.1 *48h:* IG: 65.9 ± 21.6 vs. CG: 57.7 ± 11.9 *72h:* IG: 73.4 ± 30.4 vs. CG: 61.3 ± 18.6 <u>Activated Protein C up to 72h [ng/mL], median (IQR):</u> *0h:* IG: 15.3 (5.4 – 49.5) vs. CG: 13.7 (3.5 – 51.2) *6h:* IG: 2.8 (0.7 – 4.7) vs. CG: 1.4 (0.6 – 2.7) *12h:* IG: 1.2 (0.6 – 2.5) vs. CG: 1.0 (0.4 – 2.3) *24h:* IG: 1.0 (0.5 – 1.9) vs. CG: 0.5 (0.0 – 1.4) *48h:* IG: 0.5 (0.3 – 1.7) vs. CG: 1.2 (1.1 – 1.4) *72h:* IG: 0.8 (0.6 – 2.4) vs. CG: 1.2 (0.5 – 13.4) <u>D-dimer up to 72h [mcg/mL], median (IQR):</u> *0h:* IG: 6.7 (2.4 – 9.8) vs. CG: 7.5 (3.8 – 12.0) *6h:* IG: 6.4 (3.2 – 9.4) vs. CG: 6.5 (2.6 – 23.0) *12h:* IG: 6.8 (3.8 – 10.6) vs. CG: 7.4 (4.2 – 14.6) *24h:* IG: 7.6 (3.9 – 11.4) vs. CG: 7.4 (3.8 – 10.6) *48h:* IG: 3.3 (2.1 – 5.0) vs. CG: 4.7 (2.8 – 6.7)	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			72h: IG: 3.7 (3.1 – 6.1) vs. CG: 4.4 (3.2 – 6.7) <u>Tissue plasminogen activator up to 72h [ng/mL], median (IQR):</u> *0h:* IG: 31.0 (9.0 – 46.7) vs. CG: 25.0 (14.7 – 38.3) *6h:* IG: 15.3 (11.2 – 22.6) vs. CG: 12.5 (8.0 – 15.6) *12h:* IG: 13.5 (11.4 – 18.0) vs. CG: 10.2 (8.4 – 14.3) *24h:* IG: 9.8 (6.1 – 15.3 vs. CG: 6.8 (5.8 – 11.1) *48h:* IG: 4.3 vs. CG: 5.0 (4.6 – 5.3) *72h:* IG: - vs. CG: 4.5 (3.5 – 5.4) <u>Plasminogen activator inhibitor-1 up to 72h [ng/mL], median (IQR):</u> *0h:* IG: 25.3 (11.8 – 30.2) vs. CG: 25.7 (12.4 – 38.4) *6h:* IG: 146.9 (138.7 – 372.4) vs. CG: 125.1 (49.5 – 132.6) *12h:* IG: 142.4 (134.2 – 278.9) vs. CG: 141.6 (84.1 – 251.4) *24h:* IG: 86.1 (57.7 – 124.6) vs. CG: 64.6 (43.8 – 143.4) *48h:* IG: 25.5 (8.3 – 33.5) vs. CG: 27.1 (19.1 – 33.2) *72h:* IG: - vs. CG: 19.2 (13.8 – 24.6) * p<0.05 for comparison between „low" and "high ratio" patients at each time point	
Nederpelt (2019) "Fresh Frozen Plasma-To-Packed Red Blood Cell Ratio and Mortality in Traumatic Hemorrhage: Nationwide Analysis of 4,427 Patients", *Journal of the*	**Inclusion criteria** • all trauma patients 18 years or older • transfused ≥10 pRBCs and ≥1 FFP within 24 hours **Exclusion criteria** • all transfer patients	**Participants** N=4,427 patients **Study groups** 1:1: (N=1392) (31.44%) 1:2: (N=1801) (40.68%)	**Primary outcome** <u>24-hour mortality, n/N (%), adj. OR (95% CI)</u> 1:1: 395/1392 (28.38) (Reference), p<0.0001 1:2: 598/1801 (33.20), OR 1.23 (1.02 to 1.48) 1:3: 200/492 (40.65), OR 1.62 (1.24 to 2.11) 1:4: 91/190 (47.89), OR 2.11 (1.42 to 3.13)	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ?

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
American College of Surgeons 2019; 230(6): 893-901 **Study design** Comparative registry study (TQIP Database) **Aim of the study** "The aim of the study was to investigate the association between different FFP to pRBC transfusion ratios and 24-hour mortality in trauma patients requiring mass transfusion with an attempt to statistically address delay and survival bias." **Setting** All TQIP participating hospitals (USA), 2013-2016	• patients with incorrect or missing transfusion data • patients who died in the emergency room • patients whose FFP:pRBC ratio was different in the first 4 vs. 24 hours of hospitalization • Patients with an FFP:RBC ratio of exactly 1:1.5, 1:2.5 **Characteristics** <u>Age [y], mean ± SD</u> 1:1: 39 ± 18, p=0.091 1:2: 42 ± 19 1:3: 40 ± 19 1:4: 41 ± 19 1:5: 40 ± 21 1:6: 41 ± 21 1:6+: 41 ± 18 <u>Females, n/N (%)</u> 1:1: 287/1392 (20.63) 1:2: 375/1801 (20.82) 1:3: 106/492 (21.54) 1:4: 48/190 (25.26) 1:5: 19/79 (24.05) 1:6: 15/51 (29.41) 1:6+: 76/422 (18.01) <u>ISS, median (IQR)</u> 1:1: 33 (22-43), p=0.000 1:2: 29 (22-42) 1:3: 29 (22-41) 1:4: 29 (20-42) 1:5: 29 (25-38) 1:6: 27 (22-43) 1:6+: 27 (17-38)	1:3: (N=492) (11.11%) 1:4: (N=190) (4.29%) 1:5: (N=79) (1.78%) 1:6: (N=51) (1.15%) 1:6+: (N=422) (9.53%) Patients were assigned to seven FFP:pRBC cohorts from ratios 1:1 to 1:6, and 1:6+ **Covariates** • ACS trauma center level • patient demographics • comorbidities • ED presentation • injury characteristics • surgeries and procedures performed in the first 24h	1:5: 49/79 (62.03), OR 4.11 (2.31 to 7.31) 1:6: 29/51 (56.86), OR 2.98 (2.31 to 6.13) 1:6+: 135/422 (31.99), OR 1.25 (0.94 to 1.67) **Other outcomes** <u>In-hospital mortality, n/N (%), adj. OR (95% CI)</u> 1:1: 675/1392 (48.49) (Reference), p<0.0001 1:2: 888/1801 ((49.31), OR 1.16 (0.90 to 1.49) 1:3: 266/492 (54.07), OR 1.51 (1.03 to 2.20) 1:4: 108/190 ((56.84), OR 1.52 (0.92 to 2.49) 1:5: 56/79 (70.89), OR 3.64 (1.84 to 7.22) 1:6: 36/51 (70.59), OR 2.65 (1.14 to 6.13) 1:6+: 203/422 (48.10), OR 1.43 (1.14 to 6.13) <u>ICU length of stay, mean ± SD</u> 1:1: 12 ± 13, p<0.0001 1:2: 12 ± 15 1:3: 10 ± 11 1:4: 10 ± 13 1:5: 7 ± 7 1:6: 10 ± 12 1:6+: 10 ± 11	Attrition bias: + Detection bias: + **Authors' conclusion** "[…] an FFP:pRBC ratio of 1:1 was associated with the lowest odds or 24-hour mortality. Our data suggests that the correct interpretation of the well-known PROPPR trial is perhaps that the 1:1:1 ratio is indeed superior, and that its failure to show that superiority might have been due to a type II error and a smaller patient sample than necessary. […] we suggest the use of a 1:1 FFP:pRBC ratio rather than a 1:2 ratio in the massively transfused trauma patient" **Reviewers' conclusion** The results of the study need to be interpreted carefully due to unclear performance bias. However, a large sample size and adjustment for various confounders indicate reliable results.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	GCS: median (IQR) 1:1: 8 (3-15), p=0.128 1:2: 10 (3-15) 1:3: 7 (3-14) 1:4: 8 (3-15) 1:5: 3 (3-13) 1:6: 6.5 (3-14) 1:6+: 8 (3-15)			
Pusateri (2020) "Association of Prehospital Plasma Transfusion With Survival in Trauma Patients With Hemorrhagic Shock When Transport Times Are Longer Than 20 Minutes: A Post Hoc Analysis of the PAMPer and COMBAT Clinical Trials". *JAMA Surgery* 2020; 155(2): e195085. **Study design** Post-hoc subgroup analysis of data from 2 RCTs (PAMPer & COMBAT) **Aim of the study** "Examine the combined data set to address the post hoc hypothesis that the benefits of prehospital administration of plasma are influenced by prehospital transport time."	**For inclusion and exclusion criteria see PAMPer (Sperry 2018) & COMBAT trial (Moore 2018)** **Characteristics** Age, years, median (IQR) Total: 42 (27-52) IG: 43 (29-56) CG: 42 (26-57) Males, n (%) Total: 467 (84.6) IG: 216 (72.7) CG: 251 (76.3) ISS, median (IQR) Total: 22 (12-34) IG: 22 (12-34) CG: 22 (12-33)	**Participants** N=626 patients (N=125 COMBAT, N=501 PAMPer) **Study groups** IG: prehospital plasma (N=297) CG: standard care (crystalloid) (N=329)	I**nfluence of prehospital transport time** (subgroup analysis of PAMPer & COMBAT) Mortality (28 days, 1ary outcome): HR (95% CI)§ ≤20 min transport time IG vs. CG: 1.71 (0.70-4.16), p=0.24 >20 min transport time IG vs. CG: 0.56 (0.40-0.80) p=0.001 Mortality (24 h): Hazard ratio (95% CI)§ ≤20 min transport time IG vs. CG: 1.89 (0.65-5.40), p=0.25 >20 min transport time IG vs. CG: 0.53 (0.34-0.82) p=0.004 §Patients with event not reported per group, analyses adjusted for age and ISS	**Level of evidence** 2b↓ **Risk of bias** Selection bias: + Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion** "These data suggest that prehospital plasma is associated with a survival benefit when transport times are longer than 20 minutes and that the benefit-risk ratio is favorable for use of prehospital plasma." **Reviewers' conclusion** This is post-hoc subgroup analysis of harmonized data from the PAMPer and COMBAT trial. There may be a performance bias because masking of the care

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Setting USA, 2014-2019				team was not possible and because patients in both groups did not receive similar volumes of plasma and placebo. Downgraded due to post-hoc analysis.
Reitz (2020) "Prehospital plasma in injured patients is associated with survival principally in blunt injury: Results from two randomized prehospital plasma trials". *The Journal of Trauma and Acute Care Surgery* 2020; 88(1): 33-41 **Study design** Post-hoc subgroup analysis of data from 2 randomized controlled trials (PAMPer & COMBAT) **Aim of the study** "Our overall objective was to characterize prehospital plasma outcomes across mechanism of injury using harmonized data obtained from these two recently completed prehospital plasma clinical trials. We hypothesized that the safety and beneficial effects of prehospital	*For inclusion and exclusion criteria see PAMPer (Sperry 2018) & COMBAT trial (Moore 2018)* **Characteristics** Age, years, median (IQR) Blunt trauma: 45 (28-61) Penetrating trauma: 35 (26-49) (p<0.001) Males, n (%) Blunt trauma: 326 (70.1) Penetrating trauma: 141 (87.6) (p<0.001) ISS, median (IQR) Total: 22 (12-34) Blunt trauma: 24 (17-34) Penetrating trauma: 14 (6-25) (p<0.001) GCS: median (IQR) Total: 6 (3-15) Blunt trauma: 3 (3-15) Penetrating trauma: 14 (3-15) (p=0.004)	**Participants** N=626 patients (N=501 PAMPer, N=125 COMBAT) **Study groups** IG: prehospital plasma (N=not reported) CG: standard care (crystalloid) (N=not reported) **Subgroup analysis mechanism of injury** Blunt: n=465, 75%, (including 10 suffering from blunt and penetrating trauma) (n=406 PAMPer, n=59 COMBAT) Penetrating: n=161, 25% (n=95 PAMPer, n=66 COMBAT)	**Mechanism of injury** (subgroup analysis of PAMPer & COMBAT) 28-day mortality (primary endpoint): n (%) *Blunt trauma* IG: 50 (23.5) vs CG: 86 (34.1), p=0.012 Multivariate Cox-hazard regression HR (95% CI): HR: 0.68 (0.472-0.965), p=0.031 *Penetrating trauma* IG: 12 (14.3) vs. CG. 8 (10.4), p=0.454 Multivariate Cox-hazard regression HR (95% CI): HR: 1.16 (0.430 – 3.103), p=0.775 24h mortality: n (%) *Blunt trauma* IG: 29 (15.2) vs. CG: 58 (25.8), p=0.010 Multivariate Cox-hazard regression HR (95% CI): HR: 0.59 (0.370-0.947), p=0.029 *Penetrating trauma* IG: 8 (10.4) vs. CG: 11 (13.23), p=0.595 Multivariate Cox-hazard regression HR (95% CI):	**Level of evidence** 2b↓ **Risk of bias** Selection bias: + Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion** "A survival benefit associated with prehospital plasma at 24 hours and 28 days exists primarily in blunt injured patients with no benefit shown in penetrating trauma patients" **Reviewers' conclusion** This is post-hoc subgroup analysis of harmonized data from the PAMPer and COMBAT trial. There may be a performance bias because masking of the care team was not possible and because patients in both

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
plasma would be consistent across blunt and penetrating mechanism of injury." **Setting** USA, 2014-2019			HR: 1.16 (0.430 – 3.103), p=0.775	groups did not receive similar volumes of plasma and placebo. Downgraded due to post-hoc analysis.
Roquet (2019) "Association of Early, High Plasma-to–Red Blood Cell Transfusion Ratio With Mortality in Adults With Severe Bleeding After Trauma." *JAMA network open* 2019; 2(9), e1912076. **Study design** Comparative registry trial (Traumabase) **Aim of the study** "To study the association of an early, high FFP-to-PRBC ratio with all-cause 30-day mortality in patients with severe bleeding after trauma." **Setting** France, 2012-2017	**Inclusion criteria** • patients with severe bleeding after trauma (defined as ≥4 PRBC units ≤6 h after admission) • patients who died of hemorrhagic causes before receiving 4 units of PRBCs **Exclusion criteria** • died on the scene • died during hospital transfer without any blood transfusion **Characteristics** <u>Age [y], median (IQR)</u> IG: 36 (25-54) vs. CG: 39 (26-54). p=0.10 <u>Male, n (%)</u> IG: 351 (69.4) vs. CG: 288 (73.7), p=0.18 <u>ISS, median (IQR)</u> IG: 34 (22-45) vs. CG: 34 (21-50), p=0.62 <u>GCS <9, n (%)</u> IG: 190 (37.5) vs. CG: 132 (33.8), p=0.26	**Participants** N=897 patients **Study groups** IG: high ratio, FFP-to-PRBC ratio of more than 1:1.5 (N=506) CG: low ratio, FFP-to-PRBC ratio of 1:1.5 or less (N=391) **Covariates for regression model (30d mortality)** • age • gender • anticoagulant or antiplatelet medication history • trauma characteristics including intentionality and mechanism • Injury Severity Score (ISS) • Simplified Acute Physiology Score II (SAPS II) • initial Glasgow Coma Scale (GCS) • lowest body temperature • prehospital tracheal intubation • prehospital cardiac arrest or cardiac arrest at hospital admission • prehospital lactatemia • prehospital capillary hemoglobin measurement	**Primary outcome** <u>30-d mortality: adj. HR (95% CI)</u> After multiple imputation (n=897) IG: 0.74 (0.58-0.94), p=0.01 Complete cases (n=594) IG: 0.57 (0.33-0.97), p=0.04 **Secondary outcomes** <u>6 h mortality: adj. HR (95% CI)</u> After multiple imputation (n=897) 0.91 (0.61-1.35), p=0.60 Complete cases (n=594) 0.71 (0.35-1.43), p=0.30 <u>24 h mortality, n/N (%)</u> IG: 91/506 (18.0) vs. 113/391 (28.9) HR (95% CI): 0.79 (0.58-1.06), p=0.11 <u>Length of ICU stay [d], median (IQR)</u> IG: 16 (8-32) vs. CG: 11 (4-24) OR (95% CI): 1.25 (0.28-5.40), p=0.31	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias:+ Detection bias: + **Authors' conclusion** "In this study, a transfusion strategy based on an early FFP-to-PRBC ratio of more than 1:1.5 was associated with decreased 30-day mortality among patients with severe bleeding after trauma. Further studies are needed to identify optimal, personalized, and dynamic transfusion strategies to help clinicians adjust the transfusion strategy in real time." **Reviewers' conclusion** There may be a risk for performance bias. Missing

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
		• prehospital clinical parameters incl. lowest SBP and highest heart rate • prothrombin time (PT) at admission • surgery (orthopaedic, vascular, thoracic, abdominal surgery, neurosurgery) • interventional radiology • fluid replacement ≤6 h (colloids & crystalloids) • need for vasopressor • tranexamic acid administration • platelet and fibrinogen concentrate transfusion		data might lead to a residual risk of attrition bias although the results remained significant across multiple imputation methods. About a third of patients who died in the low-ratio group did not receive any FFP.
Shea (2020) "The use of low-titer group O whole blood is independently associated with improved survival compared to component therapy in adults with severe traumatic hemorrhage." *Transfusion* 2020; 60, S2-S9. **Study design** Prospective observational study **Aim of the study** "We hypothesized that the use of LTOWB is independently associated with improved 24-hour mortality and 28-day mortality, reduces the total amount of blood products transfused in the first 72 hours	**Inclusion criteria** • ≤18 years of age • traumatic injury • MTP activation **Exclusion criteria** • no exclusion criteria reported **Characteristics** Age [y], median (IQR) IG: 32 (28-32) vs. CG: 28 (22-38), p=0.158 Male, n (%) IG: 35 (80) vs. CG: 31 (74), p=0.708 ISS, median (IQR) IG: 18 (10-29) vs. CG: 22 (17-33), p=0.162 GCS, median (IQR) IG: 11 (3-15) vs. CG: 12 (3-15), p=0.796	**Participants** N=86 patients **Study groups** IG: low-titer group O whole blood (LTOWB) (N=44 analysed) CG: Component therapy (N=42 analysed) **Co-interventions** Normal saline, lactated Ringer´s, crystalloid fluids, albumin, TXA, Calcium **Covariates for regression analysis** • maximum clot firmness (MCF) • other variables (LTOWB use, Glasgow Coma Scale (GCS) score, ISS, PT) were removed by backwards stepwise selection to arrive at a fitted model	**Adj. mortality** *by multivariate logistic regression* 24 h mortality: OR (95% CI) 0.81 (0.69-0.96), p=0.017 28 day mortality: OR (95% CI) 0.81 (0.65-1.02), p=0.059 *by Cox regression* 24 h mortality: HR (95% CI) 0.15 (0.03-0.49), p=0.001 28 day mortality: HR (95% CI) 0.30 (0.14-0.65), p=0.002 **Unadjusted mortality** Unadj. 24-h mortality: n/N (%) IG: 7/44 (16) vs. CG: 9/42 (21), p=0.518 Unadj. 28-day mortality: n/N (%) IG: 14/44 (44) vs. CG: 14/42 (33), p=0.86	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion** "The use of LTOWB is independently associated with improved 24-hour and 28-day survival, and does not increase organ dysfunction at 72 hours. Use of LTOWB most impacted survival of patients with reduced clot firmness (MCF ≤60 mm). Collectively, these data support the clinical use and continued study of LTOWB

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
after injury, and does not increase 72-hour multiple organ dysfunction scores (MODS) compared to the exclusive use of CT in adult patients with traumatic injury requiring massive transfusion protocol (MTP) activation." **Setting** USA, 2018-2019 CG: Aug 2018-Dec 2018 IG: Dec 2018- May 2019			**Unadj. outcomes: Multiple organ dysfunction scores (MODS)** total MODs, median (IQR) IG: 4 (0-7) vs. CG: 4 (2-7), p=0.913 Respiratory, median (IQR) IG: 0 (0-0) vs. CG: 0 (0-0), p=0.386 Renal, median (IQR) IG: 0 (0-1) vs. CG: 1 (0-1), p=0.461 Hepatic, median (IQR) IG: 0 (0-0) vs. CG: 0 (0-0), p=0.838 Cardiologic, median (IQR) IG: 0 (0-0) vs. CG: 0 (0-0), p=NA Hematologic, median (IQR) IG: 0 (0-2) vs. CG: 1 (0-2), p=0.838 Neurologic, median (IQR) IG: 3 (0-4) vs. CG: 4 (2-7), p=0.913	for hemostatic resuscitation." **Reviewers' conclusion** The study involved consecutive time periods for the study groups, leading to a risk for performance bias.
Stanworth (2016) Mortality from trauma haemorrhage and opportunities for improvement in transfusion practice. *BJS* 2016; 103(4): 357-365. **Study design** Prospective observational study (TARN) **Aim of the study**	**Inclusion criteria** • adult injured patients ≥16 years • admitted to the 22 trauma receiving hospitals who fulfilled the TARN inclusion criteria: injuries that result in a hospital stay of 72 h or more, transfer for specialist or intensive care, or patient death. • received at least 4 units of packed red blood cells (PRBCs) in the first 24 h of admission • with activation of the massive haemorrhage protocol (MHP). The rationale	**Participants** N=442 patients **Study groups** IG: FFP : PRBC ratio <1:2 (N=67 within 3h, N=92 within 24h) CG: FFP : PRBC ratio ≥1:2 (N=141 within 3h, N=206 within 24h)	Mortality at 3h: n/N (%) IG: 12/67 (18) vs. CG: 7/141 (5) Mortality at 24h: n/N (%) IG: 26/92 (28) vs. CG: 25/206 (12.1)	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: ? Detection bias: + **Authors' conclusion** "Higher FFP : PRBC ratios were associated with lower

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"The aim of this study was to describe the prevalence, patterns of blood use and outcomes of major haemorrhage in trauma." **Setting** UK, 2009-2011	for requiring MHP activation was to identify the more severely injured bleeding patients. **Exclusion criteria** • Patients transferred from another hospital • Patients who died within 1 h were excluded from this analysis **Characteristics** <u>Age [y], median (IQR)</u> 18 (26-54) <u>Male, n (%)</u> 326 (73,8) <u>ISS, median (IQR)</u> 27 (17-41) At 24h: IG: 29 (19-44) vs. 28 (17-43) <u>GCS, median (IQR) *</u> 14 (6-15) *data available for 391 patients			mortality rates, with no apparent difference in injury severity or physiology between the groups." **Reviewers' conclusion** The study results need to be interpreted with cause because of the risk of selection bias and unclear risk of performance and attrition bias. A substantial proportion of patients who died in the low-ratio group did not receive any FFP.
Stevens (2017) "Incompatible type A plasma transfusion in patients requiring massive transfusion protocol: outcomes of an Eastern Association for the Surgery of Trauma multicenter study." *Journal of Trauma*	**Inclusion criteria** • Trauma patients • Initiation of Massive transfusion protocol **Exclusion criteria** • patients less than 15 years of age (all participating institutions were adult trauma centers),	**Participants** N=1,536 patients **Study groups** IG: patients receiving compatible Type A plasma (N=1,416) CG: patients receiving incompatible Type A plasma (N=120) **Co-interventions**	**Adj. outcomes** <u>Adj. overall mortality at 28 d: OR (95% CI)</u> 1.00 (0.65–1.51), p=0.981 **Unadj. outcomes** <u>Mortality at 6h: % (N=1317)</u> IG: 15.2 vs. CG: 16.5, p=0.775 <u>Mortality at 24h: % (N=1314)</u>	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
and Acute Care Surgery 2017; 83(1): 25-29. **Study design** Comparative registry trial (trauma registry, blood bank, and medical record data, including centers that use type A plasma for trauma resuscitation) **Aim of the study** "The goal of this study is to determine outcomes for trauma patients who received incompatible plasma transfusions as part of a massive transfusion protocol (MTP)" **Setting** USA, 2012-2016	• patients for whom a blood type was never identified (e.g., due to early demise), • and patients with preferences limiting blood transfusion **Characteristics** Age [y], median IG: 37 vs. CG: 36, p=0.802 Male, % IG: 75.2% vs. 82,5%, p=0.076 ISS, median IG. 25 vs. CG: 25, p=0.303 Penetrating injuries, % IG: 36.1 vs. CG: 48.3, p=0.010	Transfusion of RBC, plasma **Covariates for logistic regression** • reporting center • age • injury severity • method of injury • number of units of red blood cells transfused at 4 hours (as a proxy for bleeding rate)	IG: 22.8 vs. CG: 25.2, p=0.544 Mortality at 7d: % (N=1314) IG: 31.6 vs. CG: 35.0, p=0.509 Mortality at 28d or at discharge: % (N=1,536) IG: 34.8 vs. 38.3, p=0.486 Adj. morbidity: OR (95% CI) 1.12 (0.74–1.70), p=0.581 Morbidity (any of the following six morbidities): % IG: 27.8 vs. CG: 34.2, p=0.140 ARDS: % IG: 7.6 vs. CG: 5.8, p=0.589 Pulmonary embolism or Deep vein thrombosis: % IG: 7.2 vs. CG: 9.2, p=0.464 Pneumonia: % IG: 15.3 vs. CG: 19.2, p=0.294 Sepsis: % IG: 7.6 vs. CG: 5.8, p=0.589 Acute renal failure: % IG: 7.9 vs. CG: 8.3, p=0.860 Transfusion related acute lung injury (TRALI): n IG: 2 vs. CG: 0, p=1.000 Vent days IG: 2 vs. CG: 3.5, p=0.415 ICU LOS [d] IG: 5 vs. CG: 6, p=0.715	**Authors' conclusion** "These data support the safety of incompatible type A plasma transfusions as part of a MTP in trauma centers, although perhaps at a cost of more overall plasma transfusions." **Reviewers' conclusion** The risk of performance bias is unclear. Unadjusted values need to be interpreted with caution due to variations in co-interventions.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Hospital LOS [d] IG: 9 vs. CG: 12, p=0.514 Number of operations, n IG: 2 vs. CG: 2, p=0.328	
Zeeshan (2019) Four-factor prothrombin complex concentrate is associated with improved survival in trauma-related hemorrhage: a nationwide propensity-matched analysis. *Journal of Trauma and Acute Care Surgery* 2019; 87(2): 274-281. **Study design** Comparative registry trial (American College of Surgeons-Trauma Quality Improvement Program database) **Aim of the study** "The aim of our study was to evaluate outcomes in severely injured trauma patients who received 4-PCC + FFP compared to FPP alone" **Setting** USA; 2015-2016	**Inclusion criteria** • adult trauma patients (age ≥18 years) • presented to trauma center • Received either FFP alone or 4-PCC + FFP for initial resuscitation in the ED. **Exclusion criteria** • documented bleeding disorders, • chronic liver disease, • history of preinjury anticoagulants use • received PCC alone (without FFP). • Patients who were not managed at trauma centers using ICD-10 codes **Characteristics (matched cohort)** Age [y], mean ± SD IG: 51 ± 19 vs. CG: 50 ± 21, p=0.28, Male, % IG: 69.5 vs. CG: 70.3, p=0.28 GCS, median (IQR) IG: 14 (12–15) vs. CG: 14 (12–15), p=0.18 ISS, median (IQR) IG: 27 (19–35) vs. CG: 27 (20–37), p=0.28	**Participants** N=468 (N=118,970 before matching) **Study groups** IG: 4-PCC + FFP (N=234) CG: FFP alone (N=234) **Matching criteria** • Age • Sex • Race • Body mass index • SBP • HR • GCS • Time to ignition oh therapy • Mechanism of injury • ISS • Head-AIS • Chest-AIS • Abdominal-AIS • Spine-AIS • Extremity-AIS • Comorbidities • preinjury antiplatelet use • level of trauma center	ED mortality: n (%) IG: 5 (2.1) vs. CG: 6 (2.5) vs., p=0.28 Overall in-hospital mortality: n (%) IG: 41 (17.5) vs. CG: 65 (27.7), p=0.01 Acute kidney injury: n (%) IG: 5 (2.1) vs. CG: 17 (7.3), p=0.001 Acute respiratory syndrome: n (%) IG: 3 (1.3) vs. CG: 11 (4.7), p=0.04 Deep Venous Thrombosis: n (%) IG: 8 (3.4) vs. CG: 13 (5.5), p=0.11 Pulmonary Embolism: n (%) IG: 3 (1.3) vs. CG: 4 (1.7), p=0.33 Hospital stay [d]: median (IQR) IG: 5 (2–8) vs. CG: 8 (3–11), p=0.03 ICU stay [d]: median (IQR) IG: 1 (1–3) vs. CG: 1 (1–2), p=0.19 Skilled nursing facility/ Rehabilitation disposition: n (%) IG: 92 (39.8) vs. CG: 90 (38.4), p=0.21	**Level of evidence** 2b↓ **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Our study demonstrates that compared to FFP alone, the use of 4-factor PCC as an adjunct to FFP is associated with improved survival and reduction in transfusion requirements without increasing the risk of venous thromboembolic complications." **Reviewers' conclusion** The results need to be interpreted with caution due to the retrospective nature of the study and unclear risk for performance bias. No match was found for

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
				around 40% of patients receiving 4-PCC because of systematic differences prior to matching.
Zhang (2019) "Low-dose, early fresh frozen plasma transfusion therapy after severe trauma brain injury: a clinical, prospective, randomized, controlled study." *World neurosurgery* 2019; 132: e21-e27. **Study design** Randomised controlled trial **Aim of the study** "To investigate role of Low-dose, Early Fresh frozen plasma Transfusion (LEFT) therapy in preventing perioperative coagulopathy and improving longterm outcome after severe traumatic brain injury (TBI)." **Setting** China 2018	**Inclusion criteria** • adult patients who underwent emergency craniotomy evacuation of hematomas and decompressive hemicraniectomy for subdural hematoma • preoperative GCS score of 3-8 • subdural hematoma with TCDB ≥4 • <3 hours after admission **Exclusion criteria** • severe cardiac dysfunction • pulmonary dysfunction • hepatic dysfunction • renal dysfunction • history of dementia • history of prior central nervous system disease • history of coagulating disorders • anticoagulant drug usage (e.g., aspirin, clopidogrel, warfarin) **Characteristics (analysed patients)** Age [y], mean ± SD IG: 65.7 ± 10.4 vs. CG: 64.1 ± 7.7, p=0.548 Females, n[$] IG: 7 vs. CG: 6, p=0.510 GCS, mean ± SD IG: 4.7 ±1.9 vs. CG: 5.3 ±2.9, p=0.434	**Participants** N=63 (N=52 analysed) **Study groups** IG: 5 mL/kg of FFP (N=28 randomized, N=20 analysed)[§] CG: normal saline (5 mL/kg) (N=35 randomized, N=32 analysed) • [§] 5 withdrew, 3 were radiologically misclassified, 2 were misclassified according to the GCS, 3 were lost in follow-up [$] 2 withdrew, 1 was radiologically misclassified, 1 had no FFP transfusion, 1 was lost to follow-up	Mortality at 6 months: n (%) IG: 10 (50) vs. CG: 15 (46.9), p=1.000 RR: 1.133, 95% CI: 0.370-3.467, p=1.000 Glagow Outcome Scale at 6 m: mean ± SD IG: 1.9 ± 0.8 vs. CG: 2.41 ± 1.2, p=0.082 Delayed traumatic intracranial hematoma: n (%)[§] IG: 7 (35.0) vs. CG: 3 (9.4), p=0.033 RR (95% CI): 5.2505 (1.159-23.384), p=0.023 adj. OR (95% CI): 5.493 (1.953-28.652), p=0.043 Length of mechanical ventilation [d]: mean ± SD IG: 2.4 ±3.8 vs. CG: 1.97 ± 3.9, p=0.697 Length of antibiotics administration [d]: mean ± SD IG: 28.3 ± 21.4 vs. CG: 16.91 ±14.8, p=0.027 Length of hospital stay [d] mean ± SD IG: 45.15 ±39.4 vs. 25.91 ± 23.6, p=0.032 Acute renal failure: n (%) IG: 2 (10.0) vs. CG: 3 (9.4), p=1.000 Pneumonia: n (%) IG: 11 (55.0) vs. CG: 12 (37.5), p=0.216 Acute respiratory distress syndrome: n (%) IG: 3 (15.0) vs. CG: 5 (15.6), p=1.000	**Level of evidence** 2b↓ **Risk of bias** Selection bias: + Performance bias: + Attrition bias: – Detection bias: + **Authors' conclusion** "In our study comparing LEFT with NO LEFT treatment for coagulation during surgery, DTICH and prolonged length of antibiotic administration were observed in patients with severe TBI. These findings suggest that a restricted FFP transfusion protocol in the right clinical setting may be more appropriate in patients with severe TBIs." **Reviewers' conclusion** The results of the study need to be interpreted with caution due to the small study size and substantial

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	ISS, mean ± SD IG: 19.8 ±7.4 vs. CG: 23.2 ±10.2, p=0.171 ASA, score, mean ± SD IG: 4.0 ± 0.32 vs. CG: 3.8 ± 0.5, p=0.231 $unclear percentage values		Intracranial infection: n (%) IG: 5 (25.0) vs. CG: 4 (12.5), p=0.280 Second surgery: n (%) IG: 6 (30.0) vs. CG: 3 (9.4), p=0.071 RR (95% CI): 4.143 (0.901-19.049), p=0.071 PLT, x 10^9/L: mean ± SD IG: 86.2 ± 36.3 vs. CG: 122.5 ± 40.7, p=0.008 Hemoglobin, g/L, mean ± SD IG: 102.3 ± 22.1 vs. CG: 100.9 ± 25.5, p=0.859 § The study was terminated early for futility and safety reasons because a high proportion of patients in the LEFT group developed new delayed traumatic intracranial hematoma after surgery compared with the NO LEFT group	dropout rate (no ITT analysis).
Zielinski (2015) "Multicenter comparison of emergency release group A versus AB plasma in blunt-injured trauma patients." *Clinical and translational science* 2015; 8(1): 43-47. **Study design** Comparative registry trial (Trauma databases at two institution, both part of the National Trauma Databank and the Trauma Quality Improvement Project)	**Inclusion criteria** • Bluntly injured trauma patients • Age 18 or older • Received at least one emergency release plasma unit **Exclusion criteria** N.r. **Characteristics** Age [y], mean ± SD 57.6 (25.5) 51.9 (20.0), p=0.102 Male, % IG: 65 vs. CG:67, p=0.876 ISS, mean ± SD	**Participants** N=191 patients **Study groups** IG: group A plasma (N=115) CG: group AB plasma (N=76) **Co-interventions** Plasma units (more plasma and more compatible nonidentical plasma was transfused to Group AB plasma patients), pRBC, Platelets, cristalloids (Group A received more crystalloids), tranexamic acid	**Adj. outcomes** Mortality: OR (95% CI) 0.66 (0.21–2.06) **Unadj. outcomes** Mortality: % IG: 17 vs. CG: 26, p=0.150 Ventilator days: mean ± SD IG: 2.8 ± 7.0 vs. CG: 3.8 ± 6.0, p=0.310 ICU days: mean ± SD IG: 3.8 ± 7.7 vs. CG: 7.2 ± 8.8, p=0.007 Hospital days: mean ± SD IG: 8.2 ± 9.7 vs. CG: 9.5 ± 9.1, p=0.350	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion** "Utilization of Group A plasma for emergency blood resuscitation is a safe option which may alleviate

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Aim of the study "To discriminate outcomes between practices using either the traditional universal plasma product (i.e., Group AB) and an alternative universal plasma product (i.e., Group A) in bluntly injured trauma patients, we performed a multiinstitutional retrospective review" **Setting** USA, 2012	IG: 20.3 ± 14.5 vs. CG: 26.8 ± 16.6, p=0.007 GCS, mean ± SD IG: 11.3 ± 5.3 vs. CG: 10.6 ± 5.2, p=0.371 TRISS, mean ± SD IG: 0.80 ± 0.29 vs. CG: 0.75 ± 0.32, p=0.330 Total plasma [units], mean ± SD IG: 4.5 ± 5.7 vs. CG: 7.0 ± 9.0, p=0.031 Compatible nonidentical plasma [units], mean ± SD IG: 0.17 ± 0.67 vs. CG: 1.5 ± 4.2 Total platelets [units], mean ± SD IG: 0.52 ± 1.9 vs. CG: 1.05 ± 1.1, p=0.030 Total crystalloids [mL], mean ± SD IG: 3845 ± 3163 vs. CG: 2501 ± 1569, p<0.001		Highest positive end expiratory pressure: mean ± SD IG: 10 ± 4.6 vs. CG: 8 ±3.1, p=0.002 Lowest PaO_2 /FiO_2 ratio: mean ± SD IG: 226 ± 145 vs. CG: 206 ± 97, p=0.326 Acute respiratory distress syndrome: % IG: 2 vs. CG: 8, p=0.060 Sepsis: % IG: 0 vs. CG: 5, p=0.024 Pneumonia: % IG: 7 vs. CG: 14, p=0.137 Acute renal failure: % IG: 1 vs. CG: 11, p=0.003 Deep venous thrombosis: % IG: 5 vs. CG: 16, p=0.021 Pulmonary embolus: % IG: 0 vs. CG: 5, p=0.013	potential shortages of AB plasma." **Reviewers' conclusion** The study has a risk for performance bias due to unequal co-interventions.

+: low risk; –: high risk; ?: unclear risk; ACS: American College of Surgeons; adj.: adjusted; AIS: Abbreviated Injury Scale; ARDS: Acute Respiratory Distress Syndrome; ASA: American Society of Anesthesiology Score; ATC: acute traumatic coagulopathy; CI: confidence interval; CFC: coagulation factor concentrates; CG: control group; d: days; dl: decilitres; ED: emergency department; ERP: emergency-release plasma; FFP: fresh frozen plasma; GCS: Glasgow Coma Score; h: hours; HR: hazard ratio; ICU: intensive care unit; IG: intervention group; INR: International Normalized Ratio; IQR: Interquartile Range; ITT: intention to treat; ISS: injury severity score; LEFT: low-dose, early fresh frozen plasma transfusion; mg: milligrams; mmHg: millimetres of mercury; MTP: massive transfusion protocol; NISS: New Injury Severity Score; n.r.: not reported; NTDB: National Trauma Data Bank; L: litres; LoE: level of evidence; LTOWB: low-titer group O whole blood; LQP: Never-frozen liquid plasma; min: minutes; PCC: prothrombin complex concentrate; PRBC: packed red blood cells; PLT: platelets; PT: prothrombin time; PTT: activated partial thromboplastin time; OR: Odds ratio; RBC: red blood cells; SBP: systolic blood pressure; sec: seconds; SD: Standard Deviation; TBI: traumatic brain injury; TCDB: Traumatic Coma Data Bank; TRISS: trauma injury severity score; TXA: tranexamic acid; y: years

Tranexamsäure

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
CRASH-3 collaborators (2019). "Effects of tranexamic acid on death, disability, vascular occlusive events and other morbidities in patients with acute traumatic brain injury (CRASH-3): a randomised, placebo-controlled trial". *Lancet* 2019; 394(10210): 1713-23. **Study design** Randomised controlled trial **Aim of the study** "The CRASH-3 trial aimed to quantify the effects of tranexamic acid on head injury-related death, disability, and adverse events in patients with TBI." **Setting** 29 countries, 2012-2019	**Inclusion criteria** • Adults with traumatic brain injury (TBI) ≤3 h of injury (at the beginning ≤8 h) • Glasgow Coma Scale (GCS) score ≤12 • OR any intracranial bleeding on CT scan, • no major extracranial bleeding • responsible clinician was substantially uncertain as to the appropriateness of tranexamic acid treatment **Baseline characteristics** *of those randomly assigned within 3 h of injury* Age [y], mean ± SD IG: 41.7 (19.0) CG: 41.9 (19.0) Males, n (%) IG: 3,742 (80) CG: 3,660 (80) Glagow Coma Scale Scores, n (%) GCS 3: IG: 495 (11) vs. CG: 506 (11) GCS 4: IG: 213 (5) vs. CG: 213 (5) GCS 5: IG: 163 (4) vs. CG: 172 (4) GSC 6: IG: 221 (5) vs. CG: 232 (5) GCS 7: IG: 311 (7) vs. CG: 294 (6) GCS 8: IG: 354 (8) vs. CG: 315 (7) GCS 9: IG: 335 (7) vs. CG: 292 (6)	**Participants** N=12,737 patients, out of whom 9,202 (72.2%) patients within 3 h of injury. **Study groups** IG: TXA (N=6,406; 4,649 ≤3 h) 1 g of tranexamic acid infused over 10 min, started immediately after randomisation, followed by an intravenous infusion of 1 g over 8 h (four ampules of TXA 500 mg) CG: 100 mL bag of 0.9% sodium chloride (N=6,331; 4,553 ≤3 h)	All results for patients randomly assigned within 3h: **Head injury-related death in hospital (28 days): n/N (%)** Overall: IG: 855/4,613 (18.5) vs. CG: 892/4514 (19.8) Risk ratio (95% CI): 0.94 (0.86–1.02) GCS severe (3-8) IG: 689/1,739 (39.6) vs. GC: 685/1,710 (40.1) Risk ratio (95% CI): 0.99 (0.91–1.07) no obvious effect of time to treatment in patients with severe head injury (p=0·73). **Stratification by time** Early treatment was more effective than later treatment in patients with mild and moderate head injury (p=0·005) but we found no obvious effect of time to treatment in patients with severe head injury (p=0·73). Other endpoints were not reported separately for severe TBI.	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: + Attrition bias: + Detection bias: + **Authors' conclusion** "We found a substantial reduction in head injury-related deaths with tranexamic acid in patients with mild and moderate head injuries but no apparent reduction in those with severe head injury." **Reviewers' conclusion** CRASH-3 is a randomized controlled trial of good quality with large sample size, indicating reliable results.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	GCS 10: IG: 371 (8) vs. CG: 364 (8) GCS 11: IG: 375 (8) vs. CG: 390 (9) GCS 12: IG: 476 (10) vs. CG: 478 (10) GCS 13: IG: 297 (6) vs. CG: 312 (7) GCS 14: IG: 526 (11) vs. CG: 458 (10) GCS 15: IG: 484 (10) vs. CG: 492 (11) Unknown: IG: 28 (1) vs. CG: 35 (1)			
Guyette (2020) "Tranexamic Acid During Prehospital Transport in Patients at Risk for Hemorrhage After Injury: A Double-blind, Placebo-Controlled, Randomized Clinical Trial". *JAMA Surgery* 2021; 156(1): 11-20. (STAAMP) **Study design** Randomised controlled trial **Aim of the study** "To assess the effectiveness and safety of tranexamic acid administered before hospitalization compared with placebo in injured patients at risk for hemorrhage."	**Inclusion criteria** • injured patients at risk for hemorrhage transported from the scene or transferred from an outside emergency department • at least 1 episode of hypotension (SBP ≤90 mmHg) or tachycardia (heart rate ≥110 beats per minute) before arrival at a participating center **Exclusion criteria** • age >90 years, <18 years • lack of intravenous or intraosseous access • isolated fall from standing • documented cervical cord injury • known prisoner or pregnancy • traumatic arrest of >5 minutes • penetrating brain injury • isolated drowning or hanging • objection to study voiced at scene • wearing a STAAMP study opt-out bracelet. **Characteristics**	**Participants** N=903 patients **Study groups** IG: TXA (N=477) The treatment arms received a 1-g bolus of tranexamic acid (for 10 minutes) en route to the hospital. • TXA abbreviated: 1g TXA + placebo + placebo (N=151) • TXA standard: 1g TXA +1g TXA + placebo (N=141) • TXA repeat: 1g TXA + 1g TXA + 1g TXA (N=150) CG: placebo bolus + placebo bolus + placebo infusion (N=456) **Co-interventions** Phase A (prehospital): infusion over 10 min • 1 g of TXA 10 mL of solution + 100 mL bag of 0.9% saline • 10 mL of sterile water + 100 mL bag of 0.9% saline.	**Mortality (30 days): n/N (%)** Overall IG: 36/442 (8.1) vs. 45/452 (10.0) (9 missing) Risk ratio (95% CI) 0.82 (0.60-1.11) By dosing regimen *TXA abbreviated* 14/150 (9.3) vs. CG: 45/452 (10.0) Risk ratio (95% CI): 0.94 (0.65-1.36), p=0.74 *TXA standard* 11/141 (7.8) vs. CG: 45/452 (10.0) Risk ratio (95% CI): 0.78 (0.50-1.24), p=0.30 *TXA repeat* 11/151 (7.3) vs. CG: 45/452 (10.0) Risk ratio (95% CI): 0.73 (0.54-0.99), p=0.04 **By TBI severity** No severe TBI (head AIS≤2) IG: 17/352 (4.8) vs. CG: 25/374 (6.7) Risk ratio (95% CI): 0.72 (0.46-1.14) Severe TBI (head AIS>2) IG: 19/90 (21.1) vs. 20/78 (25.6) Risk ratio (95% CI): 0.82 (0.55-1.24)	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: + Attrition bias: + Detection bias: + **Authors' conclusion** "Patients with severe shock (SBP ≤70mmHg) who received tranexamic acid demonstrated lower 30-day mortality compared with placebo." **Reviewers' conclusion** The study has a low risk of bias. The subgroup of severe shock patients (SBP ≤70mmHg) contains a small number of patients (N=58).

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Setting USA, 2015-2019	Age [y], mean ± SD Overall: 42 ± 18 IG: 41 ± 17 CG: 42 ± 18 Males, n (%) Overall: 686 (74.0) IG: 327 (73.2) CG: 341 (74.8) ISS, median (IQR) Overall: 12 (5-22) IG: 13 (5-22) CG: 11 (4-22) Initial GCS<8: n (%) IG: 89 (19.9) CG: 107 (23.5)	Phase B intervention (hospital): infusion over 10 min • 1g TXA in 10 mL of solution • 10 mL of placebo (sterile water) added to a 100 mL bag of 0.9% saline Phase C intervention (hospital): infusion over 8h • 1 g of TXA in 10 mL of solution 10 mL of placebo + 100 mL bag of 0.9% saline	Adj. p=0.86 for interaction **By transfusion received** No transfusion received IG: 10/289 (3.5) vs. CG: 10/295 (3.4) Risk ratio (95% CI): 1.02 (0.49-2.15) Transfusion received IG: 26/153 (17.0) vs. 35/157 (22.3) Risk ratio (95% CI): 0.76 (0.57-1.01) Adj. p=0.32 for interaction **By shock severity** (post-hoc analysis) Tachycardia only IG: 18/316 (5.7) vs. CG: 21/320 (6.6) Risk ratio (95% CI): 0.87 (0.56-1.34), p=0.52 SBP <90 mm Hg IG: 13/99 (13.1) vs. CG: 13/101 (12.9) Risk ratio (95% CI): 1.02 (0.55-1.90), p=0.95 SBP <70 mm Hg IG: 5/27 (18.5) vs. CG: 11/31 (35.5) Risk ratio (95% CI): 0.52 (0.34-0.80), p=0.003 **By time from injury** (post-hoc analysis) ≤1h IG: 10/219 (4.6) vs. CG: 18/238 (7.6) Risk ratio (95% CI): 0.60 (0.44-0.83) >1h IG: 26/223 (11.7) vs. 27/214 (12.6) Risk ratio (95% CI): 0.92 (0.52-1.64) §only percentage reported	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Khan (2018) „Severely Injured Trauma Patients With Admission Hyperfibrinolysis; Is There A Role Of Tranexemic Acid? Findings From The PROPPR Trial", *Journal of Trauma and Acute Care Surgery* 2019; 85(5): 851–857. **Study design** Comparative registry trial (secondary analysis of PROPPR database) **Aim of the study** "The aim of the study was to analyze the role of TXA in severely injured trauma patients with admission hyperfibrinolysis." **Setting** North America, PROPPR Trial 2012-2013	In Addition to PROPPR **Inclusion criteria** • trauma patients with hyperfibrinolysis on admission measured via thromboelastography. Hyperfibrinolysis was defined as Ly30 ≥3% on thromboelastography **Exclusion criteria** • all patients who received TXA >3 hours of injury **Characteristics** Age: mean, ± SD IG: 42.5 ± 20 (p=0.33) CG: 38.7 ± 17 Male gender: % § IG: 66% (p=0.84) CG: 68% Injury Severity Score (ISS): median (IQR) IG: 38 (23 - 45) (p=0.56) CG: 35 (21 - 45) GCS: median (IQR) IG: 6 (3 - 15) (p=0.34) CG: 8 (3 - 15) SBP: median (IQR) IG: 90 (70 - 126) (p=0.28) CG: 101 (80 - 131) Lactate: median (IQR) IG: 8.3 (5.1 - 11.7) (p=0.83) CG: 9.5 (5.1 - 12.7)	**Participants** N=93 patients, matched in 1:2 ratio (117 patients pre-matching) **Study groups** IG: TXA (N=31) CG: no TXA (N=62) **Matching criteria** Propensity score matching according to age, gender, race, ED SBP, ED heart rate, mechanism of injury, ISS, head-AIS, GCS, and PROPPR intervention groups (1:1:1 or 1:1:2 transfusion ratios).	**Mortality§** - *primary outcomes* 6-hour: %§ IG: 13 (p=0.04) CG: 34 24 hour: %§ IG: 26 (p=0.25) CG: 39 30 day: %§ IG: 45 (p=0.82) CG: 50 **Cause of death§** Exsanguination/Hemorrhagic shock: %§ IG: 26 (p=0.39) CG: 32 TBI: %§ IG: 10 (p=0.62) CG: 13 Respiratory: %§ IG: 6.4 (p=0.26) CG: 1.6 Other: %§ IG: 3.2 (p=1.00) CG: 3.2 **Complications§ -** *Secondary outcomes* Deep venous thrombosis: % IG: 6.5 (p=0.59) CG: 3.2	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: + Attrition bias: + Detection bias: + **Authors' conclusion** "Tranexamic acid (TXA) was associated with increased 6 hour survival but does not improve long term outcomes in severely injured trauma patients with hemorrhage who develop hyperfibrinolysis." **Reviewers' conclusion** There may be a risk of performance bias because TXA use was not prescribed in the PROPPR study protocol and left to the discretion of the trauma attending. However, patients received the same care apart from TXA use and cohorts were matched according to confounders and transfusion ratios showing consistent results.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Transfusion ratio (1:1:1): %§ IG: 55% CG: 47% § n=total number of patients not reported		Acute Kidney Injury: % IG: 45 (p=0.01) CG: 19 Sepsis: % IG: 35 (p=0.04) CG: 16 Multiple organ failure: % IG: 19 (p=0.01) CG: 6.4 ICU free days: median (IQR) IG: 0 (0 – 3) (p=0.22) CG: 0 (0–5) § n=number of patients with event not reported	
Moore (2017) "Tranexamic acid is associated with increased mortality in patients with physiological fibrinolysis ", *Journal of Surgical Research* 2017; 220: 438-443. **Study design** Prospective cohort study **Aim of the study** "The aim of the study was to investigate if TXA in patients with a physiological level of fibrinolysis will	**Inclusion criteria** • Adult trauma patients (aged >18 years) • highest level of activation at level I trauma center • new injury severity score (NISS) >15 **Characteristics** Age: median (IQR) IG: 27 (24-54) (p=0.214) CG: 34 (27-49) Male gender: %§ IG: 85% (p=0.362) CG: 77% NISS: median (IQR)	**Participants** N=232 patients **Study groups** IG: TXA (N=26) CG: no TXA (N=206)	**Mortality** Mortality (in-hospital): %§ IG: 50% (p<0.001) CG: 17% Mortality (in-hospital) within phenotypes (n, (%)) Hyperfibrinolysis IG: 56% (p=0.023) CG: 19% Shutdown IG: 38% (p=0.604) CG: 28% Physiologic	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion** "There was no clear benefit of receiving TXA in this study, and patients who present to the hospital with

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
have an increase in mortality compared with other fibrinolytic phenotypes." **Setting:** USA, 2014-2016	IG: 48 (29-57) (p=0.001) CG: 29 (22-43) INR:median (IQR) IG: 1.4 (1.2-1.8) (p<0.001) CG: 1.2 (1.1-1.3) **Fibrinolysis phenotype (n)** Hyperfibrinolysis: n (N=64) IG: 10 CG: 54 Shutdown: n (N=54) IG: 8 CG: 46 Physiologic: n (N=114) IG: 8 CG: 106 § n=number of patients with event not reported		IG: 63% (p<0.001) CG: 11% **Death associated with haemorrhage§ (%)** IG: 55% (p=0.060) CG: 23% **TXA as predictor of mortality by fibrinolysis phenotype (adj. for NISS)** Physiologic (p=0.018) Hyperfibrinolysis (p=0.116) Shutdown (p=0.597) **Massive transfusion: %§** IG: 69% (p<0.001) CG: 12% § n=number of patients with event not reported	physiologic levels of fibrinolysis, who received TXA, had the highest mortality." **Reviewers' conclusion** There is a substantial risk of selection bias due to imbalance of NISS and INR. Blinding was unclear and co-interventions were different (patients in the TXA group tended to receive more blood products), so that there is a risk for performance bias. The risk of attrition bias is unclear because the numbers in the analyses were not reported.
Nishijima (2019) "The Effect of Tranexamic Acid on Functional Outcomes: An Exploratory Analysis of the CRASH-2 Randomized Controlled Trial". *Annals of Emergency Medicine* 2019; 74(1), 79-87 **Study design**	**Inclusion criteria** • Same as in CRASH-2 trial and • only patients randomized 3 hours or less from the time of injury **Exclusion criteria** • patients who did not have modified Oxford Handicap Scale scores reported **Characteristics** Age (mean ± SD)	**Participants** N=13,432 patients subset of CRASH-2 dataset **Study groups** IG: TXA (N=6,753) CG: Placebo (N=6,679)	**Modified Oxford Handicap Scale score (at discharge or at 28 days): n (%)** No symptoms IG: 1,052 (15.6) CG: 941 (13.9) Minor symptoms IG: 2,190 (32.4) CG: 2,140 (32.0) Some restrictions	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: + Attrition bias: + Detection bias: + **Authors' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Randomised controlled trial (exploratory Analysis of CRASH-2 trial data) **Aim of the study** "The aim of the study was to evaluate whether tranexamic acid was associated with improved functional outcomes and, if so, which patients benefitted from tranexamic acid use. " **Setting** 40 countries, 2005-2010	IG: 34.1 (± 13.8) CG: 34.1 (± 14.2) Males: n (%)) IG: 5,605 (83.0) CG: 5,606 (84.0) Initial GCS: median (IQR) IG: 12.7 (3.6) CG: 12.7 (3.6) **Baseline risk of mortality stratum: n %)§** <6 IG: 2,415 (35.8) CG: 2,325 (34.9) 6-20 IG: 2,410 (35.7) CG: 2,391 (35.9) 21- 50 IG: 1,171 (17.4) CG: 1,201 (18.0) >50 IG: 753 (11.2) CG: 752 (11.3) Days in hospital (median, IQR) IG: 7 (3–14) CG: 7 (3–14)		IG: 1,311 (19.4) CG: 1,324 (19.8) Dependent IG: 807 (11.9) CG: 779 (11.7) Fully dependent IG: 421 (6.2) CG: 396 (5.9) Dead IG: 972 (14.4) CG: 1,109 (16.6) mean utility-weighted modified Oxford Handicap Scale score: mean ± SD IG: 0.66 (± 0.33) CG: 0.64 (± 0.34) mean difference = 0.02 (95% CI 0.01 – 0.03) (p<0.001) 28-day mean utility-weighted modified Oxford Handicap Scale score (Area under the curve analysis): mean ± SD: IG: 0.55 (± 0.30) CG: 0.53 (± 0.31) mean difference = 0.02 (95% CI 0.01 – 0.03) **Functional outcomes, stratified by CRASH-2 prognostic score: n (%) (95% CI) §** 0-6 % baseline risk Overall favourable outcome (no symptoms) IG: 534 (22.1) (95% CI 20.5 – 23.8) CG: 425 (18.3) (95% CI 16.7 – 19.9)	"In this exploratory analysis of the CRASH-2 study, we found that adult trauma patients randomized to tranexamic acid within 3 hours of injury had better functional outcomes compared with patients randomized to placebo." **Reviewers' conclusion** The trial is of good quality indicating reliable results.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			IG vs. CG: adj. OR for favourable outcome = 1.28 (95% CI 1.11 – 1.48) <u>6-20 % baseline risk</u> Overall favourable outcome (no or minor symptoms) IG: 1209 (50.2) (95% CI 48.1 – 52.2) CG: 1202 (50.3) (95% CI 48.2 – 52.3) IG vs. CG: adj. OR for favourable outcome = 0.99 (95% CI 0.88 – 1.11) <u>21-50 % baseline risk</u> Overall favourable outcome (no or minor symptoms or some restrictions) IG: 611 (52.2) (95% CI 49.3 – 55.1) CG: 588 (49.0) (95% CI 46.1% - 51.8) IG vs. CG: adj. OR for favourable outcome = 1.15 (95% CI 0.97 – 1.37) <u>>50 % baseline risk</u> Overall favourable outcome (no or minor symptoms or some restrictions or dependent) IG: 238 (31.6) (95% CI 28.3 – 35.1) CG: 217 (28.9) (95% CI 25.6 – 32.2) IG vs. CG: adj. OR for favourable outcome = 1.24 (95% CI 0.97 – 1.57) <u>Overall proportion of patients with favourable outcomes: n (%) (95% CI):</u> IG: 5,360 (79.4) (95% CI 78.4% - 80.3) CG: 5,174 (77.) (95% CI 76.5% - 78.5) difference 1.9% (95% CI 0.5% - 3.3) NNT = 52 (95% CI 30 – 196)	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			[§] Favourable versus unfavourable outcomes were defined separately for each risk stratum	
Roberts (2017) "Tranexamic acid in bleeding trauma patients: an exploration of benefits and harms." *Trials* 2017; 18: 48. **Study design** Randomised controlled trial (predefined subgroup analysis of CRASH-2) **Aim of the study** "We examine how patient characteristics vary by time to treatment in the CRASH-2 trial and explore whether any such variations explain the time-dependent treatment effect." **Setting** 40 countries, 2005-2010	Same as *CRASH-2:* **Inclusion criteria** • Adult trauma patients • with, or at risk of, significant bleeding within 8 h of their injury **Characteristics** no patient characteristics reported	**Participants** N=20,211 patients **Study groups** IG: TXA (loading dose 1 g over 10 min followed by an infusion of 1 g over 8 h) (N=10,093) CG: matching placebo (N=10,114)	**Subgroup analyses of CRASH-2** • SBP (≤75, 76–89, >89 mmHg) • GCS score (severe 3–8, moderate 9–12, mild 13–15) • type of injury (penetrating versus blunt) 1. Effects of **early** tranexamic acid (TXA) treatment stratified by systolic blood pressure on death due to bleeding: Risk Ratio (95% CI) SBP ≤75 RR: 0.73 (0.61-0.86) SBP 76-89 RR: 0.86 (0.64-1.16) SBP>89 RR: 0.71 (0.54-0.92) SBP <100 mg and treatment initiated **within 1h** RR = 0.69 (0.58 - 0.83) SBP <100 mg and treatment **between 1-3h** RR = 0.84; 95% (0.67 - 1.04) Effects of **late** tranexamic acid (TXA) treatment stratified by **systolic blood pressure** (SBP) on death due to bleeding: Risk Ratio (95% CI) Systolic blood pressure (mm Hg) ≤75, 1.36 (0.92-2.01) 2. Effects of **early** tranexamic acid (TXA) treatment stratified by **Glasgow Coma Scale** (GCS) score on death due to bleeding: Risk Ratio (95% CI) GCS 3-8 RR: 0.82 (0.66-1.02)	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: + Attrition bias: + Detection bias: + **Authors' conclusion** "When given within 3 h of injury, TXA reduces death due to bleeding regardless of injury type, GCS or blood pressure." **Reviewers' conclusion** This predefined subgroup analyses of the CRASH-2 trial is of good quality indicating reliable results.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Effects of **late** tranexamic acid (TXA) treatment stratified by **Glasgow Coma Scale** (GCS) score on death due to bleeding: Risk Ratio (95% CI) GCS 3-8 1.42 (0.90-2.25) 3. Effects of **early** tranexamic acid (TXA) treatment stratified by **type of injury** on death due to bleeding: Risk Ratio (95% CI) Blunt 0.72 (0.60 - 0.86) Penetrating 0.73 (0.60 – 0.90) Effects of **late** tranexamic acid (TXA) treatment stratified by **type of injury** on death due to bleeding: Risk Ratio (95% CI) Blunt 1.48 (1.12 – 1.96) Penetrating 1.25 (0.74 – 2.12)	
Roberts (2014) "Mechanism of action of tranexamic acid in bleeding trauma patients: an exploratory analysis of data from the CRASH-2 trial." *Critical Care* 2014; 18(6): 1-5. **Study design** Randomised controlled trial (CRASH-2) **Aim of the study** "We conducted further analyses of the CRASH-2 trial data to examine the	Same as *CRASH-2:* **Inclusion criteria** • adult trauma patients with, or at risk of, significant bleeding, and • who were within 8 h of their injury **Characteristics** no patient characteristics reported	**Participants** N=20,211 patients **Study groups** IG: TXA (loading dose 1 g over 10 minutes followed by an infusion of 1 g over 8 h) (N=10,060 with outcome data) CG: matching placebo (N=10,067 with outcome data)	**All cause mortality (incl. non-bleeding patients!)** 0 days since injury, Hazard Ratio (95% CI) 0.83 (0.73, 0.93) 1 day since injury, Hazard Ratio (95% CI) 0.91 (0.79, 1.04) 2 days since injury, Hazard Ratio (95% CI) 0.96 (0.77, 1.19) 3 days since injury, Hazard Ratio (95% CI) 1.01 (0.76, 1.34) 4 days since injury, Hazard Ratio (95% CI) 0.96 (0.70, 1.36) **Mortality due to bleeding**	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: + Attrition bias: + Detection bias: + **Authors' conclusion** "Early administration of tranexamic acid appears to reduce mortality primarily

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
timing of the effect of TXA on mortality." **Setting** 40 countries, 2005-2010			0 days since injury, Hazard Ratio (95% CI) 0.80 (0.68, 0.94) 1 day since injury, Hazard Ratio (95% CI) 0.89 (0.72, 1.11) 2 days since injury, Hazard Ratio (95% CI) 1.17 (0.74, 1.86) 3 days since injury, Hazard Ratio (95% CI) 0.66 (0.32, 1.37) 4 days since injury, Hazard Ratio (95% CI) 0.77 (0.29, 2.06) **Non-bleeding mortality** 0 days since injury, Hazard Ratio (95% CI) 0.87 (0.71, 1.06) 1 day since injury, Hazard Ratio (95% CI) 0.92 (0.76, 1.11) 2 days since injury, Hazard Ratio (95% CI) 0.91 (0.71, 1.16) 3 days since injury, Hazard Ratio (95% CI) 1.09 (0.80, 1.48) 4 days since injury, Hazard Ratio (95% CI) 1.01 (0.71, 1.43) **All cause mortality, Time to treatment ≤3h (incl. non-bleeding patients!)** 0 days since injury, Hazard Ratio (95% CI) 0.78 (0.68, 0.90)	by preventing exsanguination on the day of the injury." **Reviewers' conclusion** It is unclear if the analysis was predefined. Apart from that, this subgroup analyses of the CRASH-2 trial is of good quality indicating reliable results.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			1 day since injury, Hazard Ratio (95% CI) 0.86 (0.72, 1.02) 2 days since injury, Hazard Ratio (95% CI) 0.86 (0.65, 1.13) 3 days since injury, Hazard Ratio (95% CI) 0.95 (0.66, 1.37) 4 days since injury, Hazard Ratio (95% CI) 0.94 (0.61, 1.45) **All cause mortality, time to treatment >3h (incl. non-bleeding patients!)** 0 days since injury, Hazard Ratio (95% CI) 1.02 (0.76, 1.36) 1 day since injury, Hazard Ratio (95% CI) 1.02 (0.80, 1.31) 2 days since injury, Hazard Ratio (95% CI) 1.16 (0.81, 1.66) 3 days since injury, Hazard Ratio (95% CI) 1.11 (0.73, 1.71) 4 days since injury, Hazard Ratio (95% CI) 1.04 (0.62, 1.75)	
Spinella (2020) "The immunologic effect of early intravenous two and four gram bolus dosing of tranexamic acid compared to placebo in	**Inclusion criteria** • Age ≥18 • sustained a traumatic injury which required them to receive at least one unit of red blood cells (RBC) or required an emergent operation for possible bleeding control	**Participants** N=150 patients **Study groups** TXA 2g: 2 g of TXA (N=49)* TXA 4g: 4 g of TXA (N=50)	28-day mortality n/N, (%) CG: 6/49 (12.2) vs. TXA 2g: 5/44 (11.4) vs. TXA 4g: 4/48 (8.33), p=0.8 Thromboembolic event n/N, (%)	**Level of evidence** 2b↓ **Risk of bias** Selection bias: + Performance bias: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
patients with severe traumatic bleeding (TAMPITI): A randomized, double-blind, placebo-controlled, single-center trial". *Frontiers in Immunology* 2020; 11: 2085. **Study design** Randomised controlled trial **Aim of the study** "The hemostatic properties of tranexamic acid (TXA) are well described, but the immunological effects of TXA administration after traumatic injury have not been thoroughly examined. We hypothesized TXA would reduce monocyte activation in bleeding trauma patients with severe injury." **Setting** USA, 2016-2017	• were able to receive the study medication (TXA or placebo) within 2 h of time of injury **Exclusion criteria** • Suspected acute MI or stroke (thromboembolic and/or hemorrhagic) on admission • Known inherited coagulation disorders • Known past medical history of thromboembolic events (DVT, PE, MI, Thromboembolic Stroke) • Known history of seizures and/or seizure after injury/on admission related to this hospitalization • Suspected or known pregnancy • Futile care • Known current state of immunosuppression (i.e. on high dose steroids, chemotherapeutics, etc.) • Unknown estimated time of injury • Patients wearing an "Opt Out" TAMPITI Study bracelet • Known presence of subarachnoid hemorrhage • Isolated injuries to hands and/or feet (distal) • Administration of antifibrinolytics prehospital and/or during this ED admission prior to enrollment **Characteristics** <u>Age [y], median (IQR)</u> CG: 27.0 (22.0 – 34.0) vs. TXA 2g: 26.0 (22.0 – 40.0) vs. TXA 4g: 31.0 (25.0 – 44.0), p=0.13	CG: placebo (N=50) each in 40 mL of normal saline i.v. over 10 min * 1 patient withdrawn (age <18 y)	CG: 6/50 (12.0) vs. TXA 2g: 13/49 (26.5) vs. TXA 4g: 16/50 (32.0), p=0.05 <u>ICU admission n/N, (%)</u> CG: 37/50 (74.0) vs. TXA 2g: 36/49 (73.5) vs. TXA 4g: 38/50, p=0.96 <u>Mechanical ventilation n/N, (%)</u> CG: 30/50 (60.0) vs. TXA 2g: 28/48 (58.3) vs. TXA 4g: 30/49 (61.2), p=0.96 <u>ICU-free Days, [N] median (IQR)</u> CG: [50] 27.3 (17.4 – 28.6) vs. TXA 2g: [45] 27.1 (24.0 – 29.4) vs. TXA 4g: [49] 27.1 (24.3 – 29.0), p=0.77 <u>Max MODS in 7 days , [N] median (IQR)</u> CG: [49] 4.00 (1.00 – 7.00) vs. TXA 2g: [49] 4.00 (1.00 – 6.00) vs. TXA 4g: [50] 4.00 (1.00 – 8.00), p=0.79 <u>Seizure n/N, (%)</u> CG: 0/49 (0.00) vs. TXA 2g: 1/44 (2.27) vs. TXA 4g 2/48 (4.17), p=0.42	Attrition bias: + Detection bias: + **Authors' conclusion** "In conclusion, in this RCT in patients with primarily penetrating traumatic injuries, 2 and 4 g i.v. bolus dosing of TXA had minimal immunomodulatory and hemostatic effects." **Reviewers' conclusion** The clinical outcomes (mortality, morbidity) were secondary outcomes. The RCT was not powered to detect differences in clinical outcomes.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Male n (%) CG: 45 (90.0) vs. TXA 2g: 44 (90.0) vs. TXA 4g: 42 (84.0), p=0.58 GCS, [n] median (IQR) CG: 15.0 (12.0 – 15.0) vs. TXA 2g: 15.0 (11.0 – 15.0) vs. TXA 4g: 15.0 (14.0 – 15.0), p=0.26			

+: low risk; –: high risk; ?: unclear risk; adj.: adjusted; AIS: Abbreviated Injury Scale; BD: base deficit; CG: control group; CI: Confidence Interval; CRASH-3: Corticosteroid randomisation after significant head injury – 3; d: days; DVT: deep venous thrombosis; ED: emergency department; GCS: Glasgow Coma Score; h: hours; IG: intervention group; INR: international normalized ratio; IQR: Interquartile Range; ISS: injury severity score; ITT: Intention to treat analysis; L: litres; LoE: level of evidence; m: months; MAP: mean arterial pressure; MI: myocardial infarction; min: minutes; mmHg: millimetres of mercury; MODS: multiple organ dysfunction syndrome; NISS: new injury severity score; NTT: number needed to treat; PE: pulmonary embolism; PROPPR: Pragmatic, Randomized Optimal Platelet and Plasma Ratios; RBC: red blood cells; RR: Relative Risk; s: seconds; SBP: systolic blood pressure; SD: Standard Deviation; TBI: traumatic brain injury; TXA: tranexcamic acid; y: years

Fibrinogen

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Curry (2018) "Early fibrinogen concentrate therapy for major haemorrhage in trauma (E-FIT 1): results from a UK multi-centre, randomised, double blind, placebo-controlled pilot trial." *Critical Care* 2018; 22(1): 1-9. **Study design** Randomized controlled feasibility trial **Aim of the study**	**Inclusion criteria** • adults (judged to be aged 16 years or older), • were actively bleeding and in haemorrhagic shock and therefore required activation of the major haemorrhage protocol (MHP) or had already received a transfusion of emergency red blood cells (RBC) **Exclusion criteria** • patient transferred from another hospital, • the trauma team leader deemed the injury incompatible with life,	**Participants** N=39 patients (N=48 randomized, n=2 no intravenous access could be established, n=7 initially deemed eligible were subsequently found not to meet eligibility criteria) **Study groups** IG: 6 g of fibrinogen concentrate (N=24 randomized; N=20 analyzed) CG: equivalent volume (300 ml) 0.9% saline (N=24 randomized; N=19 analysed) **Definition standard therapy** Typically an MHP constituted two transfusion packs—pack 1 followed by repeated	**Primary outcomes** Proportion of all participants randomised who started their infusion within 45 min: % (95% CI) 69 (52–83) Proportion of participants whose fibrinogen level remained at 2 g/L or above during first 2h: n/N (%) (95% CI in %) IG: 15/20 (75) (51-91%) vs. CG: 8/17 (47) (23-72%), p=0.10 **Secondary outcomes** All-cause mortality at 28 days: % (95% CI) IG: 42.0 (25.2–64.0%) vs. CG: 29.2 (15.1–51.6)	**Level of evidence** 2b↓ **Risk of bias** Selection bias: + Performance bias: + Attrition bias: + Detection bias: + **Authors' conclusion** "Although evidence points to a key role for fibrinogen in the treatment of major bleeding, researchers need

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"The primary objectives of the E-FIT 1 study were to determine whether it was possible to deliver FgC therapy early (within 45 minutes) to adult trauma patients and the proportion of participants whose fibrinogen levels were maintained ≥2 g/L during active haemorrhage." **Setting** UK, 2016	• more than 3 hours had elapsed from time of injury, • pregnant women • severe isolated or unsalvageable head injury **Characteristics** Age [y], median (IQR) IG: 38 (31–47) vs. CG: 36 (22–56) Males, n (%) IG: 20 (83) vs. CG: 19 (79) ISS, median (IQR) IG: 34 (24–43) vs. CG: 29 (22–34) GCS, median (IQR) IG: 3 (3–14) vs. CG: 3 (3–15)	use of pack 2—until bleeding was controlled. Pack 1 included 4 RBC and 4 FFP; pack 2 included 4 RBC, 4 FFP, 10 U of cryoprecipitate (approximately 300 ml, 4 g of fibrinogen) and 1 pool platelets.	Number of participants experiencing at least one serious adverse events: n IG: 13 vs. CG: 11 Number of serious adverse events: n IG: 29 vs. CG: 21 Myocardial infarction: n IG: 0 vs. CG: 0 Stroke: n IG: 1 vs. CG: 1 Other arterial symptomatic thrombotic events: n IG: 0 vs. CG: 1 Deep venous thrombosis: n IG: 0 vs. CG: 0 Pulmonary embolus: n IG: 2 vs. CG: 0 Sepsis: n IG: 4 vs. CG: 6 Organ failure: n IG: 10 vs. CG: 2 Multiple organ failure: n IG: 4 vs. CG: 1 Single organ failure: n IG: 6 vs. CG: 1 New-oneset major bleeding: n IG: 1 vs. CG: 3 Uncontrolled major bleeding: n	to recognise the challenges of timely delivery in the emergency setting." **Reviewers' conclusion** The clinical outcomes (mortality, morbidity) were secondary outcomes. The pilot RCT was not powered to detect differences in clinical outcomes.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			IG: 2 vs. CG: 1 Other serious adverse events: n IG: 9 vs. CG: 7 Deaths: n IG: 8 vs. CG: 3 Deaths due to bleeding: n IG: 2 vs. CG: 1	
Garrigue 2018 "French lyophilized plasma versus fresh frozen plasma for the initial management of trauma-induced coagulopathy: a randomized open-label trial". *Journal of Thrombosis and Haemostasis* 2018, 16: 481–489 **Study design** Randomised controlled trial **Aim of the study** "The aim of the study was to investigate whether, in trauma patients requiring immediate delivery of plasma at a high ratio, lyophilized plasma is more effective than FFP for the initial management of trauma-induced coagulopathy."	**Inclusion criteria** • Severely injured adult trauma patients • admitted directly to the trauma center from the injury scene • attending decided on immediate transfusion of an 'emergency pack' of 4 red blood cell units associated with 4 plasma units in a 1 : 1 ratio within 6 h of injury **Exclusion criteria** • age under 18 years • transfusion of any blood product or coagulation factor concentrate prior to randomization • admission from another healthcare facility • devastating injuries and expected imminent death • recent history of anticoagulant therapy • known pregnancy • lack of mental capacity per national legal standards prior to trauma **Characteristics** Age [y], mean ± SD	**Participants** N=48 patients **Study groups** IG: FLyP, French lyophilized plasma (N=24 total, 23 analysed for primary and 21 for secondary outcomes) CG: FFP, fresh frozen plasma (N=24 total, 24 analysed for primary and 21 for secondary outcomes)	**Primary outcome** Fibrinogen concentration 45 minutes after randomization, mean ± SD, difference (95% CI)* IG: 1.56 ± 0.81, p<0.001 CG: 0.93 ± 0.40 IG vs. CG: difference: 0.40 (0.23 to 0.57) **Other outcomes** 30-day in-hospital mortality, n/N (%) IG: 5/21 (22), p=0.56 CG: 7/21 (29) Hemostatic parameters from randomization to 45 minutes, mean ± SD, difference (95% CI) PT ratio IG: 1.46 ± 0.4, p<0.001 CG: 1.74 ± 0.5 IG vs. CG: difference: -0.28 (-0.43 to -0.13) Factor II IG: 59.35 ± 21, p<0.001 CG: 43.83 ± 16 IG vs. CG: difference: 10.5 (5.55 to 15.44) Factor V IG: 53.17 ± 28, p<0.001	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion** "[…] FLyP is superior to FFP for faster plasma transfusion. FLyP induces a faster and greater fibrinogen increase and TIC improvement. FLyP is an attractive option for trauma management, especially when facing logistical issues such as combat casualties or civilian mass casualties related to terrorism or natural disasters." **Reviewers' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Setting France, 2013-2016	IG: 48.0 ± 16.5 CG: 38.0 ± 15.6 Males, n/N (%) IG: 19/23 (82.6) CG: 16/24 (66.7) ISS, mean ± SD IG: 23.5 ± 9.7 CG: 27.5 ± 11.4 GCS, median (IQR) IG: 3 (3 – 15) CG: 3 (3 – 13.5) Tranexamic acid, n/N (%) IG: 19/23 (82.6) CG: 22/24 (91.7)		CG: 32.83 ± 23 IG vs. CG: difference: 11.05 (5.89 to 16.21) Serum Lactate IG: 3.95 ± 1.7, p=0.24 CG: 5.74 ± 5.2 IG vs. CG: difference: -0.74 (1.99 to 0.52) Change in coagulation parameters in fibrinogen concentration, from randomization to 45 min and 6 h, mean (95% CI) 45 min IG: 0.17 (0.02 to 0.31), p=0.006 CG: 0.12 (0.27 to 0.02) 6 h IG: 1.18 (0.87 to 1.49), p=0.008 CG: 0.68 (0.37 to 0.98) Requirement of fibrinogen concentrates 24h after randomization, median (IQR) IG: 2 (0 - 3), p=0.052 CG: 3 (2 - 4) * per protocol analysis and adj. on baseline value	There may be a risk of performance bias as individuals administering care could not be blinded due to the investigation of inherent characteristics of the studied products
Nascimento 2016 "Fibrinogen in the initial resuscitation of severe trauma (FiiRST): a randomized feasibility trial", *British Journal of Anaesthesia* 2016; 117(6): 775–82 **Study design** Randomized controlled feasibility trial	**Inclusion criteria** • Adult (age>18 yr) • severe trauma (blunt or penetrating) • assessed by trauma team at institution • identified as being at risk for significant haemorrhage as evidenced by systolic arterial pressure ≤100 mmHg and requiring uncrossmatched red blood cell (RBC) transfusion at any time from injury until 30min after hospital arrival **Exclusion criteria**	**Participants** N=50 patients **Study groups** IG: lyophilized fibrinogen concentrate (FC, 6 g) (N=25 randomized, N=21 analysed) CG: Placebo (normal saline) (N=25 randomized, N=24 analyzed) **Co-interventions** blood product (plasma, platelet and cryoprecipitate) transfusion was ordered based	**Primary outcome** Feasibility (proportion of subjects receiving study intervention (FC or placebo) within 1h of hospital admission), n/N (%): 43/45 (95.6) (95% CI 86-99) Time to start of infusion [min]: mean ± SD$^{\$}$ IG: 51 ± 9 vs. CG: 59 ±8, p=0.6 **Other outcomes** All-cause 28-day mortality: n/N (%) (RR, 95% CI)	**Level of evidence** 2b↓ **Risk of bias** Selection bias: + Performance bias: + Attrition bias: – Detection bias: + **Authors' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Aim of the study "The aim of the study was to evaluate the feasibility, effect on plasma fibrinogen concentration and complications of early infusion of FC in trauma patients." **Setting** Canada, 2014-2015	• received any blood or blood products before admission to trauma center • presented more than 6h after injury • estimated body weight <50 kg • known or suspected pregnancy • catastrophic brain injury • non- haemorrhagic shock • underlying hereditary or acquired coagulopathy • known or suspected use of anticoagulant medications • moribund and predicted to expire in a few h **Characteristics** Age (median, range) IG: 48 (19–78) vs. CG: 28 (19–88), p=0.05 Males (%)§ IG: 77 vs. CG: 87 ISS (median, IQR) IG: 25 (19–29) vs. CG: 23 (18–29) GCS (median, IQR) IG: 15 (14–15) vs. CG: 15 (12–15) Acute Traumatic Coagulopathy (%)§ IG: 26 vs. CG: 18 Fibrinogen <2 g L-1 (%)§ IG: 53vs. CG: 54 § n=number of patients not reported	on standard coagulation tests, as per our institution's massive haemorrhage protocol.	ITT: IG: 2/25 (8) vs. 3/24 (12.5), p=0.67 PT: IG: 2/20 (10) vs. CG: 1/24 (4.2) RR = 2.4 (-0.2 to 23) Acute Kidney Injury: n/N (%) (RR, 95% CI) IG: 3/21 (14.3) vs. CG: 2/24 (8.3) RR = 1.7 (-0.3 to 9.3) Multiple Organ Failure: n/N (%) (RR, 95% CI) IG: 2/21 (9.5) vs. CG: 2/24 (8.3) RR = 1.1 (-0.2 to 7.4) Plasma fibrinogen concentration at 3 h [mg dL^{-1}]: mean ± SD$^{\$}$ IG 2.9 vs. CG: 1.8 (p<0.01) $^{\$}$units unclear	"Infusion of 6 g of FC within 1 h of arrival is feasible and improves plasma fibrinogen concentration by approximately 1 g L^{-1} 1 in a population of trauma patients at risk of significant haemorrhage." **Reviewers' conclusion** The clinical outcomes were secondary outcomes. The RCT was not powered to detect differences in clinical outcomes. There may be low risk of selection bias as the study groups significantly differed regarding age only.
+: low risk; –: high risk; ?: unclear risk; adj.: adjusted; AIS: Abbreviated Injury Scale; CG: control group; CI: Confidence Interval; d: days; E-FIT 1: Early fibrinogen concentrate therapy for major haemorrhage in trauma; FC: fibrinogen concentrate; FFP: fresh frozen plasma; FgC: fibrinogen concentrate; FLyP: French lyophilized plasma; GCS: Glasgow Coma Score; h: hours; IG: intervention group; IQR: Interquartile range; ISS: injury severity score; L: litres; LoE: level of evidence; m: months; MHP: major haemorrhage protocol; min: minutes; mmHg: millimetres of mercury; MODS: multiple organ				

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
dysfunction syndrome; PT: prothrombin time; RBC: red blood cells; RCT: randomised controlled trial; s: seconds; SBP: systolic blood pressure; SD: Standard deviation; TBI: traumatic brain injury; TIC: trauma-induced coagulopathy; UK: United Kingdom; y: years				

Thromboseprophylaxe

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Byrne (2016) "Timing of pharmacologic venous thromboembolism prophylaxis in severe traumatic brain injury: a propensity-matched cohort study." *Journal of the American College of Surgeons* 2016; 223(4): 621-631. **Study design** Comparative registry trail (American College of Surgeons TQIP) **Aim of the study** "The purpose of this study was to compare the effectiveness of early vs late VTE prophylaxis in patients with sTBI, and to characterize the risk of subsequent intracranial hemorrhage (ICH)-related complication" **Setting**	**Inclusion criteria** • adult patients (16 years or older) • isolated severe TBI (defined as head Abbreviated Injury Scale [AIS] ≥3 and Glasgow Coma Scale ≤8) • received VTE prophylaxis with either low-molecular-weight heparin (LMWH) or unfractionated heparin (UH) • survived at least 5 days **Exclusion criteria** • Trauma centers missing >10% of VTE prophylaxis data • penetrating injuries • bleeding disorders • or severe injury (AIS 3) to other body regions **Characteristics of the matched cohort** Age [y], median (IQR) IG: 43 (27-57) vs. CG: 43 (28-58) Male, % IG: 77.0 vs. CG: 75.8 ED total GCS, median (IQR) IG: 3 (3-6) vs. CG: 3 (3-6)	**Participants** N=2,468 patients (after matching) (N=3,634 pre-matching) **Study groups** IG: early venous thromboembolism prophylaxes [<72 h] (N=1,234) CG: late venous thromboembolism prophylaxes [>72 h] (N=1,234) **Matching criteria** • age • sex • race • insurance type • comorbidities • transfer status • injury mechanism • injury severity (as measured by head AIS score), • total GCS • GCS motor score • shock in the emergency department (SBP) • early blood transfusion (within 12 hours of arrival at hospital) • need for early neurosurgical intervention (within 48 hours of hospital arrival)	Mortality: n (%)§ IG: 121 (9.8) vs. CG: 111 (9.0) Adj. OR (95% CI): 1.10 (0.84-1.45) Venous thromboembolism: adj. OR (95% CI) 0.48 (0.35-0.66) Pulmonary embolism: n (%) IG: 14 (1.1) vs. CG: 29 (2.4), Adj. OR (95% CI): 0.48 (0.25-0.91) Deep vein thrombosis: n (%) IG: 52 (4.2) vs. CG: 98 (7.9) Adj. OR (95% CI): 0.51 (0.36-0.72) Craniotomy/ craniotomy after 72h: n (%)§ IG: 31 (2.5) vs. CG: 36 (2.9) Adj. OR (95% CI): 0.86 (0.53-1.40) Intracranial monitor placement after 72h: n (%)§ IG: 13 (1.1) vs. CG: 17 (1.4) Adj. OR (95% CI): 0.76 (0.37-1.58) § Late neurosurgical interventions defined as those occurring after 72 hours in hospital.	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "In this observational study of patients with sTBI, early initiation of VTE prophylaxis was associated with decreased risk of pulmonary embolism and deep vein thrombosis, but no increase in risk of late neurosurgical intervention or death. Early prophylaxis may be safe and should be the goal for each patient in the context of appropriate risk stratification." **Reviewers' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
North America, 2012-2014	ED motor GCS, median (IQR) IG: 1 (1-4) vs. CG: 1 (1-4) VTE prophylaxis with Low-molecular-weight heparin (vs. unfractionated heparin), % IG: 48.2 vs. CG: 47.7	• choice of prophylaxis agent (UH or LMWH)		There is a risk of performance bias because physicians were probably not blinded. However, cohorts were matched according to confounders, early transfusions and VTE prophylaxis agent showing consistent results.
Schellenberg (2021) "When Is It Safe to Start Pharmacologic Venous Thromboembolism Prophylaxis After Pelvic Fractures? A Prospective Study From a Level I Trauma Center." *Journal of Surgical Research* 2021; 258: 272-277. **Study design** Prospective observational study **Aim of the study** "The objective of this study was to determine if pharmacologic VTE prophylaxis initiation at ≤48 h of hospital arrival reduced the rates of VTE (defined as deep vein thrombosis [DVT] or pulmonary embolism [PE]) after blunt pelvic fracture. In addition, this study aimed to address the	**Inclusion criteria** • Patients who sustained a pelvic fracture **Exclusion criteria** • death in the emergency department (ED) • need for emergent operative intervention, defined as disposition from the ED directly to the operating room • transfer from an outside hospital • preexisting bleeding disorder • home antiplatelet or anticoagulant medication; pregnancy • patients who did not receive pharmacologic VTE prophylaxis during hospitalization **Characteristics** Age [y], median (IQR) IG: 44 (29-57) vs. CG: 42 (29-56), p=0.697 Male, n (%) IG: 36 (49) vs. CG: 39 (54), p=0.513 ISS, median (IQR)	**Participants** N=146 patients **Study groups** IG: early VTE prophylaxis (≤48 h) (N=74) CG: late VTE prophylaxes (>48 h) (N=72) Prophylaxis was delivered as enoxaparin 30 mg subcutaneously every 12 h or unfractionated heparin 5000 units subcutaneously every 8 h, with unfractionated heparin administration reserved for patients with acute or chronic renal failure **Co-interventions** All patients without contraindication (e.g., lower extremity fracture) received mechanical VTE prophylaxis (intermittent pneumatic compression devices). **Adjusting variables in multivariate logistic regression** • timing of VTE prophylaxis initiation • traumatic brain injury (TBI), defined by the presence of at least one of subarachnoid hemorrhage, subdural hematoma, or epidural hematoma	**Adjusted outcomes** Venous thromboembolism: adj. OR (95% CI) IG: 0.647 (0.002-4.510), p=0.999 CG: reference **Unadjusted outcomes** Mortality: n (%) IG: 1 (1) vs. CG: 1 (1), p=1.000 Venous thromboembolism: n (%) IG: 3 (4) vs. CG: 6 (8), p=0.323 Deep vein thrombosis: n (%) IG: 0 (0) vs. CG: 5 (7), p=0.027 Pulmonary embolism: n (%) IG: 3 (4) vs. CG: 2 (3), p=1.000 Hospital length of stay: median (IQR) IG: 11 (5-19) vs. CG: 18 (8-47), p=0.007 ICU length of stay: median (IQR) IG: 3 (0-4) vs. CG: 5 (2-9), p=0.005	**Level of evidence** 3b↓ **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Early initiation of pharmacologic VTE prophylaxis after blunt pelvic fracture is safe. Although early prophylaxis initiation did not reduce the rate of VTE, these data identify angioembolization as an independent risk factor for VTE. Patients with blunt pelvic fracture who undergo angioembolization may therefore represent a high-risk

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
safety of early prophylaxis (EP), determining if EP resulted in potential bleeding complications, need for blood transfusion, or need for delayed intervention for hemorrhage control." **Setting** USA, 2016-2017	IG: 14 (9-19) vs. CG: 17 (12-22), p=0.025 GCS, median (IQR) IG: 15 (15-15) vs. CG: 15 (14-15), p=0.009 TBI, n (%) IG: 2 (3) vs. CG: 23 (32), p<0.001 Type of prophylaxis heparin, n (%) IG: 8 (11) vs. CG: 6 (8), p=0.780	• sex • lower extremity fracture • solid organ injury • ISS • need for angioembolization		population who may especially benefit from early prophylaxis." **Reviewers' conclusion** There is a risk of selection bias because patients in the control group had a higher ISS and rate of TBI and secondary outcomes were not adjusted for important risk factors. There is a risk of performance bias because physicians were not blinded. The study was underpowered to detect clinically significant effects on VTE events and mortality. (cohort overlaps with Schellenberg 2019)
Schellenberg (2019) "When is it safe to start VTE prophylaxis after blunt solid organ injury? A prospective study from a level I trauma Center." *World journal of surgery* 2019; 43(11): 2797-2803. **Study design** Prospective observational study **Aim of the study**	**Inclusion criteria** • sustained a solid organ injury (liver, spleen, and/or kidney) managed nonoperatively (defined by a documented plan in the ED by the trauma team for nonoperative management and the lack of laparotomy within 4 h of admission) • age >15 • blunt trauma patients LAC+USC Medical Center **Exclusion criteria** • transferred from an outside hospital	**Participants** N=118 patients **Study groups** IG: early VTE prophylaxis (≤48 h) (N=61) CG: late VTE prophylaxis (>48 h) (N=57) **Co-interventions** All patients without contraindication (e.g., lower extremity fracture) received sequential compression devices to bilateral lower extremities until ambulation.	Mortality: n (%) IG: 2 (3) vs. CG: 1 (2), p=1.000 Venous thromboembolic event: n (%) IG: 2 (3) vs. CG: 6 (11), p=0.153 Deep vein thrombosis: n (%) IG: 0 (0) vs. CG: 5 (9), p=0.024 Pulmonary embolism: n (%) IG: 2 (3) vs. CG: 3 (5), p=0.672 Hospital length of stay: median (IQR) IG: 6 (4–11) vs. CG: 14 (7–35), p<0.001	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "In this prospective study of patients with nonopera-

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"The primary objective of this study was to prospectively determine the optimal timing of VTE prophylaxis initiation among patients with blunt solid organ injury managed non-operatively." **Setting** USA, 2016-2017	• died in the emergency department (ED) • had a pre-existing bleeding disorder • were on home antiplatelet • anticoagulation medication • received no VTE prophylaxis during their hospital admission **Characteristics** Age [y], median (IQR) IG: 36 (27–54) vs. CG: 36 (27–56), p=0.631 Male, n (%) IG: 39 (64) vs. CG: 39 (68), p=0.698 GCS, median (IQR) IG: 15 (14–15) vs. CG: 14 (13–15), p=0.009 ISS, median (IQR) IG: 17 (14–22) vs. CG: 22 (17–27), p=0.002 TBI, n (%) IG: 5 (8) vs. CG: 18 (32). p=0.002		Need for ICU admission: n (%) IG: 52 (85) vs. CG: 52 (91), p=0.398 ICU length of stay: median (IQR) IG: 3 (2–6) v. CG: 7 (4–12), p<0.001	tive blunt solid organ injuries, early (≤48 h) initiation of VTE prophylaxis resulted in a lower incidence of DVTs without an associated increase in bleeding or need for intervention. Early initiation of VTE prophylaxis is likely to be safe and beneficial for patients with blunt solid organ injury." **Reviewers' conclusion** There is a risk of selection bias since patients in the control group had a higher ISS and rate of TBI, and the analysis is unadjusted. There is a risk of performance bias because physicians were not blinded. (cohort overlaps with Schellenberg 2021)
+: low risk; –: high risk; ?: unclear risk; adj.: adjusted; AIS: Abbreviated Injury Scale; CG: control group; CI: Confidence Interval; d: days; DVT: deep vein thrombosis; ED: emergency department; GCS: Glasgow Coma Score; h: hours; ICU: intensive care unit; ICH: intracranial haemorrhage; IG: intervention group; IQR: Interquartile Range; ISS: injury severity score; ITT: Intention to Treat analysis; LMWH: low-molecular-weight heparin; LoE: level of evidence; m: months; MAP: mean arterial pressure; min: minutes; mmHg: millimetres of mercury; MODS: multiple organ dysfunction syndrome; OR: odds ratio; PE: pulmonary embolism; RR: Relative Risk; s: seconds; SBP: systolic blood pressure; SD: Standard deviation; sTBI: severe traumatic brain injury; TBI: traumatic brain injury; UH: unfractionated heparin; VTE: venous thromboembolism; USA: United States of America; y: years				

Zugänge

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Kunhahamed (2019)	**Inclusion criteria**	**Participants**	**Primary outcome**	**Level of evidence**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"A comparison of internal jugular vein cannulation by ultrasound-guided and anatomical landmark technique in resource-limited emergency department setting", *Journal of Medical Ultrasound* 2019; 27: 187-91. **Study design** Prospective observational study **Aim of the study** "The aim of the study was to measure and compare the success rate, time to completion, number of central venous access attempts, and acute complications during IJV catheterization by the AL technique and real-time USG-guided technique in emergency department (ED) setting." **Setting** India, 2017-2018	• ≥18 years • presented to the ED • in need of central venous access through internal jugular vein (IJV) as part of their treatment **Exclusion criteria** • Patients <18 years • patients with suspected cervical spine injury or penetrating injury to the neck • patients with coagulopathy • local site infections or burns • head-and-neck cancer patients **Characteristics** <u>Age [y], mean ± SD</u> IG: 46.74 ± 16.36 CG: 50.41 ±17.93 <u>Sex, n/N (%)</u> IG: 21/35 (60) male, 14/35 (40) female CG: 17/35 (49) male, 18/35 (51) female <u>Provisional Diagnosis, n/N (%)</u> *Polytrauma with haemorrhagic shock* IG: 8/35 (22.9) vs. CG: 4/35 (11.4) *Sepsis/Septic shock* IG: 8/35 (22.9) vs. CG: 10/35 (28.6) *Acute respiratory distress syndrome* IG: 2/35 (5.7) vs. CG: 2/35 (5.7) *Burns* IG: 6 /35 (17.1) vs. CG: 8/35 (22.9)	N=70 patients **Study groups** IG: Ultrasonography-guided technique technique (N=35) CG: Anatomical Landmark (AL) technique (N=35)	<u>Successful cannulations, n/N (%)</u> IG: 35/35 (100) vs. CG: 32/35 (91.4), p=0.239 **Other outcomes** <u>Number of attempts for successful cannulation, n/N (%)</u> 1 attempt IG: 32/35 (91.4) vs. CG: 17/35 (48.6), p<0.001 2 attempts IG: 3/35 (8.6) vs. CG: 10/35 (28.6) 3 attempts IG: 0/35 (0) vs. CG: 8/35 (22.9) <u>Cannulation time [sec]: mean ± SD</u> IG: 293.03 ± 71.15 vs. CG: 305.88 ± 66.84, p=0.425 Defined as time interval between observing blood at the syringe hub and confirming backflow of blood at all three ports in the triple lumen catheter. <u>Flash time [sec]: mean ± SD</u> IG: 4.86 ± 2.18 vs. CG: 16.59 ± 10.67, p<0.001 defined as the time interval between skin puncture and observing blood at the syringe hub.	3b↓ **Risk of bias** Selection bias: ? Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "The real-time USG guided technique significantly reduces the number of attempts to cannulate, has a higher first-pass success rate, a quicker flash time, and fewer complications when compared to the AL technique." **Reviewers' conclusion** There might be a risk of selection bias because it was up to the physician to decide for the method of cannulation. In addition, there might be a risk of performance bias as sufficient information on patient allocation and blinding is lacking. **CAVE: only 12% trauma patients.** It was included because this was the only study identified for the new questions.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Diabetic ketoacidosis IG: 6 /35 (17.1) vs. 3/35 (8.6)			
+: low risk; –: high risk; ?: unclear risk; AL: anatomical landmark; CG: control group; CI: Confidence Interval; ED: emergency department; IG: intervention group; IJV: internal jugular vein; ISS: injury severity score; LoE: level of evidence; sec: seconds; SD: Standard deviation; TBI: traumatic brain injury; USG: real-time ultrasonography				

2.5 Bildgebung

FAST zur Diagnostik von freier Flüssigkeit nach stumpfem oder penetrierendem Abdominaltrauma

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Akdemir (2019) "The Blunt Abdominal Trauma Bedside Ultrasonography Comparison with Trauma Severity Scores and Computerized Tomography ". *Jcpsp, Journal of the College of Physicians & Surgeons – Pakistan* 2019; 29(7): 621-625 **Study design** Diagnostic cross-sectional study **Aim of the study** "The aim of the present study was to investigate the relationship between the application of FAST	**Inclusion criteria** • Patients admitted to the emergency department (ED) because of blunt trauma • aged 18 years or older **Exclusion criteria** • children <18 years with blunt abdominal trauma • patients who did not want to be involved in the study for any reason • patients who were admitted in the absence of trained personnel for FAST application • patients diagnosed by CT only and without FAST **Characteristics** Age [y], mean (± SD) 37.7 (±17.3)	**Participants** N=315 patients admitted to the ED with blunt abdominal trauma **Tests evaluated** Index test: FAST, ultrasound investigation to detect free fluid (FF), done by experienced emergency physicians (emergency medicine specialists and/or emergency medicine assistants) Reference standard: Intravenous contrast-enhanced CT (gold standard) was used to assess the presence of intraperitoneal FF in patients with indications to obtain CT imaging by radiologists	**Primary outcomes** Mortality, n (%) FAST: 11 (3.5) **Diagnostic accuracy for detection of free fluid (FAST)** True positive, N=28 False positive, N=0 True negative, N=134 False negative, N=6 Sensitivity, % (95% CI)§ 82.3 (65.4-93.2) Specificity, % (95% CI)§ 100 (97.2-100) PPV, % (95% CI)§	**Level of evidence** 2b **Risk of bias (QUADAS)** Patient selection: + Index test: ? Reference standard: ? Flow and timing: ? **Authors' conclusion** "Early and appropriate FAST practice provides valuable and prognostic information. FAST prevents time delays and transportation out of the emergency department in the evaluation of hemodynamically unstable patients."

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
performed by emergency physicians in patients with blunt trauma and the management, clinical outcome, prognosis, and trauma severity scores for such patients." **Setting** Turkey, 2013-2017	Male, n (%) 219 (69.5) FAST - presence of free fluid, n (%) 28 (8.9) Patients undergoing surgery, n (%) 95 (30.1)		100 (91.5-97.8) NPV, % (95% CI)§ 95.7 (91.5-97.8) §compared to CT as gold standard FAST is strongly compatible with CT (κ= 0.882, p<0.001)	**Reviewers' conclusion** There are unclear risk of bias concerning the index test, reference standard and flow and timing as necessary information were not provided in the article. The results of the study should be interpreted with caution. Furthermore, the authors conclude that FAST prevents time delays in hemodynamically instable patients, but times were not reported and cannot be considered as relevant in this context.
Akoglu (2017) "Diagnostic accuracy of the Extended Focused Abdominal Sonography for Trauma (E-FAST) performed by emergency physicians compared to CT". *American Journal of Emergency Medicine* 2018; 36 (6): 1014-1017 **Study design** Diagnostic cross-sectional study **Aim of the study**	**Inclusion criteria** • Patients ≥18 years • Multiple trauma (defined according to ATLS as more than one anatomical area was affected) • Any patient in whom thoraco-abdominal CT was ordered during the shifts where the researchers were on duty **Exclusion criteria** • Unstable patients (systolic blood pressure (SBP) b 100 mm Hg and/or heart rate (HR) N 100 beats/min and/or ≥4 U of packed red blood cells transfused in the trauma bay	**Participants** N=144 trauma patients Finally: 132 for abdominal, 130 for thorax examinations analysed **Tests evaluated** Index test: e-FAST; all sonographic examinations were performed by two senior EM residents (OFC, AC) who were certified for bedside sonography with 3 years of experience in protocols such as E-FAST, RUSH, or POCUS with an average of 500 bedside US examinations per year. When a trauma patient was ordered to have a thoraco-abdominal CT by the attending EP, an E-FAST examination was performed before the patient has left the ED for CT, if not already. E-FAST	**Primary outcomes** Diagnostic accuracy for detection of abdominal free fluid (E-FAST) True positive, N=3 False positive, N=2 True negative, N=123 False negative, N=4 Sensitivity, % (95% CI) 42.9 (9.9, 81.6) Specificity, % (95% CI) 98.4 (94.3, 99.8) AUC (95% CI)	**Level of evidence** 2b **Risk of bias (QUADAS)** Patient selection: ? Index test: + Reference standard: + Flow and timing: + **Authors' conclusion** "E-FAST examination has an excellent specificity. However, the sensitivity of the test is not high enough to rule-out thoraco-abdominal injuries in trauma patients

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
„The aim of this study was to compare the diagnostic accuracy of the E-FAST exam performed by emergency medicine (EM) residents with the results of CT scan as a gold standard." **Setting** US, 2014-2015	• Patients unavailable for CT (unable to leave the trauma bay for CT, died in the ED, referred to the operating room before CT) • Pregnant patients • Patients intubated • Patients with anatomical defect(s) at the site of sonographic imaging, • Patients with known allergies to contrast materials **Characteristics** Age [y], median (IQR) 38 (30-49) Male, n (%) 102 (79.1) SBP (mm Hg), mean (SD), (95% CI) 127.9 (20.5), (124.3, 131.5)	exam findings were recorded on a study chart before the CT examination. Reference standard: computed tomography scans; CTs were evaluated by a radiology specialist who was blinded to the patients and results of the sonographic examinations. A senior academic radiology faculty (RE) who was blinded to patients, and sonographic findings reviewed the images and official radiology reports, and her reports were used as the gold standard. A dedicated MDCT was used for all ED imaging which had PACS capabilities (Picture Archiving and Communication System) and all examinations were contrast-enhanced according to local trauma protocol.	0.71 (0.62, 0.78) +LR (95% CI) 26.8 (5.3, 135,2) –LR (95% CI) 0.58 (0.31, 1.1) *Cave: other outcomes concerning diagnostic accuracy for detection of pneumothorax are reported under 2.123*	when performed by EM residents." **Reviewers' conclusion** There is an unclear risk of selection bias in this study as patients were included in the study when decision for CT was already made during assessment because of clinical suspicion for thoraco-abdominal injuries.
Bagheri-Hariri (2019) „The effect of extended-focused assessment with sonography in trauma results on clinical judgment accuracy of the physicians managing patients with blunt thoracoabdominal trauma". *Archives of Trauma Research* 2019; 8(4): 207-213 **Study design**	**Inclusion criteria** • Patients who were admitted to the ED with an abdominal or chest blunt trauma and for whom E-FAST was conducted **Exclusion criteria** • Patients with penetrating trauma **Characteristics (participants)** Age [y], mean (±SD) 36.2 (±12.37) Male, n (%)	**Participants** N=115 patients with blunt abdominal or chest trauma **Tests evaluated** Index Test 1: Ph/E, Physical examination Index Test 2: Ph/E + E-FAST, physical examination and additional extended-focused assessment with sonography in trauma Reference standard: findings in CT examination or intraoperative findings **Study interventions**	**Primary outcomes** **Diagnostic accuracy for detection of haemorrhagic shock (Ph/E)[1]** True positive, N=13 False positive, N=2 True negative, N=98 False negative, N=2 Sensitivity, % (95% CI) 86.7 (59.5-98.3) Specificity, % (95% CI)	**Level of evidence** 2b **Risk of bias (QUADAS)** Patient selection: ? Index test: + Reference standard: ? Flow and timing: ? **Authors' conclusion** "The results of this study showed that performing an

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Diagnostic cross-sectional study **Aim of the study** "Therefore, we decided to examine the effect of using E-FAST in the clinical judgment of the physicians managing patients with blunt abdominal and chest wall trauma." **Setting** Iran, 2014-2015	90 (80)	• On arrival to the ED, based on the Advanced Trauma Life Support (ATLS) Guideline, the patients had undergone a primary resuscitation, and airway status, head and neck condition, and vital signs status including blood pressure, heart rate, respiratory rate, and Glasgow coma score were investigated. • For data collection a checklist with three parts was used. • Part I: Patient's basic information was collected in a checklist and the revised trauma score (RTS) was calculated • Part II: Possible consequences based on the primary clinical judgment, the results from E-FAST on existence or nonexistence of free fluid, and possible consequences according to the results obtained from the E-FAST were recorded • Part III: Actual outcome of patient's condition in the first 24 h (patient discharge without a follow-up order, patient discharge with a follow-up order, patient admission in general ward and/or intensive care unit, surgical intervention, and patient's death) and also patient's condition during the first 28 days • The prediction power of E-FAST in traumatic patients was assessed.	98.0 (93.0-99.8) PPV, % (95% CI) 86.7 (59.5-98.3) NPV, % (95% CI) 98.0 (93.0-99.8) AUC (95% CI) 0.92 (0.86-0.96) **Diagnostic accuracy for detection of haemorrhagic shock (Ph/E + E-FAST)[1]** True positive, N=12 False positive, N=2 True negative, N=98 False negative, N=3 Sensitivity, % (95% CI) 80.0 (51.9-95.7) Specificity, % (95% CI) 98.0 (93.0-99.8) PPV, % (95% CI) 85.7 (57.2-98.2) NPV, % (95% CI) 97.0 (91.6-99.4) AUC (95% CI) 0.89 (0.82-0.94) [1]K= 0.803	E-FAST increases the sensitivity of history and physical examination in diagnosis of pneumothorax, hemoperitoneum, solid organ damage, and hemothorax. It can be reported that except for hemorrhagic shock, E-FAST significantly increases the accuracy of diagnosis." **Reviewers' conclusion** There is an unclear risk of bias in patient selection as the study chose a convenient sampling. It is unclear whether examiners were blinded to the results of the index test. Furthermore, there is an unclear risk of bias according to the patient flow, as not all patients received the same reference standard test.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Diagnostic accuracy for detection of hemoperitoneum (Ph/E)[3] True positive, N=5 False positive, N=2 True negative, N=100 False negative, N=8 Sensitivity, % (95% CI) 38.5 (13.9-68.4) Specificity, % (95% CI) 98.0 (93.1-99.8) PPV, % (95% CI) 71.4 (29.0-96.3) NPV, % (95% CI) 92.6 (85.9-96.7) AUC (95% CI) 0.68 (0.59-0.77) **Diagnostic accuracy for detection of hemoperitoneum (Ph/E + E-FAST)[3]** True positive, N=10 False positive, N=0 True negative, N=102 False negative, N=3 Sensitivity, % (95% CI) 76.9 (46.2-95.0) Specificity, % (95% CI)	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			100 (96.5-100) PPV, % (95% CI) 100 (69.1-100) NPV, % (95% CI) 97.1 (91.9-99.4) AUC (95% CI) 0.88 (0.81-0.94) [3]K= 0.430 **Diagnostic accuracy for detection of solid organ damage (Ph/E)[4]** True positive, N=3 False positive, N=3 True negative, N=101 False negative, N=8 Sensitivity, % (95% CI) 27.3 (6.0-61.0) Specificity, % (95% CI) 97.1 (91.8-99.4) PPV, % (95% CI) 50.0 (11.8-88.2) NPV, % (95% CI) 92.7 (86.1-96.8) AUC (95% CI) 0.62 (0.53-0.71)	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Diagnostic accuracy for detection of solid organ damage (Ph/E + E-FAST)[4] True positive, N=10 False positive, N=0 True negative, N=104 False negative, N=1 Sensitivity, % (95% CI) 90.9 (58.7-99.8) Specificity, % (95% CI) 100 (96.5-100) PPV, % (95% CI) 100 (69.2-100) NPV, % (95% CI) 99.0 (94.8-100) AUC (95% CI) 0.95 (0.90-0.98) [4]K= 0.331 The values of AUC revealed that except for hemorrhagic shock, E-FAST significantly increases the accuracy of diagnosis of posttraumatic complications, including hemoperitoneum, solid organ damage, and pneumothorax and hemothorax. Cave: outcomes for pneumothorax and hemothorax are reported under 2.123).	
Zanobetti (2018)	**Inclusion criteria**	**Participants**	Primary outcomes	**Level of evidence**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
„Chest Abdominal-Focused Assessment Sonography for Trauma during the primary survey in the Emergency Department: the CA-FAST protocol" *European Journal of Trauma Emergency Surgery* (2018); 44: 805-810 **Study design** Diagnostic cross-sectional study **Aim of the study** „(…)we developed a new protocol (CA-FAST, Chest Abdominal FAST) that integrates the detection of LCs in the E-FAST examination which can be performed during the primary survey. The aim of this study was to evaluate the feasibility and the diagnostic performance of CA-FAST examination when compared to the gold standard, thoracoabdominal CT." **Setting** Italy, 2012-2013	• Adult trauma patients presenting to the ED • Underwent a thoracoabdominal CT scan were enrolled if a CA-FAST examination was previously performed **Exclusion criteria** n.r. **Characteristics (participants)** Age [y], mean (±SD) 46 (±20) Male, n (%) 467 (75) ISS, mean (±SD) 16 (±12)	N=601 trauma patients **Tests evaluated** Index test: Chest Abdominal Focussed Assessment Sonography for Trauma (CA-FAST) protocol, CA-FAST protocol consisted of a combined ultrasonographic evaluation of chest and abdomen in order to detect the presence of the following ultrasonographic patterns: pneumothorax (PTX), pleural effusion (PE), lung contusion (LC), pericardial and intraperitoneal effusion. The full examination consisted of 8 chest scans and 4 abdominal scans acquired with the patient in obligated supine position due to spinal boards and cervical collars. Chest US was performed by a 4- to 8-MHz linear probe or a 3.5- to 5-MHz curved array probe. Performance of CA-FAST by 12 emergency physicians. The abdominal US was performed by 5-MHz curved array probe using the standard 4-views. Reference standard: thoracoabdominal CT scan, scans were enrolled if a CA-FAST examination was previously performed; CT scan was either required or not at discretion of the emergency physician (EP), independently of patient's participation to the study.	**Diagnostic accuracy for detection of free fluid (abdominal 4-view FAST)** Sensitivity, % (95% CI) 75 (67–83) Specificity, % (95% CI) 96 (93–97) PPV, % (95% CI) 81 (73–88) NPV, % (95% CI) 94 (91–96) +LR, % (95% CI) 17 (11–26) −LR, % (95% CI) 0.3 (0.2–0.4) Accuracy, % (95% CI) 91 (85–93) *Note: more relevant outcomes concerning pneumothorax are reported under 2.123.*	3b **Risk of bias (QIADAS)** Patient selection: ? Index test: + Reference standard: + Flow and timing:? **Authors' conclusion** „In summary CA-FAST protocol, performed in the emergency setting, showed important advantages: It is a noninvasive, rapid, ionizing radiation-free and an easily repeatable method; in trauma patients it allows to accurately and immediately detect diagnostic information and ultrasonographic patterns of severe injury. Moreover, the addition of four chest scans and the research of LCs did not cause a delay in the diagnosis.(…) CA-FAST protocol could represent an integrative tool of traditional CT scan in the management of trauma patients; it should be used as the initial investigation, during the primary survey, sending to further diagnostic studies

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
				only patients not clearly classified." **Reviewers' conclusion** There is an unclear risk of patient selection bias in this study as no further information about exclusion criteria was provided. Missing information about time intervals between the examinations lead to the conclusion of unclear risk for bias in the flow and timing.
+: low risk; –: high risk; ?: unclear risk; CI: Confidence Interval; E-Fast: extended Focused Abdominal Sonography for Trauma; CT: computed tomography; IQR: Interquartile Range; OR: Odds Ratio; SD: Standard Deviation; PPV: Positive Predictive Value; NPV: Negative Predictive Value; AUC: Area under the curve; adj.: adjusted; d: days; m: months; y: years; min: minutes				

Diagnostik eines Pneumo- oder Hämatothorax mittels transthorakaler Ultraschalluntersuchung, sonografische Wiederholungsuntersuchungen

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Akoglu (2017) *see 2.121* "Diagnostic accuracy of the Extended Focused Abdominal Sonography for Trauma (E-FAST) performed by emergency physicians compared to CT". *American Journal of Emergency Medicine* 2018; 36 (6): 1014-1017	**Inclusion criteria** • Patients ≥18 years • Multiple trauma (defined according to ATLS as more than one anatomical area was affected) • Any patient in whom thoraco-abdominal CT was ordered during the shifts where the researchers were on duty **Exclusion criteria**	**Participants** N=144 trauma patients Finally: 132 for abdominal, 130 for thorax examinations analysed **Tests evaluated** Index test: e-FAST; all sonographic examinations were performed by two senior EM residents (OFC, AC) who were certified for bedside sonography with 3 years of experience	**Primary outcomes** **Diagnostic accuracy for detection of pleural effusion (E-FAST)** True positive, N=2 False positive, N=0 True negative, N=128 False negative, N=0 Sensitivity, % (95% CI)	**Level of evidence** 2b **Risk of bias (QUADAS)** Patient selection: ? Index test: + Reference standard: + Flow and timing: + **Authors' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Study design Diagnostic cross-sectional study **Aim of the study** „The aim of this study was to compare the diagnostic accuracy of the E-FAST exam performed by emergency medicine (EM) residents with the results of CT scan as a gold standard." **Setting** US, 2014-2015	• Unstable patients (systolic blood pressure (SBP) b 100 mm Hg and/or heart rate (HR) N 100 beats/min and/or ≥4 U of packed red blood cells transfused in the trauma bay • Patients unavailable for CT (unable to leave the trauma bay for CT, died in the ED, referred to the operating room before CT) • Pregnant patients • Patients intubated • Patients with anatomical defect(s) at the site of sonographic imaging, • Patients with known allergies to contrast materials **Characteristics** Age [y], median (IQR) 38 (30-49) Male, n (%) 102 (79.1) SBP (mm Hg), mean (SD), (95% CI) 127.9 (20.5), (124.3, 131.5)	in protocols such as E-FAST, RUSH, or POCUS with an average of 500 bedside US examinations per year. When a trauma patient was ordered to have a thoraco-abdominal CT by the attending EP, an E-FAST examination was performed before the patient has left the ED for CT, if not already. E-FAST exam findings were recorded on a study chart before the CT examination. Reference standard: computed tomography scans; CTs were evaluated by a radiology specialist who was blinded to the patients and results of the sonographic examinations. A senior academic radiology faculty (RE) who was blinded to patients, and sonographic findings reviewed the images and official radiology reports, and her reports were used as the gold standard. A dedicated MDCT was used for all ED imaging which had PACS capabilities (Picture Archiving and Communication System) and all examinations were contrast-enhanced according to local trauma protocol.	100.0 (15.8, 100.0) Specificity, % (95% CI) 100.0 (97.2, 100.0) AUC (95% CI) 1.0 (0.97, 1.0) **Diagnostic accuracy for detection of pneumothorax (E-FAST)** True positive, N=6 False positive, N=1 True negative, N=121 False negative, N=2 Sensitivity, % (95% CI) 75.0 (35.0, 96,8) Specificity, % (95% CI) 99.2 (95.5, 100.0) AUC (95% CI) 0.87 (0.80, 0.92) Positive Likelihood Ratio (+LR) (95% CI) 91.5 (12.5, 671.1) Negative Likelihood Ratio (-LR) (95% CI) 0.25 (0.08, 0.84) *Note: other outcomes of this study are reported under 2.121*	"E-FAST examination has an excellent specificity. However, the sensitivity of the test is not high enough to rule-out thoraco-abdominal injuries in trauma patients when performed by EM residents." **Reviewers' conclusion** There is an unclear risk of selection bias in this study as patients were included in the study when decision for CT was already made during assessment because of clinical suspicion for thoraco-abdominal injuries.
Bagheri-Hariri (2019)	**Inclusion criteria**	**Participants**	**Primary outcomes**	**Level of evidence**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
see also 2.121 „The effect of extended-focused assessment with sonography in trauma results on clinical judgment accuracy of the physicians managing patients with blunt thoracoabdominal trauma". *Archives of Trauma Research* 2019; 8(4): 207-213 **Study design** Diagnostic cross-sectional study **Aim of the study** "Therefore, we decided to examine the effect of using E-FAST in the clinical judgment of the physicians managing patients with blunt abdominal and chest wall trauma." **Setting** Iran, 2014-2015	• Patients who were admitted to the ED with an abdominal or chest blunt trauma and for whom E-FAST was conducted **Exclusion criteria** • Patients with penetrating trauma **Characteristics (participants)** Age [y], mean (±SD) 36.2 (±12.37) Male, n (%) 90 (80)	N=115 patients with blunt abdominal or chest trauma **Tests evaluated** Index Test 1: Ph/E, Physical examination Index Test 2: Ph/E + E-FAST, physical examination and additional extended-focused assessment with sonography in trauma Reference standard: findings in CT examination or intraoperative findings **Study interventions** • On arrival to the ED, based on the Advanced Trauma Life Support (ATLS) Guideline, the patients had undergone a primary resuscitation, and airway status, head and neck condition, and vital signs status including blood pressure, heart rate, respiratory rate, and Glasgow coma score were investigated. • For data collection a checklist with three parts was used. • Part I: Patient's basic information was collected in a checklist and the revised trauma score (RTS) was calculated • Part II: Possible consequences based on the primary clinical judgment, the results from E-FAST on existence or nonexistence of free fluid, and possible consequences according to the results obtained from the E-FAST were recorded • Part III: Actual outcome of patient's condition in the first 24 h (patient discharge without a follow-up order, patient discharge with a follow-up order, patient	**Diagnostic accuracy for detection of pneumothorax (Ph/E)[2]** True positive, N=5 False positive, N=6 True negative, N=103 False negative, N=1 Sensitivity, % (95% CI) 83.3 (35.9-99.6) Specificity, % (95% CI) 94.5 (88.4-97.9) PPV, % (95% CI) 45.5 (16.7-76.6) NPV, % (95% CI) 99.0 (94.8-100) AUC (95% CI) 0.89 (0.82-0.94) **Diagnostic accuracy for detection of pneumothorax (Ph/E + E-FAST)[2]** True positive, N=10 False positive, N=2 True negative, N=102 False negative, N=1 Sensitivity, % (95% CI) 90.9 (58.7-99.8) Specificity, % (95% CI)	2b **Risk of bias (QUADAS)** Patient selection: ? Index test: + Reference standard: ? Flow and timing: ? **Authors' conclusion** "The results of this study showed that performing an E-FAST increases the sensitivity of history and physical examination in diagnosis of pneumothorax, hemoperitoneum, solid organ damage, and hemothorax. It can be reported that except for hemorrhagic shock, E-FAST significantly increases the accuracy of diagnosis." **Reviewers' conclusion** There is an unclear risk of bias in patient selection as the study chose a convenient sampling. It is unclear whether examiners were blinded to the results of the index test. Furthermore, there is an unclear risk of bias according to the pa-

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
		admission in general ward and/or intensive care unit, surgical intervention, and patient's death) and also patient's condition during the first 28 days. • The prediction power of E-FAST in traumatic patients was assessed.	98.1 (93.2-99.8) PPV, % (95% CI) 83.3 (51.6-97.9) NPV, % (95% CI) 99.0 (94.7-100) AUC (95% CI) 0.94 (0.89-0.98) ^{2}K= 0.642 **Diagnostic accuracy for detection of hemothorax (Ph/E)[5]** True positive, N=1 False positive, N=1 True negative, N=109 False negative, N=4 Sensitivity, % (95% CI) 20.0 (0.51-71.6) Specificity, % (95% CI) 99.1 (95.0-100) PPV, % (95% CI) 50.0 (1.3-98.7) NPV, % (95% CI) 96.5 (91.2-99.0) AUC (95% CI) 0.60 (0.50-0.69)	tient flow, as not all patients received the same reference standard test.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Diagnostic accuracy for detection of hemothorax (Ph/E + E-FAST)[5] True positive, N=4 False positive, N=0 True negative, N=110 False negative, N=1 Sensitivity, % (95% CI) 80.0 (28.4-99.5) Specificity, % (95% CI) 100 (96.7-100) PPV, % (95% CI) 100 (39.8-100) NPV, % (95% CI) 99.1 (95.1-100) AUC (95% CI) 0.90 (0.83-0.95) [5]K= 0.318 Note: other outcomes of this study were reported under 2.121	
Ezzat (2018) „Evaluation of the role of bedside ultrasonography in the detection of traumatic occult pneumothorax". *Journal of the Egyp-*	**Inclusion criteria** • Age ≥18 years • Polytraumatized patients with trauma experienced within the same day of presentation in the emergency department	**Participants** N=80 polytraumatized patients **Tests evaluated** Index test: X-Ray & Ultrasonography. Patients were subjected to chest X-ray revealing no pneumothorax. All of those patients	**Primary outcomes** Diagnostic accuracy for detection of OPTX (chest ultrasonography) True positive, N=56 False positive, N=2	**Level of evidence** 2b **Risk of bias (QUADAS)** Patient selection: ? Index test: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
tian Society of Cardio-Thoracic Surgery 2018; 26(2): 146-150 **Study design** Diagnostic cross-sectional study **Aim of the study** "The aim of the study was to evaluate the role of bedside thoracic ultrasonography (U/S) for detection of occult pneumothorax in patients with chest trauma." **Setting** Egypt, 2016-2018	**Exclusion criteria** • Patients having chest wall skin loss • subcutaneous emphysema • morbid obesity (BMI more than 40) preventing adequate ultrasound evaluation • preexisting pulmonary conditions such as pulmonary surgery or chronic lung disease • haemodynamic instability **Characteristics (participants)** Age [y], mean (±SD) 36.7 (± 13.17) Male, n (%) 64 (80) Head injuries, n (%) 60 (75) Spinal injuries, n (%) 6 (7.5) Abdominopelvic injuries, n (%) 35 (43.75) Limb injuries, n (%) 16 (20) CT chest findings, n (%) No Pneumothorax: 18 (22.5) Pneumothorax: 62 (77.5) Side, Bilateral: 4 (5) Side, Unilateral: 58 (72.5)	underwent thoracic U/S examination using Digital Ultrasonic Imaging System Model Phillips Affiniti 50G and portable Mindray dp20 afterwards. The characteristic ultrasonographic features for detection of pneumothorax were: absence of lung sliding, absence of B lines and identification of the lung point on 2D and M-mode ultrasonography. Occult pneumothorax (OPTX) distribution was described by patient side (unilateral or bilateral), into apical, basal, medial and lateral. Reference standard: WBCT. After X-ray and thoracic U/S all patients received whole body CT scanning performed by Toshiba Alicson 16 slice within 2 h of admission	True negative, N=16 False negative, N=6 Sensitivity, %* 90.32 Specificity, %* 88.89 PPV, %* 96.55 NPV, %* 72.73 Accuracy, %* 90 • *no 95% CI provided **Subgroup analysis ultrasound features** Diagnostic accuracy in detection of B-Lines True positive, N=56 False positive, N=2 True negative, N=16 False negative, N=6 Sensitivity, % 90.32 Specificity, % 88.89 PPV, %	Reference standard: ? Flow and timing: + **Authors' conclusion** „Bedside thoracic ultrasonography is a simple, rapid and reliable tool with high sensitivity, specificity and accuracy that can be dependable for diagnosis of occult pneumothorax in chest trauma patients." **Reviewers' conclusion** Results of the study should be interpreted with caution as the study population is mainly male and young, patients with preexisting pulmonary conditions, which also have a risk for occult PTX, were excluded. There is an unclear risk of selection bias and reference standard bias as no further information was provided about blinding. The authors report statistical testing but without presenting results.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Location, apical: 40 (50) Location, basal: 12 (15) Location, medial: 2 (2.5) Location, lateral: 8 (10)		96.55 NPV, % 72.73 Accuracy, % 90 Diagnostic accuracy in detection of lung sliding True positive, N=60 False positive, N=4 True negative, N=14 False negative, N=2 Sensitivity, % 96.77 Specificity, % 77.77 PPV, % 93.75 NPV, % 87.5 Accuracy, % 92.5 Diagnostic accuracy in detection of lung point True positive, N=44 False positive, N=0 True negative, N=18	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			False negative, N=18 Sensitivity, % 70.97 Specificity, % 100 PPV, % 100 NPV, % 50 Accuracy, % 77.5 Examiners detected signs like lung point and absence of lung sliding, but decision for diagnosis of pneumothorax was mainly made by detecting the absence of B-Lines	
Kozaci (2019) „Comparison of ultrasonography and computed tomography in the determination of traumatic thoracic injuries.“ *American Journal of Emergency Medicine*. 2019;37(5):864-8. **Study design** Diagnostic cross-sectional study **Aim of the study**	**Inclusion criteria** • suffered multiple traumas • thoracic trauma was identified on physical examination, and by thoracic computed tomography imaging **Exclusion criteria** • Patients who underwent thoracic computed tomography imaging at other medical centers before referral to the emergency department • pregnant patients **Characteristics**	**Participants** N=81 patients, 76 patients analysed **Tests evaluated** Index test: Thoracic ultrasonography, performed following a physical examination by an emergency physician to identify thoracic injuries. Pneumothorax was diagnosed if: B lines, lung sliding and lung pulse were absent (examination with linear probe). The presence of hemothorax was considered when the anechoic area was detected in the pleural area with a convex probe. Pulmonary contusion was diagnosed if B and C lines were detected with the linear probe	**Primary outcomes** **Diagnostic accuracy for detection of pneumothorax (thoracic ultrasonography)** N=76 Sensitivity [%] 86 Specificity [%] 97 AUC (95% CI) 0.912 (0.820–1.000)	**Level of evidence** 2b **Risk of bias (QUADAS)** Patient selection: + Index test: ? Reference standard: ? Flow and timing: - **Authors' conclusion** “In conclusion, ultrasound was found to be highly specific but only moderately

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"In this study, the accuracy of bedside thoracic ultrasonography (TUSG) performed by emergency physicians with patients in the supine position was compared with that of thoracic computed tomography (TCT) for the determination of thoracic injuries due to trauma." **Setting** Turkey, 2015 – 2018	Age [y], mean ± SD 38 ± 20 Male, n (%) 64 (79) GCS, n (%) 14–15: 73 (89) 9–13: 2 (3) 3–8: 7 (9)	and hepatization and parenchymal disruption were detected with the convex probe. Reference standard: Thoracic computed tomography, performed after the ultrasonography examination was completed.	**Diagnostic accuracy for detection of hemothorax (thoracic ultrasonography)** Sensitivity [%] 45 Specificity [%] 98 AUC (95% CI) 0.717 (0.567–0.867) **Diagnostic accuracy for detection of pulmonary contusion (thoracic ultrasonography)** Sensitivity [%] 63 Specificity [%] 91 AUC (95% CI) 0.769 (0.648–0.889)	sensitive for the identification of thoracic injuries." **Reviewers' conclusion** Unclear risk of bias due to missing information about blinded examiners to the results of index and reference tests. Additionally 5 participants were not included in analysis; reasons for this are not reported. This leads to risk of bias in flow and timing.
Leblanc (2014) "Early lung ultrasonography predicts the occurrence of acute respiratory distress syndrome in blunt trauma patients". *Intensive Care Medicine.* 2014;40(10):1468-74. **Study design** Diagnostic cross-sectional study	**Inclusion criteria** • Patients with multiple blunt trauma were enrolled in the study if one of the physicians trained in lung ultrasonography (i.e., with an experience of more than 30 LUS in trauma patients) was present. **Exclusion criteria** n.r. **Characteristics (participants)**	**Participants** N=45 multiple trauma patients Tests evaluated Index test 1: combined physical examination and chest radiography Index test 2: Lung ultrasonography (LUS) was performed after completion of clinical examination by an anesthesiologist trained for LUS blinded to the clinical examination and chest radiography (CXR) results.	**Primary outcomes** **Diagnostic accuracy for detection of pneumothorax (lung ultrasonography)** AUC-ROC (95% CI)* 0.81 (0.50–1.00) vs. 0.74 (0.48–1.00), p=0.24§ **Diagnostic accuracy for detection of lung contusion** AUC- ROC (95% CI)* 0.88 (0.76–1.00) vs. 0.69 (0.47–0.92), p<0.05	**Level of evidence** 2b **Risk of bias (QUADAS)** Patient selection: + Index test: + Reference standard: + Flow and timing: + **Authors' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Aim of the study "We hypothesized that early assessment of lung contusion extent using lung ultrasonography (LUS) can predict the occurrence of acute respiratory distress syndrome (ARDS) in blunt trauma patients." **Setting** France, 2010-2011	Age [y], mean ± SD 35 ± 16 Male, n (%) 32 (71) ISS, median (IQR) 34 (25–48) GCS , mean (± SD) 11 ± 4	Reference standard: CT	**Diagnostic accuracy for detection of hemothorax** AUC- ROC (95% CI)* 0.84 (0.59–1.00) vs. 0.73(0.51–0.94), p<0.05 *compared to reference standard §no significant difference between the two diagnostic modalities for pneumothorax diagnosis **Index test 1** *detection of pneumothorax* Sensitivity [%] (95% CI) 50 (NR) Specificity [%] (95% CI) 92 (NR) *detection of hemothorax* Sensitivity [%] (95% CI) 52 (NR) Specificity [%] (95% CI) 80 (NR) *detection of pulmonary contusion* Sensitivity [%] (95% CI) 78 (NR) Specificity [%] (95% CI) 57 (NR) **Index test 2** *detection of pneumothorax*	"(…)lung ultrasonography on admission identifies patients at risk of developing ARDS after blunt trauma. In addition, lung ultrasonography allows rapid and accurate diagnosis of common traumatic thoracic injuries." **Reviewers' conclusion** Risk of bias is low, but the sample size is small.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Sensitivity [%] (95% CI) 53 (NR) Specificity [%] (95% CI) 95 (NR) *detection of hemothorax* Sensitivity [%] (95% CI) 60 (NR) Specificity [%] (95% CI) 99 (NR) *detection of pulmonary contusion* Sensitivity [%] (95% CI) 90 (NR) Specificity [%] (95% CI) 87 (NR)	
Ojaghi Haghighi (2014) "Ultrasonographic diagnosis of suspected hemo-pneumothorax in trauma patients." *Trauma Monthly.* 2014;19(4):e17498. **Study design** Diagnostic cross-sectional study **Aim of the study**	**Inclusion criteria** • Patients with severe multiple trauma who were suspected of having chest injuries, and who had indications for a chest CT-scan according to ATLS algorithms **Exclusion criteria** • Patients who underwent a tube thoracostomy, before they had an opportunity to have an ultrasound due to their unstable clinical situation, or for	**Participants** N=150 patients **Tests evaluated** Index test 1: ultrasonography Index test 2: portable chest radiography Reference test: CT **Notes** • Examination findings included: chest pain, tenderness over the ribs, decreased	**Primary outcomes** **Diagnostic accuracy for detection of pneumothorax (ultrasonography)** True positive: 50 True negative: 98 False positive: 0 False negative: 2 Sensitivity [%] 96.15 Specificity [%]	**Level of evidence** 2b **Risk of bias (QUADAS)** Patient selection: ? Index test: + Reference standard: + Flow and timing: + **Authors' conclusion** "Ultrasonography sensitivity and specificity for diag-

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"The aim of this study was to evaluate the sensitivity and specificity of ultrasonography in the diagnosis of pneumothorax and hemothorax in comparison with portable CXR and CT-Scan." **Setting** Iran, 2013	any other reason, such as a lack of access to ultrasound at the time of admission, were excluded from the study. **Characteristics** Age [y], mean ± SD n.r Male, n (%) 124 (82.66) ISS **n.r**	lung sounds or chest percussion, subcutaneous emphysema, or any sign of trauma such as abrasions and/or bruises. **Patients were evaluated according to the ATLS algorithm, and examination findings were recorded following initial evaluations, an emergency medicine specialist performed chest ultrasonography to detect pneumothorax and hemothorax.**	100 PPV [%] 100 NPV [%] 98 **Diagnostic accuracy for detection of hemothorax (ultrasonography)** True positive: 39 True negative: 101 False positive: 2 False negative: 8 Sensitivity [%] 82.97 Specificity [%] 98.05 PPV [%] 95.12 NPV [%] 92.66 **Diagnostic accuracy for detection of pneumothorax (portable CXR)** True positive: 18 True negative: 96 False positive: 2	nosis of hemopneumothorax was high. The sensitivity of portable CXR was low despite its high specificity for the detection of hemothorax and pneumothorax" **Reviewers' conclusion** There is an unclear risk of bias due to missing information regarding patient selection.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			False negative: 34 Sensitivity [%] 34.61 Specificity [%] 97.95 PPV [%] 90 NPV [%] 73.84 **Diagnostic accuracy for detection of hemothorax (portable CXR)** True positive: 12 True negative: 98 False positive: 5 False negative: 35 Sensitivity [%] 25.53 Specificity [%] 95.14 PPV [%] 70.58 NPV [%] 73.68	
Zanobetti (2018) *(already extracted for 2.121)*	**Inclusion criteria**	**Participants**	**Primary outcomes**	**Level of evidence**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
„Chest Abdominal-Focused Assessment Sonography for Trauma during the primary survey in the Emergency Department: the CA-FAST protocol" *European Journal of Trauma Emergency Surgery* (2018); 44: 805-810 **Study design** Diagnostic cross-sectional study **Aim of the study** „(…)we developed a new protocol (CA-FAST, Chest Abdominal FAST) that integrates the detection of LCs in the E-FAST examination which can be performed during the primary survey. The aim of this study was to evaluate the feasibility and the diagnostic performance of CA-FAST examination when compared to the gold standard, thoracoabdominal CT." **Setting** Italy, 2012-2013	• Adult trauma patients presenting to the ED • Underwent a thoracoabdominal CT scan were enrolled if a CA-FAST examination was previously performed **Exclusion criteria** n.r. **Characteristics (participants)** Age [y], mean (±SD) 46 (±20) Male, n (%) 467 (75) ISS, mean (±SD) 16 (±12)	N=601 trauma patients **Tests evaluated** Index test: Chest Abdominal Focussed Assessment Sonography for Trauma (CA-FAST) protocol, CA-FAST protocol consisted of a combined ultrasonographic evaluation of chest and abdomen in order to detect the presence of the following ultrasonographic patterns: pneumothorax (PTX), pleural effusion (PE), lung contusion (LC), pericardial and intraperitoneal effusion. The full examination consisted of 8 chest scans and 4 abdominal scans acquired with the patient in obligated supine position due to spinal boards and cervical collars. Chest US was performed by a 4- to 8-MHz linear probe or a 3.5- to 5-MHz curved array probe. Performance of CA-FAST by 12 emergency physicians. The abdominal US was performed by 5-MHz curved array probe using the standard 4-views. Reference standard: thoracoabdominal CT scan, scans were enrolled if a CA-FAST examination was previously performed; CT scan was either required or not at discretion of the emergency physician (EP), independently of patient's participation to the study.	**Diagnostic accuracy for detection of pneumothorax (chest ultrasound)** Sensitivity, % (95% CI) 84 (77–89) Specificity, % (95% CI) 98 (96–99) PPV, % (95% CI) 93 (87–96) NPV, % (95% CI) 95 (93–97) +LR, % (95% CI) 39 (21–73) −LR, % (95% CI) 0.2 (0.1–0.2) Accuracy, %, (95% CI) 95 (91–97) **Diagnostic accuracy for detection of pleural effusion(chest ultrasound)** Sensitivity, % (95% CI) 82 (74–88) Specificity, % (95% CI) 97 (95–98) PPV, % (95% CI) 87 (79–92) NPV, % (95% CI)	3b **Risk of bias (QIADAS)** Patient selection: ? Index test: + Reference standard: + Flow and timing:? **Authors' conclusion** „In summary CA-FAST protocol, performed in the emergency setting, showed important advantages: It is a noninvasive, rapid, ionizing radiation-free and an easily repeatable method; in trauma patients it allows to accurately and immediately detect diagnostic information and ultrasonographic patterns of severe injury. Moreover, the addition of four chest scans and the research of LCs did not cause a delay in the diagnosis.(…) CA-FAST protocol could represent an integrative tool of traditional CT scan in the management of trauma patients; it should be used as the initial investigation, during the primary survey, sending to further diagnostic studies

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			95 (93–97) +LR, % (95% CI) 25 (16–41) −LR, % (95% CI) 0.2 (0.1–0.3) Accuracy, %, (95% CI) 94 (87–95) **Diagnostic accuracy for detection of lung contusion(chest ultrasound)** Sensitivity, % (95% CI) 59 (51–66) Specificity, % (95% CI) 98 (96–99) PPV, % (95% CI) 92 (86–96) NPV, % (95% CI) 86 (82–89) +LR, % (95% CI) 29 (15–55) −LR, % (95% CI) 0.4 (0.4–0.5) Accuracy, %, (95% CI) 87% (95% CI 85–92) **Other outcomes** Time [min] for examination , average (±SD)	only patients not clearly classified." **Reviewers' conclusion** There is an unclear risk of patient selection bias in this study as no further information about exclusion criteria was provided. Missing information about time intervals between the examinations lead to the conclusion of unclear risk for bias in the flow and timing.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			CA-FAST: 7 (±3) Chest Ultrasound only: 4 (±2) Abdominal FAST only: 3 (±1) *Note: Outcomes for 4-view fast are reported under 2.121*	
+: low risk; –: high risk; ?: unclear risk; CA-Fast: Chest-abdominal Focused Assessment Sonography for Trauma; CI: Confidence Interval; CT: Computer Tomography, E-Fast: extended Focused Abdominal Sonography for Trauma; EM_ Emergency Medicine; GCS: Glasgow Coma Scale; IQR: Interquartile Range; ISS: Injury Severity Score; LC: Lung Contusion; OR: Odds Ratio; SD: Standard Deviation; PPV: Positive Predictive Value; NPV: Negative Predictive Value; AUC: Area under the curve; +LR: Positive Likelihood Ratio; -LR: Negative Likelihood Ratio; adj.: adjusted; d: days; m: months; y: years; min: minutes; POCUS: Point of Care Ultrasound; PTX: Pneumothorax; RUSH: Rapid Ultrasound in Shock and Hypotension; SBP: systolic Blood Pressure;				

Röntgenaufnahme des Thorax als Alterantive zur unmittelbare CT-Thorax

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Bolteho Finho (2015) "Complementary exams in blunt torso trauma. Perform only radiographs and fast: is it safe?". *Rev. Col. Bras. Cir.* 2015; 42(4): 220-223 **Study design** Diagnostic cross-sectional study **Aim of the study** „(…) it was decided to investigate the extent to which radiological examinations of primary trauma assessments (pelvic and	**Inclusion criteria** • Blunt trauma patients **Exclusion criteria** • n.r. **Characteristics** Age [y], average 33 Male, n (%) n.r. Revised Trauma Score, mean 6.98 GCS, mean	**Participants** N=74 patients **Tests evaluated** Index test: set of three examinations (chest X-ray, pelvis X-ray and FAST). The set of examinations was performed on the included blunt trauma patients to identify traumatic injuries. Reference standard 1: CT scan of the torso of the same patients was used as reference standard Reference standard 2: if patients did not have CT scans clinical observation during hospitalization was replaced as reference standard (7 days for those who were intubated, 48h for patients who were conscious	**Primary outcomes** **Diagnostic accuracy for screening for significant injuries** True positive, N=27 False positive, N=3 True negative, N=41 False negative, N=3 Sensitivity, %* 90 Specificity, %* 93 NPV, %*	**Level of evidence** 3b **Risk of bias (QUADAS)** Patient selection: - Index test: - Reference standard: - Flow and timing: - **Authors' conclusion** „We conclude [sic] that CT can be used selectively in cases of altered clinical examinations or when the patient shows alterations in

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chest X-rays and FAST - focused abdominal sonography trauma) are sufficient in indicating the best approach for the initial care of polytrauma patients." **Setting** Brazil, 2013-2014	12	but required hospitalization for some other reason (e.g. orthopedic fracture), 12 hours for those who remained in hospital for only the minimum observation time)	93 PPV, %* 89 *No 95% CI provided	these requested examinations. A full-body CT scan therefore does not [sic] need be used for an initial diagnosis for all polytrauma patients, which is in line [sic] with Brazilian reality, the reality of a developing country which is seeking to reduce medical costs wherever possible." **Reviewers' conclusion** Results of the study should be interpreted with caution as the methodology lacks essential information about recruitment, sampling, randomization, blinding and drop-out patients. There are risks of bias concerning patient selection and index test. Besides that, not all patients received the same reference test which causes risk of bias in reference standard and flow and timing. In general, it is debatable that intubated trauma patients did not receive an adequate initial diagnostic imaging with CT scans, but were observed only.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
+: low risk; –: high risk; ?: unclear risk; CI: Confidence Interval; IQR: Interquartile Range; OR: Odds Ratio; RR: Relative Risk; SD: Standard Deviation; PPV: Positive Predictive Value; NPV: Negative Predictive Value; AUC: Area under the curve; +LR: Positive Likelihood Ratio; -LR: Negative Likelihood Ratio; adj.: adjusted; d: days; m: months; y: years; min: minutes				

Zeitpunkt und Indikationen zur Ganzkörper-CT, traumaspezifisches Protokoll

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Bieler (2020) „Why do some trauma patients die while others survive? A matched-pair analysis based on data from Trauma Register DGU R". *Chinese Journal of Traumatology* 2020; 23(4): 224-232 **Study design** Case-control study (Trauma Register DGU®) **Aim of the study** „The aim of this study was to use a matched-pair analysis in order to identify factors that influence the mortality of severely injured patients (ISS≥16). The limitations of retrospective register studies must be kept in mind." **Setting**	**Inclusion criteria** • patients who received primary care were included • ISS≥16 **Exclusion criteria** • Patients who were transferred from another hospital or were transferred to another hospital at an early stage • younger than 16 years of age and older than 55 in order to minimize age-related factors that could influence mortality • Patients with American Society of Anaesthesiologists Classification (ASA) scores 5 and 6 **Characteristics** Age [y], mean (SD) SV: 36.8 ± 12.4 NSV: 36.9 ± 12.4 Male, n (%) SV: 535 (81.4) NSV: 535 (81.4)	**Participants** N=1,314 patients **Study groups** SV: Survivor group, 657 patients NSV: Non-Survivor, 657 patients **Matching criteria** • Four age groups were created (16-25, 26-35, 36-45 and 46-55 years). • Two categories, i.e. American Society of Anaesthesiologists Classification System (ASA) 1, 2 and ASA 3, 4 were created to match pre-traumatic states of health, and the partners were allocated to these categories. • Patients were matched on the basis of the AIS for four relevant body regions in order to take into account the influence of injury patterns. • After the data transformation of the respective matched pair criteria into a numerical code, the matching of non-survivor to a survivor was done by the authors RL and DB in four-eye principle.	**Primary outcomes** **Factors associated with survival or nonsurvival (Procedures received)** WBCT, n (%) SV: 597 (91.1) NSV: 565 (86.4) p=0.006 cCT, n (%) SV:650 (98.9) NSV:622 (94.7) p<0.001 FAST, n (%) SV: 525 (80.2) NSV: 520 (79.5) p=0.77 Conventional X-ray diagnostic, n (%) SV: 258 (39.4) NSV: 232 (35.5) p=0.14	**Level of evidence** 3b **Risk of bias** Selection of participants: + Assessment: + Confounding factors: + Statistical analysis: - **Authors' conclusion** „The results of this study show that there are significant factors that predict or influence the mortality of severely injured patients. On the basis of paraclinical values as hemoglobin level and base excess, bleeding patients in particular are likely to have an unfavorable outcome. The mechanism of injury also appears to have an influence on the likelihood of survival. In this

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Germany, 2009-2014	ISS, mean (SD) SV: 30.7 ± 8,7 NSV: 30.9 ± 9,4 GCS at scene of accident, mean (SD) SV: 7.4 ± 4.3 NSV: 6.6 ± 4.5 <0.001	Two homogeneous groups were formed.		study a car accident is associated with a significant better outcome concerning mortality and a fall of >3 m is survived significantly less. Factors that other studies have found to exert an influence, such as care level and the length of the emergency room stay, did not make a significant difference in our study." **Reviewers' conclusion** Results need to be interpreted with caution due to the retrospective design of the study.. The imitations due to the case-control design were minimized by the matching procedure.
Lang (2017) „The role of whole-body computed tomography in the diagnosis of thoracic injuries in severely injured patients - a retrospective multi-centre study based on the trauma registry of the German trauma society (TraumaRegister DGU®)." *Scandinavian Journal of Trauma, Resuscitation & Emergency Medicine.* 2017;25(1):82.	**Inclusion criteria** • all cases of patients who were admitted to the trauma room with an ISS ≥9 • Only patients who underwent primary treatment at a regional (Level II) or supraregional trauma centre (Level I) (as defined by the TraumaRegister DGU®) were included • continuous documentation over a period of at least five consecutive years was required **Exclusion criteria**	**Participants** N=16,545 trauma patients **Study groups** IG: trauma scan/ WBCT group, n=8,559 CG: traditional diagnostic imaging/ pre-WBCT group, n=5,002 **Study interventions** • For cases in which the box for Whole-body CT in the TraumaRegister DGU® data collection form was checked, we assumed that a whole-body trauma scan was performed as a primary diagnostic	**Primary outcomes** Length of stay in the trauma room [min], mean (95% CI) IG: 64 (63.0 – 65.0) CG: 78 (76.0–79.0) Length of ICU stay [d], mean (95% CI) IG: 9.7 (9.4–10.0) CG: 10.8 (10.5–11.2), p=nr Length of intubation/ventilation [d], mean (95% CI)	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Study design Comparative registry study (TraumaRegister DGU®) **Aim of the study** We conducted a retrospective analysis of the trauma registry of the German Trauma Society (TraumaRegister DGU®) in order to assess the number of diagnosed thoracic injuries before and after the introduction of WBCT as a standard imaging modality and to investigate whether the trauma scan led to a change in patient outcomes. **Setting** Germany, 2002-2012	• Patients who did not undergo immediate surgery or were not admitted to ICU • The patients who underwent an imaging procedure in the year in which the trauma scan was introduced for routine use (N=2981; 18.0%) were not included in this study because of a wide variety of implementation rates **Characteristics** Age [y], mean (95% CI) IG: 45.7 (45.2–46.1) CG: 43.0 (42.5–43.6) Male, n (%) IG: 6248 (73.0) CG: 3677 (73.5) Patients with blunt trauma [%], mean (95% CI) IG: 94.5 (94.2–95.0) CG: 94.8 (94.2–95.2) GCS, mean (95% CI) IG: 11.1 (11.0–11.2) CG: 11.0 (10.8–11.1) ISS, mean (95% CI) IG: 24.5 (24.2–24.7) CG: 23.9 (23.5–24.2) Type of thoracic injuries Injury to the lung parenchyma, % (n.r.)	procedure. The TR-DGU defines WBCT as a combination of CT studies that produce images (or slices) of the body in a continuous manner and cover at least the region from the skull base to the pelvis. The other diagnostic approach consists of traditional imaging that involves conventional radiography of the cervical spine, the chest and the pelvis, often followed by focused CT (e.g. cranial CT).	IG: 5.6 (5.4–5.8) CG: 6.9 (6.6–7.2) Length of hospital stay [d], mean (95% CI) IG: 23.3 (22.7–23.8) CG: 26.2 (25.8–26.9) Ventilator-free days [d], mean (95% CI) IG: 20.8 (20.6–1.1) CG: 19.8 (19.4–20.1) 24-h mortality [%], mean (95% CI) IG: 8.2 (7.6–8.8) CG: 8.9 (8.1–9.7) Hospital mortality [%], mean (95% CI) IG: 15.6 (14.9–16.4) CG: 15.5 (14.5–16.5) Organ failure [%], mean (95% CI) IG: 43.9 (42.7–45.1) CG: 43.5 (42.0–45.0) Pulmonary failure [%], mean (95% CI) IG: 22.2 (21.2–23.2) CG: 26.2 (24.9–27.6) Multi-organ failure [%] mean (CI) IG: 26.9 (25.8–27.9) CG: 26.5 (25.2–27.8)	„Following the replacement of traditional imaging (conventional radiography and focused CT) by WBCT as the standard imaging modality in the trauma room setting, a higher number of thoracic injuries were detected. The majority of these cases, however, were minor injuries requiring no immediate treatment. There was no change in the clinical management of the thoracic injuries investigated here. During the period from 2002 to 2012, the routine use of the trauma scan did not improve survival in the non-selected patient population (ISS = 9). WBCT, however, led to a relevant reduction in the time spent in the trauma room (i.e. from 78 to 64 min).“ **Reviewers' conclusion** Even though risk of attrition and detection bias is low, there might be a moderate overall risk of bias due to high risk of bias regarding selection of participants and unclear performance bias.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG: 5.9 (5.4–6.4) CG: 12.6 (11.7–13.5) Pulmonary contusion, % (n.r.) IG: 28,7 (27.7–29.7) CG: 18,5 (17.4–19.6) Pneumothorax, % (n.r.) IG: 21.6 (20.7–22.5) CG: 17.3 (16.3–18.4) Tension pneumothorax, % (n.r.) IG: 2.5 (2.2–2.8) CG: 2.9 (2.4–3.4) Haemothorax, % (n.r.) IG: 14.0 (13.3–14.7) CG: 15.6 (14.6–16.6) Multiple rib fractures and flail chest, % (n.r.) IG: 21.6 (20.7–22.5) CG: 10.6 (9.7–11.4) Arterial injury (thorax), % (n.r.) IG: 1.5 (1.2–1.8) CG: 1.5 (1.2–1.8) Diaphragmatic injury, % (n.r.) IG: 1.1 (0.9–1.3) CG: 1.0 (0.7–1.3) Thoracic spine injury ≥AIS 2, % (n.r.) IG: 13.2 (12.5–13.9) CG: 10.9 (10.0–11.8) Thoracic spinal cord injury, % (n.r.)			

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG: 1.9 (1.6–2.2) CG: 1.7 (1.3–2.1) Cardiac injury, % (n.r.) IG: 0.5 (0.4–0.7) CG: 0.4 (0.2–0.6)			
Palm (2018) "Changes in trauma management following the implementation of the whole-body computed tomography: a retrospective multicentre study based on the trauma registry of the German Trauma Society (TraumaRegister DGU®)". **Study design** Comparative registry study (TraumaRegister DGU®) **Aim of the study** „The objective of our retrospective multi-centre study was to analyse data from the TraumaRegister DGU® to assess whether the introduction of the trauma scan led to changes in terms of the number of injuries detected, the body parts af-	**Inclusion criteria** • Patients who were admitted to the trauma room with an Injury Severity Score (ISS) ≥9 and who either underwent surgery or were transferred to the intensive care unit (ICU) following management in the trauma room or died in the trauma room. • Patients who underwent primary treatment at a regional (level II) or supraregional (level I) trauma centre were included. **Exclusion criteria** **The year in which the trauma scan was introduced was excluded from analysis since this year was usually a period of transition associated with a mixture of both imaging approaches.Characteristics** Age [y], median (95% CI) IG: 46.6 (45.9–47.2) CG: 43.0 (42.1–43.9) Male, % (95% CI) IG: 72.2 (71.6–72.8) CG: 72.7 (72.1–73.3) ISS, mean (95% CI)	**Participants** N=16,928 trauma patients **Study groups** IG: whole-body computed tomography scan (WBCT) group, patients underwent whole-body multi-slice CT as the primary diagnostic imaging modality; N=11,307 CG: before WBCT was introduced (Pre-WBCT) group, patients in this group underwent diagnostic procedures such as conventional radiography, abdominal ultrasound and focused CT; N=5,621 **Study intervention** • Up to 3 years before (pre-WBCT group) and up to 3 years after the introduction of the trauma scan (WBCT group) as a standard imaging procedure were analysed and compared • A maximum variation of 30% in both the pre-WBCT and the WBCT group provided the basis for decision. In addition, there had to be an increase in the WBCT rate by at least 50% or to at least 60% in the year following the introduction of WBCT when compared to the year preceding the introduction of the trauma scan.	**Primary outcomes** Mortality, % (95% CI) IG: 15.9 (15.4–16.4) CG: 15.7 (15.2–16.3) Mortality according to RISC II, % IG: 15.2 CG: 15.7 Number of diagnoses, mean (95% CI) IG: 5.1 (5.0–5.2) CG: 4.6 (4.5–4.7) Patients underwent surgery immediately after completion of treatment in the trauma room, % (95% CI) IG: 39.1 (38.3–39.9) CG: 44.5 (43.7–45.3) Patients who required emergency surgery or died during trauma room management, % (95% CI) IG: 5.1 (4.7–5.5) CG: 6.8 (6.4–7.2) Patients directly transferred to the ICU, % (95% CI) IG: 54.4 (53.6–55.2) CG: 46.2 (45.4–47.0)	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** „Our study shows that the trauma scan is not superior to a combination of conventional radiography, ultrasound and focused CT in terms of mortality in a non-selected population of patients (ISS ≥9). Against this background, more importance should be placed on decision trees that are independent of imaging modalities and allow trauma team leaders to decide on an individual basis whether a patient is a candidate for a trauma scan. Our study also showed,

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fected, the indication-dependent management of patients following the completion of trauma room procedures, and patient outcomes and thus to determine whether trauma room processes before WBCT were different from those after the introduction of the trauma scan as a standard imaging modality." *European Journal of Trauma Emergency Surgery* 2018; 44:759–766 **Setting** Germany, 2002-2013	IG: 23.9 (23.4–24.3) CG: 23.7 (23.1–24.3)		<u>Total time spent in the trauma room [min], mean (95% CI)</u> IG: 63.6 (62.0–65.1) CG: 77.9 (75.7–80.2) <u>Length of ICU stay [d], mean (95% CI)</u> IG: 8.9 (8.6–9.3) CG: 10.6 (10.0–11.2) <u>Length of hospital stay [d], mean (95% CI)</u> IG: 21.6 (20.9–22.3) CG: 25.3 (24.1–26.4)	however, that the introduction of the trauma scan as a standard imaging modality led to a relevant reduction in almost all trauma room processes and enabled trauma teams to make faster treatment decisions. We observed an increase in the number of diagnoses per patient. Since we were also able to prove that the introduction of the trauma scan was associated with a relevant decrease in the length of ICU stay and hospital stay, trauma teams should adhere to current practices and procedures until the aforementioned decision trees are available." **Reviewers' conclusion** There is an unclear risk of performance bias in this study as it is unclear if the knowledge about the diagnostic procedure may have influenced the care. The study population overlaps significant with the one analyzed in Lang (2017), which should be considered during interpretation of both studies results. The ef-

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				fect size might be overestimated due to double analysis of the same population.
Sierink (2016) "Sierink, J.C., et al., Immediate total-body CT scanning versus conventional imaging and selective CT scanning in patients with severe trauma (REACT-2): a randomised controlled trial." *Lancet*, 2016. 388(10045): p. 673-83. **Study design** Randomised controlled trial **Aim of the study** „We undertook a randomised clinical trial (REACT-2) to examine the eff ect of immediate total-body CT scanning as part of the primary assessment of patients with severe trauma on in-hospital mortality, and compared it with that of the standard work-up of conventional imaging supplemented with selective CT scanning." **Setting**	**Inclusion criteria** • Trauma patients with the presence of life-threatening vital problems, at least one of the following: respiratory rate ≥30 min of ≤10/min; pulse ≥120/min; systolic blood pressure ≤100 mmHg; estimated exterior blood loss ≥500 ml; Glasgow Coma Score ≤13; Abnormal pupillary reaction onsite. • patients with one of the following clinically suspicious diagnoses: flail chest, open chest or multiple rib fractures; severe abdominal injury; pelvic fracture; unstable vertebral fractures/spinal cord compression; fractures from at least two long bones • patients with one of the following injury mechanisms: fall from height (>3 m/>10 ft); ejection from the vehicle; death occupant in same vehicle; severely injured patient in same vehicle; wedged or trapped chest/abdomen. **Exclusion criteria** • known age <18 years • known pregnancy • referred from another hospital • clearly low-energy trauma with blunt injury mechanism • penetrating injury in 1 body region (except gunshot wounds) as the clearly isolated injury	**Participants** N=1,403 patients randomized, 1083 analyzed **Study groups** IG: Total-body CT; following a two-step acquisition (from vertex to pubic symphysis) without gantry angulations:starting with a non-enhanced CT of the head and neck with arms alongside the trunk. The second scan covered the chest, abdomen, and pelvis. The second scan was split-bolus intravenous contrast imaging immediately after raising the arms alongside the head. CT scanners were all 64-slice multidetector row CT scanners; N=541 CG: standard work-up; according to ATLS guidelines with chest and pelvic radiographs and focused assessment with sonography in trauma. During the secondary survey, a selective CT scan could be made from individual body regions, with segmented acquisition of the respective body regions; N=542 **Note** ITT analysis ‡Patients who died in the emergency department (six [1%] of 541 patients in the total-body CT group vs four [1%] of 542 in the	**Primary outcomes** In-hospital mortality, n (%) IG: 86 (16%) vs. 85 (16%), p=0.92 24-h mortality, n (%) IG: 43 (8) vs. CG 33 (6), p=0.23 30-day mortality, n (%) IG: 81 (17) vs. CG: 78 (16), p=0.69 Complications, n (%) IG: 129 (24) vs. CG: 124 (23), p=0.73 Serious adverse events (safety endpoint)**, n (%) IG: 3 (1) vs. 1 (<1), p=0.37 Blood transfusions in hospital, n (%) § IG: 147 (27) vs. 150 (28), p=0.91 Length of stay at ICU [d] , median (IQR)¶ IG: 3 (1–8) vs. CG: 3 (1–8),p=0.83 Ventilator use [d], median (IQR) IG: 2 (1–5) vs. CG: 1 (1–6), p=0.78 Time to end of imaging [min], median (IQR) IG: 30 (24–40) vs. CG: 37 (28–52); p<0.0001 Time spend in the trauma room [min], median (IQR) IG: 63 (47–102) vs. CG: 72 (50–109); p=0.067	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion** "Diagnosing patients with an immediate total-body CT scan does not reduce in-hospital mortality compared with the standard radiological work-up. Because of the increased radiation dose, future research should focus on the selection of patients who will benefit from immediate total-body CT." **Reviewers' conclusion** The study was a well conducted RCT achieving the sample size necessary to detect differences in mor-

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
The Netherlands and Switzerland, 04.2011 -01.2014	• any patient who is judged to be too unstable to undergo a CT scan and requires (cardiopulmonary) resuscitation or immediate operation because death is imminent according to the trauma team leader in mutual agreement with the other leading care givers. **Characteristics** Age [y], median (IQR) IG: 42 (27–59) vs. CG: 45 (26–59) Male sex, n (%) IG: 413 (76) vs. CG: 411 (76) In hospital GCS, median (IQR): IG: 13 (3–15) vs. CG: 13 (3–15) Abbreviated Injury Scale ≥3, n (%) Head: IG: 247 (46) vs. CG: 218 (40) Chest: IG: 229 (42) vs. CG: 206 (38) Abdomen: IG: 49 (9) vs. CG: 67 (12) Arms, legs, hand, and feet: IG: 150 (28) vs. CG: 154 (28) ISS, median (IQR): IG: 20 (10–29) vs. CG: 542 19 (9–29) Patients with polytrauma, n (%) IG: 362 (67%) vs. CG: 331 (61) Patients with traumatic brain injury, mean (SD): IG: 178 (32.9) vs. CG: 151 (27.9)	standard work-up group) and those with incomplete follow-up for radiation exposure (15 [3%] vs seven [1%]) were excluded. §Packed cells, thrombocytes, or plasma. ¶Excluded patients who died during the initial admission (86 patients in the total-body CT group and 85 in the standard work-up group). ||Excluded patients with incomplete follow-up for readmissions (60 in the total-body CT group and 45 in the standard work-up group). **One other serious adverse event occurred in a patient who was excluded after random allocation.	Readmission within 6 months, n (%)|| IG: 67 (17) vs. CG. 44 (11), p=0.01 **Subgroup analysis patients with polytrauma** In-hospital mortality, n (%) IG: 81 (22) vs. CG: 82 (25), p=0.46 24-h mortality, n (%) IG: 41 (11) vs. CG 33 (10), p=0.56 30-day mortality, n (%) IG: 76 (23) vs. 75 (24), p=0.69 **Subgroup analysis patients with severe TBI** In-hospital mortality, n (%) IG: 68 (38) vs. CG 66 (44), p=0.31 24-h mortality, n (%) IG: 37 (21) vs. CG: 27 (18), p=0.51 30-day mortality, n (%) IG: 66 (39) vs. CG: 60 (41), p=0.65	tality. Physicians and patients could not be blinded to the intervention.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Topp (2015) "Radiologic diagnostic procedures in severely injured patients - is only whole-body multislice computed tomography the answer?". *International Journal of Emergency Medicine* 2015; 8:3 **Study design** Comparative registry study (TraumaRegister DGU®) **Aim of the study** „The objective of this study was to compare a protocol that uses whole-body multi-sclice CT (WB-MSCT) as the first and only diagnostic tool to a protocol that uses conventional radiographs prior to WB-MSCT regarding a) duration of the initial treatment phase in the resuscitation room, b) length of stay in the intensive care unit (ICU), c) ventilation days, d) length of hospital stay, and e) mortality." **Setting**	**Inclusion criteria** • primary admitted patients with an ISS of ≥16 • documented times of conventional radiographs and WB-MSCT diagnosis **Exclusion criteria** • Patients with penetrating injuries **Characteristics** Age [y], mean (SD) IG: 45.1 (±19.8) CG: 45.5 (±20) p=0.429 Male, n (%) IG: 2,932 (72.8) CG: 2,937 (73.5) p=0.497 ISS, mean (%) IG: 29.9 (±12.6) CG: 29.9 (±12.3) p=0.913 AIS head, n (%) IG: 2,338 (57.7) CG: 2,220 (55.1), p<0.05 AIS thorax, n (%) IG: 2,603 (64.2) CG: 2,558 (63.5), p=0.501 AIS abdomen, n (%) IG: 877 (21.6)	**Participants** N=8,020 patients **Study groups** IG: group received initial WB-MSCT, mostly with the scanner located in the resuscitation room; N=4,025 CG: group received conventional radiographs prior to WB-MSCT, N=3,995 **Study interventions** Both groups also received an initial FAST ultrasound.	**Primary outcomes** Mortality, n (%) IG: 746 (18.4) CG: 732 (18.2) p=0.786 Time in Rescutation Room [min], mean (SD) 64 (±39) 72 (±40) p<0.001 Time to admittance on ICU [min], mean (SD) IG: 197 (±147) CG: 197 (±149) p=1.0 Time to arrival in the Operation Room [min], mean (SD) IG: 141(±203) CG: 144 (±187) p=0.687 Length of Hospitalization [d], mean (SD) IG: 27.9 (±30.2) CG: 25.2 (±25.2) p<0.001 Length of ICU stay [d], mean (SD) IG: 13.0 (±15.4) CG: 12.3 (±14.3) p<0.01 RISC, mean (SD) IG: 21.4 % (±28) CG: 21.4 % (±28) p=0.961	**Level of evidence** 2b **Risk of bias** Selection bias: ? Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** „Emergency room protocols that use initial conventional radiographs prior to WB-MSCT have comparable results regarding mortality compared to protocols that use WBMSCT as the initial diagnostic tool. Furthermore, the emergency room team can perform life-savings procedures like chest-tube insertion, thoracotomy, and cardiopulmonary resuscitation immediately. Especially in patients in extremis, surgical procedures and diagnostic work-up can be performed simultaneous without wasting precious time." **Reviewers' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Germany, 1993-2009	CG: 944 (23.4), p<0.05 AIS extremities, n (%) IG: 1,543 (38.1) CG: 1,667 (41.4) p<0.01		SMR IG: 0.86 CG: 0.85 p=0.910	There is a risk of selection bias in this study and unclear performance bias. Besides that, there is high deviation within the reported outcomes (high standard deviations), results should be interpreted with caution.
+: low risk; –: high risk; ?: unclear risk; AIS: Abbreviated Injury Scale; CI: Confidence Interval; IQR: Interquartile Range; ISS: Injury Severity Score; OR: Odds Ratio; RR: Relative Risk; SD: Standard Deviation; PPV: Positive Predictive Value; NPV: Negative Predictive Value; AUC: Area under the curve; +LR: Positive Likelihood Ratio; -LR: Negative Likelihood Ratio; adj.: adjusted; d: days; m: months; y: years; min: minutes; RISC: Revised Injury Severity Calssification; SMR: Standardized Mortality Ratios; WB-MSCT: Whole Body-Multislice Computer Tomography				

Lokalisation des Computertomografen (CT)

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Wulffeld (2017) "The effect of CT scanners in the trauma room - an observational study". *Acta Anaesthesiologica Scandinavica* 2017; 61(7): 832-840 **Study design** Retrospective before–after study **Aim of the study** „A CT scanner incorporated in the trauma resuscitation bay may benefit	**Inclusion criteria** • Trauma patients in two 1-year periods before and after the reconstruction of the rescutation room, which took place from June 2012 to October 2013. • Patients who triggered trauma team activation. **Exclusion criteria** • Patients younger than 18 years • Burn patients **Characteristics** Age [y], median (IQR) IG: 43 (29–59)	**Participants** N=1,526 trauma patients, 1,310 analyzed **Study groups** IG: after reconstruction, mobile CT scanners with a moving gantry (combined with a trauma resuscitation table) placed in rescutation room; N=742 CG: before reconstruction, CT scanner in a room 15m from the trauma room; N=784 **Study interventions** • The before period went from 1 June 2011 to 31 May 2012 and the after pe-	**Primary outcomes§** 30-day mortality, n (%)* IG: 45 (6) CG: 28 (3.6) p=0.006 *Unadjusted Adjusted OR, (95% CI) 1.1 (0.59-2.05) Time to first CT image [min], median (IQR) IG: 21 (17–28) CG: 20 (15–29) p=0.008,	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** „However, our results add to the current body of evidence where previous studies have found minor time

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trauma patients by fastening work-up times; however, evidence in the area is still sparse. We assessed if time from admission to first CT scan was lower after incorporation of a CT scanner in the resuscitation bay." **Setting** Denmark, 2011-2012 & 2013-2014	CG: 38 (26–55) p=0.001 Male, n (%) IG: 555 (74.8%) CG: 561 (71.6) p=0.2 ISS <15, n (%) IG: 147 (19.8) CG: 176 (22.5) p=n.r. ISS 16-24, n (%) IG: 123 (16.6) CG: 129 (16.5) p=n.r. ISS 25-49, n (%) IG: 123 (16.6) CG: 92 (11.7) p=n.r. ISS 50-75, n (%) IG: 8 (1.1) CG: 3 (0.4) p=n.r. First GCS<9, n (%) IG: 134 (19.7) CG: 99 (13.9) TBI (AIS>3), n (%) IG: 141 (19) CG: 119 (15.2) CT scans performed, n (%)	riod from 1 January 2014 to 31 December 2014. We chose two 1-year periods to eliminate bias due to seasonal variations. • We allowed a 3-month period between completion of the rebuilding and the after period to avoid bias due to start-up difficulties.	HL median difference (95% CI) 1 (0-2) Trauma room length of stay [min], median (IQR) IG: 95 (67–136) CG: 83 (60–129) p<0.0001, HL median difference, (95% CI): 10 (5–15) Time to urgent surgery [min], median (IQR) IG: 126.5 (78–209.5) CG: 143 (92.5–230.5) p=0.1, HL median difference, (95% CI): -18 (-40–3) **Subgroup patients with injury severity score >15§** Time to first CT image [min], median (IQR) IG: 23 (18–32) CG: 22 (16–34) p=0.4, HL median difference, (95% CI): 1 (-1–3) Trauma room length of stay [min], median (IQR) IG: 105 (78–141) CG: 103 (67–146) p=0.2, HL median difference, (95% CI): 6 (-4–15) Time to urgent surgery [min], median (IQR) IG: 123 (85–183) CG: 151 (100–224)	gains only and no clear benefit in terms of patient outcomes. At this point, we think it is difficult to say if there is a clear benefit associated with having CT scanners in the trauma room." **Reviewers' conclusion** Results need to be interpreted with caution due to the retrospective before-after design of the study. Risk of performance bias is unclear. Results of the study showed no significant benefits which was already considered by the authors in their conclusion.

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	IG: 643 (86.7) CG: 667 (85) p=0.4 Urgent surgery, n (%) IG: 148 (20) CG: 160 (20.4) p=0.8 Urgent surgery (subgroup ISS >15), n (%) IG: 86 (33.9) CG: 97 (43.3) p=0.03		p=0.06, HL median difference, (95% CI): -24 (-49–2)	
+: low risk; –: high risk; ?: unclear risk; CI: Confidence Interval; ISS. Injury Severity Score; HL: Hodges Lehmann estimate of the median difference; IQR: Interquartile Range; OR: Odds Ratio; RR: Relative Risk; SD: Standard Deviation; PPV: Positive Predictive Value; NPV: Negative Predictive Value; AUC: Area under the curve; +LR: Positive Likelihood Ratio; -LR: Negative Likelihood Ratio; adj.: adjusted; d: days; m: months; y: years; min: minutes				

Ganzkörper-CT mit Kontrastmittel bei hämodynamisch instabilen Schwerverletzten

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Cook (2015) "An Abdominal CT may be Safe in Selected Hypotensive Trauma Patients with Positive FAST Exam". *American Journal of Surgery* 2015; 209(5): 834–840 **Study design** Prospective cohort study	**Inclusion criteria** • Patients who required the highest level activation at one of 10 Level I trauma centers & who received one or more units of red blood cells (RBCs) within 6 hours of hospital admission (PROMMTT inclusion criteria) • Patients with a positive FAST and hypotension defined as an admission systolic blood pressure (SBP) ≤90mmHg (studies inclusion criteria)	**Participants** N=255 patients, 92 analyzed **Study groups** IG: Patients with positive FAST, hypotension and CT diagnostic; N=32 CG: Patients with positive FAST, hypotension and without CT diagnostic; N=60 **Study interventions** • CT was defined as Abdominal/Pelvis CT scan	**Primary outcomes** Urgent Operation, %; OR (95% CI) IG: 22 CG: 93; 0.02 (95% CI: <0.01 – 0.15)*; p<0.01 *CT was associated with reduced odds of an urgent operation Urgent Angiography, %; OR (95% CI) IG: 22 CG: 2; 15.8 (1.5–133.2)*; p<0.01	**Level of evidence** 2b **Risk of bias** Selection bias: ? Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion**

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(database created by the Prospective Observational Multicenter Major Trauma Transfusion (PROMMTT) study Data Coordinating Center at the University of Texas Health Science Center at Houston) **Aim of the study** „We therefore sought to determine if patients who were initially hypotensive who undergo an abdomen and pelvis CT (CT) scan following a positive FAST exam have similar long term outcomes and less urgent operations than patients who do not undergo a CT." **Setting** US, year n.r.	**Exclusion criteria** • age younger than 16 years • transfer from another hospital • pregnancy • more than 20% burn injury • inhalation injury • incarceration • cardiopulmonary resuscitation lasting more than 5 minutes occurring prehospital or in the first 30 minutes after admission • death within 30 minutes of hospital admission **Characteristics** Age [y], median (IQR) IG: 34 (24 - 45) CG: 41 (24 - 54), p=0.15 Male, n (%) n.r. GCS, median (IQR) CG: 9 (4 - 14) IG: 13 (3 - 5), p=0.15 ISS, median (IQR) CG: 34 (23 - 41) IG: 27 (16 - 35), p=0.12 Head AIS, median (IQR) IG: 0.5 (0 - 4) CG: 0 (0 - 0.8), p<0.05 Face AIS, median (IQR) IG: 0 (0 - 1)	• An urgent operation was defined as direct admission to the operating room less than 3 hours from presentation. This longer time was chosen to allow for the inherent delay in obtaining a CT scan during trauma workup. **Criteria for adjustment, multivariable model** • Age • GCS • ISS • Admission systolic blood pressure • Heart rate • Mechanism of injury	*CT was associated with increased odds of proceeding to interventional radiography. Time to Operation [min], median (95% CI) IG: 93 (41 - 121) CG: 26 (19 - 35), p<0.01 24-h mortality, % OR (95% CI) IG: 6 CG: 20, p<0.01 0.41 (0.05–3.6) 30 Day Mortality, % OR (95% CI) IG: 19 CG: 30, p=0.32 1.4 (0.24–7.7) Length of stay, median (IQR) IG: 20 (14 - 37) CG: 17 (11 - 30), p=0.49	"In conclusion, we find that some patients with initial hypotension and a positive FAST may be taken to CT without a significant difference in 30 day mortality. We additionally find that undergoing an CT is independently associated with reduced odds of an urgent operation and increased odds of angiographic intervention. This suggests that the information obtained from the CT may impact clinical decisions and that admission hypotension and a positive FAST exam does not mandate laparotomy." **Reviewers' conclusion** There is an unclear risk of selection and performance bias as the study groups remained different concerning the ISS although attempts to reduce confounding factors were made. Furthermore, the patient selection process remains unclear as more patient data were selected for the PROMMTT database but only a minority was ana-

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	CG: 0 (0 - 0), p=0.05 Chest AIS, median (IQR) IG: 3 (3 - 4) CG: 3 (1 - 4), p=0.19 Abdomen AIS, median (IQR) IG: 3 (3 - 4) CG: 3 (2 - 4), p=0.8 Extremity AIS, median (IQR) IG: 2 (0 - 3) CG: 2 (0 - 3), p=0.82 External AIS, median (IQR) IG: 1 (0 - 1) CG: 1 (0 - 1), p=0.62			lyzed. Reason for the selection of the other patients was not explained.
Katayama (2018) "Delay of computed tomography is associated with poor outcome in patients with blunt traumatic aortic injury (BTAI) - A nationwide observational study in Japan" *Medicine*, 2018. 97(35): p. e12112. **Study design** Comparative registry study (Japanese Trauma Data Bank) **Aim of the study**	**Inclusion criteria** • Emergency patients who had a BTAI in the chest and/or the abdomen among those who were transported to the JTDB-participating hospitals and were registered in the database. **Exclusion criteria** • patients with cardiopulmonary arrest on hospital arrival • patients with interhospital transport • patient which had no records on the time interval from hospital arrival to CT scanning • patients with penetrating trauma • inappropriate datasets	**Participants** N=421 BTAI patients **Study groups** IG1: Time interval from hospital arrival to CT scanning; 27-40 min; N=135 IG2: Time interval from hospital arrival to CT scanning; >=41 min; N=144 CG: Time interval from hospital arrival to CT scanning; =<26 min; N=142 **Study interventions** The tertile groups by CT scanning time were classified according to the time interval from hospital arrival to implementation of first CT scanning by a CT operator.	**Primary outcomes** Death in the ED, n (%) IG1: 15 (11.1); adj. OR*= 1.833, 95% CI: 0.601 – 5.590; p=0.287 IG2: 25 (17.6); adj. OR*= 2.832, 95% CI: 1.007 – 7.960; p=0.048 CG: 11 (7.7) * Adjusted for: age, gender, falling from a high place, pedestrian injured by traffic accident, calendar year, time of the day (daytime/nighttime), day of the week (weekday/weekend and holiday), shock at hospital arrival, RTS, ISS, case volume (upper/middle/lower) Death to discharge, n (%)§	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "We showed in a retrospective review of a nationwide hospital based trauma registry in Japan that the prognosis of BTAI patients in the ED worsened as the time to

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"The aim of this study was to assess the relationship between the timing of CT scanning and the prognosis of BTAI patients using this database." **Setting** Japan, 2004-2015	• patients in whom the first elective CT scanning was performed ≥72hours after hospital arrival **Characteristics** <u>Age[y], median (IQR)</u> IG1: 59 (38–71) IG2: 57 (37–73) CG: 62 (47–77), p=0.496 <u>Male, n (%)</u> IG1: 93 (68.9) IG2: 106 (73.6) CG: 109 (76.8), p=0.332 <u>ISS, median (IQR)</u> IG1: 34 (24–48 IG2: 35 (26–50) CG: 34 (25–50), p=0.451 <u>Shock (systolic blood pressure<90mmHg), n (%)</u> IG1: 48 (35.6) IG2: 52 (36.1) CG: 37 (26.1), p=0.128 <u>Surgical operation, n (%)</u> IG1: 20 (14.8) IG2: 34 (23.6) CG: 28 (19.7), p=0.179 <u>Time interval from patient's call to hospital arrival [min], median (IQR)</u> IG1: 38 (29–47) IG2: 38 (29–51) CG: 38 (28–54), p=0.405		IG1: 43 (31.9); adj. OR[1]= 1.032 , 95% CI: 0.517 – 2.059; p=0.930 IG2: 55 (38.2); adj. OR[1]= 1.438 , 95% CI: 0.735 – 2.813; p=0.288 CG: 41 (28.9) [1]Adjusted for age, gender, time of the day, day of the week, falling from a high place, pedestrian injured by traffic accident, revised trauma score, injury severity score, shock at hospital arrival, case volume, and calendar year. **Subgroup: Death in the ED of BTAI patients with and without shock according to CT scanning time[§]** *Shock (n=137)* <u>Death in the ED, n (%)</u> IG1: 10 (20.8); adj. OR[2]= 3.292; 95% CI: 0.495 – 21.902; p=0.218 IG2: 14 (26.9); adj. OR[2]= 6.039; 95% CI: 0.990 – 36.837; p=0.051 CG: 5 (13.5) *No shock (n=284)* <u>Death in the ED, n (%)</u> IG1: 5 (5.7); adj. OR[2]= 1.527; 95% CI: 0.337 – 7.103; p=0.575 IG2: 11 (12); adj. OR[2]= 2.165; 95% CI: 0.533 – 8.785; p=0.280 CG: 6 (5.7)	first CT scanning was delayed." **Reviewers' conclusion** Results need to be interpreted with caution due to the retrospective design of the study and the unclear risk of performance bias. There is only one significant finding: there is an increase of deaths in the ED upon patients receiving CT scanning later compared to early scan. The other findings were not significant. Furthermore, results show wide 95% confident intervals.

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			[2]Adjusted for age, gender, time of the day, day of the week, falling from a high place, pedestrian injured by traffic accident, revised trauma score, injury severity score, case volume, and calendar year. [§]findings without significance	
Tsutsumi (2017) „Computed tomography during initial management and mortality among hemodynamically unstable blunt trauma patients: a nationwide retrospective cohort study". *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine* 2017; 25:74 **Study design** Comparative registry study (Japan Trauma Data Bank) **Aim of the study** „In this study, we examined the association between CT and mortality among unstable blunt trauma patients using nationwide Japanese registry data, to clarify whether CT has harmful effect among	**Inclusion criteria** • all blunt trauma patients with hypotension (SBP <90 mmHg) on arrival at the emergency department (ED) during the study period **Exclusion criteria** • aged <16 years • patients who were transferred from other facilities • patients who suffered cardiac arrest (no heart rate; no respiratory rate; and no palpable pulse) or near-arrest (SBP ≤40 mmHg; based on the JTDB registration criteria that blood pressure cannot be measured at 40 mmHg SBP but a pulse is palpable) on arrival. • patients with missing data on items such as prognosis, CT information, and date of admission • patients with missing data of any covariate necessary for the multivariate analysis • patients treated in facilities that had small volumes of eligible patients (<10 patients) **Characteristics**	**Participants** N=5,809 data sets of blunt trauma patients **Study groups** IG: CT group, defined as CT of at least one body region; whole-body CT and those undergoing selective CT were all included; N=5,352 CG: no CT received; N=457	**Primary outcomes** <u>In-hospital death, n (%)</u> IG: 1,276 (23.8) CG: 207 (45.3) p<0.001 <u>Death within 24h, n (%)</u> IG: 655 (12.8) CG: 147 (34.9), p<0.001 <u>Number of excess deaths (per 100 patients) in-hospital mortality, n (95% CI)[§]</u> inverse probability of treatment weighted analysis: -20.6 (-26.2 to-14.9) instrumental variable analysis: -4.1 (-23.1 to 14.8) <u>Number of excess deaths (per 100 patients) 24h-mortality, n (95% CI)[§]</u> inverse probability of treatment weighted analysis: −20.9 (−26.4 to −15.5) instrumental variable analysis: −13.6 (−30.6 to 3.4) [§] age, gender, systolic blood pressure, heart rate and Glasgow Coma Scale, Injury Severity Score	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** „In summary, most unstable blunt trauma patients undergo CT as part of initial management in Japan. We did not find clinically meaningful harmful effect of CT on survival for unstable blunt trauma patients after adjusting both for measured and unmeasured confounders. Our results do not support the current guidelines, of which only a few recommend CT for unstable patients." **Reviewers' conclusion**

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these patients after adjusting both for measured and unmeasured confounders." **Setting** Japan, 2004–2014	<u>Age [y], mean (±SD)</u> IG: 56.2 (21.8) CG: 58.7 (20.6) p=0.013 <u>Male, n (%)</u> IG: 3,535 (66.1) CG: 278 (60.8) p=0.024 <u>Systolic Blood pressure on arrival [mmHg], mean (SD)</u> IG: 75.8 (10.0) CG: 73.6 (11.1) p<0.001 <u>Heart Rate [per min], mean (SD)</u> IG: 92.9 (27.7) CG: 99.2 (31.2) p<0.001 <u>GCS, mean (SD)</u> IG: 11.4 (4.3) CG: 10.9 (4.8) p=0.008 <u>ISS, mean (±SD)</u> IG: 26.2 (15.1) CG: 23.9 (16.8) p=0.002		and year of injury were included as covariate in both analyses	Results need to be interpreted with caution due to the retrospective design of the study. The authors integrated covariates and confounding factors in their analysis. The sampler sample size of the control (no CT group) was adjusted by calculating a pseudo-population of no-CT group with the same size as the intervention group.
+: low risk; –: high risk; ?: unclear risk; CI: Confidence Interval; IQR: Interquartile Range; OR: Odds Ratio; SD: Standard Deviation; PPV: Positive Predictive Value; NPV: Negative Predictive Value; AUC: Area under the curve; +LR: Positive Likelihood Ratio; -LR: Negative Likelihood Ratio; adj.: adjusted; d: days; m: months; y: years; min: minutes				

Prähospitales Sonographie

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Press (2014) "Prospective Evaluation of Prehospital Trauma Ultrasound During Aeromedical Transport". *The Journal of Emergency Medicine* 2014, Vol. 47, No. 6, pp. 638–645. **Study design** Diagnostic cross-sectional study **Aim of the study** "The goal was to assess prehospital provider accuracy in performing the abdominal, cardiac, and lung components of EFAST." **Setting** USA, 7-month-study	**Inclusion criteria** • adult trauma patients transferred directly from scene if time allowed after standard stabilization • age ≥18 years **Exclusion criteria** n.r. **Characteristics** Age [y], mean ± SD 41 ± 17 Male, n (%) 216 (74) ISS mean ± SD 16 ± 11 Trauma type, n (%) Blunt 252 (88.4) Penetrating 33 (11.6) Weight (kg), mean ± SD 82 ± 18 Scene systolic blood pressure (mm Hg), mean ± SD 130 ± 27 Scene heart rate (bpm), mean ± SD 94 ± 22	**Participants** Adult trauma patients from scene N=833 Patients with at least one HEMS ultrasound n=293 Number of lung HEMS ultrasound n=511 **Tests evaluated** Index text: In-flight ultrasound. HEMS providers were trained to perform EFAST during a 2-month period. HEMS providers performed EFAST using the following views: hepatorenal, splenorenal, suprapubic, cardiac (subcostal or parasternal long-axis), right lung, and left lung. All views were standard and in accordance with imaging described by the American College of Emergency Physicians and American Institute of Ultrasound in Medicine (19). Abdominal and cardiac examinations were performed to evaluate for intraperitoneal and pericardial fluid, respectively. Lung ultrasound was performed to evaluate for lung slide to exclude or diagnose pneumothorax. Abdominal views were saved as still images, and cardiac and lung views as 4-s video clips. Reference standard: ED diagnostics and management including CT, chest radiography and clinical examination.	**Primary outcomes** **Diagnostic accuracy for detection of pneumothorax** true positive, n=8 false positive, n=2 true negative, n=444 false negative, n=35 Sensitivity, % (95% CI) 18.7 (8.9–33.9) Specificity, % (95% CI) 99.5 (98.2–99.9), PPV, % (95% CI) 80 (44.2–96.5), NPV, % (95% CI) 92.7 (89.9–94.8) **Diagnostic accuracy for detection of pneumothorax that required intervention** true positive, n=9 false positive, N=1 true negative, n=469 false negative, n=0	**Level of evidence** 2b **Risk of bias (QUADAS)** Patient selection: + Index test: + Reference standard: + Flow and timing: + **Authors' conclusion** "Positive interpretations significantly raised the probability of injury, more reliably so for lung ultrasound. Negative interpretations were predictive, but low prevalence limited the value of these results. Sensitivity was not sufficient for ruling out injury. We believe further study is needed to elucidate accuracy as providers gain experience, and to explore clinical outcomes that may be affected by prehospital trauma ultrasound." **Reviewers' conclusion** HEMS providers were new to inflight ultrasound and received a training. The

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	Base deficit, mean ± SD 3.1 ± 4.5 Transport time to ED (min), mean ± SD 20.9 ± 8.7 ED GCS 12 + 3/–4		Sensitivity, % (95% CI) 50 (22.3–58.7) Specificity, % (95% CI) , n/N 99.8 (98.6–100), 469/470 PPV, % (95% CI) 90 (54.1–99.5) NPV, % (95% CI) 98.1 (96.3–99.1)	guidance from this training may have a high influence on current behaviour. Also all staff knew about the study which may have introduced a Hawthorne effect.
Quick (2016) "In-flight ultrasound identification of pneumothorax". *Emerg Radiol* (2016) 23:3–7. **Study design** Diagnostic cross-sectional study **Aim of the study** "Our study sought to demonstrate the accurate and timely detection of correctable thoracic pathology, specifically pneumothorax and improperly positioned endotracheal tubes by non-physician, prehospital flight crews trained in the use of thoracic ultrasound." **Setting**	**Inclusion criteria** • all adult trauma patients, • all intubated adult medical patients transported by one of University of Missouri's Staff for Life Helicopters **Exclusion criteria** n.r. **Characteristics** Age [y], mean (range) 44.4 (16-94) Male, n (%) 133 (69) ISS mean (range) 17.68 (1-75) Chest AIS mean (range) 2.93 (0-6) BMI mean (range)	**Participants** N=149 patients receiving in-flight ultrasound N=116 patients receiving CT scan **Tests evaluated** Index text: In-flight ultrasound. Twenty-six flight crew members were trained to perform and interpret thoracic ultrasound prior to the initiation of the study. Flight crews recorded their interpretations of radiographic findings using an evaluation form. Reference standard: CT scan. Routine clinical care was provided in accordance with ATLS methods to include the completion of an E-FAST by the trauma team. Further imaging was obtained as needed during patient evaluation. Computed tomography (CT) was considered the criterion standard and utilized to confirm either the presence or absence of pneumothorax and proper endotracheal tube placement. Patients that did not undergo CT evaluation had either	**Primary outcomes** **Diagnostic test performance for detecting pneumothorax** true positive, n=16 false positive, n=1 true negative, n=129 false negative, n=3 Accuracy, % (95% CI) 91 (0.85-0.95) Sensitivity, % (95% CI) 68 (0.46–0.85) Specificity, % (95% CI) 96% (CI 0.90–0.98) PPV, % (95% CI)* 94.1	**Level of evidence** 2b **Risk of bias (QUADAS)** Patient selection: + Index test: + Reference standard: + Flow and timing: ? **Authors' conclusion** "Ultrasonography should be utilized to augment the diagnostic capabilities of all prehospital aeromedical providers. Routine use of in-flight ultrasound is one step closer to getting the right care to the right patient at the earliest possible instance and could lead to better outcomes. A multicenter trial is warranted to

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USA, 15-month	28.2 (15–50)	clearly visible pneumothorax on chest X-ray or definitive clinical signs of a pneumothorax.	*calculated with true positive/ all positives NPV, % (95% CI)* 97.7 *calculated with true negatives/ all negatives	further confirm this benefit." **Reviewers' conclusion** Providers were new to in-flight ultrasound and received a training. The guidance from this training may have a high influence on current behaviour. It is unclear how many patients received only chest radiography as reference standard.
+: low risk; –: high risk; ?: unclear risk; CI: Confidence Interval; IQR: Interquartile Range; OR: Odds Ratio; RR: Relative Risk; SD: Standard Deviation; SEM: Standard Error of Mean; PPV: Positive Predictive Value; NPV: Negative Predictive Value; AUC: Area under the curve; +LR: Positive Likelihood Ratio; -LR: Negative Likelihood Ratio; adj.: adjusted; d: days; m: months; y: years; min: minutes				

Ganzkörper-CT

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Treskes (2020) "Refining the criteria for immediate total-body CT after severe trauma." *European Radiology*, 2020. 30(5): p. 2955-2963. **Study design** Secondary analysis of an RCT (Sierink 2016) (five trauma centers)	**Inclusion criteria** • Trauma patients with the presence of life-threatening vital problems, at least one of the following: respiratory rate ≥30 min or≤10/min; pulse ≥120/min; systolic blood pressure ≤100 mmHg; estimated exterior blood loss ≥500 ml; Glasgow Coma Score ≤13; Abnormal pupillary reaction onsite. • patients with one of the following clinically suspicious diagnoses: flail chest, open chest or multiple rib fractures;	**Participants** N=1,083 patients **Study groups/ original REACT-2 iTBCT criteria** Respiratory rate ≥30/min or ≤10/min: n=16 Pulse ≥120/min: n=69 Pulse ≥130/min†: n=49 Pulse ≥140/min†: n=26	**Primary outcomes** Selected adjusted REACT-2 iTBCT criteria N=10 **Prognostic performance of the adjusted criteria (overall performance)** Number needed to overscan†, n (95% CI) 5.6 (4.9–6.5)	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "This study presents a revised set of 10 clinically criteria for iTBCT with a high

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Aim of the study „The aim of the present analysis was to assess the discriminatory power of REACT-2 criteria for severely injured patients that could benefit from immediate total-body CT (iTBCT) during the primary assessment of trauma care. Furthermore, a revised set of criteria was derived and tested for discriminatory characteristics on detection of severe injury and shifts in radiation exposure compared to the original set of REACT-2 inclusion criteria." **Setting** The Netherlands and Switzerland, 2011 -2014	severe abdominal injury; pelvic fracture; unstable vertebral fractures/spinal cord compression; fractures from at least two long bones • patients with one of the following injury mechanisms: fall from height (>3 m/>10 ft); ejection from the vehicle; death occupant in same vehicle; severely injured patient in same vehicle; wedged or trapped chest/abdomen. **Exclusion criteria** • known age <18 years • known pregnancy • referred from another hospital • clearly low-energy trauma with blunt injury mechanism • penetrating injury in 1 body region (except gunshot wounds) as the clearly isolated injury • any patient who is judged to be too unstable to undergo a CT scan and requires (cardiopulmonary) resuscitation or immediate operation because death is imminent according to the trauma team leader in mutual agreement with the other leading care givers. **Characteristics** Age [y], median (IQR) 43 (27–59) Male sex, n (%) 824 (76.1) In hospital GCS, median (IQR):	Systolic blood pressure ≤100 mmHg: N=116 Systolic blood pressure <90 mmHg†: n=82 Systolic blood pressure <80 mmHg†: n=32 Estimated exterior blood loss ≥500 ml: n=43 GCS ≤13 or abnormal pupillary reaction: n=485 GCS ≤8†: n=437 GCS = 3†: n=394 Fractures from at least two long bones: n=90 Flail chest, open chest, or multiple rib fractures: n=114 Severe abdominal injury: n=65 Pelvic fracture: n=98 Unstable vertebral fractures/spinal cord compression: n=69 Fall from height (>3 m/>10 ft): n=319 Fall from height (>4 m/>13 ft)†: n=166 Fall from height (>5 m/>16 ft)†: n=126 Fall from height (>6 m/>20 ft)†: n=82 Fall from height (>7 m/>23 ft)†: n=60 Fall from height (>8 m/>26 ft)†: n=40 Ejection from a vehicle: n=30 Death of occupant in same vehicle: n=17 Severely injured patient in same vehicle: n=18	Decrease of unnecessary iTBCT-scans‡, % (95% CI): 6 (2–10) PPV, % (95% CI): 82 (80–85) Relative sensitivity*, % (95% CI): 91% (89–93) AUC ROC, (95% CI): 0.80 (0.77–0.83) **Performance of each selected criteria** Selected adjusted criteria, OR (95% CI): Systolic blood pressure ≤100 mmHg (n=116) 5.72 (2.22–14.75), p<0.001 Estimated exterior blood loss ≥500 ml (n=43) 3.70 (1.20–11.37), p=0.023 GCS ≤13 or abnormal pupillary reaction (n=485) 12.65 (8.23–19.45), p<0.001 Fractures from at least two long bones (n=90) 4.94 (2.41–10.15), p<0.001 Flail chest, open chest, or multiple rib fractures (n=114) 3.27 (1.85–5.76), p<0.001 Pelvic fracture (n=98) 1.82 (1.05–3.14), p=0.033 Unstable vertebral fractures/spinal cord compression (n=69) 1.87 (1.06–3.31), p=0.032 Fall from height (>4 m/>13 ft)* (n=166) 1.64 (1.07–2.52), p=0.022	predictive value for severe injury and therefore reduces radiation for the less severely injured patients for iTBCT. The criteria selected as predictors in this study should be prospectively validated in another cohort of patients for whom screening by iTBCT is considered after severe trauma." **Reviewers' conclusion** The study was a secondary analysis on prognostic factors of a well conducted RCT. There was a lack of information on patients who were not selected by the original REACT-2 criteria for eligibility of screening by iTBCT. This study could therefore only report the relative reduction of the sensitivity by the revised set compared to the original set of criteria.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	13 (3–15) Abbreviated Injury Scale ≥3, n (%) Head: 465 (42.9) Chest: 435 (40.2) Abdomen: 116 (10.7) Arms, legs, hand, and feet: 304 (28.1) ISS, median (IQR): 20 (9–29) Patients with polytrauma, n (%) 693 (64.0) Patients with traumatic brain injury, mean (SD): 329 (30.4)	Wedged or trapped chest/abdomen: n=60 **Note** By logistic regression analysis with backward selection on the 15 study inclusion criteria, a revised set of criteria was derived and subsequently tested for prediction of severe injury and shifts in radiation exposure. When clinically appropriate, the threshold values for vital parameters and trauma mechanism characteristics of specific criteria were retrospectively adjusted and included again in the regression analysis.	Wedged or trapped chest/abdomen (n=60) 2.57 (1.20–5.51), p=0.015 †Number of iTBCT scans to perform one unnecessary iTBCT for a non-severely injured patient ‡ Percentage decrease of iTBCT scans for non-severely injured patients *Relative sensitivity within the population preselected by the original criteria	
+: low risk; –: high risk; ?: unclear risk; CI: Confidence Interval;; IQR: Interquartile Range; OR: Odds Ratio; RR: Relative Risk; SD: Standard Deviation; SEM: Standard Error of Mean; PPV: Positive Predictive Value; NPV: Negative Predictive Value; AUC: Area under the curve; +LR: Positive Likelihood Ratio; -LR: Negative Likelihood Ratio; adj.: adjusted; d: days; m: months; y: years; min: minutes				

2.6 Endovaskuläre Therapie von Blutungen und Gefäßläsionen

Diagnostik pelviner Blutungen

Study: Reference, design, aim, databases, period	Selection criteria; included studies	N Sample; index vs. reference test	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Moon (2021) "Accuracy of Contrast Extravasation on Computed	**Inclusion criteria** • (1) study population included pelvic trauma patients	**Participants** N=13 studies n=2642 patients	**Pooled outcomes, diagnosis of severe pelvic hemorrhage** N=11 studies (12 subgroups)§	**Level of evidence** 2a

Study: Reference, design, aim, databases, period	Selection criteria; included studies	N Sample; index vs. reference test	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Tomography for Diagnosing Severe Pelvic Hemorrhage in Pelvic Trauma Patients: A Meta-Analysis". *Medicina* 2021; 57(1): 63. **Study design** Systematic review with meta-analysis (DTA studies) **Aim of the study** "to determine the diagnostic test accuracy of CT for detecting severe pelvic hemorrhage. In contrast to the recent meta-analysis [8] that showed high sensitivity and specificity in 64-detector row CT, we intended to investigate if 16 or higher detector row CT might have a sufficient diagnostic accuracy." **Databases; search period** PubMed, Embase, Cochrane databases; inception to Nov. 2020	• (2) contrast-enhanced CT as an index test; positive finding on CT defined as contrast extravasation • (3) as the reference standard, severe pelvic hemorrhage was defined as an identification of bleeding at angiography or by direct inspection using laparotomy that required hemostasis by angioembolization or surgery • (4) study purpose: to evaluate the diagnostic accuracy of CT in pelvic trauma patients • (5) adequate information provided to build a 2 x 2 table consisting of true positive (TP), false positive (FP), false negative (FN), and true negative (TN). **Exclusion criteria** • articles that studied another disease • nonoriginal articles • non-human study • pediatric study • non-English-language publications **Included studies** [10] Brasel et al. 2007 [11] Brown et al. 2005 [12] Brun et al. 2014 [13] Dormagen et al. 2010 [14] Hallinan et al. 2016 [15] Juern et al. 2017 [16] Kanezaki et al. 2016 [17] Kuo et al. 2016 [18] Lai et al. 2018 [19] Mohseni et al. 2011 [20] Pereira et al. 2000	**Index test** CT with contrast agent infusion; positive finding on CT defined as contrast extravasation (CE+) **Reference test** identification of bleeding at angiography or by direct inspection using laparotomy that required hemostasis by angioembolization or surgery **Meta-analysis** • random-effects model • heterogeneity measured by I^2 **Subgroup analysis** • according to the CT modality, by the number of detector rows	Sensitivity of CT, % (95% CI) 78.6 (57.4–90.9), I^2 = 90% Specificity of CT, % (95% CI) 94.4 (90.0–97.0), I^2 = 88% Diagnostic odds ratio (DOR) of CT (95% CI) 53.5 (14.7–194.7) **Subgroup analysis: 1–4 detector row group** N=4 studies (5 subgroups)§ Sensitivity of CT, % (95% CI) 48.7 (21.5–76.7), I^2 = 86% Specificity of CT, % (95% CI) 95.6 (87.6–98.5), I^2 = 81% DOR of CT (95% CI) 19.6 (1.9–200.9) **Subgroup analysis: 16–64 detector row group** N=5 studies Sensitivity of CT, % (95% CI) 91.5 (84.8–95.3), I^2 = 0% Specificity of CT, % (95% CI) 90.6 (82.8–95.1), I^2 = 72% DOR of CT (95% CI) 76.2 (29.3–198.3) **Clinical characteristics** *according to contrast extravasation (CE) on CT, obtained via random effects meta-analysis*	**Methodological quality (AMSTAR)** A-priori design: + Two reviewers: ? Literature search: + Status of publication: – List of studies: – Study characteristics: + Critical appraisal: + Conclusion: – Combining findings: + Publication bias: + Conflict of interest: – **Authors' conclusion** "Our meta-analysis demonstrated that modern multidetector CT, with 16 or more detector rows, has acceptable high sensitivity and specificity, whereas 1–4 detector row CT has limitations in diagnosis. We found that even the CT with 16 detector rows has sufficient accuracy compared to the previous meta-analysis [8]. Extravasation on CT indicates severe hemorrhage in pelvic fracture patients."

Study: Reference, design, aim, databases, period	Selection criteria; included studies	N Sample; index vs. reference test	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	[21] Ramin et al. 2018 [22] Stephen et al. 1999		Age [y], mean (95% CI) CE+ 49.3 (46.8, 51.8) CE– 19.2 (17.7, 20.7) ISS, mean (95% CI) CE+ 29.5 (24.2, 34.9) CE– 19.2 (17.7, 20.7) Mortality rate [%], mean (95% CI) CE+ 16.3 (12.5, 20.8) CE– 4.8 (2.9, 7.8) (age, ISS, and mortality significantly higher in the positive-extravasation group) § subgroups in [13]: anterior /posterior area	**Reviewer's conclusion** The study population was highly relevant to our guideline, i.e. adult pelvic trauma patients at risk of severe hemorrhage. Studies with high risk of bias were excluded from meta-analysis. However, all studies used a retrospective design. There was between-study heterogeneity regarding the duration from admission to the reference test, and further, unexplained heterogeneity in diagnostic outcomes. Therefore, the SR results should be interpreted with caution.
+: low risk; –: high risk; CE: contrast extravasation; CI: confidence interval; CT: Computed Tomography; DOR: diagnostic odds ratio; DTA: diagnostic test accuracy; SR: systematic review; adj.: adjusted; d: days; m: months; y: years				

Therapie der traumatischen Aortenruptur (thorakal)

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Alarhayem (2021) "Timing of Repair of Blunt Thoracic Aortic Injuries in the TEVAR era". *Journal of Vascular Surgery* 2021; 73(3):896-902.	**Inclusion criteria** • Age ≥16y • traumatic thoracic aortic injury • with blunt mechanism of injury **Exclusion criteria**	**Participants** N=2821 patients **Study groups**	**Adjusted outcomes** In-hospital mortality: OR (95% CI) IG vs. CG: 2.54 (1.66-3.91), p=0.001 **Unadjusted outcomes**	**Level of evidence** 2b **Risk of bias** Selection bias: –

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Study design Comparative registry study (ACS National Trauma Data Bank) **Aim of the study** "to examine the association between mortality and the time interval to TEVAR in patients with BTAI." **Setting** USA, 2012-2017	patients • managed non-operatively • that underwent open repair • dead on arrival • with prehospital/ED cardiac arrest • who expired prior to operative intervention • with incomplete data (including time to operative intervention) **Characteristics** Age [y], mean ± SD IG: 42.1 ± 20.2 vs. CG: 43.2 ± 20.1, p=0.209 Male, n (%) IG: 1601 (74.8) vs. CG: 539 (75.2), p=0.217 GCS ≤8, n (%) IG: 543 (26.2) vs. CG: 180 (26.2), p=0.992 ISS, mean ± SD IG: 32.8 ± 13.3 vs. CG: 30.4 ± 13.9, p<0.05 ED hypotension, n (%) IG: 297 (14.2) vs. CG: 97 (14.1), p=0.939	IG: time from aortic injury to TEVAR ≤24h (N=2118); mean time to repair 6.9 ± 5.6h CG: delayed TEVAR >24h from aortic injury (N=703); mean time to repair 106.0 ± 132.8h **Variables in logistic regression analysis** • age >65 years • GCS score <8 • SBP<90 mmHg at admission • ISS	In-hospital mortality: n/N (%) IG: 207/2118 (9.8) vs. CG: 31/703 (4.4), p<0.01 ICU LOS [d], mean ± SD IG: 10.8 ± 10.6 vs. CG: 12.5 ± 11.0, p<0.05 Hospital LOS [d], mean ± SD IG: 14.6 ± 16.0 vs. CG: 18.1 ± 16.6, p<0.05	Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Patients undergoing delayed repair have improved survival when compared to those repaired within the first 24 hours of injury, in spite of similar injury patterns and severity. In BTAI patients without signs of imminent rupture, delaying TEVAR beyond 24 hours after injury should be considered." **Reviewers' conclusion** The study results need to be interpreted with caution due to the retrospective study design and risk of selection bias. The groups were not balanced at baseline, but the mortality analysis was adjusted for important confounders. All other outcomes are unadjusted. (population overlaps with Elkbuli 2020 and Scalea 2019)
Calvo (2018)	**Inclusion criteria** • blunt-injured trauma patients	**Participants**	**Adjusted outcomes***	**Level of evidence**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"A population-based analysis of outcomes after repair of thoracic aortic emergencies in trauma". *J Surg Res* 2018; 231: 352-360. **Study design** Comparative registry study (California Office of Statewide Planning and Development (OSHPD) patient discharge database) **Aim of the study** "we evaluated TEVAR and open repair and their respective perioperative and long-term outcomes among trauma patients with thoracic aortic emergencies." **Setting** USA, 2007-2014	• with a thoracic aortic emergency **Exclusion criteria** • minor injuries • penetrating injuries • late effects of injury, foreign bodies, and burns • no valid record linkage numbers available **Characteristics** Age [y], mean ± SD IG: 47.1 ± 20.4 vs. CG: 52.5 ± 19.2, p=0.035 Male, % IG: 77.7 vs. CG: 70.0; p=0.158 Trauma mortality prediction model (TMPM) probability of death, median (IQR) IG: 42.5 (29.8-53.4) vs. CG: 3.5 (1.0-35.0), p<0.001	N=336 patients **Study groups** IG: thoracic endovascular repair, TEVAR (N=256) CG: open repair of the thoracic aorta (N=80) **Adjusting variables in logistic regression** First level: • operative timing • age • sex • log-transformed length of stay • log-transformed TMPM probability of death • Charlson score Second level: • hospital ID number. TEVAR was taken as reference.	In-hospital death, OR (95% CI) 0.93 (0.23-3.76), p=0.917 Any complication, OR (95% CI) 1.34 (0.62-2.90), p=0.460 Cardiac complication, OR (95% CI) 16.05 (2.30-112.09), p=0.005 Pulmonary complication, OR (95% CI) 1.08 (0.35-3.34), p=0.900 Renal complication, OR (95% CI) 1.71 (0.67-4.36), p=0.263 Deep vein thrombosis, OR (95% CI) 0.60 (0.10-3.48), p=0.570 Spinal cord complications incl. paralysis, OR (95% CI) 3.64 (1.09-12.14), p=0.035 Neurological complication, OR (95% CI) 2.54 (1.05-6.15), p=0.038 30 d readmission (survivors to discharge), OR (95% CI) 1.37 (0.44-4.28), p=0.591 * for open repair; TEVAR as reference **Unadjusted outcomes** In-hospital death, % IG: 7.8 vs. CG: 6.3, p=0.642 LOS [d], median (IQR) IG: 15 (8-28) vs. CG: 14 (8.5-22), p=0.468	2b **Risk of bias** Selection bias: – Performance bias; ? Attrition bias: + Detection bias: + **Authors' conclusion** "Although the mortality rate in trauma patients who underwent TEVAR was similar to that in those who received open repair, TEVAR was associated with fewer complications." **Reviewers' conclusion** The results should be interpreted with caution due to the high risk of selection and unclear risk of performance bias. The data are retrieved from an administrative database.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			30 d readmission (survivors to discharge), % IG: 12.6 vs. CG: 15.7, p=0.408 Cardiac complication, % IG: 0.8 vs. CG: 8.8, p<0.001 Pulmonary complication, % IG: 28.5 vs. CG: 30.0, p=0.798 Renal complications, % IG: 16.0 vs. CG: 31.3, p=0.003 Deep vein thrombosis, % IG: 5.1 vs. CG: 3.8, p=0.626 Spinal cord complications including paralysis, % IG: 3.5 vs. CG: 12.5, p=0.002 Neurological complications, % IG: 7.8 vs. CG: 21.3, p=0.001	
Elkbuli (2020) "Thoracic Endovascular Aortic Repair Versus Open Repair: Analysis of the National Trauma Data Bank". *Journal of Surgical Research* 2020; 245: 179-182. **Study design** Comparative registry study (ACS National Trauma Data Bank) **Aim of the study**	**Inclusion criteria** • all patients with blunt thoracic aortic injuries (BTAI) **Exclusion criteria** n.r. **Characteristics** Age [y], mean ± SD Open: 35.9 ± 21.1 TEVAR: 41.2 ± 23.9, NS Male, n (%) Open: 83 (80.6) TEVAR: 123 (71.1), NS	**Participants** N=275 patients **Study groups** Open: open repair (N=103) TEVAR: thoracic endovascular aortic repair (N=172)	**Adjusted outcomes** Injury-adjusted all-cause mortality, O/E ratio§ Open: 0.68 vs. TEVAR: 0.40, p<0.000008 **Unadjusted outcomes** All-cause mortality, n/N (%) Open: 26/103 (25.2) vs. TEVAR: 19/172 (11), p<0.05 Acute kidney injury, n/N (%) Open: 9/103 (8.7) vs. TEVAR: 8/172 (4.7), NS ICU LOS [d], mean ± SD Open: 10.05 ± 11.48 vs. TEVAR: 11.25 ± 10.04, NS	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "For patients sustaining BTAIs, TEVAR versus open repair was associated with

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"Our study aim was to compare clinical outcomes of TEVAR versus open repair in patient's sustaining BTAIs using the observed over expected mortality (O/E) ratio" **Setting** USA, 2016	ISS, mean ± SD Open: 35 ± 14 TEVAR: 36 ± 12, NS Revised trauma score (RTS), mean ± SD Open: 5.5 ± 2.6 TEVAR: 6.7 ± 1.7, NS		§ observed mortality divided by expected mortality; probability of survival calculated using Trauma Revised Injury Severity Score (TRISS) which accounts for age, mechanism of injury, revised trauma score (GCS, SBP, unassisted respiratory rate), and ISS	significantly less injury-adjusted all-cause mortality." **Reviewers' conclusion** The study results need to be interpreted with caution due to the retrospective study design and potential for performance bias. The groups were balanced at baseline regarding important confounders, and the mortality analysis was risk-adjusted. All other outcomes are unadjusted. (population overlaps with Alarhayem 2021)
Gombert (2017) "Treatment of blunt thoracic aortic injury in Germany-Assessment of the TraumaRegister DGU". *PLOS One* 2017; 12(3): e0171837. **Study design** Comparative registry study (TraumaRegister DGU®) **Aim of the study** "to evaluate the pattern of treatment" (different therapies of blunt thoracic aortic injury in Germany)	**Inclusion criteria** • Treated in a German trauma center level I • Primary admission from the scene of injury • Injury Severity Score (ISS) ≥16 points • Blunt thoracic aortic injury **Exclusion criteria** • inter- hospital transfers • early transfer out (<48h) **Characteristics (subgroup analysis open surgical vs. endovascular treatment)** Age [y], mean ± SD IG: 41.2 ± 18.5 vs. CG: 44.8 ± 19, p=0.15 Male, n (%)	**Participants** N=250 patients **Study groups** IG: endovascular treatment (N=157) CG: open surgical treatment (N=93) **Co-interventions** Blood transfusions, n (%) IG: 81 (45.5) vs. CG: 22 (53.7), p=0.221	In-hospital mortality, n (%) IG: 13 (7.3) vs. CG: 12 (29.3), p<0.001 24h mortality, n (%) IG: 3 (1.7) vs. CG: 11 (26.8), p<0.001 Acute renal failure, n (%) IG: 16 (9) vs. CG: 5 (15.6), p=0.197 Sepsis, n (%) IG: 24 (13.6) vs. CG: 6 (18.2), p=0.327 Multiorgan failure, n (%) IG: 79 (44.4) vs. CG: 17 (53.1), p=0.235 ICU stay [d] , mean ± SD IG: 18.2 ± 14.3 vs. CG: 11.93 ± 14.1, p=0.187 Hospital LOS [d] , mean ± SD	**Level of evidence** **3b↓Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusions** "all ICU-parameters showed reduced rates of complications in the endovascular subgroup, whereas no significant difference could be assessed while comparing open and endovascular treatment. Yet the

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"between the years 2002 till 2013." **Setting** Germany, 2002-2013	IG: 127 (80.9) vs. CG: 72 (77.4), p=0.50 Prehospital GCS <8, n (%) IG: 44 (29.3) vs. CG: 41 (47.1), p=0.006 ISS, mean ± SD IG: 34.1 ± 10.5 vs. CG: 31.17 ± 12, p=0.298		IG: 35.5 ± 26.7 vs. CG: 24.6 ± 28.8, p=0.178	mortality rates were significantly lower after endovascular treatment." **Reviewers' conclusions** The results should be interpreted with caution due to the risk of selection bias and unclear risk of performance bias. The analysis is unadjusted, and the groups differ with respect to important confounders.
Grigorian (2018) **"**National Trends of Thoracic Endovascular Aortic Repair Versus Open Repair in Blunt Thoracic Aortic Injury". *Ann Vasc Surg* 2018; 52: 72-78. **Study design** Comparative registry study (National Trauma Data Bank) **Aim of the study** "we hypothesized that the mortality risk in BTAI patients undergoing TEVAR would be lower than open repair." **Setting**	**Inclusion criteria** • patients aged ≥18 y • with blunt thoracic aortic injury (BTAI) **Exclusion criteria** n.r. **Characteristics** Age [y], mean ± SD IG: 42.5 ± 19 vs. CG: 39.3 ± 18, p<0.05 Male, n (%) IG: 2,383 (75.1) vs. CG: 312 (70.6), p<0.05 ISS, median (IQR) IG: 33.0 (15) vs. CG: 34.0 (14), p=0.07 Admission SBP<90 mmHg, n (%) IG: 384 (12.1) vs. CG: 59 (13.3), p=0.47	**Participants** N=3,671 patients **Study groups** IG: thoracic endovascular aortic repair, TEVAR (N=3,226) CG: open repair (N=445) **Variables in multivariable analysis** • age ≥65 • male gender • ISS ≥25 • traumatic brain injury • spine injury	**Adjusted outcomes** Mortality, OR (95% CI)§ IG: reference CG: 1.63 (1.19-2.23), p<0.05 § concomitant TEVAR/open repair (N=43) excluded **Unadjusted outcomes** Mortality, n/N (%) IG: 278/3,226 (8.8) vs. CG: 56/445 (12.8), p<0.05 LOS [d], mean ± SD IG: 19.8 ± 18 vs. CG: 21.3 ± 18, p<0.05 ICU LOS [d], mean ± SD IG: 12.2 ± 12 vs. CG: 14.4 ± 15, p<0.001 Paraplegia, n/N (%) IG: 4/3,226 (0.1) vs. CG: 0/445 (0.0), p=0.45 Acute kidney injury, n/N (%)	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: ? **Authors' conclusion** "In confirmation of previous reports, we found that endovascular repair is associated with decreased mortality, LOS, and major complications, including AKI." **Reviewers' conclusion** The results should be interpreted with caution due to the risk of selection and unclear risk of performance

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
USA, 2007-2015			IG: 178/3,226 (5.6) vs. CG: 40/445 (9.0), p<0.05 Acute respiratory distress syndrome, n/N (%) IG: 336/3,226 (10.6) vs. CG: 66/445 (14.8), p<0.05 Cerebrovascular accident, n/N (%) IG: 104/3,226 (3.3) vs. CG: 11/445 (2.5), p=0.37 Myocardial infarction, n/N (%) IG: 22/3,226 (0.7) vs. CG: 2/445 (0.4), p=0.56 Pulmonary embolism, n/N (%) IG: 122/3,226 (3.8) vs. CG: 10/445 (2.2), p=0.09 Pneumonia, n/N (%) IG: 646/3,226 (20.3) vs. CG: 105/445 (23.6), p=0.11	bias. Procedure-related complications (i.e. paraplegia) may be underreported in the NTDB.
Marcaccio (2018) "Delayed endovascular aortic repair is associated with reduced in-hospital mortality in patients with blunt thoracic aortic injury". *J Vasc Surg* 2018; 68(1): 64-73. **Study design** Comparative registry study (National Trauma Data Bank's National Sample Program) **Aim of the study** "to determine if delayed TEVAR is associated with a	**Inclusion criteria** • adult patients (age ≥18 years) • with blunt thoracic aortic injury (BTAI) • who underwent TEVAR **Exclusion criteria** • age <18 y • injury mechanism other than blunt trauma • missing data on TEVAR timing **Characteristics** *Analysis 1* Age, median (IQR) IG: 40 (27–56) vs. CG: 42 (26–58), p=0.14 Male, n (%)	**Participants** N=507 patients **Study groups** *Analysis 1* IG: early thoracic endovascular aortic repair (TEVAR) <24h (N=378) CG: delayed TEVAR ≥24h (N=129) *Analysis 2* TEVAR (N=534) OAR: open aortic repair (N=101) **Variables in multivariate logistic regression analysis** • age • ISS	**Analysis 1, adjusted** In-hospital mortality, OR (95% CI) IG: 2.39 (1.01–5.67), p=0.047 CG: reference **Analysis 1, unadjusted** In-hospital mortality, n/N (%); OR (95% CI) IG: 45/378 (11.9) vs. CG: 7/129 (5.4), n=0.04 IG 2.36 (1.03–5.36), p=0.042 Hospital LOS [d], median (IQR) IG: 15 (IQR 8-26) vs. CG: 20 (IQR 11-32), p<0.001 Acute kidney injury, n/N (%) IG: 26/378 (6.9) vs. CG: 10/129 (7.8), p=0.74 Acute respiratory distress syndrome, n/N (%) IG: 53/378 (14.0) vs. CG: 23/129 (17.8), p=0.30	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "we showed that BTAI patients undergoing early repair had lower rates of bleeding, decubitus ulcer, superficial surgical site infection, and pneumonia as well as fewer hospital, ICU,

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
decrease in mortality compared to early TEVAR in this population." **Setting** USA, 2009-2013	IG: 285 (75.4) vs. CG: 96 (74.4), p=0.82 SBP<90mmHg, n (%) IG: 49 (13.0) vs. CG: 19 (14.7), p=0.61 ISS, median (IQR) IG: 34 (26-41) vs. CG: 33 (IQR 26-41), p=0.63 *Analysis 2* Age, median (IQR) TEVAR: 40.5 (27-56) vs. OAR: 43 (28-59), p<0.001 Male, n (%) TEVAR: 400 (74.9) vs. OAR: 76 (75.2), p=0.57 SBP<90mmHg, n (%) TEVAR: 72 (13.5) vs. OAR: 21 (20.8), p<0.001 ISS, median (IQR) TEVAR: 34 (26-41) vs. OAR: 38 (29-48), p<0.001	• admission GCS motor score	Bleeding, n/N (%) IG: 3/378 (0.8) vs. CG: 6/129 (4.7), p=0.01 Cardiac arrest, n/N (%) IG: 25/378 (6.6) vs. CG: 4/129 (3.1), p=0.14 Cerebrovascular accident, n/N (%) IG: 13/378 (3.4) vs. CG: 7/129 (5.4), p=0.32 Decubitus ulcer, n/N (%) IG: 21/378 (5.6) vs. CG: 14/129 (10.9), p=0.04 Deep vein thrombosis, n/N (%) IG: 33/378 (8.7) vs. CG 9/129 (7.0), p=0.53 Graft failure, n/N (%) IG: 0/378 (0.0) vs. CG: 2/129 (1.6), p=0.06 Organ space surgical site infection, n/N (%) IG: 11/378 (2.9) vs. CG: 1/129 (0.8), p=0.31 Superficial surgical site infection, n/N (%) IG: 6/378 (1.6) vs. CG: 6/129 (4.7), p=0.05 Severe sepsis, n/N (%) IG: 11/378 (2.9) vs. CG: 1/129 (0.8), p=0.31 Pneumonia, n/N (%) IG: 74/378 (19.8) vs. CG: 40/129 (31.0), p=0.01 Pulmonary embolism, n/N (%) IG: 15/378 (4.0) vs. CG: 7/129 (5.4), p=0.48 Urinary tract infection, n/N (%) IG: 16/378 (4.2) vs. CG: 11/129 (8.5), p=0.06 Any complication, n/N (%)	and ventilator days. However, these patients still had a significantly higher odds of mortality compared to those undergoing delayed repair." **Reviewers' conclusion** The results need to be interpreted with care due to the retrospective nature of the study, risk of selection bias and unclear risk of performance bias.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			IG: 179/378 (47.4) vs. CG: 73/129 (56.6), p=0.07 Total complications, n per patient (IQR) IG: 0 (0-2) vs. CG: 1 (0-2), p=0.07 **Analysis 2** In-hospital mortality, n (%) TEVAR: 54 (10.1) vs. OAR: 26 (25.7), p<0.001 ICU LOS [d], median (IQR) TEVAR: 9 (4-18) vs. OAR: 12 (4-21), p<0.001 Hospital LOS [d], median (IQR) TEVAR: 17 (8-27) vs. OAR: 16 (3-27), p=0.001 Any complication, n (%) TEVAR: 387 (72.5) vs. OAR: 73 (72.3), p=0.01	
Scalea (2019) "Blunt Thoracic Aortic Injury: Endovascular Repair Is Now the Standard". *Journal of the American College of Surgeons* 2019; 228(4): 605-610. **Study design** Comparative registry study (ACS National Trauma Data Bank's National Sample Program) **Aim of the study**	**Inclusion criteria** • Patients aged ≥18y • who sustained a blunt thoracic aortic injury **Exclusion criteria** n.r. **Characteristics (overall cohort)** Age [y], median (IQR) 46.00 (29.25-62.00) Male, n (%) 2673 (70.8) ISS, median (IQR) 34.00 (26.00-45.00)	**Participants** N=3774 patients before matching; N after matching not reported **Study groups** NonOp: no operative management (N=2970) TEVAR: thoracic endovascular repair (N=639 before matching, N after matching not reported) OAR: open aortic repair (N=165 before matching, N after matching not reported) **Matching criteria (OAR vs. TEVAR)** • age • sex • presence of coma	Mortality after PS matching: % TEVAR: 8.1 vs. OAR: 16.2, p=0.05	**Level of evidence** 2b **Risk of bias** Selection bias: ? Performance bias: ? Attrition bias: + Detection bias: ? **Authors' conclusion** "TEVAR was associated with a 50% lower mortality than OAR." **Reviewers' conclusion** Mortality analysis was not the primary study aim.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"to use a national level, population-weighted dataset to characterize the temporal trends in TEVAR use and the mortality associated with it." **Setting** USA, 2003-2013	Coma (GCS <8), n (%) 1,498 (41.1) Hypotension, n (%) 1006 (27.5)	• ISS		Many study aspects are unclear, including the risk of selection and performance bias, the quality of matching, and the study power. Conclusions drawn from this study may be unreliable. (population overlaps with Alarhayem 2021)
Tagami (2015) "Thoracic aortic injury in Japan--nationwide retrospective cohort study". *Circulation Journal* 2015; 79(1): 55-60. **Study design** Comparative registry study (Diagnosis Procedure Combination inpatient database) **Aim of the study** "we investigated the current trends in patient background characteristics, in-hospital mortality, and selection of treatment options (endovascular repair, open repair, or no repair) among patients with traumatic thoracic aortic injury in Japan"	**Inclusion criteria** • thoracic aortic injury • aged ≥18 years **Exclusion criteria** • patients with readmission • planned admission for elective surgery • "suspected" thoracic aortic injury **Characteristics** Age [y], mean ± SD IG1: 56.5 ± 18.5 vs. IG2: 48.2 ± 22.4 vs. CG: 59.1 ± 20.5, p=0.005[$] Male, n (%) IG1: 85 (67.5) vs. IG2: 58 (76.3) vs. CG: 269 (64.8), p=0.20[$] Japan coma scale by strata p=0.46[$]	**Participants** N=617 patients **Study groups** IG1: endovascular repair (N=126) IG2: open repair (N=76) CG: non repair (N=415) **Co-interventions** There were significant differences in blood transfusion, albumin use, cardiopulmonary bypass, and extracorporeal membrane oxygenation between groups **Subgroup analysis by repair day** repair day defined as the interval from admission to treatment procedure (day 1, days 2-6, and day 7 onwards). N in each group not reported	**Unadjusted outcomes**[$] In-hospital mortality, n (%) IG1: 7 (5.6) vs. IG2: 12 (15.8) vs. CG: 188 (45.3), p=0.02 Death in emergency room, n (%) IG1: 0 (0) vs. IG2: 0 (0) vs. CG: 85 (20.5) Death within 24h, n (%) IG1: 2 (1.6) vs. IG2: 6 (7.9) vs. CG: 170 (41.0), p=0.06 Hospital LOS [d], median (quartile) IG1: 31 (39) vs. IG2: 35 (43) vs. CG: 4 (35), p=0.36 Cerebral infarction after admission, n (%) IG1: 3 (2.4) vs. IG2: 3 (3.9) vs. CG: 6 (1.4), p=0.67 **Subgroup analysis by repair day** Mortality (time unclear), % *day 1*: IG1: 8.1 vs. IG2: 25.6, p=0.02 *days 2-6*: IG1: 2.3 vs. IG2: 4.8, NS *≥day 7*: IG1: 4.8 vs. IG2: 6.3, NS	**Level of evidence** **3b↓Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "The results from the present Japanese nationwide database study of 234 hospitals suggested that the in-hospital survival rate of thoracic aortic injury was higher in the endovascular repair group than in the open repair group." **Reviewers' conclusion** The results should be interpreted with caution due to the high risk of selection

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Setting Japan, 2007-2013			$ all p-values are for the comparison open vs. endovascular repair	and unclear risk of performance bias.
Zambetti (2021) "Use of Thoracic Endovascular Aortic Repair in Patients with Concomitant Blunt Aortic and Traumatic Brain Injury". *J Am Coll Surg* 2021; 232(4): 416-423. **Study design** Comparative registry study (Trauma Quality Improvement Program) **Aim of the study** "to examine the impact of TBI and use of thoracic endovascular aortic repair on patients with blunt aortic injury." **Setting** USA, 2007-2016	**Inclusion criteria** • patients with blunt aortic injury (BAI) • with and without concomitant TBI **Exclusion criteria** • patients with penetrating injuries **Characteristics** Comparison NonOP vs. TEVAR Age [y], median (range) 45 (28-60) vs. 42 (25-58), p=0.0007 Male, n (%) 2772 (70.2) vs. 579 (72.2), p=0.2533 GCS, median (range) 3 (3-13) vs. 8 (3-15), p<0.0001 ISS, median (range) 43 (34-57) vs. 41 (33-50), p<0.0001 SBP [mmHg], median (range) 102 (0-131) vs. 119 (97-140), p<0.0001 Comparison early vs. late TEVAR Age [y], median (range) 42 (25-58) vs. 43 (25-57), p=0.7269 Male, n (%) 280 (75.5) vs. 256 (69.2), p=0.0559	**Participants** N=17,040 patients **Study groups** Comparison NonOP vs. TEVAR NonOP: BAI patients managed non-operatively (N=3949) TEVAR: BAI patients managed with thoracic endovascular aortic repair (TEVAR) (N=799) Comparison early vs. late TEVAR Early: <9h time to TEVAR (N=371) Late: ≥9h time to TEVAR (N=370) **Variables in multivariable logistic regression modelling** • age • ISS • admission heart rate • lower GCS	**NonOP vs. TEVAR, adjusted, patients with BAI and TBI** Mortality: OR (95% CI) TEVAR: 0.414 (0.319-0.537), p<0.0001 **NonOP vs. TEVAR, unadjusted, patients with BAI and TBI** Mortality, n/N (%) 829/3949 (21) vs. 79/799 (9.9), p<0.0001 Overall morbidity, n/N (%) 770/3949 (19.5) vs. 198/799 (24.8), p=0.0007 Acute renal failure, n/N (%) 130/3949 (3.3) vs. 63/799 (7.8), p<0.0001 ARDS, n/N (%) 272/3949 (6.9) vs. 103/799 (12.9), p<0.0001 MI, n/N (%) 18/3949 (0.46) vs. 6/799 (0.75), p=0.2834 Pulmonary embolism, n/N (%) 71/3949 (1.8) vs. 31/799 (3.9), p=0.0001 Cerebrovascular accident, n/N (%) 67/3949 (1.7) vs. 34/799 (4.3), p<0.0001 Cardiac arrest, n/N (%) 383/3949 (9.7) vs. 38/799 (4.8), p<0.0001 ICU LOS [d], median (range)	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Use of TEVAR was identified as the only modifiable predictor of reduced mortality in patients with concomitant blunt aortic injury and traumatic brain injury. In addition, delayed repair (after 9 hours) was also associated with reduced mortality." **Reviewers' conclusion** The study results need to be interpreted with caution due to the retrospective study design and risk of selection bias. The groups were not balanced at baseline, but the mortality analysis was adjusted for important confounders. All

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	GCS, median (range) 7 (3-14) vs. 9 (3-15), p=0.0761 ISS, median (range) 41 (34-50) vs. 38 (29-48), p=0.0007 SBP [mmHg], median (range) 117 (95-140) vs. 120 (100-142), p=0.0582		1 (0-10) vs. 12 (6-21), p<0.0001 Hospital LOS [d], median (range) 1 (1-16) vs. 20 (11-31), p<0.0001 **Early vs. late TEVAR, unadjusted** Mortality, n/N (%) 48/371 (12.9) vs. 24/370 (6.5), p=0.0030 Overall morbidity, n/N (%) 97/371 (26.2) vs. 89/370 (24.1), p=0.0007 Acute renal failure, n/N (%) 29/371 (7.8) vs. 27/370 (7.3), p<0.0001 ARDS, n/N (%) 50/371 (13.5) vs. 50/370 (13.5), p=0.9884 Myocardial infarction, n/N (%) 4/371 (1.1) vs. 1/370 (0.3), p=0.1792 Pulmonary embolism, n/N (%) 14/371 (3.8) vs. 16/370 (4.3), p=0.7037 Cerebrovascular accident, n/N (%) 18/371 (4.9) vs. 15/370 (4.1), p=0.5987 Cardiac arrest, n/N (%) 23/371 (6.2) vs. 14/370 (3.8), p=0.1312 ICU LOS [d], median (range) 1 (0-10) vs. 12 (6-21), p=0.0265 Hospital LOS [d], median (range) 18 (10-28) vs. 21 (12-33), p=0.0011	other outcomes are unadjusted. (possible overlap of population with NTDB studies)
+: low risk; –: high risk; ?: unclear risk; AAI: abdominal aortic injury; BTAI: Blunt thoracic aortic injury; CI: Confidence Interval; ED: emergency department, GCS: Glasgow coma scale, HR: Hazard Ratio; ICU: intensive care unit, IQR: Interquartile Range; ISS: injury severity score, ITT: Intention to Treat; LOS: length of stay, MFH: maxillofacial fractures with life-threating haemorrhage; NS: not significant;				

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
OAR: open aortic repair, OR: Odds Ratio; PS: propensity score; RR: Relative Risk; RTS: revised trauma score, SBP: systolic blood pressure, SD: Standard Deviation; SEM: Standard Error of Mean; TAE: Transcatheter arterial embolization; TEVAR: thoracic endovascular aortic aneurysm repair, TRISS: Trauma Revised Injury Severity Score; adj.: adjusted; d: days; m: months; y: years				

Therapie der traumatischen Aortenruptur (abdominell)

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Dayama (2017) „Open and Endovascular Abdominal Aortic Injury Repair Outcomes in Polytrauma Patients". *Ann Vasc Surg* 2017; 42: 156-161. **Study design** Comparative registry study (ACS National Trauma Data Bank) **Aim of the study** "to assess the incidence of AAI reported to the National Trauma Data Bank (NTDB). We also aim to evaluate the perioperative mortality in polytrauma patients receiving endovascular repair of AAI versus open repair of AAI. In addition, we sought to evaluate the factors affecting inpatient mortality."	**Inclusion criteria** • Patients with traumatic abdominal aortic injury (AAI) using ICD-9 codes • All patients registered between 2008 and 2012 **Exclusion criteria** • Patients without ICD-9 procedure codes corresponding to open or endovascular repair listed in the NTDB database **Characteristics** Age [y], mean ± SD IG: 31.67 ± 15.67 CG: 46.24 ± 21.70, p<0.001 Female gender, n (%) IG: 35 (15) CG: 28 (30.8), p=0.001 ISS, mean ± SD IG: 30.59 ± 11.87 CG: 31.56 ± 11.33, p=0.525 SBP at presentation [mmHg], mean ± SD IG: 84.44 ± 55.86 CG: 115.75 ± 38.69, p<0.001	**Participants** N=325 patients **Study groups** IG: Open repair of aortic injury (N=234) CG: Endovascular aortic repair (N=91) **Variables in multivariable logistic regression modeling** variables with a P value <0.20 in univariate analysis included in the multivariable models: • age • ISS • SBP at presentation • bowel injury • liver-pancreatic injury • renal-urinary tract injury • retroperitoneal injury, splenic injury, • nonspecified abdominal injury • acidosis	**Adjusted outcomes** In-hospital mortality, adjusted OR (95% CI) IG: 6.586 (3.25-13.33), p<0.001 CG: ref. **Unadjusted outcomes** In-hospital mortality, n/N (%) IG: 149/234 (63.7) vs. CG: 19/91 (20.9), p<0.001 Pulmonary embolism, n/N (%) IG: 2/234 (0.9%) vs. CG: 4/91 (4.4%), p=0.033 Acute respiratory distress syndrome, n/N (%) IG: 5/234 (2.1%) vs. CG: 6/91 (6.6%), p=0.046 Unplanned intubation, n/N (%) IG: 1/234 (0.4%) vs. CG: 3/91 (3.3%), p=0.035 Pneumonia, n/N (%) IG: 12/234 (5.1%) vs. CG: 16/91 (17.6%), p<0.001 Cardiac arrest CPR, n/N (%) IG: 39/234 (16.7%) vs. CG: 5/91 (5.5%), p=0.008	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "In this study, endovascular repair of AAI in polytrauma patients confers a statistically significant reduction of perioperative mortality; however, endovascular repair of these injuries continues to be a challenge." **Reviewers' conclusion** The study results need to be interpreted with caution due to the retrospective study design and risk of selection bias. The groups were not balanced at baseline, but the analysis was

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Setting USA, 2008-2012				adjusted for important confounders.
Kondo (2019) "Characteristics, treatments, and outcomes among patients with abdominal aortic injury in Japan: a nationwide cohort study". *World J Emerg Surg* 2019; 43(14): 1-6. **Study design** Comparative registry study (Japanese Diagnosis Procedure Combination database) **Aim of the study** "to investigate the characteristics, treatments, and clinical outcomes among patients with AAI using a Japanese nationwide database." **Setting** Japan, 2010-2017	**Inclusion criteria** • diagnosis of AAI • with emergency admission **Exclusion criteria** • age ≤18 y • died in the emergency room • underwent both open and endovascular repairs **Characteristics** Age by strata p=0.91 Male, n (%) IG1: 13 (48.1) vs. IG2: 10 (50.0) vs. CG: 127 (66.5), p=0.082 Modified ICD-10-based ISS, median (IQR) IG1: 5.9 (4.1–7.8) vs. IG2: 4.8 (3.5–6.2) vs. CG: 5.3 (4.1–7.1), p=0.60 Japan coma scale by strata p=0.58	**Participants** N=238 patients **Study groups** IG1: endovascular repair (N=27) IG2: open repair (N=20) CG: treated non-operatively (N=191) **Co-interventions** There were significant differences for ventilator usage, chest tube, defibrillator, noradrenalin, dobutamine, albumin, tranexamic acid between groups	24h mortality, n (%) IG1: 3 (11.1) vs. IG2: 3 (15.0) vs. CG: 36 (18.9), p=0.74 In-hospital mortality, n (%) IG1: 5 (18.5) vs. IG2: 7 (35.0) vs. CG: 50 (26.2), p=0.44 LOS [d], median (IQR) IG1: 40 (28–51) vs. IG2: 20.5 (4.3–52.8) vs. CG: 18 (3–43), p=0.033 Hospital-acquired pneumonia, n (%) IG1: 3 (11.1) vs. IG2: 2 (10.0) vs. CG: 12 (6.3), p=0.58 Thrombosis/phlebitis, n (%) IG1: 0 (0.0) vs. IG2: 0 (0.0) vs. CG: 4 (2.1), p=0.61	**Level of evidence** 3b↓ **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "The present nationwide cohort study showed no significant differences in in-hospital mortality and major complications among the non-repair, open repair, and endovascular repair groups" **Reviewers' conclusion** The study may be underpowered to detect clinically relevant differences. Important confounders may be different across groups and the results are unadjusted. Therefore, the results need to be interpreted with great care.
Sheehan (2020)	**Inclusion criteria**	**Participants**	**Unadjusted outcomes**	**Level of evidence**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"Predictors of blunt abdominal aortic injury in trauma patients and mortality analysis". *J Vasc Surg* 2020; 71(6): 1858-1866. **Study design** Comparative registry study (Trauma Quality Improvement Program (TQIP) database) **Aim of the study** "to identify the injury patterns and risk factors associated with BAAI, and their association with mortality" **Setting** USA, 2010-2016	• Patients with blunt trauma with and without BAAI **Exclusion criteria** • Age <18y **Characteristics (all patients with BAAI)** Age [y], mean ± SD 45.0 ± 30 Male, n (%) 728 (71.9) SBP ≤90 mm HG, n (%) 195 (20.8) ISS, median (IQR) 33.0 (25-41)	N=1012 with BAAI; N=96 with BAAI and aortic surgery (data extracted only for patients with BAAI and aortic surgery) **Study groups** IG: endovascular repair (N=67) CG: open aorta surgery (N=29)	In-hospital mortality, % IG 14.9 vs. CG: 24.1	2b **Risk of bias** Selection bias: ? Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** n.a. **Reviewers' conclusion** The comparison of interest is derived from a small study subgroup. Neither patient characteristics nor detailed results are reported. The results are unadjusted for risk factors and therefore need to be interpreted with great caution. (population potentially overlaps with the other US studies)

+: low risk; –: high risk; ?: unclear risk; AAI: abdominal aortic injury; BAAI: blunt abdominal aortic injury; BTAI: Blunt thoracic aortic injury; CI: Confidence Interval; CPR: cardio-pulmonary resuscitation; HR: Hazard Ratio; IQR: Interquartile Range; ISS: injury severity score; ITT: Intention to Treat; MFH: maxillofacial fractures with life-threating haemorrhage; NS: not significant; OR: Odds Ratio; PS: propensity score; RR: Relative Risk; SBP: systolic blood pressure; SD: Standard Deviation; SEM: Standard Error of Mean; TAE: Transcatheter arterial embolization; TEVAR: thoracic endovascular aortic aneurysm repair; adj.: adjusted; d: days; m: months; y: years

Endovaskuläre Therapie bei Gesichtsverletzungen / Verletzungen der Carotis

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Blitzer (2020) "Timing of intervention may influence outcomes in blunt injury to the carotid artery". *J Vasc Surg* 2019; 71(4); 1323-1332. **Study design** Comparative registry study (US National Trauma Data Bank) **Aim of the study** " to assess the epidemiologic characteristics of BCI and, after controlling for presenting features intrinsic to the data, evaluate outcomes based on management (operative vs nonoperative), operative approach (open vs endovascular), and timing to intervention (early [<24h] vs delayed [>24h])." **Setting** USA, 2002-2016	**Inclusion criteria** • adult patients (age ≥18 years) • injury to the common carotid artery and/or internal carotid artery • blunt mechanism of injury **Exclusion criteria** • death in the ED • transfer from the ED to another hospital or institution • discharge directly home from the ED **Characteristics (overall cohort)** Age [y], median (IQR) 38 (26-53) Male sex, n (%) 5777 (62.9) SBP [mmHg], median (IQR) 129 (110-148) Hypotension (SBP<90 mm Hg), n (%) 846 (9.4) ISS, median (IQR) 29 (20-38) GCS, median (IQR) 11 (3-15)	**Participants** N=9190 patients with blunt carotid artery injury (BCI) **Study groups** Comparison OPEN vs. ENDO OPEN: open repair only (N=288) ENDO: endovascular repair only (N=481 before and N=288 after matching) Comparison EARLY vs. DELAYED EARLY: endovascular repair <24h (N=198) DELAYED: endovascular repair >24h (N=274 before and N=198 after matching) **Matching criteria, OPEN vs. ENDO** • gender • SBP • pulse • ISS • ISS≥25 • severe head injury • severe chest injury • severe abdominal injury • severe lower extremities injury **Matching criteria, EARLY vs. DELAYED** • SBP • hypotension (SBP<90 mmHg) • shock index >0.9 • temperature • GCS • coma (GCS ≤8)	**Adjusted outcomes, OPEN vs. ENDO** Mortality, n/N (%) OPEN: 54/288 (18.8) ENDO: 29/288 (10.1), p<0.01 Acute kidney injury: n/N (%) OPEN: 3/288 (1.0) ENDO: 10/288 (3.5), n.s. ARDS: n/N (%) OPEN: 13/288 (4.5) ENDO: 22/288 (7.6), n.s. Pulmonary embolism: n/N (%) OPEN: 4/288 (1.4) ENDO: 6/288 (2.1), n.s. Sepsis: n/N (%) OPEN: 8/288 (2.8) ENDO: 12/288 (4.2), n.s. Stroke, n/N (%) OPEN: 31/288 (10.8) ENDO: 29/288 (10.1), n.s. **Adjusted outcomes, OPEN vs. ENDO, for patients alive at the time of discharge** Hospital LOS, median (IQR) OPEN (N=234): 16 (6.75-30.00) ENDO (N=259): 17 (10-31), p<0.05 ICU LOS, median (IQR) OPEN (N=234): 9 (4-19) ENDO (N=259): 11 (4-20), n.s.	**Level of evidence** 2b **Risk of bias** Selection bias: ? Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "after critically assessing the timing to intervention, results strongly suggested that, if possible, intervention should be delayed for at least 24 hours." **Reviewers' conclusion** Propensity score matching included a limited number of variables, and baseline characteristics post matching were not provided. Therefore, it is unclear whether the groups were balanced with respect to important risk factors, and the results of the study need to be interpreted with caution.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
		• ISS • ISS≥25 • severe chest injury • severe abdominal injury • severe spinal injury	**Adjusted outcomes, EARLY vs. DELAYED** Mortality: n/N (%) EARLY: 38/198 (19.2) DELAYED: 5/198 (2.5), p<0.001 Acute kidney injury: n/N (%) EARLY: 11/198 (5.6) DELAYED: 3/198 (1.5), n.s. ARDS: n/N (%) EARLY: 17/198 (8.6) DELAYED: 21/198 (10.6), n.s. Pulmonary embolism: n/N (%) EARLY: 4/198 (2.0) DELAYED: 6/198 (3.0), n.s. Sepsis: n/N (%) EARLY: 10/198 (5.1) DELAYED: 12/198 (6.1), n.s. Stroke: n/N (%) EARLY: 24/198 (12.1) DELAYED: 25/198 (12.6), n.s. Surgical site infection: n/N (%) EARLY: 5/198 (2.5) DELAYED: 8/198 (4.0), n.s. **Adjusted outcomes, EARLY vs. DELAYED, for patients alive at the time of discharge** Hospital LOS, median (IQR) EARLY (N=160): 18 (11-32) DELAYED (N=193): 21 (14-34), p<0.05 ICU LOS, median (IQR)	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			EARLY (N=160): 13 (6-21) DELAYED (N=193): 14 (7-25), n.s.	
Matsumoto (2018) "Transcatheter Arterial Embolization in the Treatment of Maxillofacial Fractures With Life-Threatening Hemorrhage". *Ann Plast Surg* 2018; 80(6): 664-668. **Study design** Comparative registry study (Japan Trauma Data Bank) **Aim of the study** "[to evaluate] the effectiveness of TAE for MFH, based on data obtained from the Japan Trauma Data Bank." **Setting** Japan, 2004-2014	**Inclusion criteria** • AIS code 250810.4: Maxilla fracture, Le Fort III, Blood loss >20% **Exclusion criteria** • Age <16 • Declared dead on arrival to the ED • AIS score of 6 for any region of the body • unknown hospital discharge disposition • penetrating injuries **Characteristics** Age [y], median (IQR) IG: 46 (32-57) vs. CG: 42 (27-69), p=0.222 Male, n (%) IG: 16 (61.5) vs. CG: 69 (75.0), p=0.177 SBP [mmHg], median (IQR) IG: 105 (90-124) vs. CG: 106 (69-127), p=0.516 GCS score, median (IQR) IG: 7 (4-10) vs. CG: 11 (6-13), p=0.019 ISS by strata p=0.350	**Participants** N=118 patients **Study groups** IG: with transcatheter arterial embolization (TAE) (N=26) CG: without TAE (N=92) The use of TAE was determined using the queries "the urgent angiography of head" or "the urgent angiography of neck" in the examination field, as the JTDB data set does not contain a specific procedure code for TAE of the face. **Adjusting variables in multivariate regression** • patient demographics (age, gender) • Hypotension (SBP<90 mm Hg) • Low GCS score (≤8) • High ISS (≥40) • Head AIS ≥3 • Spine AIS ≥3 • TAE	**Adjusted outcomes** In-hospital mortality, adjusted OR (95% CI) 0.32 (0.66-0.88), p=0.032 **Unadjusted outcomes** In-hospital mortality, n/N (%); adjusted OR (95% CI) IG: 6/26 (23.1) vs. CG: 41/92 (44.6), p=0.048 0.37 (0.14-1.02), p=0.054 Length of stay [d], median (IQR) IG: 40 (7-54) vs. CG: 14 (0-55), p=0.072	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Although MFH is still associated with high mortality, using TAE may encourage a higher proportion of successful outcomes." **Reviewers' conclusion** The study results need to be interpreted with caution due to the retrospective study design and risk of selection bias. The groups were not balanced at baseline, but the analysis was adjusted for some important confounders. Note that patients in the intervention group tended to be more severely injured.
+: low risk; –: high risk; ?: unclear risk; AAI: abdominal aortic injury; ARDS: acute respiratory distress syndrome; BTAI: Blunt thoracic aortic injury; CI: Confidence Interval; ED: emergency department; HR: Hazard Ratio; IQR: Interquartile Range; ISS: injury severity score; ITT: Intention to Treat; MFH: maxillofacial fractures with life-threating haemorrhage; NS: not significant; OR: Odds Ratio; PS:				

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
propensity score; RR: Relative Risk; SBP: systolic blood pressure; SD: Standard Deviation; SEM: Standard Error of Mean; TAE: Transcatheter arterial embolization; TEVAR: thoracic endovascular aortic aneurysm repair; adj.: adjusted; d: days; m: months; y: years				

Embolisationstherapie im Abdomen (parenchymatöse Organe)

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Arvieux (2020) "Effect of Prophylactic Embolization on Patients With Blunt Trauma at High Risk of Splenectomy A Randomized Clinical Trial". *JAMA Surgery* 2020; 155(12): 1102-1111. **Study design** Randomised controlled trial **Aim of the study** "To determine whether the 1-month spleen salvage rate is better after prophylactic splenic arterial embolization (pSAE) or surveillance and then embolization only if necessary (SURV)." **Setting** France, 2014-2017	**Inclusion criteria** • adults (≥18 years) • hemodynamically stabilized patients • with blunt splenic trauma • that had occurred ≤48h • spleen damage with high risk of splenectomy assessed by injected abdominal CT • either OIS grade 3 splenic trauma with a large pelvic hemoperitoneum (defined as large if there was perisplenic effusion associated with pelvic effusion) and/or serious damage with a New Injury Severity Score of 15 or more; OIS grade 4 splenic trauma; or OIS grade 5 splenic trauma with persisting vascularization of the spleen **Exclusion criteria** • unstable patients • patients with OIS grade 5 shattered spleen • patients who were stable but immediately needed embolization of the spleen or another organ (ie, an active leak and/or SPA or SAVF detected on the initial CT scan) • No health insurance coverage	**Participants** N=140 patients randomised, N=133 analysed **Study groups** IG: prophylactic splenic arterial embolization (N=71 randomised, N=66 analysed) CG: surveillance and then embolization only if necessary (N=69 randomised, N=67 analysed) For pSAE, an arterial approach via the femoral artery was preferred, or, for patients with unfavorable anatomy, a humeral approach via the celiac trunk, using a maximum 6F catheter, was preferred. The choice of catheterization equipment was at the discretion of the operator. Rigid coils of 0.089 cm (0.035 in) were preferred to reduce the risk of emboli migration. The use of microcoils was discouraged, and the use of glue, gelatin fragments, or microparticles was prohibited. Proximal or combined proximal and distal splenic artery embolization was required.	**Primary outcome** <u>Patients with ≥50 % viable spleen (by CT) at month 1: n/N (%)</u> IG: 56/57 (98.2) vs. CG: 56/60 (93.3) % difference (95% CI): 4.9 (−2.4 to 12.1); p=0.37 **Secondary outcomes** <u>Mortality</u> IG: 0/66 (0) vs. CG: 1/67 (1.5) <u>Overall complications, day 5, n/N (%)</u>§ IG: 19/65 (29.2) vs CG: 27/65 (41.5) % difference (95% CI): −12.3 (−28.3 to 4.4); p=0.14 <u>Overall complications, day 5 to month 1, n/N (%)</u> IG: 11/59 (18.6) vs CG: 12/63 (19.0) % difference (95% CI): −0.4 (−14.4 to 13.6); p=0.96 <u>Complications at month 6 visit, n/N (%)</u> IG: 2/50 (4.0) vs. CG: 5/47 (10.6), p=0.26 <u>Need for splenic embolization, day 5, n/N (%)</u> IG: 1/65 (1.5) vs. CG: 19/65 (29.2) % diff. (95% CI): −27.7 (−41.0 to −15.9), p<0.001 <u>Need for splenic embolization, day 5 to month 1, n/N (%)</u>	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion** "For hemodynamically stable patients with splenic trauma at high risk of rupture, there was no significant difference in the rates of splenic rescue and complications or in their effects on activities between immediate pSAE and SURV with SAE performed only if necessary." **Reviewers' conclusion** There is a risk of performance bias, as patients and clinicians were not blinded.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	• AIDS **Characteristics** Age [y], median (IQR) IG: 30 (22-42) vs. CG: 30 (23-48) Male, n (%) IG: 55 (83.3) vs. CG: 50 (74.6) NISS, median (IQR) IG: 19 (12-25) vs. CG: 20 (13-29)		IG: 1/59 (1.7) vs. CG: 3/63 (4.8), p=0.62 Length of hospitalization, days, median (IQR) IG: 9 (6-14) vs. CG: 13 (9-17), p=0.002 Activity Score (WOMAC) at month 1, median (IQR) IG: 4 (0-13) vs CG: 4 (0-26), p=0.51 Activity Score (WOMAC) at month 6, median (IQR) IG: 0 (0-7) vs. CG: 0 (0-6.5), p=0.63 Return to work or studies at month 1, n/N (%) IG: 6/43 (14) vs. CG. 5/45 (11.1) % difference (95% CI): 2.9 (–11.2 to 16.8); p=0.69 Return to work or studies at month 6, n/N (%) IG: 27/36 (75.0) vs 22/36 (61.1) % difference (95% CI): 13.9 (–8.2 to 36.2); p=0.21 § for results of individual complications, see the publication	The results apply to hemodynamically stable patients. The study may have been underpowered to detect clinically significant differences in short-term complication rates.
Chehab (2020) "Angioembolization in intra-abdominal solid organ injury: Does delay in angioembolization affect outcomes?" *J Trauma Acute Care Surg.* 2020; 89(4): 723-729. **Study design** Comparative registry study (ACS-TQIP database)	**Inclusion criteria** • adult (≥18 years) trauma patients • blunt intra-abdominal solid organ (liver, spleen, kidney) injury • underwent angioembolization (AE) ≤4h after admission **Exclusion criteria** • patients • who underwent any operative intervention before AE • presenting with burns • transferred from another hospital • declared dead on arrival	**Participants** N=924 patients **Study groups** patients stratified into four groups: AE ≤1h: angioembolization up to 1 hour from admission to AE (N=76) AE 1-2h: angioembolization 1 to 2 hours from admission to AE (N=224) AE 2-3h: angioembolization 2 to 3 hours from admission to AE (N=350)	**Adjusted outcomes** 24h mortality, adjusted OR (95% CI) AE ≤1h: reference AE 1-2h: 1.41 (1.22–2.42), p=0.013 AE 2-3h: 1.69 (1.48–3.13), p=0.021 AE 3-4h: 3.72 (1.51–5.11), p=0.018 **Unadjusted outcomes** 24h mortality, n/N (%) AE ≤1h: 2/76 (2.6) AE 1-2h: 8/224 (3.6) AE 2-3h: 14/350 (4.0) AE 3-4h: 24/274 (8.8), p=0.016	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Delayed AE for hemorrhage control in blunt trauma patients with intra-

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Aim of the study "The aim of our study was to evaluate the impact of the length of time from admission to AE on outcomes of patients with blunt intra-abdominal solid organ injury." **Setting** USA, 2013-2016	**Characteristics** Age [y], mean ± SD AE ≤1h: 44 ± 16 AE 1-2h: 45 ± 19 AE 2-3h: 45 ± 19 AE 3-4h: 46 ± 19, p=0.203 Male, n (%) AE ≤1h: 50 (65.7) AE 1-2h: 140 (62.5) AE 2-3h: 235 (67.1) AE 3-4h: 183 (66.8), p=0.363 ISS, median (IQR) AE ≤1h: 36 (29–43) AE 1-2h: 26 (19–38) AE 2-3h: 29 (22–38) AE 3-4h: 29 (23–41), p<0.001 ED shock index, mean ± SD AE ≤1h: 1.15 ± 0.44 AE 1-2h: 0.99 ± 0.33 AE 2-3h: 1.04 ± 0.38 AE 3-4h: 1.09 ± 0.44, p=0.004 ED GCS, median (IQR) AE ≤1h: 14 (5–15) AE 1-2h: 15 (13–15) AE 2-3h: 15 (11–15) AE 3-4h: 15 (12–15), p=0.004	AE 3-4h: angioembolization 3 to 4 hours from admission to AE (N=274) Time to AE is defined in the TQIP database as the time the first AE was done, and the procedure start time is the time of needle insertion in the groin. **Adjusting variables in multivariate regression** hierarchical mixed-effects logistic regression model with a random hospital effect • patient demographics (age, gender) • ED vitals (SBP, GCS) • injury severity (ISS) • injury characteristics (liver, spleen, kidney) • ACS trauma center verification level (level 1, level 2) • intracluster effect (117 hospitals)	In-hospital mortality, n/N (%) AE ≤1h: 9/76 (11.8) AE 1-2h: 30/224 (13.4) AE 2-3h: 55/350 (15.7) AE 3-4h: 48/274 (17.5), p=0.493	abdominal solid organ injury is associated with increased mortality and no difference in blood product transfusion requirements." **Reviewers' conclusion** The study results need to be interpreted with caution due to the retrospective study design and risk of selection bias. The groups were not balanced at baseline, but the analysis was carefully adjusted for important confounders.
+: low risk; –: high risk; ?: unclear risk; AE: angioembolisation; CI: Confidence Interval; ED: emergency department; GCS: Glasgow coma scale; HR: Hazard Ratio; IQR: Interquartile Range; ISS: injury severity score; ITT: Intention to Treat; OR: Odds Ratio; RR: Relative Risk; SBP: systolic blood pressure; SD: Standard Deviation; SEM: Standard Error of Mean; adj.: adjusted; d: days; m: months; y: years				

REBOA

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Abe (2016) "Resuscitative endovascular balloon occlusion of the aorta versus aortic cross clamping among patients with critical trauma: a nationwide cohort study in Japan". *Critical Care* 2016; 20(1): 400. **Study design** Comparative registry study (Japan Trauma Data Bank) **Aim of the study** "to analyze the present situation of REBOA and ACC usage with nationwide trauma registry data and to then evaluate as to whether or not REBOA should be deemed a preferential alternative to resuscitative ACC." **Setting** Japan, 2004-2013	**Inclusion criteria** • presence of critical trauma • reception of either REBOA or ACC **Exclusion criteria** • patients who had received both REBOA and ACC • subjects ≤14 years old • those with age data missing • Patients with cardiopulmonary arrest on arrival at the ED (systolic blood pressure of 0 mmHg or data missing on arrival) or SBP data missing • or with an AIS score of 6 (i.e., non-survivable injury) for any region **Characteristics after matching** Age [y], mean, ± SD IG: 52.8 ± 21.0 vs. CG: 54.8 ± 22.1, p=0.421 Male, n (%) IG: 111 (73) vs. CG: 101 (66), p=0.261 SBP at ED [mmHg], median (interquartile) IG: 77.5 (64) vs. CG: 73.5 (64), p=0.421 GCS at ED, median (interquartile) IG: 8 (10) vs. CG: 8 (10), p=0.909 RTS, mean ± SD IG: 4.8 ± 2.0 vs. CG: 4.7 ± 2.1, p=0.631 ISS, mean ± SD	**Participants** N=903 patients before matching, N=304 after matching **Study groups** IG: resuscitative endovascular balloon occlusion of the aorta (REBOA) (N=636 before matching, n=152 after matching) REBOA access is typically accomplished through a common femoral artery and the balloon insertion follows a blind approach CG: open aortic cross-clamping (ACC) (N=267 before matching, N=152 after matching) **Matching criteria** • age • gender • mechanism of injury • cause of injury • transport type • pre-hospital treatment • vital signs at ED • ISS	In-hospital mortality, n/N (%); OR (95% CI) IG: 106/146 (73) vs. CG: 122/134 (91) OR 0.261 (0.130-0.523) Mortality in ED, n/N (%); OR (95% CI) IG: 24/149 (16) vs. CG: 77/150 (51) 0.182 (0.106-0.313)	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Despite any residual indication bias, REBOA might be a favorable alternative method to ACC, especially for severe trauma below the diaphragm." **Reviewers' conclusion** The results should be interpreted with caution due to the retrospective nature of the study and unclear risk of performance bias. A substantial number of patients were excluded during matching.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG: 34 (23) vs. CG: 36 (20), p=0.341 TRISS, mean ± SD IG: 0.45 ± 0.35 vs. CG: 0.39 ± 0.31, p=0.115			
Aso (2017) "Resuscitative endovascular balloon occlusion of the aorta or resuscitative thoracotomy with aortic clamping for noncompressible torso hemorrhage: A retrospective nationwide study". *J Trauma Acute Care Surg* 2017; 82(5): 910-914. **Study design** Comparative registry study (Japanese Diagnosis Procedure Combination database) **Aim of the study** "The aim of the present study was to compare early mortality between REBOA and RT in trauma patients with uncontrolled hemorrhagic shock, using data from a national inpatient database in Japan." **Setting**	**Inclusion criteria** • patients aged ≥15 y • received REBOA or RT • within 1 day after admission **Exclusion criteria** • penetrating thoracic injury, such as cardiovascular injury • hemothorax **Characteristics before matching** Age by strata p=0.8046 Male, n (%) IG: 114 (59.7) vs. CG: 44 (64.7), p=0.4661 Japan coma scale by strata p=0.0178	**Participants** N=259 patients **Study groups** IG: Resuscitative endovascular balloon occlusion of the aorta, REBOA (N=191 before matching) CG: resuscitative thoracotomy with aortic clamping, RT (N=68 before matching) **Matching criteria** • age • sex • BMI • etiology • Japan Coma Scale (JCS) • presence of head injury • presence of cardiopulmonary arrest on admission • TMPM-ICD9 annual number of patients receiving RT at each hospital	**Propensity score-adjusted outcomes** In-hospital mortality, Cox HR (95% CI) IG vs. CG: 0.94 (0.60–1.48); p=0.7917 ICU-free days, % difference (95% CI) IG vs. CG: −0.9% (−24.8 to 30.4); p=0.9465 **Outcomes before matching** In-hospital mortality, n/N (%) IG: 90/191 (47.1) vs. CG: 48/68 (70.6), p=0.0009 ICU-free days, n (%) 0: IG: 142 (74.3) vs. CG: 58 (85.3) 1–4: IG 14 (7.3) vs. CG: 5 (7.4) 5–8: IG 16 (8.4) vs. CG: 2 (2.9) 9–13: IG: 19 (9.9) vs. CG: 3 (4.4), p=0.1935	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "REBOA was not associated with improved mortality compared with RT." **Reviewers' conclusion** The results should be interpreted with caution due to the risk of selection bias and unclear risk of performance bias. Baseline characteristics after matching were not reported.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Japan, 2010-2014				
Brenner (2018) "Resuscitative Endovascular Balloon Occlusion of the Aorta and Resuscitative Thoracotomy in Select Patients with Hemorrhagic Shock: Early Results from the American Association for the Surgery of Trauma's Aortic Occlusion in Resuscitation for Trauma and Acute Care Surgery Registry". *J Am Coll Surg* 2018; 226(5): 730-740. **Study design** Comparative registry study (AAST AORTA registry) **Aim of the study** "The purpose of this study was to investigate the use of REBOA and RT as a means of AO in a more selective group of patients." **Setting** USA, 2013-2017	**Inclusion criteria** • Adults ≥18 y • with trauma and acute care surgery • undergoing AO in the acute phases after injury • AO in zone 1 (distal thoracic aorta) in the ED **Exclusion criteria** • REBOA in the operating room • penetrating thoracic injuries • incomplete outcomes or survival data **Characteristics** Age [y], mean ± SD IG: 44.6 ± 20.2 vs. CG: 37.8 ± 15.7, p=0.008 Male, n (%) IG: 65 (78.3) vs. CG: 168 (83.2), p=0.335 ISS, mean ± SD IG: 35.1 ± 16.5 vs. CG: 34.7 ± 20.0, p=0.908 Admission GCS, median (IQR) IG: 3 (0) vs. CG: 3 (3), p=0.118 SBP at AO initiation [mmHg], median (IQR) IG: 0 (55) vs. CG: 0 (0), p<0.001	**Participants** N=285 patients **Study groups** IG: resuscitative endovascular balloon occlusion of the aorta, REBOA (N=83) Most REBOA procedures were performed with the Coda balloon catheter (Cook Medical) (59%), with the ER-REBOA (Prytime Medical Inc) used in 26.5% after FDA approval of this device in the latter portion of the study period. The right CFA was most frequently accessed (75%) for REBOA. Open surgical common femoral artery exposure was required in 53% of patients, and percutaneous methods were used for the remainder, including using external landmarks (28%) and ultrasound-guided (14.5%), CG: resuscitative thoracotomy, RT (N=202) allocation according to standard protocol at the admitting institution. **Co-interventions** There were significant differences between groups with regard to adjunctive procedures required, including pelvic binders/packing, exploratory laparotomy, splenectomy, craniectomy/craniotomy, and pelvis embolization.	Survival beyond ED, n/N (%) IG: 52/83 (62.7) vs. CG: 89/202 (44.1), p=0.004 Survival to discharge, n/N (%) IG: 8/83 (9.6) vs. CG: 5/202 (2.5), p=0.023 ICU LOS [d], median (IQR) IG: 0 (1) vs. CG: 0 (1), p=0.170 Hospital LOS [d], median (IQR) IG: 1.0 (2) vs. CG: 1.0 (0), p=0.075 Discharge GCS among survivors, median (IQR) IG: 3.0 (0) vs. CG: 3.0 (0), p=0.039 Complication rates for those who survived 24 h, % IG: 10 vs. CG: 1.5	**Level of evidence** 3b↓ **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Our findings demonstrate a potential overall survival benefit for patients without penetrating thoracic injury who receive zone 1 REBOA compared with RT, particularly in those patients who do not require CPR before AO." **Reviewers' conclusion** The results should be interpreted with caution due to the high risk of selection bias and the unclear risk of performance bias. Furthermore, the majority of REBOA participants was treated in two institutions having implemented policies to replace RT with REBOA. In contrast, the majority of RT participants were treated in institutions

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
				not having implemented REBOA (yet).
Bukur (2021) "Temporal Changes in REBOA Utilization Practices are Associated With Increased Survival: an Analysis of the AORTA Registry". *Shock* 2021; 55(1): 24-32. **Study design** Comparative registry study (AAST AORTA registry) **Aim of the study** "Our primary objective was to determine if REBOA survival has improved with time since the inception of the AORTA registry. Secondary objectives were to examine changes in patient selection, types of device utilization, operator patterns, and approach-specific complication rates." **Setting** USA, 2014-2018	**Inclusion criteria** • adult trauma and acute care surgery patients (age 18 or older) • undergoing AO in the acute phases after injury **Exclusion criteria** n.r. **Characteristics** Age [y], mean ± SD IG: 42.6 ± 17.7 vs. CG: 36.7 ± 15.6, p=0.001 Male, % IG: 76.6 vs. CG: 83.7, p=0.001 ISS, median (IQR) IG: 34 (24-43) vs. CG: 33 (25-58), p=0.442 Admission SBP [mmHg], mean ± SD IG: 81.6 ± 48.5 vs. CG: 37 ± 53.2, p=0.001 Admission GCS, median (IQR) IG: 3 (3-13) vs. CG: 3 (3-3), p=0.001	**Participants** N=1458 patients **Study groups** IG: REBOA (N=568) CG: OPEN (N=887) **Co-interventions** There were significant differences in the following adjunctive procedures between groups: pelvic binder, exploratory laparotomy, hepatic packing, pelvic packing, splenectomy, hepatic resection, bowel resection, pelvic ex-fix, embolization of pelvis, thoracotomy, pulmonary resection, cardiac repair	**Unadjusted outcomes** In-hospital mortality, % (N=1363) IG: 51.4 vs. CG: 91.2, p<0.001 Hospital stay [d], median (IQR) (N=1295) IG: 3 (1-22) vs. CG: 1 (1-1), p=0.006 ICU stay [d], median (IQR) (N=1169) IG: 2 (1-12) vs. CG: 0 (0-1), p=0.219 Acute kidney injury, % (N=1455) IG: 16.9 vs. CG: 5.8, p=0.015 Acute kidney injury with dialysis required, % (N=1312) IG: 7.4 vs. CG: 2.4, p=0.106 Acute lung injury or respiratory distress syndrome, % (N=1455) IG: 8.5 vs. CG: 3.1, p=0.012 Bacteremia, % (N=1455) IG: 5.5 vs. CG: 1.3, p=0.065 Pneumonia, % (N=1455) IG: 10.2 vs. CG: 3.2, p=0.882 Sepsis/septic shock, % (N=1455) IG: 8.6 vs. CG: 2.7, p=0.274 Stroke, % (N=1455) IG: 0.5 vs. CG: 1.1, p=0.311 Paraplegia, % (N=1455)	**Level of evidence** 3b↓ **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Though we demonstrate a crude survival advantage in patients undergoing REBOA over Open AO, we concede that these are two very different groups of patients making a direct comparison between these two cohorts unrealistic." **Reviewers' conclusion** The authors' conclusions account for the high risk of selection bias (very heterogeneous study groups), unclear risk of performance bias, and unadjusted analysis of outcomes.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			IG: 1.6 vs. CG: 0.2, p=0.621 Myocardial infarction, % (N=1455) IG: 0.5 vs. CG: 1.1, p=0.283 Multiorgan dysfunction, % (N=1455) IG: 8.5 vs. CG: 4.1, p=0.693 Spinal cord ischemia, % (N=1455) IG: 1.1 vs. CG: 0.1, p=0.369 Survivor discharge GCS, median (IQR) (N=218/247) IG: 15 [15] vs. CG: 15 [15], 0.801 Survivor discharge GOS, median (IQR) (N=143/247) IG: 4 [3-5] vs. CG: 5 [4-5], p=0.157	
DuBose (2016) "The AAST prospective Aortic Occlusion for Resuscitation in Trauma and Acute Care Surgery (AORTA) registry: Data on contemporary utilization and outcomes of aortic occlusion and resuscitative balloon occlusion of the aorta (REBOA)". *J Trauma Acute Care Surg* 2016; 81(3): 409-419. **Study design** Comparative registry study (AAST AORTA registry)	**Inclusion criteria** • Adult trauma and acute care surgery patients (age ≥18 y) • undergoing AO in the acute phases after injury **Exclusion criteria** n.r. **Characteristics** Age [y], mean ± SD IG: 43.2 ± 19.6 vs. CG: 39.2 ± 16.7, p=0.244 Male, n (%) IG: 32 (69.6) vs. CG: 60 (88.2), p=0.013 ISS, median (IQR)	**Participants** N=114 patients **Study groups** IG: resuscitative balloon occlusion of the aorta, REBOA (N=46) CG: Open occlusion of the aorta (N=68) Open operative exposure approaches included anterolateral thoracotomy (43), clamshell thoracotomy (18), and via laparotomy (7). **Co-intervention** There was a significant difference between groups with regard to pelvic external fixation.	**Adjusted outcomes** Mortality, OR (95% CI)§ 0.263 (0.043–1.609); p=0.148 § no information provided on method of adjustment or variables **Unadjusted outcomes** In-hospital mortality, n/N (%) IG: 33/46 (71.7) vs. CG: 57/68 (83.8), p=0.120 Discharge GCS among survivors, median (IQR) IG: 15.0 (0) vs. CG: 15.0 (0), p=0.766 Discharge GOS among survivors, median (IQR) IG 4.0 (1) vs. CG: 4.5 (1), p=0.196 ICU LOS [d], median (IQR)	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "The described modern experience demonstrates that the mortality among patients requiring AO after injury remains high, but that survivors demonstrate an

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Aim of the study "It is our objective to provide some meaningful data on the effectiveness of AO via both open and endovascular means." **Setting** USA, 2013-2015	IG: 31.0 (30) vs. CG: 31.5 (22), p=0.871 Admission SBP [mmHg], median (IQR) IG: 23 (105) vs. CG: 0 (80), p=0.017 Admission GCS, median (IQR) IG: 3.0 (9) vs. CG: 3.0 (4), p=0.509		IG: 1.0 (1) vs. CG: 0 (1), p=0.855 Hospital LOS [d], median (IQR) IG: 1.0 (1) vs. CG: 1.0 (1), p=0.083 Acute kidney injury with dialysis required, n/N (%) IG: 2/46 (4.3) vs. CG: 2/68 (2.9), p=0.660 Acute lung injury or adult respiratory distress syndrome, n/N (%) IG: 0/46 (0) vs. CG: 3/68 (4.4), p=0.149 Bacteremia, n/N (%) IG 1/46 (2.2) vs. CG: 2/68 (2.9), p=0.802 Pneumonia, n/N (%) IG: 2/46 (4.3) vs. CG: 5/68 (7.4), p=0.512 Sepsis or septic shock, n/N (%) IG: 2/46 (4.3) vs. CG: 5/68 (7.4), p=0.512 Myocardial infarction, n/N (%) IG: 0/46 (0) vs. CG: 2/68 (2.9), p=0.241 Multiorgan dysfunction, n/N (%) IG: 2/46 (4.3) vs. CG: 5/68 (7.4), p=0.512	appreciable rate of good neurologic outcome." **Reviewers' conclusion** The results should be interpreted with caution due to the risk of selection bias and unclear risk of performance bias. The results are unadjusted and the groups differ with respect to important confounders.
Henry (2020) "Validation of a Novel Clinical Criteria to Predict Candidacy for Aortic Occlusion: An Aortic Occlusion for Resuscitation in Trauma and Acute Care Surgery Study". *The American Surgeon* 2020; 86(10): 1418-1423.	**Inclusion criteria** • trauma patients • with signs of life • age ≥15 y • underwent zone 1 REBOA or RT **Exclusion criteria** n.r. **Characteristics**	**Participants** N=998 patients **Study groups** IG: resuscitative endovascular occlusion of the aorta (REBOA) (N=364) CG: resuscitative thoracotomy (RT) with cross-clamping of the thoracic aorta (N=634)	In-hospital mortality, n/N (%) IG: 261/364 (71.7) vs. CG: 488/634 (77.0), p=0.36 Death in ED, n/N (%) IG: 141/364 (38.7) vs. CG: 332/634 (52.4), p=0.035	**Level of evidence** **3b↓Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Study design Comparative registry study (AAST AORTA registry) **Aim of the study** The aim of this study was to evaluate whether simple clinical criteria can also be utilized in the emergency department (ED) for determining which trauma patients may benefit from AO procedures for NCTH. **Setting** USA, 2013-2019	Age [y], median (IQR) IG: 35 (23-44) vs. CG: 36 (21-47), p=0.83 Male, n (%) IG 293 (80.5) vs. CG: 519 (81.9), p=0.71 SBP<90 mmHg, n (%) IG: 269 (73.9) vs. CG 589 (92.9), p<0.001 GCS ≥9, n (%) IG: 288 (79.1) vs. CG 155 (24.4), p<0.001 ISS, median (IQR) IG: 35 (24-40) vs. CG: 38 (22-49), p=0.074	RT and REBOA were performed solely at physician discretion, and the decision between the two was not directed prospectively.		(none provided for the comparison of interest) **Reviewers' conclusion** The results should be interpreted with great caution due to the high risk of selection bias, between-group differences in important confounders, and unadjusted analysis.
Inoue (2016) "Resuscitative endovascular balloon occlusion of the aorta might be dangerous in patients with severe torso trauma: A propensity score analysis". *J Trauma Acute Care Surg* 2016; 80(4); 559-567. **Study design** Comparative registry study (Japan Trauma Data Bank) **Aim of the study**	**Inclusion criteria** • trauma patients • undergone emergency surgery or transcatheter embolization • on the chest, abdomen, or pelvis **Exclusion criteria** • ≤16 years old • patients with cardiopulmonary arrest on arrival at the ED • with unsurvivable injuries (patients with SBP of 0 mmHg on arrival and patients with an AIS score of 6 for any region) **Characteristics after matching**	**Participants** N=12,053 patients before matching, N=1,250 after matching **Study groups** IG: REBOA (N=634 before matching, N=625 after matching) patients who had undergone emergency surgery or transcatheter embolization with REBOA CG: non-REBOA (N=11,419 before matching, N=625 after matching) those who had undergone the same procedures but without REBOA **Matching criteria** • age	In-hospital mortality, % (95% CI) IG: 61.8 (57.9–65.7) vs. CG: 45.3 (41.3–49.3) % difference 16.5 (10.9 to 22.0) ED mortality, % (95% CI) IG: 17.1 (14.1–20.1) vs. CG: 9.7 (7.3–12.1) % difference 7.3 (3.5 to 11.2) In-hospital survival up to 30d, HR (95% CI) overall period: 1.59 (1.36, 1.86) Day 1-2: 1.71 (1.43, 2.03) Day 3+: 1.12 (0.76, 1.66)	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Using a propensity score analysis and an instrumental variable method to control for biases, we found that REBOA might increase mortality in surgically

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"Our study objective was to elucidate the efficacy and safety of REBOA via propensity score matching analysis in surgically treated torso trauma subjects by using data from the Japan Trauma Data Bank (JTDB)." **Setting** Japan, dates n.r.	Age [y], median (IQR) IG: 54 (35–70) vs. CG: 52 (33–69) Male, n (%) IG: 434 (69.4) vs. CG: 436 (69.8) SBP [mmHg], median (IQR) IG: 80 (59–107) vs. CG: 80 (60–102) GCS, median (IQR) IG: 11 (5–14) vs. CG: 11 (6–14) ISS, median (IQR) IG: 35 (25–50) vs. CG: 36 (25–50)	• sex • injury type • indicators of trauma severity • indications for emergency surgery		treated severe trauma patients. However, REBOA could be potentially effective when integrated into surgery or transcatheter embolization without delay." **Reviewers' conclusion** This is a well-conducted study with good sample size, but with unclear risk of performance bias. The indication for REBOA varies across hospitals, which needs to be accounted for when interpreting the study results.
Johnson (2021) "Determination of optimal deployment strategy for REBOA in patients with non-compressible hemorrhage below the diaphragm". *Trauma Surgery & Acute Care Open* 2021; 6(1): e000660. **Study design** Subgroup analysis of a prospective cohort study **Aim of the study** "to optimize early decision-making regarding	**Inclusion criteria** • Age ≥15 • evidence of truncal hemorrhage arising below the diaphragm in which the decision for emergent truncal hemorrhage control intervention (operative or endovascular) was made within 60min of emergency department (ED) arrival • presentation to one of the participating level 1 trauma centers at highest activation level • REBOA treatment **Exclusion criteria** • Patients with potentially unsalvageable injuries	**Participants** N=57 patients **Study groups** IG1: Zone 1, followed algorithm (N=32) CG1: Zone 1, violated algorithm (N=4) IG2: Zone 3, followed algorithm (N=8) CG2: Zone 3, violated algorithm (N=13)	**Unadjusted outcomes** Mortality, n/N (%) IG1: 20/32 (62.5) vs. CG1: 3/4 (75.0), p=0.62 IG2: 2/8 (25.0) vs. CG2: 3/13 (23.1), p=0.92 Acute kidney injury, n/N (%) overall Zone 1: 9/23 (39.0) overall Zone 3: 10/25 (40.0), p=0.95 Multiple organ failure overall Zone 1: 6/23 (26.1) overall Zone 3: 1/25 (4.0), p=0.03 Rates of exsanguination among Zone 3 patients that died, n/N (%) IG2: 0/2 (0.0) vs. CG2: 3/3 (1.0), p=0.10	**Level of evidence** 3b↓ **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "A zone 3 REBOA should not be performed when a zone 1 is indicated by the algorithm as 100% of these patients exsanguinated. MOF, perhaps from visceral ischemia in patients with an

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
aortic zone selectivity in patients receiving REBOA“ **Setting** USA, 2017-2018	• Patients which cannot be appropriately assessed with regard to the algorithm in question • no FAST exam • indeterminate FAST exam • positive cardiac FAST • unknown primary bleeding source • Prisoners **Characteristics** Age [y], median IG1: 33 CG1: 50 IG2: 27 CG2: 48 Male, n (%) IG1: 78.1 CG1: 100 IG2: 87.5 CG2: 76.9 SBP [mmHg], median IG1: 60 CG1: 68.5 IG2: 77 CG2: 75 ISS, median IG1: 31.5 CG1: 28 IG2: 38.5 CG2: 33			inappropriate zone 1 RE-BOA, may have been prevented with zone 3 placement or limited zone 1 occlusion time.” **Reviewers’ conclusion** The results are unadjusted for risk factors and therefore need to be interpreted with great caution. The study may have been underpowered to detect clinically significant differences in mortality or morbidity.
Joseph (2019)	**Inclusion criteria** • adult patients ≥18 y	**Participants**	Overall mortality, n/N (%) IG: 50/140 (35.7) vs. CG: 53/280 (18.9), p=0.01	**Level of evidence** 2b

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
„Nationwide Analysis of Resuscitative Endovascular Balloon Occlusion of the Aorta in Civilian Trauma". *JAMA Surgery* 2019; 154(6): 500-508. **Study design** Comparative registry study (ACS Trauma Quality Improvement Program data set) **Aim of the study** "the aim of our study was to evaluate the outcomes in trauma patients after REBOA placement by using the national American College of Surgeons Trauma Quality Improvement Program data set (ACS-TQIP)." **Setting** USA, 2015-2016	**Exclusion criteria** • dead on arrival • patients who were transferred • with missing physiological parameters • who underwent resuscitative thoracotomy **Characteristics after matching** Age [y], mean (SD) IG: 44 (20) vs. CG: 43 (19), p=0.88 Male, n (%) IG: 104 (74.3) vs. CG: 203 (72.5), p=0.76 SBP [mmHg], mean ± SD IG: 108.8 ± 32.7 vs. CG: 106.5 ± 28.7, p=0.65 GCS, median (IQR) IG: 14 (3-15) vs. CG: 13 (3-15), p=0.88 ISS, median (IQR) IG: 29 (18-38) vs. CG: 28 (17-35), p=0.91	N=593,818 patients before matching, 420 after matching **Study groups** IG: received REBOA (N=140 before matching, N=140 after matching) CG: did not receive REBOA (N=593,678 before matching, N=280 after matching) **Matching criteria** • demographics • vital signs (prehospital and ED SBP, HR, and GCS score) • mechanism of injury • ISS • each body region AIS • pelvic fractures (intact, incompletely disrupted, and completely disrupted pelvic ring) • lower extremity vascular injuries and fractures • number and grades of intraabdominal solid organ injuries (liver, spleen, and kidney injuries)	Mortality in the ED, n/N (%) IG 4/140 (2.9) vs. CG: 5/280 (1.8) p=0.35 24-h mortality, n/N (%) IG 37/140 (26.4) vs. CG: 33/280 (11.8), p=0.01 In-hospital mortality after 24 h, n/N (%) IG 9/140 (6.4) vs. CG: 15/280 (5.4), p=0.21 Hospital LOS [d], median (IQR) IG: 8 (1-20) vs. CG: 10 (5-22), p=0.21 ICU LOS [d], median (IQR) IG: 5 (2-14) vs. CG: 6 (3-15), p=0.19 Acute kidney injury, n/N (%) IG: 15/140 (10.7) vs. CG: 9/280 (3.2), p=0.02 Amputation of lower limb, n/N (%) IG: 5/140 (3.6) vs. CG: 2/280 (0.7), p=0.04 Deep venous thrombosis, n/N (%) IG: 6/140 (4.3) vs. CG: 14/280 (5.0), p=0.42 Pulmonary embolism, n/N (%) IG: 2/140 (1.4) vs. CG: 5/280 (1.8), p=0.28 Stroke, n/N (%) IG: 2/140 (1.4) vs. CG: 3/280 (1.1), p=0.37 Myocardial infarction, n/N (%) IG 0/140 (0) vs. CG: 1/280 (0.4), p=0.51 Extremity compartment syndrome, n/N (%) IG 1/140 (0.7) vs. CG: 2/280 (0.7), p=0.39	**Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Placement of REBOA in severely injured trauma patients was associated with higher mortality compared with a similar cohort of patients who did not undergo REBOA placement. Resuscitative endovascular balloon occlusion of the aorta was also associated with higher rates of acute kidney injury and lower-leg amputations." **Reviewers' conclusion** This is a well-conducted study with reasonable sample size, but with unclear risk of performance bias.
Matsumoto (2019)	**Inclusion criteria**	**Participants**	**Adjusted outcomes**	**Level of evidence**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
„Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) for Severe Torso Trauma in Japan: A Descriptive Study". *World Journal of Surgery* 2019; 43(7): 1700-1707. **Study design** Comparative registry study (Japan Trauma Data Bank) **Aim of the study** "We examined 1) the usage trend of procedures of aortic occlusion for resuscitation (REBOA and ACC) in Japan for severe torso trauma and 2) whether these procedures were associated with the time of death distribution based on a large database from the Japan Trauma Data Bank (JTDB)" **Setting** Japan, 2004-2014	• Severe torso trauma (AIS score of ≥4 for chest, abdomen and pelvic fracture) **Exclusion criteria** • dead on arrival • AIS 6 in any region • received both REBOA and ACC • primary outcome unknown **Characteristics** <u>Age by strata</u> p=0.023 <u>Male, n (%)</u> IG1: 400 (65.5) IG2: 232 (72.5) CG: 14,566 (70.7), p=0.015 <u>SBP by strata</u> p<0.001 <u>GCS, median (IQR)</u> IG1: 10.0 (4.0–14.0) IG2: 3.0 (3.0–9.5) CG: 14.0 (11.0–15.0), p<0.001 <u>ISS, median (IQR)</u> IG1: 38.0 (29.0–50.0) IG2: 35.0 (26.0–45.0) CG: 29.0 (20.0–36.0), p<0.001	N=21,533 patients **Study groups** IG1: resuscitative endovascular balloon occlusion of the aorta (REBOA) (N=611) IG2: open aortic cross-clamping (ACC) (N=320) CG: non-aortic procedure (N=20,062) **Variables in time-to-event multivariate Cox proportional hazards model** • sex • age • injury type • SBP • cardiac arrest • AIS (head AIS≥4, chest AIS ≥4, abdomen AIS ≥4, pelvic fracture AIS ≥4) • ISS	<u>Time to death, HR (95% CI)</u> IG1: 1.23 (1.09-1.39), p=0.001 IG2: 2.37 (2.04-2.75) CG: reference **Unadjusted outcomes** <u>In-hospital mortality, n/N (%)</u> IG1: 417/611 (68.2) IG2: 297/320 (92.8) CG: 3,831/20,602 (18.6), p<0.001	2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "REBOA is more commonly used compared to ACC for patients with severe torso trauma in Japan. Moreover, it appears that REBOA influences the time of death distribution in the hyperacute phase." **Reviewers' conclusion** The results should be interpreted with caution due to the retrospective nature of the study, risk of selection bias and unclear risk of performance bias. The study groups were heterogeneous with regard to important confounders.
Matsumura (2018) „Early arterial access for resuscitative endovascular balloon occlusion of the aorta is related to survival	**Inclusion criteria** • patients who received REBOA • refractory hemorrhagic shock **Exclusion criteria**	**Participants** N=109 patients **Study groups**	**Adjusted outcomes** <u>30-day survival, OR arrival to access (95% CI)</u> presumably OR per min increase from arrival to access completion	**Level of evidence** 2b **Risk of bias**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
outcome in trauma". *J Trauma Acute Care Surg* 2018; 85(3): 507-511. **Study design** Comparative registry study (Diagnostic and Interventional Radiology in Emergency, Critical care and Trauma (DIRECT)-IABO Registry) **Aim of the study** "to identify the time course factors associated with better survival outcomes in the patients undergoing REBOA." **Setting** Japan, 2011-2016	• patients ≤18 years • without any attempt of balloon inflation after REBOA catheter placement • nontrauma cases • patients who underwent both RT and REBOA **Characteristics** Age [y], median (IQR) IG: 59 (46–65) vs. CG: 63 (41–77), p=0.23 Male, n (%) IG: 25 (75.8) vs. CG: 36 (58.1), p=0.12 ISS, median (IQR) IG: 34 (22–43) vs. CG: 37 (33–50), p=0.29 SBP on arrival [mmHg], median (IQR) IG: 65 (45–99) vs. CG: 90 (70–111), p=0.29	IG: Early REBOA access (<21.5 minutes; N=33) CG: Late REBOA access (>21.5 minutes; N=62) The arterial sheath was placed in the common femoral artery either by blind puncture, ultrasound (US)-guided puncture, or cutdown. Variables in multiple logistic regression analysis • preocclusion SBP • total duration of occlusion • arrival to definitive hemostasis • ISS	0.989 (0.979–0.999), p=0.034 **Unadjusted outcomes** 30-day survival, n (%) IG: 24 (72.7) vs. CG: 27 (43.5), p=0.009 ICU-free days, median (IQR), N=93 patients IG: 8 (0–19) vs. CG: 0 (0–18), p=0.27	Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "The shorter arrival to access time and lower ISS were significantly associated with increased survival in hemorrhagic patients undergoing REBOA. Patients with arterial access obtained within 21.5 minutes from arrival demonstrated prompt subsequent hemostasis and better survival curves. Proactive early access in the resuscitation phase may be associated with survival outcomes." **Reviewers' conclusion** The results should be interpreted with caution due to the high risk of selection bias and unclear risk of performance bias.
Matsumura (2018) "Partial occlusion, conversion from thoracotomy, undelayed but shorter occlusion: resuscitative endovascular balloon oc-	**Inclusion criteria** • Patients receiving REBOA for refractory hemorrhagic shock **Exclusion criteria** • Age <18y	**Participants** N=106 **Study groups** IG: REBOA alone (N=76) CG: RT+REBOA (N=30)	**Unadjusted outcomes** 24-h survival, n/N (%) IG: 46/76 (61.0) CG: 6/30 (20.0), p<0.001 30-day survival, n/N (%)	**Level of evidence** **3b↓Risk of bias** Selection bias: – Performance bias: ? Attrition bias: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
clusion of the aorta strategy in Japan". *European Journal of Emergency Medicine* 2018; 25(5): 348-354. **Study design** Comparative registry study (Intra-Aortic Balloon Occlusion (IABO) Registry) **Aim of the study** "to evaluate current REBOA strategies in trauma from a Japanese multi-institutional database" **Setting** Japan, 2011-2015	• Nontrauma cases **Characteristics** Age [y], median (IQR) IG: 60 (42-75) vs. CG: 60 (40-78), p=0.84 Male, n (%) IG: 51 (67.0) vs. CG: 20 (67.0), p=1.00 ISS, median (IQR) IG: 36 (28-50) vs. CG: 44 (38-59), p=0.001		IG: 39/76 (51.0) CG: 3/30 (10.0), p<0.001 Survival discharge, n/N (%) IG: 35/76 (46.0) CG: 3/30 (10.0), p<0.001	Detection bias: + **Authors' conclusion** "The RT+REBOA cohort showed more severe chest injuries and were obviously more sick than the REBOA alone cohort. This was reflected in the physiology and outcome." **Reviewers' conclusion** Data were retrieved from a multi-institutional (not nationwide) registry. The results are unadjusted for risk factors and therefore need to be interpreted with great caution.
Norii (2015) "Survival of severe blunt trauma patients treated with resuscitative endovascular balloon occlusion of the aorta compared with propensity score-adjusted untreated patients." *Journal of Trauma and Acute Care Surgery* 2015: 78(4): 721-728. **Study design** Comparative registry study	**Inclusion criteria** • Age ≥18y • Blunt trauma • Receiving care at a facility where at least one REBOA device had been placed **Exclusion criteria** • Unknown survival status • Sites never had REBOA **Characteristics after matching** Age [y], mean ± SD	**Participants** N=45,153 before matching; N=1,807 after matching **Study groups** IG: treated with REBOA (N=452 before matching; N=351 after matching) CG: not treated with REBOA (N=44,701 before matching; N=1,456 after matching) **Matching criteria** • Age • Sex • Calendar year • Revised Trauma Score	Survival to discharge: n/N (%) IG: 92/351 (26.2) vs. CG: 747/1456 (51.3), p<0.0001 OR (95% CI): 0.30 (0.23-0.40) Survival, Cox model, HR (95% CI) with only REBOA treatment in the model: 0.52 (0.45-0.60) after adjustment for additional covariates[§]: 0.35 (0.30-0.42) **Subgroup analysis for isolated serious abdominal injury**	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "REBOA treatment is associated with higher mortality compared with similarly ill trauma patients who did

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
(Japan Trauma Data Bank) **Aim of the study** "To address these limitations, we analyzed prospectively collected data from the Japan Trauma Data Bank (JTDB) to compare the mortality between patients who received a REBOA to control life-threatening hemorrhage with those who did not receive a REBOA, adjusting for the likelihood of treatment and injury severity." **Setting** Japan, 2004-2011	IG: 51.6 ± 20.6 vs. CG: 51.8 ± 20.2, p=0.9443 Male, n (%) IG: 234 (66.7) vs. CG: 974 (66.9), p=0.9348 ISS, median (IQR) IG: 34 (22-45) vs. CG: 29 (19-42) RTS, median (IQR) IG: 5.35 (2.83-6.90) vs. 6.08 (0.00-7.84)	• Mechanism of injury • Maximum AIS for each of the nine body regions • Treating facility • Vital signs	Survival: OR (95% CI) 0.32 (0.08-1.23) **Subgroup analysis for isolated serious pelvis/ lower extremity injury** Survival: OR (95% CI) 0.27 (0.03-2.7) § age, RTS, ISS, and the interaction of REBOA and RTS	not receive a REBOA. The higher observed mortality among REBOA-treated patients may signal ''last ditch'' efforts for severity not otherwise identified in the trauma registry" **Reviewers' conclusion** The results should be interpreted due to the unclear risk of performance bias. The analysis is limited to blunt trauma patients.
Ordoñez (2020) "The critical threshold value of systolic blood pressure for aortic occlusion in trauma patients in profound hemorrhagic shock". *J Trauma Acute Care Surg* 2020; 89(6): 1107-1113. **Study design** Prospective cohort study **Aim of the study** The main objective of this analysis was to determine	**Inclusion criteria** • Adult trauma patients ≥15 y • AO via REBOA or thoracotomy with aortic cross clamping (TACC) **Exclusion criteria** • Patients who required CPR in the prehospital setting **Characteristics (overall)** Age [y], median (IQR) 31 (23–41) Male, n (%) 94 (88)	**Participants** N=107 patients **Study groups** IG: resuscitative endovascular balloon occlusion of the aorta (REBOA) (N=50) Femoral access was obtained in the emergency department (ED) by ED physicians via ultrasound-guided percutaneous approach and/or by the attending trauma surgeon via ultrasound guided percutaneous or open cutdown technique. At our institution, we commonly practice partial REBOA and commonly reposition the balloon catheter from zone I to III according	**Adjusted outcomes** Mortality after 24h, OR (95% CI) OR 0.61 (0.15–2.46), p=0.49 **Unadjusted outcomes** Mortality after 24h, n/N IG: 11/50 vs. CG: 39/57	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** (none provided for the comparison of interest) **Reviewers' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
the critical threshold of SBP at which AO correlates with higher probability of survival of severely injured patients who had not yet reached TCA. **Setting** Colombia, 2014-2018	SBP in ED [mmHg], median (IQR) 60 (20–80) GCS in ED, median (IQR) 13 (7–15) ISS, median (IQR) 25 (25–34) **Characteristics (by group)** SBP [mmHg], mean (IQR) IG: 56 (40-78) vs. CG, 0 (0-77)	to the specific requirements of each trauma patient. CG: thoracotomy with aortic cross clamping (TACC) (N=57) **Adjusting variables in multivariate logistic regression** • age • ISS • trauma mechanism • SBP		This is a single-center study with a high risk of selection bias and an unclear risk of performance bias.
Sadeghi (2018) "The use of aortic balloon occlusion in traumatic shock: first report from the ABO trauma registry". *Eur J Trauma Emerg Surg* 2018; 44(4): 491-501. **Study design** Comparative registry study (Aortic Balloon Occlusion Trauma Registry) **Aim of the study** to present the initial findings of the registry and patient outcomes. **Setting** 6 countries in Europe/Asia, 2011-2016	**Inclusion criteria** • use of REBOA • trauma patients in hemorrhagic shock **Exclusion criteria** • Balloon not deployed • Balloon not inflated **Characteristics** Age [y], mean ± SD IG: 54 ± 25 vs. CG: 51 ± 18, p=0.403 Male, n (%) IG: 35 (70) vs. CG: 30 (65), p=0.617 ISS, median (IQR) IG: 41 (30-54) vs. CG: 38 (26-50), p=0.225 GCS<8 on admission, n (%) IG: 13 (41) vs. CG: 15 (35), p=0.611 SBP<80 mmHg on admission, n (%)	**Participants** N=96 patients **Study groups** IG: continuous REBOA using a balloon fully inflated from insertion for the entire duration of its use, and only deflated once it is no longer required clinically (N=50) CG: non-continuous REBOA is a heterogeneous group of techniques, such as partial or intermittent inflation (N=46)	Mortality n/N (%) IG: 32/50 (64) vs. CG: 22/46 (48), p=0.111 Extremity compartment syndrome, n (%) (N=42) IG: 3 (11) vs. CG: 0.0, p=0.180 Balloon migration, n (%) (N=90) IG: 1 (2) vs. CG: 3 (7), p=0.285 Balloon rupture, n (%) (N=90) IG: 1 (2) vs. CG: 2 (5), p=0.531 Signs of embolization, n (%) (N=85) IG: 2 (4) vs. CG: 1 (3), p=0.628 MOF, n/N IG: 6/18 vs. CG: 4/11, p=0.868	**Level of evidence** 3b↓ **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: ? Detection bias: + **Authors' conclusion** "The current study demonstrates a reduced mortality, albeit not statistically significant, in patients treated with partial or intermittent techniques. The non-continuous aortic occlusion techniques show a generally lower mortality rate but also a lower morbidity

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG: 22 (67) vs. CG: 21 (66), p=0.929			rate regarding organ failure." **Reviewers' conclusion** The results should be interpreted with caution due to the retrospective nature of the study and risk of selection bias. The analysis was not adjusted for confounders. The study may have been underpowered to detect clinically important differences between groups.
Teeter (2018) "Treatment Effect or Effective Treatment? Cardiac Compression Fraction and End-tidal Carbon Dioxide Are Higher in Patients Resuscitative Endovascular Balloon Occlusion of the Aorta Compared with Resuscitative Thoracotomy and Open-Chest Cardiac Massage". *The American Surgeon* 2018; 84(10): 1691-1695. **Study design** Subgroup analysis of a prospective cohort study **Aim of the study** "to compare EtCO2 measurements as an assess-	**Inclusion criteria** • OCCM performed with ACC or REBOA with CCC **Exclusion criteria** • Age <18y • Patients receiving both procedures • Patients with penetrating thoracic trauma of the heart or great vessels **Characteristics** <u>Age [y], mean ± SD</u> IG: 35.6 ± 16.0 vs. CG: 34.7 ± 11.9, p=0.84 <u>ISS, mean ± SD</u> IG: 37.0 ± 15.6 vs. CG: 39.3 ± 13.1, p=0.60 <u>GCS on admission, mean ± SD</u> IG: 3.0 ± 0.0 vs. CG: 3.5 ± 1.9, p=0.20 <u>Revised trauma score, mean ± SD</u>	**Participants** N=51 patients **Study groups** IG: REBOA with closed-chest compressions (CCC) (N=33) CG: RT with open-chest cardiac massage (OCCM) and aortic cross-clamping (ACC) (N=18)	**Unadjusted outcomes** <u>Emergency/operating room death, n/N (%)</u> IG: 18/33 (54.6) vs CG: 15/18 (83.3); p=0.038 <u>In-hospital mortality, n/N (%)</u> IG: 29/33 (87.9) vs. CG: 18/18 (100.0), p=0.28 <u>ICU stay [d], mean ± SD</u> IG: 3.6 ± 9.6 vs. CG: 0.0 ± 0.0, p=0.07 <u>Hospital length of stay [d], mean ± SD</u> IG: 8.3 ± 24.3 vs. CG: 0.0 ± 0.0, p=0.14	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "The rate of return of spontaneous circulation was higher in REBOA versus OCCM, and REBOA patients survived to operative intervention more frequently." **Reviewers' conclusion** The primary study outcome was EtCO2, and mortality was a secondary outcome

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
ment of quality of resuscitation in patients undergoing either OCCM with ACC, or REBOA with CCC“ **Setting** USA, 2013-2016	IG: 0.8 ± 1.8 vs. CG: 1.2 ± 1.9, p=0.47 <u>SBP, mean ± SD</u> IG: 38.2 ± 59.4 vs. CG: 39.0 ± 54.9, p=0.98			only. The results are unadjusted for risk factors and therefore need to be interpreted with great caution.
Vella (2019) “Intraoperative REBOA: an analysis of the American Association for the Surgery of Trauma AORTA registry”. *Trauma Surg Acute Care Open* 2019; 4: e000340. **Study design** Comparative registry study (AAST AORTA registry) **Aim of the study** “We sought to characterize the use of intraoperative REBOA and hypothesized that insertion in the OR is associated with increased in-hospital mortality.” **Setting** USA, 2013-2017	**Inclusion criteria** • patients who underwent endovascular occlusion of the aorta • Data on the location and timing of insertion available **Exclusion criteria** n.r. **Characteristics** <u>Age, median (IQR)</u> IG: 32.5 (22–51) vs. CG: 40.5 (27–58), p=0.01 <u>Male, n (%)</u> IG: 44 (75.8) vs. CG: 189 (76.5), p=0.92 <u>ISS, median (IQR)</u> IG: 34 (25–42) vs. CG: 34 (25–45), p=0.38 <u>SBP on admission, median (IQR)</u> IG: 110 (80–130) vs. CG: 80 (0–111), p=<0.001 <u>GCS on admission, median (IQR)</u> IG: 7 (3–15) vs. CG: 3 (3–9), p<0.001	**Participants** N=305 patients **Study groups** IG: REBOA in the operating room (N=58) CG: REBOA in ED (N=247) **Variables for multivariate logistic regression analysis** • time to AO • admission SBP • GCS score • HR • ISS • age • lactate • CPR at admission	**Unadjusted outcomes** <u>In-hospital mortality, n/N (%); OR (95% CI)</u> IG: 21/58 (36.2) vs. CG: 170/247 (68.8), p<0.001 0.53 (0.393 to 0.737), p<0.001 **Adjusted outcomes** <u>In-hospital mortality, OR (95% CI)</u> 1.8 (0.295 to 11.498), p=0.513	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors’ conclusion** “Placement of REBOA catheters in the OR is relatively common and does not appear to be associated with increased in-hospital mortality despite longer times to AO and definite hemostasis when compared with catheters placed in the ED.” **Reviewers’ conclusion** The results should be interpreted with caution due to the high risk of selection bias and the unclear risk of performance bias.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Yamamoto (2019) "Resuscitative endovascular balloon occlusion of the aorta (REBOA) is associated with improved survival in severely injured patients: a propensity score matching analysis." *Am J Surg* 2019; 218(6): 1162-1168. **Study design** Comparative registry study (Japan Trauma Data Bank) **Aim of the study** "Accordingly, in an effort to verify the efficacy of REBOA on severely injured patients, we examined outcomes in patients treated with REBOA compared with those treated without REBOA, using propensity score matching analysis that offered the most reliable method in a retrospective study for reducing the effects of confounding factors." **Setting** Japan, 2004-2016	**Inclusion criteria** • trauma patients **Exclusion criteria** • missing or unknown survival data **Characteristics after matching** <u>Age [y], mean ± SD</u> IG: 52 ± 21 vs. CG: 57 ± 23 <u>Male, n (%)</u> IG: 82 (70) vs. CG: 69 (59) <u>Systolic BP mmHg, mean ± SD</u> IG: 96 ± 45 vs. CG: 91 ± 47 <u>Diastolic BP mmHg, mean ± SD</u> IG: 65 ± 32 vs. CG: 63 ± 30 <u>GCS, mean ± SD</u> IG: 9.7 ± 4.8 vs. CG: 8.9 ± 4.7 <u>ISS, mean ± SD</u> IG: 35 ± 13 vs. CG: 33 ± 11 <u>RTS, mean ± SD</u> IG: 5.55 ± 2.29 vs. CG: 5.24 ± 2.23 <u>TRISS calculated probability of survival, mean ± SD</u> IG: 0.56 ± 0.53 vs. CG; 0.51 ± 0.31	**Participants** N=82,371 before matching, N=234 after matching **Study groups** IG: REBOA (N=385 before matching, n=117 after matching) CG: NON-REBOA (N=81,986 before matching, N=117 after matching) **Matching criteria** • age • vital signs on arrival (GCS, respiratory rate, heart rate, and SBP) • mechanism of injury (blunt or penetrating, self-inflicted or not, and alcohol-related or not) • result of Focused Assessment with Sonography in Trauma (FAST) exam (positive or negative) • hemostatic procedure (surgery and angiography) • unplanned second surgical procedure or interventional angiography within 48 h after the initial hemostatic operation • transfusion within 24 h after arrival • ISS • RTS • TRISS calculated probability of survival	<u>Survival 1-2 d after injury, HR (95% CI)</u> 1.04 (0.61-1.78), p=0.89 <u>Survival after 2 d after injury, HR (95% CI)</u> 0.58 (0.34-0.98), p=0.04 <u>Survival to discharge, n/N (%)</u> IG: 53/117 (45.3) vs. CG: 38/117 (32.5) OR (95% CI): 1.72 (1.01-2.93), p=0.04 Survival at 28 days, n/N (%) IG: 55/113 (48.7) vs. CG: 39/117 (33.3) OR (95% CI): 1.77 (1.05-3.01), p=0.03 <u>Hospital free days to day 90, mean ± SD</u> (composite of in-hospital death and hospital length of stay defined as the number of days alive and out of the hospital between the hospital arrival and 90 days later) IG: 15 ± 26 vs. CG: 11 ± 25, p=0.15	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "REBOA use was associated with improved survival to discharge as well as at 28 days after injury and should therefore be considered during the management of severely injured trauma patients." **Reviewers' conclusion** This is a well-conducted study with comparatively reliable results. Still, the retrospective nature of the study may have led to some bias, and the large number of patients excluded after propensity-score matching might limit generalisability.
Yamamoto (2020)	**Inclusion criteria**	**Participants**	<u>Survival to discharge, n/N (%); OR (95% CI)</u>	**Level of evidence**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"Delays in Surgical Intervention and Temporary Hemostasis Using Resuscitative Endovascular Balloon Occlusion of the aorta (REBOA): Influence of Time to Operating Room on Mortality". *Am J Surg* 2020; 220(6): 1485-1491. **Study design** Comparative registry study (Japan Trauma Data Bank) **Aim of the study** "to identify the optimal candidates for REBOA, we examined outcomes in patients treated with REBOA compared with a similar propensity-matched cohort of patients treated without REBOA, evaluating three preoperative time periods (…) we hypothesized that REBOA use would improve survival in severely injured trauma patients who experience delays in surgical intervention, compared to those who do not." **Setting** Japan, 2014-2019	• trauma patients • ≥15 years of age • who arrived with a palpable pulse • were eventually transferred to the operating room • received a transfusion of any blood product type within 24 h after arrival **Exclusion criteria** • Patients with missing or invalid data regarding prehospital information, vital signs on arrival, time of arrival, time of surgery, or in-hospital survival • Patients who were transferred to the operating room >3h after hospital arrival • No surgical intervention within 3 hours • Patients with missing covariates for propensity score matching **Characteristics after matching** <u>Age [y], mean ± SD</u> IG: 56 ± 21 vs. CG: 58 ± 22 <u>Male, n (%)</u> IG: 146 (65%) vs. CG: 135 (61%) <u>GCS on arrival, mean ± SD</u> IG: 10 ± 5 vs. CG: 9 ± 5 <u>SBP [mmHg], mean ± SD</u> IG: 95 ± 37 vs. CG: 93 ± 36 <u>ISS, mean ± SD</u> IG: 33 ± 15 vs. CG: 36 ± 16 <u>RTS, mean ± SD</u>	N=5,258 patients before matching, N=446 after matching) **Study groups** IG: REBOA (N=310 before matching, N=223 after matching) CG: Non-REBOA (N=,4948 before matching, N=223 after matching) **Co-interventions** <u>Thoracotomy preceding other surgical interventions, n (%)</u> IG: 32 (14) vs. CG: 39 (17) <u>Angiography, n (%)</u> IG: 99 (44) vs. CG: 92 (41) <u>Laparotomy, n (%)</u> IG: 103 (46) vs. CG: 57 (26) **Matching criteria** • Age • vital signs on arrival (GCS, respiratory rate, heart rate, and SBP) • mechanism of injury (blunt or penetrating) • result of Focused Assessment with Sonography in Trauma (FAST) exam (positive, negative, or not performed) • ISS **Subgroup analysis for timing of transfer** transfer refers to the time to the operating room after hospital arrival Early transfer (≤1 h), REBOA N=66; non-REBOA N=77	IG: 126/223 (56.5) vs. CG: 71/223 (31.8), p<0.001 OR 2.78 (1.89–4.09) <u>Survival at 28 days, n/N (%); OR (95% CI)</u> IG: 132/223 (59.2) vs. CG: 79/223 (35.4), p<0.001 OR 2.64 (1.80–3.88) <u>Hospital-free days to day 90, mean ± SD</u> defined as the number of days alive and out of the hospital between day of hospital arrival and 90 days later IG: 24 ± 30 vs. CG: 15 ± 35, p<0.001 **Subgroup analysis for timing of transfer** <u>Survival to discharge, n/N (%); OR (95% CI)</u> *Early transfer*: IG: 26/66 (39.4) vs. CG: 26/77 (33.8), p=0.49 OR 1.28 (0.64–2.53) *Delayed transfer:* IG: 66/100 (66.0) vs. CG: 30/91 (33.0), p<0.001 OR 3.95 (2.16–7.21) *Significantly-delayed transfer:* IG: 34/57 (59.6) vs. CG: 15/112 (27.3), p=0.001 OR 3.94 (1.78–8.73) <u>Survival at 28 days, n/N (%)</u> *Early transfer*: IG: 27/66 (40.9) vs. CG: 29/77 (37.7), p=0.69 OR 1.15 (0.58–2.25) *Delayed transfer:* IG: 68/100 (68.0) vs. CG: 30/91 (33.0), p<0.001 OR 4.32 (2.36–7.92)	2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusions** "In severely injured patients, the use of REBOA was associated with improved survival." **Reviewers' conclusions** This is a well-conducted study with good sample size, but with unclear risk of performance bias. The indication for REBOA varies across hospitals, which needs to be accounted for when interpreting the study results.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG: 5.75 ± 1.83 vs. CG: 5.33 ± 1.68	Delayed transfer (1-2 h), REBOA N=100; non-REBOA N=91 Significantly-delayed transfer (≥2 h), REBOA N=57; non-REBOA N=112	*Significantly-delayed transfer:* IG: 37/57 (64.9) vs. CG: 20/112 (36.4), p=0.003 OR 3.24 (1.49–7.01) Survival, Kaplan-Meier HR (95% CI)* Early transfer: 0.92 (0.60–1.40) Delayed transfer: 0.43 (0.28–0.65) Significantly-delayed transfer: 0.42 (0.25–0.71) * non-REBOA as reference Hospital-free days to day 90, mean ± SD *Early transfer*: IG: 17 ± 28 vs. CG: 15 ± 26, p=0.40 *Delayed transfer:* IG: 29 ± 30 vs. CG: 13 ± 24, p<0.001 *Significantly-delayed transfer:* IG: 25 ± 30 vs. CG: 17 ± 55, p=0.02	
Yamamoto (2020) "Resuscitative endovascular balloon occlusion of the aorta and traumatic out-of-hospital cardiac arrest: A nationwide study." *Journal of the American College of Emergency Physicians Open* 2020; 1(4): 624-632. **Study design** Comparative registry study (Japan Trauma Data Bank) **Aim of the study**	**Inclusion criteria** • patients with traumatic out-of-hospital cardiac arrest (t-OHCA) • aged 15 years or older • arrived without a palpable pulse and with a Glasgow Coma Scale (GCS) score of 3, • and received aortic occlusion by either cross-clamping through RT or REBOA **Exclusion criteria** • Patients who had arrived with >30 minutes of transportation time from the scene • Patients with missing or invalid data on inhospital survival or transportation time	**Participants** N=1483 patients before IPW, N=1342 after IPW **Study groups** IG: resuscitative endovascular balloon occlusion of the aorta (N=144 before IPW, N=129 after IPW) CG: aortic occlusion by cross-clamping through resuscitative thoracotomy (N=1339 before IPW, N=1213 after IPW) **Matching criteria for IPW** • age • sex • mechanism of injury • severity of injuries (ISS)	**Adjusted outcomes** Survival to discharge, % (95% CI) IG: 3.0 (2.1–3.9) vs. CG: 0.8 (0.3–1.3), p<0.001 OR (95% CI): 3.73 (1.90–7.32) Hospital-free days to 90 days, mean, median (IQR) *(composite of in-hospital mortality and hospital length of stay, defined as the number of days alive and out of the hospital between day of hospital arrival and 90 days later)* IG: 1.1, 0 (0) vs. CG: 0.7, 0 (0) OR (95% CI): 1.3 (0.6–2.0) **Unadjusted outcomes** Survival to discharge, n/N (%) IG: 5/144 (3.5) vs. CG: 10/1339 (0.7)	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "In summary, in patients with t-OHCA, REBOA was associated with improved survival to discharge instead of cross-clamping the aorta through RT"

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"To eventually ascertain whether REBOA might be a therapeutic option during the resuscitation of t-OHCA in a prospective study, we used a Japanese nationwide trauma database to examine the clinical outcomes of trauma victims with OHCA who had received aortic occlusion by RT or REBOA" **Setting** Japan, 2004-2019	**Characteristics after matching** Age [y], median (IQR) IG: 53 (30) vs. CG: 53 (33) standardised difference 0.080 Male, n (%) IG: 903 (69.2) vs. CG: 928 (69.1) standardised difference 0.002 ISS , median (IQR) IG: 36 (29) vs. CG: 38 (45) standardised difference 0.120	• presence of severe head and/or chest injury • presence of signs of life at scene and/or on hospital arrival • transportation time		**Reviewers' conclusion** The study included only patients without a palpable pulse for whom RT was recommended in Japan, which might limit the generalisability of the findings. When interpreting results, one should be aware on a quite large proportion of patients excluded for missing data. Patients who received both REBOA and RT were included in IG or CG depending on the first treatment received.
+: low risk; –: high risk; ?: unclear risk; ACC: aortic cross clamping; AE: angioembolisation; AIS: abbreviated injury scale; AO: aortic occlusion; CI: Confidence Interval; ED: emergency department; EF: external fixation; GCS: Glasgow coma scale; GOS: Glasgow Outcome Score; HR: Hazard Ratio; IQR: Interquartile Range; ISS: injury severity score; ITT: Intention to Treat; OR: Odds Ratio; PP: preperitoneal pelvic packing; REBOA: resuscitative endovascular balloon occlusion of the aorta; RR: Relative Risk; RT: resuscitative thoracotomy; RTS: revised trauma score; SBP: systolic blood pressure; SD: Standard Deviation; SEM: Standard Error of Mean; adj.: adjusted; d: days; m: months; y: years				

Therapie der Beckenverletzung (REBOA, Embolisation)

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Asmar (2021) "Resuscitative Endovascular Balloon Occlusion of the Aorta vs Pre-Peritoneal Packing in Patients with Pelvic Fracture." *Journal of the American College of Surgeons* 2021; 232(1): 17-26.	**Inclusion criteria** • adult (age ≥18 years) trauma patients • blunt pelvic fractures • hemodynamic instability (SBP<100 mmHg) • who underwent zone III REBOA and/or PP prior to laparotomy and/or angioembolization **Exclusion criteria**	**Participants** N=749 before matching; N=156 after matching **Study groups** PP: pre-peritoneal packing (N=548 before matching; N=52 after matching)	24-hour mortality: n/N (%) PP: 13/52 (25) REBOA: 7/52 (14) REBOA + PP: 18/52 (35), p=0.042 In-hospital mortality: n/N (%) PP: 23/52 (44) REBOA: 15/52 (29)	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Study design Comparative registry study (ACS-TQIP) **Aim of the study** "Our study aims to evaluate the outcomes of PP, REBOA, and REBOA with PP, as a bridge to definitive laparotomy and/or angioembolization, in hemodynamically unstable patients with pelvic fractures." **Setting** USA, 2017	• severe extra-pelvis injuries (abbreviated injury score (AIS) ≤2), except for concomitant lower extremity injuries • transfer patients • patients declared dead on arrival • REBOA ≥1h after admission • patients who underwent ED thoracotomy • patients with a known history of bleeding diathesis • patients with missing ED vital signs and missing time to procedure **Characteristics after matching** Age [y], mean ± SD PP: 39±18 REBOA: 44±18 REBOA + PP: 45±17, p=0.284 Male, n (%) PP: 34 (65) REBOA: 41 (79) REBOA + PP: 41 (79), p=0.193 SBP [mmHg], mean ± SD PP: 77 ± 8 REBOA: 76 ± 10 REBOA+PP: 75 ± 8, p=0.296 GCS, median (IQR) PP: 11 (11-14) REBOA: 11 (11-14) REBOA + PP: 11 (11-14), p=0.123	REBOA: resuscitative endovascular balloon occlusion of the aorta (n=149 before matching; N=52 after matching) REBOA+PP: underwent both procedures (N=52 before and after matching) **Matching criteria** • demographics • comorbidities • ED vital signs • mechanism of injury • injury characteristics • ACS trauma center verification level • intervention for definitive hemorrhage control	REBOA + PP: 28/52 (54), p=0.034 Hospital LOS [d]: median (IQR) PP: 22 (10-33) REBOA: 20 (10-31) REBOA + PP: 21 (13-35), p=0.775 ICU LOS [d]: median (IQR) PP: 9 (5-18) REBOA: 10 (5-16) REBOA + PP: 9 (6-16), p=0.992 Acute kidney injury): n/N (%) PP: 3/52 (6) REBOA: 5/52 (10) REBOA + PP: 4/52 (8), p=0.642	**Authors' conclusion** "REBOA is a less invasive procedure compared to PP and is associated with improved outcomes. Further clinical trials are needed to define the optimal patient who will benefit from REBOA." **Reviewers' conclusion** Results need to be interpreted with caution due to the retrospective study design and unclear risk of performance bias. Results are post matching for important confounders. No matching was possible for variables including duration of occlusion or responsiveness of patients to initial resuscitation efforts.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	ISS, median (IQR) PP: 28 (17-29 REBOA: 28 (17- 33) REBOA + PP: 28 (17-33), p=0.837			
Chu (2016) "Trends in the management of pelvic fractures, 2008-2010". *Can J Surg* 2016; 202(2); 335-340. **Study design** Comparative registry study (National Trauma Data Bank) **Aim of the study** "We sought to determine how frequently the two most commonly used techniques, AE and EXFIX, were used in severely injured patients admitted to US trauma centers with a diagnosis of a pelvic ring fracture in the United States. (…) We also hypothesized that there would be a difference in mortality based on procedure." **Setting** USA, 2008-2010	**Inclusion criteria** • pelvic fractures • age ≥18 years • angioembolization or external fixation within 24 h of arrival **Exclusion criteria** • isolated acetabular fractures • patients who were not admitted to the hospital • minor injuries (ISS<15) • hospitals that performed only 1 of the procedures **Characteristics** Age by strata p<0.001 Male, n (%) IG1: 450 (60.3) IG2: 422 (63.7) CG: 12,568 (59.4), p=0.512 SBP [mmHg], mean (SEM) IG1: 92.35 (1.95) IG2: CG: 93.14 (1.93) CG: 100.31 (0.38), p<0.001 GCS, mean (SEM)	**Participants** N=1409 patients **Study groups** IG1: angioembolization (N=746) IG2: external fixation (N=663) CG: no procedure (N=21,159) **Adjusting variables in logistic regression** • demographics (age and gender) • injury severity • emergency room physiology (including hypotension, tachycardia, GCS) • diagnosis of traumatic shock • hospital characteristics (hospital region, trauma center status, hospital bed size, and university hospital) • year of admission	**Adjusted outcomes** Mortality, OR (95% CI) IG1: 1.63 (1.29-2.05) IG2: 0.95 (0.70-1.30) CG: reference **Unadjusted outcomes** In-hospital mortality, n/N (%) IG1: 153/746 (20.5) IG2: 89/663 (13.4) CG: 2,319/21,159 (11.0)	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "AE is associated with higher mortality, which may reflect the fact that it is used for patients at higher risk of death." **Reviewers' conclusion** The authors' conclusion accounts for the risk of selection bias and heterogeneity between intervention groups.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG1: 9.55 (0.24) IG2: 9.57 (0.26) CG: 9.81 (0.05), p=0.203 ISS ≥26, n (%) IG1: 440 (59.0) IG2: 323 (48.7) CG: 8,880 (42.0), p<0.001			
Coccolini (2020) "Aortic balloon occlusion (REBOA) in pelvic ring injuries: preliminary results of the ABO Trauma Registry". *Updates in Surgery* 2020; 72(2): 527-536. **Study design** Comparative registry study (ABO (aortic balloon occlusion) Trauma Registry) **Aim of the study** "to present the preliminary data of the ABO Trauma Registry regarding patients with severe pelvic trauma managed by the positioning of REBOA" **Setting** 31 centres from different geographic locations, registry inception to 2018	**Inclusion criteria** • severe pelvic trauma **Exclusion criteria** n.r. **Characteristics** Age [y], median (IQR) 58 (36-65) Male, n (%) 48 (66.7) ISS, median (IQR) 41 (34-53)	**Participants** N=72 patients **Study groups** Comparison 1 Z1: REBOA zone 1 (N=59) Z2: REBOA zone 2 (N=1) Z3: REBOA zone 3 (N=12) Comparison 2 tAO: total aortic occlusion (N=37) pAO: partial aortic occlusion (N=35) **Variables in multivariable regression** (all the significant variables at the univariate analysis) • pH values • base deficit • INR • SBP post-insertion	*Comparison 1* Early mortality <24h, n/N Z1: 29/59 (49.2) vs. Z2: 0/1 (0) vs. Z3: 3/12 (25.0), p=0.205 Comparison 2 Early mortality (<24h), n (%) tAO: 22/37 (59.9) vs. pAO: 10/35 (28.6), univariate p=0.008; multivariate p=0.929	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Interestingly, partial aortic occlusion was statistically associated with survival in the univariate analysis, whereas total occlusion was associated with early mortality." **Reviewers' conclusion** The results should be interpreted with caution due to the retrospective nature of the study, high risk of selection bias, and unclear risk of performance bias. Only comparison 2 was part of

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
				the multivariate logistic regression model.
Harfouche (2021) "Patterns and outcomes of zone 3 REBOA use in the management of severe pelvic fractures: Results from the AAST Aortic Occlusion for Resuscitation in Trauma and Acute Care Surgery database". *The Journal of Trauma and Acute Care Surgery* 2021; 90(4): 659-665. **Study design** Comparative registry study (AAST AORTA registry) **Aim of the study** "The aim of this study is to describe the outcomes of patients in the Aortic Occlusion for Resuscitation in Trauma and Acute Care Surgery (AORTA) registry who have undergone zone 3 REBOA placement with a focus on the number and types of hemostatic interventions performed for the management of pelvic fractures." **Setting**	**Inclusion criteria** • Adult patients ≥18 y • zone 3 AO in the acute phases after injury **Exclusion criteria** • no blunt mechanism • death in the ED **Characteristics (overall)** Age [y], mean ± SD 47 ± 18 Male, n (%) 115 (72.3) ISS, mean ± SD 36 ± 13 SBP on admission [mmHg], mean ± SD 86 ± 41 GCS on admission, mean ± SD 9 ± 5	**Participants** N=160 patients **Study groups** IG1: REBOA + preperitoneal pelvic packing (PP) (N=44) IG2: REBOA + angioembolization (AE) (N=28) IG3: REBOA + PP + AE (N=15) CG: Zone 3 REBOA alone (N=60) Subgroup analysis for patients with external fixation (EF) and without EF With EF: IG1: REBOA + preperitoneal pelvic packing (PP) (N=27) IG2: REBOA + angioembolization (AE) (N=8) IG3: REBOA + PP + AE (N=1) CG: Zone 3 REBOA alone (N=n.r.) Without EF: IG1: REBOA + preperitoneal pelvic packing (PP) (N=17) IG2: REBOA + angioembolization (AE) (N=20) IG3: REBOA + PP + AE (N=14) CG: Zone 3 REBOA alone (N=n.r.) **Variables in multivariable regression** • age <50 y • male sex	**Adjusted outcomes** Mortality, OR (95% CI) following zone 3 REBOA for pelvic hemorrhage PP: 0.75 (0.27–2.14), p=0.596 Pelvic AE: 1.02 (0.37–2.84), p=0.963 Pelvic EF: 0.22 (0.07–0.70), p=0.011 **Unadjusted outcomes, overall group§** following zone 3 REBOA for pelvic hemorrhage In-hospital mortality, n/N (%) PP: 17/44 (38.6) Pelvic AE: 9/28 (32.1) PP + AE: 7/15 (46.7), p=0.64 CG: 24/60 (40.0) Overall complications, n/N (%) PP: 20/44 (45.5) Pelvic AE: 12/28 (42.9) PP + AE: 13/15 (86.7), p=0.012 CG: 27/60 (45.0) Acute kidney injury, n/N (%) PP: 13/44 (29.5) Pelvic AE: 8/28 (28.6) PP + AE: 11/15 (73.3), p=0.005 CG: 10/60 (16.7) Dialysis, n/N (%)	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "The findings of this study indicate that trauma centers use REBOA as both a stand-alone technique and with additional techniques, such as AE, PP, and EF, to control pelvic fracture-related hemorrhage. The increasing number of interventions was associated with higher complication rates. No combination of interventions was found to be superior, and only EF was associated with a significant mortality benefit when controlling for multiple variables." **Reviewers' conclusion** The study was not designed to test the benefit of one interventions over another

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
USA, 2013-2020		• ISS >30 • AIS ≥3 (head, chest, abdomen) • SBP<80 • HR >120 • GCS <8 • CPR in progress • thoracotomy • laparotomy	PP: 3/44 (6.8) Pelvic AE: 5/28 (17.9) PP + AE: 4/15 (26.7), p=0.036 CG: 3/60 (5.0) <u>Sepsis/septic shock, n/N (%)</u> PP: 5/44 (11.4) Pelvic AE: 2/28 (7.1) PP + AE: 3/15 (20.0), p=0.45 CG: 7/60 (11.7) <u>Acute lung injury/acute respiratory distress syndrome, n/N (%)</u> PP: 6/44 (13.6) Pelvic AE: 5/28 (17.9) PP + AE: 3/15 (20.0), p=0.81 CG: 13/60 (21.7) <u>Multiple organ dysfunction syndrome, n/N (%)</u> PP: 5/44 (11.4) Pelvic AE: 4/28 (14.3) PP + AE: 5/15 (33.3), p=0.13 CG: 7/60 (11.7) **Subgroup analysis – patients with EF§** <u>In-hospital mortality, n/N (%)</u> PP: 6/27 (22.2) Pelvic AE: 2/8 (25.0) PP + AE: 0/1 (0), p=0.85 CG: n.r. <u>Overall complications, n/N (%)</u>	making direct comparison between the different study groups difficult. The number of included patients is small, so that the study power is limited.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			PP: 14/27 (51.9) Pelvic AE: 4/8 (50.0) PP + AE: 1/1 (100), p=0.063 CG: n.r. <u>Acute kidney injury, n/N (%)</u> PP:10/27 (37.0) Pelvic AE: 4/8 (50.0) PP + AE: 1/1 (100), p=0.39 CG: n.r. <u>Dialysis, n/N (%)</u> PP: 3/27 (11.1) Pelvic AE: 3/8 (37.5) PP + AE: 1/1 (100), p=0.13 CG: n.r. <u>Sepsis/septic shock, n/N (%)</u> PP: 3/27 (11.1) Pelvic AE: 0/8 (0) PP + AE: 1/1 (100), p=0.011 CG: n.r. <u>Acute lung injury/acute respiratory distress syndrome, n/N (%)</u> PP: 5/27 (18.5) Pelvic AE: 0/8 (0) PP + AE: 0/1 (0), p=0.38 CG: n.r. <u>Multiple organ dysfunction syndrome, n/N (%)</u> PP: 3/27 (11.1) Pelvic AE: 1/8 (12.5) PP + AE: 0/1 (0), p=0.93 CG: n.r.	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Subgroup analysis –patients without EF§ In-hospital mortality, n/N (%) PP: 11/17 (64.7) Pelvic AE: 7/20 (35.0) PP + AE: 7/14 (50.0) , p=0.20 CG: n.r. Overall complications, n/N (%) PP: 6/17 (35.3) Pelvic AE: 8/20 (40.0) PP + AE: 12/14 (85.7), p=0.009 CG: n.r. Acute kidney injury, n/N (%) PP: 3/17 (17.6) Pelvic AE: 4/20 (20.0) PP + AE: 10/14 (71.4), p=0.002 CG: n.r. Dialysis, n/N (%) PP: 0/17 (0) Pelvic AE: 2/20 (10.0) PP + AE: 3/14 (21.4), p=0.027 CG: n.r. Sepsis/septic shock, n/N (%) PP: 2/17 (11.8) Pelvic AE: 2/20 (10.0) PP + AE: 2/14 (14.3), p=0.92 CG: n.r. Acute lung injury/acute respiratory distress syndrome, n/N (%)	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			PP: 1/17 (5.9) Pelvic AE: 5/20 (25.0) PP + AE: 3/14 (21.4), p=0.029 CG: n.r. <u>Multiple organ dysfunction syndrome, n/N (%)</u> PP: 2/17 (11.8) Pelvic AE: 3/20 (15.0) PP + AE: 5/14 (35.7), p=0.10 CG: n.r. § all p-values for comparison IG1 vs. IG2 vs. IG3	
Matsushima 2018 "Effect of door-to-angioembolization time on mortality in pelvic fracture: Every hour of delay counts". *J Trauma Acute Care Sug.* 2018; 84(5): 685-692. **Study design** Comparative registry study (AAS Trauma Quality Improvement Program database) **Aim of the study** "to evaluate the impact of a delay in performing pelvic AE on patients' survival. We hypothesized that a longer time-to-AE	**Inclusion criteria** • Blunt trauma patients • age ≥18 years • underwent pelvic AE for pelvic fractures **Exclusion criteria** • Patients who underwent pelvic AE ≥4h after admission • Patients who required haemorrhage control surgery (laparotomy; thoracotomy; sternotomy; peripheral vascular procedures; neck and mangled extremity/traumatic amputation) within 4 hours **Characteristics** <u>Age [y], median (IQR)</u> Total: 54 (38-68) AE ≤1h: 59 (43-75) AE 1-2h: 51 (33-59) AE 2-3: 53 (37-63) AE 3-4: 54 (34-73), p=0.11	**Participants** N=181 patients **Study groups** patients divided into four groups: AE ≤1h: angioembolization up to 1 hour from admission to AE (N=19) AE 1-2h: angioembolization 1 to 2 hours from admission to AE (N=36) AE 2-3h: angioembolization 2 to 3 hours from admission to AE (N=79) AE 3-4h: angioembolization 3 to 4 hours from admission to AE (N=47)	**Adjusted outcomes** <u>In-hospital mortality (primary outcome), adjusted OR (95% CI) per additional hour to pelvic AE</u> 1.79 (1.11–2.91), p=0.018 <u>24h mortality, adjusted OR (95% CI) per additional hour to pelvic AE</u> 1.39 (0.76–2.55), p=0.28 **Unadjusted outcomes** <u>In-hospital mortality (primary outcome), n (%)</u> Total: 38 (21.0) AE ≤1h: 1 (5.3) AE 1-2h: 6 (16.7) AE 2-3: 20 (25.3) AE 3-4: 11 (23.4), p=0.23 <u>24-hour mortality, n (%)</u> Total: 15 (8.3) AE ≤1h: 0 (0) AE 1-2h: 4 (11.1)	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "This study showed that a shorter time-to-AE is significantly associated with improved survival among patients with pelvic fractures." **Reviewers' conclusion** The groups were reasonably balanced, and the analysis was adjusted for important confounders. The

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
would be significantly associated with increased mortality in patients with pelvic fracture." **Setting** USA, 2013-2014	Male, n (%) Total: 126 (69.6) AE ≤1h: 12 (63.2) AE 1-2h: 27 (75.0) AE 2-3: 52 (65.8) AE 3-4: 35 (74.5), p=0.59 SBP<90 [mmHg], n (%) Total: 49 (27.1) AE ≤1h: 5 (26.3) AE 1-2h: 8 (22.2) AE 2-3: 24 (30.4) AE 3-4: 12 (25.5), p=0.82 GCS, median (IQR) Total: 14 (4-15) AE ≤1h: 10 (3-15) AE 1-2h: 14 (3-15) AE 2-3: 15 (11-15) AE 3-4: 14 (6-15), p=0.19 ISS, median (IQR) Total: 34 (27-43) AE ≤1h: 38 (24-43) AE 1-2h: 34 (27-43) AE 2-3: 34 (22-43) AE 3-4: 34 (27-48), p=0.84		AE 2-3: 6 (7.6) AE 3-4: 5 (10.6), p=0.48 Hospital LOS, median (IQR) Total: 15 (8–28) AE ≤1h: 26 (10–45) AE 1-2h: 16 (9–34) AE 2-3: 14 (6–23) AE 3-4: 8 (8–31), p=0.11 ICU LOS, median (IQR) Total: 7 (4–14) AE ≤1h: 8 (5–15) AE 1-2h: 8 (4–15) AE 2-3: 7 (3–13) AE 3-4: 8 (4–16), p=0.81	study results still need to be interpreted with caution due to the retrospective study design.
Mikdad (2020) "Pre-peritoneal pelvic packing for early hemorrhage control reduces mortality compared to resuscitative endovascular balloon occlusion of the aorta in severe blunt pel-	**Inclusion criteria** • age ≥15 years • Blunt pelvic fractures • Received either PPP or abdominal REBOA (none-zone 1) • Patients with these codes were only included if they had a second exploratory laparotomy indicating removal of packing within 72 hours or if they dies	**Participants** N=420 patients before matching; N=204 after matching **Study groups** IG: received pre-peritoneal packing as primary procedure (N=307 before matching; N=102 after matching)	In-hospital mortality: n/N (%) IG: 38/102 (37.3) vs. CG: 53/102 (52.0). p=0.048 24-h mortality: n/N (%) IG: 18/102 (17.7) vs. CG: 33/102 (32.4). p=0.023 ED mortality: n/N (%) IG: 1/102 (1.0) vs. CG: 7/102 (6.9). p=0.065	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
vic trauma patients: A nationwide analysis." *Injury* 2020; *51*(8): 1834–1839. **Study design** Comparative registry study (ACS-TQIP) **Aim of the study** "The aim of this study is to compare the efficacy and outcomes of pre-peritoneal packing (PPP) and Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) with a subsequent hemorrhage control procedure to control life-threatening pelvic hemorrhage in trauma patients." **Setting** USA, 2015-2017	within 72 hours with no ability to go back to the operating room to remove packing **Exclusion criteria** • Dead on arrival • Transferred from an outside hospital • A penetrating mechanism • No have pelvic fractures • PPP or REBOA after 4 h • External fixation or angioembolization before PPP or REBOA **Characteristics after matching** <u>Age [y], mean ± SD</u> IG: 45.0 ± 17.6 vs. CG: 45.6 ± 18.1, p=0.811 <u>Female, n (%)</u> IG: 36 (35.3) vs. CG: 35 (34.3), p=1.00 <u>SBP<90 mmHg, n (%)</u> IG 33 (32.4) vs. CG 38 (37.3), p=0.557 <u>ISS, median (IQR)</u> IG: 34 (27-45) vs. CG 34 (27-43), p=0.828 <u>GCS ≤8, n (%)</u> IG: 52 (51.0) vs. CG: 52 (51.0), p=1.00	CG: treated with REBOA in conjunction with a definitive procedure for hemorrhage control (N=113 before matching; N=102 after matching) Patients receiving pre-peritoneal packing as a second hemorrhage control procedure after initially undergoing REBOA were considered to be in the REBOA group **Co-interventions** There were statistically significant differences in exploratory laparotomy and surgical management after PPP and REBOA between groups. **Matching criteria** • Vital signs in ED • Injury parameters (ISS and AIS) • Intra-abdominal, solid organ injuries	<u>Acute kidney injury: n/N (%)</u> IG: 11/102 (10.8) vs. CG: 10/102 (9.8), p=1 <u>Sepsis: n/N (%)</u> IG: 6/102 (5.9) vs. CG: 3/102 (2.9), p=0.498 <u>Surgical Site Infection: n/N (%)</u> IG: 5/102 (4.9) vs. CG: 2/102 (2.0), p=0.445 <u>Lower limb amputation: n/N (%)</u> IG: 7/102 (6.9) vs. CG: 4/102 (3.9), p=0.537 <u>Venous thromboembolism: n/N (%)</u> IG: 13/102 (12.8) vs. CG: 10/102 (9.8), p=0.659 <u>Extremity Compartment Syndrome: n/N (%)</u> IG: 2/102 (2.0) v. CG: 1/102 (1.0), p=1.000 <u>Fasciotomy: n/N (%)</u> IG: 5/102 (4.9) vs. 2/102 (2.0), p=0.445 <u>Hospital length of stay [d], median (IQR)</u> IG: 26 (16-38) vs. CG 17 (10-29), p=0.02 <u>ICU length of stay [d], median (IQR)</u> IG: 15 (9-22) vs. 8 (4-16), p<0.001	Detection bias: + **Authors' conclusion** "PPP is associated with improved survival compared to REBOA placement. Delay in definitive hemorrhage control may provide a potential explanation, but causation remains unresolved. This data suggests that early PPP may offer a benefit over REBOA in the setting of hemorrhage after blunt pelvic trauma." **Reviewers' conclusion** The study was well conducted and reported. Due to the retrospective nature of the study and unclear blinding, there may be residual biases. The population may overlap with that of Asmar 2021.
+: low risk; –: high risk; ?: unclear risk; AE: angioembolisation; AO: aortic occlusion; CI: Confidence Interval; ED: emergency department; EF: external fixation; GCS: Glasgow coma scale; GOS: Glasgow Outcome Score; HR: Hazard Ratio; ICU: intensive care unit; IQR: Interquartile Range; ISS: injury severity score; ITT: Intention to Treat; OR: Odds Ratio; PP: preperitoneal pelvic packing; RR: Relative Risk; RTS: revised trauma score; SBP: systolic blood pressure; SD: Standard Deviation; SEM: Standard Error of Mean; adj.: adjusted; d: days; m: months; y: years				

2.7 Thorax

Apparative Diagnostik (Röntgen-Thorax, Ultraschall, CT, Angiografie, EKG, Laboruntersuchungen)

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Lang (2017) „The role of whole-body computed tomography in the diagnosis of thoracic injuries in severely injured patients - a retrospective multi-centre study based on the trauma registry of the German trauma society (TraumaRegister DGU^{R})." *Scandinavian Journal of Trauma, Resuscitation & Emergency Medicine.* 2017;25(1):82. **Study design** Comparative registry study (TraumaRegister DGU®) **Aim of the study** We conducted a retrospective analysis of the trauma registry of the German Trauma Society (TraumaRegister DGU®) in order to assess the number of diagnosed thoracic injuries before and after the introduction of WBCT as a standard imaging modality and to investigate whether the trauma scan	**Inclusion criteria** • all cases of patients who were admitted to the trauma room with an ISS greater than or equal to 9 • Only patients who underwent primary treatment at a regional (Level II) or supraregional trauma centre (Level I) (as defined by the TraumaRegister DGU®) were included • continuous documentation over a period of at least five consecutive years was required **Exclusion criteria** • Patients who did not undergo immediate surgery or were not admitted to ICU • The patients who underwent an imaging procedure in the year in which the trauma scan was in troduced for routine use (N=2981; 18.0%) were not included in this study because of a wide variety of implementation rates **Characteristics** <u>Age [y], mean (CI)</u> IG: 45.7 (45.2–46.1) CG: 43.0 (42.5–43.6), p=nr <u>Male, n (%)</u> IG: 6248 (73.0) CG: 3677 (73.5), p=nr	**Participants** N=16,545 patients **Study groups** **IG:** trauma scan (WBCT group) (N=8,559) For cases in which the box for Whole-body CT in the TraumaRegister DGU® data collection form was checked, we assumed that a whole-body trauma scan was performed as a primary diagnostic procedure. The TR-DGU defines WBCT as a combination of CT studies that produce images (or slices) of the body in a continuous manner and cover at least the region from the skull base to the pelvis. **CG:** traditional diagnostic imaging (pre-WBCT group) (N=5,002) The other diagnostic approach consists of traditional imaging that involves conventional radiography of the cervical spine, the chest and the pelvis, often followed by focused CT (e.g. cranial CT).	Length of ICU stay [d] mean (CI) IG: 9.7 (9.4–10.0) CG: 10.8 (10.5–11.2), p=nr Length of intubation/ventilation [d] mean (CI) IG: 5.6 (5.4–5.8) CG: 6.9 (6.6–7.2), p=nr Length of hospital stay [d] mean (CI) IG: 23.3 (22.7–23.8) CG: 26.2 (25.8–26.9) , p=nr Ventilator-free days [d] mean (CI) IG: 20.8 (20.6–1.1) CG: 19.8 (19.4–20.1) , p=nr 24-h mortality [%] mean (CI) IG: 8.2 (7.6–8.8) CG: 8.9 (8.1–9.7) , p=nr Hospital mortality [%] mean (CI) IG: 15.6 (14.9–16.4) CG: 15.5 (14.5–16.5) , p=nr Organ failure [%] mean (CI) IG: 43.9 (42.7–45.1) CG: 43.5 (42.0–45.0) , p=nr Pulmonary failure [%] mean (CI) IG: 22.2 (21.2–23.2) CG: 26.2 (24.9–27.6) , p=nr Multi-organ failure [%] mean (CI)	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Following the replacement of traditional imaging (conventional radiography and focused CT) by WBCT as the standard imaging modality in the trauma room setting, a higher number of thoracic injuries were detected. The majority of these cases, however, were minor injuries requiring no immediate treatment. There was no change in the clinical management of the thoracic injuries investigated here. During the period from 2002 to 2012, the routine use of the trauma scan did not improve survival in the non-selected patient population (ISS = 9). WBCT, how-

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
led to a change in patient outcomes. Setting Germany, 2002-2012, 59 hospitals	Patients with blunt trauma [%] mean (CI) IG: 94.5 (94.2–95.0) CG: 94.8 (94.2–95.2), p=nr GCS mean (CI) IG: 11.1 (11.0–11.2) CG: 11.0 (10.8–11.1), p=nr Systolic blood pressure [mmHg] mean (CI) IG: 121.2 (120.5–122.0) CG: 119.9 (119.0–120.9), p=nr SpO2 [%] mean (CI) IG: 92.7 (92.4–93.0) CG: 92.5 (92.2–92.9), p=nr Patients with a GCS ≥8 [%] mean (CI) IG: 28.9 (28.0–29.6) CG: 30.3 (29.0–31.6), p=nr Patients with a systolic blood pressure = 90 mmHg [%] mean (CI) IG: 17.9 (17.0–18.7) CG: 18.2 (17.2–19.4), p=nr Patients with an AIS_{head} ≥3 [%] mean (CI) IG: 48.7 [47.6–49.8] CG: 48.9 [47.5–50.3], p=nr Patients with an AIS_{face} ≥3 [%] mean (CI) IG: 4.2 (3.8–4.6) CG: 2.4 (2.0–2.9), p=nr		IG: 26.9 (25.8–27.9) CG: 26.5 (25.2–27.8), p=nr	ever, led to a relevant reduction in the time spent in the trauma room (i.e. from 78 to 64 min).” **Reviewers’ conclusion** Even though risk of attrition and detection bias is low, there might be a moderate overall risk of bias due to high risk of bias regarding selection of participants and unclear performance bias.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Patients with an AIS_{thorax} ≥3 [%] mean (CI) IG: 50.0 (48.9–51.0) CG: 44.1 (42.8–45.5), p=nr Patients with an $AIS_{abdomen}$ ≥3 [%] mean (CI) IG: 15.8 (15.0–16.6) CG: 17.5 (16.4–18.5), p=nr Patients with an $AIS_{extremities}$ ≥3 [%] mean (CI) IG: 34.0 (33.0–35.0) CG: 37.2 (35.9–38.6), p=nr Patients with an $AIS_{soft\ tissues}$ ≥3 [%] mean (CI) IG: 2.0 (1.7–2.3) CG: 0.9 (0.6–1.1), p=nr Patients without thoracic injuries [%] mean (CI) IG: 40.2 (39.2–41.3) CG: 45.8 (44.4–47.2), p=nr ISS mean (CI) IG: 24.5 (24.2–24.7) CG: 23.9 (23.5–24.2), p=nr Type of thoracic injuries Injury to the lung parenchyma, % IG: 5.9 [5.4–6.4] CG: 12.6 [11.7–13.5] Pulmonary contusion, %			

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG: 28,7 [27.7–29.7]] CG: 18,5 [17.4–19.6] Pneumothorax, % IG: 21.6 [20.7–22.5] CG: 17.3 [16.3–18.4] Tension pneumothorax, % IG: 2.5 [2.2–2.8] CG: 2.9 [2.4–3.4] Haemothorax, [% IG: 14.0 [13.3–14.7] CG: 15.6 [14.6–16.6] Multiple rib fractures and flail chest, % IG: 21.6 [20.7–22.5] CG: 10.6 [9.7–11.4] Arterial injury (thorax), % IG: 1.5 [1.2–1.8] CG: 1.5 [1.2–1.8] Diaphragmatic injury, % IG: 1.1 [0.9–1.3] CG: 1.0 [0.7–1.3] Thoracic spine injury ≥AIS 2, % IG: 13.2 [12.5–13.9] CG: 10.9 [10.0–11.8] Thoracic spinal cord injury, % IG: 1.9 [1.6–2.2] CG: 1.7 [1.3–2.1] Cardiac injury, % IG: 0.5 [0.4–0.7] CG: 0.4 [0.2–0.6]			

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	No thoracic injuries, % IG: 40.2 [39.2–41.3] CG: 45.8 [44.4–47.2] AIS thorax = 1, % IG: 2.0 [1.7–2.3] CG: 2.8 [2.3–3.2] AIS thorax = 2, % IG: 9.3 [8.7–9.9] CG: 9.2 [8.4–10.0] AIS thorax = 3, % IG: 28.2 [27.3–29.2] CG: 24.9 [23.7–26.1] AIS thorax = 4, % IG: 14.6 [13.8–15.3] CG: 12.4 [11.5–13.3] AIS thorax = 5, % IG: 5.3 [4.8–5.8] CG: 4.7 [4.1–5.3] AIS thorax = 6, % IG: 0.3 [0.2–0.4] CG: 0.2 [0.1–0.3]			
Matsumoto (2016) "Diagnostic accuracy of oblique chest radiograph for occult pneumothorax: comparison with ultrasonography." World *Journal Of Emergency Surgery*. 2016; 11: 5.	**Inclusion criteria** • All consecutive blunt trauma patients 18 years or older clinically suspected of OPX on arrival at the emergency department were included in this study. Clinical findings suggestive of OPX were at least one of the following conditions: (1) radiographic abnormality without overt pneumothorax finding	**Participants** N=159 patients **Tests evaluated** Index test: The performance of lung US and OXR for the detection of pneumothorax was compared to CT scans as the gold standard. The diagnostic sensitivity, specificity, posi-	**Diagnostic test performance** **Sensitivity [%]** OXR 61.4 (0.56–0.64) Lung US 62.9 (0.57–0.66) **Specificity [%]** OXR 99.2 (0.98–1.00)	**Level of evidence** 2b **Risk of bias (QUADAS)** Patient selection: + Index test: ? Reference standard: ?

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Study design Diagnostic accuracy study **Aim of the study** The aim of this study was to evaluate the usefulness of OXR (oblique chest Radiograph) in the diagnosis of OPX (occult Pneumothorax). **Setting** Japan, 2010-2014	on APXR (rib fracture, permeability decay of lung field) or (2) physical abnormalities (chest pain, bruise, subcutaneous emphysema). **Exclusion criteria** • overt pneumothorax • patients requiring immediate invasive interventions • transferred from another hospital • age younger than 18 years • refractory shock • cardiac arrest **Characteristics (validation cohort)** Age [y], median (range) 49.6 (18-99) Male, n (%) 110 (69.2) traffic accidents, n (%) (71.5) falls n (%) (20) others n (%) (8.5) mechanical ventilation, n (%) 19 (11.9) average injury score (SD) 14 ± 9.8.	tive predictive value (PPV), negative predictive value (NPV), and accuracy for US and OXR were calculated using standard formulas. A value of p<0.05 was considered statistically significant. The agreement between lung US and OXR was assessed using the k coefficient, which gauges whether the agreement is better than would occur by chance alone; a k value of 1 indicates perfect agreement. Reference standard: In accordance with ATLS guidelines, all patients had an examination and underwent APRX immediately upon admission. If the criteria were met, patients underwent OXR and lung US in the supine position in the emergency department, and underwent CT scans as soon as possible. OXR and lung US were performed on the bilateral-lung field as part of the routine method. In these patients, CT scans were considered the gold standard and were analyzed together with OXR and lung US.	Lung US 98.8 (0.97–1.00) **Positive predictive value [%]** OXR 95.6 (0.86–0.99) Lung US 93.6 (0.84–0.98) **Negative predictive value [%]** OXR 90.1 (0.87–0.91) Lung US 90.4 (0.89–0.91) **Accuracy [%]** OXR 90.9 (0.88–0.92) Lung US 90.9 (0.88–0.92 true positive (N=318) n (%): 43(12.8) false positive (N=318) n (%): 2(0.6) true negative (N=318) n (%): 246(73.2) false negative (N=318) n (%): 27(11.9) There was no significant difference between the accuracies of the two methods in terms of OPX diagnosis (p=0.88). The agreement between the two methods for OPX diagnosis was 93.3 % (k = 0.804, p<0.001). **Subgroup according to size (N=70)** Sensitivity Minuscule (n=19) OXR: 15.8 Lung US: 10.5, p=0.63	Flow and timing: + **Authors' conclusion** "OXR appears to be as good method as lung ultrasonography in the detection of large occult pneumothorax. In trauma patients who are difficult to transfer to computed tomography scan, OXR may be effective at detecting occult pneumothorax with a risk of progression." **Reviewers' conclusion** The results should be interpreted with caution due to missing information on index test and reference standard.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Anterior (n=32) OXR: 68.8 Lung US: 75.0, p=0.59 Anterolateral (n=19) OXR: 94.7 Lung US: 94.7, p=1.0	
+: low risk; –: high risk; ?: unclear risk; AIS: Abbreviated Injury Scale; CG: control group; CI: 95% Confidence Interval; CT: computed tomography; CXR: chest radiography; ED: emergency department; HR: Hazard Ratio; IG: intervention group; IQR: Interquartile Range; ISS: injurie severity score; ITT: Intention to Treat; LoE: level of evidence; nr: not reported; OXR: oblique chest Radiograph; OPX: occult Pneumothorax; OR: Odds Ratio; PC: pulmonary contusion; RR: Relative Risk; SD: Standard Deviation; SEM: Standard Error of Mean; SOCTO: seen on CT only; WBCT: Whole body CT; adj.: adjusted; d: days; m: months; y: years				

Ultraschalluntersuchung des Thorax

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Kozaci 2019 „Comparison of ultrasonography and computed tomography in the determination of traumatic thoracic injuries." *American Journal of Emergency Medicine.* 2019; 37(5): 864-8. **Study design** Diagnostic accuracy study **Aim of the study** "In this study, the accuracy of bedside thoracic	**Inclusion criteria** • suffered multiple traumas • thoracic trauma was identified on physical examination, and by thoracic computed tomography imaging **Exclusion criteria** • Patients who underwent thoracic computed tomography imaging at other medical centers before referral to the emergency department • pregnant patients **Characteristics** Age [y], mean ± SD	**Participants** N=81 patients **Tests evaluated** Patients who suffered the multiple traumas, whose thoracic trauma was identified on physical examination or thoracic computed tomography imaging were included in the study. Thoracic ultrasonography was performed following a physical examination by the emergency physician who managed the trauma patient. Subcutaneous emphysema, pneumothorax, pulmonary contusions (PCs), hemothorax, pericardial effusion and tamponade, sternal and clavicular fractures and	**Diagnostic test performance** **N=76** **Sensitivity [%]** Subcutaneous emphysema 56 Pneumothorax 86 Sternal fracture 83 Clavicular fracture 83 Rib fracture 67 Hemothorax 45 Pulmonary contusion 63	**Level of evidence** 2b **Risk of bias (QUADAS)** Patient selection: + Index test: ? Reference standard: ? Flow and timing: - **Authors' conclusion** "In conclusion, ultrasound was found to be highly specific but only moderately

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
ultrasonography (TUSG) performed by emergency physicians with patients in the supine position was compared with that of thoracic computed tomography (TCT) for the determination of thoracic injuries due to trauma." **Setting** Turkey, June 2015 – March 2018	38 ± 20 Male, n (%) 64 (79) Penetrating wound n (%) 10 (12) Blunt trauma due to accident n (%) 43 (53) Blunt trauma due to falling n (%) 26 (32) Blunt trauma due to direct impact n (%) 2 (3) GCS n (%) 14–15: 73 (89) 9–13: 2 (3) 3–8: 7 (9)	rib fractures were identified by thoracic ultrasonography. Thoracic computed tomography imaging was performed after the ultrasonography examination was completed. Thoracic ultrasonography scanning was performed in the following steps 1. Scanning for the presence of subcutaneous emphysema (SE); the presence of SE was accepted when E lines were detected. The linear probe was used to detect E lines. E lines are vertical lines that reach the edge of the screen but do not arise from the pleural line. 2. Scanning for the presence of sternal, clavicular and rib fractures; the linear probe was used to detect bone fractures. The sternal cortex, clavicular cortex and rib cortex in the longitudinal and transverse planes were scanned for the detection of fractures. Bone fractures were accepted when cortical impairment was detected. 3. Scanning for the presence of pneumothorax; the linear probe was used to detect B lines, lung sliding and lung pulse. B lines, lung sliding, lung pulse and "seashore" mark were also scanned. In the absence of these findings, the presence of pneumothoraxwas accepted. 4. Scanning for the presence of PCs; the linear probe was used to detect B and C lines. The convex probe was used to detect hepatization and parenchymal disruption. 5. Scanning for the presence of pericardial effusion and tamponade; the heart was	**Specificity [%]** Subcutaneous emphysema 95 Pneumothorax 97 Sternal fracture 97 Clavicular fracture 100 Rib fracture 98 Hemothorax 98 Pulmonary contusion 91 **AUC (CI)** Subcutaneous emphysema 0.758 (0.601–0.915) Pneumothorax 0.912 (0.820–1.000) Sternal fracture 0.903 (0.726–1.000) Clavicular fracture 0.917 (0.739–1.000) Rib fracture 0.825 (0.698–0.952) Hemothorax 0.717 (0.567–0.867) Pulmonary contusion	sensitive for the identification of thoracic injuries." **Reviewers' conclusion** Unclear risk of bias due to missing information and poor reporting regarding index test and reference standard. Additionally 5 participants were not included in analysis; reasons for this are not reported. This leads to high risk of bias in flow and timing.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
		evaluated by the convex probe in the subxiphoid area. The presence of cardiac tamponade was accepted when researchers revealed an anechoic pericardial effusion with collapse of the right atrium and right ventricle in the diastolic phase. 6. Scanning for the presence of hemothorax. The presence of hemothorax was considered when the anechoic area was detected in the pleural area with a convex probe.	0.769 (0.648–0.889) Physical examination Subcutaneous emphysema n (%) 15 (18.5) Pneumothorax n (%) 12 (14.8) Sternal fracture n (%) 2 (2.5) Rib fracture n (%) 12 (14.8) Clavicular facture n (%) 2 (2.5) Hemothorax n (%) 3 (3.7) Pulmonary contusion n (%) 11 (13.6) Pericardial effusion n (%) 0 (0)	
Leblanc (2014) "Early lung ultrasonography predicts the occurrence of acute respiratory distress syndrome in blunt trauma patients." Intensive Care Medicine. 2014; 40(10): 1468-74.	**Inclusion criteria** • Patients with multiple blunt trauma were enrolled in the study if one of the physicians trained in lung ultrasonography (i.e., with an experience of more than 30 LUS in trauma patients) was present. **Exclusion criteria**	**Participants** N=45 patients **Tests evaluated** Index test: LUS was performed after completion of clinical examination by an anesthesiologist trained for LUS blinded to the clinical examination and CXR results.	We found no significant difference between the two diagnostic modalities for pneumothorax diagnosis (p=0.24). Ultrasonography in the diagnosis of pneumothorax. **ARDS** severe ARDS AUC (95% CI) 0.86 (0.77–0.96), p=nr severe to moderate ARDS AUC (95% CI)	**Level of evidence** 2b **Risk of bias (QUADAS)** Patient selection: + Index test: + Reference standard: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Study design Diagnostic accuracy study **Aim of the study** "We hypothesized that early assessment of lung contusion extent using lung ultrasonography can predict the occurrence of ARDS in blunt trauma patients." **Setting** France, May 2010 - July 2011	• NR **Characteristics** Age [y], mean ± SD 35 ± 16 Male, n (%) 32 (71) ISS median [IQR] 34 [25–48] GCS , mean ± SD 11 ± 4 Distribution of injuries Head trauma, n (%) 18 (40) Chest trauma, n (%) 40 (89) Abdominal trauma, n (%) 21 (47) Spinal fractures, n (%) 13 (29) Extremity bone fractures, n (%) 16 (36) Physiologic parameters on admission SBP [mmHg], mean ± SD	Reference standard: The diagnostic accuracy of LUS was compared to that of combined clinical examination and chest radiography for pneumothorax, lung contusion, and hemothorax, with thoracic CT scan as reference.	0.77 (0.61–0.92), p=nr. severe to mild ARDS AUC (95% CI) 0.78 (0.64–0.92), p=nr **Ultrasonography in the diagnosis of** pneumothorax AUC-ROC (95% CI) 0.81 (0.50–1.00) vs. 0.74 (0.48–1.00), p=0.24 lung contusion AUC- ROC (95% CI) 0.88 (0.76–1.00) vs. 0.69 (0.47–0.92), p=0.05 Hemothorax AUC- ROC (95% CI) 0.84 (0.59–1.00) vs. 0.73(0.51–0.94), p=0.05	Flow and timing: + **Authors' conclusion** "lung ultrasonography on admission identifies patients at risk of developing ARDS after blunt trauma. In addition, lung ultrasonography allows rapid and accurate diagnosis of common traumatic thoracic injuries." **Reviewers' conclusion** Risk of bias is low, but the sample size is small.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	122 ± 30 Heart rate, [beats/min], mean ± SD 93 ± 25 Lactates [mmol/L], mean ± SD 2.3 ± 1.3 Ventilator-free days by day 28 [d] 21 ± 7 Length of ICU stay [d] 2.5 [1–8.5] Patients developing ARDS, n (%) Overall 20 (44) Severe 5 Moderate 10 Mild 5 Death, n (%) 8 (18)			
Ojaghi Haghighi 2014 Ojaghi Haghighi SH, Adimi I, Shams Vahdati S, Sar-	**Inclusion criteria** • Patients with severe multiple trauma who were suspected of having chest	**Participants** N=150 patients	**Primary outcomes** **Diagnostic accuracy for detection of pneumotho-rax (ultrasonography)**	**Level of evidence** 2b

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
khoshi Khiavi R. "Ultrasonographic diagnosis of suspected hemopneumothorax in trauma patients." *Trauma Monthly*. 2014;19(4):e17498. **Study design** Diagnostic cross-sectional study **Aim of the study** "The aim of this study was to evaluate the sensitivity and specificity of ultrasonography in the diagnosis of pneumothorax and hemothorax in comparison with portable CXR and CT-Scan." **Setting** Iran, 2013	injuries, and who had indications for a chest CT-scan according to ATLS algorithms **Exclusion criteria** • Patients who underwent a tube thoracostomy, before they had an opportunity to have an ultrasound due to their unstable clinical situation, or for any other reason, such as a lack of access to ultrasound at the time of admission, were excluded from the study. **Characteristics** Age [y], mean ± SD nr Male, n (%) 124 (82.66) ISS nr	**Tests evaluated** Index test 1: ultrasonography Index test 2: portable chest radiography Reference test: CT **Notes** • Examination findings included: chest pain, tenderness over the ribs, decreased lung sounds or chest percussion, subcutaneous emphysema, or any sign of trauma such as abrasions and/or bruises. Patients were evaluated according to the ATLS algorithm, and examination findings were recorded following initial evaluations, an emergency medicine specialist performed chest ultrasonography to detect pneumothorax and hemothorax.	True positive: 50 True negative: 98 False positive: 0 False negative: 2 Sensitivity [%] 96.15 Specificity [%] 100 PPV [%] 100 NPV [%] 98 **Diagnostic accuracy for detection of hemothorax (ultrasonography)** True positive: 39 True negative: 101 False positive: 2 False negative: 8 Sensitivity [%] 82.97 Specificity [%] 98.05 PPV [%] 95.12 NPV [%]	**Risk of bias (QUADAS)** Patient selection: ? Index test: + Reference standard: + Flow and timing: + **Authors' conclusion** "Ultrasonography sensitivity and specificity for diagnosis of hemopneumothorax was high. The sensitivity of portable CXR was low despite its high specificity for the detection of hemothorax and pneumothorax" **Reviewers' conclusion** Unclear risk of bias due to missing information regarding patient selection.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			92.66 **Diagnostic accuracy for detection of pneumothorax (portable CXR)** True positive: 18 True negative: 96 False positive: 2 False negative: 34 Sensitivity [%] 34.61 Specificity [%] 97.95 PPV [%] 90 NPV [%] 73.84 **Diagnostic accuracy for detection of hemothorax (portable CXR)** True positive: 12 True negative: 98 False positive: 5 False negative: 35 Sensitivity [%] 25.53 Specificity [%] 95.14 PPV [%]	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			70.58 NPV [%] 73.68	
+: low risk; –: high risk; ?: unclear risk; adj.: adjusted; CI: Confidence Interval; CT: computed tomography; CXR: chest X-ray; d: days; HR: Hazard Ratio; IQR: Interquartile Range; ISS: injurie severity score; ITT: Intention to Treat; LoE: level of evidence; m: months; nr: not reported; OXR: oblique chest Radiograph; OPX: occult Pneumothorax; OR: Odds Ratio; RR: Relative Risk; SD: Standard Deviation; SEM: Standard Error of Mean; TCT: thoracic CT; TUSG: thoracic ultrasonography; WBCT: whole body CT; y: years				

Thoraxdrainage

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Mahmood (2015) "Outcome of concurrent occult hemothorax and pneumothorax in trauma patients who required assisted ventilation." *Emergency Medicine International Print.* 2015; 2015: 859130. **Study design** Prospective cohort study **Aim of the study** "Therefore, the present study aims to evaluate the management and outcomes of blunt trauma patients with occult HPTX who need PPV and to determine the role of tube thoracostomy in their	**Inclusion criteria** • blunt chest trauma patients who required positive pressure ventilation or ventilator support for surgical procedure and presented with concurrent hemopneumothorax by chest CT **Exclusion criteria** • nr **Characteristics** Age [y],mean ± SD IG: 35.3 ± 14.1 CG: 36 ± 12.7, p=0.85 Male, n (%) IG: 14 (93.3 CG: 41 (100%),p=0.09 *Mechanism of injury (p=0.13)* Motor vehicle crash n (%)	**Participants** N=56 patients **Study groups** IG: chest tube (N=15) CG: no chest tube (N=41) Indications for chest tube placement are respiratory compromise with oxygen desaturation and X-ray evidence of pneumothorax or hemothorax progression (increased haziness with obliteration of both costophrenic and cardiophrenic angles).	Ventilatory days, median (range) IG: 6 (1–20) CG: 2 (1–21), p=0.02 Hospital length of stay [d] media (range) IG: 18 (5–90) CG: 17 (3-90), p=0.42 Ventilator-associated pneumonia n (%) IG: 4 (26.7) CG: 12 (29.3), p=0.84 Acute Respiratory Distress Syndrome n (%) IG: 6 (40) CG: 3 (7.3), p=0.003 Mortality n (%) IG: 2 (13.3) CG: 2 (4.9), p=0.28	**Level of evidence** 2b **Risk of bias** Selection bias: ? Performance bias: ? Attrition bias: + Detection bias: ? **Authors' conclusion** "The majority of occult hemopneumothorax can be carefully managed without tube thoracostomy in patients who required positive pressure ventilation. Tube thoracotomy could be restricted to those who had evidence of increase in the size of the hemothorax or pneumothorax on follow-

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
management. We hypothesized that occult HPTX in patients with blunt trauma who need PPV or ventilatory support for surgical procedure can be managed conservatively." **Setting** Qatar, 2011-2013	IG: 5 (33.3) CG: 20 (48.8) Fall from height n (%) IG: 3 (20) CG: 13 (31.7) Pedestrian n (%) IG: 4 (26.7) CG: 6 (14.6) Stab n (%) IG: 0 (0) CG: 1 (2.4) Other n (%) IG: 3 (20) CG: 1 (2.4) Lung contusion n (%) IG: 14 (93.3) CG: 33 (80.5), p=0.25 Number of fractured ribs, median (range) IG: 4 (1–7) CG: 4 (1–6), p=0.59 Hemothorax thickness, median (range) IG: 13 (1–40) CG: 9 (1–21), p=0.04 Pneumothorax thickness, median (range) IG: 12 (2–80) CG: 10 (2–70), p=0.12 Injury severity score, mean ± SD IG: 24.9 ± 6.5 CG: 24.3 ± 9.5, p=0.79			up chest radiographs or developed respiratory compromise." **Reviewers' conclusion** Unclear risk of bias due to missing information on selection bias, performance bias and detection bias.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Chest AIS, mean ± SD IG: 2.93 ± 0.25 CG: 2.98 ± 0.27, p=0.60 Surgical procedures n (%) IG: 2 (13.3) CG: 17 (41.5), p=0.04			
Clements (2021) "OPTICC: A multicentre trial of Occult Pneumothoraces subjected to mechanical ventilation: The final report." American Journal of Surgery. 2021; 20: 20 **Study design** Randomised controlled trial **Aim of the study** **Setting** Five Regional trauma centers participated Canada: Calgary, 2006-2020 Toronto, 2008-2011 Quebec City, 2007-2008 Sherbrooke, 2008-2020 UK: London, 2014-2016	**Inclusion criteria** • 18 years or older, had an OPTX identified on CT scan, had no pre-existing chest drain or hemothorax, and no respiratory compromise of any nature in the judgement of the attending clinician. PTX size was not a disqualifying criterion • Patients were enrolled within 6 h of OPTX diagnosis if they were already undergoing PPV or upon commencing PPV for an operative procedure if they were not ventilated at enrollment, but within 24 h of hospital admission. Patients were also eligible if scheduled to undergo PPV for a surgical procedure within 24 h of admission. **Exclusion criteria** • Patients were excluded if they were not expected to survive or had OPTX felt to require drainage by the attending, treating physician. **Characteristics** Age [y],median (IQR) IG: 31.0 (22.0-47.5) CG: 33.0 (23.5-49.0), p=0.61	**Participants** N=133 patients **Study groups** IG: chest tube (drainage) (N=64) CG: observation (N=69) Patients randomized to drainage could receive traditional tube thoracostomy or any other percutaneous catheter as per attending physician discretion. For patients randomized to observation, a chest drain could be inserted any time that the responsible clinicians perceived the patient had hemodynamic or respiratory compromise, or if a new event arose requiring drainage (e.g., pleural fluid accumulation).	Respiratory distress, n (%) IG: 16 (25.0) CG: 26 (37.7), p=0.14 Mortality, n (%) IG: 6 (nr) CG: 4 (nr), p=0.51 ICU days, median IG: 5.0 (2.0-9.7) CG: 5.0.(2.0-11.5), p=0.50 Ventilator days, median (IQR) IG: 3.0 (0.25-7.0) CG: 4.0 (1.0-8.75), p=0.32 Hospital days, median (IQR) IG: 20 (9-45.5) CG: 18.0 (11.0-43.0), p=0.83 Respiratory-related tracheostomy, n (%) IG: 5 (8.2) CG: 8 (11.7), p=0.99 VAP, n (%) IG: 9 (14.7) CG: 16 (23.0), p=0.36 ALI/ARDS, n (%)	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: – Attrition bias: + Detection bias: – **Authors' conclusion** "RD was not significantly different with observation. Thus, OPTXs may be cautiously observed in stable patients undergoing short-term PPV when prompt "rescue drainage" is immediately available. As 40% of patients undergoing prolonged (≥5 days) ventilation (PPPV) require drainage, we suggest consideration of chest drainage performed with expert guidance to reduce risk of chest tube complications."

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Male, n (%) IG: 44 (68.8) CG: 50 (72.0), p=0.70 ISS, median (IQR) IG: 30.5 (26-41) CG: 32.0 (22-43), p=0.85 Mechanism of injury, n (%) *MVC/MBC* IG: 40 (62.5) CG: 46 (66.7), p=0.72 *Pedestrian vs. MV* IG: 9 (14.0) CG: 10 (14.5), p=0.76 *Falls* IG: 6 (9.0) CG: 7 (10.0), p=1.00 *Snowboard* IG: 1 (1.6) CG: 1 (1.3), p=1.00 *Struck by Object* IG: 1 (1.6) CG: 1 (1.3), p=1.00 *All-Terrain Vehicle* IG: 1 (1.6) CG: 1 (1.3), p=1.00 *Assault*		IG: 4 (6.5) CG: 4 (nr), p=1.00 Empyema, n (%) IG: NA CG: 1(nr), p=NA Pleural drainage duration[d], median (IQR) IG: 5.0 (3.5-8.7) CG: NA, p=NA	**Reviewers' conclusion** High risk of performance and detection bias due to missing blinding of participants and investigators. Though blinding in this setting might not be possible anyway. Additionally, information on length of follow up and determination of outcomes are missing.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG: 1 (1.6) CG: 1 (1.3), p=1.00 *Self-inflicted* IG: 2 (nr) CG: 1 (1.3), p=0.20 *Wheelchair* IG: 0 (0) CG: 1 (1.3), p=1.00 *Unknown* IG: 3 (4.6) CG: 1 (1.3), p=0.31 <u>Size of OPTXs, median (IQR)</u> *Ball index* IG: 15.5 (5.5-63.0) CG: 17.6 (3.8-45.9), p=0.66 *de Moya score* IG: 21.5 (16.0-29.0) CG: 20.0 (15.0-25.0), p=0.34 *AAST (mm)* IG: 11 (6.0-19.7) CG: 9.8 (5.0-15.0), p=0.30			

+: low risk; –: high risk; ?: unclear risk; CG: control group; CI: 95 % Confidence Interval; CT: computed tomography; CXR: chest X-Ray; ED: Emergency department; HR: Hazard Ratio; IG: intervention group; IQR: Interquartile Range; ISS: injurie severity score; ITT: Intention to Treat; LoE: level of evidence; NA: not applicable; nr: not reported OXR: oblique chest Radiograph; OPTX: occult Pneumothorax; OR: Odds Ratio; PC: pulmonary contusion; PPV: positive-pressure ventilation; PTX: pneumothorax; RR: Relative Risk; SD: Standard Deviation; SEM: Standard Error of Mean; SOCTO: seen on CT only; y: years

Intubation, Perikardpunktion, Thorakotomie

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Kulvatunyou (2021) „The Small 14-French (Fr) Percutaneous Catheter vs. Large (28-32Fr) Open Chest Tube for Traumatic Hemothorax (P-CAT): A Multi-center Randomized Clinical Trial." *The Journal of Trauma and Acute Care Surgery.* 2021; 16: 16. **Study design** Randomised controlled trial **Aim of the study** "We hypothesized that PCs are still as equally effective as CTs in the management of patients with traumatic HTX." **Setting** USA, July 2015 – September 2020	**Inclusion criteria** • ≥18 years • suffered traumatic HTX or hemo-pneumothorax (HPTX) requiring drainage **Exclusion criteria** • For HPTX, if the HTX was small and the drainage tube was being placed primarily for the PTX, the patient was not enrolled in the study. • emergency placement due to hemodynamic instability (patient was in extremis as determined by treating physician and/or unable to provide consent due to the physiologic stress produced by the trauma injuries) • the catheter placement in the operating room as part of the operating procedure, • the catheter placement in patients who declined to participate in the study or researcher was unable to obtain consent from either the patient or the next-of-kin. **Characteristics** Age [y], mean ± SD IG: 54 ± 19 CG: 56 ± 17, p=0.50 Male, n (%) IG: nr (81) CG: nr (84), p=0.67 Blunt trauma, n (%)	**Participants** N=120 patients **Study groups** IG: large-bore (36-40French [Fr]) chest tube (CT) (N=63) CG: 14 Fr percutaneous (pigtail) catheter (PC) (N=57)	Failure rate, %, (n) IG: 13 (8) CG: 11 (7), p=0.74 Initial output (ml), median (IQR) IG: 400 (250, 650) CG: 600 (375, 1037), p=0.005 24-hour output (ml), median (IQR) IG: 685 (450, 1000) CG: 930 (600, 1350), p=0.05 48-hour output (ml), median (IQR) IG: 180 (80, 300) CG: 150 (60, 310), p=0.77 72-hour output (ml), median (IQR) IG: 130 (0, 272) CG: 45 (0, 200), p=0.28 Tube days, median, (nr) IG: 5 (3, 7) CG: 4 (3, 6), p=0.31 IPE score, median (IQR) IG: 3 (2, 5) CG: 1 (1, 2), p<0.001 VATS, % IG: 5 CG: 7, p=0.58	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: ? **Authors' conclusion** "Small caliber 14Fr PCs are equally as effective as 28-32Fr CTs in their ability to drain traumatic HTX with no difference in complications. Patients reported better IPE scores with PCs over CTs, suggesting PCs are better tolerated." **Reviewers' conclusion** Unclear risk of bias due to missing information regarding blinding of participants and investigators. However, investigators or individuals administrating care would probably see the difference in tube size anyway. Low risk of bias regarding selection and attrition bias.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG: nr (75) CG: nr (87), p=0.08 ISS IG: 17.3 ± 6.8 CG: 17.8 ± 6.8, p=0.71 Number of rib fractures, mean ± SD IG: 4.5 ± 3.6 CG: 4.4 ± 3.5, p=0.50 Fail (yes), % IG: 10 CG: 16, p=0.28 Days from injuriy tube inserted, median (IQR) IG: 1 (1,2) CG: 2 (1,5), p=0.21		Ventilator day, median (IQR) IG: 0 (0, 0) CG: 0 (0, 2), p=0.13 ICU day, median (IQR) IG: 2 (0, 4) CG: 2.5 (0, 3.5), p=0.28 Hospital length of stay [d], median (nr) IG: 8 (5, 12) CG: 8.5 (5.5, 15), p=0.30	
Bauman (2021) "Randomized Clinical Trial of 14-French (14F) Pigtail Catheters versus 28-32F Chest Tubes in the Management of Patients with Traumatic Hemothorax and Hemopneumothorax." *World Journal of Surgery*. 2021; 45(3): 880-6. **Study design** Randomised controlled trial **Aim of the study**	**Inclusion criteria** • ≥18 years • suffered traumatic HTX/HPTX requiring drainage. Chest trauma can result in the combination of both a HTX and PTX. • Patients presenting with a combined HPTX were only enrolled in the study if the HTX component was substantial enough for drainage based on chest X-ray or computed tomography. **Exclusion criteria** • If the HTX component was small and the drainage tube was being placed primarily for the PTX portion, the patient was not enrolled.	**Participants** N=43 patients **Study groups** IG: 28–32Fr chest tubes (N=23) CG: 14Fr Pigtail Catheters (PCs) (N=20) The remaining tube management and secondary interventions were left to the discretion of the rounding attending trauma surgeon. At our institution, eight trauma surgeons routinely crossover for management of patients with traumatic HTX/HPTX, therefore not one surgeon is only managing PC patients and vice versa. Given there is no standardization of chest catheter management in the current literature, this crossover	Failure rate, %, (n) IG: 17 (4) CG: 10 (2), p=0.49 Initial output (ml), median (IQR) IG: 400 (240, 700) CG: 650 (375, 1087), p=0.06 24-hour output (ml), median (IQR) IG: 660 (430, 1000) CG: 980 (600, 1625), p=0.10 48-hour output (ml), median (IQR) IG: 225 (90, 400) CG: 300 (110, 424), p=0.22 72-hour output (ml), median (IQR)	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: ? **Authors' conclusion** "In patients with traumatic HTX/HPTX, 14Fr PCs were equally as effective as 28–32Fr CTs with no significant difference in failure rates.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"The aim of our study was to compare the effectiveness between 14Fr PCs and 28–32Fr CTs in the management of traumatic HTX/HPTX by performing the first randomized controlled trial (RCT). We hypothesized PCs would be as equally effective as CTs in the management of patients with traumatic HTX/HPTX." **Setting** USA, July 2015 - January 2018	• emergency placement of the catheter due to hemodynamic instability (patient was in extremis or unable to provide consent due to the physiologic stress produced by the traumatic injuries) • the catheter was placed in the operating room when the patient was under anesthesia or the patient declined enrollment Age [y], mean + SD IG: 55+ 18 CG: 62 + 13, p=0.16 Male, n (%) IG: 96 CG: 85, p=0.23 Blunt trauma, n (%) IG: 74 CG: 95 p=0.06 ISS IG: 15.8 + 5.9 CG: 17.5 + 6.6, p=0.40 C-AIS, median (IQR) IG: 4 (3, 4) CG: 3.5 (3, 4), p=0.89 Number of rib fractures, mean ± SD IG: 4 (1, 6) CG: 5 (2.5, 7), p=0.50 Fail (yes), % IG: 0 CG: 9, p=0.18	allows for better imitation of real-world clinical practice and accounts for any variability present with tube management. Prior to the implementation of a secondary intervention when a possible retained HTX (rHTX) was suspected, a repeated chest computed tomography scan or ultrasound was obtained for confirmation.	IG: 130 (0, 260) CG: 50 (0, 200), p=0.54 Tube days, median, (nr) IG: 4 (2, 7) CG: 4 (3, 5.5), p=0.79 IPE score, median (IQR) IG: 3 (3, 4) CG: 1 (1, 2), p=0.001 VATS, % IG: 9 CG: 5, p=0.64 Ventilator day, median (IQR) IG: 0 (0, 0) CG: 0 (0, 0.5), p=0.30 ICU day, median (IQR) IG: 0 (0, 3) CG: 0 (0, 3.5), p=0.86 Hospital length of stay [d], median (nr) IG: 7 (3, 9) CG: 6.5 (4.5, 10) 0.54	PC patients, however, reported a better insertion experience." **Reviewers' conclusion** Unclear risk of bias due to missing information regarding blinding of participants and investigators. However, investigators or individuals administrating care would probably see the difference in tube size anyway. Low risk of bias regarding selection and attrition bias.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Days from injuriy tube inserted, median (IQR) IG: 1 (1, 2) CG: 2.5 (1, 5), p=0.18			

+: low risk; –: high risk; ?: unclear risk; adj.: adjusted; C-AIS: chest abbreviated injury scale scoreCG: control group; CI: Confidence Interval; CT: chest tubes; d: days; HR: Hazard Ratio; ICU: intensive care unit; IG: intervention group; IPE: insertion perception experience; IQR: Interquartile Range; ISS: injurie severity score; ITT: Intention to Treat; OXR: oblique chest Radiograph; m: months; nr: not reported; OPX: occult Pneumothorax; OR: Odds Ratio; PC: pigtail catheters; RR: Relative Risk; SD: Standard Deviation; SEM: Standard Error of Mean; VATS = Video-Assisted Thoracoscopy; y: years

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Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Asmar (2021) "Resuscitative Endovascular Balloon Occlusion of the Aorta vs Pre-Peritoneal Packing in Patients with Pelvic Fracture." *Journal of the American College of Surgeons* 2021; 232(1): 17-26. **Study design** Comparative registry study (ACS-TQIP) **Aim of the study** "Our study aims to evaluate the outcomes of PP,	**Inclusion criteria** • adult (age ≥18 years) trauma patients • blunt pelvic fractures • hemodynamic instability (SBP<100 mmHg) • who underwent zone III REBOA and/or PP prior to laparotomy and/or AE **Exclusion criteria** • severe extra-pelvis injuries (AIS ≤2), except for concomitant lower extremity injuries • transfer patients • patients declared dead on arrival • REBOA ≥1h after admission • patients who underwent ED thoracotomy	**Participants** N=749 before matching; N=156 after matching **Study groups** PP: pre-peritoneal packing (N=548 before matching; N=52 after matching) REBOA: resuscitative endovascular balloon occlusion of the aorta (N=149 before matching; N=52 after matching) REBOA+PP: underwent both procedures (N=52 before and after matching) **Matching criteria** • demographics • comorbidities • ED vital signs • mechanism of injury	24-hour mortality: n/N (%) PP: 13/52 (25) REBOA: 7/52 (14) REBOA + PP: 18/52 (35), p=0.042 In-hospital mortality: n/N (%) PP: 23/52 (44) REBOA: 15/52 (29) REBOA + PP: 28/52 (54), p=0.034 Hospital LOS [d]: median (IQR) PP: 22 (10-33) REBOA: 20 (10-31) REBOA + PP: 21 (13-35), p=0.775 ICU LOS [d]: median (IQR) PP: 9 (5-18) REBOA: 10 (5-16) REBOA + PP: 9 (6-16), p=0.992	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "REBOA is a less invasive procedure compared to PP and is associated with improved outcomes. Further clinical trials are needed to define the optimal patient

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
REBOA, and REBOA with PP, as a bridge to definitive laparotomy and/or angioembolization, in hemodynamically unstable patients with pelvic fractures." **Setting** USA, 2017	• patients with a known history of bleeding diathesis • patients with missing ED vital signs and missing time to procedure **Characteristics after matching** Age [y], mean ± SD PP: 39±18 REBOA: 44±18 REBOA + PP: 45±17, p=0.284 Male, n (%) PP: 34 (65) REBOA: 41 (79) REBOA + PP: 41 (79), p=0.193 SBP [mmHg], mean ± SD PP: 77 ± 8 REBOA: 76 ± 10 REBOA+PP: 75 ± 8, p=0.296 GCS, median (IQR) PP: 11 (11-14) REBOA: 11 (11-14) REBOA + PP: 11 (11-14), p=0.123 Pelvic AIS, median (IQR) PP: 4 (3-5) REBOA: 4 (3-5) REBOA+PP: 4 (3-5), p=0.801 ISS, median (IQR) PP: 28 (17-29 REBOA: 28 (17- 33) REBOA + PP: 28 (17-33), p=0.837 Mechanism of injury, n (%)	• injury characteristics • American College of Surgeons trauma center verification level • intervention for definitive hemorrhage control	Acute kidney injury): n/N (%) PP: 3/52 (6) REBOA: 5/52 (10) REBOA + PP: 4/52 (8), p=0.642	who will benefit from REBOA." **Reviewers' conclusion** Results need to be interpreted with caution due to the retrospective study design and unclear risk of performance bias. Results are post matching for important confounders. No matching was possible for variables including duration of occlusion or responsiveness of patients to initial resuscitation efforts.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Motor vehicle intrusion PP: 20 (39) REBOA: 20 (39) REBOA+PP: 19 (37), p=0 .973 *Pedestrian struck* PP: 18 (35) REBOA: 18 (35) REBOA+PP: 20 (39), p=0.895 *Fall* PP: 3 (6) REBOA: 6 (12) REBOA+PP: 5 (10), p=0.577			
Chu (2016) "Trends in the management of pelvic fractures, 2008-2010". *Can J Surg* 2016; 202(2); 335-340. **Study design** Comparative registry study (National Trauma Data Bank) **Aim of the study** "We sought to determine how frequently the two most commonly used techniques, AE and EXFIX [external fixation], were used in severely injured patients admitted to US	**Inclusion criteria** • pelvic fractures • age ≥18 years • AE or external fixation within 24 h of arrival **Exclusion criteria** • isolated acetabular fractures • patients who were not admitted to the hospital • minor injuries (ISS<15) • hospitals that performed only 1 of the procedures **Characteristics** Age by strata p<0.001 Male, n (%)	**Participants** N=1409 patients **Study groups** IG1: AE (N=746) IG2: external fixation (N=663) CG: no procedure (N=21,159) **Adjusting variables in logistic regression** • demographics (age and gender) • injury severity • emergency room physiology (including hypotension, tachycardia, GCS) • diagnosis of traumatic shock • hospital characteristics (hospital region, trauma center status, hospital bed size, and university hospital) • year of admission	**Adjusted outcomes** Mortality, OR (95% CI) IG1: 1.63 (1.29-2.05) IG2: 0.95 (0.70-1.30) CG: reference **Unadjusted outcomes** In-hospital mortality, n/N (%) IG1: 153/746 (20.5) IG2: 89/663 (13.4) CG: 2,319/21,159 (11.0%)	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "AE is associated with higher mortality, which may reflect the fact that it is used for patients at higher risk of death." **Reviewers' conclusion** The authors' conclusion accounts for the risk of se-

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
trauma centers with a diagnosis of a pelvic ring fracture in the United States. (…) We also hypothesized that there would be a difference in mortality based on procedure." **Setting** USA, 2008-2010	IG1: 450 (60.3) IG2: 422 (63.7) CG: 12,568 (59.4), p=0.512 SBP [mmHg], mean (SEM) IG1: 92.35 (1.95) IG2: CG: 93.14 (1.93) CG: 100.31 (0.38), p<0.001 GCS, mean (SEM) IG1: 9.55 (0.24) IG2: 9.57 (0.26) CG: 9.81 (0.05), p=0.203 ISS ≥26, n (%) IG1: 440 (59.0) IG2: 323 (48.7) CG: 8,880 (42.0), p<0.001			lection bias and heterogeneity between intervention groups.
Harfouche (2021) "Patterns and outcomes of zone 3 REBOA use in the management of severe pelvic fractures: Results from the AAST Aortic Occlusion for Resuscitation in Trauma and Acute Care Surgery database". *The Journal of Trauma and Acute Care Surgery* 2021; 90(4): 659-665. **Study design** Comparative registry study (AAST AORTA registry)	**Inclusion criteria** • Adult patients ≥18 y • zone 3 aortic occlusion in the acute phases after injury **Exclusion criteria** • no blunt mechanism • death in the ED **Characteristics (overall)** Age [y], mean ± SD 47 ± 18 Male, n (%) 115 (72.3) ISS, mean ± SD	**Participants** N=160 patients **Study groups** IG1: REBOA + PP (N=44) IG2: REBOA + AE (N=28) IG3: REBOA + PP + AE (N=15) CG: Zone 3 REBOA alone (N=60) **Subgroup analysis: patients with external fixation** IG1: REBOA + PP (N=27) IG2: REBOA + AE (N=8) IG3: REBOA + PP + AE (N=1) CG: Zone 3 REBOA alone (N=n.r.)	**Adjusted outcomes** Mortality, OR (95% CI) following zone 3 REBOA for pelvic hemorrhage PP: 0.75 (0.27–2.14), p=0.596 Pelvic AE: 1.02 (0.37–2.84), p=0.963 Pelvic EF: 0.22 (0.07–0.70), p=0.011 **Unadjusted outcomes, overall group[§]** following zone 3 REBOA for pelvic hemorrhage In-hospital mortality, n/N (%) PP: 17/44 (38.6) Pelvic AE: 9/28 (32.1) PP + AE: 7/15 (46.7), p=0.64 CG: 24/60 (40.0) Overall complications, n/N (%)	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "The findings of this study indicate that trauma centers use REBOA as both a stand-alone technique and with additional techniques, such as AE, PP, and EF [external fixation], to

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Aim of the study "The aim of this study is to describe the outcomes of patients in the Aortic Occlusion for Resuscitation in Trauma and Acute Care Surgery (AORTA) registry who have undergone zone 3 REBOA placement with a focus on the number and types of hemostatic interventions performed for the management of pelvic fractures." **Setting** USA, 2013-2020	36 ± 13 SBP on admission [mmHg], mean ± SD 86 ± 41 GCS on admission, mean ± SD 9 ± 5	**Subgroup analysis: patients without external fixation** IG1: REBOA + PP (N=17) IG2: REBOA + AE (N=20) IG3: REBOA + PP + AE (N=14) CG: Zone 3 REBOA alone (N=n.r.) **Variables in multivariable regression** • age <50 y • male sex • ISS >30 • AIS ≥3 (head, chest, abdomen) • SBP<80 • HR >120 • GCS <8 • Cardiopulmonary resuscitation in progress • thoracotomy • laparotomy	PP: 20/44 (45.5) Pelvic AE: 12/28 (42.9) PP + AE: 13/15 (86.7), p=0.012 CG: 27/60 (45.0) Acute kidney injury, n/N (%) PP: 13/44 (29.5) Pelvic AE: 8/28 (28.6) PP + AE: 11/15 (73.3), p=0.005 CG: 10/60 (16.7) Dialysis, n/N (%) PP: 3/44 (6.8) Pelvic AE: 5/28 (17.9) PP + AE: 4/15 (26.7), p=0.036 CG: 3/60 (5.0) Sepsis/septic shock, n/N (%) PP: 5/44 (11.4) Pelvic AE: 2/28 (7.1) PP + AE: 3/15 (20.0), p=0.45 CG: 7/60 (11.7) Acute lung injury/acute respiratory distress syndrome, n/N (%) PP: 6/44 (13.6) Pelvic AE: 5/28 (17.9) PP + AE: 3/15 (20.0), p=0.81 CG: 13/60 (21.7) Multiple organ dysfunction syndrome, n/N (%) PP: 5/44 (11.4) Pelvic AE: 4/28 (14.3) PP + AE: 5/15 (33.3), p=0.13 CG: 7/60 (11.7) **Subgroup analysis – patients with external fixation§**	control pelvic fracture-related hemorrhage. The increasing number of interventions was associated with higher complication rates. No combination of interventions was found to be superior, and only EF [external fixation] was associated with a significant mortality benefit when controlling for multiple variables." **Reviewers' conclusion** The study was not designed to test the benefit of one interventions over another making direct comparison between the different study groups difficult. The number of included patients is small, so that the study power is limited.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			In-hospital mortality, n/N (%) PP: 6/27 (22.2) Pelvic AE: 2/8 (25.0) PP + AE: 0/1 (0), p=0.85 CG: n.r. Overall complications, n/N (%) PP: 14/27 (51.9) Pelvic AE: 4/8 (50.0) PP + AE: 1/1 (100), p=0.063 CG: n.r. Acute kidney injury, n/N (%) PP:10/27 (37.0) Pelvic AE: 4/8 (50.0) PP + AE: 1/1 (100), p=0.39 CG: n.r. Dialysis, n/N (%) PP: 3/27 (11.1) Pelvic AE: 3/8 (37.5) PP + AE: 1/1 (100), p=0.13 CG: n.r. Sepsis/septic shock, n/N (%) PP: 3/27 (11.1) Pelvic AE: 0/8 (0) PP + AE: 1/1 (100), p=0.011 CG: n.r. Acute lung injury/acute respiratory distress syndrome, n/N (%) PP: 5/27 (18.5) Pelvic AE: 0/8 (0) PP + AE: 0/1 (0), p=0.38 CG: n.r. Multiple organ dysfunction syndrome, n/N (%)	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			PP: 3/27 (11.1) Pelvic AE: 1/8 (12.5) PP + AE: 0/1 (0), p=0.93 CG: n.r. **Subgroup analysis –patients without external fixation§** <u>In-hospital mortality, n/N (%)</u> PP: 11/17 (64.7) Pelvic AE: 7/20 (35.0) PP + AE: 7/14 (50.0) , p=0.20 CG: n.r. <u>Overall complications, n/N (%)</u> PP: 6/17 (35.3) Pelvic AE: 8/20 (40.0) PP + AE: 12/14 (85.7), p=0.009 CG: n.r. <u>Acute kidney injury, n/N (%)</u> PP: 3/17 (17.6) Pelvic AE: 4/20 (20.0) PP + AE: 10/14 (71.4), p=0.002 CG: n.r. <u>Dialysis, n/N (%)</u> PP: 0/17 (0) Pelvic AE: 2/20 (10.0) PP + AE: 3/14 (21.4), p=0.027 CG: n.r. <u>Sepsis/septic shock, n/N (%)</u> PP: 2/17 (11.8) Pelvic AE: 2/20 (10.0) PP + AE: 2/14 (14.3), p=0.92 CG: n.r.	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Acute lung injury/acute respiratory distress syndrome, n/N (%) PP: 1/17 (5.9) Pelvic AE: 5/20 (25.0) PP + AE: 3/14 (21.4), p=0.029 CG: n.r. Multiple organ dysfunction syndrome, n/N (%) PP: 2/17 (11.8) Pelvic AE: 3/20 (15.0) PP + AE: 5/14 (35.7), p=0.10 CG: n.r. § all p-values for comparison IG1 vs. IG2 vs. IG3	
Hsu (2016) "Controlling hemorrhage in exsanguinating pelvic fractures: Utility of extraperitoneal pelvic packing as a damage control procedure" *Int J Crit Illn Inj Sci.* 2016; 6(3): 148-152. **Study design** Prospective cohort study **Aim of the study** „to determine the effect of EPP compared with angioembolization as a primary intervention for patients with exsanguinating pelvic fracture" **Setting**	**Inclusion criteria** • age >15 y • presenting with an exsanguinating pelvic fracture defined as 1) the presence of a pelvic fracture (as per Young and Burgess classification, i.e.,lateral compression, anterior-posterior compression, or vertical shear) on pelvic X-ray and 2) hemodynamic instability (sustained systolic blood pressure [SBP] <90 mmHg and/or initial base deficit >5) **Exclusion criteria** • death before arrival • death in resuscitation room before determination of primary intervention for the pelvic fracture **Characteristics** Age [y], mean ± SD	**Participants** N=24 patients overall **Comparison groups** IG: Extraperitoneal pelvic packing followed by AE (N=14) CG: AE alone (N=10) **Co-interventions** In the IG, there were significantly more laparotomies performed (IG: 10/14 (71%) vs. CG: 1/10 (10%)), p=0.005 The CG received significantly more ED red blood cell transfusion (IG: 3.7 ± 3.2 vs. CG: 6.6 ± 3.4), p=0.04	Mortality, n/N (%) IG: 1/14 (7.1) CG: 3/10 (30), not significant ICU LOS [d], median (IQR) IG: 11.5 (6-16) CG: 0 (0), p=0.002 LOS [d], median (IQR) IG: 58 (26-165) CG: 11 (6-21), P=0.003 24 h packed red blood cell transfusion (units), mean ± SD IG: 12.6 ± 9.5 CG: 11.3 ±2.3, not significant	**Level of evidence** 3b↓ **Risk of bias** Selection bias: – Performance bias: – Attrition bias: ? Detection bias: ? **Authors' conclusion** "Extraperitoneal pelvic packing appears to be a safe and efficient technique for primary haemorrhage control in exsanguinating pelvic fractures. Given the high rate of associated arterial injury, EPP [extraperitoneal pelvic

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Australia, 2011-2014	IG: 49.9 ± 17.5 CG: 60.3 ± 23.5, not significant ISS, mean ± SD IG: 32.0 ± 6.7 CG: 23.8 ± 12.7, not significant Lowest SBP in ED [mmHg], mean ± SD IG: 74.2 ± 22.3 CG: 84.3 ± 16.2, not significant			packing] should be considered as the first part of a "damage control" approach for exsanguinating pelvic fractures." **Reviewers' conclusion** The small sample size should be kept in mind when interpreting the results. The study was downgraded, because it was underpowered to show a significant difference in mortality between groups.
Johnson (2021) "Determination of optimal deployment strategy for REBOA in patients with non-compressible hemorrhage below the diaphragm". *Trauma Surgery & Acute Care Open* 2021; 6(1): e000660. **Study design** Subgroup analysis of a prospective cohort study **Aim of the study** "to optimize early decision-making regarding aortic zone selectivity in patients receiving REBOA"	**Inclusion criteria** • Age ≥15 • evidence of truncal hemorrhage arising below the diaphragm in which the decision for emergent truncal hemorrhage control intervention (operative or endovascular) was made within 60minutes of ED arrival • presentation to one of the participating level 1 trauma centers at highest activation level • REBOA treatment **Exclusion criteria** • Patients with potentially unsalvageable injuries • Patients which cannot be appropriately assessed with regard to the algorithm in question • no FAST exam	**Participants** N=57 patients **Study groups** IG: Zone 3, followed algorithm (N=8) CG: Zone 3, violated algorithm (N=13)	Mortality, n/N (%) IG: 2/8 (25.0) CG: 3/13 (23.1), p=0.92 Rates of exsanguination among Zone 3 patients that died, n/N (%) IG: 0/2 (0.0) CG: 3/3 (1.0), p=0.10	**Level of evidence** 3b↓ **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "A zone 3 REBOA should not be performed when a zone 1 is indicated by the algorithm as 100% of these patients exsanguinated. MOF [multiple organ failure], perhaps from visceral ischemia in pa-

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Setting USA, 2017-2018	• indeterminate FAST exam • positive cardiac FAST • unknown primary bleeding source • Prisoners **Characteristics** Age [y], median IG: 27 CG: 48 Male, n (%) IG: 87.5 CG: 76.9 SBP [mmHg], median IG: 77 CG: 75 ISS, median IG: 38.5 CG: 33			tients with an inappropriate zone 1 REBOA, may have been prevented with zone 3 placement or limited zone 1 occlusion time." **Reviewers' conclusion** The results are unadjusted for risk factors and therefore need to be interpreted with great caution. The study may have been underpowered to detect clinically significant differences in mortality or morbidity.
Li (2016) "Retroperitoneal packing or angioembolization for haemorrhage control of pelvic fractures—Quasi-randomized clinical trial of 56 haemodynamically unstable patients with Injury Severity Score≥33" *Injury* 2016; 47(2): 395-401. **Study design** Prospective cohort study	**Inclusion criteria** • multitrauma defined as ISS >17 • dislocated pelvic fracture type B or C according to Tile on emergency department pelvic radiograph • haemodynamic instability defined as SBP <90 mmHg after administration of 4 units of packed red blood cells **Exclusion criteria** • age ≥65 y **Characteristics** Age [y], mean ± SD	**Participants** N=56 patients overall **Comparison groups** IG: primarily AE (N=27) CG: primarily retroperitoneal packing (N=29) **Covariates included in logistic regression** • female gender • Age • ISS • Traffic accident • Fall from height	Logistic regression for mortality, OR (95% CI) IG: 1.73 (0.09-33.97), p=0.72 Logistic regression for complications, OR (95% CI) IG: 1.14 (0.11-11.85), p=0.91 In-hospital mortality (total), n/N (%) IG: 5/27 (19) CG: 4/29 (14), p=0.449 Mortality due to exsanguination, n/N (%) IG: 2/27 (7) CG: 0/29 (0), p=0.141 Days on ICU, mean ± SD	**Level of evidence** 3b↓ **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Main findings of this study were (1) complications and mortality do not

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Aim of the study "to compare survival and complications of pelvic packing and angioembolization in massive haemorrhage related to pelvic fractures" **Setting** China, 2003-2013	IG: 40 ± 9 CG: 43 ± 13, p=0.373 Female gender, n (%) IG: 12 (44) CG: 12 (41), p=0.821 ISS, mean ± SD IG: 43 ± 7 CG: 48 ± 6, p=0.005 Pelvic fracture type, n (%) B-type IG: 13 (48) CG: 13 (45) C-type IG 14 (52) CG: 16 (55), p=0,808 Injury type, n (%) Traffic accident IG 12 (44) CG: 13 (45) Fall from height IG 9 (33) CG: 10 (34) Crush injury IG: 6 (22) CG: 6 (21), p=0.928 overall	• Preoperative PRBC units • Pelvic fracture type • Delay to surgery • Operative time	IG: 4.9 ± 1.8 CG: 4.3 ± 2.3, p=0.214 Infections, n/N (%) IG: 1/27 (4) CG: 3/29 (10), p=0.491 Deep venous thrombosis, n/N (%)* IG: 4/27 (15) CG: 1/29 (3), p=0.508 *Cave: Opposing results are reported in the main text. Renal failure, n/N (%) IG: 1/27 (4) CG: 0/29 (0), p=0.561 Multiple organ failure, n/N (%) IG: 2/27 (7) CG: 2/29 (7), p=0.120 Postoperative packed red blood cell units, mean ± SD IG: 6 ± 2 CG: 5 ± 2, p=0.124	differ between angioembolization and retroperitoneal packing, (2) angioembolization had a greater delay from admission to treatment, (3) more preoperatively administered PRBC units and a C-type pelvic fracture were associated with more PRBC [packed red blood cells] units administered postoperatively." **Reviewers' conclusion** The small sample size should be kept in mind when interpreting the results. The study was downgraded, because it was underpowered to show a significant difference in mortality between groups. Both groups differed significantly for ISS.
Mann (2018)	**Inclusion criteria** • Patients with a pelvic fracture according to predefined ICD-10 codes (more	**Participants** N=3915 patients overall	**Adjusted outcomes** 30 day mortality, RR (95% CI)	**Level of evidence** 2b

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"High-energy trauma patients with pelvic fractures: Management trends in Ontario, Canada" *Injury* 2018; 49(10): 1830–1840. **Study design** Comparative registry study (Institute for Clinical Evaluative Science and linked Ontario Trauma Registry) **Aim of the study** "The purpose of the study was to examine trends in the incidence, diagnosis, treatment, and mortality rates of high-energy pelvic fractures in Ontario, Canada over a 10-year period" **Setting** Canada, 2005-2015	information about which codes were selected are provided in the study) **Exclusion criteria** • Low energy pelvic fracture (exclusion codes provided in the appendix of the study) • no resident of Ontario • no Institute for Clinical Evaluative Science Key Number for data linkage • age <18 years • ISS <16 **Characteristics (overall)** Female gender, n (%) 1421 (36.3) Age [y], mean ± SD 46.0 ± 19.2 Blood pressure at admission, mean ± SD 126.9 ± 26.7 GCS at admission, n (%) 13-15: 2691 (68.7) 9-12: 154 (3.9) 3-8: 230 (5.9) ISS, n (%) 16-24: 1488 (38.0) 25-40: 1530 (39.1) 41-49: 496 (12.7) 50-75: 401 (10.2) Cause of trauma, n (%) Automobile 401 (10.2) Bicycle 1684 (43)	**Comparison groups** Laparotomy (N=496) Pelvic binding (N=139) External fixation (N=683) Open reduction with internal fixation (N=1476) Skeletal Traction (N=28) AE (N=229) No intervention (N=1907) **Adjustment criteria for logistic regression** • Sex • age • comorbidity as measured by Johns Hopkins Aggregated Diagnosis Group Score • ISS	Laparotomy 0.97 (0.79, 1.20), p=0.812 Pelvic binding 0.61 (0.37, 1.01), p=0.054 External fixation 0.52 (0.40, 0.68), p<0.0001 Open reduction with internal fixation 0.24 (0.18, 0.33), p<0.0001 Skeletal Traction 0.27 (0.04, 2.02), p=0.203 AE 0.68 (0.51, 0.91), p=0.011 No intervention reference group 1 year mortality, RR (95% CI) Laparotomy 0.95 (0.78, 1.16), p=0.638 Pelvic binding 0.54 (0.33, 0.90), p=0.018 External fixation 0.54 (0.43, 0.69), p<0.0001 Open reduction with internal fixation 0.27 (0.21, 0.35), p<0.0001 Skeletal Traction 0.68 (0.27, 1.72), p=0.416 AE 0.72 (0.56, 0.94), p=0.017 No intervention reference group 2 year mortality, RR (95% CI) Laparotomy 0.96 (0.79, 1.17), p=0.684 Pelvic binding 0.51 (0.31, 0.85), p=0.010 External fixation 0.55 (0.44, 0.69), p<0.0001 Open reduction with internal fixation 0.31 (0.24, 0.40), p<0.0001 Skeletal Traction 0.62 (0.25, 1.54), p=0.302 AE 0.69 (0.53, 0.89), p=0.005 No intervention reference group	**Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Embolisation appears to be beneficial in a subset of patients with less severe systemic injuries, as it did not confer a survival benefit in patients with higher ISS. Laparotomy is typically used for the most severely injured, and is often the most rapidly- achieved intervention." **Reviewers' conclusion** The authors state that the administrative data might not adequately capture interventions such as pelvic binding and skeletal traction, which typically occur in the emergency department rather than the operating room. Furthermore, it was not possible to identify severe pelvic fractures from ISS. No patient characteristics are available for the different comparison groups. The authors state that it is

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Fall 120 (3.1) Motorcycle 493 (12.6) Pedestrian struck 313 (8.0) Other 637 (16.3)			likely that not all relevant confounders were fully adjusted.
Matsushima 2018 "Effect of door-to-angioembolization time on mortality in pelvic fracture: Every hour of delay counts". *J Trauma Acute Care Sug.* 2018; 84(5): 685-692. **Study design** Comparative registry study (AAS Trauma Quality Improvement Program database) **Aim of the study** "to evaluate the impact of a delay in performing pelvic AE on patients' survival. We hypothesized that a longer time-to-AE would be significantly associated with increased mortality in patients with pelvic fracture." **Setting** USA, 2013-2014	**Inclusion criteria** • Blunt trauma patients • age ≥18 years • underwent pelvic AE for pelvic fractures **Exclusion criteria** • Patients who underwent pelvic AE ≥4h after admission • Patients who required haemorrhage control surgery (laparotomy; thoracotomy; sternotomy; peripheral vascular procedures; neck and mangled extremity/traumatic amputation) within 4 hours **Characteristics** Age [y], median (IQR) Total: 54 (38-68) AE ≤1h: 59 (43-75) AE 1-2h: 51 (33-59) AE 2-3: 53 (37-63) AE 3-4: 54 (34-73), p=0.11 Male, n (%) Total: 126 (69.6) AE ≤1h: 12 (63.2) AE 1-2h: 27 (75.0) AE 2-3: 52 (65.8) AE 3-4: 35 (74.5), p=0.59 SBP<90 [mmHg], n (%)	**Participants** N=181 patients **Study groups** patients divided into four groups: AE ≤1h: AE up to 1 hour from admission to AE (N=19) AE 1-2h: AE 1 to 2 hours from admission to AE (N=36) AE 2-3h: AE 1 to 2 hours from admission to AE (N=79) AE 3-4h: AE 1 to 2 hours from admission to AE (N=47)	**Adjusted outcomes** In-hospital mortality (primary outcome), adjusted OR (95% CI) per additional hour to pelvic AE 1.79 (1.11–2.91), p=0.018 24h mortality, adjusted OR (95% CI) per additional hour to pelvic AE 1.39 (0.76–2.55), p=0.28 **Unadjusted outcomes** In-hospital mortality (primary outcome), n (%) Total: 38 (21.0) AE ≤1h: 1 (5.3) AE 1-2h: 6 (16.7) AE 2-3: 20 (25.3) AE 3-4: 11 (23.4), p=0.23 24-hour mortality, n (%) Total: 15 (8.3) AE ≤1h: 0 (0) AE 1-2h: 4 (11.1) AE 2-3: 6 (7.6) AE 3-4: 5 (10.6), p=0.48 Hospital LOS, median (IQR) Total: 15 (8–28) AE ≤1h: 26 (10–45) AE 1-2h: 16 (9–34) AE 2-3: 14 (6–23) AE 3-4: 8 (8–31), p=0.11	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "This study showed that a shorter time-to-AE is significantly associated with improved survival among patients with pelvic fractures." **Reviewers' conclusion** The groups were reasonably balanced, and the analysis was adjusted for important confounders. The study results still need to be interpreted with caution due to the retrospective study design.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Total: 49 (27.1) AE ≤1h: 5 (26.3) AE 1-2h: 8 (22.2) AE 2-3: 24 (30.4) AE 3-4: 12 (25.5), p=0.82 GCS, median (IQR) Total: 14 (4-15) AE ≤1h: 10 (3-15) AE 1-2h: 14 (3-15) AE 2-3: 15 (11-15) AE 3-4: 14 (6-15), p=0.19 ISS, median (IQR) Total: 34 (27-43) AE ≤1h: 38 (24-43) AE 1-2h: 34 (27-43) AE 2-3: 34 (22-43) AE 3-4: 34 (27-48), p=0.84		ICU LOS, median (IQR) Total: 7 (4–14) AE ≤1h: 8 (5–15) AE 1-2h: 8 (4–15) AE 2-3: 7 (3–13) AE 3-4: 8 (4–16), p=0.81	
Mikdad (2020) "Pre-peritoneal pelvic packing for early hemorrhage control reduces mortality compared to resuscitative endovascular balloon occlusion of the aorta in severe blunt pelvic trauma patients: A nationwide analysis." *Injury* 2020; *51*(8): 1834–1839. **Study design** Comparative registry study (ACS-TQIP)	**Inclusion criteria** • age ≥15 years • Blunt pelvic fractures • Received either PP or abdominal REBOA (none-zone 1) • Patients with these codes were only included if they had a second exploratory laparotomy indicating removal of packing within 72 hours or if they dies within 72 hours with no ability to go back to the operating room to remove packing **Exclusion criteria** • Dead on arrival • Transferred from an outside hospital • A penetrating mechanism	**Participants** N=420 before matching; N=204 after matching **Study groups** IG: received PP as primary procedure (N=307 before matching; N=102 after matching) CG: treated with REBOA in conjunction with a definitive procedure for hemorrhage control (N=113 before matching; N=102 after matching) Patients receiving PP as a second hemorrhage control procedure after initially undergoing REBOA were considered to be in the REBOA group	In-hospital mortality: n/N (%) IG: 38/102 (37.3) CG: 53/102 (52.0). p=0.048 24-h mortality: n/N (%) IG: 18/102 (17.7) CG: 33/102 (32.4). p=0.023 ED mortality: n/N (%) IG: 1/102 (1.0) CG: 7/102 (6.9). p=0.065 Acute kidney injury: n/N (%) IG: 11/102 (10.8) CG: 10/102 (9.8), p=1 Sepsis: n/N (%)	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "PPP is associated with improved survival compared to REBOA placement. Delay in definitive hemorrhage control may provide a potential explanation,

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Aim of the study "The aim of this study is to compare the efficacy and outcomes of pre-peritoneal packing (PPP) and Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) with a subsequent hemorrhage control procedure to control life-threatening pelvic hemorrhage in trauma patients." **Setting** USA, 2015-2017	• No have pelvic fractures • PP or REBOA after 4 h • External fixation or AE before PP or REBOA **Characteristics after matching** Age [y], mean ± SD IG: 45.0 ± 17.6 CG: 45.6 ± 18.1, p=0.811 Female, n (%) IG: 36 (35.3) CG: 35 (34.3), p=1.00 SBP<90 mmHg, n (%) IG: 33 (32.4) CG: 38 (37.3), p=0.557 ISS, median (IQR) IG: 34 (27-45) CG: 34 (27-43), p=0.828 GCS ≤8, n (%) IG: 52 (51.0) CG: 52 (51.0), p=1.00	**Co-interventions** There were statistically significant differences in exploratory laparotomy and surgical management after PP and REBOA between groups. **Matching criteria** • Vital signs in ED • Injury parameters (ISS and AIS) • Intra-abdominal, solid organ injuries	IG: 6/102 (5.9) CG: 3/102 (2.9), p=0.498 Surgical Site Infection: n/N (%) IG: 5/102 (4.9) CG: 2/102 (2.0), p=0.445 Lower limb amputation: n/N (%) IG: 7/102 (6.9) CG: 4/102 (3.9), p=0.537 Venous thromboembolism: n/N (%) IG: 13/102 (12.8) CG: 10/102 (9.8), p=0.659 Extremity Compartment Syndrome: n/N (%) IG: 2/102 (2.0) CG: 1/102 (1.0), p=1.000 Fasciotomy: n/N (%) IG: 5/102 (4.9) CG: 2/102 (2.0), p=0.445 Hospital length of stay [d], median (IQR) IG: 26 (16-38) CG: 17 (10-29), p=0.02 ICU length of stay [d], median (IQR) IG: 15 (9-22) CG: 8 (4-16), p<0.001	but causation remains unresolved. This data suggests that early PPP may offer a benefit over REBOA in the setting of hemorrhage after blunt pelvic trauma." **Reviewers' conclusion** The study was well conducted and reported. Due to the retrospective nature of the study and unclear blinding, there may be residual biases. The population may overlap with that of Asmar 2021.

+: low risk; –: high risk; ?: unclear risk
AE: Angioembolization; AIS: Abbreviated Injury Score; CG: Comparison Group; CI: Confidence Interval; d: Days; ED: Emergency Department; FAST: **F**ocused Assessment with Sonography in Trauma; GCS: Glasgow Coma Scale; HR: Heart Rate; ICU: Intensive Care Unit; IG: Intervention Group; ISS: Injury Severity Score; IQR: Interquartile Range; LOS: Length Of Stay; n.r.: Not Reported; OR: Odds Ratio; PP: Pre-peritoneal Packing; REBOA: Resuscitative Endovascular Balloon Occlusion; RR: Relative Risk; SBP: Systolic Blood Pressure; SD: Standard Deviation; y: Years

Stabilisierung (invasiv und nicht-invasiv)

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Berger-Groch (2021) "Evaluation of pelvic circular compression devices in severely injured trauma patients with pelvic fractures" DOI: 10.1080/10903127.2021.1945717 **Study design** Comparative registry study (TraumaRegister DGU®) **Aim of the study** "The purpose of the current investigation is to determine whether patients with significant pelvic trauma, treated with a PCCD, have decreased mortality and a lower risk for blood loss." **Setting** Germany 2015-2016	**Inclusion criteria** • patients suffering from a relevant pelvic trauma (AIS severity 3-5; unstable fractures with or without relevant blood loss or open fracture) • ISS ≥9 • age ≥16 y • directly admitted from the scene of the accident to the participating hospital • complete outcome documentation (survival to hospital discharge or death) **Exclusion criteria** • patients transferred from another hospital (no prehospital data available) • patients transferred to another hospital within 48 h (outcome unknown) • no information about the use of PCCD, either prehospital or in the ED **Characteristics** Age [y], mean ± SD no PCCD: 51.3 ± 20.6 PH-PCCD:46.9 ± 19.3 ED-PCCD: 53.0 ± 19.0, p=0.001 Male, n (%) no PCCD: 385 (59.3) PH-PCCD: 181 (63.7) ED-PCCD: 99 (58.2), p=0.37	**Participants** N=1103 patients **Study groups** no PCCD: patients without PCCD stabilization (N=649) PH-PCCD: patients receiving PCCD stabilization in the prehospital phase (N=284) ED-PCCD: patients receiving PCCD stabilization in the resuscitation phase in the emergency department (N=170) No information on the type of PCCD used, no confirmation that it had been properly fitted. Missing data for pelvic binder were not replaced; 11% of patients had missing data for PH PCCD, and 8% of cases had missing data for ED PCCD. **Adjusting variables in multivariable logistic regression** • age (8 categories) • sex • prehospital shock • shock on admission • cardio-pulmonary resuscitation • unconsciousness (GCS≤8) • prehospital intubation • prehospital catecholamines • ISS • severe pelvic trauma (AIS 4-5)	**Adjusted outcomes** In-hospital mortality, adjusted OR (95% CI) no PCCD: reference PH-PCCD: 1.493 (0.802-2.780), p=0.206 ED-PCCD: 1.453 (0.709-2.974), p=0.307 In-hospital mortality, O/E ratio (95% CI)§ no PCCD: 0.910 (0.721-1.100) PH-PCCD: 1.033 (0.815-1.251) ED-PCCD: 1.161 (0.875-1.448) Transfusion, adjusted OR (95% CI) no PCCD: reference PH-PCCD: 1.607 (1.049-2.464), p=0.029 ED-PCCD: 1.423 (0.847-2.389), p=0.182 **Unadjusted outcomes** In-hospital mortality, n/N (%) no PCCD: 78/649 (12) PH-PCCD: 66/284 (23.2) ED-PCCD: 46/170 (27.1), p<0.001 24h mortality, n/N (%) no PCCD: 34/649 (5.2) PH-PCCD: 37/284 (13) ED-PCCD: 30/170 (17.6), p<0.001 ICU stay [d], median / mean SD no PCCD: 4.0 / 9.3 ± 12.5 PH-PCCD: 5.0 / 11.1 ± 15.0 ED-PCCD: 6.0 / 12.4 ± 16.0, p=0.064 Hospital stay [d], median / mean SD	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Even after subsequent adjustment in this study, the postulated beneficial effect of PCCDs in terms of decreased mortality and lower needs for blood transfusion could not be confirmed. Application of PCCDs in patients with a severe pelvic trauma is a general indicator for a critical patient with increased mortality." **Reviewers' conclusion** The study conclusions account for the retrospective study design and substantial risk of selection bias. The groups were not balanced at baseline, but the analysis was adjusted

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	ISS, mean ± SD no PCCD: 27.9 ± 13.8 PH-PCCD: 34.12 ± 16.4 ED-PCCD: 35.9 ± 5.5, p<0.001 GCS, median / mean ± SD no PCCD: 15 / 12.6 ± 4.1 PH-PCCD: 14 / 11.3 ± 4.7 ED-PCCD: 14 / 11.6 ± 4.4, p<0.001 Tile/OTA C, n (%) No PCCD: 182 (28.0) PH-PCCD: 154 (54.2) ED_PCCD: 92 (54.1), p<0.001 Pelvic Injury Severity, p<0.001: AIS_{pelvis} = 3, n (%) no PCCD: 332 (51.2) PH-PCCD: 94 (33.2) ED-PCCD: 44 (25.9) AIS_{pelvis} = 4, n (%) no PCCD: 244 (37.6) PH-PCCD: 121 (42.6) ED-PCCD: 67 (39.4) AIS_{pelvis} = 5, n (%) no PCCD: 73 (11.2) PH-PCCD: 69 (24.3) ED-PCCD: 59 (34.7) Shock (SBP ≤90 prehospital), n (%) no PCCD: 70 (11.9) PH-PCCD: 69 (27.2) ED-PCCD: 31 (21.7), p<0.001 Trauma mechanism, n (%)	• relevant injuries (AIS 3+) to the head, the thorax, and the abdomen	no PCCD: 20.0 / 24.01 ± 18.3 PH-PCCD: 21.5 / 25.7 ± 24.8 ED-PCCD: 20.5 / 24.6 ± 24.1, p=0.78 § observed/expected ratio; expected mortality calculated using the RISC prognosis in %	for important confound-ers.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Car No PCCD: 142 (22) PH-PCCD: 64 (22.7) ED-PCCD: 38 (22.4) *Motorcycle* No PCCD: 80 (12.4) PH-PCCD: 46 (16.3) ED-PCCD: 30 (17.6) *Bicycle* No PCCD: 37 (5.7) PH-PCCD: 18 (6.4) ED-PCCD: 12 (7.1) *Pedestrian* No PCCD: 102 (15.8) PH-PCCD: 38 (13.5) ED-PCCD: 25 (14.7) *Fall>3m* No PCCD: 183 (28.4) PH-PCCD: 89 (31.6) ED-PCCD: 52 (30.6) *Fall <3m* No PCCD: 61 (9.5) PH-PCCD: 6 (2.1) ED-PCCD: 7 (4.1) *Others* No PCCD: 40 (6.2) PH-PCCD: 21 (7.4) ED-PCCD: 6 (3.5), p=0.010 overall			
Esmer (2017)	**Inclusion criteria**	**Participants**	Mortality within 6 h, n/N (%)	**Level of evidence**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"Influence of external pelvic stabilization on hemodynamically unstable pelvic fractures". Unfallchirurg 2017; 120(4): 312-319. **Study design** Comparative registry study (TraumaRegister DGU®) **Aim of the study** "This study examined the influence of external pelvic compression on mortality and outcome in cases of hemodynamically unstable pelvic fractures in a larger number of cases" **Setting** Germany, 2002-2011	• Isolated hemodynamically unstable pelvic injury (defined as pelvic AIS ≥4 and SBP ≤100 mmHg) • Primarily admitted to the hospital via the shock room • Preclinical shock index >1 **Exclusion criteria** n.r. **Characteristics** Age, mean ± SD IG: 40.2 ± 15 CG: 49.2 ± 23.2, p=0.024 SBP at scene of accident [mmHg], mean ± SD IG: 99.9 ± 25.7 CG: 90.8 ± 33.6, p=0.130 ISS, mean ± SD IG: 20.6 ± 4.4 CG: 20.8 ± 3.9, p=0.8 NISS, mean ± SD IG: 28.7 ± 6.9 CG: 28.8 ± 7.7, p=0.9	N=104 patients **Comparison groups** IG: external pelvic stabilization, defined as either external pelvic fixator, pelvic c-clamp or pelvic binder, or when a recorded external stabilization was performed but no fracture of the extremities or the spine was reported (N=47) CG: no external pelvic stabilization (N=57) **Co-interventions (significant differences only)** • preclinical volume administration • volume administration in shock room • number of red cell concentrates	IG: 7/47 (14.9) CG: 15/57 (26.3) Mortality within 24 h, n/N (%) IG: 8/47 (17) CG: 17/57 (29.8) Overall mortality, n/N (%) IG: 9/47 (19.1) CG: 19/57 (33.3) Hospital length of stay [d] , mean ± SD IG: 43.1 ± 36.9 CG: 28.3 ± 30.2, p=0.026 ICU LOS [d], mean ± SD IG: 12,9 ± 11,3 CG: 12,9 ± 11,3, p=0,004 Ventilatior use [d], mean ± SD IG: 6.4 ± 7.2 CG: 2.9 ± 8.4, p=0.026 Complication during hospitalization: Sepsis, n/N (%) IG: 6/n.r. (14.6) CG: 2/n.r. (5.0) Complication during hospitalization: Multiorgan failure, n/N (%) IG. 17/n.r. (40.5) CG: 10/n.r. (26.3)	2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "External pelvic stabilization seems to be an important instrument for the initial treatment of hemodynamically unstable pelvic fractures and showed a positive effect on patient mortality" **Reviewers' conclusion** Only isolated pelvic injuries were included. The high risk of selection bias should be kept in mind when interpreting the results. The inclusion criteria also include type B pelvic injuries, which can also be treated conservatively if signs of instability are missing.
Höch (2021) „Trends and efficacy of external emergency stabilization of pelvic ring fractures: results from	**Inclusion criteria** • patients undergoing a pelvic-related emergency procedure in hospital **Exclusion criteria**	**Participants** N=989 patients **Comparison groups**	Efficacy across all fracture types, % IG1: 84.4 IG2: 70.4 IG3: 90.1	**Level of evidence** 2b **Risk of bias**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
the German Pelvic Trauma Registry". Eur J Trauma Emerg Surg 2021; 47(2): 523-531. **Study design** Comparative registry study (German Pelvic Trauma Registry) **Aim of the study** "(…) a paucity of data on the relation of the suggested pelvic fracture morphology to the used device and the time to application exists. Therefore, these data were investigated in the present study." **Setting** Germany, 2007-2016	• Patients without external emergency stabilization but treated with embolization or pelvic packing and/or external emergency stabilization application as primary treatment pre-hospital or after the first 6 h after admission **Characteristics** Age [y], mean ± SD IG1: 44.5 ± 19.3 IG2: 46.0 ± 18.7 IG3: 44.3 ± 20.1 IG4: 45.7 ± 19.6 IG5: 51.4 ± 16.7, p>0.05 for comparison across groups Male gender, n (%) IG1: 121 (61) IG2: 138 (69) IG3: 318 (68) IG4: 69 (64) IG5: 10 (59), p>0.05 for comparison across groups ISS, mean ± SD IG1: 31.8 ± 14.3 IG2: 30.2 ± 13.2 IG3: 28.0 ± 11.4 IG4: 35.2 ± 12.9 IG5: 39.2 ± 10.5, p<0.001 for comparison across groups Fracture type A according OTA/ Tile, n (%) IG1: 8 (4) IG2: 8 (4) IG3: 5 (1)	IG1: Sheet sling (N=199) IG2: Pelvic binder (N=199) IG3: External fixator (N=467) IG4: Pelvic C-clamp (N=107) IG5: Combination of external fixator and pelvic C-clamp (N=17)	IG4: 77.6 IG5: 76.5, p<0.05 for comparison across groups **Subgroup analysis for type B fractures** Efficacy of the procedure, % IG1: 88.3 IG2: 75.0 IG3: 92.5 IG4: 89.5 IG5: 100, p<0.05 for comparison across groups **Subgroup analysis for type C fractures** Efficacy of the procedures, % IG1: 77.8 IG2: 68.0 IG3: 88.6 IG4: 75.6 IG5: 73.3, p<0.05 for comparison across groups	Selection bias: – Performance bias: ? Attrition bias: + Detection bias: ? **Authors' conclusion** "In conclusion, in case of suspected unstable pelvic fracture, an external emergency stabilization should be performed, in case of doubt, with a non-invasive external emergency stabilization until imaging and final diagnosis. Which method should be used depends on the individual situation and the available information about the overall injury pattern." **Reviewers' conclusion** The high risk of selection bias should be kept in mind when interpreting the results. The database did not provide any information on the correct or incorrect application. Efficacy was reported in the German Pelvic Trauma Registry subjectively by the treating trauma leader of the respective clinic.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG4: 1 (1) IG5: 0 (0) <u>Fracture type B according OTA/ Tile, n (%)</u> IG1: 103 (52) IG2: 64 (32) IG3: 159 (34) IG4: 19 (18) IG5: 2 (12) <u>Fracture type C according OTA/ Tile, n (%)</u> IG1: 81 (41) IG2: 125 (63) IG3: 298 (64) IG4: 66 (80) IG5: 15 (88)			
Mann (2018) "High-energy trauma patients with pelvic fractures: Management trends in Ontario, Canada" *Injury* 2018; 49(10): 1830–1840. **Study design** Comparative registry study (Institute for Clinical Evaluative Science and linked Ontario Trauma Registry) **Aim of the study** "The purpose of the study was to examine	**Inclusion criteria** • Patients with a pelvic fracture according to predefined ICD-10 codes (more information about which codes were selected are provided in the study) **Exclusion criteria** • Low energy pelvic fracture (exclusion codes provided in the appendix of the study) • no resident of Ontario • no Institute for Clinical Evaluative Science Key Number for data linkage • age <18 years • ISS <16 **Characteristics (overall)** <u>Female gender, n (%)</u>	**Participants** N=3915 patients overall **Comparison groups** Laparotomy (N=496) Pelvic binding (N=139) External fixation (N=683) Open reduction with internal fixation (N=1476) Skeletal Traction (N=28) Angioembolization (N=229) No intervention (N=1907) **Adjustment criteria for logistic regression** • Sex	**Adjusted outcomes** <u>30-day mortality, RR (95% CI)</u> Laparotomy 0.97 (0.79, 1.20), p=0.812 Pelvic binding 0.61 (0.37, 1.01), p=0.054 External fixation 0.52 (0.40, 0.68), p<0.0001 Open reduction with internal fixation 0.24 (0.18, 0.33), p<0.0001 Skeletal Traction 0.27 (0.04, 2.02), p=0.203 Angioembolization 0.68 (0.51, 0.91), p=0.011 No intervention reference group <u>1 year mortality, RR (95% CI)</u> Laparotomy 0.95 (0.78, 1.16), p=0.638 Pelvic binding 0.54 (0.33, 0.90), p=0.018 External fixation 0.54 (0.43, 0.69), p<0.0001 Open reduction with internal fixation 0.27 (0.21, 0.35), p<0.0001 Skeletal Traction 0.68 (0.27, 1.72), p=0.416	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Embolisation appears to be beneficial in a subset of patients with less severe systemic injuries, as it did not confer a survival benefit in patients with higher

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
trends in the incidence, diagnosis, treatment, and mortality rates of high-energy pelvic fractures in Ontario, Canada over a 10-year period" **Setting** Canada, 2005-2015	1421 (36.3) Age [y], mean ± SD 46.0 ± 19.2 Blood pressure at admission, mean ± SD 126.9 ± 26.7 GCS at admission, n (%) 13-15: 2691 (68.7) 9-12: 154 (3.9) 3-8: 230 (5.9) ISS, n (%) 16-24: 1488 (38.0) 25-40: 1530 (39.1) 41-49: 496 (12.7) 50-75: 401 (10.2) Cause of trauma, n (%) Automobile 401 (10.2) Bicycle 1684 (43) Fall 120 (3.1) Motorcycle 493 (12.6) Pedestrian struck 313 (8.0) Other 637 (16.3)	• age • comorbidity as measured by Johns Hopkins Aggregated Diagnosis Group Score • ISS	Angioembolization 0.72 (0.56, 0.94), p=0.017 No intervention reference group 2-year mortality, RR (95% CI) Laparotomy 0.96 (0.79, 1.17), p=0.684 Pelvic binding 0.51 (0.31, 0.85), p=0.010 External fixation 0.55 (0.44, 0.69), p<0.0001 Open reduction with internal fixation 0.31 (0.24, 0.40), p<0.0001 Skeletal Traction 0.62 (0.25, 1.54), p=0.302 Angioembolization 0.69 (0.53, 0.89), p=0.005 No intervention reference group	ISS. Laparotomy is typically used for the most severely injured, and is often the most rapidly- achieved intervention." **Reviewers' conclusion** The authors state that the administrative data might not adequately capture interventions such as pelvic binding and skeletal traction, which typically occur in the emergency department rather than the operating room. Furthermore, it was not possible to identify severe pelvic fractures from ISS. No patient characteristics are available for the different comparison groups. The authors state that it is likely that not all relevant confounders were fully adjusted.
Ohmori (2018) "The impact of external fixation on mortality in patients with an unstable pelvic ring fracture: a propensity-matched cohort study" *Bone & Joint Journal* 2018; 100(2): 233-241. **Study design**	**Inclusion criteria** • Unstable pelvic ring fracture (AIS ≥4) due to trauma • Isolated pelvic fracture (in case of trauma AIS for other injuries <3) **Exclusion criteria** • Age <16 y • Dead on arrival at the hospital • Early death in the ED	**Participants** N=1163 patients before matching, N=692 after matching **Comparison groups** IG: external fixation (N=386 before matching, N=346 after matching) CG: no external fixation (N=777 before matching, N=346 after matching)	**Overall sample** Logistic regression analysis for mortality within 7 d, n/N (%); OR (95% CI) IG: 10/346 (3) CG: 18/346 (5); 0.529 (0.236 -1.188), p=0.123 Logistic regression analysis for mortality after 28 d, n/N (%); OR (95% CI) IG: 10/346 (3) CG: 21/346 (6); 0.450 (0.205-0.988), p=0.047	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Comparative registry study (Japan Trauma Data Bank) **Aim of the study** "In this study, we (…) target isolated unstable pelvic ring fractures, to exclude the possibility of blood loss from other injuries and investigate the effectiveness of external fixation on mortality" **Setting** Japan, 2004-2015	**Characteristics (after matching)** Age [y], mean (range) IG: 54 (16-97) CG: 55 (16-100), p=0.736 Male gender, n (%) IG: 229 (66) CG: 231 (67), p=0.872 SBP on ED arrival [mmHg], mean (range) IG: 117 (40-219) CG: 119 (40-244), p=0.343 GCS on ED arrival, mean (range) IG: 15 (3-15) CG: 15 (3-15), p=0.630	**Matching criteria** Not explicitly reported; adjusted for the patient characteristics; variables that were associated with blood loss due to pelvic ring fractures.	Logistic regression analysis for in hospital mortality, n/N (%); OR (95% CI) IG: 11/346 (3) CG: 29/346 (8); 0.333 (0.157-0.709), p=0.004 **Subgroup analysis: patients requiring blood transfusion within 24 h (N=171 after matching)** Logistic regression analysis for mortality within 7 d, n/N (%); OR (95% CI) IG: 8/171 (5) CG: 19/171 (11); 0.421 (0.184-0.962), p=0.040 Logistic regression analysis for mortality after 28 d, n/N (%); OR (95% CI) IG: 9/171 (5) CG: 23/171 (14); 0.364 (0.162- 0.817), p=0.014 Logistic regression analysis for in hospital mortality, n/N (%); OR (95% CI) IG: 10/171 (6) CG: 26/171 (15); 0.333 (0.150- 0.742), p=0.007 **Subgroup analysis: massive blood loss patients (>20% by volume) (N=92 after matching)** Logistic regression analysis for mortality within 7 d, n/N (%); OR (95% CI) IG: 7/92 (8) CG: 18/92 (20); 0.353 (0.139- 0.895), p=0.028 Logistic regression analysis for mortality after 28 d, n/N (%); OR (95% CI) IG: 7/92 (8) CG: 19/92 (21); 0.294 (0.109-0.797), p=0.016 Logistic regression analysis for in hospital mortality, n/N (%); OR (95% CI)	**Authors' conclusion** "The use of EF [external fixation] to treat unstable pelvic ring fractures was associated with a significantly lower risk of mortality. This result tended to be particularly marked in patients with more severe fractures." **Reviewers' conclusion** The indications for external fixations were different across the hospitals which might bias the results. Only isolated pelvic injuries were included.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			IC: 8/92 (9) CG: 21/92 (23); 0.350 (0.148- 0.828), p=0.017	
Schweigkofler (2021) "Is there any benefit in the pre-hospital application of pelvic binders in patients with suspected pelvic injuries?" *European Journal of Trauma & Emergency Surgery* 2021; 47(2): 493-498. **Study design** Subgroup analysis of a prospective observational multi-center study **Aim of the study** "to evaluate effects of an early pelvic binder application on transfusion requirements and hospital mortality." **Setting** Germany, 2013-2014	**Inclusion criteria** • radiologically confirmed type B or C (according to Tile) pelvic ring fracture • a blood requirement, in the first 72 h after admission **Exclusion criteria** • transferrals from another hospital **Characteristics** Age [y], mean ± SD IG: 51 ± 19.6 CG: 48 ± 21.0 (17–78), p=0.402 Male gender, n (%) IG: 12 (60) CG: 9 (69), p=0.637 ISS, mean ± SD IG: 29.7 ± 12.3 CG: 24.4 ± 9.0, p=0.082 NISS, mean ± SD IG: 35.2 ± 14.1 CG: 31.3 ± 10.2, p=0.323 Probability of survival according to RISC II [%], mean ± SD IG: 81.2 ± 22.9 CG: 89.2 ± 15.2, p=0.525 Trauma Associated Severe Hemorrhage Score on admission, mean ± SD	**Participants** N=35 patients **Comparison groups** IG: pelvic binder during prehospital treatment (N=20) CG: no pelvic binder during prehospital treatment (N=15)	In hospital mortality. n/N (%) IG: 4/20 (20) CG: 2/15 (13.33), p=0.452 Standardized mortality ratio IG: 1.06 CG: 1.35, p=0.500 Units of red packed blood cells /patient in 72 h, mean ± SD IG: 10.5 ± 7.8 CG: 7.5 ± 8.4, p=0.457 Mass-transfusion (≥10 red packed blood cells/24 h), n/N (%) IG: 7/20 (35) CG: 3/15 (20), p=0.247	**Level of evidence** 3b↓ **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "We were unable to identify blood-saving effects with application of a pelvic binder to patients with instable pelvic ring fractures in terms of RPBC [packed red blood cells] requirements. Nevertheless, some salutary effect of prehospital pb [pelvic binder] application may be assumed." **Reviewers' conclusion** The study was downgraded because the subgroup analysis was not preplanned and was therefore not adequately powered to show effects on the outcomes. The authors state that their results might be mainly

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG: 10.1 ± 5.7 CG: 6.2 ± 3.9, p=0.690			driven by heterogeneity of injury severity, injury pattern and sample size.

+: low risk; –: high risk; ?: unclear risk
AIS: Abbreviated Injury Score; CG: Comparison Group; CI: Confidence Interval; d: Days; ED: Emergency Department; GCS: Glasgow Coma Scale; h: Hours; ICU: Intensive Care Unit; IG: Intervention Group; ISS: Injury Severity Score; IQR: Interquartile Range; LOS: Length Of Stay; NISS: New Injury Severity Score; n.r.: Not Reported; O/E: Observed vs. expected; OR: Odds Ratio; OTA: Orthopaedic Trauma Association; PCCD: Pelvic Circumferential Compression Devices; PH-PCCD: Pelvic Circumferential Compression Devices applied prehospital; RISC: Revised Injury Severity Classification; RR: Relative Risk; SBP: Systolic Blood Pressure; SD: Standard Deviation; y: Years

Klinische Untersuchung

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Lustenberger (2016) "The Reliability of the Pre-hospital Physical Examination of the Pelvis: A Retrospective, Multicenter Study" *World J Surg* 2016: 40(12): 3073–3079. **Study design** Diagnostic/prognostic cross-sectional study (TraumaRegister DGU®) **Aim of the study** "to determine the value of the pre-hospital physical pelvic examination." **Setting** Germany, 2002-2011	**Inclusion criteria** • primary admission • blunt trauma • ISS ≥9 • available information regarding the pre-clinically suspected injury pattern • a proven (AIS 8561xx) and/or pre-hospital suspected pelvic injury **Exclusion criteria** • n.r. **Characteristics (overall)** Age [y], mean ± SD 42.7 ± 20.3 Male, n (%) 7,489 (68.1) SBP, mean ± SD	**Participants** N=11,062 overall **Tests evaluated** Index test: Clinical examination by emergency physician at scene Reference test: Radiology	**Diagnostic part** Accuracy of the prehospital clinical examination Sensitivity: 55.9% Proportion of pre-hospital suspected pelvic injuries (no/minor/moderate/severe) stratified for the pelvic AIS score, n (%) AIS 0 (N=3861) • no pelvic injury 0 (0) • minor pelvic injury 1728 (44.8) • moderate pelvic injury 1387 (35.9) • severe pelvic injury 746 (19.3) AIS 2 (N=2358) • no pelvic injury 1316 (55.8) • minor pelvic injury 208 (8.8) • moderate pelvic injury 500 (21.2) • severe pelvic injury 334 (14.2) AIS 3 (N=1610)	**Level of evidence** 2b **Risk of bias** Diagnostic part Patient selection: + Index test: ? Reference standard: ? Flow and timing: + Prognostic part no tool available for prognostic studies **Authors' conclusion** "The main finding of the present study is that a significant proportion of severe pelvic fractures type

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	113.9 ± 32.6 GCS at scene, mean ± SD 11.4 ± 4.5 ISS, mean ± SD 27.7 ± 14.4		• no pelvic injury 725 (45.0) • minor pelvic injury 99 (6.1) • moderate pelvic injury 401 (24.9) • severe pelvic injury 385 (23.9) AIS 4 (N=2750) • no pelvic injury 992 (36.1) • minor pelvic injury 140 (5.1) • moderate pelvic injury 609 (22.1) • severe pelvic injury 1009 (36.7) AIS 5 (N=483) • no pelvic injury 145 (30.0) • minor pelvic injury 11 (2.3) • moderate pelvic injury 73 (15.1) • severe pelvic injury 254 (52.6) Proportion of pre-hospital suspected pelvic injuries (no/minor/moderate/severe) stratified for the Tile pelvic fracture type, n (%) Type A (N=2737) • no pelvic injury 1491 (54.5) • minor pelvic injury 225 (8.2) • moderate pelvic injury 592 (21.6) • severe pelvic injury 429 (15.7) Type B (N=2986) • no pelvic injury 1209 (40.5) • minor pelvic injury 157 (5.3) • moderate pelvic injury 665 (22.3) • severe pelvic injury 955 (32.0) Type C (N=1478) • no pelvic injury 478 (32.3) • minor pelvic injury 76 (5.1) • moderate pelvic injury 326 (22.1)	B and C (40.5 and 32.3%, respectively) was not suspected by the emergency physician at the scene. (…) However, missing a pelvic injury in the prehospital setting did not significantly impact the in-hospital outcome with regard to mortality and the requirement for an early transfusion." **Reviewers' conclusion** Probably, the quality and extent of the clinical examination of the pelvis at the scene was very heterogeneous. Detailed information on the reference test are missing. Due to restriction to patients with proven and/or suspected pelvic injuries calculation of specificity and negative predictive value was not possible. When interpreting the results, one should keep in mind that this important information is missing.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			• severe pelvic injury 598 (40.5) **Prognostic part** <u>Mortality, n (%)</u> Suspicion only 461 (12.3) Missed injury 538 (17.5) Correctly suspected injury 629 (16.3), p<0.001 <u>Patients transfused (packed red blood cells), n (%)</u> Suspicion only 850 (22.1) Missed injury 1182 (37.5) Correctly suspected injury 1512 (38.1), p<0.001 <u>Packed red blood cells transfused [units], mean ± SD</u> Suspicion only 1.6 ± 4.6 Missed injury 3.2 ± 7.3 Correctly suspected injury 3.6 ± 7.9, p=0.33 <u>Massive transfusion (≥10 units packed red blood cells), n (%)</u> Suspicion only 210 (5.5) Missed injury 354 (11.2) Correctly suspected injury 487 (12.3), p<0.001	
van Leent (2019) "Clinical Examination of the Pelvic Ring in the Prehospital Phase" *Air Medical Journal* 2019: 38(4); 294–297. **Study design** Diagnostic cross-sectional study	**Inclusion criteria** • high-energy blunt trauma • ISS >16 • on-scene examination of the pelvic ring conducted by the attending HEMS physician **Exclusion criteria** • age <18 y • history of pelvic fracture(s) • no indication for CT imaging	**Participants** N=56 patients **Tests evaluated** Index test 1: Pre-hospital clinical examination Index test 2: Manual compression test Reference standard: Radiology examination	<u>Accuracy of the prehospital clinical examination</u> Sensitivity 0.45 (95% CI, 0.16-0.75) Specificity 0.93 (95% CI, 0.86-1.01) Positive predictive value 0.63 (95% CI, 0.29-0.96) Negative predictive value 0.88 (95% CI, 0.78-0.97) <u>Accuracy of the manual compression test</u> Sensitivity 0.30 (95% CI, 0.02-0.58) Specificity 0.98 (95% CI, 0.93-1.02) Positive predictive value 0.75 (95% CI, 0.33-1.17)	**Level of evidence** 2b **Risk of bias** Patient selection: + Index test: + Reference standard: + Flow and timing: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Aim of the study "to establish the diagnostic accuracy of the prehospital clinical examination of the pelvic ring by a HEMS physician, guiding for therapeutic intervention by a pelvic binder" **Setting** Netherlands, 2015-2016	• HEMS physician did not examine the patient by himself • radiologic examination outcome known by HEMS before completing our questionnaire • incomplete questionnaires **Characteristics (overall)** Age [y], mean ± SD 49.3 ± 20.1 Male gender, n (%) 39 (70) Trauma mechanism, n (%) Traffic accident: 35 (63) Fall from height: 16 (29) Crush: 2 (4) Sport: 3 (5) Fracture type, n (%) Tile A: 4 (7) Tile B: 5 (9) Tile C: 2 (4)		Negative predictive value 0.86 (95% CI, 0.76-0.96)	**Authors' conclusion** "In summary, we can conclude that diagnosing a pelvic ring fracture in the prehospital phase based on the MCT [manual compression test] is not reliable. (…) We advise that every severely injured trauma patient, independent of the trauma mechanism, should be given a pelvic binder to prevent ongoing bleeding from an undiagnosed pelvic ring fracture. Manual testing of the pelvis is not reliable and potentially dangerous and should therefore be abandoned in the prehospital phase." **Reviewers' conclusion** This is a well conducted blinded diagnostic accuracy study. The small sample size should be kept in mind.
Schweigkofler (2018) "Diagnostics and early treatment in prehospital and emergency room phase in suspicious pelvic ring fractures" *Eur J Trauma Emerg Surg* 2018: 44(5); 747–752.	**Inclusion criteria** • strong clinical suspicion of pelvic injury (could be declared by the trauma room leader or the emergency medical service) • initial treatment in the emergency trauma room	**Participants** N=147 patients with documented results from examination (excluding 9 being inconclusive) **Tests evaluated** Index test: pelvic stability examination	Sensitivity, n/N (%) 18/57 (31.6) Specificity, n/N (%) 83/90 (92) Positive predictive value, n/N (%) 18/25 (72)	**Level of evidence** 2b **Risk of bias (QUADAS)** Patient selection: + Index test: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Study design Diagnostic cross-sectional study (TraumaRegister DGU®) **Aim of the study** "to analyze closely the clinical practice in Germany to manage pelvic injuries in prehospital and early hospital setting." **Setting** Germany, 2013-2014	**Exclusion criteria** • transferred from another hospital **Characteristics (overall)** n.r. for group of interest	Reference standard: radiology (either only X-ray, x-ray and pelvic or whole body trauma CT scan or only trauma CT scan)	Negative predictive value, n/N (%) 83/122 (68)	Reference standard: ? Flow and timing: **+** **Authors' conclusion** "Our study generated similar data for the accuracy of manual examination for pelvic stability in identifying unstable pelvic fractures in comparison to previous studies (…). More than 2/3 of all unstable pelvic fractures would be missed if the manual examination of pelvic stability was used as the only diagnostic tool" **Reviewers' conclusion** The authors state that it was not possible to differentiate whether the pelvic stability examination was performed in the hospital or prior to admission to the hospital. This might lead to a high level of heterogeneity concerning the examinations. Furthermore, there is a lack of information in clinical characteristics. Confidence intervals for diagnostic accuracy outcomes are missing.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
+: low risk; –: high risk; ?: unclear risk AIS: Abbreviated Injury Score; CT: **C**omputed Tomography; GCS: Glasgow Coma Scale; HEMS: Helicopter Emergency Medical Service; ISS: Injury Severity Score; n.r.: Not Reported; SBP: Systolic Blood Pressure; SD: Standard Deviation; y: Years				

2.10 Schädel-Hirn-Trauma

Wiederholte Erfassung und Dokumentation von Bewusstseinslage, Pupillenfunktion und Glasgow Coma Scale

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Grote (2011) "Diagnostic value of the Glasgow Coma Scale for traumatic brain injury in 18,002 patients with severe multiple injuries*" J. Neurotrauma* (2011); 28(4): 527-534. **Study design** Diagnostic cross-sectional study (Trauma Register of the German Society for Trauma Surgery) **Aim of the study** "we investigated the diagnostic value of GCS to identify severe TBI in multiple-injured patients" **Setting**	**Inclusion criteria** • adult patients • admitted primarily with ISS ≥16 **Exclusion criteria** • secondarily admitted to trauma centers • age <16 • missing ISS data • missing age data • incomplete GCS data **Characteristics** Age [y], mean ± SD 43 ± 20 Male gender, % 73.7 ISS, mean ± SD 30 ± 12	**Participants** N=18,002 patients **Tests evaluated** Index test: GCS Reference test: Head AIS	Sensitivity of GCS ≤8 to predict severe TBI, n/N; % (95% CI) 4903/8746; 56.1 (55.0–57.1) Specificity of GCS ≤8 to predict severe TBI, n/N; % (95% CI) 7613/9256; 82.2 (81.5–83.0) Positive predictive value of GCS ≤8 to predict severe TBI, n/N; % (95% CI) 4903/6546; 74.9 (73.9–76.0) Negative predictive value of GCS ≤8 to predict severe TBI, n/N; % (95% CI) 7613/11456; 66.5 (65.6–67.3) Correlation between AIS head and GCS ≤8, Spearman's rank correlation - 0.52, p<0.001	**Level of evidence** 2b **Risk of bias** Patient selection: + Index test: + Reference standard: ? Flow and timing: ? **Authors' conclusion** "Our study indicates that the GCS (as defined ≤8) in unconsciousness patients with multiple injuries shows only a moderate correlation with the diagnosis of severe TBI. TBI must always be considered in patients with multiple injuries even with GCS 15" **Reviewers' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Germany, 1993-2007				Head AIS was used as a reference test.
Hoffmann (2012) "Introduction of a novel trauma score" *J. Trauma Acute Care Surg*. (2012); 73(6): 1607-1613. **Study design** Diagnostic/prognostic cross-sectional study (Trauma Register of the German Society for Trauma Surgery) **Aim of the study** "to introduce a novel trauma score to predict TBI presence and outcome. It was hypothesized that the complete GCS evaluation is unnecessarily complex and that the modified GCS motor component in combination with pupil reactivity and size might perform better in the prediction of TBI and outcome." **Setting** Europe, mainly Germany, 1993-2010	**Inclusion criteria** • complete GCS documentation (motor, coded 1-6; verbal, coded 1-5; eye, coded 1-4), pupil size (coded 1-3), and pupil reactivity (coded 1-3) • recorded by an emergency physician at the scene before resuscitation and on hospital admission by a different emergency physician • complete outcome documentation in terms of survival to hospital discharge or death • ISS ≥9 • admitted from the scene directly to the participating hospital **Exclusion criteria** • interhospital-transferred patients • patients with missing data **Characteristics** Age [y], mean ± SD 42.8 ± 20.7 Male, n (%) 20463 (72.3) ISS, mean ± SD 24.9 ± 13.7 ISS ≥16, n (%) 21137 (74.7) GCS, mean ± SD	**Participants** N=28,305 patients **Tests evaluated** Index test 1: GCS Index test 2: ECS Reference test: Head AIS	**Prognostic part** Prediction of mortality, AUROC (95% CI) GCS: 0.811 (0.804-0.818) ECS: 0.824 (0.817-0.831) Spearman's rank correlation: 0.887, p<0.001 **Diagnostic part** Prediction of head AIS ≥3, AUROC (95% CI) GCS: 0.777 (0.768-0.786) ECS: 0.813 (0.805-0.822) Spearman's rank correlation: 0.889, p<0.001	**Level of evidence** 2b **Risk of bias** Diagnostic part: Patient selection: + Index test: + Reference standard: ? Flow and timing: ? Prognostic part: no tool available for prognostic studies **Authors' conclusion** "The present study demonstrated that the ECS exhibits significantly more accuracy for prediction of TBI prevalence and outcome compared with the GCS and provides a simple, yet reliable, stratification tool." **Reviewers' conclusion** When interpreting the results, it should be kept in mind that the motor component of the novel score has been modified on the basis of existing data of the

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
	11 ± 4.6 GCS ≤8, n (%) 8,238 (29.1)			GCS motor component. Furthermore, head AIS was used as a reference test.
Hoffmann (2012) "Pupil evaluation in addition to Glasgow Coma Scale components in prediction of traumatic brain injury and mortality" *Br. J. Surg*. (2012); 99: 122-130. **Study design** Prognostic/diagnostic cross-sectional study (Trauma Registry of the German Society for Trauma Surgery) **Aim of the study** "to assess the mortality prediction value of the GCS, its components, and pupil size and reactivity" **Setting** Europe (mainly Germany), 1993-2009	**Inclusion criteria** • ISS ≥9 • directly admitted patients • alive on admission • complete data on GCS recorded at the scene before resuscitation and on hospital admission • complete data on pupil size and pupil reactivity • complete outcome documentation in terms of survival to hospital discharge or death **Exclusion criteria** • minor injuries and burns **Characteristics** Age [y], mean ± SD 42.3 ± 20.5 Male, n (%) 17482 (72.5) ISS, median (IQR) 22 (16–32) GCS, median (IQR) 14 (7–15) GCS ≤8, n (%) 7141 (29.6)	**Participants** N=24,115 patients **Model components (index tests)** Pupil reactivity Pupil size Motor (GCS) Verbal (GCS) Eye (GCS) GCS Reference test: Head AIS	**Prognostic part** Area under the curve for the prediction of mortality (95% CI) Pupil size: 0.686 (0.675 – 0.696) Pupil reactivity: 0.770 (0.761 – 0.779) GCS motor component: 0.797 (0.788 – 0.805) GCS verbal component: 0.791 (0.783 – 0.798) GCS eye component: 0.770 (0.761 – 0.778) Pupil reactivity & motor (GCS): 0.822 (0.814 – 0.830) Pupil reactivity & pupil size: 0.778 (0.769 – 0.787) Pupil reactivity & pupil size & motor (GCS): 0.824 (0.816 – 0.832) Pupil reactivity & pupil size & motor (GCS) & verbal (GCS): 0.829 (0.821- 0.837) Pupil reactivity & pupil size & motor (GCS) & verbal (GCS) & eye (GCS): 0.830 (0.822 – 0.838) Pupil reactivity & GCS: 0.827 (0.820 – 0.835) Motor (GCS) & verbal (GCS) & eye (GCS): 0.808 (0.800 – 0.815) Predictive value of change in status at scene and after initial resuscitation in terms of mortality, n (%) Pupil reactivity: identical 81.1 (15.1)	**Level of evidence** 2b **Risk of bias** Prognostic part: no tool available for prognostic studies Diagnostic part: Patient selection: + Index test: + Reference standard: ? Flow and timing: + **Authors' conclusion** "The present study has demonstrated that prediction of outcome using pupil reactivity and the GCS motor component provides a simple yet reliable stratification tool when assessing patients with TBI." **Reviewers' conclusion** Not all patients had polytrauma even though minor injuries and burns were excluded, (ISS ≥9 included).

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
	Head AIS ≥3, n (%) 11601 (48.1)		Pupil reactivity: worse 13.9 (24.5) Pupil reactivity: improved 5.0 (21.4) Pupil size: identical 91.1 (14.7) Pupil size: worse 3.7 (54.5) Pupil size: improved 5.2 (25.0) **Diagnostic part** Area under the curve for the prediction of Head AIS ≥3 (95% CI) Pupil size: 0.598 (0.591-0.605) Pupil reactivity: 0.669 (0.662 – 0.676) GCS motor component: 0.748 (0.741 – 0.754) GCS verbal component: 0.775 (0.769 – 0.781) GCS eye component: 0.746 (0.739 – 0.752) Combined model using all five predictor variables: 0.784 (0.778 – 0.790)	Furthermore, head AIS was used as a reference test.
Hoffmann (2017) "Prospective evaluation of the Eppendorf-Cologne Scale" *Eur J Emerg Med* 2017; 24(2): 120-25. **Study design** Prognostic cross-sectional study (Trauma Registry of the German Society for Trauma Surgery) **Aim of the study**	**Inclusion criteria** • patients supplying a complete status documentation of the ECS (pupil reactivity, coded 0–3; pupil size, coded 0–2; motor, coded 0–3) and the GCS (motor, coded 1–6; verbal, coded 1–5; eye, coded 1–4) • recorded by an emergency physician at the scene before resuscitation and on hospital admission by a different emergency physician • complete outcome documentation in terms of survival to hospital discharge or death • ISS ≥9	**Participants** N=12,146 patients **Comparison groups** GCS N=12146 ECS N=12146	Mortality prediction, AUROC (05% CI) GCS 0.836 (0.825-0.848) ECS 0.853 (0.831-0.854), p=0.062	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "The ECS had higher accuracy in terms of mortality prediction compared with the GCS" **Reviewers' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
"to re-evaluate the ECS as a predictor for TBI presence and outcome on the basis of a prospective data set." **Setting** Europe (mainly Germany), 2012-2013	• patient admitted from the scene directly to the participating hospital **Exclusion criteria** • Patients with missing data • Interhospital transferals **Characteristics (overall)** Age [y], mean ± SD 47.7 ± 21.5 Male, n (%) 8711 (71.9) ISS, mean ± SD 22.9 ± 13.1 New ISS, mean ± SD 28.5 ± 15.5			The study could not account for inter-rater variability which was found for GCS and ECS. Furthermore, there was no information on experience or grade of prehospital physicians.

+: low risk; ?: unclear risk; AIS: Abbreviated Injury Scale; AUROC: Area under the receiver operating curve; CG: Control group; CI: Confidence interval; ECS: Eppendorf-Cologne-Scale; GCS: Glasgow Coma Scale; IQR: Interquartile range; ISS: Injury Severity Score; LoE: Level of evidence; n: number; SD: Standard deviation; TBI: Traumatic brain injury; y: years

*For underpowered studies, the LoE was downgraded and marked with an arrow (↓)

Anstreben einer Normoxie, Normokapnie und Normotonie. Vermeidung eines Absinkens der arteriellen Sauerstoffsättigung unter 90%

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Baekgaard (2020) "Early hyperoxemia is associated with lower adjusted mortality after severe trauma: results from a French registry" *Crit. Care* (2020); 24(1): 604.	**Inclusion criteria** • Trauma patients • >17 years • with a PaO_2 measured and registered in the TraumaBase® registry **Exclusion criteria**	**Participants (for GCS <≤8)** N=n.r. **Study groups (for GCS ≤8)** Normoxemia (PaO_2 60 -150 mmHg) at hospital admission (N=n.r.)	**Adjusted outcomes (for GCS ≤8)** In-hospital mortality, OR (95% CI) Normoxemia: reference Hyperoxemia: 0.69 (0.53–0.89), p=0.005 **Unadjusted outcomes (for GCS ≤8)**	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Study design Prognostic cross-sectional study (TraumaBase) **Aim of the study** "to assess the association between early hyperoxemia and in-hospital mortality after severe trauma" **Setting** France, 2016-2019	• hypoxemic patients (PaO_2 <60 mmHg on arrival) • patients withdrawn from life-sustaining therapy In the following, only results for the subgroup of GCS ≤8 were extracted **Characteristics (for GCS ≤8)** n.r.	Hyperoxemia PaO_2 ≥150 mmHg at hospital admission (N=n.r.) **Adjustment criteria** • age • sex • prehospital heart rate • SBP • Temperature • Hemoglobin • Lactate • Airway management • TBI • Initial GCS • ASA>1 • Presence of hemorrhagic shock	<u>In-hospital mortality, OR (95% CI)</u> Normoxemia: reference Hyperoxemia: 0.55 (0.43–0.71), p<0.0001	**Authors' conclusion** "In accordance with several of the above studies, we found a clinical benefit of early hyperoxemia in the current study. Of note, however, all the latter studies focus solely on trauma patients with TBI, whereas we chose to include all trauma patients to present a broader and more pragmatic perspective, as isolated TBI may not always be evident in the acute phase. Nonetheless, in our subgroup analysis of patients with GCS <8, our results were unchanged." **Reviewers' conclusion** Since our population of interest only refers to a subgroup, no patient characteristics were reported. Furthermore, the authors report that in-hospital mortality was missing in 18% and that the PaO_2 value was missing in a substantial proportion of patients, which might have biased the results.

CG: Control group; CI: Confidence interval; GCS: Glasgow Coma Scale; IG: Intervention group; LoE: Level of evidence; n: number; n.r.: not reported; OR: Odds ratio; SBP: Systolic Blood Pressure; TBI: Traumatic brain injury

*For underpowered studies, the LoE was downgraded and marked with an arrow (↓)

Intubation mit adäquater Beatmung (mit Kapnometrie und Blutgasanalyse) bei Bewusstlosigkeit

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Bukur (2011) "Pre-hospital intubation is associated with increased mortality after traumatic brain injury" *J Surg Res* (2011); 170(1): e117-21. **Study design** Comparative registry study (Los Angeles County Trauma System Database) **Aim of the study** "to investigate the relationship between pre-hospital endotracheal intubation and mortality in patients with isolated moderate to severe TBI." **Setting** USA, 2005-2009	**Inclusion criteria** • patients >14 y of age • with isolated moderate to severe TBI (head AIS ≥3, all other AIS <3) **Exclusion criteria** • patients who were dead on arrival • died in the emergency department • were found to have non-survivable injuries (any AIS = 6) • had missing intubation data • age <14 y **Characteristics** Age [y], mean ± SD IG: 35.9 ± 18.2 vs. CG: 38.1 ± 24.2, p=0.472 Male, % IG: 82.0 vs. CG: 76.3, p=0.304 GCS, mean ± SD IG: 3.3 ± 1.1 vs. CG: 11.7 ± 4.2, p<0.001 Head AIS, mean ± SD IG: 4.8 ± 0.5 vs. CG: 4.0 ± 0.8, p<0.001 ISS, mean ± SD IG: 26.7 ± 8.4 vs. CG: 18.4 ± 7.0, p<0.001	**Participants** N=2366 patients **Study groups** IG: intubation in the field (N=61) CG: intubation in the emergency room (N=2305) **Adjusting variables** • mechanism of injury • mean admission SBP • hypotension on admission (SBP <90 mmHg) • mean admission GCS • admission GCS ≤8 • head AIS • mean ISS • severe injury (ISS >16) ➔ all variables with p<0.05 were included in multivariable analysis	**Adjusted outcomes** Mortality, % OR (95% CI) 5.0 (1.7–13.7), p=0.004 Propensity score mortality, % OR (95% CI) 6.8 (2.3–19.6), p=0.001 In-hospital complication rate, % OR (95% CI) 1.5 (0.6–3.9), p=0.397 **Unadjusted outcomes** Mortality, %; OR (95% CI) IG: 90.2 vs. CG: 12.4; 64.7 (27.6–151.7), p<0.001 Complication rate, %; OR (95% CI) IG: 11.5 vs. CG: 10.8; 0.9 (0.4–2.1), p=0.876	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: ? **Authors' conclusion** "our findings from a countywide database suggest that pre-hospital endotracheal intubation for isolated moderate to severe TBI patients rarely occurs in an urban setting and is associated with a nearly 5-fold increase in mortality" **Reviewers' conclusion** Both study groups were heterogeneous with regard to injury and physiologic parameters. Furthermore, the use of intubation medications and therapies directed at treating intracranial hypertension for both study groups and their effects on outcome is unknown.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Wang (2014) "Association of out-of-hospital advanced airway management with outcomes after traumatic brain injury and hemorrhagic shock in the ROC hypertonic saline trial" *Emerg Med J* (2014); 31(3): 186-191. **Study design** Secondary analysis of an RCT (ROC HS study) **Aim of the study** "to determine the association of out-of-hospital advanced airway management with outcomes in patients with (1) isolated severe TBI and (2) haemorrhagic shock with or without concomitant TBI" **Setting** North America, 2006-2008	**Inclusion criteria** • adult (age ≥15 years) • injured patients with either (1) severe TBI (a blunt mechanism of injury with a Glasgow Coma Scale ≤8); or, (2) haemorrhagic shock (a SBP of ≤70 mm Hg, or a SBP of 71–90 mm Hg with a concomitant heart rate ≥108 beats per minute) **Exclusion criteria** • known or suspected pregnancy • age <15 years • out-of-hospital cardiopulmonary resuscitation • administration of ≥2000 ml of crystalloid or any colloid or blood products prior to enrolment • severe hypothermia (<28°C) • drowning • asphyxia due to hanging • burns of ≥20% total body surface area • isolated penetrating head injury • inability to obtain venous access • prisoner status • intrafacility transfers • or >4 h elapsed time between receipt of dispatched call and study intervention • patients who were pronounced dead in the field or on arrival to the ED • missing key covariates • no advanced airway management in the out-of-hospital or ED settings In the following, only results for the subgroup of TBI patients were extracted	**Participants (for TBI)** N=1116 **Study group (for TBI)** IG: out-of-hospital advanced airway management (N=764) CG: advanced airway management in ED (N=352) Advanced airway management was defined as endotracheal intubation, insertion of supraglottic airway, or surgical airway placement (cricothyroidotomy) **Adjustment criteria** • age • sex • ISS • mechanism of injury • initial SBP and GCS • highest field heart rate • out-of-hospital neuromuscular blockade use • mode of transportation • head and neck AIS • parent trial intervention arm (HTS, HTS plus dextran, or normal saline) ROC study site	**Adjusted outcomes (for TBI)** <u>28-day mortality, adjusted OR (95% CI)</u> 1.57 (0.93-2.64) <u>6-month GOSE ≤4, adjusted OR (95% CI)</u> 1.80 (1.09-2.96) <u>6-month DRS ≥4, adjusted OR (95% CI)</u> 1.63 (1.00-2.68) **Unadjusted outcomes (for TBI)** <u>Survival to 28-days, n (%)</u> IG: 558 (73.0) vs. CG: 259 (73.6) <u>6-month GOSE, mean ± SD</u> IG: 4.0 ± 2.7 vs. CG: 3.9 ± 2.7 <u>6-month GOSE≤4, n (%)</u> IG: 403 (59.3) vs. CG: 185 (62.3) <u>6-month DRS, mean ± SD</u> IG: 12.2 ± 13.1 vs. CG: 12.7 ± 13.3 <u>6-month DRS≥4, n (%)</u> IG: 405 (59.6) vs. CG: 181 (61.1)	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: – Attrition bias: ? Detection bias: + **Authors' conclusion** "Compared with emergency department AAM, out-of-hospital AAM was associated with worsened 28-day mortality in patients with haemorrhagic shock. The associations between out-of-hospital AAM and TBI outcomes were smaller and less certain." **Reviewers' conclusion** The high risk of selection and performance bias as well as the unclear risk of attrition bias should be kept in mind when interpreting the results. Only successful airway insertions were analyzed. Due to the limited number of included patients, the authors could not segregate the different airway types. Patients receiving both out-of-hospital

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
	Characteristics (for TBI) Age [y], mean ± SD IG: 38.3 ± 18.1 vs. CG: 40.1 ± 19.0 Male, n (%) IG: 585 (76.6) vs. CG: 271 (77.0) Head/Neck AIS, mean ± SD IG: 3.8 ±1.5 vs. CG: 3.4 ± 1.9 ISS, mean ± SD IG: 29.4 ± 15.4 vs. CG: 24.9 ± 14.8 Initial GCS; mean ± SD IG: 5.0 ± 2.4 vs. CG: 5.5 ± 2.4			advanced airway management and advanced airway management in the ED were assigned to the out-of-hospital advanced airway management group

+: low risk; ?: unclear risk; AIS: Abbreviated Injury Scale; CG: Control group; CI: Confidence interval; DRS: Disability Rating Scale; GCS: Glasgow Coma Scale; GOSE: extended Glasgow Outcome Scale; HTS: Hypertonic saline solution; IG: Intervention group; ISS: Injury Severity Score; LoE: Level of evidence; n: number; OR: Odds ratio; RCT: Randomised controlled trial; SBP: Systolic Blood Pressure; SD: Standard deviation; TBI: Traumatic brain injury; y: years

*For underpowered studies, the LoE was downgraded and marked with an arrow (↓)

Arterielle Normotension

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Asmar (2021) "The ED Systolic Blood Pressure Relationship After Traumatic Brain Injury" *J Surg Res* 2021; 257: 493-500. **Study design**	**Inclusion criteria** • adult trauma patients aged ≥18 y • who had an isolated blunt TBI on presentation (AIS ≥1 and other body region AIS <2) **Exclusion criteria** • patients being dead on arrival • transferred from other institutions	**Participants** N=94,411 patients overall N=12,984 patients with severe TBI **Study groups (for GCS≤8)** ED SBP<70 (N=n.r.) ED SBP 70-89 (N=n.r.) ED SBP 90-109 (N=n.r.)	Multivariate logistic regression for in-hospital mortality for subgroup analysis (severe TBI), OR (95% CI) (for GCS≤8) ED SBP<70: 3.59 (3.01-4.29) ED SBP 70-89: 2.36 (2.07-2.069) ED SBP 90-109: 1.42 (1.28-1.59) ED SBP 110-129: Reference	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Prognostic cross-sectional study (American College of Surgeons (ACS) Trauma Quality Improvement Program (TQIP) database) **Aim of the study** "to assess the association between ED SBP on presentation and mortality in patients with isolated TBI and to determine which range of ED SBP was associated with the lowest mortality." **Setting** USA, 2015-2016	• presenting with acute intoxication of alcohol or illicit substances In the following data from subgroup analysis for severe TBI (GCS≤8 was extracted) **Characteristics (for GCS≤8)** Age [y], mean ± SD 52 ± 22 Male, % 70.6 ISS, median (IQR) 25 (16-26) ED GCS, median (IQR) 3 (3-6) Head AIS, median (IQR) 5 (4-5) Epidural hematoma, % 3.4 Intraventricular haemorrhage, % 1.5 Intraparenchymal haemorrhage, % 21.7 Subdural hematoma, % 33.0	ED SBP 110-129 (N=n.r.) ED SBP 130-149 (N=n.r.) ED SBP 150-169 (N=n.r.) ED SBP 170-189 (N=n.r.) ED SBP ≥190 (N=n.r.) **Variables included in regression** • age • ED heart rate • GCS • Emergency department SBP • ISS • Head AIS	ED SBP 130-149: 0.93 (0.85-1.023) ED SBP 150-169: 1.11 (1.003-1.24) ED SBP 170-189: 1.24 (1.089-1.04) ED SBP ≥190: 1.38 (1.21-1.57)	"In severe TBI, only ED SBP 130-149 mmHg had no difference in mortality compared with ED SBP 110-129 mmHg, as both ED SBP <110 and ≥150mmHg were associated with increased risk of mortality" **Reviewers' conclusion** The results should be interpreted in view of the fact that there are no number of participants and characteristics for the different comparison groups provided. Furthermore, the authors stated that they could not adjust for all possible confounders such as interventions to normalize blood pressure.
Barmparas (2014) "Prehospital hypertension is predictive of traumatic	**Inclusion criteria** • blunt trauma patients	**Participants** N=45,732 patients	**Adjusted outcomes** Overall mortality, adjusted OR (95% CI)	**Level of evidence** 2b

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
brain injury and is associated with higher mortality" *J. Trauma Acute Care Surg*. (2014); 77(4): 592-598. **Study design** Prognostic cross-sectional study (National Trauma Data Bank) **Aim of the study** "to investigate the effect of early adrenergic hyperactivity as manifested by prehospital (emergency medical service [EMS]) hypertension on outcomes of TBI patients" **Setting** USA, 2007-2008	• head (AIS) score ≥3 (for the study aim of interest) • ≥15 years • with available EMS and ED vital signs **Exclusion criteria** • patients with missing demographics, vital signs • nonsurvivable injuries (any body region AIS score 6) • hospital disposition • outlier values for EMS BPS, EMS HR, ED BPS, ED HR **Characteristics** <u>Age [y], mean (SD)</u> 48.5 (22.6) <u>Male gender, %</u> 69.6	**Comparison groups** EMS SBP <100 mm Hg: N=2913 EMS SBP 100-150 mm Hg: N=32505 EMS SBP 160-180 mm Hg: N=7826 EMS SBP 190-230 mm Hg: N=1821 **Adjustment criteria** • age • sex • ISS • EMS GCS • AIS for all body regions • isolated TBI	EMS SBP <100 mm Hg: 1.76 (1.58-1.95) EMS SBP 100-150 mm Hg: reference group EMS SBP 160-180 mm Hg: 1.33 (1.22-1.44) EMS SBP 190-230 mm Hg: 1.97 (1.76-2.21)	**Risk of bias** no tool available for prognostic studies **Authors' conclusion** "Prehospital hypertension in TBI is associated with a higher mortality risk." **Reviewers' conclusion** Some possible confounders (including medication) were not recorded in the database and could not be included in adjustment. A high percentage of patients was excluded because of missing data.
Becker (2020) "Hypotension on admission in patients with isolated traumatic brain injury: contemporary examination of the incidence and outcomes using a national registry" *Brain Inj*. (2020); 34(10): 1422-1426. **Study design**	**Inclusion criteria** • blunt trauma • TBI (presence of any type of intracranial bleeding, diffuse axonal injury, or brain edema) • ≥2 years **Exclusion criteria** • concomitant injuries to other body regions (AIS >2) • dead on arrival • incomplete data	**Participants (for >14y)** N=23,571 patients **Comparison groups (for >14y)** IG: SBP <90 mmHg on admission (N=307) CG: SBP ≥90 mmHg on admission (N=23264)	<u>Mortality, n/N (%) (for >14y)</u> IG: 142/307 (46) vs. CG: 1715/23264 (7.4), p<0.0001 <u>ICU need, n/N (%) (for >14y)</u> IG: 156/307 (51) vs. CG: 6346/23264 (27), p<0.0001 <u>ICU days >3, n/N (%) (among admitted to ICU) (for >14y)</u> IG: 72 (46) vs. CG: 3048 (48), p=0.7 <u>LOS >7 days, n (%) (for >14y)</u>	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "Adult mortality in the hypotensive group reached 46% compared to 7.4%

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Prognostic cross-sectional study (Israeli National Trauma Registry) **Aim of the study** "to examine the incidence and impact of hypotension in contemporary trauma care; using a subset of patients with isolated TBI." **Setting** Israel, 1998-2017	In the following, only results for adults (>14y) were extracted **Characteristics (for >14y)** <u>Age, mean ± SD</u> 46.8 ± 19		IG: 84 (51) vs. CG: 6431 (30), p<0.0001 <u>Rehabilitation, n (%) (for >14y)</u> IG: 43 (26) vs. CG: 3492 (16.2), p=0.0006	among normotensive counterparts" **Reviewers' conclusion** The database does not include information regarding resuscitative interventions. Since our population of interest includes only a subgroup, characteristics are only scarcely reported. In the overall population, diffuse axonal injury was more often in patients with hypotension.
Berry (2012) "Redefining hypotension in traumatic brain injury" *Injury* (2012); 43(11): 1833-7. **Study design** Prognostic cross-sectional study (Los Angeles County Trauma System Database) **Aim of the study** "to determine the age-adjusted optimal SBP in patients with isolated moderate to severe TBI. We hypothesize, that similarly to non-TBI trauma patients, hypotension should	**Inclusion criteria** • all adults (≥15 years) • with blunt isolated moderate to severe TBI (head AIS ≥3, all other AIS ≤3) **Exclusion criteria** • age <15 • Head AIS >5 • dead on arrival • data missing on mortality, gender, ISS, GCS score, or admission SBP **Characteristics across different age groups** <u>Age [y], mean ± SD</u> 43.4 ± 20.8 <u>Male, %</u> 77.5	**Participants** N=15,733 patients (N=10,284 age 15-49; N=3093 age 50-69; N=2356 age ≥70) **Comparison groups** SBP <60: N=38 SBP <70: N=76 SBP <80: N=228 SBP <90: N=495 SBP <100: N=900 SBP <110: N=1714 SBP <120: N=3237 SBP <130: N=5412 SBP <140: N=8044 SBP <150: N=10,589	**Logistic regression for mortality rate stratified for different age groups, n/N (%)** <u>Age 15-49</u> SBP <60: 9/24 (37.5) SBP <70: 34/47 (47.9) SBP <80: 62/150 (41.3) SBP <90: 120/333 (36.0) SBP <100: 179/618 (29.0) SBP <110: 258/1205 (21.4)* SBP <120: 361/2375 (15.2) SBP <130: 484/4070 (11.9) SBP <140: 624/6062 (10.3) SBP <150: 759/7744 (9.8) Optimal SBP and mortality; AOR (95% CI)**	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "Patients with isolated moderate to severe TBI should be considered hypotensive for SBP <110 mm Hg." **Reviewers' conclusion** The authors stated that they were unable to record any effects of other potential interventions such medications which may have af-

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
be defined at a higher SBP than 90 mm Hg." **Setting** USA, 1998-2005	ISS, mean ± SD 19.3 ± 8.2 GCS, mean ± SD 11.4 ± 4.5 Head AIS, mean ± SD 3.79 ± 0.81	**Covariates included in logistic regression** • age • sex • ISS ≥16 • GCS ≤8	1.98 (1.65–2.39), p<0.0001 Age 50-69 SBP <60: 4/8 (50.0) SBP <70: 10/17 (58.8) SBP <80: 21/45 (66.7) SBP <90: 34/94 (66.2) SBP <100: 49/168 (29.2)* SBP <110: 60/306 (19.6) SBP <120: 85/536 (15.9) SBP <130: 110/871 (12.6) SBP <140: 146/1312 (11.1) SBP <150: 183/1784 (10.3) Optimal SBP and mortality; AOR (95% CI)** 2.20 (1.46–3.31), p=0.0002 Age ≥70 SBP <60: 4/6 (66.7 SBP <70: 6/12 (50.0) SBP <80: 15/33 (45.5) SBP <90: 37/68 (54.4) SBP <100: 53/114 (46.5) SBP <110: 77/203 (37.9)* SBP <120: 104/326 (31.9) SBP <130: 138/471 (29.3) SBP <140: 177/670 (26.4) SBP <150: 239/961 (24.9)	fected outcomes. Furthermore, the measurement of the blood pressure was stated as a limitation (only one measurement and values were found to be depending on the device).

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			Optimal SBP and mortality; AOR (95% CI)** 1.92 (1.35–2.74), p=0.0003 * the greatest C-Statistic, and the smallest Akaike Information Criterion and Schwartz Criterion. p<0.0001 ** Optimal SBP is compared to SBP reference groups, adjusting for age, gender, ISS ≥16, and GCS ≤8; reference groups for age 15–49 (≥110 mm Hg); for age 50–69 (≥100 mm Hg), for age ≥70 (≥110 mm Hg)	
Ley (2011) "Elevated admission systolic blood pressure after blunt trauma predicts delayed pneumonia and mortality" *J Trauma Inj Infect Crit Care* (2011); 71(6): 1689-1693. **Study design** Prognostic cross-sectional study (Los Angeles County Trauma System Database) **Aim of the study** "to determine the association between elevated admission SBP and delayed outcomes after trauma" **Setting** USA, 2003-2008	**Inclusion criteria** • blunt trauma patients • age ≥14 years **Exclusion criteria** • LOS <2 days • dead on arrival • AIS >5 for any body region • missing data on age, sex, or AIS In the following, only results for the subgroup of patients with Head AIS ≥3 were extracted **Characteristics (for Head AIS ≥3)** Age, mean ± SD 41.6 ± 18.2 Male, n (%) 2071 (79.6) ISS, mean ± SD 21.5 ± 10.7 ISS ≥16; n (%)	**Participants (for Head AIS ≥3)** N=2601 patients **Comparison groups (for Head AIS ≥3)** SBP ≥160 mm Hg (N=445) SBP ≥170 mm Hg (N=278) SBP ≥180 mm Hg (N=173) SBP ≥190 mm Hg (N=111) SBP ≥200 mm Hg (N=54) SBP ≥210 mm Hg (N=35) SBP ≥220 mm Hg (N=21) **Variables included in multivariable regression modeling** • age • gender • ISS ≥16 • GCS ≤8 • blood alcohol level positive • SBP <90 mm Hg • SBP ≥160 mm Hg	**Adjusted outcomes (for Head AIS ≥3)** Multivariable Regression Modeling Determined Predictors of in-hospital mortality, adjusted OR (95% CI) SBP <90 mm Hg 1.62 (0.81–3.28), p=0.17 SBP ≥160 mm Hg 1.59 (1.10–2.29), p=0.03 Multivariable Regression Modeling Determined Predictors of pneumonia, adjusted OR (95% CI) SBP <90 mm Hg 1.84 (1.00–3.36), p=0.05 SBP ≥160 mm Hg 1.79 (1.30–2.46), p=0.0004 Unadjusted outcomes (for Head AIS ≥3) In-hospital mortality, n/N (%); RR (95% CI) SBP ≥160 56/445 (12.6) vs. SBP <160 129/2156 (6.0); 2.10 (1.56–2.83) SBP ≥170 39/278 (14.0) vs. SBP <170 146/2323 (6.3); 2.23 (1.60–3.11) SBP ≥180 29/173 (16.8) vs. SBP <180 156/2428 (6.4); 2.61 (1.81–3.76)	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors' conclusion** "In conclusion, elevated admission SBP after trauma may affect delayed outcomes." **Reviewers' conclusion** The low number of patients with SBP at higher levels should be kept in mind when interpreting the results. The multivariable modeling did not control for related comorbidities or medications so patients with high blood pressure before trauma may have

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	1887 (72.5) GCS, mean ± SD 11.5 ± 4.3 GCS ≤8, n (%) 735 (28.3) Head AIS, mean ± SD 3.75 ± 0.78		SBP ≥190 22/111 (19.8) vs. SBP <190 163/2490 (6.6); 3.03 (2.02–4.53) SBP ≥200 17/54 (31.5) vs. SBP <200 168/2547 (6.6); 4.77 (3.14–7.26) SBP ≥210 11/35 (31.4) vs. SBP <210 174/2566 (6.8); 4.63 (2.78–7.72) SBP ≥220 7/21 (33.3) vs. SBP <220 178/2580 (6.9); 4.83 (2.60–8.99) Pneumonia, n/N (%); RR (95% CI) SBP ≥160 70/445 (15.7) vs. SBP <160 177/2156 (8.2); 1.92 (1.48–2.48) SBP ≥170 47/278 (16.9) vs. SBP <170 200/2323 (8.6); 1.96 (1.47–2.63) SBP ≥180 26/173 (15.0) vs. SBP <180 221/2428 (9.1); 1.65 (1.13–2.40) SBP ≥190 21/111 (18.9) vs. SBP <190 226/2490 (9.1); 2.08 (1.39–3.12) SBP ≥200 13/54 (24.1) vs. SBP <200 224/2547 (9.2); 2.62 (1.61–4.27) SBP ≥210 11/35 (31.4) vs. SBP <210 236/2566 (9.2); 3.42 (2.06–5.66) SBP ≥220 8/21 (38.1) vs. SBP <220 239/2580 (9.3); 4.11 (2.35–7.19)	associated worse outcomes.
Shibahashi (2018) "Defining Hypotension in Patients with Severe Traumatic Brain Injury" *World Neurosurg* (2018); 120: e667-e674. **Study design**	**Inclusion criteria** • adult (≥18 years) patients • with severe TBI (admission GCS≤8) after blunt injury **Exclusion criteria** • SBP<60 [mmHg]	**Participants** N=12,537 patients **Comparison groups** SBP 60-69: N=n.r. SBP 70-79: N=n.r.	Multiple Logistic Regression Analysis for in-hospital mortality, OR (95% CI)* SBP 60-69: 2.94 (2.20-3.92), p<0.001 SBP 70-79: 2.71 (2.10-3.49), p<0.001 SBP 80-89: 2.06 (1.61-2.63), p<0.001 SBP 90-99: 1.51 (1.20-1.90), p<0.001	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Prognostic cross-sectional study (Japan Trauma Data Bank) **Aim of the study** "to redefine hypotension and determine its optimal threshold in patients with TBI." **Setting** Japan, 2004-2015	• unknown in-hospital mortality **Characteristics (overall)** <u>Male, n (%)</u> 8798 (70.2)	SBP 80-89: N=n.r. SBP 90-99: N=n.r. SBP 100-109: N=n.r. SBP 110-119: N=n.r. SBP 120-129: N=n.r. SBP 130-139: N=n.r. SBP 140-149: N=n.r. SBP 150-159: N=n.r. SBP 160-169: N=n.r. SBP 170-179: N=n.r. SBP 180-189: N=n.r. SBP 190-199: N=n.r. SBP ≥200: N=n.r. **Covariates included in regression** • age • sex • year of hospital admittance • GCS on arrival • major extracranial injury • maximum AIS in the head • ISS	SBP 100-109: 1.40 (1.13-1.73), p=0.0023 SBP 110-119: 1.19 (0.97-1.46), p=0.094 SBP 120-129: 1.03 (0.84-1.24), p=0.80 SBP 130-139: Reference SBP 140-149: 1.06 (0.88-1.28), p=0.53 SBP 150-159: 1.15 (0.95-1.39), p=0.14 SBP 160-169: 1.15 (0.95-1.40), p=0.15 SBP 170-179: 1.39 (1.12-1.72), p=0.0024 SBP 180-189: 1.35 (1.08-1.69), p=0.0093 SBP 190-199: 1.58 (1.24-2.00), p<0.001 SBP ≥200: 1.72 (1.41-2.09), p<0.001	**Authors' conclusion** "In the overall analyses, SBP of 130-139 mm Hg was associated with the lowest odds for mortality. SBP of 60-109 mm Hg on admission was significantly associated with mortality, even after adjusting for possible confounders. These findings suggest an optimal threshold of 110 mm Hg for hypotension." **Reviewers' conclusion** The authors stated that they could not adjust for all possible confounders such as pupillary reactions to light. Neither are the patient characteristics across all age groups reported, nor the case numbers per study group. Because only 1 measurement was assessed, no conclusion on effects of interventions on hypotension could be made.
Shibahashi (2021) "Acceptable Blood Pressure Levels in the Prehospital Setting for Patients with Traumatic Brain Injury: A Multicenter Observational Study"	**Inclusion criteria** • adult patients (age ≥18 years) • with severe TBI (maximum head AIS score ≥3)	**Participants** N=34,175 patients **Comparison groups** Prehospital SBP 60-69 N=348 Prehospital SBP 70-79 N=595	**Adjusted outcomes** <u>Logistic regression analysis for in-hospital mortality, adjusted OR (95% CI) (N=32702)</u> Prehospital SBP 60-69: 2.68 (2.02-3.55), significant	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies

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World Neurosurg 2021; 6:6. **Study design** Prognostic cross-sectional study (Japan Trauma Data Bank) **Aim of the study** "To investigate the association between prehospital blood pressure and the outcomes pf patients with TBI to determine optimal threshold for hypotension that could be considered in the prehospital setting" **Setting** Japan, 2004-2019	• transported directly from the scene of the blunt trauma occurrence to the hospital **Exclusion criteria** • prehospital SBP <60 and ≥160 mm Hg • unknown prehospital SBP and final outcome information • AIS of 6 in the head region • non-blunt injury • not transported by ambulance from the scene **Characteristics (overall)** Age, median (IQR) 61 (41-75) Male, n (%) 23607 (69)	Prehospital SBP 80-89 N=1142 Prehospital SBP 90-99 N=1972 Prehospital SBP 100-109 N=3082 Prehospital SBP 110-119 N=4323 Prehospital SBP 120-129 N=5437 Prehospital SBP 130-139 N=5868 Prehospital SBP 140-149 N=6029 Prehospital SBP 150-159 N=5379 **Covariates included in regression** • Age • sex • year of hospital admission • time of day • nature of the injury • prehospital Japan Coma Scale • maximum head AIS score • ISS	Prehospital SBP 70-79: 2.55 (2.02-3.22), significant Prehospital SBP 80-89: 1.91 (1.57-2.31), significant Prehospital SBP 90-99: 1.59 (1.35-1.89), significant Prehospital SBP 100-109: 1.18 (1.01-1.38), significant Prehospital SBP 110-119: 1.30 (0.88-1.19) Prehospital SBP 120-129: 1.10 (0.96-1.27) Prehospital SBP 130-139: Reference Prehospital SBP 140-149: 1.06 (0.92-1.21) Prehospital SBP 150-159: 1.10 (0.96-1.26) Prehospital SBP<110: 1.52 (1.39-1.65)	**Authors' conclusion** "An SBP of <110 mm Hg in the prehospital setting was found to be significantly associated with in-hospital mortality" **Reviewers' conclusion** The authors stated that they could not adjust for all possible confounders such as pupillary reaction to light. Since only single one-time measurements were assessed, no conclusion could be drawn about the effect of therapeutic interventions. Furthermore, the authors state that the absence of an inflection point might indicate that the threshold is an arbitrary value depending on the sample size.
Zafar (2011) "Presenting blood pressure in traumatic brain injury: a bimodal distribution of death" *J TRAUMA* (2011); 71(5): 1179-84. **Study design** Prognostic cross-sectional study	**Inclusion criteria** • patients ≥16 years old • with isolated moderate to severe blunt TBI (defined by an AIS head severity score of 3 to 6) **Exclusion criteria** • penetrating injuries • patients who were dead on arrival • injuries to other body regions of AIS severity ≥3	**Participants** N=7238 patients **Comparison groups** Emergency department SBP <120: N=1177 Emergency department SBP 120-140: N=1931 Emergency department SBP ≥140: N=4130 **Variables included in regression** • age	**Adjusted outcomes** <u>Multivariate Logistic Regression Analysis for in-hospital mortality, OR (95% CI)*</u> Emergency department SBP <120 vs. 120–140: 2.7 (2.13–3.48), p<0.001 Emergency department SBP ≥140 vs. 120–140: 1.6 (1.32–1.96), p<0.001 **Unadjusted outcomes** <u>Length of stay (of survivors), mean</u>	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies **Authors'' conclusion** "Even though our data have many limitations and we cannot be precise about

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(National Trauma Data Bank) **Aim of the study** "to evaluate the relationship of the initial emergency department systolic blood pressure with outcome." **Setting** USA, n.r.	• missing or invalid emergency department SBP values **Characteristics** Male, n (%) 4,626 (64)	• gender • race • insurance category • emergency department SBP • injury severity	Emergency department SBP <120: 5.0 Emergency department SBP 120-140: 4.9 Emergency department SBP ≥140: 6.6, p<0.001 Length of ICU stay (of survivors), mean Emergency department SBP <120: 2.1 Emergency department SBP 120-140: 2.2 Emergency department SBP ≥140: 3.0, p<0.001	the threshold value for hypotension in patients with moderate to severe TBI, we can be sure that is much higher than 90 mm Hg." **Reviewers' conclusion** The authors stated that it was not possible to determine whether extremes of blood pressure are causally associated with mortality or whether blood pressure is simply a predictor with no contribution to cellular processes that lead to death. Furthermore, a lack of data on possible confounders for adjustment was mentioned.
AIS: Abbreviated Injury Scale; CG: Control group; CI: Confidence interval; CT: Computer tomography; GCS: Glasgow Coma Scale; ICH: Intracranial haemorrhage; ICU: Intensive care unit; IG: Intervention group; IQR: Interquartile range; ISS: Injury Severity Score; LoE: Level of evidence; n: number; n.r.: not reported; OR: Odds ratio; RR: Relative risk; SBP: Systolic Blood Pressure; SD: Standard deviation; TBI: Traumatic brain injury; y: years *For underpowered studies, the LoE was downgraded and marked with an arrow (↓)				

Kraniale Computertomografie (CCT)

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Bendinelli (2013) „Brain CT perfusion provides additional useful in-	**Inclusion criteria** • trauma patient requiring Trauma Team activation • GCS <9 at admission to Emergency Department	**Participants** N=30 patients **Comparison groups** IG: Brain CT perfusion (N=30)	Additional findings because of IG, n (%)* 18 (60) *defined as area of altered perfusion being larger than the injured area detected by CG	**Level of evidence** 2b **Risk of bias** Selection bias: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
formation in severe traumatic brain injury" *Injury*. 2013; 44(9): 1208-12. **Study design** Subgroup analysis of a prospective cohort study **Aim of the study** "We aimed to study with CTP those patients with severe TBI, who during the first 48 h from trauma deteriorated or failed to improve neurologically" **Setting** n.r., 2009-2012	• admission NCCT without pathology requiring craniectomy • age ≥18 • only the following subgroup was analysed: those who (during the first 48 h from trauma) deteriorated (raising ICP, and/ or new onset of localising signs) and/or failed to improve neurologically (despite minimal or no sedation). **Exclusion criteria** • Craniectomy • haemodynamically unstable (systolic blood pressure <90 mmHg and base deficit <-6 mEq/L) • pregnancy (confirmed on blood test) • any allergic reaction to i.v. contrast • severe renal impairment (estimated glomerular filtration rate <30 mL/min) **Characteristics (overall)** Age, mean (SD) 38.6 (16.9) Male, % 90 Lowest GCS, mean (SD) 5.1 (2.0) ISS, mean (SD) 30.5 (8.3) AIS head–neck, mean (SD) 4.4 (0.8)	CG: Brain non-contrast CT (N=30)	Change in clinical management due to IG, n (%) 3 (10)** ** massive and unsurvivable strokes were identified	Performance bias: + Attrition bias: + Detection bias: + **Authors' conclusion** "even in an observational study, CTP changed the management of three (10%) patients. Additionally, CTP abnormalities were found to extend beyond the NCCT findings, suggesting specific blood flow changes." **Reviewers' conclusion** In this study, all patients received both types of CT. Even though the study was intended to be observational, treatment was changed in 3 patients due to the IG.
Sierink (2016)	**Inclusion criteria**	**Participants**	**Subgroup severe TBI (GCS <9 and Head AIS ≥3)**	**Level of evidence**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
"Immediate total-body CT scanning versus conventional imaging and selective CT scanning in patients with severe trauma (REACT-2): a randomised controlled trial" *Lancet* (2016); 388(10045): 673-683. **Study design** RCT (REACT-2) **Aim of the study** "We aimed to assess the effect of total-body CT scanning compared with the standard work-up on in-hospital mortality in patients with trauma" **Setting** Netherlands and Switzerland, 2011-2014	• ≥18 years • with trauma with compromised vital parameters, clinical suspicion of life-threatening injuries, or severe injury • (detailed inclusion criteria can be found on https://ars.els-cdn.com/content/image/1-s2.0-S0140673616309321-mmc1.pdf) **Exclusion criteria** • known age <18 years • known pregnancy • referred from another hospital • clearly low-energy trauma with blunt injury mechanism • any patient with a stab wound in one body region • any patient who is judged to be too unstable to undergo a CT scan and requires (cardiopulmonary) resuscitation or immediate operation because death is imminent In the following, results for the subgroup of severe TBI patients (GCS <9 and Head AIS ≥3) and polytrauma (ISS ≥16) are extracted **Characteristics** n.r. for subgroups of interest	N=329 patients with severe TBI (for GCS <9 and Head AIS ≥3) N=693 patients with polytrauma (for ISS ≥16) **Study groups** IG: immediate total-body CT (N=178 with severe TBI; N=362 with polytrauma) CG: standard work-up with conventional imaging supplemented with selective CT scanning (N=151 with severe TBI, N=331 with polytrauma) The protocol for the intervention (total-body CT) group consisted of a two-step acquisition (from vertex to pubic symphysis) without gantry angulations, starting with a non-enhanced CT of the head and neck with arms alongside the trunk. The second scan covered the chest, abdomen, and pelvis. The preferred technique for the second scan was split-bolus i.v. contrast imaging immediately after raising the arms alongside the head	In-hospital mortality, n/N (%) (N=329) IG: 68/178 (38) vs. 66/151 (44), p=0.31 OR 0.80 (0.51-1.24), p=0.31 24h mortality, n/N (%) (N=329) IG: 37/178 (21) vs. CG: 27/151 (18), p=0.51 Mortality after 30 days, n/N (%) (N=317) IG: 66/171 (39) vs. CG: 60/146 (41), p=0.65 Radiation exposure [mSv] in the trauma resuscitation room, median (IQR) (N=318) IG: 20.9 (20.0–20.9) vs. CG: 20.6 (10.5–22.4), p=0·040 Total radiation exposure [mSv] during hospital stay, median (IQR) (N=318) IG: 22.7 (20.6–26.4) vs. CG: 21.4 (15.1–29.1), p=0.068 **Subgroup polytrauma (for ISS ≥16)** In-hospital mortality, n/N (%) (N=693) IG: 81/362 (22) vs. CG: 82/331 (25), p=0.46 OR 0.88 (0.62-1.24), p=0.46 24h mortality, n/N (%) (N=693) IG: 41/362 (11) vs. CG: 33/331 (10), p=0.56 Mortality after 30 days, n/N (%) (N=647) IG: 76/335 (23) vs. CG: 75/312 (24), p=0.69 Radiation exposure [mSv] in the trauma resuscitation room, median (IQR) (N=669) IG: 20.9 (20.1–20.9) vs. CG: 20.6 (17.6–22.7), p=0.27	2b↓ **Risk of bias** Selection bias: ? Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion** "Mortality also did not differ between groups in subgroup analyses of patients with polytrauma and TBI" **Reviewers' conclusion** The high risk of performance bias and the unclear risk of selection bias should be kept in mind when interpreting the results. Since our comparison of interest refers to a subgroup analysis, no patient characteristics were provided. The study might be underpowered to detect differences in the comparisons of interest. Another aspect that should be kept in mind is that 46% of patients in the CG underwent sequential segmental CT scans of all body regions, comprising a total-body CT scan in the end.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
			Total radiation exposure [mSv] during hospital stay, median (IQR) (N=669) IG: 22.3 (20.7–26.5) vs. CG: 22.5 (20.0–33.1), p=0.77	
+: low risk; ?: unclear risk; AIS: Abbreviated Injury Scale; CG: Control group; CT: Computer tomography; GCS: Glasgow Coma Scale; ICP: Intracranial pressure; IG: Intervention group; IQR: Interquartile range; ISS: Injury Severity Score; i.v.: Intravenous; LoE: Level of evidence; n: number; n.r.: not reported; OR: Odds ratio; RCT: Randomised controlled trial; SD: Standard deviation; TBI: Traumatic brain injury; y: years *For underpowered studies, the LoE was downgraded and marked with an arrow (↓)				

(Kontroll-)CT bei neurologischer Verschlechterung, Verlaufs-CT bei bewusstlosen Patienten und /oder Verletzungszeichen in der initialen CCT

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Connon (2011) "Do routinely repeated computed tomography scans in traumatic brain injury influence management? A prospective observational study in a level 1 trauma center" Annals of Surgery (2011); 254(6): 1028-31. **Study design** Prospective cohort study **Aim of the study** "To prospectively examine the clinical role of routine	**Inclusion criteria** • ≥18 y • admitted for at least 24 hours after blunt head injury • investigated with initial head CT scan either at this institution or at another institution before transfer **Exclusion criteria** • immediate craniotomy/ craniectomy • incomplete data • dead within 24 hours of admission In the following, only results for subgroup of GCS≤8 are extracted **Characteristics (for GCS≤8)** n.r.	**Participants (for GCS≤8)** N=81 patients **Study groups (for GCS≤8)** IG1: subsequent CT of the brain due to increase in ICP, decrease in GCS, failure to improve neurologically as expected, new focal neurologic signs, new or persistent headache, worsening mental status (drowsiness or confusion), seizure, new or increased aggression/agitation, nausea/vomiting (N=61 CT scans) IG2: subsequent routine CT (obtained in the absence of clinical deterioration or sustained rise in ICP in the last 24 hours or	Change in management (medical or surgical intervention designed to lower ICP) (for GCS≤8) IG1: 17/64 (27,9 %) vs. IG2: 0/42 (0 %)	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Our findings also show that patients with severe head injury and neurologic deterioration, particularly younger patients, are likely

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
repeat computed tomographic scans of the brain (CTB) in patients with traumatic head injury." **Setting** Australia, 2007-2008		since the last scan (whichever was more recent)) of the brain; generally performed after 24 h (N=42 CT scans) CG: no subsequent CT of the brain (N=29 patients)		to need further management and CT scans of the brain is a useful adjunct in these patients' management" **Reviewers' conclusion** The results should be interpreted with regard to the high risk of selection and unclear risk of performance bias. Since our population of interest refers to a subgroup, no patient characteristics are reported.
+: low risk; ?: unclear risk; CG: Control group; CT: Computer tomography; GCS: Glasgow Coma Scale; ICP: Intracranial pressure; IG: Intervention group; n: number; n.r.: not reported; y: years *For underpowered studies, the LoE was downgraded and marked with an arrow (↓)				

Glukokortikoide

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Asehnoune (2014) "Hydrocortisone and fludrocortisone for prevention of hospital-acquired pneumonia in patients with severe traumatic brain injury (CortiTC): a double-blind, multicentre phase 3, randomised placebo-controlled trial" *Lancet Respir Med* (2014); 2(9): 706716.	**Inclusion criteria** • 15-65 years • severe TBI (GCS score ≤8 and trauma-associated lesion on brain CT scan) • enrolment within 24 h of trauma **Exclusion criteria** • treatment with corticosteroids in the previous 6 months • immunosuppression • tetraplegia	**Participants** N=368 participants enrolled **Study groups** IG: hydrocortisone (i.v. continuous infusion of 200 mg per day for 7 days starting on day 1, 100 mg on days 8 and 9, and 50 mg on day 10) and fludrocortisone (50 µg tablet once per day) for 10 days (N=168 enrolled; N=165 included in intention to treat analysis)	**Adjusted outcomes** Hospital-acquired pneumonia at day 28, Hazard ratio (95% CI) (N=271) IG: 0.75 (0.55–1.03) vs. CG: reference, p=0.07 **Unadjusted outcomes** Kaplan-Meier-estimator for number of hospital-acquired pneumonia at day 28, absolute risk reduction (95% CI) –7% (–19 to 5)	**Level of evidence** 2b↓ **Risk of bias** Selection bias: + Performance bias: + Attrition bias: + Detection bias: + **Authors' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Study design RCT (Corti-TC) **Aim of the study** "We tested the efficacy of low-dose hydrocortisone with fludrocortisone for the prevention of hospital-acquired pneumonia" **Setting** France, 2010-2012	• or antibiotic treatment at the time of inclusion • enrolment in another study **Characteristics** Age [y], median (IQR) IG: 36 (24–49) vs. CG: 31 (22–47) Male gender, n (%) IG: 138 (84) vs. CG: 136 (83) ISS, median (IQR) IG: 20 (10–27) vs. CG: 22 (13–30) GCS, median (IQR) IG: 6 (3–7) vs. CG: 6 (4–7)	CG: placebo for 10 days (N=368 enrolled; N=163 included in intention to treat analysis) **Co-interventions** After randomisation, there was no significant difference in terms of interventions for prevention of hospital-acquired pneumonia or the management of TBI between the study groups	Death in ICU, n (%) IG: 23 (14) vs. CG: 19 (12), p=0.52 Survival, median (IQR) IG: 9 (8–11) vs. CG: 7 (5–17), p=0.56 Death at 6 months, n (%) (N=247) IG: 27 (16) vs. CG: 21 (13), p=0.38 Cases of hospital acquired pneumonia per patient, median (IQR) IG: 0 (0–1) vs. CG: 1 (0–1), p=0.07 **Other infections** Surgical site infection, n (%) IG: 3 (2) vs. CG: 4 (2), p=1.00 Meningitis, n (%) IG: 3 (2) vs. CG: 2 (1), p=1.00 Bacteraemia, n (%) IG: 10 (6) vs. CG: 11 (7), p=0.82 Urinary tract infection, n (%) IG: 19 (12) vs. CG: 22 (14), p=0.62 Antibiotic-free days at day 28, median (IQR) IG: 20 (15–24) vs. CG: 19 (12–22), p=0.15 Duration of mechanical ventilation [d], mean (SD) IG: 15 (11) vs. CG: 16 (13), p=0.31 Duration of intensive care [d], mean (SD) IG: 20 (14) vs. CG: 22 (17), p=0.35 SOFA Score at day 1, median (IQR) IG: 9 (7-10) vs. CG: 9 (7-10), p=0.33	"Low-dose hydrocortisone with fludrocortisone did not improve the outcome of patients with traumatic brain injury. However, the study was underpowered because the proportion of patients with hospital-acquired pneumonia in the placebo group was lower than expected. The results were close to statistical significance for efficacy, meaning that further studies are therefore needed." **Reviewers' conclusion** Even though we found no risk of bias in this multicenter RCT, the study could not show any difference because it was underpowered. Only results for hospital-acquired pneumonia are adjusted.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
			SOFA Score at day 3, median (IQR) IG: 8 (5-9) vs. CG: 8 (6-10), p=0.38 SOFA Score at day 7, median (IQR) IG: 5 (2-7) vs. CG: 5 (3-7), p=0.97 Serious adverse events Serious adverse events did not differ greatly between the groups (table 5)	
+: low risk; CG: Control group; CI: Confidence interval; CT: Computer tomography; GCS: Glasgow Coma Scale; ICU: Intensive care unit; IG: Intervention group; IQR: Interquartile range; ISS: Injury Severity Score; i.v.: Intravenous; LoE: Level of evidence; n: number; RCT: Randomised controlled trial; SD: Standard deviation; SOFA: Sequential Organ Failure Assessment; TBI: Traumatic brain injury; y: years *For underpowered studies, the LoE was downgraded and marked with an arrow (↓)				

Hyperventilation / hypertone Kochsalzlösung / Mannitol

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Hendoui (2013) "Reliability of calcium-binding protein S100B measurement toward optimization of hyperosmolar therapy in traumatic brain injury." *Eur. Rev. Med. Pharmacol. Sci.* 2013: 17(4): 477-485 **Study design** RCT **Aim of the study**	**Inclusion criteria** • age 18 - 65 years • GCS ≤12 and evidence of brain edema on head Computed Tomography (CT) scan **Exclusion criteria** • Patients with penetrating head trauma • serum sodium >160 meq/l or <130 meq/l • serum osmolarity >350 mOsmol/kg • acute renal failure (an abrupt (within 48 hours) absolute increase in the serum creatinine concentration of ≥0.3 mg/dl from baseline, a percentage in-	**Participants** N=33 patients **Study groups** IG1: N=10 MTL 20%, 1 g/kg was administered over 20 minutes via central venous catheter and repeated with a dose of 0.25-0.5 g/kg every 6 hours based on patient response (defined by GCS and CT improvement) for 3 days IG2: N=11 125 mL HTS 5%, over an hour via central venous catheter every 6 hours for 3 days CG: N=12 500 ml HTS 5% was continuously infused over 24 hours for 3 days	60 days survival: mean ± standard error (%) (95% CI): IG1: 28.9 ± 8.5 (21%) (12.06-45.7) IG2: 40.2 ± 4.9 (82%) (30.5-49.9) CG: 46.8 ± 9.2 (65.5%) (28.7-64.8) Overall: 41.9 ± 5.9 (48%) (30.4-53.5) no significant difference between different groups (p=0.1) GCS: mean ± SD GCS level increased significantly during study period (*p*=0.047). The evaluation of each group showed that this elevation was significant only for infusion part (*p*=0.002). The p value comparing between groups was 0.1.	**Level of evidence** 1b **Risk of bias** Selection bias: ? Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Our data suggest that osmotherapy with HTS and mannitol improves GCS- and SOFA score."

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
"In this study we are going to compare both administration methods of HTS delivering (bolus and continuous infusion) versus mannitol and evaluate the role of S100B as a therapeutic tool for monitoring treatment." **Setting** Iran, ICU, 2009- 2011	crease in the serum creatinine concentration of ≥50 percent, or oliguria of less than 0.5 ml/kg per hour for more than six hours) during the study • hepatic failure (ALT, AST >5 upper limit normal or cirrhosis) before or during the study • shock (MAP ≤60 mmHg) • heart failure (EF <40%) • pulmonary edema (CVP >15 mmHg) • BMI >25 kg/m2 • psychiatric and neurologic disorders history • pregnant women **Characteristics** Age [y], mean ± SD: IG1: 34.2±9 IG2: 33.6 ± 13.05 CG: 40.58 ± 16, p=0.1 Male, n (%): IG1: 6 (60) IG2: 11 (100) CG: 11 (92), p=0.002 Initial GCS, mean ± SD: IG1: 6.5 ± 3.3 IG2: 8.1 ± 2.1 CG: 6.4 ± 1.5, p=0.1 Initial SOFA, mean ± SD: IG1: 6.7 ± 2.2 IG2: 6.5 ± 1.5 CG: 6.5 ± 2.4, p=0.9 Initial MAP (mmHg), mean ± SD:	**(Co)-interventions** • All patients were intubated • received mechanically ventilation with a head elevation of 30° • Volume resuscitation was achieved with 0.9% normal saline for a target CVP of 8-12 mmHg • after adequate fluid resuscitation, MAP was kept above 90 mmHg • Sedation and analgesia were provided for all patients, using continuous infusion of midazolam and morphine to maintain good analgesic control and sedation • Insulin treatment was administered to maintain glucose at <200 mg/dl	IG1: 1st day: 5.9 ± 3.3 2nd day: 7±2.7 3rd day: 6.6 ± 3.5, p=0.7 IG2: 1st day: 7.9 ± 2.02 2nd day: 8.3 ± 2.1 3rd day: 9±2.3, p=0.2 CG: 1st day: 6.7 ± 1.5 2nd day: 7±1.8 3rd day: 7.6 ± 1.9, p=0.002 SOFA: mean ± SD Our intervention reduced SOFA score significantly (p=0.018), and the evaluation of each group showed that this reduction was significant only in bolus group (p=0.002). The p value between groups was 0.9. IG1: 1st day: 6.4 ± 2.2 2nd day: 6.7 ± 2.5 3rd day: 6 ± 1.8, p=0.4 IG2: 1st day: 7 ± 1.9 2nd day: 5.7 ± 2 3rd day: 5.3 ± 1.5, p=0.002 CG: 1st day: 6.7 ± 2.4 2nd day: 6.2 ± 2.4 3rd day: 6.2 ± 2.09, p=0.5	**Reviewers' conclusion** The risk of selection and performance bias is unclear because there is no information on the blinding and the concealment of allocation.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
	IG1: 85 ± 7.2 IG2: 85.45 ± 14.5 CG: 84.16 ± 5.4, p=0.9 Initial APACHE II, mean ± SD: IG1: 14.6 ± 5.4 IG2: 12.18 ± 5.9 CG: 17.08 ± 4.6, p=0.1 Mechanism of injury, n (%): *Car accident* IG1: 4 (40) IG2: 5 (45.5) CG: 5 (41.7), p=0.6 *Motor accident* IG1: 5 (50) IG2: 4 (36.4) CG: 3 (25) *Falling* IG1: 1 (10) IG2: 1 (9.1) CG: 4 (33.3) *Electricity insult* IG1: 0 (0) IG2: 1 (9.1) CG: 0 (0)		Length of ICU stay (day): mean ± SD IG1: 16.9 ± 9 IG2: 14.2 ± 12 CG: 11.17 ± 7.7, p=0.5 Length of hospital stay (day): mean ± SD IG1: 20.7 ± 21.25 IG2: 18.18 ± 12.4 CG: 18.09 ± 1.84, p=0.9 Morbidity, n (%) *Sepsis:* IG1: 3 (30) vs. IG2:0 (0) vs. CG: 2 (17) *MOF:* IG1: 3 (30) vs. IG2:0 (0) vs. CG: 1 (8) *Seizure:* IG1: 1 (10) vs. IG2:0 (0) vs. CG: 0 (0)	
Jagannatha (2016) "An equiosmolar study on early intracranial physiology and long term outcome in severe traumatic brain injury comparing mannitol and hypertonic	**Inclusion criteria** • patients with severe TBI • aged between 15 and 70 years • within 24 hours of injury **Exclusion criteria**	**Participants** N=38 patients **Study groups** IG: 20% MTL (N=20) CG: 3% HTS (N=18)	In-hospital mortality, n (%) IG: 10 (50%) CG: 3 (16,7%), p=0.07 Mortality at 6 months, n (%)	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: ?

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
saline." J. Clin. Neurosci. 2016; 27: 68-73 **Study design** RCT **Aim of the study** "In the current study, we aimed to compare the effect of equiosmolar doses of 3% HTS and 20% mannitol on the treatment of post-traumatic ICH over 6 days." **Setting** India, ICU, n.r.	• Patients with a GCS score of 3 and absent brainstem reflexes • Pregnant women • patients with spinal cord injury • patients with multiple systemic injuries **Characteristics** Age [y], mean ± SD IG: 31 ± 13 CG: 27 ± 8, p=0.24 Male, n (%) IG: 18 (90) CG: 16 (89), p=0.91 Admission GCS score post-resuscitation, median (IQR) IG: 5 (4–6) CG: 4 (4–5), p=0.654 GCS score (Eye + Motor) at inclusion to study (IQR), median (IQR) IG: 5 (3–7) CG: 4 (3–7), p=0.317 Duration of monitoring, hours, mean ± SD IG: 130 ± 54 CG: 131 ± 42, p=0.94 Mode of injury, n (%) *Road traffic accident* IG: 12 (60) CG: 12 (67) *Fall from height*	Both infused as a bolus through a central venous catheter over 5 minutes. Both were administered as 2.5 ml/kg doses (equiosmolar dose). If the first dose of the osmotic agent failed to decrease the ICP to below 20 mmHg, a maximum of three doses of the same drug were administered. **(Co)-interventions** • surgically treatable lesions were immediately operated upon • placement of an external ventricular drain catheter on the • more severely injured side through a frontal twist drill craniotomy • All patients were sedated with morphine or fentanyl in combi- nation with midazolam or diazepam to facilitate mechanical ventilation • Glycemic levels were targeted to around 150 mg/dl by administering insulin • The head-end of the patient's bed was elevated by 15–30°. • All patients received 1 mg/kg of i.v. lignocaine before tracheal suction and chest-physiotherapy • If an ICH episode occurred despite adequacy of sedation, ventilation and head position, CSF was drained until it stopped flowing spontaneously as a first line intervention. If the ICP remained elevated (>20 mmHg for >10 minutes) in spite of CSF drainage (until the CSF egress ceased), patients received osmotic therapy. • If the ICH persisted, hyperosmolar therapy was considered a failure and thio-	IG: 10 (50) CG: 6 (33,3), p=0.41 Median GCS score at ICU discharge, median (IQR) IG: 8.5 (8–10) CG: 9 (8–10), p=0.98 Median GCS score at hospital discharge, median (IQR) IG: 9.5 (8–12) CG: 9 (8–12), p=0.98 Length of ICU stay, days, mean ± SD IG: 17 ± 6 CG: 16 ± 7, p=0.6 Length of hospital stay, days, mean ± SD: IG: 26 ± 10 CG: 30 ± 11, p=0.38 Favourable GOS score at 6 months, n IG: 0 CG: 2 Unfavourable GOS score at 6 months, n IG: 16 CG: 12, p=0.21	Attrition bias: + Detection bias: + **Authors' conclusion** "To conclude, immediate physiological advantages seen with HTS over mannitol did not translate into long term benefit on ICP/CPP control or mortality of patients with TBI." **Reviewers' conclusion** There is an unclear risk of attrition and selection bias and there is only a small sample size of patients.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
	IG: 4 (20) CG: 4 (22) *Others* IG: 4 (20) CG: 2 (11), p=0.54 <u>Injury to hospital duration (hours) mean ± SD</u> IG: 4.3 ± 3.6 CG: 4.5 ± 3.2, p=0.88 <u>Injury to surgery duration (hours) mean ± SD</u> IG: 6.7 ± 5.2 CG: 6.1 ± 5.5, p=0.73 <u>Predominant lesion on CT scan, n (%)</u> *Extradural haematoma* IG: 3 (15) CG: 7 (39) *Subdural haematoma* IG 15 (75) CG: 7 (39) *Contusion* IG: 2 (10) CG: 2 (11) *Diffuse* IG: 0 (0) CG: 2 (11), p=0.67	pentone, propofol, or moderate hyperventilation (PaCO2= 30 mmHg) were instituted • Decompressive craniectomy was considered after exhausting general measures, CSF drainage, osmotic therapy and metabolic suppression • Hyperosmolar therapy was temporarily suspended if serum sodium increased to >160 mmol/dl or if serum osmolality increased to >320 mOsm/kg • Inotropes/vasopressors (dopamine, adrenaline and noradrenaline) were administered as and when required to maintain CPP. • A CT scan of the head was repeated at 24 hours and 5 days post-trauma, and whenever the patient suffered a neurological deterioration. • The ICP catheter was left in situ for 6 days but was removed earlier if the patient started obeying commands or the ICP was maintained <20 mmHg for 24 hours.		
Mangat (2015) "Hypertonic saline reduces cumulative and	**Inclusion criteria** • aged ≥16 years • severe TBI	<u>Before matching</u>	**1:1 Matching** <u>2-week mortality, n (%)</u>	**Level of evidence** 2b

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
daily intracranial pressure burdens after severe traumatic brain injury." J. Neurosurg. 2015; 122(1): 202-210 **Study design** Comparative registry study (The Brain Trauma Foundation TBI-trac New York State database) **Aim of the study** "The authors compare the effect of mannitol versus HTS on lowering the cumulative and daily ICP burdens after severe TBI." **Setting** USA, prehospital, emergency room, ICU, 2000-2008	• hospitalisation ≥5 days • patients who received only 1 hyperosmotic agent (MTL or HTS) for the treatment of intracranial hypertension **Exclusion criteria** • patients who received both agents • GCS score of >9 • motor score of 6 • GCS score of 3 with bilateral fixed and dilated pupils • death on Day 1 • arrival at the trauma centre 24 hours or more after injury • Patients with advanced directives requesting no heroic measures or a do-not-resuscitate/do- not-intubate instruction • Patients without matches or with missing or erroneous data **Characteristics (after Matching)** Age [y], mean ± SD IG: 34.96 ± 15.41 CG: 36.68 ± 16.90, p=0.96 GCS score, mean ± SD IG & CG: 5.40 ± 1.55 Abnormal pupils, n (%) IG & CG: 4 (16.0) Hypotension, n (%) IG & CG: 4 (16.0) Craniotomy, n (%) IG & CG: 6 (24.0)	IG: n=35; HTS 3%-23,4% CG: n=477; MTL 20% **Matching criteria** • initial GCS score • hypotension • pupil reactivity • surgical lesions 1:1 Matching **Participants** N=50 patients **Study groups** IG: HTS 3% (N=24), 23,4% (N=1) the osmolar doses were similar for 3% and 23.4% HTS leading to (N=25) CG: MTL 20% (N=25) 1:2 Matching **Participants** N=72 patients **Study groups** IG: HTS 3% (N=24) CG: MTL 20% (N=48)	IG: 1(4) CG: 2(8), p=0.56 Days in ICU, mean ± SD IG: 8.5 ± 2.1 CG: 9.8 ± 0.6, p=0.004 **1:2 Matching** 2-week mortality, n (%) IG: 1 (4.2) CG: 4 (8.3), p=0.53 Days in ICU, mean ± SD IG: 8.6 ± 2.1 CG: 9.4 ± 1.1, p=0.06	**Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Patients in the HTS group had significantly lower number of ICU days. The 2-week mortality rates were not statistically different between the 2 groups." **Reviewers' conclusion** The results of the study need to be interpreted carefully due to small group sizes and unclear performance bias. Patient characteristics after matching were sparsely reported.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
	Day of ICP monitor insertion, mean ± SD IG & CG: 1.16 ± 0.47 CT scan abnormalities, n (%) IG: 23 (92.0) CG: 24 (96.0), p=0.56			
Patil (2019) "A Comparative Study of Bolus Dose of Hypertonic Saline, Mannitol, and Mannitol Plus Glycerol Combination in Patients with Severe Traumatic Brain Injury." World Neurosurg 2019; 125: e221-e228 **Study design** RCT **Aim of the study** "This prospective randomized controlled study compared the efficacy of an equiosmolar and isovolumetric dose of 3% hypertonic saline, 20% mannitol, and 10% mannitol plus 10% glycerol combination in reducing the raised intracranial pressure (ICP) in patients with severe traumatic brain injury (TBI)." **Setting** India, n.r., 2015-2017	**Inclusion criteria** • aged >18 years, • GCS ≤8 • elevated ICP of >20 mm Hg for more than 5 minutes **Exclusion criteria** • patients had an imminent cranial or extracranial surgery • Previous decompressive craniectomy • Leakage or drainage of CSF • Polytrauma • Oliguria, renal failure • Hemoglobin <8 g/l • Serum osmolality of >320 mOsm/l • The use of MTL or HTS in the previous 6 hours **Characteristics** Age [y], mean ± SD Overall: 38.42 (+/-15.5) range: 18-75 Baseline GCS, mean (minimum-maximum) IG1: 5 (3-7) IG 2: 5 (3-6) CG: 6 (3-8)	**Participants** N=120 patients **Study groups** IG 1: N=40 (MTL 20%) IG 2: N=40 (MTL 10%/ Glycerol 10%) CG: N=40 (HTS 3%) **Intervention** When ICP exceeded 20 mm Hg and lasted for more than 5 minutes: • isovolume and equimolar bolus dose of the 3 hyperosmolar solutes was infused via the central venous line at a defined infusion rate, that is, 6 ml/minute or 120 drops/minute (osmolarity of MTL, MTL plus glycerol combination, and 3% HTS are almost the same, in example: 1100 mOsm/l, 1049 mOsmo/l, and 1027 mOsm/l, respectively). • infusion was stopped when ICP was reduced to <15 mm Hg **(Co)-interventions** • Analgesia was provided to all the patients • if required sedation also provided in irritable patients (dexmedetomidine)	GCS, after the end of the observation period, mean (minimum- maximum) IG 1: 6 (3-10), p<0.0001* IG 2: 7 (3-11), p<0.0001* CG: 8 (3- 12), p<0.0001* *p-values relate to a comparison at the beginning and at the end of the observation period in each group	**Level of evidence** 1b **Risk of bias** Selection bias: ? Performance bias: ? Attrition bias: + Detection bias: ? **Authors' conclusion** - **Reviewers' conclusion** The results should be interpreted carefully because of the unclear risk of performance bias, detection bias and selection bias.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
		• Vasoactive support (norepinephrine) was administered in hypotensive patients. • Insulin treatment was administered to maintain glycemia at <140 mg/dl.		
+: low risk; ?: unclear risk; ALT: Alanin-Aminotransferase; APACHE II: Acute Physiologic and Chronic Health Evaluation; AST: Aspartat-Aminotransferase; BMI: Body mass index; CG: Control group; CI: Confidence interval; CPP: Cerebral perfusion pressure; CSF: Cerebrospinal fluid; CT: Computer tomography; CVP: Central venous pressure; EF: Ejection fraction; GCS: Glasgow Coma Scale; GOS: Glasgow Outcome Scale; HTS: Hypertonic saline solution; ICH: Intracranial haemorrhage; ICP: Intracranial pressure; ICU: Intensive care unit; IG: Intervention group; IQR: Interquartile range; i.v.: Intravenous; LoE: Level of evidence; MAP: Mean arterial pressure; MOF: Multi Organ Failure; MTL: Mannitol; n: number; n.r.: not reported; RCT: Randomised controlled trial; SD: Standard deviation; SOFA: Sequential Organ Failure Assessment; TBI: Traumatic brain injury; y: years *For underpowered studies, the LoE was downgraded and marked with an arrow (↓)				

2.12 Unterkiefer und Mittelgesicht

Diagnostik

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Elfiky (2017) "Diagnostic performance of multi-slice computed tomography using 2D and 3D images in the assessment of Le Fort fractures" *The Egyptian Journal of Radiology and Nuclear Medicine* 48 (2017): 415-424 **Study design** Diagnostic cross-sectional study **Aim of the study**	**Inclusion criteria** • Patients with clinical evidence of maxillofacial injury who underwent multislice CT examination and were shown to be positive for pterygoid process fractures **Exclusion criteria** • Patient with non-fractured pterygoid bone • Pregnant females **Characteristics** Age [y], mean (SD) 35.1 (11.82)	**Participants** N=30 patients **Test evaluated** Index tests: multislice computed tomography • Radiologist A: 2D images • Radiologist B: 3D images • Radiologist C: both 2D and 3D images Patients were scanned in supine position without gantry tilt from upper margin of frontal sinus to chin using the following parameters: 128.1 mm detector row configuration, 1.25 mm slice thickness, 1 mm collimation, 1 mm reconstruction interval, 1.375	**Diagnostic test performance of 2D multislice CT images compared with intraoperative findings for Le Fort fractures (Radiologist A)** Sensitivity, % Compound Le Fort: 94.4 Isolated Le Fort I: 100 Isolated Le Fort II: 100 Isolated Le Fort III: 100 Specificity, % Compound Le Fort: 100 Isolated Le Fort I: 100 Isolated Le Fort II: 100 Isolated Le Fort III: 96.4 Positive predictive value, %	**Level of evidence** 3b↓ **Risk of bias (QUADAS)** Patient selection: - Index test: ? Reference standard: + Flow and timing: + **Authors' conclusion** „Both 2D-CT and 3D-CT are the best methods in imaging of Le Fort fractures." **Reviewers' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"to assess the role of multislice computed tomography (MSCT) using 2D and 3D images in evaluation of different types of Le Fort fractures." **Setting** Egypt, 2015-2016	Male patients, n (%) 23 (76.7) Types of Le Fort fractures, n (%) Compound fractures: 18 (60) Isolated Le Fort type I: 6 (20) Isolated Le Fort type II: 4 (13.3) Isolated Le Fort type III: 2 (6.7)	pitch, 300 mAs, 120 kVp. Standard bone window 3000/300 (WW/WL). Standard soft tissue window 400/50 (WW/WL). Multiplanar reformatted images (MPR) were acquired using the machine software in coronal and sagittal planes. The thin axial slices were transmitted directly from the MSCT scanner to a workstation for reconstruction of 3D images which were important adjuncts to 2D images. Reference standard: Intraoperative findings	Compound Le Fort: 100 Isolated Le Fort I: 100 Isolated Le Fort II: 100 Isolated Le Fort III: 66.7 Negative predictive value, % Compound Le Fort: 92.3 Isolated Le Fort I: 100 Isolated Le Fort II: 100 Isolated Le Fort III: 100 Accuracy, % Compound Le Fort: 96.7 Isolated Le Fort I: 100 Isolated Le Fort II: 100 Isolated Le Fort III: 96.6 **Diagnostic test performance of 3D multislice CT images compared with intraoperative findings for Le Fort fractures (Radiologist B)** Sensitivity, % Compound Le Fort: 66.7 Isolated Le Fort I: 100 Isolated Le Fort II: 100 Isolated Le Fort III: 100 Specificity, % Compound Le Fort: 75 Isolated Le Fort I: 100 Isolated Le Fort II: 96.2 Isolated Le Fort III: 92.9 Positive predictive value, % Compound Le Fort: 80 Isolated Le Fort I: 100 Isolated Le Fort II: 80 Isolated Le Fort III: 50	The results should be interpreted with caution, because of the small study sample and missing confidence intervals. It is unclear whether a consecutive sample of patients was enrolled. Further, patients without fractured pterygoid bone were excluded from the study. Moreover, it is unclear whether the radiologists interpreted the 2D and 3D images without knowledge of the initial imaging diagnostic examinations which were performed on some patients for exclusion.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Negative predictive value, % Compound Le Fort: 60 Isolated Le Fort I: 100 Isolated Le Fort II: 100 Isolated Le Fort III: 100 Accuracy, % Compound Le Fort: 70 Isolated Le Fort I: 100 Isolated Le Fort II: 96.7 Isolated Le Fort III: 93.3 **Diagnostic test performance of 2D and 3D multislice CT images compared with intraoperative findings for Le Fort fractures (Radiologist C)** Sensitivity, % Compound Le Fort: 100 Isolated Le Fort I: 100 Isolated Le Fort II: 100 Isolated Le Fort III: 100 Specificity, % Compound Le Fort: 100 Isolated Le Fort I: 100 Isolated Le Fort II: 100 Isolated Le Fort III: 100 Positive predictive value, % Compound Le Fort: 100 Isolated Le Fort I: 100 Isolated Le Fort II: 100 Isolated Le Fort III: 100 Negative predictive value, % Compound Le Fort: 100 Isolated Le Fort I: 100	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Isolated Le Fort II: 100 Isolated Le Fort III: 100 Accuracy, % Compound Le Fort: 100 Isolated Le Fort I: 100 Isolated Le Fort II: 100 Isolated Le Fort III: 100	
Ojaghi Haghighi (2014) „Diagnostic Accuracy of Ultrasound in Detection of Traumatic Lens Dislocation." *Emergency* 2(3):121-124. **Study design** Diagnostic cross-sectional study **Aim of the study** "to evaluate the diagnostic value of ultrasonography versus orbital computed tomography (OCT) in traumatic lens dislocation." **Setting** Iran, 2013-2014	**Inclusion criteria** • multiple trauma patient with head trauma • with traumatic eye injuries **Exclusion criteria** • Patients with irregularity of the globe contour • lack of ability to cooperate for imaging **Characteristics** Age [y], mean (±SD) 35.4 ± 18.0 Male, n (%)§ 98 (75.4) Hypotension (yes), n (%) 5 (3.8) GCS, n (%) 14-15: 74 (56.9) 9-13: 35 (26.9) 3-9: 21 (16.2) Visual accuracy, n (%)	**Participants** N=130 patients **Tests evaluated** Index test: eye ultrasonography by a trained emergency medicine specialist. Ultrasonography was done using bedside machine (GH Healthcare; LOGIQ 200, PRO series; Korea) with 10 MHz micro-convex linear transducer in sagittal and transverse plane and closed eye technique with water-soluble gel. Reference standard: orbital computed tomography (OCT), interpreted by a radiologist OCT was done using a Toshiba Asteion 16 slices scanner with considering the one-millimeter distance between image slices.	**Diagnostic test performance** Sensitivity, % (95% CI) 84.6 (53.7-97.3) Specificity, % (95% CI) 98.3 (93.3-99.7) Positive predictive value, % (95% CI) 84.6 (53.7-97.3) Negative predictive value, % (95% CI) 98.3 (93.3-99.7) Positive likelihood Ratio, (95% CI) 49.5 (12.3-199.4) Negative likelihood Ratio, (95% CI) 0.15 (0.04-0.56) Accuracy, (95% CI) 96.9 (93.9-99.9)	**Level of evidence** 2b **Risk of bias (QUADAS)** Patient selection: + Index test: + Reference standard: ? Flow and timing: + **Authors' conclusion** "It seems that in cases, [in] which OCT is not possible, ultrasonography, could be an acceptable option to assess traumatic eye injuries." **Reviewers' conclusion** Even if the overall risk for patient selection is low, one should keep in mind that is unclear whether a consecutive sample of patients was enrolled. It also remains unclear whether the radiologist was aware

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Normal: 57 (43.85) Abnormal: 8 (6.15) No cooperation: 65 (50.0) Laceration (yes), n (%) 57 (43.85) Ecchymosis (yes), n (%) 113 (89.9) Eye bleeding (yes), n (%) 2(1.5) Globe Rupture (yes), n (%) 6 (4.6) Periorbital edema (yes), n (%) 63 (48.5) §contradictory results reported			of the results of the sonography although he or she was blinded to the goal of the study. Moreover, it remains unclear whether all patients were included in the analysis.
Ojaghihaghighi (2019) "Diagnosis of Traumatic Eye Injuries With Point-of-Care Ocular Ultrasonography in the Emergency Department." *Annals of Emergency Medicine* 74(3): 365-371. **Study design** Diagnostic cross-sectional study **Aim of the study**	**Inclusion criteria** • mechanism of injury and clinical signs and symptoms suggestive of serious facial trauma that warranted diagnostic evaluation of at least one eye • patients with significant facial or periorbital edema • ecchymosis • orbital edema • or eyelid laceration **Exclusion criteria** • patients unable to undergo orbital CT imaging or bedside ocular examination	**Participants** N=232 patients N=351 eyes **Tests evaluated** Index test: point-of-care ultrasonography by trained emergency physicians All point-of-care ultrasonographic imaging in this study was performed with a SonoSite M-Turbo machine (SonoSite, Bothell, WA) with a 7- to 15-MHz linear transducer. Scanning was performed in sagittal and transverse plane, using closed-eye technique	**Diagnostic test performance of ultrasonography compared with CT examination for ocular injuries** Sensitivity, % (95% CI) Lens dislocation: 96.8 (83.3–99.9) Globe foreign body: 100.0 (79.4–100.0) Globe rupture: 100.0 (39.7–100.0) Retrobulbar hematoma: 95.7 (78.1–99.9) Specificity, % (95% CI) Lens dislocation: 99.4 (97.8–99.9) Globe foreign body: 99.7 (98.3–100.0) Globe rupture: 99.7 (98.4–100.0) Retrobulbar hematoma: 99.7 (98.3–100.0)	**Level of evidence** 2b **Risk of bias (QUADAS)** Patient selection: + Index test: + Reference standard: + Flow and timing: + **Authors' conclusion** "Point-of-care ultrasonography demonstrates high sensitivity and specificity in the diagnosis of traumatic

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"to compare point-of-care ultrasonography with ophthalmologist clinical examination and CT for 6 types of traumatic eye injury." **Setting** Iran, 2015-2016	• patients with gross globe deformity consistent with globe rupture **Characteristics** Age [y], mean 34.3 Male gender, n (%) 171 (73.7) GCS Score, n (%) <9: 50 (21.6) 9-13: 76 (32.8) >13: 106 (45.7) Visual acuity, n (%) Normal: 73 (31.5) Abnormal: 20 (8.6) Unable to cooperate: 139 (59.9) External ocular trauma, n (eyes) (%) Eyelid laceration: 103 (29.3) Periorbital ecchymosis: 187 (53.3) Cutaneous orbital-area bleeding: 6 (1.7) Periorbital edema: 156 (44.4) Nonorbital facial trauma: 55 (14.2)	with water-soluble gel. Transparent adhesive films were applied to protect the injured eye. Reference standard: orbital CT evaluated by trained radiologists and full bedside ophthalmoscopy and slit lamp biomicroscopy performed by an ophthalmologist, depending on the type of injury: CT imaging was performed with a SOMATOM Emotion (Siemens, Munich, Germany) 16-slice scanner with 1-mm slices.	Positive likelihood Ratio, (95% CI) Lens dislocation: 154.8 (38.8–617.0) Globe foreign body: 335.0 (47.3–2,371.0) Globe rupture: 347.0 (49.0–2,456.0) Retrobulbar hematoma: 313.7 (44.2–2,225.0) Negative likelihood Ratio, (95% CI) Lens dislocation: 0.032 (0.005–0.22) Globe foreign body: 0.0 (0.0–0.0) Globe rupture: 0.0 (0.0–0.0) Retrobulbar hematoma: 0.044 (0.0064–0.30) **Diagnostic test performance of ultrasonography compared with complete ophthalmologist clinical examination for ocular injuries** Sensitivity, % (95% CI) Lens dislocation: 96.6 (82.2–99.9) Vitreous hemorrhage: 97.8 (88.2–99.9) Retinal detachment: 88.9 (70.8–97.6) Specificity, % (95% CI) Lens dislocation: 98.8 (96.9–99.7) Vitreous hemorrhage: 98.7 (96.7–99.6) Retinal detachment: 100.0 (98.9–100.0) Positive likelihood Ratio, (95% CI) Lens dislocation: 77.7 (29.3–206.0) Vitreous hemorrhage: 74.8 (28.2–198.0) Retinal detachment: Infinite Negative likelihood Ratio, (95% CI) Lens dislocation: 0.035 (0.0051–0.24) Vitreous hemorrhage: 0.023 (0.032–0.16) Retinal detachment: 0.11 (0.038–0.32)	eye injury, and represents a valuable diagnostic tool in addition to orbital CT and complete beside ocular examination by an ophthalmologist in the diagnosis of traumatic eye injury." **Reviewers' conclusion** It remains unclear if a consecutive sample of patients were enrolled and which eyes were excluded (113/464 eyes), for example if eyes with any other injury than the six injuries analyses were excluded.
+: low risk; –: high risk; ?: unclear risk; 2D: two-dimensional; 3D: three-dimensional; adj.: adjusted CI: Confidence Interval; CT: Computer Tomography; d: days; HR: Hazard Ratio; IQR: Interquartile Range; ITT: Intention to Treat; kVp: Peak kilovoltage; m: months; mAs: Milliampere second; mm: millimetre; MPR: Multiplanar reformatted images; MODS: Multiple Organ Dysfunction Syndrome; N:				

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; study groups; tests evaluated	Main outcomes	Assessment: LoE, risk of bias; Conclusions
patients at risk; n: number of patients; OCT: Orbital computed tomography; OR: Odds Ratio; RR: Relative Risk; SD: Standard Deviation; SEM: Standard Error of Mean; WW/WL: Window Width / window level; y: years				

2.13 Hals

Versorgung offener Halstraumen mit akuter Blutung

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Blitzer (2020) "Penetrating Injury to the Carotid Artery: Characterizing Presentation and Outcomes from the National Trauma Data Bank". *Ann Vasc Surg* 2020; 67: 192-199. **Study design** Comparative registry study (National Trauma Databank) **Aim of the study** "The purpose of this study was to assess presenting characteristics associated with penetrating injury to the carotid artery and directly compare approaches to surgical management."	**Inclusion criteria** Adult patients (≥18 years) Penetrating mechanism of injury to the common carotid artery (CCA) and internal carotid artery (ICA) **Exclusion criteria** Patients who did not survive beyond initial presentation to the emergency department (ED) **Characteristics before matching** Age [y], median (IQR) OM: 30 (23-42) nOM: 31 (23-43), p=0.186 OPEN: 30 (23-42) ENDO: 31 (22-44), p=0.716 Male, n (%) OM: 1219 (86.1) nOM: 1692 (85.6), p=0.215 OPEN: 1025 (86.0) ENDO: 137 (89.0), p=0.313	**Participants** N=3391 patients **Study groups** **Study groups** OM: Operative Management (N=1415 before and N=1415 after matching) nOM: Nonoperative Management (N=1976 before and N=1415 after matching) **Co-interventions** OPEN: Open repair (N=1192 before and N=308 after matching) ENDO: Endovascular repair (N=154 before and N=154 after matching) Analyses were conducted on 2 independent variables: 1) operative management (OM), including patients who underwent open repair, endovascular repair, or both at any point during their hospitalization versus nonoperative management (nOM)	Mortality, n/N (%) OM: 228/1415 (18.5) nOM: 350/1415 (28.9), p<0.001 OPEN: 55/308 (19.6) ENDO: 19/154 (14.6), p=0.274 Acute kidney injury, n/N (%) OM: 27/1415 (1.9) nOM: 16/1415 (1.1), p=0.124 OPEN: 6/308 (1.9) ENDO: 3/154 (1.9), p=1 Acute respiratory distress syndrome, n/N (%) OM: 64/1415 (4.5) nOM: 6/1415 5 (4.6), p=1 OPEN: 21/308 (6.8) ENDO: 12/154 (7.8), p=0.848 Pulmonary embolism, n/N (%) OM: 10/1415 (0.7) nOM: 14/1415 (1.0), p=0.539 OPEN: 3/308 (1.0) ENDO: 2/154 (1.3), p=1	**Level of evidence** 2b **Risk of bias** Selection bias: ? Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "These results indicate that nonoperative patients often present with a more severe overall injury burden, particularly injury to the head, and not surprisingly, have higher rates of mortality. The lack of significant differences in outcomes relating to surgical approach indicates open versus endovascular invention should be individualized to the patient for example,

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Setting USA, 2002-2016	GCS, median (IQR) OM: 13 (3-15) nOM: 9 (3-15), p<0.001 OPEN: 13 (3-15) ENDO: 14 (3-15), p=0.331 ISS, median (IQR) OM: 18 (11-25) nOM: 20 (13-29), p<0.001 OPEN: 17 (10-25) ENDO: 19 (13-26), p=0.222 ISS ≥25, n (%) OM: 415 (33.3) nOM: 750 (42.3), p<0.001 OPEN: 342 (32.5) ENDO: 46 (34.3), p=0.761 Severe head injury (AIS ≥3), n (%) OM: 254 (22.0) nOM: 736 (44.9), p<0.001 OPEN: 174 (18.0) ENDO: 56 (43.1), p<0.001 GSW, n (%) OM: 752 (53.1) nOM: 1471 (74.4), p<0.001 OPEN: 585 (49.1) ENDO: 124 (80.5), p<0.001 SW, n (%) OM: 646 (45.7) nOM: 453 (22.9), p<0.001	2) within the OM group, comparing open repair only (open) versus endovascular repair only (endovascular) versus combined open and endovascular repair (combined).	Sepsis, n/N (%) OM: 28/1415 (2.0) nOM: 29/1415 (2.0), p=1 OPEN: 7/308 (2.3) ENDO: 2/154 (1.3), p=0.721 Stroke, n/N (%) OM: 148/1415 (10.5) nOM: 93/1415 (6.6), p<0.001 OPEN: 31/308 (10.1) ENDO: 18/154 (11.7), p=0.708 LOS [d], median (IQR); patients discharged alive OPEN: 11.00 (6.00-19.00) ENDO: 12.00 (6.50-20.00), p=0.342 ICU LOS [d], median (IQR); patients discharged alive OPEN: 5.00 (3.00-11.00) ENDO: 6.00 (3.00-11.00), p=0.573	based on presenting characteristics and the location of the injury." **Reviewer's conclusion** The risk of selection bias is unclear because patient characteristics post matching are not reported. Furthermore the risk of performance bias is unclear as it is not reported whether the groups received the same care. Therefore the results should be interpreted with caution.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	OPEN: 591 (49.6) ENDO: 29 (18.8), p<0.001			
+: low risk; –: high risk, ?: unclear risk; AIS: Abbreviated injury scale; CCA: Common carotid artery; ED: Emergency department; ENDO: endocascular repair; GCS: Glasgow Coma Score; GSW: Gunshot wound; ICA: Internal carotid artery; ICU: Intensive care unit; IQR: Interquartile Range; ISS: Injury severity score; LoE: Level of evidence; LOS: Length of stay; nOM: Non-operative management; OM: Operative management; OPEN: open repair; SW: Stab wound; adj.: adjusted; d: days; y: years				

Endoskopische Untersuchung des traumatisierten Bereichs bei Halsverletzungen

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics of patients with esophageal stricture yes/no	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Bruzzi (2019) "Emergency Computed Tomography Predicts Caustic Esophageal Stricture Formation ". *Annals of Surgery* 2019; 270(1): 109-114. **Study design** Prognostic cross-sectional study **Aim of the study** "Our aim was to compare the accuracy of emergency computed tomography (CT) and endoscopy in predicting risks of esophageal stricture." **Setting** France 2007-2014	**Inclusion criteria** • Adult patients (>16 years) • Esophageal preservation after caustic ingestion • Both CT and endoscopy evaluation **Exclusion criteria** • Patients with Grade III esophageal injuries (transmural necrosis as shown by the absence of postcontrast wall enhancement) **Characteristics** Male, n (%) 76 (50.0) Age [y], mean (IQR) 45 [31-55] Suicide attempt, n (%) 135 (89.0) Ingested agents, n (%)	**Participants** N=152 patients **Study groups** Group 1 (G1): endoscopic evaluation by Zargar endoscopic grading (n=152) Group 2 (G2): CT evaluation (n=152) Group 3 (G3): endoscopic + CT evaluation (n=152)	**Prognostic test performance: prediction of esophageal stricture at 120 days** AUC, % (95 % CI)[§] *time-dependent AUC using nonparametric estimation methods; probably reported in %* G1: 77.8 (66.5; 89.0) G2: 85.1 (74.9; 95.3), p=0.047 G3: 85.8 (76.5; 95.0), p=0.02 Sensitivity, % (95 % CI) G1: n.r. G2: 86.19 (74.12; 92.68) G3: n.r. Specificity, % (95 % CI) G1: n.r. G2: 75.00 (64.4; 81.85) G3: n.r. Positive predictive value, % (95 % CI)	**Level of evidence** 2b **Risk of bias** no tool available for prognostic studies. **Authors' conclusion** "Emergency CT outperforms endoscopy in predicting esophageal stricture formation after caustic ingestion. Emergency endoscopy evaluation after caustic ingestion is not indispensable." **Reviewer's conclusion** The results should be interpreted with caution, as no tool is currently available to systematically assess the risk of bias of prognostic

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics of patients with esophageal stricture yes/no	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Acids: 36 (24.0) Strong alkali: 95 (63.0) Bleach: 21 (13.0) <u>Endoscopic grades of esophageal injuries, n (%)</u> 1: 50 (33.0) 2a: 11 (7.0) 2b: 19 (13.0) 3a: 14 (9.0) 3b: 58 (38.0) <u>CT grades of esophageal injuries, n (%)</u> I: 47 (31.0) IIa: 47 (31.0) IIb: 58 (38.0)		G1: n.r. G2: 76.16 (59.73; 89.02) G3: n.r. <u>Negative predictive value, % (95 % CI)</u> G1: n.r. G2: 85.43 (74.93; 94.40) G3: n.r. **Prognostic test performance: prediction of the need for esophageal reconstruction at 12 months** AUC (95% CI)§ G1: 54.9 (43.7; 66.1) G2: 70.9 (47.6; 79.3), p=0.004 G3: n.r. **Median delay in reconstruction, n/N (m [IQR])** 34/150 (8 [6-9]) § p-values compared to G1 (endoscopy alone)	studies, and because no study protocol is available. The study population represents a relevant clinical situation. However, the most severely injured patients, i.e. those in need of emergency esophagectomy, had to be excluded. Strictures were ascertained by the gold-standard endoscopy examination and barium swallow meal. Prognostic test accuracy at 6 months is reported only for CT, so that no comparison with the standard endoscopic method is possible. In addition, it is unclear for which CT grade cut-off these values are reported (IIa or IIb), limiting their interpretability.
AUC: Area under the curve; CI: Confidence Interval; CT: Computed tomography; d: days; IQR: Interquartile Range; LoE: Level of evidence; n.r.: not reported; y: years				

Versorgung gedeckter Halstraumen

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Blitzer (2020) "Timing of intervention may influence outcomes	**Inclusion criteria** • adult patients (age ≥18 years) • injury to the common carotid artery and/or internal carotid artery	**Participants** N=9190 patients with blunt carotid artery injury (BCI)	**Adjusted outcomes, OPEN vs. ENDO** <u>Mortality, n/N (%)</u>	**Level of evidence** 2b **Risk of bias**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
in blunt injury to the carotid artery". *J Vasc Surg* 2019; 71(4); 1323-1332. **Study design** Comparative registry study (US National Trauma Data Bank) **Aim of the study** "to assess the epidemiologic characteristics of BCI and, after controlling for presenting features intrinsic to the data, evaluate outcomes based on management (operative vs nonoperative), operative approach (open vs endovascular), and timing to intervention (early [<24h] vs delayed [>24h])." **Setting** USA, 2002-2016	• blunt mechanism of injury **Exclusion criteria** • death in the ED • transfer from the ED to another hospital or institution • discharge directly home from the ED **Characteristics (overall cohort)** Age [y], median (IQR) 38 (26-53) Male sex, n (%) 5777 (62.9) SBP [mmHg], median (IQR) 129 (110-148) Hypotension (SBP<90 mmHg), n (%) 846 (9.4) ISS, median (IQR) 29 (20-38) GCS, median (IQR) 11 (3-15) Neck injury, n (%) 7297 (81.3)	**Study groups** *Comparison OPEN vs. ENDO* OPEN: open repair only (N=288) ENDO: endovascular repair only (N=481 before and N=288 after matching) *Comparison EARLY vs. DELAYED* EARLY: endovascular repair <24h (N=198) DELAYED: endovascular repair >24h (N=274 before and N=198 after matching) **Matching criteria, OPEN vs. ENDO** • gender • SBP • pulse • ISS • ISS≥25 • severe head injury • severe chest injury • severe abdominal injury • severe lower extremities injury • Matching criteria, EARLY vs. DELAYED • hypotension (SBP<90 mmHg) • shock index >0.9 • temperature • GCS • coma (GCS ≤8) • severe spinal injury	OPEN: 54/288 (18.8) ENDO: 29/288 (10.1), p<0.01 Acute kidney injury: n/N (%) OPEN: 3/288 (1.0) ENDO: 10/288 (3.5), n.s. ARDS: n/N (%) OPEN: 13/288 (4.5) ENDO: 22/288 (7.6), n.s. Pulmonary embolism: n/N (%) OPEN: 4/288 (1.4) ENDO: 6/288 (2.1), n.s. Sepsis: n/N (%) OPEN: 8/288 (2.8) ENDO: 12/288 (4.2), n.s. Stroke, n/N (%) OPEN: 31/288 (10.8) ENDO: 29/288 (10.1), n.s. **Adjusted outcomes, OPEN vs. ENDO, for patients alive at the time of discharge** Hospital LOS, median (IQR) OPEN (N=234): 16 (6.75-30.00) ENDO (N=259): 17 (10-31), p<0.05 ICU LOS, median (IQR) OPEN (N=234): 9 (4-19) ENDO (N=259): 11 (4-20), n.s. **Adjusted outcomes, EARLY vs. DELAYED** Mortality: n/N (%)	Selection bias: ? Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "After critically assessing the timing to intervention, results strongly suggested that, if possible, intervention should be delayed for at least 24 hours." **Reviewer's conclusion** Propensity score matching included a very limited number of variables, and baseline characteristics post matching were not provided. Therefore, it is unclear whether the groups were balanced with respect to important risk factors. . The study sample included around 80 percent of patients with neck injuries. Therefore the results of the study need to be interpreted with caution.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			EARLY: 38/198 (19.2) DELAYED: 5/198 (2.5), p<0.001 Acute kidney injury: n/N (%) EARLY: 11/198 (5.6) DELAYED: 3/198 (1.5), n.s. ARDS: n/N (%) EARLY: 17/198 (8.6) DELAYED: 21/198 (10.6), n.s. Pulmonary embolism: n/N (%) EARLY: 4/198 (2.0) DELAYED: 6/198 (3.0), n.s. Sepsis: n/N (%) EARLY: 10/198 (5.1) DELAYED: 12/198 (6.1), n.s. Stroke: n/N (%) EARLY: 24/198 (12.1) DELAYED: 25/198 (12.6), n.s. Surgical site infection: n/N (%) EARLY: 5/198 (2.5) DELAYED: 8/198 (4.0), n.s. **Adjusted outcomes, EARLY vs. DELAYED, for patients alive at the time of discharge** Hospital LOS, median (IQR) EARLY (N=160): 18 (11-32) DELAYED (N=193): 21 (14-34), p<0.05 ICU LOS, median (IQR) EARLY (N=160): 13 (6-21) DELAYED (N=193): 14 (7-25), n.s.	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
+: low risk; –: high risk, ?: unclear risk; ARDS: acute respiratory distress syndrome; BCI: Blunt carotid injury d: days; ED: Emergency department; ENDO: endovascular repair; GCS: Glasgow coma scale; ICU: Intensive care unit; IQR: Interquartile Range; ISS: Injury severity score; LoE: Level of evidence; LOS: length of stay; mmHg: millimeters of mercury; n.s.: not significant; OPEN: open repair; SBP: systolic blood pressure; y: years				

3 Erste OP-Phase

3.1 Thorax

Parenchymsparender Eingriff bei Lungenverletzungen

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Aiolfi (2020) "Lung Resection for Trauma: A Propensity Score Adjusted Analysis Comparing Wedge Resection, Lobectomy, and Pneumonectomy." *American Surgeon.* 2020; 86(3): 261-5. **Study design** Comparative registry study (National Trauma Databank Italy) **Aim of the study** "The aim of this study was to analyze a large contermporary series of patients who required lung resection for severe chest	**Inclusion criteria** • Adult patients (≥16 years) who sustained severe chest trauma (defined as AIS ≥3) and required any type of lung resection • Wedge resection (ICD-9 32.29), lobectomy (ICD-9 32.39, 32.40, 32.59) and pneumonectomy (ICD-9 32.50, 32.59) **Exclusion criteria** • Lung tractotomy and pneumonorraphy were not included because of the lack of a specific ICD-9 code • Patients declared dead on the arrival • AIS=6 • Patients with missing data **Characteristics** Age [y], mean ± SD 33 ± 16	**Participants** N=3,107 patients **Study groups** IG: Wedge (N=1,696) IG2: Lobectomy (N=1,187) CG: Pneumonectomy (N=224) "To reduce the impact of treatment selection bias inherent to an observational study, we compared postoperative outcomes of treatment through inverse probability of treatment weighting using propensity score."	Overall mortality n (%) IG: 344 (20.3) vs. IG2: 366 (30.8) vs. CG: 142 (63.4), p<0.001 Adjusted OR (95% CI) IG2 vs IG1: 1.42 (1.26-1.71) CG vs. IG1: 4.16 (2.84-6.07) Mechanical ventilation [d] mean ± SD IG: 9.1 ± 13.8 vs. IG2: 10.6 ± 15.4 vs. CG: 12.2 ± 12.1, p=0.038 ICU stay [d] mean ± SD IG: 11.4 ± 14.3 vs. IG2: 13.3 ± 16.4 vs. CG: 15.4 ± 13.3, p=0.002 Hospital length of stay [d] mean ± SD IG: 19.8 ± 18.9 vs. IG2: 22.2 ± 20.8 vs. CG: 22.7 ± 17.7, p=0.011 Overall complications, n (%)	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: ? **Authors' conclusion** "Lung resection for chest trauma is infrequent but associated with significant morbidity and mortality. Lobectomy and pneumonectomy are associated with a statistically significant higher overall morbidity and mortality after PS matching"

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
injury and to analyze outcomes for wedge resection, lobectomy, and pneumonectomy." **Setting** Italy, 2007-2015	Male, n (%) 2,704 (87) ISS mean ± SD 25 ± 13 GCS mean ± SD 10 ± 5 AIS ≥3, n (%) Head 423 (13.6) Abdomen 842 (27.1) Extremities 513 (16.5) Chest AIS, n (%) 3 1867 (60.1) 4 988 (31.8) 5 255 (8.2) Isolated chest injury, n (%) 1789 (57.5) Injury mechanism, n (%) Blunt 911 (29.3) Penetrating 2196 (70.7) Systolic blood pressure, mean ± SD 104 ± 41 *Significant differences exist between wedge and lobectomy and between wedge and pneumonectomy groups at baseline.*		IG: 461 (29.8) vs. IG2: 369 (37.4) vs. CG: 63 (51.2), p<0.001 Adjusted OR (95% CI) IG2 vs IG1: 1.21 (1.02-1.44) CG vs. IG1: 1.56 (1.07-2.28) Infections, n (%) IG: 306 (19.8) vs. IG2: 250 (25.4) vs. CG: 35 (28.5), p=0.001 Pulmonary, n (%) IG: 340 (22.0) vs. IG2: 271 (27.5) vs. CG: 39 (31.7), p=0.001 Cardiac arrest, n (%) IG: NR (6.8) vs. IG2: NR (10.9) vs. CG: NR (24.1), p<0.001 **Subgroup analysis (isolated lung injury)** Overall mortality, adjusted OR IG2 vs IG1: 1.24, p=0.028 CG vs. IG1: 3.46, p=0.001 Overall complications, adjusted OR IG2 vs IG1: 1.17, p=0.031 CG vs. IG1: 1.39, p=0.013	**Reviewers' conclusion** For the outcomes mortality and complications risk of selection bias is low, as there are adjusted results reported. There is a high risk of selection bias for the other outcomes without adjustment, as authors report that significant differences in patient characteristics exists in between the treatment options. It is not known to the reader, if e.g. patients undergoing pneumonectomy are injured more severely which may increase the mortality rate. Also, there is no specific cause of death provided in the database.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
+: low risk; –: high risk; ?: unclear risk; adj.: adjusted; CG: control group; CI: Confidence Interval; GCS: Glasgow coma scale; HR: Hazard Ratio; ICU: intensive care unit; IG: intervention group; IQR: Interquartile Range; ITT: Intention to Treat; LoE: level of evidence; LOS: Length of stay; m: months; NA: not applicable; NR: not reported; OR: Odds Ratio; RR: Relative Risk; SD: Standard Deviation; SEM: Standard Error of Mean; VATS: video assisted thoracoscopic surgery; V-TT: Video-Tube Thoracostomy; TT: Tube Thoracostomy; d: days; y: years				

3.3 Abdomen

Nichtoperatives Management bei hämodynamisch stabilen Patienten mit isolierter stumpfer Leber- oder Milzverletzung

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Lewis (2021) "Splenic Artery Angioembolization is Associated with Increased Venous Thromboembolism." World Journal of Surgery. 2021; 45 (2): 638-44. **Study design** Comparative registry study (American College of Surgeons Trauma Quality Improvement Performance (TQIP) Database) **Aim of the study** "The purpose of this study was to determine if patients who undergo angioembolization as an adjunct to nonoperative management of splenic injury are at increased risk	**Inclusion criteria** • adult (>16 years) patients • significant blunt splenic trauma (AIS 3, 4, or 5) **Exclusion criteria** • Patients with other significant injuries (AIS 4 or 5), including head, chest, spine, upper and lower extremities, liver, kidney, or pancreas • with any untreatable injury (AIS 6) • Patients with no signs of life on arrival • transferred from another hospital • who died within 72 h • those with missing information, such as age, ICU or hospital length of stay (LOS), procedures performed, hospital disposition, or type of VTE prophylaxis **Characteristics (IG/CG)** Gender [male] n (%) 1536 (65.4)/183 (62.7), p=0.36 Age [y], measurement nr	**Participants** n=2643 patients IG n (%): no AE 2351 (89.0) CG n (%): AE 292 (11.0) Those patients who were managed nonoperatively and received pharmacological thromboprophylaxis were then divided into two groups: those that underwent angioembolization and those that did not.	The incidence of DVT was 4.5% in patients who underwent angioembolization, compared to 1.4% in patients who did not (p<0.001). On logistic regression, angioembolization was found to be an independent risk factor for both DVT (p<0.006) or any VTE event (p<0.006), with patients who underwent angioembolization being more than twice as likely to develop these complications.	**Level of evidence** 2b **Risk of bias** Selection bias: ? Performance bias: ? Attrition bias: + Detection bias: ? **Authors' conclusion** "Splenic artery angioembolization may be an independent risk factor for VTE events in isolated, severe blunt splenic trauma managed nonoperatively. Early prophylaxis with LMWH after intervention should be strongly considered." **Reviewer´s conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
for VTE in comparison to those who do not." **Setting** USA, 2013 to 2016	36 (25–52)/43 (28–56), p<0.001 SBP [<90 mm Hg] n (%) 105 (4.5)/33 (11.6), p<0.001 HR [>120 bpm] n (%) 254 (10.9)/66 (22.9), p<0.001 GCS [<9], n (%) 124 (5.4)/24 (8.3), p=0.05 Grade III injury n (%) 1686 (71.7)/139 (47.6), p<0.001 Grade IV injury n (%) 575 (24.5)/125 (42.8) Grade V injury n (%) 90 (3.8)/28 (9.6) Heparin prophylaxis n (%) 480 (20.4)/76 (26.0), p=0.03 LMWH prophylaxis n (%) 1871 (79.6)/216 (74.0) Smoker n (%) 7 (0.3)/1 (0.3), p=0.61			Due to poor reporting risk of bias remains unclear in selection bias, performance bias and detection bias.
Wong (2020) "Differences of liver CT perfusion of blunt trauma treated with therapeutic embolization and observation management." Sci Rep 2020; 10 (1): 19612. **Study design**	**Inclusion criteria** • (1) age ≥20 years • (2) major blunt liver trauma (grade III and IV) • (3) NOM patients who had been treated by observation or embolization • (4) stable for transportation to CT examination room	**Participants** n=16 patients IG n (%):observation (no AE) 7 (nr) CG n (%):AE 9 (nr)	Mortality There was no mortality is this study. Hepatic necrosis None had massive hepatic necrosis **Liver CT perfusion parameters** HAP [mL/min/100 mL] mean (measurement nr)	**Level of evidence** 2b **Risk of bias** Selection bias: ? Performance bias: ? Attrition bias: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Prospective cohort study **Aim of the study** "Our hypothesis is that therapeutic embolization of the liver alone does not cause devascularization injury. We presume that liver devascularization injury can occur only when portal venous system and hepatic arterial system are concurrently disrupted." **Setting** Taiwan, 2013-2016	• (5) conscious clear and tolerable to breath-hold CT scanning **Exclusion criteria** • (1) allergy to iodinated contrast medium • (2) expected glomerular filtration rate <45 mL/min/1.73m2 • (3) no satisfactory antecubital venous access for an 18-gauge cannula • (4) pregnancy • Patients treated with embolization and liver surgery • Associated spleen or pancreas trauma **Characteristics (IG/CG)** Gender [male/female] n (%) 10 (nr)/6 (nr) Age [y] mean (measurement nr) 32.3 (±13.3)/36.9 (±12.8) ISS mean (measurement nr) 25.4 (±11.9)/23.9 (±11.0) HR [bpm] mean (measurement nr) 100.6 (±24.2)/97.0 (±15.1), p=0.672 SBP [mmHg] mean (measurement nr) 130.0 (±22.7)/115.0 (±16.5), p=0-204 AAST liver trauma *Grade III n (%)* 6 (nr) *Grade IV n (%)*	Eight embolization therapies were performed at right hepatic artery. One embolization therapy was performed at both right hepatic artery and middle hepatic artery. We perform liver CT perfusion on major liver trauma to clarify whether or not our hypothesis regarding therapeutic liver embolization alone dose not cause liver devascularization injury is true.	100.9 (± 73.7)/163.1 (± 134.3), p=0.266 PVP [mL/min/100 mL] mean (measurement nr) 231.1 (± 174.4)/160.9 (± 140.8), p=0.368 HPI HAP/ (HAP + PVP) % (measurement nr) 37.1 (± 24.1)/50.6 (± 24.5), p=0.315	Detection bias: ? **Authors' conclusion** "Therefore, reduction of both arterial and portal venous perfusion can occur when therapeutic embolization was performed in preexisting major liver trauma, but hepatic perfusion index may not be compromised." **Reviewer´s conclusion** Due to poor reporting risk of bias remains unclear in selection bias, performance bias and detection bias.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	10 (nr)			

AAST: American Association for the Surgery of Trauma; AE: angioembolization; AIS: Abbreviated Injury Scale; bpm: beats per minute; CG: control group; GCS: Glasgow Coma Scale; DVT: deep venous thrombosis; HAP: hepatic arterial perfusion; HPI: hepatic perfusion index; HR: heart rate; IG: intervention group; ISS: Injury Severity Score; IQR: interquartile range; LMWH: low molecular weight heparin; OM: operative management; NOM: non operative management; nr: not reported; PVP: portal venous perfusion; SBP: systolic blood pressure

Selektive Angioembolisation, Laparotomie

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Samuels (2020) "Reevaluation of Hepatic Angioembolization for Trauma in Stable Patients: Weighing the Risk." J Am Coll Surg 2020; 231 (1): 123-31.e3. **Study design** Comparative registry study (Trauma Quality Improvement Project (TQIP) database) **Aim of the study** "This study aimed to evaluate outcomes after the use of hepatic AE, as well as the frequency of complication for isolated liver injury in the stable trauma patient." **Setting**	**Inclusion criteria** • adult (16 years or older) patients • grade III or higher liver injury (Organ Injury Score [OIS] of the liver ≥3) • blunt mechanism. • presented with stable vital signs: SBP 90 mmHg and heart rate between 50 and 110 bpm. **Exclusion criteria** • Patients with intra-abdominal (nonhepatic) or pelvic OIS • taken to the operating room for laparotomy within 6 h • underwent AE 24 hours after arrival **Characteristics (IG/CG)** Age [y] median (IQR) 36 (24-54)/ 35 (24-54) Sex [male] n (%) 64 (56.6)/ 136 (60.2), p=0.04 Liver Organ Injury score n (%), p-value overall <0.001	**Participants** n=1948 patients (N=339 after propensity score matching) IG n (%): liver AE within 24h 113 (33.3) CG n (%): no liver AE 226 (66.7) The package "MatchIt" was used for propensity score matching. Propensity score matching was performed in a 1:2 ratio using a nearest-neighbor method with a logistic regression model used to estimate the propensity score. Patients were matched according to the following criteria: age, sex, ISS, admission systolic blood pressure, admission, heart rate, and need for blood transfusion in the first 4 hours from admission. All of these were continuous variables, with the exception of sex and need for blood transfusion, which were binary. Transfusions in the first 4 hours were used as part of the matching algorithm because	Blood product, n (%) Any packed RBCs in 4 h: 35 (31.0)/ 58 (25.7), p=0.37 Any packed RBCs between 4 and 24 h: 5 (4.4)/17 (7.5), p=0.39 In-hospital mortality, n (%) 6 (5.3)/7 (3.1), p=0.48 Hospital LOS, d, median (IQR) 10 (5-16)/6 (4-10), p<0.001 ICU LOS, d, median (IQR) 4 (2-7)/3 (2-5), p=0.005 Ventilator days, median (IQR) 0 (0-2)/0 (0-0), p=0.45 **Complications** Acute kidney injury, n (%) 4 (3.5)/3 (1.3) Acute respiratory distress syndrome, n (%) 0 (0.0)/2 (0.9)	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: ? **Author´s conclusion** Hepatic AE was associated with increased morbidity without improving mortality, suggesting the benefits of AE do not outweigh the risks in stable liver injury. Observing these patients is likely a more prudent approach. **Reviewer´s conclusion** Propensity score matching secures low selection bias although poor reporting leads to

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
USA, 2016	Grade III: 31 (27.4)/62 (27.4) Grade IV: 56 (49.6)/121 (53.5) Grade V: 26 (23.0)/43 (19.0) ISS median (IQR) 25 (18-30)/25 (17-30), p=0.001 AIS, n (%) Head >3 9 (8.0)/24 (10.6), p=0.15 Chest >3 54 (47.8)/95 (42.0), p=0.69 Lower extremity >3 11 (9.7)/32 (14.2), p=0.28 SBP [mmHg] median (IQR) 123 (110-142)/125 (110-138), p=0.20 Heart rate [bpm] median (IQR) 89 (79-97)/89 (78-99), p=0.62	need for transfusion was significantly different between groups and was likely a factor in patients needing AE.	Cardiac arrest with CPR, n (%) 1 (0.9)/3 (1.3) Catheter-associated urinary tract infection, n (%) 0 (0.0)/3 (1.3) Deep surgical site infection, n (%) 1 (0.9)/1 (0.4) Deep vein thrombosis, n (%) 3 (2.7)/3 (1.3) Extremity compartment syndrome, n (%) 0 (0.0)/1 (0.4) Organ space surgical site infection, n (%) 3 (2.7)/3 (1.3) Pulmonary embolism, n (%) 0 (0.0)/3 (1.3) Severe sepsis, n (%) 1 (0.9)/3 (1.3) Superficial surgical site infection, n (%) 1 (0.9)/0 (0.0) Unplanned admission to the ICU, n (%) 5 (4.4)/7 (3.1) Unplanned intubation, n (%) 4 (3.5)/5 (2.2) Unplanned return to the operating room, n (%) 1 (0.9)/0 (0.0) Ventilator-associated pneumonia, n (%)	unclear risk of performance and detection bias.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			3 (2.7)/3 (1.3) Any complication, n (%) 20 (17.7)/21 (9.3) p 0.033	
AE: angioembolization; AIS: Abbreviated Injury Scale; bpm: beats per minute; CG: control group; ICU: intensive care unit; IG: intervention group; ISS: Injury Severity Score; IQR: interquartile range; LOS: length of hospital stay; nr: not reported; OIS: Organ Injury Score; RBC: red blood cell; SBP: systolic blood pressure				

3.4 Schädel-Hirn-Trauma

Notfallmäßige operative Versorgung raumfordernder intrakranielle Verletzungen

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Chen (2020) "The effect of controlled decompression for severe traumatic brain injury: a randomized, controlled trial." *Frontiers in neurology* 11 (2020): 107. **Study design** RCT **Aim of the study** "to compare the efficacy of controlled decompression and rapid decompression after craniotomy for severe TBI at our hospital."	**Inclusion criteria** • aged 18–75 years • severe traumatic brain injury (TBI) defined as a Glasgow Coma Scale (GCS) score between 3 and 8 on admission • Indications for decompressive craniectomy (DC) included preoperative diffuse brain swelling, large-volume preoperative hematoma (≥30ml) and obvious compression of the brain tissue (deviation from the midline >1 cm, pressure, and distortion of the lateral ventricles and basal cistern) **Exclusion criteria** • brain swelling caused by anoxia or hypotension with minor intracranial bleeding after injury	**Participants** N=248 patients **Study groups** IG: Controlled decompression (N=124 randomised, N=113 analysed) CG: Rapid craniectomy N=107 248 were randomly assigned to undergo either IG: (N=124) or CG: (N=124). 11 cases dropped out of the IG: and 17 out of the CG, leading to 113 participants in the IG: and 107 in the CG IG: The aim of controlled decompression was to ensure gradual release of the ICP through the overall procedure by all types of methods. The rate of ICP decrease was 10–15 mmHg per 10min. Briefly, an ICP probe was inserted to obtain the initial ICP	Extended Glasgow Outcome Scale: n (%), p overall=0.032 Favorable (5-8 score): IG: 48 (42.5) vs. CG: 33 (30.8) Unfavorable (2-4 score): IG: 34 (30.1) vs. CG: 31 (29.0) Dead (1 score): IG: 31 (27.4) vs. CG: 43 (40.2) 30 days all-cause mortality: n (%) IG: 21 (18.6) vs. CG: 32 (30.8), p=0.035; OR 0.512, 95% CI 0.273–0.958) Delayed hematoma: n (%) IG: 20 (17.7) vs. 31 (29.0), p=0.048 Acute brain swelling: n (%) IG: 15 (13.3) vs. CG: 26 (24.3), p=0.036	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion** "Our data suggest that controlled decompression surgery significantly improves severe TBI outcomes and decreases the rates of severe TBI-related complications."

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Setting China, 2014-2016	• coagulation disorder or a history of aspirin intake and multiorgan malfunction • special injury location, such as hematoma of the brain stem or ventricle • initial need for bilateral craniectomy • preoperative GCS score of 3 with no improvement after treatment in the emergency room • presentation without attenuated respiration and blood pressure • combination with severe injury in another bodily region • patient participation in other clinical trials **Characteristics** Age [y], mean ± SD IG: 48.0 ± 13.5 vs. CG: 50.3 ± 14.6, p=0.191 Male, n (%) IG: 94 (75.8%) vs. CG: 88 (71.0%), p=0.473 GCS at admission (3-5), n (%) IG: 49 (39.5) vs. CG: 42 (33.9), p=0.429 GCS at admission (6-8), n (%) IG: 75 (60.5) vs. CG: 82 (66.1) Rotterdam CT score at admission, n (%), p overall=0.268 I–II: IG: 21 (16.9) vs. CG: 26 (21.0) III–IV: IG: 46 (37.1) vs. CG: 49 (39.5) V–VI: IG: 57 (46.0) vs. CG: 49 (39.5)	before craniectomy. Ventricular ICP monitor was the best choice, the next was brain tissue monitor. If the initial ICP was >40 mmHg, then cerebrospinal fluid (CSF) was gradually released until the ICP was 40 mmHg. Second, craniotomy with a bone window (12 × 15 cm) was required to pressurize the brain to avoid a rapid decrease in the ICP after the bone was removed. Third, the dura was opened with an incision that was generally no larger than 5mm, which is often the diameter of the aspirator head. The hematoma and brain contusion tissue were slowly aspirated, gradually reducing the ICP. When the ICP was below 10 mmHg and there were no signs of bulging brain tissue, the dura was completely opened, and the hematoma or brain contusion tissue was then removed. CG: A standard large craniotomy (12 × 15 cm) completely opened the dura, and the ICP was released rapidly, completely and without control. All patients in this group received ICP monitoring. The rate of decrease in the ICP was not controlled throughout the operation, and the intraoperative surgical method did not consider the ICP. **Pre-randomization treatment** All patients underwent baseline cranial CT and CT angiography to assess changes in cerebral blood vessels and blood flow before the operation and to guide the surgery. According to the Chinese guidelines for TBI and our previous research, emergency craniotomy was indicated if the ICP (Codman, USA) continued to increase and was >25mmHg after treatment with mannitol	Cerebral infarction: n (%) IG: 17 (15.0) vs. CG: 24 (22.4), p=0.127	**Reviewers' conclusion** Due to the high risk of performance bias, results should be interpreted with caution. Even though the study was randomized, it was performed at a single center.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
	Type of hematoma, n (%), p overall=0.974 Epidural: IG: 44 (35.5) vs. CG: 39 (31.5) Subdural: IG: 57 (46.0) vs. CG: 60 (48.4) Intracerebral: IG: 68 (54.8) vs. CG: 62 (50.0) Intubation, n (%) IG: 26 (21.0) vs. CG: 21 (16.9), p=0.517	dehydration, sedation, and analgesia, if the GCS score decreased by >2 and CT re-examination showed that the contusions and hematomas had enlarged, and if the cisterna ambiens had disappeared, there was a midline shift, the ventricles were compressed, or similar features were present. If patients had a large hematoma and cerebral hernia, then ICP monitor placement and craniotomy were performed at the same time, with the ICP monitor being placed just prior to opening of the bone flap and dura. Two neurosurgeons together determined whether DC was needed. When both neurosurgeons confirmed the operation and the patients' family members provided consent, the patients were randomly assigned to undergo controlled or rapid decompression surgery. **Post-randomization treatment** After the operation, all patients were sent directly to the neurosurgical intensive care unit. The post-operative management strategy was selected by one neurosurgeon and one neurosurgical intensive care unit doctor. The post-operative treatments were the same for the patients in both groups. Therapeutic hypothermia was performed for 7–10 days for patients who had a high ICP. An ICP sensor was routinely used to monitor the ICP post-operatively (the sensor was typically removed about 1 week after surgery). The vital signs and ICP were observed and recorded every 2 h. The cranial CT results were reviewed routinely at 1, 24, and 72 h after the operation if the patients were stable.		

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Mendelow (2015) "Early surgery versus initial conservative treatment in patients with traumatic intracerebral hemorrhage (STITCH [Trauma]): the first randomized trial." *Journal of neurotrauma* 32.17 (2015): 1312-1323. **Study design** RCT **Aim of the study** "to find out whether early surgery would improve outcomes, compared with initial conservative treatment, in patients with supratentorial traumatic intracerebral hemorrhage." **Setting** multinational (13 countries from low to high income, 2009-2012)	**Inclusion criteria** • Adults • Within 48h of TBI • evidence of a traumatic intracerebral hemorrhage on CT with a confluent volume of attenuation significantly raised above that of the background white and gray matter greater than 10 mL calculated by: (length · width ·height)/2 in cm. **Exclusion criteria** • a significant surface hematoma (extradural hemorrhage or subdural hemorrhage) requiring surgery • three or more separate hematomas fulfilling the inclusion criteria • a cerebellar hemorrhage/contusion • surgery could not be performed within 12 h of randomization • severe pre-existing physical or mental disability or comorbidity that would lead to a poor outcome even if the patient made a full recovery from the TBI • permanent residence outside a study country preventing follow-up • patient and/or relative expressed a strong preference for one treatment modality. **Characteristics** Age [y], median (IQR) range IG: 51 (32–63) 18–83 vs. CG: 50 (33–61) 16–77 Age [y], mean ± SD	**Participants** N=170 patients **Study groups** IG: early surgery (N=83 randomized, N=82 analysed) CG: best medical treatment (N=87 randomized, N=86 analysed) IG: early surgery (hematoma evacuation within 12 h of randomization) by a method of the surgeon's choice combined with appropriate best medical treatment N=83 (1 drop out leading to N=82) CG: best medical treatment combined with delayed (more than 12 h after randomization) evacuation if it became appropriate later N=87 (1 drop out leading to N=86) **Co-interventions** Best medical treatment could include (depending on the practices within the center) monitoring of ICP or other modalities and management of metabolism, sodium osmotic pressure, temperature, and blood gasses. Both groups were monitored according to local standard neurosurgical practice. **Follow up** IG: N=61 received allocated therapy vs. CG: N=55 received allocated therapy At 6 months: IG: N=82 vs. CG: N=85	**2 weeks post-randomization** Still on the neurosurgical ward: n (%) IG:29 (35) vs. CG: 32 (37) Transferal to another ward or hospital n (%) IG: 3 (4) vs. CG: 4 (5) Discharge: n (%) IG: 43 (52) vs. CG: 33 (38) Death: n (%) IG: 7 (9) vs. CG: 17 (20), p=0.047 ICP monitoring (some point in the first 2 weeks): n (%) IG: 7 (9) vs. CG: 16 (19), p=0.073) Pneumonia: n (%) IG: 8 vs. CG: 8 Ischemic stroke: n (%) IG: 0 vs. CG: 1 Pulmonary embolism: n (%) IG: 1 vs. CG: 2 Postoperative extradural: n (%) IG: 0 vs. CG: 2 Septicemia: n (%) IG: 1 vs. CG: 0 Urinary tract infection: n (%) IG: 1 vs. CG: 0 Seizures: n (%)	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion** "A larger trial is needed to confirm this potentially very beneficial effect of earlier surgery." **Reviewer´s conclusion** Due to the high risk of performance bias results should be interpreted with caution. The trial was stopped early by the funding agency (due to a low recruitment rate in the United Kingdom). There was a quite large number of crossovers between both groups.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
	IG: 48 ± 17.7 vs. CG: 48 ± 16.9 Male, n (%) IG: 57 (70) vs. CG: 65 (76) GCS, n (%) 3: IG: 0 (0) vs. CG: 1 (1) 4: IG: 0 (0) vs. CG: 0 (0) 5: IG: 1 (1) vs. CG: 2 (2) 6: IG: 6 (7) vs. CG: 3 (3) 7: IG: 4 (5) vs. CG: 3 (3) 8: IG: 1 (1) vs. CG: 6 (7) 9: IG: 11 (13) vs. CG: 8 (9) 10: IG: 11 (13) vs. CG: 14 (16) 11: IG: 6 (7) vs. CG: 8 (9) 12: IG: 6 (7) vs. CG: 7 (8) 13: IG: 10 (12) vs. CG: 8 (9) 14: IG: 14 (17) vs. CG: 13 (15) 15: IG: 12 (15) vs. CG: 13 (15)	**Surgery details for IG: patients who had surgery (N=61) and CG: who required delayed surgery (N=31)** Surgery method: n (%) Craniotomy IG:59 (97) vs. CG: 25 (81), p=0.016 Other IG:2 (3) vs. CG: 6 (19) Bone flap replaced: n (%) IG:47 (77) vs. CG: 13 (42), p=0.001 Other cranial surgery: n (%) IG:1 (2) vs. CG: 3 (10) Paralyzed and sedated: n (%) IG:17 (28) vs. CG: 12 (39) Any noncranial surgery: n (%) IG:1 (2) vs. CG: 2 (7) Time injury to surgery [h], median (IQR) range IG:23 (16–36) 4–69 vs. CG: 45 (26–99) 9–332 Surgery within 12 hours of injury: n (%) IG:9 (15) vs. CG: 3 (10)	IG: 3 vs. CG: 0 Other postrandomization event: n (%) IG: 5 vs. CG: 1 Primary outcome: 6-month Glasgow Outcome Scale dichotomized into favorable and unfavorable outcome; dead, vegetative, and severe disability were coded as unfavorable and moderate disability and good recovery as favorable 6 months (primary outcome) favorable (1 patient from CG: lost to follow up): n (%) IG: 52 (63) vs. CG: 45 (53), OR, 0.65; 95% CI, 0.35, 1.21; p=0.170 absolute difference 10.5% (95% CI, - 4.4, 25.3) Adjusting for age, volume, and GCS: OR 0.58 (95% CI, 0.29, 1.16; p=0.122) **Secondary outcomes** Mortality at 6 months: n (%) IG:12 (15) vs. CG: 28 (33), OR, 0.35; 95% CI, 0.16, 0.75; p=0.007 absolute difference 18.3% (95% CI, 5.7, 30.9). Kaplan-Meier's plot of survival found a significant survival advantage of early surgery compared with initial conservative treatment (p=0.008). Rankin favorable: n (%) IG:55 (67) vs. CG: 48 (56), p=0.159, OR, 0.67; 95% CI, 0.39, 1.15; p=0.147 Absolute difference 10.6 (- 4.0–25.3)	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
			Glasgow Outcome Scale: n (%), overall p=0.047, OR, 0.67; 95% CI, 0.39, 1.16; p=0.153 Dead: IG: 12 (15) vs. CG: 28 (33) Vegetative: IG: 0 (0) vs. CG: 0 (0) Severely dependent: IG: 18 (22) vs. CG: 12 (14) Moderately dependent: IG: 26 (32) vs. CG: 18 (21) Good recovery: IG: 26 (32) vs. CG: 27 (32) Glasgow Outcome Scale Extended: n (%), overall p=0.052, OR, 0.66, 95% CI, 0.38, 1.13; p=0.127 Dead IG: 12 (15) vs. CG: 28 (33) Vegetative IG: 0 (0) vs. CG: 0 (0) Lower severe disability IG: 4 (5) vs. CG: 8 (9) Upper severe disability IG: 14 (17) vs. CG: 4 (5) Lower moderate disability IG: 5 (6) vs. CG: 3 (4) Upper moderate disability IG: 21 (26) vs. CG: 15 (18) Lower good recovery IG: 12 (15) vs. CG: 12 (14) Upper good recovery IG: 14 (17) vs. CG: 15 (18) Rankin: n (%), overall p=0.043 0: IG: 17 (21) vs. CG: 18 (21) 1: IG: 27 (33) vs. CG: 22 (26) 2: IG: 11 (13) vs. CG: 8 (9) 3: IG: 8 (10) vs. CG: 4 (5) 4: IG: 7 (9) vs. CG: 3 (4) 5: IG: 0 (0) vs. CG: 2 (2) Dead: IG: 12 (15) vs. CG: 28 (33)	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
			<u>EuroQoL Index median, quartiles, range</u> IG: 0.80; 0.52–1.00; - 0.33–1.00 vs. CG: 0.71; 0.00–1.00; - 0.59–1.00; p=0.218 <u>Limb movement: n (% excluding one patient not providing information)</u> Worst affected leg (overall p=0.374) Unaffected: IG: 50 (72) vs. CG: 47 (82) Weak: IG: 18 (26) vs. CG: 9 (16) Paralyzed: IG: 1 (1) vs. CG: 1 (2) Worst affected arm (overall p=0.464) Unaffected: IG: 48 (70) vs. CG: 43 (75) Weak: IG: 21 (30) vs. CG: 14 (25) Paralyzed: IG: 0 (0) vs. CG: 0 (0)	
Shibahashi (2017) "Emergency trepanation as an initial treatment for acute subdural hemorrhage: a multicenter retrospective cohort study." *World neurosurgery* 106 (2017): 185-192. **Study design** Comparative registry study **Aim of the study** "In this study, we aimed to elucidate the efficacy of emergency trepanation to test our hypothesis that it	**Inclusion criteria** • patients with abbreviated injury scale (AIS) codes indicating large (>50 cc; >1 cm thick; massive; extensive) supratentorial subdural hemorrhages • who underwent craniotomy with or without bone flap removal and duraplasty **Exclusion criteria** • age <16 years • systolic blood pressure <40 mmHg • AIS score of 6 (nonsurvivable injury) in any region • Unknown onset • unknown hospital arrival time • invalid recorded times • time from onset to arrival >4 hours	**Participants** N=1391 patients **Study groups** IG: emergency trepanation (N=305) In brief, local anesthesia was administered, and a small surgical incision was created at the center of the thickest hematoma region. A burr hole was drilled to expose the dura, and a cross-shaped incision was created to permeate the dura until an outflow of bloody fluid was achieved. A drainage tube was placed into the hematoma cavity, and the incision was subsequently sutured layer by layer. The drainage tube was connected to a sterile drainage bag, and the incision was covered with sterile dressing.	<u>Survival at discharge: n (%)</u> IG: 115 (38) vs. CG: 644 (59), p<0.001 <u>Multivariate logistic regression (survival)*</u> Trepanation in an emergency room adjusted OR 0.55 (95% CI 0.40-0.76), p<0.001 *explanatory variables were age, sex, year of hospital admittance, preexisting chronic medical diseases, GCS score on hospital arrival, presence of severe injury (AIS score ≥3) in any region of the body, hypotension (<90 mmHg systolic) on arrival, Trauma and Injury Severity Score predictive score, onset-arrival interval, prehospital neurologic deterioration, presence of traumatic subarachnoid hemorrhage, presence of contusion, presence of	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "Our results indicate that performing trepanation in an emergency room is associated with a decreased survival rate."

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
improves outcomes in patients with thick acute subdural hemorrhage who require craniotomy." **Setting** Japan, 2004-2015	• unknown outcome (survival at discharge) **Characteristics** Age [y], median (IQR) IG: 62 (45-74) vs. CG: 65 (49-76), p=0.047 Male, n (%) IG: 207 (68) vs. CG: 717 (66), p=0.58 GCS on arrival at hospital median (IQR) IG: 4 (3-7) vs. CG: 6 (4-11), p<0.001 **AIS** Face, median (IQR) IG: 0 (0-0) vs. CG: 0 (0-0) Severe injury, n (%) IG: 1 (0) vs. CG: 10 (1), p=0.47 Neck, median (IQR) IG: 0 (0-0) vs. CG: 0 (0-0) Severe injury, n (%) IG: 0 (0) vs. CG: 0 (0) Thorax, median (IQR) IG: 0 (0-3) vs. CG: 0 (0-0) Severe injury, n (%) IG: 85 (28) vs. CG: 205 (19), p=0.001 Abdomen and pelvic, median (IQR) IG: 0 (0-0) vs. CG: 0 (0-0) Severe injury, n (%)	CG: no emergency trepanation (N=1086)	intracerebral hemorrhage, and presence of epidural hemorrhage	**Reviewers' conclusion** Due to the high risk of selection and the unclear risk of performance bias results should be interpreted with caution. The rationale for choosing among both treatment options remains unclear. The conclusions only rely on survival at discharge.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
	IG: 11 (4) vs. CG: 25 (2), p=0.22 Spine, median (IQR) IG: 0 (0-0) vs. CG: 0 (0-0) Severe injury, n (%) IG: 9 (3) vs. CG: 28 (3), p=0.69 Upper extremity, median (IQR) IG: 0 (0-0) vs. CG: 0 (0-0) Severe injury, n (%) IG: 10 (3) vs. CG: 14 (1), p=0.025 Lower extremity, median (IQR) IG: 0 (0-0) vs. CG: 0 (0-0) Severe injury, n (%) IG: 30 (10) vs. CG: 68 (6), p=0.042 External, burns, and other, median (IQR) IG: 0 (0-0) vs. CG: 0 (0-0) Severe injury, n (%) IG: 0 (0) vs. CG: 0 (0) ISS, median (IQR) IG: 26 (25-38) vs. CG: 26 (25-34), p=0.029 Revised Trauma Score, median (IQR) IG: 5.0 (4.1-6.0) vs. CG: 6.0 (4.4-6.9), p<0.001 Probability of survival per Trauma and Injury Severity Score model, median (IQR) IG: 0.45 (0.26-0.68) vs. CG: 0.63 (0.31-0.82), p<0.001			

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
	Brain injury, n (%) Traumatic subarachnoid hemorrhage: IG: 116 (38) vs. CG: 386 (36), p=0.46 Contusion: IG: 120 (39) vs. CG: 455 (42), p=0.43 Intracerebral hemorrhage: IG: 8 (3) vs. CG: 30 (3), p=0.99 Epidural hemorrhage: IG: 42 (14) vs. CG: 99 (9), p=0.024			

AIS: Abbreviated Injury Scale; CG: control group; CI: confidence interval; CSF: cerebrospinal fluid; CT: computer tomography; DC: Decompressive Craniectomy; GCS: Glasgow Coma Scale; h: hours; IG: intervention group; ICP: intracranial pressure; IQR: interquartile range; ISS: Injury Severity Score; OR: odds ratio; RCT: randomized controlled trial; SD: standard deviation; TBI: traumatic brain injury; y: years

*LoE was not downgraded

Messung des intrakraniellen Drucks

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Ahl (2019) "The association of intracranial pressure monitoring and mortality: a propensity score-matched cohort of isolated severe blunt traumatic brain injury." *Journal of emergencies, trauma, and shock* 12.1 (2019): 18. **Study design** Comparative registry study	**Inclusion criteria** • adult patients (≥18 years) • isolated severe intracranial injury following blunt trauma: AIS head of ≥3, GCS of ≤8, and an AIS score of zero for all other body areas **Exclusion criteria** • Penetrating injuries • AIS score of 6 • death within 48 h of admission **Characteristics**	**Participants** N=1154 patients **Study groups** IG: ICP monitoring (N=577 after matching) CG: No ICP monitoring (N=577 after matching) **Matching criteria** Cases receiving ICP monitoring were matched in a 1:1 ratio with controls who did not receive such therapy using propensity score matching. Propensity scores were cal-	Mortality: n (%; 95% CI) IG: 158 (27.4; 23.8–31.2) vs. CG: 128 (22.2; 18.9–25.8), p=0.038 IG: had an increased mortality OR of 1.6 (95% CI: 1.1–2.5, p=0.038). Craniectomy/craniotomy: n (%) IG: 193 (33.4) vs. CG: 190 (32.9), p=0.865 Deep vein thrombosis: n (%) IG: 45 (7.8) vs. CG: 18 (3.1), p=0.001 Acute respiratory distress syndrome: n (%) IG: 25 (4.3) vs. CG: 13 (2.3), p=0.073	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "ICP monitoring is associated with increased in-hospital mortality in patients

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Aim of the study "This study investigates the association of ICP monitoring and clinical outcome in patients with an isolated severe blunt TBI." **Setting** USA, 2014	Age [y], mean ± SD IG: 44.3 ± 16.5 vs. CG: 44 ± 18.5, p=0.668 Male, n (%) IG: 456 (79.0) vs. CG: 470 (81.5), p=0.175 GCS median (LQ, UQ) IG: 4 (3,6) vs. CG: 4 (3,7), p=0.320 AIS head, n (%) Score 3: IG: 25 (4.3) vs. CG: 23 (4.0), p=0.754 Score 4: IG: 319 (55.3) vs. CG: 333 (57.7), p=0.275 Score 5: IG: 233 (40.4) vs. CG: 221 (38.3), p=0.346 Subarachnoid hemorrhage, n (%) IG: 276 (47.8) vs. CG: 290 (50.3), p=0.333 Subdural hemorrhage, n (%) IG: 202 (35.0) vs. CG: 194 (33.6), p=0.594 Epidural hemorrhage, n (%) IG: 40 (6.9) vs. CG: 35 (6.1), p=0.620 Contusion, n (%) IG: 86 (14.9) vs. CG: 79 (13.7), p=0.582	culated for all patients with an isolated severe TBI using binary logistic regression. Variables included in the propensity score model were level of admitting trauma center, age, gender, type of intracranial injury, GCS on admission, intracranial AIS, and neurosurgical intervention. After propensity matching, 577 matched pairs were available for analysis.	Sepsis: n (%) IG: 18 (3.1) vs. CG: 8 (1.4), p=0.076 Kidney injury: n (%) IG: 11 (1.9) vs. CG: 5 (0.9), p=0.210 Unplanned return to intensive care unit: n (%) IG: 15 (2.6) vs. CG: 14 (2.4), p=1.000 Unplanned return to operating room: n (%) IG: 11 (1.9) vs. CG: 9 (1.6), p=0.824 Intensive care unit length of stay [d], median (IQR) IG: 12 (6, 18) vs. CG: 6 (3, 12) Intensive care unit length of stay [d], mean ± SD IG: 13.6 ± 12.2 vs. CG: 8.9 ± 8.7, p<0.001 Hospital Length of stay [d], median (IQR) IG: 16 (9, 26) vs. CG: 10 (5, 19) Hospital Length of stay [d], mean ± SD IG: 19.6 ± 21.8 vs. CG: 14.6 ± 16.1, p<0.001	with an isolated severe TBI. Further investigation into which patients may benefit from this intervention is required." **Reviewers' conclusion** There is an unclear risk of performance bias because of a lack of information. Even though the risk of selection bias is low due to the propensity score matching, the rationale for the treatment decision (ICP vs no ICP) remains unclear.
Aiolfi (2017) "Brain trauma foundation guidelines for intracranial pressure monitoring: Compliance and effect on outcome." *World journal*	**Inclusion criteria** • adult patients (≥16 years) • isolated severe blunt head trauma: head AIS≥3 and GCS <9 **Exclusion criteria** • severe extracranial injuries AIS ≥3	**Participants** N=13,188 patients **Study groups** IG: ICP monitoring (N=1519) CG: No ICP monitoring (N=11,669)	Mortality (overall): n (%) IG: 495 (32.6) vs CG: 3774 (32.3), p=0.848 Mortality (1-day): n (%) IG: 46 (3.0) vs. CG: 1373 (11.8), p<0.001 Mortality (30-days): n (%)	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ?

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
of surgery 41.6 (2017): 1543-1549. **Study design** Comparative registry study **Aim of this study** "The purpose of this study was to assess guidelines compliance in patients who sustain a severe TBI and to analyze the effect of ICP monitoring on outcomes." **Setting** USA, 2013-2014	• transferals from outside hospitals • death upon arrival **Characteristics** Age [y], median (IQR) IG: 41 (25–56) vs. CG: 54 (33–72), p<0.001 Male, n (%) IG: 1165 (76.7) vs. CG: 8211 (70.4), p<0.001 ISS, median (IQR) IG: 25 (17–27) vs. CG: 21 (14–26), p<0.001 Head abbreviated Injury n (%) Score 3: IG: 44 (2.9) vs. CG: 1431 (12.3), p<0.001 Score 4: IG: 462 (30.4) vs. CG: 4215 (36.1), p<0.001 Score 5: IG: 1013 (66.7) vs. CG: 6023 (51.6), p<0.001 Epidural hematoma, n (%) IG: 221 (14.5) vs. CG: 974 (8.3), p<0.001 Subdural hematoma, n (%) IG: 1180 (77.7) vs. CG: 7996 (68.5), p<0.001 Subarachnoid hemorrhage, n (%) IG: 882 (58.1) vs. CG: 5558 (47.6), p<0.001 Intracranial hemorrhage, n (%) IG: 248 (16.3) vs. CG: 1467 (12.6), p<0.001 Diffuse axonal injury, n (%)		IG: 482 (31.7) vs. CG: 3749 (32.1), p=0.756 Craniotomy/craniectomy ≤24 h: n (%) IG: 484 (31.9) vs. CG: 1472 (12.6), p<0.001 Venous thromboembolism prophylaxis: n (%) IG: 868 (58.3) vs. CG: 3366 (37.1), p<0.001 Intensive care unit length of stay [d], median (IQR)[a] IG: 14 (9–21) vs. CG: 5 (3–11), p<0.001 Hospital length of stay [d], median (IQR)[a] IG: 20 (13–30) vs. 9 (4–17), p<0.001 Mechanical ventilation [d], median (IQR)[a] IG: 11 (5–17) vs. CG: 3 (2–7), p<0.001 Complications (overall): n (%)[b] IG: 639 (46.0) vs. CG: 2211 (26.0), p<0.001 Infectious complications: n (%)[b] IG: 553 (39.8) vs. CG: 1685 (19.8), p<0.001 Thromboembolic event: n (%)[b] IG: 152 (10.9) vs. CG: 526 (6.2), p<0.001 Acute respiratory distress syndrome: n (%)[b] IG: 68 (4.9) vs. CG: 305 (3.6), p=0.018 Acute kidney injury: n (%)[b] IG: 19 (1.4) vs. CG: 134 (1.6), p=0.554 Cardiac arrest: n (%)[b] IG: 20 (1.4) vs. CG: 106 (1.2), p=0.557 Myocardial infarction: n (%)[b] IG: 4 (0.3) vs. CG: 63 (0.7), p=0.056	Attrition bias: + Detection bias: + **Authors' conclusion** "ICP monitoring does not have any survival benefit in patients with isolated severe blunt TBI and is associated with more complications." **Reviewers' conclusion** Due to the high risk of selection bias und the unclear risk of performance bias, results should be interpreted with caution. The exclusion of severe extracranial injuries must be kept in mind when interpreting the results. The rationale for the treatment decision (ICP vs no ICP) remains unclear.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
	IG: 66 (4.3) vs. CG: 195 (1.7), p<0.001		Deep surgical site infection: n (%)[b] IG: 1 (0.1) vs. 19 (0.2), p=0.345 Organ/space surgical site infection: n (%)[b] IG: 7 (0.5) vs. CG: 25 (0.3), p=0.202 Superficial surgical site infection: n (%)[b] IG: 13 (0.9) vs. CG: 34 (0.4), p=0.007 Pneumonia: n (%)[b] IG: 489 (35.2) vs. CG: 1274 (15.0), p<0.001 Pulmonary embolism: n (%)[b] IG: 22 (1.6) vs. CG: 67 (0.8), p=0.004 Stroke/cerebrovascular accident: n (%)[b] IG: 35 (2.5) vs. CG. 143 (1.7), p=0.030 Urinary tract infection: n (%)[b] IG: 115 (8.3) vs. CG: 521 (6.1), p=0.003 Catheter blood stream-related complication: n (%)[b] IG: 13 (0.9) vs. CG: 46 (0.5), p=0.078 Sepsis: n (%)[b] IG: 39 (2.8) vs. CG: 154 (1.8), p=0.013 Deep vein thrombosis: n (%)[b] IG: 109 (7.8) vs. CG: 302 (3.6), p<0.001 Functional independence measure (good): n (%)[a] IG: 169 (16.6) vs. CG: 2212 (29.7), p<0.001 Results of stepwise logistic regression ICP monitoring as risk factor for mortality: OR 1.12 (95% CI 0.983–1.275), adjusted p=0.088	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
			ICP monitoring as risk factor for systemic complication: OR 2.089 (95% CI 1.850–2.358), p<0.001 ICP monitoring as risk factor for infectious complication: OR 2.282 (95% CI, 2.015–2.584), p<0.001 ICP monitoring as risk factor for poor functional independence: OR 1.889 (95% CI, 1.575–2.264), p<0.001 [a] includes only patients without mortality (n=8919) [b] includes only patients with hospital length of stay >2 days (n=9881)	
Al Saiegh (2020) "Comparison of outcomes of severe traumatic brain injury in 36,929 patients treated with or without intracranial pressure monitoring in a mature trauma system." *World neurosurgery* 136 (2020): e535-e541. **Study design** Comparative registry study **Aim of the study** "we sought to examine whether severe TBI patients in the mature	**Inclusion criteria** • severe TBI patients greater than 18 years of age with an admission GCS <9 **Exclusion criteria** • Patients who were deceased on arrival **Characteristics** <u>Age [y], mean ± SD</u> IG: 41.18 ± 18.66 vs. CG: 46.88 ± 21.59, P<0.0001 <u>Male, n (%)</u> IG: 4,597 (76%) vs. CG: 22,588 (73%), p<0.0001 <u>ISS, mean ± SD</u> IG: 32 ± 11 vs. CG: 21 ± 15, p<0.0001	**Participants** N=36,929 patients **Study groups** IG: ICP monitoring (N=6,025) CG: No ICP monitoring (N=30,904)	<u>Craniotomy: n (%)</u> IG: 2,208 (41) vs. CG: 1,869 (7), p<0.0001 <u>Intensive care unit length of stay, mean ± SD</u> IG: 13.13 ± 11.55 vs. CG: 6.02 ± 10.83, p<0.0001 <u>Hospital length of stay, mean ± SD</u> IG: 18.97 ± 18.71 vs. CG: 9.68 ± 14.74, p<0.0001 <u>Functional Independence Measure at discharge: n (%) (applies only to patients alive at discharge n=25821)</u> IG: 9.53 (5.07) vs. 16.21 (4.91), p<0.0001 <u>Modified log-poisson regression analysis</u> ICP monitoring adjusted for all other factors: adjusted RR of death was 1.03 (95% CI: 0.99 - 1.08), p=0.1215	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "We found that ICP-monitored patients had a lower risk of in-hospital mortality. Our findings support the use of ICP monitors in eligible patients." **Reviewers' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
trauma system of Pennsylvania fared better with a treatment guided by continuous ICP monitoring compared to those without ICP monitoring." **Setting** USA, 2000-2017	<u>GCS, n (%), (p overall= 0.6554)</u> Score 3: IG: 4,316 (72%) vs. CG: 22,489 (73%) Score 4: IG: 238 (4%) vs. CG: 869 (3%) Score 5: IG: 246 (4%) vs. CG: 938 (3%) Score 6: IG: 461 (8%) vs. CG: 2,328 (8%) Score 7: IG: 501 (8%) vs. CG: 2,289 (7%) Score 8: IG: 2,289 (7%) vs. CG: 1,991 (6%)		CG: had a mean Functional Independence Measure 5.02 (95% CI: 4.82, 5.22) times higher than IG, p<0.0001 <u>Survival analysis</u> Mortality during the first 200 days Kaplan-Meier product-limit survival IG: vs CG: (Log-Rank $\chi 2 = 4.86$, p=0.0275). IG hazard ratio of 0.85 ($\chi 2 = 32.63$, p<0.0001) compared to CG	Due to the high risk of selection bias und the unclear risk of performance bias, results should be interpreted with caution. The rationale for the treatment decision (ICP vs no ICP) remains unclear.
Lele (2019) "Patients who benefit from intracranial pressure monitoring without cerebrospinal fluid drainage after severe traumatic brain injury." *Neurosurgery* 85.2 (2019): 231-239. **Study design** Secondary analysis of a prospective cohort study **Aim of the study** "To examine the association between ICP monitor placement and outcomes, and identify Indian patients with severe TBI who	**Inclusion criteria** • 18 years or older • severe TBI, defined as having >one ICD-9 discharge diagnosis code: 800.0-801.9, 803.0-804.9, 850.0-854.1, 959.01, 950.1-950.3, 995.55 • a minimum head AIS ≥3 • post resuscitation GCS score <8 • alive with tracheal intubation in the intensive care unit >48 h from the time of intensive care unit admission • trauma history • abnormal admission head computed tomography • extracranial injuries and those who were transferred from scene to an outside hospital before admission **Exclusion criteria** • Deaths prior to 48 h	**Participants** N=200 patients Four patients were lost to follow-up (12-mo retention rate 98%). **Study groups** IG: ICP monitor (either a parenchymal monitor or a bolt) (N=126) CG: No ICP monitor (N=74) **Co-interventions** The decision to place an ICP monitor was left to the attending neurosurgeon, and no protocol was in place. All patients were endotracheally intubated and received mechanical ventilation.	<u>Intensive care unit length of stay hours, mean ± SD</u> IG: 6.1 ± 1.8 vs. CG: 5.9 ± 2.5, p=0.57 <u>Discharge Glasgow Outcome Scale score: n (%), p overall 0.009</u> In-hospital death IG: 21 (16.7) vs. CG: 27 (36.5) Vegetative state IG: 8 (6.4) vs. CG: 3 (4.1) Major impairment IG: 19 (15.1) vs. CG: 7 (9.5) Minor to moderate impairment IG: 64 (50.8) vs. CG: 35 (47.3) Baseline functioning IG: 14 (11.1) vs. CG: 2 (2.7) <u>Discharge disposition: n (% of IG: n=105 and CG: n=47), p overall 0.38</u> Home IG: 97 (92.4) vs. CG: 46 (97.9) Outpatient rehabilitation IG: 6 (5.7) vs. CG: 1 (2.1)	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion** "ICP monitor placement without CSF drainage within 72 h of admission was associated with reduced in-patient mortality. Patients with severe TBI but without cerebral edema and without intraventricular hemorrhage

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
benefit from ICP monitoring" **Setting** India, 2012-2014	**Characteristics** Age [y], mean ± SD IG: 34.8 ± 13.7 vs. CG: 38.0 ± 14.1, p=0.11 Male, n (%) IG: 108 (85.7) vs. CG: 60 (81.1), p=0.38 ISS, mean ± SD IG: 30.6 ± 12.1 vs. CG: 32.7 ± 14.9, p=0.27 Head AIS, n (%) 3: IG: 22 (17.5) vs. CG: 10 (13.5) 4: IG: 82 (65.1) vs. CG: 51 (68.9) 5: IG: 22 (17.5) vs. CG: 13 (17.6), p=0.75 Highest non-head AIS, n (%) 0: IG: 22 (17.5) vs. CG: 15 (20.3) 1: IG: 7 (5.6) vs. CG: 3 (4.1) 2: IG: 75 (59.5) vs CG: 36 (48.7) 3: IG: 21 (16.7) vs. CG: 18 (24.3) 4: IG: 0 (0.0) vs. CG: 1 (1.4) 5: IG: 0 (0.0) vs. CG: 1 (1.4) 6: IG: 1 (0.8) vs. CG: 0 (0.0), p=0.34 Admit GCS (motor), n (%) 1: IG: 5 (4.0) vs. CG: 8 (10.8) 2: IG: 10 (7.9) vs. CG: 16 (21.6) 3: IG: 10 (7.9) vs. CG: 4 (5.4) 4: IG: 22 (17.5) vs. CG: 12 (16.2) 5: IG: 67 (53.2) vs. CG: 30 (40.6) 6: IG: 12 (9.5) vs. CG: 4 (5.4), p=0.02 Head CT finding, n (%) Epidural hematoma: IG: 19 (15.1) vs. CG: 14 (18.9), p=0.48	Central (CG: 78.4% vs IG: 54.7%, *p*=.005) and arterial (CG: 66.2% vs IG: 43.7%, *p*=0.002) line placement were higher in the CG. Mannitol (Albert David, Kolkata, India; IG: 7.9% vs CG: 1.3%) hypertonic saline (IG: 6.3% vs CG: 1.4%), hyperventilation (IG: 3.2% vs CG: 0%), and propofol (Claris, Ahmedabad, India; IG: 5.6% vs CG: 1.4%) use was higher in the IG Overall, the frequency of advanced neuromonitoring (electroencephalogram, brain tissue oxygenation and cerebral blood flow) was low. Decompressive craniectomy (DC) was performed lower in the IG: (IG: 38.9%, vs CG: 79.7%, *p* ≤.001). The CG: was more likely to get DC only (DC without any form of evacuation), whereas DC with subdural hematoma evacuation was more common in the IG: (IG: 59.2% vs CG: 67.8% and IG: 28.6% vs CG: 15.3%, respectively; overall p=0.3. Overall, only 26 patients had subdural hematoma evacuation out of which majority (88.4%) had subdural hematoma evacuation combined with DC. Twenty-four patients had epidural hematoma evacuation with the majority (63%) undergoing epidural hematoma evacuation with DC.	Another facility IG: 2 (1.9) vs. CG: 0 (0.0) Discharge GCS: n (% of IG: n=108 and CG: n=55); p overall 0.128 <9 IG: 56 (51.9) vs. CG: 23 (41.8) 9-12 IG: 32 (29.6) vs. CG: 25 (45.5) 13-15 IG: 20 (18.5) vs. CG: 7 (12.7) Association of ICP Monitor Placement and in-hospital mortality[a] RR (95% CI) 0.50 (0.29, 0.87) [a]adjusted for age, epidural hematoma, subdural hematoma, intraventricular hemorrhage, cerebral edema, diffuse axonal injury, and midline shift Association of ICP Monitor Placement and Glasgow Outcome Scale at Discharge[b] RR (95% CI) 1.20 (0.58, 2.49) [b] crude RR as there are no confounders or precision variables for this model 3 months Glasgow Outcome Scale: n (%), p overall 0.045 Death: IG: 28 (22.2) vs. CG: 30 (40.5) Vegetative state: IG: 17 (13.5) vs. CG: 12 (16.2) Major impairment: IG: 19 (15.1) vs. CG: 7 (9.5) Minor to moderate impairment: IG: 25 (19.8) vs. CG: 14 (18.9) Baseline functioning: IG: 35 (27.8) vs. CG: 11 (14.9) Lost to follow up: IG: 2 (1.6) vs. CG: 0 (0.0)	may benefit from ICP monitoring." **Reviewers' conclusion** The results should be interpreted with caution due to the high risk of performance bias. The rationale for choosing ICP monitoring or not remain unclear. Furthermore, the study as performed in a large tertiary trauma center in India.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
	Subdural hematoma: IG: 54 (42.9) vs. CG: 41 (55.4), p=0.09 Subarachnoid hemorrhage: IG: 29 (23.0) vs. CG: 6 (8.1), p=0.007 Intracerebral hemorrhage: IG: 16 (12.7) vs. CG: 10 (13.5), p=0.86 Intraventricular hemorrhage: IG: 9 (7.1) vs. CG: 3 (4.1), p=0.37 Cerebral edema: IG: 16 (12.7) vs. CG: 16 (21.6), p=0.09 Any herniation on admission: IG: 24 (19.1) vs. CG: 38 (51.4), p<0.001 Midline shift on admission: IG: 50 (39.7) vs. CG: 58 (78.4), p<0.001 Cerebral infarction: IG: 2 (1.6) vs. CG: 4 (5.4), p=0.13 Contusion: IG: 91 (72.2) vs. CG: 43 (58.1), p=0.04 Diffuse axonal injury: IG: 10 (7.9) vs. CG: 5 (6.8), p=0.76		Association of ICP Monitor Placement and Mortality after 3 months[c] RR (95% CI) 0.65 (0.40, 1.05) [c]adjusted for age, intraventricular hemorrhage, cerebral edema, diffuse axonal injury, cerebral infarction, midline shift Association of ICP Monitor Placement and Glasgow Outcome Scale after 3 months[d] RR (95% CI) 0.87 (0.50, 1.51) [d] crude RR as there are no confounders or precision variables for this model 6 months Glasgow Outcome Scale: n (%), p overall 0.14 Death: IG: 34 (27.0) vs. CG: 33 (44.6) Vegetative: state IG: 3 (2.4) vs. CG: 3 (4.1) Major impairment: IG: 14 (11.1) vs. CG: 6 (8.1) Minor to moderate impairment: IG: 32 (25.4) vs. CG: 15 (20.2) Baseline functioning: IG: 41 (32.5) vs. CG: 17 (23.0) Lost to follow up: IG: 2 (1.6) vs. CG: 0 (0.0) Association of ICP Monitor Placement and Mortality after 6 months[e] RR (95% CI) 0.70 (0.45, 1.11) [e]adjusted for age, admit GCS (motor), subdural hematoma, cerebral edema, diffuse axonal injury, midline shift. Association of ICP Monitor Placement and GOS after 6 months [f]	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
			RR (95% CI) 0.99 (0.44, 2.25) [f]adjusted age and admit GCS (motor). <u>12 months Glasgow Outcome Scale: n (%); p overall 0.19</u> Death: IG: 38 (30.2) vs. CG: 33 (44.5) Vegetative state: IG: 0 (0.0) vs. CG: 1 (1.4) Major impairment: IG: 1 (0.8) vs. CG: 1 (1.4) Minor to moderate impairment: IG: 17 (13.5) vs. CG: 8 (10.8) Baseline functioning: IG: 68 (53.9) vs. CG: 31 (41.9) Lost to follow up: IG: 2 (1.6) vs. CG: 0 (0.0) <u>Association of ICP Monitor Placement and Mortality after 12 months[g]</u> RR (95% CI) 0.78 (0.51, 1.18) [g] adjusted for age, cerebral edema, diffuse axonal injury, midline shift	
Liveris (2021) "Is There an Age Cutoff for Intracranial Pressure Monitoring?: A Propensity Score Matched Analysis of the National Trauma Data Bank." *The American Surgeon* (2021): 0003134821991985 **Study design** Comparative registry study	**Inclusion criteria** • Patients aged 18 years or older • With TBI (classified by the International Classification of Disease, Ninth Revision, Clinical Modification (ICD-9-CM) codes published by the Center for Disease Control 800.0-801.9, 803.0-804.9, 850.0-854.1, 950.1-950.3, 959.01) • Head AIS ≥3 • GCS ≤8 **Exclusion criteria**	**Participants** N=23,652 patients (before propensity score matching) N=7118 (after propensity score matching) **Study groups** IG: ICP monitoring defined as ICD-9-CM procedure codes 01.10, 01.16, 01.17, 01.26, 01.28, 02.20, 02.21 (N=3696 before and N=3559 after propensity score matching) CG: no ICP monitoring (N=19956 before and N=3559 after propensity score matching)	<u>Mortality (before matching): n (%)</u> IG: 1273 (34.4) vs. CG: 5642 (28.3) **Results after matching** <u>Craniotomy: n (%)</u> IG: 1196 (33.6) vs. CG: 1232 (34.6), p=0.368 <u>Craniectomy: n (%)</u> IG: 496 (13.9) vs. CG: 406 (11.4), p=0.001	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** -

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Aim of the study "Our aim was to use the National Trauma Data Bank, the largest aggregation of trauma registry data in the United States, and propensity-matching analysis to elucidate the association between age and mortality in severe TBI patients with invasive ICP monitoring." **Setting** USA, 2008-2014	• Patients with any other ICD-9-CM injury codes outside of those listed above • Patients with other associated injuries • Penetrating trauma • Death on arrival to the emergency department of within 24 hours of admission **Characteristics** Age [y], n (%) 18-25: IG: 524 (14.7) vs. CG: 516 (14.5), P=0.788 26-35: IG: 522 (14.7) vs. CG: 504 (14.2), p=0.544 36-45: IG: 476 (13.4) vs. CG: 484 (13.6), p=0.781 46-55: IG: 683 (19.2) vs. 683 (19.2), p=1.000 56-66: IG: 618 (17.4) vs. CG: 634 (17.8), p=0.618 66-75: IG: 420 (11.8) vs. CG: 424 (11.9), p=0.883 76-85: IG: 270 (7.6) vs. CG: 267 (7.5), p=0.893 86 or older: IG: 46 (1.3) vs. CG: 47 (1.3), p=0.917 Female, n (%) IG: 918 (25.8) vs. CG: 906 (25.5), p=0.745 Head AIS, median (IQR) IG: 4 (4-5) vs. CG: 4 (4-5), p=0.660			**Reviewers' conclusion** Due to missing information the risk of performance bias remains unclear. The results are based on patients with isolated severe head injury. Only short-term outcomes were measured. The rationale for choosing ICP monitoring (vs. not) remains unclear.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
	GCS, median (IQR) IG: 3 (3-6) vs. CG: 3 (3-6), p=0.935 Intracranial hemorrhage, n (%) Subarachnoid, n (%): IG: 1255 (35.3) vs. CG: 1253 (35.2), p=0.960 Epidural, n (%): IG: 244 (6.9) vs. CG: 243 (6.8), p=0.963 Other, n (%): IG: 951 (26.7) vs. CG: 951 (26.7), p=1.00 Intubation at some point (before matching), n (%) IG: NR (46.3) vs. CG: NR (33.5)			
Piccinini (2017) "Intracranial pressure monitoring in severe traumatic brain injuries: a closer look at level 1 trauma centers in the United States." *Injury* 48.9 (2017): 1944-1950. **Study design** Comparative registry study **Aim of the study** "Our goal was to evaluate current practice patterns regarding the use of ICP monitors in TBI, and to assess the impact of ICP	**Inclusion criteria** • Adults (>16 years old) • with isolated severe blunt TBI (head AIS greater than or equal to 3) • and no other injuries (body part AIS greater than or equal to 3) • who met the Brain Trauma Foundation criteria for ICP monitoring **Exclusion criteria** • Patients with no signs of life on arrival • transferred from other hospitals • receiving a craniectomy within 24 hours • patients who died within 24 hours **Characteristics** Age [y], median (IQR) IG: 40 (25-55) vs. CG: 52 (32-70), p<0.001	**Participants** N=4880 patients **Study groups** IG: ICP monitoring (N=529) CG: no ICP monitoring (N=4351) All ICP monitors were considered equivalent.	Mortality: n (%) IG: 144 (27.2) vs. CG: 974 (22.4), p=0.012 Logistic regression: OR 1.63 (95% CI 1.28; 2.07), adj p<0.001 30-days mortality: n (%) IG: 136 (25.7) vs. CG: 962 (22.1), p=0.061 Ventilation days, median (IQR) IG: 8 (4-14) vs. CG: 2 (1-6), p<0.001 Logistic regression: OR for mechanical ventilation >48 hours 5.74 (95% CI 4.42; 7.46), adj p<0.001 Hospital length of stay, median (IQR) IG: 17 (9-26) vs. CG: 6 (3-14), p<0.001 Intensive care unit stay [d], median (IQR) IG: 12 (6-17) vs. CG: 4 (2-9), p<0.001	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "In this study, ICP monitoring was associated with poor outcomes, and was found to be an independent risk factor for mortality." **Reviewers' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
monitoring on outcomes at level 1 trauma centers." **Setting** USA, 2013-2014	<u>Male, n (%)</u> IG: 417 (78.8%) vs. CG: 3130 (72.0%), p=0.001 <u>GCS 3-5, n (%)</u> IG: 381 (72.0%) vs. CG: 2971 (68.3%), p=0.089 <u>Head AIS, n (%)</u> 3: IG: 23 (4.3%) vs. CG: 639 (14.7%), p<0.001 4: IG: 188 (35.5%) vs. CG: 1804 (41.5%), p<0.001 5: IG: 318 (60.1%) vs. CG: 1908 (43.9%), p<0.001 <u>Epidural hematoma, n (%)</u> IG: 55 (10.4) vs. CG: 280 (6.4), p=0.001 <u>Subdural hematoma, n (%)</u> IG: 368 (69.6) vs. CG: 2834 (65.1), p=0.048 <u>Subarachnoid hemorrhage, n (%)</u> IG: 330 (62.4%) vs. CG: 2217 (51.0%), p<0.001 <u>Intraparenchymal hemorrhage, n (%)</u> IG: 106 (20.0) vs. CG: 581 (13.4), p<0.001 <u>Diffuse axional injury, n (%)</u> IG: 34 (6.4) vs. CG: 85 (2.0), p<0.001		Logistic regression: Intensive care unit length of stay >48 hours OR 4.03 (95% CI 2.94; 5.52), adj p<0.001 <u>Complications: n (%)</u> Overall: IG: 230 (43.5%) vs. CG: 893 (20.5%), p<0.001 Logistic regression: OR 2.78 (95% CI 2.29; 3.37), adj p<0.001 Infectious: IG: 200 (37.8%) vs. CG: 667 (15.3%), p<0.001 Thromboembolic event: IG: 67 (12.7%) vs. CG: 206 (4.7%), p<0.001 Acute Respiratory Distress Syndrome: IG: 19 (3.6%) vs. CG: 122 (2.8%), p=0.377 Acute kidney injury: IG: 3 (0.6%) vs. CG: 56 (1.3%), p=0.222 Cardiac arrest: IG: 5 (0.9%) vs. CG: 57 (1.3%), p=0.616 MIO infarction: IG: 1 (0.2%) vs. CG: 21 (0.5%), p=0.504 Deep surgical site infection: IG: 0 (0.0%) vs. CG: 2 (0.0%), p=1.000 Organ/space surgical site infection: IG: 1 (0.2%) vs. CG: 5 (0.1%), p=0.498 Superficial surgical site infection: IG: 4 (0.8%) vs. CG: 16 (0.4%), p=0.265 Pneumonia: IG: 182 (34.4%) vs. CG: 506 (11.6%), p<0.001 Pulmonary embolism: IG: 8 (1.5%) vs. CG: 17 (0.4%), p=0.004	The results should be interpreted with caution due to the high risk of selection bias und unclear risk of performance bias. There are many statistically significant differences between IG: and CG. The inclusion of isolated severe blunt TBI without other injuries should be kept in mind.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
			Stroke/ cardiovascular accident: IG: 12 (2.3%) vs. CG: 54 (1.2%), p=0.083 Urinary tract infection: IG: 46 (8.7%) vs. CG: 199 (4.6%), p<0.001 Catheter blood stream related complication: IG: 4 (0.8%) vs. CG: 14 (0.3%), p=0.123 Sepsis: IG: 9 (1.7%) vs. CG: 60 (1.4%), p=0.553 Deep vein thrombosis: IG: 51 (9.6%) vs. CG: 130 (3.0%), p<0.001 Functional independence measure at discharge: n (% alive patients) Good: IG: 68 (17.8%) vs. CG: 911 (28.7%), p<0.001 Logistic regression: Poor functional outcome OR 1.71 (95% CI 1.29; 2.26), p<0.001	
Schupper (2019) "Respect your elders: effects of ageing on intracranial pressure monitor use in traumatic brain injury." *Trauma surgery & acute care open* 4.1 (2019): e000306. **Study design** Comparative registry study **Aim of the study** "to evaluate for potential age disparities in ICP monitor placement"	**Inclusion criteria** • blunt TBI • admission GCS scores between 3 and 8 **Exclusion criteria** • hospital length of stay <24 hours • discharged from the emergency department • transferred out to another healthcare facility • non-Head AIS score ≥3 **Characteristics** Age [y], mean ± SD IG: 44.5 ± 18.4 vs. CG: 52.8 ± 21.1, p<0.001	**Participants** N=30,710 patients **Study groups** IG: ICP monitoring (N=4093) CG: No ICP monitoring (N=26617)	Overall mortality: n (%) IG: 1257 (30.7) vs. CG: 7236 (27.2), p<0.001 Hospital days, median (IQR) IG: 15 (8–26) vs. CG: 12 (6–21, p<0.001 Intensive care unit stay, median (IQR) IG: 11 (6–17) vs. CG: 4 (2–10), p<0.001 Time on ventilator, median (IQR) IG: 9 (4–14) vs. CG: 3 (2–7), p<0.001 Craniotomy: n (%) IG: 991 (24.2) vs. CG: 3244 (12.2), p<0.001 Craniectomy: n (%) IG: 582 (14.2) vs. CG: 929 (3.5), p<0.001	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: – Attrition bias: + Detection bias: ? **Authors' conclusion** - **Reviewers' conclusion** Due to the high risk of selection and performance bias und the unclear risk of

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Setting USA, 2010-2014	Male, n (%) IG: 3074 (75.1) vs. CG: 18 632 (70.0), p<0.001 ISS, median (IQR) IG: 22.7 (17–26) vs. CG: 19.0 (13–25, p<0.001 AIS-Head, n (%) 1: IG: 2 (0.0) vs. CG: 129 (0.5), p=0.0001 2: IG: 3 (0.0) vs. CG: 366 (1.4), p<0.0001 3: IG: 225 (5.5) vs. CG: 4008 (15.1), p<0.0001 4: IG: 1481 (36.2) vs. CG: 11 172 (42.0), p<0.0001 5: IG: 2373 (58.0) vs. CG: 10 707 (40.2), p<0.0001 TBI, n (%) Subarachnoid hemorrhage: IG: 2189 (53.5) vs. CG: 12 220 (45.9), p<0.001 Subdural hemorrhage: IG: 2743 (67.0) vs. CG: 15 376 (57.8), p<0.001 Epidural hematoma: IG: 419 (10.2) vs. CG: 1871 (7.0), p<0.001			detection bias, results must be interpreted with caution. The rationale for choosing ICP monitoring remains unclear. No long-term outcomes were assessed and baseline characteristics differed significantly between both groups.
Suehiro (2017) "Directions for use of intracranial pressure monitoring in the treatment of severe traumatic brain injury using data from the	**Inclusion criteria** • GCS scores ≤8 on admission • or deterioration to that level within 48 h of impact • or craniotomy for traumatic hematoma	**Participants** N=1091 patients **Study groups** IG: ICP monitoring (N=305)	Mortality: n (%) IG: 99 (32.5) vs. CG: 354 (45.0), p<0.001 Favorable outcome (measured by Glasgow Outcome Scale at discharge defined as good recovery and moderate disability)	**Level of evidence** 2b **Risk of bias** Selection bias: –

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
japan neurotrauma data bank." *Journal of neurotrauma* 34.14 (2017): 2230-2234. **Study design** Comparative registry study **Aim of the study** "In this study, we retrospectively investigated the effects of ICP monitoring on treatment of severe TBI, using data from the Japan Neurotrauma Data Bank." **Setting** Japan, 2009-2011	**Characteristics** Age [y], mean ± SD IG: 51.5 ± 23.5 vs. CG: 57.1 ± 24.3, p=0.001 Male, n (%) IG: 222 (72.8) vs. CG: 532 (67.7), p=0.102 GCS, mean ± SD IG: 7.2 ± 3.7 vs. CG: 7.2 ± 4.0, p=0.872 CT findings classified according to the Traumatic Coma Data Bank, n (%), overall p<0.001 *Diffuse injury I-II:* IG: 47 (15.4) vs. CG: 204 (26.0) *Diffuse injury III-IV:* IG: 44 (14.4) vs. CG: 79 (10.1) *Evacuated mass lesion:* IG: 165 (54.1) vs. CG: 290 (36.9) *Others:* IG: 49 (16.1) vs. CG: 213 (27.1), p<0.001*	CG: no ICP monitoring (N=786) ICP sensors were placed subdurally in 64 subjects (21.0%), epidurally in 4 (1.3%), in brain tissue in 206 (67.5%), and ventricularly in 30 (9.8%)	IG: 89 (29.2) vs. CG: 236 (30.0), p=0.784 Therapy: n (%) Hyperventilation: IG: 40 (13.1) vs. CG: 60 (7.6), p=0.005 Hyperosmolar diuretics: IG: 198 (64.9) vs. CG: 251 (31.9), p<0.001 Sedatives: IG: 239 (78.4) vs. CG: 224 (28.5) p<0.001 Anticonvulsants: IG: 155 (50.8) vs. CG: 227 (28.9), p<0.001 Surgical treatment: IG: 262 (85.9) vs. CG: 391 (49.7), p<0.001 Body temperature management: IG: 209 (68.5) vs. CG: 191 (24.3), p<0.001	Performance bias: – Attrition bias: + Detection bias: ? **Authors' conclusion** "We conclude that ICP monitoring and management of ICP are both important for management and care of severe TBI. However, current therapies do not control ICP sufficiently, and more effective therapies are needed." **Reviewers' conclusion** Due to the high risk of selection and performance bias and the unclear risk of detection bias, results must be interpreted with caution. There were some statistically significant differences in baseline characteristics. The length of follow up remains unclear.
You (2016) "Intraventricular intracranial pressure monitoring improves the outcome of older adults with severe traumatic brain injury: an observational, prospective study." BMC anesthesiology 16(1):35 (2016): 1-8.	**Inclusion criteria** • aged ≥65 y • history of acute TBI • GCS score <9 at admission • initial CT scan showed intracranial abnormalities consistent with head trauma. **Exclusion criteria**	**Participants** N=187 patients **Study groups** IG: intraventricular ICP monitoring (N=91 assigned, N=80 analysed) CG: no ICP monitoring (N=96 assigned, N=86 analysed)	In-hospital mortality: n (%) IG: 27 (33.8) vs. CG: 44 (51.2), p=0.035 6-month Glasgow Outcome Scale, mean ± SD IG: 3.0 ± 1.4 vs. CG: 2.5 ± 1.2, p=0.014 Length of intensive care unit stay [d], mean ± SD IG: 14.3 ± 6.4 vs. CG: 11.6 ± 5.8, p=0.004 Length of total hospital stay [d], mean ± SD	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: – Attrition bias: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Study design Prospective cohort study **Aim of the study** "This study evaluated the effect of intraventricular ICP monitoring on the outcome of older adults suffering from a severe TBI." **Setting** China, 2008-2014	• Patients who died within 24 h of brain injury or were admitted with a diagnosis of brain death • Those admitted to our department 24 h after sustaining the injury **Characteristics** Age [y], median (IQR) IG: 74 (68–78) vs. CG: 76 (69–82), p=0.29 Female, n (%) IG: 46 (57.5) vs. CG: 52 (60.5), p=0.71 GCS on admission, n (%), p overall = 0.64 6-8: IG: 56 (70.0) vs. CG: 64 (74.4) 3-5: IG: 24 (30.0) vs. CG: 22 (25.6) AIS head, mean ± SD IG: 3.78 ± 0.92 vs. CG: 3.80 ± 0.91, p=0.89 ISS, mean ± SD IG: 27.5 ± 9.2 vs. CG: 28.4 ± 9.5, p=0.54 Marshall classification on initial CT, n (%) Diffuse injury II: IG: 13 (16.3) vs. CG: 27 (31.4); p=0.037 Diffuse injury III: IG: 28 (35.0) vs. CG: 20 (23.5), p=0.14 Diffuse injury IV: IG: 18 (22.5) vs. CG: 17 (19.8), p=0.81 Evacuated mass lesion: IG: 9 (11.3) vs. CG: 8 (9.3), p=0.87 Nonevacuated mass lesion: G: 12 (14.9) vs. CG: 14 (16.0), p=0.98	IG: In the intraventricular ICP monitoring group, when the ICP was higher than 20 mmHg, the CSF was drained and mannitol or a diuretic was administered to maintain the ICP below this threshold. Drainage of CSF was intermittent to remove the smallest volume of fluid necessary to control ICP. The cerebral perfusion pressure was maintained between 60 mmHg and 70 mmHg. Refractory intracranial hypertension was defined as an ICP increase to more than 30 mmHg or a reduction in cerebral perfusion pressure to less than 60 mmHg for a period of more than 15 min, along with failure to respond to the above-mentioned maximum medical treatment. If refractory intracranial hypertension occurred, a decompressive craniotomy was performed as soon as possible. CG: For patients in the non- ICP monitoring group, ICP and cerebral perfusion pressure were not monitored; thus, the management was solely based on clinical and radiologic findings. Mannitol (0.25–1.0 g/kg) was routinely administered every 6 or 8 h to maintain osmotic pressure at 310–320 mOsm/L. **Indications** Indications for ICP monitoring were: a) severe TBI with an abnormal CT scan at presentation or b) severe TBI with a normal CT scan and the presence of two or more of the following features at admission: age older than 40 years, motor posturing, or systolic blood pressure lower than 90 mmHg. Patients in the control group met the crite-	IG: 28.5 ± 12.1 vs. CG: 26.1 ± 13.5, p=0.23 Length of mechanical ventilation [d], mean ± SD IG: 6.7 ± 3.5 vs. CG: 5.6 ± 2.4, p=0.019 Mannitol administration: Dosage of mannitol [g], mean ± SD IG: 514 ± 246 vs. CG: 840 ± 323, p<0.0001 Duration of mannitol treatment [d], mean ± SD IG: 6.7 ± 3.6 vs. CG: 8.4 ± 4.3, p=0.007 Device-related complications after ICP monitoring (not applicable for CG) Ceased draining because of catheter obstruction: n (%) 6 (7.5) Infections: n (%) 3 (3.8) Hemorrhage: n (%) 7 (8.7)	Detection bias: + **Authors' conclusion** "In our study, older severe TBI patients who underwent intraventricular ICP monitoring had lower in-hospital mortality and improved 6-month outcomes compared with patients without ICP monitoring." **Reviewers' conclusion** Due to the high risk of performance and selection bias results should be interpreted with caution. The decision making process among both treatment options in this single center cohort study was not entirely standardized.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
		ria of ICP monitoring, but were not monitored for several reasons, including: the judgment and experience of the neurosurgeons, the patient's or their caregiver's decision to receive more conservative treatment, and the limited availability of monitoring devices and trained staff for inserting the ICP monitor. **Co-interventions** Patients with a TBI were managed according to a standardized protocol based on the guidelines set up by the Brain Trauma Foundation. For patients in both groups, the clinical neurological status (GCS score, pupil size, and reactivity) was monitored hourly. Head CT were obtained at admission, 48 h, 5 to 7 days after admission, and any time as needed based on the clinical condition. Invasive mean arterial pressure was measured and maintained between 70 mmHg and 100 mmHg. Patients were positioned in a 30° head-up position and initially sedated with benzodiazepine and an opioid. Phenytoin was given for seven days as prophylaxis for early post-traumatic seizure, and a stress ulcer prophylaxis and thromboembolic prophylaxis were given as appropriate. Nutritional support was provided with early enteral feeding.		
Yuan (2016) "Is intracranial pressure monitoring of patients with diffuse traumatic brain injury valuable? An observational multicenter	**Inclusion criteria** • adult patient (age ≥14 y) • with a severe TBI (GCS score on admission <9) • Marshall class Ⅱ to IV (diffuse TBI) as revealed by primary CT on admission.	**Participants** N=258 patients (after propensity score matching) **Study groups**	**Data only available before matching** Intensive care unit stay [d], median (IQR) IG: 11 (NR) vs. CG: 7 (NR), p=0.001 Length of hospital stay [d], median (IQR) IG: 31 (NR) vs. CG: 18 (NR); p=0.02	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ?

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
study." *Neurosurgery* 78.3 (2016): 361-369. **Study design** Comparative registry study **Aim of the study** "To evaluate the effects of ICP monitoring on the mortality of and functional outcomes in patients with severe diffuse TBI." **Setting** China, 2012-2013	**Exclusion criteria** • Penetrating brain injury • admission with a diagnosis of brain death **Characteristics** Age [y], mean ± SD IG: 43.85 ± 16.45 vs. CG: 43.96 ± 17.54, p=0.96 Male, n (%) IG: 100 (77.5) vs. CG: 110 (85.3), p=0.11 GCS score on admission, mean ± SD IG: 5.64 ± 1.56 vs. CG: 5.86 ± 1.57, p=0.27 Marshall CT classification, n (%), p overall =0.05 II: IG: 36 (27.9) vs. CG: 46 (35.7) III: IG: 55 (42.6) vs. CG: 36 (27.9) IV: IG: 38 (29.5) vs. CG: 47 (36.4) Intracranial lesion, n (%) Epidural hematoma: IG: 32 (24.8) vs. CG: 30 (23.3), p=0.77 Subdural hematoma: IG: 75 (58.1) vs. CG: 66 (51.2), p=0.26 Traumatic subarachnoid hemorrhage: IG: 83 (64.3) vs. CG: 86 (66.7), p=0.69 Intraparenchymal hematoma or contusion: IG: 98 (76.0) vs. CG: 107 (82.9), p=0.17	IG: ICP monitoring N=129 after propensity score matching CG: no ICP monitoring N=129 after propensity score matching IG: ICP monitors were inserted into 287 patients (59.5%): intraventricular monitoring was conducted in 162 (56.4%), parenchymal monitoring in 81 (28.2%), subdural monitoring in 42 (14.6%), and epidural monitoring in 2 (0.7%). Patients in the ICP group had an ICP monitor placed as soon as possible and were treated to maintain an ICP of,20 mmHg. CG: The care for patients in the no-ICP group was provided in accordance with imaging-clinical examination based on the treating physician's experience. **Co-interventions** Clinical neurological status (GCS score, pupil size, and reactivity) was monitored every hour in both groups. A head CT was obtained at admission; before operation; immediately after operation; at 1, 2, 5, and 7 days after admission; and at any other time clinically indicated in both groups. All patients were positioned in a 30° head-up position and initially sedated with benzodiazepine and an opioid. If the patients had an elevated ICP, mannitol or hypertonic saline was administered to an osmolality of 310 to 320 mOsmL21. CSF was drained via an intraventricular catheter if the ventricular pres-	Neither the duration of mechanical ventilation nor the duration of osmotherapy differed significantly between the 2 groups (median and IQR not reported) **Data available after matching:** Glasgow Outcome Scale extended after 6 months: n (%), p overall=0.33 Dead: IG: 27 (20.9) vs. CG: 39 (30.2) Vegetative state: IG: 19 (14.7) vs. CG: 11 (8.5) Lower severe disability: IG: 15 (11.6) vs. CG: 15 (11.6) Upper severe disability: IG: 11 (8.5) vs. CG: 11 (8.5) Lower moderate disability: IG: 8 (6.2) vs. CG: 8 (6.2) Upper moderate disability: IG: 6 (4.7) vs. CG: 10 (7.8) Lower good recovery: IG: 16 (12.4) vs. CG: 9 (7.0) Upper good recovery: IG: 27 (20.9) vs. CG: 26 (20.2) 6 months mortality rate ICP monitoring was also associated with a decrease in 6-month mortality rates even after controlling for independent predictors* of mortality (AOR, 0.46; 95% CI, 0.24- 0.90; adjusted P=.02). *Age, GCS on admission, Marshall CT classification, hypotension during the first day, and ICP	Attrition bias: + Detection bias: + **Authors' conclusion** "ICP monitor placement was associated with a significant decrease in 6-month mortality after adjustment for the baseline risk profile and the monitoring propensity of patients with diffuse severe TBI." **Reviewers' conclusion** Due to missing information the risk of performance bias remains unclear. The rationale for choosing among both treatment options remains unclear.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
		sure exceeded 20 mmHg. Drainage of intraventricular fluid was intermittent; efforts were made to remove the smallest volume of fluid necessary to control ICP over the shortest possible period of time. Mild hyperventilation (PCO2, 30-33 mmHg) was applied as necessary. Refractory intracranial hypertension was considered present if the ICP increased to .30 mm Hg or the cerebral perfusion pressure falls to ,60 mmHg for .15 minutes with failure to respond to the maximal medical treatment described above. If refractory intracranial hypertension occurred, DC or consecutive DC on the other side was performed as soon as possible.	monitoring use≥50% were independent predictors 6 months favorable outcome (Glasgow Outcome Scale extended Score 5-8) After propensity score matching, monitoring remained non associated with a 6-month favorable outcome for the overall sample (AOR, 1.57; 95% CI, 0.87-2.82; adjusted p=0 .13). Surgical management: n (%), p overall=0.97 Craniotomy for mass lesion: IG: 6 (4.7) vs. CG: 6 (4.7) Craniectomy: IG: 83 (64.3) vs. CG: 81 (62.8) No surgical management: IG: 40 (31.0) vs. CG: 42 (32.6) **Data only available before matching** Intensive care unit stay [d], median (IQR) IG: 11 (NR) vs. CG: 7 (NR), p=0.001 Length of hospital stay [d], median (IQR) IG: 31 (NR) vs. CG: 18 (NR); p=0.02 Neither the duration of mechanical ventilation nor the duration of osmotherapy differed significantly between the 2 groups (median and IQR not reported)	
Yuan (2015) "Effects and clinical characteristics of intracranial pressure monitoring–targeted management for subsets of traumatic brain	**Inclusion criteria** • patients who were more than 14 years old • with moderate or severe TBI (GCS score ≤12) that was not the result of	**Participants** N=1077 patients **Study groups** IG: ICP monitoring (N=650)	6 month mortality: n (%) IG: NR (20.9) vs CG: NR (26.0), p=0.053 Unfavorable outcome (assessed with the Glasgow Outcome Scale Extended score 1-4): n (%)	**Level of evidence** 2b **Risk of bias** Selection bias: –

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
injury: an observational multicenter study." *Critical care medicine* 43.7 (2015): 1405-1414. **Study design** Comparative registry study **Aim of the study** "To evaluate the efficacy of TBI management guided by ICP monitoring and to explore the specific subgroups for which ICP monitoring might be significantly associated with improved outcomes based on a classification of the various TBI pathophysiologies using the clinical features and CT scans." **Setting** China, 2012-2013	scalp laceration, avulsion, or penetrating brain injury • who had available outcome data Subgroup analysis for GCS 3-8 at admission **Characteristics** No baseline characteristics for the subgroup GCS 3-8 given	CG: no ICP monitoring (N=427) IG: was treated with ICP monitoring, placed after admission as soon as possible, to maintain an ICP of less than 20 mm Hg. CSF was drained if an intraventricular catheter was available and the ventricular pressure exceeded 20 mm Hg. CG: group was given management based on imaging or clinical examination. CSF was drained if the imaging or clinical examination indicated intracranial hypertension. **Co-interventions** For both groups, clinical neurological status (GCS score, pupil size, and reactivity) was monitored each hour. Head CT was obtained at admission, before and after operation, 1 day, 2 days, 5 days, and 7 days after admission, and any time as needed based on clinical condition. All patients were positioned in a30° head-up position and initially sedated with benzodiazepine and an opioid. Mean arterial pressure was measured and maintained between 70 mmHg and 100 mmHg. Mannitol (0.25 g/ kg every 6–8 hr) or hypertonic saline (3%; 250–500-cc boluses) was administered up to an osmolality of 310–320 mOsm/L, if indicated. Drainage of intraventricular fluid was intermittent in order to remove the smallest volume of fluid necessarily to control ICP and use the shortest period of time possible. Mild hyperventilation (pco2; 30–33 mmHg) was used as necessary. Refractory intracranial hypertension was defined as ICP increases to more than 30 mmHg and/or decreases in cerebral perfusion pressure to	IG: NR (56.9) vs. CG: NR (55.5), p=0.646 <u>Results of multivariate logistic regression*</u> ICP monitoring resulted in a significantly lower 6-month mortality for patients who had a GCS score of 3–5 at admission (AOR, 0.57; 95% CI, 0.36–0.90; adjusted p=0.016), those who had a GCS score of 9–12 at admission that dropped to 3–8 within 24 hours after injury (AOR, 0.28; 95% CI, 0.08–0.96; adjusted p=0.043). * Having undergone ICP monitoring or not was entered into the model as an independent variable together with the propensity score to adjust for potential confounding by indication.	Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "In conclusion, this retrospective observational multicenter study revealed multiple differences between the ICP monitoring and no-ICP monitoring groups regarding patient characteristics, injury severity, characteristics of CT scan, and hospital type. ICP monitoring was significantly associated with an improved 6-month mortality for patients with TBI who had a GCS score of 3–5 at admission, had a GCS score of 9–12 at admission that dropped to 3–8 within 24 hours after injury." **Reviewers' conclusion** Due to the high risk of selection bias and the unclear risk of performance bias, results should be interpreted with caution. Because the results do not refer to the whole sample of participants but to a subgroup, baseline characteristics remain unclear.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
		less than 60 mmHg for a period longer than 15 minutes and failure to respond to the maximum medical treatment mentioned above. Once refractory intracranial hypertension occurred, DC was performed as soon as possible.		

AIS: Abbreviated Injury Scale; AOR: adjusted odds ratio; CG: control group; CI: confidence interval; CSF: cerebrospinal fluid; CT: computer tomography; d: days; DC: Decompressive Craniectomy; GCS: Glasgow Coma Scale; h: hours; ICP: intracranial pressure; IG: intervention group; IQR: interquartile range; ISS: Injury Severity Score; NR: not reported; OR: odds ratio; RR: relative risk; SD: standard deviation; TBI: traumatic brain injury; y: years

*LoE was not downgraded

Operative Dekompression durch Kraniektomie und Duraerweiterungsplastik

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Cooper (2020) "Patient outcomes at twelve months after early decompressive craniectomy for diffuse traumatic brain injury in the randomized DECRA clinical trial." *Journal of neurotrauma* 37.5 (2020): 810-816. **Study design** Secondary analysis of an RCT **Aim of the study** "The 12-month outcomes from the DECRA trial are presented here and are	**Inclusion criteria** • age between 15 and 59 y • with a severe, nonpenetrating traumatic brain injury (TBI) (among patients who were evaluated either after resuscitation or before intubation, this injury was defined as a score of 3 to 8 on the Glasgow Coma Scale (GCS) or Marshall class III) **Exclusion criteria** • Patients not deemed suitable for full active treatment by the clinical staff caring for the patient • had dilated, unreactive pupils, mass lesions (unless too small to require surgery), spinal cord injury, or cardiac arrest at the scene of the injury • DECRA excluded patients with intracranial hematomas (mass lesions) and it	**Participants** N=155 patients **Study groups** IG: decompressive craniectomy (DC) plus standard care (N=73) CG: standard care (N=82) IG: A standardized surgical approach, modeled on the Polin technique, was used. This approach included a large bifrontotemporoparietal craniectomy with bilateral dural opening to maximize the reduction in intracranial pressure (ICP). The sagittal sinus and falx cerebri were not divided. After craniectomy, the excised bone was stored at −70°C or in a subcutaneous abdominal pouch, according to the standard practice of the op-	<u>Use of barbiturates: n (%)</u> IG: NR (32) vs. CG: NR (77), p<0.001 <u>Use of high total doses (>30g) of barbiturates: n (%)</u> IG: 0 (0) vs. CG: NR (17) <u>Extended Glasgow Outcome Scale Score at 12 months: n (%)</u> Dead: IG: 15 (21) vs. CG: 16 (19) Vegetative: IG: 8 (11) vs. CG: 2 (3) Low severe disability: IG: 14 (19) vs. CG: 13 (16) Upper severe disability: IG: 6 (8) vs. CG: 8 (10)	**Level of evidence** 1b **Risk of bias** Selection bias: + Performance bias: – Attrition bias: + Detection bias: + **Authors' conclusion** "Twelve months after diffuse severe TBI, in patients who had intracranial hypertension refractory to optimized first- and secondtier therapies in their first 72 h, early DC compared with standard intensive medical

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
considered in comparison with those of RESCUEicp." **Setting** Australia, New Zealand, and Saudi Arabia, 2002-2010	also did not include patients with penetrating gunshot or blast craniocerebral injury **Characteristics** <u>Age [y], median (IQR)</u> IG: 23.7 (19.4-29.6) vs. CG: 24.6 (18.5-34.9), p=0.89 <u>Male, n (%)</u> IG: 59 (81) vs. CG: 61 (74), p=0.44 <u>GCS, median (IQR)</u> IG: 5 (3-7) vs. CG: 6 (4-7), p=0.31 <u>GCS motor, median (IQR)</u> IG: 3 (1-4) vs. CG: 3 (1-5), p=0.49 <u>Maximum score for head injury on AIS, n (%), p overall= 0.52</u> 3 or 4: IG: 35 (48) vs. CG: 44 (54) 5: IG: 18 (52) vs. CG: 38 (46) <u>ISS, median (IQR)</u> IG: 33 (25-38) vs. CG: 32 (24-41), p=0.88 <u>Marshall class n (%), p overall=0.39</u> Diffuse injury II: IG: 17 (23) vs. CG: 27 (33) Diffuse injury III/IV: IG: 53 (73) vs. CG: 53 (65)	erating surgeon. After all swelling and infection had resolved, 2 to 3 months after craniectomy, the bone was replaced. CG: Standard care from the time of enrollment followed clinical practice guidelines that were based on those recommended by the Brain Trauma Foundation. In the two study groups, second-tier options for refractory elevation of ICP included mild hypothermia (to 35°C), the optimized use of barbiturates, or both. For patients receiving standard care, the trial protocol permitted the use of lifesaving DC after a period of 72 hours had elapsed since admission **Co-interventions** All patients in the study were treated in intensive care units with advanced neurosurgical management capabilities and equipment, including the availability of intracranial-pressure monitoring with the use of either an external ventricular drain or a parenchymal catheter. Patients received treatment for intracranial hypertension whenever the ICP was greater than 20 mmHg. We defined an early refractory elevation in ICP as a spontaneous (not stimulated) increase in ICP for more than 15 minutes (continuously or intermittently) within a 1-hour period, despite optimized first-tier interventions. Such interventions included optimized sedation, the normalization of arterial carbon dioxide pressure, and the use of mannitol, hypertonic saline, neuromuscular blockade, and external ventricular drainage.	Low moderate disability: IG: 10 (14) vs. CG: 10 (12) Upper moderate disability: IG: 14 (19) vs. CG: 16 (19) Low good recovery: IG: 4 (5) vs. CG: 13 (16) Upper good recovery: IG: 2 (3) vs. CG: 4 (5) Unfavorable score (<5): IG: 43 (59) vs. CG: 39 (48) OR for a worse functional outcome in the craniectomy group 1.68; 95% CI: 0.96-2.93; p=0.07 <u>Functional outcome using Glasgow Outcome Scale-Extended 6 months after injury %</u> Unfavorable, all patients (1-4/1-8): IG: 70 vs.CG: 51 Vegetative survivors (2/2-8): IG: 15 vs.CG: 3 Severe disability survivors (2-4/2-8): IG: 63 vs. CG: 40 Good outcome survivors (7-8/2-8): IG: 5 vs. CG: 10 <u>Functional outcome using Glasgow Outcome Scale-Extended 6 months after injury OR (95% CI), p</u> Unfavorable, all patients (1-4/1-8): Adjusted 2.40 (1.18-4.91), 0.02* Vegetative survivors (2/2-8): Adjusted 5.96 (1.15-30.9), 0.03*	care did not improve survival or neurological outcomes." **Reviewers' conclusion** Due to the high risk of performance bias, results should be interpreted with caution.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
			Severe disability survivors (2-4/2-8): Adjusted 2.52 (1.18-5.37), 0.02* Good outcome survivors (7-8/2-8): Adjusted 0.48 (0.12-1.97), 0.31* <u>Functional outcome using Glasgow Outcome Scale-Extended 12 months after injury %</u> Unfavorable, all patients (1-4/1-8): IG: 59 vs. CG: 48 Vegetative survivors (2/2-8): IG: 14 vs. CG: 3 Severe disability survivors (2-4/2-8): IG: 48 vs. CG: 35 Good outcome survivors (7-8/2-8): IG: 10 vs. CG: 26 <u>Functional outcome using Glasgow Outcome Scale-Extended 12 months after injury OR (95% CI), p</u> Unfavorable, all patients (1-4/1-8): Adjusted 1.65 (0.83-3.28), 0.15* Vegetative survivors (2/2-8): Adjusted 5.16 (0.95-27.9), 0.06* Severe disability survivors (2-4/2-8): Adjusted 1.70 (0.80-3.62), 0.17* Good outcome survivors (7-8/2-8): Adjusted 0.34 (0.12-0.94), 0.04* * We adjusted using a single summary measure of brain injury severity—the estimated probability of unfavorable outcome from the International Mission for Prognosis and Analysis of Clinical Trials in TBI (IMPACT) core and extended algorithms.	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
Girotto (2014) "Neurosurgical Procedure for Treatment of Traumatic Subdural Hematoma with Severe Brain Injury: A Single Center Matched-Pair Analysis." *Collegium antropologicum* 38.4 (2014): 1255-1258. **Study design** Prospective cohort study **Aim of the study** "A matched-pair analysis has been performed to compare long-term clinical outcomes in patients with and without the DC technique applied." **Setting** Croatia 2002-2012	**Inclusion criteria** • patients with severe TBI • with acute subdural hematoma • aged between 18 and 82 y • followed for 10 y **Characteristics** Age [y] Across all groups, 2/3 were aged between 26 and 40 y Gender Sex ratio of 2:1 (male/female)	**Participants** N=150 patients **Study groups** IG1: Early DC (N=50) IG2: Late DC (N=50) CG: No DC (N=50) IG1: DC treatment applied early within 24 hours from the time of injury and standard medical neurosurgical acute subdural hematoma patients care IG2: initially subdural hematoma surgically removed, and then 24 hours after the primary surgical procedure and also after a head computer tomography (CT) scan additionally the DC treatment had been applied (obviously later than 24 hours from the time of injury) CG: initially subdural hematoma surgically removed, but without application of DC treatment (matched-pair analysis)	Mortality: n (%) IG1: NR (18) vs. IG2: NR (54) vs. CG: NR (35) Numerous complications were recorded such as the increased number of encephalocele.	**Level of evidence** 2b **Risk of bias** Selection bias: ? Performance bias: ? Attrition bias: + Detection bias: ? **Authors' conclusion** "Our data with confidence justify and strongly support the idea to apply the DC technique of adequate size, early from the time of injury, to a very specific group of severe TBI patients that have acute intracranial extra-axial haemorrhage" **Reviewers' conclusion** Due to a lack of reporting on various aspects, risk of bias is generally unclear. No basic characteristics are provided for different treatment groups.
Shibahashi (2020) "In-hospital mortality and length of hospital stay with craniotomy versus craniectomy for acute subdural hemorrhage: a	**Inclusion criteria** • patients aged ≥18 y • AIS code 140656.5, which indicates large (>50 cm3, >1 cm thick, massive, or extensive) supratentorial acute subdural hemorrhage	**Participants** N=1788 patients (overall) N=1028 (after propensity score matching) **Study groups**	In-hospital mortality: n (%) IG: 41.6 vs. CG: 39.1 Difference (95% CI): −2.5 (−8.5 to 3.5) Estimated 30-day survival	**Level of evidence** 2b **Risk of bias** Selection bias: +

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
multicenter, propensity score–matched analysis." *Journal of neurosurgery* 133.2 (2020): 504-513. **Study design** Comparative registry study **Aim of the study** "In this study, we aimed to evaluate the association between surgical treatment strategy (craniotomy or DC) and outcomes in patients with acute subdural hemorrhage and to identify the subgroups that would benefit from each procedure." **Setting** Japan, 2004-2015	• who underwent surgical evacuation of the hemorrhage with or without bone-flap removal after a blunt injury **Exclusion criteria** • AIS score of 6 (nonsurvivable injury) in the head region • major extracranial injuries (maximum AIS score ≥3) in body regions other than the head • unknown final outcomes (in-hospital mortality) **Characteristics after propensity score matching** <u>Age [y], mean ± SD</u> IG: 64 ± 18 vs. CG: 63 ± 17 standardized mean difference 0.098 <u>Male, n (%)</u> IG: 353 (69) vs. CG: 353 (69) standardized mean difference <0.001 <u>Maximum AIS, mean ± SD</u> Face: IG: 0.13 ± 0.44 vs. CG: 0.13 ± 0.44, standardized mean difference 0.004 Neck: IG: 0.00 ± 0.00 vs. CG: 0.00 ± 0.00 standardized mean difference <0.001 Chest: IG: 0.05 ± 0.27 vs. CG: 0.05 ± 0.27, standardized mean difference 0.014	IG: craniotomy (N=1255 overall, N=514 after propensity score matching) CG: craniectomy (N=533 overall, N=514 after propensity score matching)	IG: 59.3% (95% CI 54.8% to 63.5%) vs. CG: 61.4% (95% CI 57.0% to 65.5%) (p=0.141 for the log-rank test) <u>Length of stay [d], median (IQR)</u> Overall: IG: 23 (4–52) vs. CG: 30 (7–60), p=0.005 Survived to discharge: IG: 44 (28–65) vs. CG: 53 (33–79), p=0.001	Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "The results of this study showed that overall, DC did not appear to be superior to craniotomy in acute subdural hematoma treatment in terms of in-hospital mortality." **Reviewers' conclusion** Due to missing information the risk of performance bias remains unclear. The rationale for choosing craniotomy or craniectomy remains unclear. No long term outcomes are provided. The exclusion of major extracranial injuries should be kept in mind.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
	Abdomen: IG: 0.01 ± 0.15 vs. CG: 0.02 ± 0.14, standardized mean difference 0.014 Spine: IG: 0.07 ± 0.37 vs. CG: 0.07 ± 0.37, standardized mean difference 0.005 Upper extremity: IG: 0.16 ± 0.50 vs. CG: 0.13 ± 0.46, standardized mean difference 0.057 Lower extremity: IG: 0.13 ± 0.45 vs. CG: 0.14 ± 0.43, standardized mean difference 0.018 External: IG: 0.02 ± 0.14 vs. CG: 0.03 ± 0.16, standardized mean difference 0.026 ISS, mean ± SD IG: 26 ± 2 vs. CG: 26 ±2, standardized mean difference 0.008 Probability of survival per Trauma and Injury Severity Score model mean ± SD IG: 0.63 ± 0.24 vs. CG: 0.63 ± 0.24, standardized mean difference<0.001 Intracranial injuries, n (%) Contusion: IG: 231 (45) vs. CG: 237 (46), standardized mean difference 0.023 Intracerebral hemorrhage: IG: 18 (4) vs. CG: 19 (4), standardized mean difference 0.010 Traumatic subarachnoid hemorrhage: IG: 194 (38) vs. CG: 190 (37), standardized mean difference 0.016			

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE*, risk of bias; Conclusions
AIS: Abbreviated Injury Scale; CG: control group; CI: confidence interval; CT: computer tomography; DC: Decompressive Craniectomy; GCS: Glasgow Coma Scale; ICP: intracranial pressure; IG: intervention group; IQR: interquartile range; ISS: Injury Severity Score; NR: not reported; OR: odds ratio; SD: standard deviation; TBI: traumatic brain injury; y: years *LoE was not downgraded				

3.5 Wirbelsäule

In diesem Kapitel wurde nur LoE für randomisiert-kontrollierte Studien herabgestuft.

Frühzeitige Operation instabiler Wirbelsäulenverletzungen mit gesicherten oder anzunehmenden neurologischen Ausfällen

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Balas (2021) „Earlier Surgery Reduces Complications in Acute Traumatic Thoracolumbar Spinal Cord Injury: Analysis of a Multi-Center Cohort of 4108 Patients." *J Neurotrauma* 2021 Apr 26. doi: 10.1089/neu.2020.7525. PMID: 33724051. **Study design** Comparative registry study (American College of Surgeons Trauma Quality Improvement Program) **Aim of the study** "To explore the association between timing of	**Inclusion criteria** • Adult patients (≥16 years) with a • diagnosis of acute thoracolumbal spinal cord injury (TLSCI), but without evidence of a concurrent cervical spinal cord injury (SCI) **Exclusion criteria** • Those with a non-survivable injury (AIS score of 6 in any body region) were excluded, as those with non-blunt trauma, those who did not undergo surgical intervention, and those with missing data for time-to-surgery. • Anyone who underwent surgery after 120 Hours (5 days) form the time of presentation to the ED was excluded • Patients that arrived without signs of life, had pre-existing advanced directive to limit life sustaining interven-	**Participants** N=4,108 patients (study cohort, full sample) N=2976 (propensity score-matched cohort) **Study groups** IG: early surgery (N=1494 study cohort, N=1488 propensity score-matched cohort; 99.6% of the full sample) CG: delayed surgery (N=2614 study cohort, N=1488 propensity score-matched cohort; 56.9% of the full sample) Time-to-surgery was defined as the total time elapsed (in hours) from arrival in the trauma center to arrival in the operating room Surgery occurring at or before 12 hours from arrival was classified as early surgery Surgery occurring beyond 12 hours after arrival was classified as delayed	**Outcomes after propensity score matching** Main complication n (%); OR (95% CI) § IG: 229 (15.4) vs. CG: 283 (19.0); OR: 0.77 (0.64 to 0.94) Composite outcome defined by TQIP as the occurrence of one or more of the following: acute kidney injury, acute respiratory distress syndrome, cardiac arrest (with CPR), decubitus ulcer, deep or organ space surgical site infection, myocardial infarction, pneumonia or ventilator-associated pneumonia, pulmonary embolism, stroke, catheter-related bloodstream infection, unplanned return to the OR, unplanned admission to the intensive care unit (ICU), or severe sepsis Immobility complication n (%); OR (95% CI) § IG: 180 (12.1) vs. CG: 211 (14.9); OR:0.79 (0.64-0.97) Defined as decubitus ulcer, pneumonia, or pulmonary embolism.	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: ? **Authors' conclusion** "This observational analysis of a multicenter North American trauma database suggests that the risk of complications for patients with TLSCI begins to rise after 12 hours of surgical wait-time and increases consistently thereafter. Those treated within this threshold have significantly

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
surgery for traumatic TLSCI and the risk of adverse events using a large multicenter North American trauma database." **Setting** USA 2010-2016 **Classification of spine injury** stable/unstable: NR with/without neurology: with neurology	tions, were discharged from the emergency department (ED) or had severe burns are not included in the data base **Characteristics (propensity score-matched cohort)** Male, n (%) IG: 1121 (75.3) CG: 1124 (75.5), SMD=0.00 Age [y], mean (SD) IG: 37.61 (16.19) CG: 37.93 (16.24), SMD=0.02 Incomplete thoracolumbar injury, n (%) IG: 649 (43.6) CG: 624 (41.9), SMD =0.03 ISS ≥16, n (%) IG: 1475 (99.1) CG: 1475 (99.1), SMD=0.00 GCS 3-8, n (%) IG: 80 (5.4) CG: 86 (5.8), SMD=0.01 GCS 9-12, n (%) IG: 32 (2.2) CG: 41 (2.8), SMD=0.04 GCS 13-14, n (%) IG: 142 (9.5) CG: 142 (9.5), SMD=0.00 GCS 15, n (%) IG: 1234 (82.9) CG: 1219 (81.9), SMD=0.02		In-hospital mortality n (%); OR (95% CI) § IG: 32 (2.2) vs. CG: 21 (1.4); OR: 1.41 (0.89 to 2.71) Hospital LOS [d] mean (SD); MD (95% CI) § IG: 14.5 (14.0) vs. CG: 16.1 (13.5); MD: -1.63 (-2.61 to -0-64) Postoperative LOS [d] mean (SD); MD (95% CI)§ IG: 14.2 (14.0) vs. CG: 14.4 (13.3); MD: -0.21 (-1.19 to 0.77) ICU LOS [d] mean (SD); MD (95% CI) § IG: 6.4 (7.5) vs. CG: 7.9 (9.3); MD: -1.48 (-2.09 to -0.88) Days on Ventilator mean (SD); MD (95% CI) § IG: 3.0 (7.7) vs. CG: 3.6 (8.8); MD: -0.60 (-1.20 to -0.01)	lower risk of adverse events, as well and shorter overall hospital and ICU stays." **Reviewers' conclusion** Propensity score matching equalized baseline characteristics (e.g. age or injury severity) between the groups, probably leading to a low risk of selection bias. However, spine and neurologic injury classification might affect treatment decision, but details on these are mostly missing. Risk of performance or detection bias remains unclear, due to missing information.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Head AIS score ≥3, n (%) IG: 200 (13.4) CG: 230 (15.5), SMD=0.06 Face AIS score ≥3, n (%) IG: 7 (0.5) CG: 5 (0.3), SMD=0.02 Neck AIS score ≥3, n (%) 10 (0.7)/12 (0.8), SMD=0.01 Thorax AIS score ≥3, n (%) IG: 800 (53.8) CG: 823 (55.3), v0.03 Abdomen AIS score ≥3, n (%) IG: 83 (5.6) CG: 82 (5.5), SMD=0.00 Upper extremity AIS score ≥3, n (%) IG: 27 (1.8) CG: 32 (2.2), SMD=0.02 Lower extremity AIS score ≥3, n/N (%) IG: 96 (6.5) CG: 109 (7.3), SMD=0.04			
Bliemel (2014) "Early or delayed stabilization in severely injured patients with spinal fractures? Current surgical objectivity according to the Trauma Registry of DGU: treatment of spine injuries in polytrauma patients." *J Trauma Acute*	**Inclusion criteria** • Patients at least 16 years of age with a severe blunt trauma classified as ISS of 16 or higher • Patients included in this analysis must have reached ICU following shock room treatment while additionally surviving at least 1 week following trauma	**Participants** N=2,303 patients **Study groups** IG: early stabilization (Thoracic spine N=893, Lumbar spine N=706) CG: Late stabilization (Thoracic Spine N=416 Lumbar Spine N=288)	**Thoracic spine** Ventilation days, mean (SD) IG: 9.1 (13.8) vs. CG: 13.7 (15.3), p<0.001 Days on ICU, mean (SD) IG: 14.5 (15.8) vs. CG: 21.3 (19.2), p<0.001 Days in hospital, mean (SD) IG: 47.0 (47.7) vs. CG: 45.4 (37.8), p<0.001	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: ?

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Care Surg 2014;76 (2):366-73. **Study design** Comparative registry study (TraumaRegister DGU®) **Aim of the study** "To analyze the data of the Trauma Registry of German Trauma Society (Deutsche Gesellschaft für Unfallchirurgie [DGU]) (TR-DGU) to examine the medical care situation of severely injured patients with relevant spine injuries so as to analyze the outcome related to an early or late surgical stabilization." **Setting** Centres in Germany, the Netherlands, Austria, Switzerland, Slovenia, Luxembourg, Belgium, United Arab Emirates, 1993-2010 **Classification of spinal injuries** Stable/unstable: Unstable With/without neurology: with neurology (patients with severe spinal injuries classified as having spine	• Only patients with thoracic or lumbar spinal injuries, classified as spine AIS score of 2 higher, were considered **Exclusion criteria** • Patients with penetrating trauma mechanism • Patients with cervical spine injuries were excluded a priori **Characteristics (thoracic spine)** Male, n/N (%) IG: 708/893 (79.3) CG: 328/416 (78.8), p=0.856 Age [y], mean (SD) IG: 42.3 (17.2) CG: 45.0 (17.9), p=0.012 ISS, mean (SD) IG: 29.4 (10.1) CG: 31.6 (11), p<0.001 NISS, mean (SD) IG: 37.7 (13.0) CG: 39.7 (13.2), p=0.019 Head AIS score ≥3, n/N (%) IG: 244/893 (27.3) CG: 188/416 (45.2), p<0.001 Chest AIS score ≥3, n/N (%) IG: 893/893 (100) CG: 416/416 (100) Abdominal AIS score ≥3, n/N (%)	Early stabilization was defined as a surgical treatment performed within the first 72 hours following admission Late stabilization was defined as surgical treatment after 72 hours The subgroup of patients with relevant spine injuries classified as spine AIS score of 3 or greater was analysed regarding the timing of surgery (early or late stabilization)	Blood transfusion, n/N (%) IG: 282/893 (31.6) vs. CG: 120/416 (28.8), p=0.318 Sepsis, n/N (%) IG: 104/871 (11.9) vs. CG: 69/395 (17.5), p=0.008 Late deaths (at earliest, 7d after trauma), n/N (%) IG: 31/893 (3.5) vs. CG: 10/416 (2.4), p=0.935 GOS score 1, n/N (%) IG: 31/686 (4.5) vs. CG: 10/326 (3.1) GOS score 2, n/N (%) IG: 7/686 (1.0) vs. CG: 7/326 (2.1) GOS score 3, n/N (%) IG: 290/686 (42.3) vs. CG: 103/326 (31.6) GOS score 4, n/N (%) IG: 173/686 (25.2) vs. CG: 107/326 (32.8) GOS score 5, n/N (%) IG: 185/686 (27.0) vs. CG: 99/326 (30.4) Concerning ICU length of stay, patients with late surgery had an adjusted increase of +2.7 days (SE,3.1; p=0.374) in the case of thoracic spine injury, relative to those cases with an early surgery. In terms of the duration of ventilation, an adjusted increase of +2.0 days (SE, 1.1; p=0.068) was seen in patients with late surgical stabilization of thoracic spine injuries compared with those with an early surgery. **Lumbar spine** Ventilation days, mean (SD)	**Authors' conclusion** "Multivariate regression analysis of our results gives a hint that early surgical stabilization can lead to shorter ICU stays, fewer days on mechanical ventilation, and therefore, an estimated lower incidence of pulmonary complications, thereby resulting in a lower rate of sepsis. Disadvantages of early spine stabilization could not be seen." **Reviewers' conclusion** There is a risk for selection bias as the groups differ significantly in baseline factors (e.g. ISS, GCS). Adjustments for confounders were done only for selected outcomes. Risk for performance and detection bias remains unclear, due to missing information.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
AIS score of 3 or greater such as spinal fractures with additional spinal cord contusion and incomplete or complete cord syndrome.)	IG: 138/893 (15.5) CG: 89/416 (21.4), p=0.008 Extremity AIS score ≥3, n/N (%) IG: 177/893 (19.8) CG: 130/416 (21.4), p<0.001 Single region injured, n/N (%) IG: 427/893 (47.8) CG: 91/416 (21.9), p<0.001 Preclinical GCS score ≤8, n/N (%) IG: 82/658 (12.5) CG: 80/312 (25.6), p>0.001 **Characteristics (lumbar spine)** Male, n/N (%) IG: 466/706 (66) CG: 212/288 (73.6), p=0.019 Age [y], mean (SD) IG: 39.5 (16.0) CG: 41.5 (17.4), p=0.190 ISS, mean (SD) IG: 28.1 (10.2) CG: 31.5 (12.5), p<0.001 NISS, mean (SD) IG: 31.0 (11.2) CG: 34.9 (12.9), p<0.001 Head AIS score ≥3, n/N (%) IG: 105/706 (14.9) CG: 98/288 (34), p<0.001 Chest AIS score ≥3, n/N (%)		IG: 5.3 (9.1) vs. CG: 9.4 (12.1), p<0.001 Days on ICU, mean (SD) IG: 11.5 (13.3) vs. CG: 15.9 (13.2), p<0.001 Days in hospital, mean (SD) IG: 40.1 (34.7) vs. CG: 41.2 (27.9), p<0.028 Blood transfusion, n/N (%) IG: 234/706 (33.1) vs. CG: 101/288 (35.1), p=0.560 Sepsis, n/N (%) IG: 47/685 (6.9) vs. CG: 43/274 (15.7), p<0.001 Late deaths (at earliest, 7d after trauma), n/N (%) IG: 13/706 (1.8) vs. CG: 8/288 (2.8), p=0.352 GOS score 1, n/N (%) IG: 13/544 (2.4) vs. CG: 8/222 (3.6) GOS score 2, n/N (%) IG: 5/544 (0.9) vs. CG: 0/222 (0.0) GOS score 3, n/N (%) IG: 105/544 (19.3) vs. CG: 34/222 (15.3) GOS score 4, n/N (%) IG: 211/544 (38.8) vs. CG: 74/222 (33.3) GOS score 5, n/N (%) IG: 210/544 (38.6) vs. CG: 106/222 (47.7) Concerning ICU length of stay, patients with late surgery had an adjusted increase of +1.4 days (SE, 1.3; p=0.283), in case of lumbar spine injury, relative to those cases with an early surgery.	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG: 370/706 (52.4) CG: 178/288 (61.8), p=0.007 Abdominal AIS score ≥3, n/N (%)§ IG: 706/706 (100) CG: 288/288 (100) Extremity AIS score ≥3, n/N (%) IG: 257/706 (36,4) CG: 138/288 (47.9), p=0.001 Single region injured, n/N (%) IG: 162/706 (22.9) CG: 162/31 (10.8), p<0.001 Preclinical GCS score ≤8, n/N (%) IG: 64/541 (11.8) CG: 34/219 (15.5), p=0.169		In terms of the duration of ventilation, an adjusted increase of +3.6 days (SE, 2.2; p=0.108) was seen in patients with late surgical stabilization of lumbar spine injuries, compared to those cases with an early surgery.	
Godzik (2019) "Early surgical intervention among patients with acute central cord syndrome is not associated with higher mortality and morbidity." *J Spine Surg* 2019; 5 (4):466-474. **Study design** Comparative registry study (National Trauma Data Bank) **Aim of the study**	**Inclusion Criteria** • all patients over the age of 18 with acute traumatic central cord syndrome (ATCCS), as identified using International Classification of Diseases, Ninth Revision (ICD-9) codes for central spinal cord injuries **Exclusion Criteria** NR **Characteristics (propensity score-matched cohort)** Male, n (%) IG: 585 (80.0) CG: 600 (82.1), p=0.317 Age [y], mean (SD)	**Participants** N=2,379 patients (study cohort, full sample) N=1,462 (propensity score-matched cohort) **Study groups** IG: early surgery (N=731 study cohort, N=731 propensity score-matched cohort) CG: late surgery (N=1.648 study cohort, N=731 propensity score-matched cohort) Time to surgery was categorized as early surgery, if surgery was within less than 24 hours. Time to surgery was categorized as late surgery if surgery was within more than 24 hours	**Outcomes after propensity score matching** All-cause mortality OR (95% CI) 1.68 (0.89-3.17), p=0.107 Serious adverse event + death OR (95% CI) 1.22 (0.87-1.71), p=0.255 Serious adverse events (SAE) included acute respiratory distress syndrome, cardiac arrest requiring cardiopulmonary resuscitation, myocardial infarction, severe sepsis, stroke, thromboembolic event, or an unplanned return to the operating room	**Level of evidence** 2b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: ? **Authors' conclusion** "Early surgical intervention does not appear to be associated with increased mortality among ACS patients unlike previously suggested. We theorize that survival noted within the

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"To determine the association between early surgery for acute traumatic central cord and all-cause mortality among multisystem trauma patients in the National Trauma Data Bank (NTDB) using propensity score matching." **Setting** USA, 2011-2014 **Classification of spine injury** stable/unstable: NR with/without neurology: with neurology	IG: 53.1 (16.77) CG: 53.0 (15.83), p=0.907 <u>Injury severity CCI, mean (SD)</u> IG: 20.03 (9.18) CG: 20.02 (9.50), p=0.991 <u>GCS, mean (SD)</u> IG: 13.64 (2.88) CG: 13.70 (3.08), p=0.712 <u>Head injury, n (%)</u> IG: 220 (30.1) CG: 211 (28.9), p=0.606 <u>ACS level 1, n (%)</u> IG: 475 (65.3) vs. CG: 486 (66.5) <u>ACS level 2, n (%)</u> IG: 238 (32.7) vs. CG: 234 (32.0) <u>ACS level 3, n (%)</u> IG: 14 (1.9) vs. CG: 11 (1.5) <u>ACS level 4, n (%)</u> IG: 0 vs. CG: 0			NTDB is confounded by factors including existing comorbidities and multisystem trauma, rather than surgical timing. Delaying definitive surgical care may predispose patients to worsened greater neurological morbidity." **Reviewers' conclusion** Propensity score matching equalized baseline characteristics (e.g. age or injury severity) between the groups, probably leading to a low risk of selection bias. However, spine and neurologic injury classification might affect treatment decision, but details on these are mostly missing. Risk of performance or detection bias remains unclear, due to missing information.
Ruddell (2021) "Timing of Surgery for Thoracolumbar Spine Trauma: Patients With Neurological Injury." *Clin Spine Surg* 2021; 1;34 (4):E229-E236. **Study design**	**Inclusion Criteria** • Admissions were isolated based on the presence of specific International Classifications of Disease, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis codes for closed thoracic or lumbar spinal fracture with associated neurological injury (806.20–806.29, 806.4), as well as the presence of ICD-9-CM	**Participants** N=19,136 patients **Study groups** Same day group: N=4,724 1-2 days group: N=8,121 3-6 days group: N=4,289 7+ days group: N=2,002	<u>Mortality, n (%)</u> Same day: 75 (1.58) 1-2 days: 111 (1.37) 3-6 days: 62 (1.46) 7+ days: 33 (1.64) <u>In-hospital complications, n (%)</u> Same day: 683 (14.46) 1-2 days: 1195 (14.72)	**Level of evidence** 2b **Risk of bias** Selection bias: ? Performance bias: ? Attrition bias: + Detection bias: ?

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Comparative registry study (National Inpatient Sample data from the Healthcare Cost and Utilization Project) **Aim of the study** "To analyze the effect of fusion timing on inpatient outcomes in a nationally representative population with thoracolumbar fracture and concurrent neurological injury." **Setting** USA, 2004-2014 **Classification of spine injury** stable/unstable: NR with/without neurology: with neurology	• Procedure codes for thoracolumbar or lumbosacral fusion (81.04–81.08) • Patients with nonelective admission types **Exclusion Criteria** • Patients with diagnosis codes for any open, cervical, or sacral spinal fractures or any neurological injury of a non thoracolumbar region • Patients with ICD-9-CMprocedure codes for cervical fusion and any revision fusion **Characteristics full sample** Female sex, n (%) 6040 (31.6) Age, mean (95% CI) 41.8 (41.17-42.46) **Characteristics** Paralysis, n (%) Same day:758 (16.0) 1-2 days: 1080 (13.3) 3-6 days: 462 (10.8) 7+ days: 233 (11.7) Concussion/intracranial injury, n (%) Same day: 746 (15.8) 1-2 days: 1332 (16.4) 3-6 days: 737 (17.2) 7+ days: 512 (25.6) Brain damage/coma/stupor, n (%) Same day: 98 (2.07) 1-2 days: 259 (3.19)	Timing of surgical intervention following hospital admission was classified using the following framework: same day, 1–2-, 3–6-, and = 7-day delay. These classifications may be viewed as immediate, early, delayed, and late.	3-6 days: 738 (17.20) 7+ days: 382 (19.06) Haemorrhage/hematoma, n (%) Same day: 97 (2.06) 1-2 days: 119 (1.46) 3-6 days: 43 (1.00) 7+ days: 70 (3.52) Cardiac complications, n (%) Same day: 44 (0.94) 1-2 days: 122 (1.50) 3-6 days: 108 (2.52) 7+ days: 68 (3.40) Respiratory complications, n (%) Same day: 65 (1.37) 1-2 days: 116 (1.42) 3-6 days: 136 (3.16) 7+ days: 81 (4.05) Postoperative infection, n (%) Same day: 66 (66) 1-2 days: 30 (1.60) 3-6 days: 59 (1.37) 7+ days: 114 (5.69 **In-hospital complication and infection Odds Ratios for each timing group when compared with all other timing groups, controlling for injury severity, age, sex, fracture location, fusion approach, and comorbidities** In-hospital complications, OR (95% CI) Same day: 0.933 (0.760-1.145) 1-2days: 0.931 (0.778-1.113) 3-6days: 1.090 (0.887-1.340) 7+ days: 1.151 (0.883-1.502)	**Authors' conclusion** "This study […] demonstrates that spinal fusion within 72 hours of admission is associated with reduced complications, infections, LOS, and hospital charges. Contrarily, delay in treatment for thoracolumbar fracture patients with neurological injury is not associated with any benefit and may increase the odds of certain complications." **Reviewers' conclusion** Risk of selection bias remains unclear as only few baseline characteristics are reported. However, adjustments for confounders were done. Risk for performance and detection bias remains unclear, due to missing information.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	3-6 days: 185 (4.32) 7+ days: 82 (4.09) Hereditary or degenerative neurological disorder, n (%) Same day: 225 (4.76) 1-2 days: 353 (4.35) 3-6 days: 190 (4.43) 7+ days: 102 (5.11)		Cardiac complications, OR (95% CI) Same day: 0.543 (0.262-1.127) 1-2days: 0.848 (0.506-1.419) 3-6days: 1.384 (0.803-2.385) 7+ days: 1.432 (0.744-2.757) Haemorrhage/hematoma, OR (95% CI) Same day: 1.326 (0.779-2.258) 1-2days: 0.856 (0.517-1.418) 3-6days: 0.467 (0.236-0.922), p<0.05 7+ days: 0.236-0.922, p<0.05 Respiratory Complications, OR (95% CI) Same day: 0.687 (0.382-1.233) 1-2days: 0.613 (0.367-1.023) 3-6days: 1.619 (1.009-2.598), p<0.05 7+ days: 1.850 (1.076-3.180), p<0.05 Postoperative Infection, OR (95% CI) Same day: 0.711 (0.398-1.270) 1-2days: 0.776 (0.481-1.253) 3-6days: 0.651 (0.350-1.210) 7+ days: 3.155 (1.891-5.263), p<0.001 **In-hospital complication and infection Odds Ratios comparing 1–2-day delay to same-day operation, controlling for injury severity, age, sex, fracture location, fusion approach, and comorbidities** In-hospital complications, OR (95% CI) 1.003 (0.798-1.259) Cardiac complications, OR (95% CI) 1.568 (0.696-3.57) Haemorrhage/hematoma, OR (95% CI) 0.733 (0.401-1.343)	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Respiratory Complications, OR (95% CI) 1.057 (0.522-2.140) Postoperative Infection, OR (95% CI) 1.178 (0.612-2.271) **In-hospital complication and infection Odds Ratios for each timing group when compared with all other timing groups, controlling for injury severity, age, sex, fracture location, fusion approach, and comorbidities** In-hospital complications, OR (95% CI) 0-2 days: 0.875 (0.728-1.050) 3-6 days: 1.090 (0.887-1.340) 7+ days: 1.151 (0.883-1.502) Cardiac complications, OR (95% CI) 0-2 days: 0.595 (0,357-0.991), p<0.05 3-6 days: 1.384 (0.803-2.385) 7+ days: 1.432 (0.744-2.757) Haemorrhage/hematoma, OR (95% CI) 0-2 days: 1.087 (0.669-1.767) 3-6 days: 0.467 (0.236-0.922), p<0.05 7+ days: 2.019 (1.107-3.683), p<0.05 Respiratory Complications, OR (95% CI) 0-2 days: 0.495 (0.313-0.784), p<0.01 3-6 days: 1.619 (1.009-2.598), p<0.05 7+ days: 1.850 (1.075-3.180). p<0,05 Postoperative Infection, OR (95% CI) 0-2 days: 0.615 (0.390-0.969), p<0.05 3-6 days: 0.651 (0.350-1.210) 7+ days: 3.155 (1.891-5.263), p<0.001 **Percent change in total LOS and postoperative LOS associated with operation timing groups**	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			compared with the rest of the cohort, controlling for injury severity, age, sex, fracture location, fusion approach, and comorbidities Total -length of stay percent change (95% CI) mean: 14.9 days Same day: -24.2% (-29.2 to-18.9%), p<0.001 1-2 days: -24.2% (-28.3 to-20.0%), p<0.001 3-6 days: +11.2% (5.1 to.17.7%), p<0.001 7+ days: +114.6% (98.6 to 131.9%), p<0.001 Postoperative length of stay percent change (95% CI) mean: 12.1 days Same day: +0.1% (-6.7 to 7.4%) 1-2 days: -11.9% (-17.2 to-6.10%), p<0.001 3-6 days: -0.6% (-7.5 to.6.8%) 7+ days: +35.3% (19.0 to 53.7%), p<0.001	

Zeitpunkt der Operation instabiler Wirbelsäulenverletzungen

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Hager (2020) "Possible advantages of early stabilization of spinal fractures in multiply injured patients with leading thoracic trauma - analysis based on the TraumaRegister DGU®." *Scand J Trauma Resusc Emerg Med* 2020, 24;28 (1):42. **Study design**	**Inclusion Criteria** • European trauma centers • age ≥16 years • ISS ≥16 • chest injury severity (AIS_{Thorax}) ≥3 • thoracic and/or lumbar spine injury with severity (AIS_{Spine}) ≥3. **Exclusion Criteria** • patients with a basic dataset only (reduced dataset without interventions) • patients transferred to a referring hospital longer than 24 h after trauma	**Participants** N=1,740 patients No surgery n=402 Early surgery n=976 Late surgery n=362 **Study groups** IG: early stabilization (n=976) Thoracic spine (AIS_{TS}=3): N=295 Thoracic spine (AIS_{TS}=4-5):N=353	Mortality within the first 24h, n (%) IG: 3 (0.3) vs. CG: 0 (0) Mortality during hospital stay, n (%) IG: 34 (3,5) vs. CG: 7 (1.9) RISC II prognosis, (%) IG: 5.9 vs. CG: 8.2 Early (within 24 h of hospital admission) deceased patients were excluded from the following results	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: ? **Authors' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Comparative registry study (TraumaRegister DGU®) **Aim of the study** "We proposed that an early stabilization of thoracolumbar spine fractures will result in significant benefits regarding respiratory organ function, multiple organ failure and length of ICU / hospital stay." **Setting** Centres in Germany, the Netherlands, Austria, Switzerland, Slovenia, Finland, Belgium, 2009-2015 **Classification of spine injury** stable/unstable: NR with/without neurology: with and without neurology	• patients transferred into another institution within 2 days after admission (because of lack of outcome data) • penetrating injury • severe injury to either the head, abdomen or extremities defined as AIS_{Head} >3, $AIS_{Abdomen}$ >3 and • $AIS_{Extremity}$ >3 **Characteristics** Male, n (%) IG: 739 (76.2) vs. CG: 275 (76.0), p=0.98 Age [y], mean (SD) IG: 45.9 (17.6) vs. CG: 50.1 (19.), p<0.001 ISS, mean (SD) IG: 27.5 (9.3) vs. CG: 25.6 (8.9), p=0.001 ISS ≥25, n (%) IG: 637 (65.3) vs. CG: 190 (52.2), p<0.001	Lumbar spine (AIS_{TS}=3): N=239 Lumbar spine (AIS_{TS}=4-5): N=120 CG: late stabilization (n=362) Thoracic spine (AIS_{TS}=3): N=189 Thoracic spine (AIS_{TS}=4-5): N=54 Lumbar spine (AIS_{TS}=3): N=126 Lumbar spine (AIS_{TS}=4-5): N=14 Early spinal stabilization was defined as surgery within the first 72 h after hospital admission Late stabilization was defined as surgery more than 72 h after admission	**Outcome of multiple injured patients with severe thoracic trauma and concomitant serious thoracic spine trauma (AIS_{TS}=3)** ISS, mean IG: 20.3 vs. CG: 21.8, p=0.12 Days on ventilator, mean (median) IG: 5.6 (1) vs. CG: 8.4 (1), p=0.21 Days on ICU, mean (median) IG: 10.4 (6) vs. CG: 14.5 (9), p=0.004 Days in hospital, mean (median) IG: 23.9 (20) vs. CG: 31.0 (26), p<0.001 MOF, n (%) IG: 56 (20.4) vs. CG: 67 (39.0), p<0.001 Lung failure (ARDS), n (%) IG: 58 (21.2) vs. CG: 52 (30.2), p=0.031 Sepsis, n (%) IG: 18 (6.8) vs. CG: 21 (12.4), p=0.045 Blood transfusion, n (%) IG: 29 (9.8) vs. CG: 25 (13.2), p=0.25 GOS 3, n (%) IG: 15 (5.1) vs. CG: 23 (12.2), p=0.003 GOS 4, n (%) IG: 65 (22.3) vs. CG: 59 (31.2) GOS 5, n (%) IG: 200 (68.5) vs. CG: 103 (54.5)	"Multiply injured patients with at least serious thoracic trauma (AIS_{Thorax}3) and accompanying spine trauma can significantly benefit from early spine stabilization within the first 72 h after hospital admission. Based on the presented data, primary spine surgery within 72 h for fracture stabilization in multiply injured patients with leading thoracic trauma, especially in patients suffering from fractures of the thoracic spine, seems to be beneficial." **Reviewers' conclusion** There is a risk of selection bias as the groups differ significantly in age and injury severity. No adjustments were done. Detailed information regarding spine injury classification are missing. Risk for performance and detection bias remains unclear due to missing information.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			Outcome of multiple injured patients with severe thoracic trauma and concomitant severe/critical thoracic spine trauma (AIS_{TS}=4-5) ISS, mean IG: 31.6 vs. CG: 32.5, p=0.19 Days on ventilator, mean (median) IG: 8.0 (3) vs. CG: 13.7 (9), p=0.038 Days on ICU, mean (median) IG: 14.4 (11) vs. CG: 21.1 (19), p=0.002 Days in hospital, mean (median) IG: 32.0 (19) vs. CG: 37.4 (34), p<0.001 MOF, n (%) IG: 120 (35.4) vs. CG: 21 (44.7), p=0.22 Lung failure (ARDS), n (%) IG: 105 (31.0) vs. CG: 18 (38.3), p=0.31 Sepsis, n (%) IG: 35 (10.4) vs. CG: 10 (21.7), p=0.026 Blood transfusion, n (%) IG: 93 (26.3) vs. CG: 11 (20.4), p=0.35 GOS 2, n (%) IG: 3 (0.9) vs. CG: 0 (0), p=0.063 GOS 3, n (%) IG: 194 (57.4) vs. CG: 22 (40.7) GOS 4, n (%) IG: 71 (21.0) vs. CG: 18 (33.3) GOS 5, n (%)	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			IG: 53 (15.7) vs. CG: 13 (24.1) **Outcome of multiple injured patients with severe lumbar trauma and concomitant serious thoracic spine trauma (AIS_{TS}=3)** ISS, mean IG: 25.2 vs. CG: 27.9, p=0.010 Days on ventilator, mean (median) IG: 3.4 (1) vs. CG: 5.3 (1), p=0.010 Days on ICU, mean (median) IG: 8.4 (4) vs. CG: 12.7 (10), p<0.001 Days in hospital, mean (median) IG: 24.4 (21) vs. CG: 30.6 (25), p=0.001 MOF, n (%) IG: 39 (17.3) vs. CG: 34 (29.8), p=0.008 Lung failure (ARDS), n (%) IG: 37 (16.4) vs. CG: 33 (28.9), p=0.007 Sepsis, n (%) IG: 12 (5.3) vs. CG: 12 (10.5), p=0.076 Blood transfusion, n (%) IG: 25 (10.5) vs. CG: 24 (19.0), p=0.022 GOS 2, n (%) IG: 0 (0) vs. CG: 1 (0.8), p=0.37 GOS 3, n (%) IG: 12 (5.1) vs. CG: 11 (8.8) GOS 4, n (%) IG: 60 (25.4) vs. CG: 34 (27.2)	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			GOS 5, n (%) IG: 159 (67.4) vs. CG: 77 (61.6) **Outcome of multiple injured patients with severe lumbar trauma and concomitant severe/critical thoracic spine trauma (AIS_{TS}=4-5)** ISS, mean IG: 39.6 vs. CG: 43.3, p=0.95 Days on ventilator, mean (median) IG: 4.2 (1) vs. CG: 7.1 (4), p=0.12 Days on ICU, mean (median) IG: 12.7 (9) vs. CG: 15.6 (14), p=0.13 Days in hospital, mean (median) IG: 34.1 (26) vs. CG: 29.5 (28), p=0.46 MOF, n (%) IG: 25 (21.9) vs. CG: 6 (46.2), p=0.054 Lung failure (ARDS), n (%) IG: 24 (21.1) vs. CG: 5 (38.5), p=0.16 Sepsis, n (%) IG: 7 (6.1) vs. CG: 2 (15.4), p=0.22 Blood transfusion, n (%) IG: 34 (28.6) vs. CG: 1 (7.7), p=0.088 GOS 3, n (%) IG: 43 (36.8) vs. CG: 5 (35.7), p=0.26 GOS 4, n (%) IG: 39 (33.3) vs. CG: 3 (21.4) GOS 5, n (%)	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			IG: 34 (29.1) vs. CG: 5 (35.7)	
Konieczny (2015) "Early versus late surgery of thoracic spine fractures in multiple injured patients: is early stabilization always recommendable?" *Spine J* 2015, 1;15 (8):1713-8. **Study design** Prospective cohort study **Aim of the study** To investigate prospectively the effect of the timing of spinal surgery on multiple injured patients and other variables, in addition to timing of surgery, which may influence patient outcomes. **Setting** Germany, 2006-2008 **Classification of spine injury** stable/unstable: unstable	**Inclusion Criteria** • Multiple injured patients with unstable fractures of vertebral column from level TH1 to L1 (the definite classification of the spine fractures was according to the AO classification (Type B or C fracture, >30° kyphosis, and/or neurologic impairment) • Injury severity score (ISS) of 16 or more • ICU stay of more than 7 days • Age of included patients was limited from 16 or more to 75 or less years **Exclusion Criteria** • Impairment of the immune system like human immunodeficiency, virus infection, known genetic alternations that affect the immune system as severe combined immunodeficiency autoimmune disorders or coexisting cancerous disease • Addiction to alcohol and other drugs **Characteristics** Male, n/N IG: 14/22 vs. CG: 13/16 Age [y], median (range)	**Participants** N=38 patients **Study groups** IG: early operation (N=22) Operation of vertebral column was performed 72 hours after trauma. CG: late operation (N=16) Operation of vertebral column was performed 72 hours after trauma.	Stay on ICU [d] median (range) IG: 9.5 (7-55) vs. CG: 13 (7-28), p>0.016 Hospital stay [d], median (range) IG: 52 (8-255) vs. CG: 38 (10-211), p>0.016 Mortality, n/N (%) IG: 5/22 (22.7) vs. CG: 2/16 (12.5), (p<0.016) Because we were conducting three pair comparisons, we applied the Bonferroni adjustment on our testing. Thus, adjusted α was 0.05/3 (0.016).	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: – Attrition bias: ? Detection bias: ? **Authors' conclusion** "Although some reports indicate advantages for early surgery for thoracic spine trauma in the polytraumatized patient, careful patient selection should be used. Based on the results of this prospective study, early surgery for thoracic spine trauma in patients with concomitant severe thoracic trauma and low initial Hb levels may pose a risk for poor clinical outcomes." **Reviewer´s conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
with/without neurology: with and without neurology	IG: 34.5 (16-68) vs. CG: 43.5 (16-62) ISS, median (range) IG: 24 (16-29) vs. CG: 27 (23.5-29.5), p>0.05 GCS median (range), (p-value) IG: 14.2 (10-15) vs. CG: 13.4 (8-15), p>0.05 Operated segments, Median (range) IG: 3 (2-4) vs. CG: 3 (2-5), p>0.05 Grade A Frankel score, n (%) IG: 10 (45) vs. CG: 5 (31), p>0.05			There may be a risk of selection bias and performance bias. Due to poor reporting, risk for attrition and detection bias remains unclear. This study has a small sample size. Results should be interpreted with caution.
Stahel (2013) "The impact of a standardized "spine damage-control" protocol for unstable thoracic and lumbar spine fractures in severely injured patients: a prospective cohort study." *J Trauma Acute Care Surg* 2013,74 (2):590-6. **Study design** Prospective cohort study **Aim of the study** "To evaluate the safety and efficacy of a standardized SDC protocol for severely injured patients with Injury Severity Score (ISS) of greater than 15	**Inclusion Criteria** • 18 years or older • ISS of greater than 15 points • Presence of an unstable thoracic or lumbar fracture (Arbeitsgemeinschaft für Osteosynthesefragen/Orthopaedic Trauma Association [AO/OTA] location 52/53) with or without spinal cord injury, according to the American Spinal Injury Association (ASIA) grading scale **Exclusion Criteria** • stable spine fractures amenable to non-operative management **Characteristics** Age [y], mean (SD) IG: 36.2 (15.5) vs. CG: 34.1 (11.2) ISS mean, range IG: 25.4, 16-54 vs. CG: 27.2, 16-54	**Participants** N=112 patients **Study groups** IG: Spine damage control (SDC) group (N=42) Early spine fixation within 24 hours of admission CG: Delayed surgery (DS) group (N=70) Delayed fixation/fusion beyond 24 hours of admission	Intraoperative blood loss [ml], mean (SD) IG: 630 (160) vs. CG: 790 (230) Packed red blood cells units, mean (SD) IG: 3.0 (3.4) vs. CG: 5.38 (5.4) Fresh frozen plasma units, mean (SD) IG: 0.7 (1.3) vs. CG: 1.42 (2.5) Lactate, Emergency Department, mean (SD) IG: 2.8 (1.1) vs. CG: 3.1 (1.9) Lactate, 24 h, mean (SD) IG: 2.1 (1.1) vs. CG: 1.7 (0.6) Base deficit, Emergency Department, mean (SD) IG: -5.9 (2.4) vs. CG: -7.5 (3.6) Base deficit, 24 h, mean (SD) IG: -1.6 (1.9) vs. CG: -0.9 (3.1) Ventilator-dependent [days], n	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: – Attrition bias: ? Detection bias: – **Authors' conclusion** "The present study likely contributes to the evolving scientific knowledge from the peer-reviewed literature, advocating for early ''limited'' spine fixation within 24 hours in the vulnerable subset of severely

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
and an associated unstable fracture of the thoracic or lumbar spine." **Setting** USA, 2008-2011 **Classification of spine injury** stable/unstable: unstable with/without neurology: with and without neurology	Thoracic spine fracture, n (%) IG: 29 (69) vs. CG: 51 (73) Lumbar spine fracture, n (%) IG: 13 (31) vs. CG: 19 (27) Time to first surgery [h], mean (SD) IG: 8.9 (1.7) vs. CG: 98.7 (22.4) Time to second surgery [h], mean (SD) IG: 207.5 (95.5) vs. CG: NA AO/OTA classification A3, n (%) IG: 17 (40.5) vs. CG: 25 (35.7) AO/OTA classification B1, n (%) IG: 2 (4.8) vs. CG: 4 (5.7) AO/OTA classification B2, n (%) IG: 1 (2.4) vs. CG: 10 (14.3) AO/OTA classification B3, n (%) IG: 4 (9.5) vs. CG: 5 (7.1) AO/OTA classification C1, n (%) IG: 4 (9.5) vs. CG: 3 (4.3) AO/OTA classification C2, n (%) IG: 9 (21.4) vs. CG: 10 (14.3) AO/OTA classification C3, n (%) IG: 5 (11.9) vs. CG: 13 (18.6) ASIA classification A, n (%) IG: 15 (35.7) vs. CG: 22 (31.5) ASIA classification B, n (%)		IG: 2.2 (1.5) vs. CG: 9.1 (2.4), p<0.05 Hospital length of stay [days], mean (SD) IG: 14.1 (2.9) vs. CG: 32.6 (7.8), p<0.05 Wound complications, n (%) IG: 1 (2.4) vs. CG: 5 (7.1), (p<0.05 Pulmonary complications (including pneumonia and pulmonary embolism), n (%) IG: 6 (14.3) vs. CG: 18 (25.7), p<0.05 Urinary tract infections, n (%) IG: 2 (4.8) vs. CG: 15 (21.4), p<0.05 Pressure scores, n (%) IG: 1 (2.4) vs. CG: 6 (8.6)	injured patients with unstable thoracic or lumbar spine fractures." **Reviewers' conclusion** There is a risk of selection bias as the groups differ in baseline characteristics (e.g. classification of spine injury). In addition, there is a risk for performance and detection bias, particularly due to missing blinding. Risk for attrition bias remains unclear, due to poor reporting. Results should be interpreted cautiously.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG: 4 (9.5) vs. CG: 5 (7.1) ASIA classification C, n (%) IG: 1 (2.4) vs. CG: 1 (1.4) ASIA classification D, n (%) IG: 3 (7.2) vs. CG: 6 (8.6) ASIA classification E, n (%) IG: 19 (45.2) vs. CG: 36 (51.4)			
+: low risk of bias; ?: unclear/unknown risk; -: high risk of bias; AIS: Abbreviated Injury Scale; CCI: Charlson Comorbidity Index; CG: control group; CI: Confidence Interval; D: days; DS: Delayed surgery; ED: Emergency Department; GCO: Glasgow Coma Score; GOS: Glasgow Outcome Scale; h: hours; IC: intervention group; ICU: Intensive Care Unit; ISS: Injury Severity Score; MD: Mean Difference; NA: not applicable; NIS: National Inpatient Sample; HCUP: Healthcare Cost and Utilization Project; ICD: International Statistical Classification of Diseases and Related Health Problem; NR: not reported; NTDB: National Trauma Data Bank; OR: Odds Ratio; RIsC II: Revised Injury Severity Classification Version 2 SAE: Serious Adverse Event; SCI: Spinal Cord Injury; SD: Standard Deviation; SDC: Spine damage control, SMD: standard mean difference; TLSCI: Thoracolumbar Spinal Cord Injury				

3.10 Untere Extremitäten

In diesem Kapitel wurde das LoE nicht herabgestuft.

Empfehlung 3.67 & 3.69

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Blair 2019 "Early Stabilization of Femur Fractures in the Setting of Polytrauma is Associated With Decreased Risk of Pulmonary Complications and Mortality" *J Surg Orthop Adv. Summer* 2019;28(2):137-143.	**Inclusion criteria** • Age 18-65 years • ICD-9 821.01 and 821.11 (closed and open femoral shaft fracture) • ISS >15 • Underwent femoral external or internal fixation • Time to surgery available **Characteristics**	**Participants** N=10,072 patients **Study groups** IG1: definitive fixation <24 hours (N=6,569) IG2: definitive fixation 24-48 hours (N=1,327) IG3: definitive fixation 48-72 hours (N=631)	**Univariate analysis time to surgery with reference category <24h** Hospital LOS, regression coefficient (SD) 0.07 (0.01), p<0.0001 ICU LOS, regression coefficient (SD) 0.04 (0.01), p<0.0001 Ventilator time, regression coefficient	**Level of evidence 2009** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: ?

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Study design Comparative registry study **Aim of the study** The purpose of the study is to identify ideal timing of definitive fixation of femoral shaft fractures in the setting of polytrauma with regard to decreased risk of major systemic complications, mortality and lengths of hospital stay by using a large nationalized hospital database. **Setting** USA, 2009-2012	Age [y], mean ± SD IG1: 32.3 ± 30.5 IG2: 33.9 ± 30.2, p=0.1208 IG3: 35.4 ± 52.2, p=0.1385 CG: 35.1 ± 30.2, p=0.0002 ISS, mean ± SD IG1: 24.3 ± 23.9) IG2: 26.2 ± 26.9, p=0.0048 IG3: 30.7 ± 62.9, p=0.0163 CG: 30.4 ± 49.3, p<0.0001 GCS, mean ± SD IG1: 13.3 ± 17.2 IG2: 12.3 ± 15.6, p=0.0052) IG3: 11.9 ± 12.9, p=0.0091) CG: 11.1 ± 22.0, p<0.0001 Pulmonary contusion (ICD-9 861-20/21), (%) IG1: 6.9 IG2: 2.2, p=0.0070 IG3: 1, p=0.0001) CG: 1, p<0.0001	CG: definitive fixation >72 hours (N=1545)	(SD) 0.03 (0.01), p<0.0001 ARDS, OR (95% CI) 1.005 (1.003-1.007), p<0.0001 Major systemic complication, OR (95% CI) 1.005 (1.003-1.006), p<0.0001* Mortality (in hospital), OR (95% CI) 1.001 (1.000-1.002), p=0.028 **Multivariate analysis time to surgery 24-48h with reference category <24h** Hospital LOS, regression coefficient (SD) 2.6 (0.87), p=0.0037 ICU LOS, regression coefficient (SD) NR, NS Ventilator time, regression coefficient (SD) 2.35 (1.13), p=0.0422 ARDS, OR (95% CI) 1.50 (1.01-2.23), p=0.0431 Major systemic complication, OR (95% CI) NR, NS* Mortality (in hospital), OR (95% CI) NR, NS **Multivariate analysis time to surgery 49-72h with reference category <24h** Hospital LOS, regression coefficient (SD) 5.08 (1.04), p<0.0001 ICU LOS, regression coefficient (SD)	**Authors' conclusion** "Acute definitive fixation of femoral shaft fractures in the polytraumatically injured patient is safe and is associated with a lower 30-day mortality rate and lower incidence of major systemic complications to include ARDS. Initial management should consist of resuscitation to previously established guidelines before definitive fixation." **Reviewers' conclusion** There is a high risk of selection bias as the ISS and GCS differ in the treatment groups.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			2.73 (0.90), p=0.0033 Ventilator time, regression coefficient (SD) 2.61 (0.94), p<0.0001 ARDS, OR (95% CI) NR, NS Major systemic complication, OR (95% CI) NR, NS* Mortality (in hospital), OR (95% CI) NR, NS **Multivariate analysis time to surgery >72h with reference category <24h** Hospital LOS, regression coefficient (SD) 12.21 (1.47), p<0.0001 ICU LOS, regression coefficient (SD) 7.64 (1.52), p<0.0001 Ventilator time, regression coefficient (SD) 6.52 (0.98), p<0.0001 ARDS, OR (95% CI) 1.75 (1.06-2.87), p<0.0283 Major systemic complication, OR (95% CI) NR, NS* Mortality, OR (95% CI) NR, NS *Major complications necessitated complex medical intervention such as ARDS, acute kidney injury,	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			pulmonary embolism, unplanned intubation, cardiac arrest requiring cardiopulmonary resuscitation, severe sepsis, ad stroke or cerebrovascular accident	
Bläsius 2021 "Strategies for the treatment of femoral fractures in severely injured patients: trends in over two decades from the TraumaRegister DGU." *European Journal of Trauma and Emergency Surgery*. 2021 Feb 15;1-10 **Study design** Comparative registry study (TraumaRegister DGU®) **Aim of the study** To investigate the application frequency of different strategies (ETC, EF and conservative) for the treatment of femoral fractures in severely injured patients over the last two decades. Furthermore, to identify the factors that might influence decision making in choosing one of the aforementioned therapeutic options	**Inclusion criteria** • Age ≥16 years • at least femur fracture and a maximum AIS ≥3 • ISS ≥9 has been previously used • Survival ≥6 h **Exclusion criteria** • Secondary transfer to reporting hospital • Incomplete core dataset (e.g., lack of information about the type of surgery) • Death within 6 hours after admission **Characteristics** Male (%) IG1: 70.5 IG2: 70.6 CG: 74.3 Age [y], mean ± SD IG1: 47.0 ± 21.7 IG2: 48.1 ± 22.3 CG: 40.6 ± 18.9 (IG2: vs. CG: p<0.001) ISS, mean ± SD IG1: 26.1 ± 15.4 IG2: 19.1 ± 10.7	**Participants** N=13,091 patients **Study groups** IG1: TC (includes both immobilization in the form of a cast or brace and no immobilization) (N=1601) IG2: EF (within the DCO concept) (N=5,249) CG: ETC (N=6,241)	ICU stay: (%) IG1: 83.8 vs. IG2: 91.9 CG: 96.7 ICU LOS: mean ± SD, day IG1: 8.2 ± 13.3 vs. IG2: 7.6 ± 11.5 vs. CG: 13.2 ± 15.7 Ventilation time: mean ± SD, day IG1: 4.2 ± 9.3 vs. IG2: 3.8 ± 9.0 vs. CG: 7.4 ± 12.4 Ventilator-free days: mean ± SD IG1: 22.0 ± 11.9 vs. IG2: 25.7 ± 8.4 vs. CG: 21.8 ± 10.6 LOS: mean ± SD IG1: 24.8 ± 25.2 vs. IG2: 23.7 ± 20.4 vs. CG: 32.9 ± 25.9 MOF (%) IG1: 30.2 vs. IG2: 16.0 vs. CG: 33.1 Sepsis (%) IG1: 7.4 vs. IG2: 5.4 vs. CG: 11.8 Mortality (in hospital) (%) IG1: 24.5 vs. IG2: 5.0 vs. CG: 8.7 RISC II prognosis (%) IG1: 18.8 vs. IG2: 5.9 vs. CG: 10.4 SMR (95% CI)	**Level of evidence 2009** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: ? **Authors´ conclusion** Subgroup analyses revealed that the incidence of sepsis decreased in ETC and EF patients, while the incidence of MOF remained stable in both groups. **Reviewer´s conclusion** There is a high risk of selection bias as the ISS, AIS and the proportion of multiple fractures differ in the treatment groups.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Setting Germany, 2002-2018	CG: 25.4 ± 13.4 (IG2: vs. CG: p<0.001) ISS ≥16, (%) IG1: 71.3 IG2: 53.5 CG: 73.9 AIS head ≥3, (%) IG1: 29.4 IG2: 17.0 CG: 27.5 (IG2: vs. CG: p<0.001) AIS thorax ≥3, (%) IG1: 46.2 IG2: 31.7 CG: 49.8 (IG2: vs. CG: p<0.001) AIS abdomen ≥3, (%) IG1: 14.1 IG2: 9.2 CG: 17.5 (IG2: vs. CG: p<0.001) Multiple femur fractures, (%) IG1: 3.7 IG2: 5.1 CG: 14.9 (IG2: vs. CG: p<0.001)		IG1: 1.30 (1.19–1.41) vs. IG2: 0.85 (0.75–0.95) vs. CG: 0.83 (0.77–0.90)	
Cantu 2014 "In-hospital mortality from femoral shaft fracture depends on the initial delay to fracture fixation and injury severity score-	**Inclusion criteria** • Age ≥18 years • Unilateral closed or open femoral shaft fracture (ICD-9 821.01 or 821.11)	**Participants** N=2,323 **Study groups**	Adjusted* in-hospital mortality rates ISS 16-25, % (95% CI) <12h: 1.53 (0.84–2.77) 12-24h: 2.65 (1.30–5.41)	**Level of evidence 2009** 2b **Risk of bias** Selection bias: –

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
a retrospective cohort study from the NTDB 2002-2006*" J Trauma Acute Care Surg*. 2014; 76(6): 1433–1440 **Study design** Comparative registry study **Aim of the study** The purpose of this study was to investigate the optimal time for definitive fixation of femur fractures for patients with varying levels of injury severity. **Setting** USA, 2002-2006	• Closed or open reduction and internal fixation of the femur (Current Procedural Terminology code 79.15 or 79.35). **Exclusion criteria** • No valid mortality code based on hospital discharge status • No valid ISS code • No valid time to procedure date • No valid admission • transferred from another facility, which could make time to procedure data misleading • transferred out of the facility after surgery, which might bias in-hospital mortality • residing in a burn unit, which might affect surgical timing • missing patient sex designation **Characteristics** NR for subgroup ISS>15 separately	IG: <12h IMN from hospital presentation (N=NR) IG: 12-24h IMN from hospital presentation (N=NR) IG: 24-48h IMN from hospital presentation (N=NR) CG: >48h to 30 days IMN from hospital presentation (N=NR)	24-48h: 1.76 (0.59–5.28) 48h-30d: 2.68 (1.05–6.84) Adjusted* in-hospital mortality rates ISS >25, % (95% CI) <12h: 5.24 (3.59–7.66) 12-24h: 1.36 (0.36–5.14) 24-48h: 1.26 (0.33–4.83) 48h-30d: 5.90 (3.63–9.60) *adjusted for full model, surgical timing, injury severity, patient age, sex, race, and Deyo-Charlson comorbidities status ISS 16-25 time to surgery with reference category <12h Mortality (in hospital), RR** (95% CI) >12 to 24h: 1.74 (0.69-4.40) >24 to 48h: 1.16 (0.33-4.02) >48h to 30d: 1.76 (0.58-5.33) ISS 16-25 time to surgery with reference category >12-24h Mortality (in hospital), RR** (95% CI) >24 to 48h: 1.50 (0.41-5.55) >48h to 30d: 1.01 (0.31-3.28) ISS 16-25 time to surgery with reference category >24-48h Mortality (in hospital), RR** (95% CI)	Performance bias: ? Attrition bias: + Detection bias: ? **Authors' conclusion** "For patients in the most severely injured ISS group (26+), surgical delay beyond 48 hours was associated with significantly increased mortality risk (ARR, 4.7 vs. within 25–48 hours; 95% CI, 1.1–19.5). The only group in which there was reduced mortality risk with surgical delay was in the most severely injured patients (ISS, 26+) in whom surgical delay of greater than 24 hours but less than 48 hours was associated with the lowest mortality risk compared with surgery within 12 hours (ARR, 4.2; 95% CI, 1.0–16.7)" **Reviewers' conclusion** Risk of bias in the selection of participants might be controlled due to the division according to ISS. Though it is not clear how ISS is distributed within the ISS divisions. Through the nature of the study a risk of selection bias still exists.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			>48h to 30d: 1.52 (0.36-6.39) ISS >26 time to surgery with reference category <12h Mortality (in hospital), RR** (95% CI) >12 to 24h: 3.85 (0.97-15.28) >24 to 48h: 4.16 (1.03-16.75) (significant) >48h to 30d: 1.12 (0.61-2.08) ISS >26 time to surgery with reference category >12-24h Mortality (in hospital), RR** (95% CI) >24 to 48h: 1.08 (0.16-7.13) >48h to 30d: 4.33 (1.05-17.79) (significant) ISS >26 time to surgery with reference category >24-48h Mortality (in hospital), RR** (95% CI) >48h to 30d: 4.68 (1.12-19.46) (significant) **adjusted for sex, race (categorized as white, black, Hispanic, and other), the Deyo-Charlson comorbidity index (dichotomized as 0 and 1+), fracture type (open or closed), and surgical procedure (79.15 closed reduction internal fixation or 79.35 open reduction internal fixation	
Flagstad 2021 "Single-Stage versus Two-Stage Bilateral Intramedullary Nail Fixation in Patients with Bilateral Femur Fractures, A Multicenter	**Inclusion criteria** • Skeletally mature • Bilateral, extra-articular femur fractures	**Participants** N=246 patients **Study groups**	Hospital LOS days: mean ± SD IG 28.5 ± 29.5 vs. CG: 16.4 ± 28.5, p<0.012 ICU LOS days: mean ± SD IG 11.8 ± 12.8 vs. CG: 7.6 ± 8.2, p=0.023	**Level of evidence 2009** 2b **Risk of bias** Selection bias: –

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Retrospective Review" *J Orthop Trauma* 2021 Jan 5 online ahead of print **Study design** Comparative registry study **Aim of the study** The purpose of our study is to evaluate and compare the rates of complications in patients with bilateral femoral shaft fractures treated with bilateral IMN in either one, single procedure or two, separate procedures. **Setting** NR, 1998-2018	• Both fractures treated definitely with IMN **Exclusion criteria** • Intra-articular femur fractures • Died before definitive fixation of both femurs • Definitely treated with plate or external fixation **Characteristics** Age [y], mean ± SD IG 36.7 ± 14.6 vs. CG: 32.9 ± 15.6, p=0.11 Male, n (%) IG 34 (58.6) vs. CG: 123 (65.4), p=0.35 ISS, mean ± SD IG 24.9 ± 11.9 vs. CG: 24.5 ± 11.9, p=0.79 GCS, mean ± SD IG 11.4 ± 5.1 CG: 12.3 ± 4.5, p=0.22 Open fracture n, (%) Unilateral: IG: 13 (22.8) vs. CG: 52 (29.5) Bilateral: IG: 3 (5.3) vs. CG: 12 (6.6.), p=0.54 Secondary Injuries, n (%) Head: IG: 22 (37.9) vs. CG: 66 (35.3), p=0.711 Chest: IG: 31 (53.4) vs. CG: 86 (46.0), p=0.321	IG: IMN during two separate procedures (two-stage) (N=58) CG: IMN during one procedure (single-stage) (N=188)	Unadjusted outcomes: Mortality (in hospital): n (%) IG 0 (0.0) vs. CG: 5 (2.7), p=0.22 Rhabdomyolysis: n (%) IG 7 (12.1) vs. CG: 0 (0.0%), p<0.01 60-Day Readmission: n (%) IG 7 (12.3) vs. CG: 18 (9.6), p=0.56 Pulmonary Complications*: n (%) IG 26 (44.8) vs. CG: 46 (24.5) Fat Emboli Syndrome: n (%) IG 6 (10.3) vs. CG: 11 (5.9), p=0.24 Pulmonary Embolism: n (%) IG 4 (6.9) vs. CG: 7 (3.7), p=0.31 ARDS: n (%) IG 8 (13.8) vs. CG: 11 (5.9), p=0.05 Hospital-Acquired Pneumonia: n (%) IG 3 (5.2) vs. CG: 4 (2.1), p=0.22 Ventilator-Acquired Pneumonia: n (%) IG 5 (8.6) vs. CG: 13 (7.0), p=0.67 Deep Vein Thrombosis: n (%) IG 6 (10.3) vs. CG: 10 (5.4), p=0.18 Acute Stroke: n (%) IG 2 (3.4) vs. CG: 4 (2.1), p=0.59 Inpatient Dialysis: n (%) IG 5 (8.6) vs. CG: 2 (1.1), p<0.01	Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusions** Polytrauma patients may benefit from single-stage bilateral femur IMN if able to receive definitive fixation no later than 48 hours from admission. However, a larger study is required to discern whether single- versus two-stage fixation has an effect on mortality and to identify the individuals at risk for mortality. **Reviewers' conclusion** There is a high risk of selection bias in the study as the two-stage group underwent IMN (first procedure and definitive procedure) later than the single-stage group

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Abdominal: IG: 21 (36.2) vs. CG: 79 (42.0), p=0.431 AIS, mean ± SD Head: IG: 1.2 ± 1.5 vs. CG: 1.3 ± 1.6, p=0.45 Face: IG: 0.5 ± 0.8 vs. CG: 0.5 ± 0.8, p=0.832 Neck: IG: 0.3 ± 0.9 vs. CG: 0.2 ± 0.7, p=0.553 Chest: IG: 2.0 ± 1.7 vs. CG: 1.8 ± 1.7, p=0.432 Abdomen: IG: 1.3 ± 1.6 vs. CG: 1.1 ± 1.4, p=0.472 Spine: IG: 0.6 ± 0.9 vs. CG: 0.5 ± 1.0, p=0.692 Extremity: IG: 3.2 ± 0.5 vs. CG: 3.2 ± 0.4, p=0.613 Time to definitive fixation hours, mean ± SD IG: 163.5 ± 218.4 vs. CG: 52.6 ± 140.3, p<0.013 Time to 1st IMN fixation hours, mean ± SD IG: 86.4 ± 218.4 vs. CG: N/A Time between 1st and 2nd IMN fixation hours, mean ± SD IG: 103.2 (180) vs. CG: N/A Placement of external fixator, n (%) IG: 45 (78) vs. CG: 31 (16), p<0.011 Definitive Fixation ≤24h, n (%)		Sepsis: n (%) IG 4 (7.0) vs. CG: 9 (4.9), p=0.53 Adjusted* outcomes reporting RRs for single-stage procedure, RR (95% CI) Fat Emboli Syndrome: 0.50 (0.15-1.63), p=0.25 Pulmonary Embolism: 1.56 (0.27-8.14), p=0.62 ARDS: 0.22 (0.06-0.75), p=0.02 Hospital-Acquired Pneumonia: 0.06 (0.01-1.53), p=0.09 Ventilator-Associated Pneumonia: 0.59 (0.17-2.08), p=0.41 Deep Vein Thrombosis: 0.67 (0.16-2.73), p=0.58 Acute Stroke: 0.43 (0.05-3.44), p=0.42 Inpatient Dialysis: 0.16 (0.01-2.07), p=0.16 Sepsis: 0.44 (0.12-1.64), p=0.22 *Adjusted for age, gender, ISS, AIS, GCS, and admission lactate	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG: 1 (1.7) vs. CG: 132 (70), p<0.011 <u>Definitive Fixation >24-72h, n (%)</u> IG: 17 (29.3) vs. CG: 32 (17), p=0.041 <u>Definitive Fixation >72-120h, n (%)</u> IG: 13 (22) vs. CG: 8 (4), p<0.011 <u>Definitive Fixation >120h, n (%)</u> IG: 16 (9) vs. CG: 27 (47), p<0.011			
Morshed 2009 "Delayed Internal Fixation of Femoral Shaft Fracture Reduces Mortality Among Patients with Multisystem Trauma" *J Bone Joint Surg Am*. 2009;91:3-13 **Study design** Comparative registry study **Aim of the study** The effect of the timing of definitive care of femoral shaft fractures with use of a multilevel definition of treatment time drawn from the largest available multicenter database of patients with multisystem trauma was studied (the National Trauma Data Bank). **Setting**	**Inclusion criteria** • Age ≥16 years • closed or open fracture (or fractures) of the femoral shaft (ICD-9 821.0/ 821.01/821.1/821.11) • ISS ≥15 • definitive treatment procedure involving internal fixation of the • femur as identified by an ICD-9-CM procedure code of 78.55 (internal fixation—femur), 79.15 (closed reduction and internal fixation—femur), or 79.35 (open reduction and internal fixation—femur) **Exclusion criteria** • patient was received in transfer or was not admitted on the day of injury • record lacked information on time from admission to definitive fracture fixation, mortality status, or length of hospitalization, or on time of surgery • associated burn • fracture was not definitely fixed within two weeks of admission	**Participants** N=3,069 patients **Study groups** IG: <12h definitive fixation (N=1,759) IG: 12-24h definitive fixation (N=540) IG: 24-48h definitive fixation (N=359) IG: 48-120h definitive fixation (N=272) CG: >120h definitive fixation (N=139)	<u>Adjusted* in-hospital mortality reporting RRs time to surgery with reference category <12h, inverse probability of treatment-weighted RR (95% CI)</u> 12 to 24h: 0.45 (0.15-0.98), p=0.03 24 to 48h: 0.83 (0.43-1.44), p=0.49 48 to 120h: 0.58 (0.28-0.93), p=0.03 >120h: 0.43 (0.10-0.94), p=0.03 *Adjusted for NISS, GCS, Northeast region, age, arrival time, the number of serious extremity/pelvic or head/neck injuries, the number of femoral fractures, the presence of cardiac or cerebrovascular comorbidities, teaching status, and American College of Surgeons level-1 designation <u>Standardized risk ratio**</u> 12 to 24h: 0.47 (0.14 to 1.11), p=0.07 24 to 48h: 0.94 (0.44 to 1.76), p=0.85 48 to 120h: 0.58 (0.21 to 1.09), p=0.09 >120h: 0.43 (0.09 to 0.94), p=0.05	**Level of evidence 2009** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: ? **Authors' conclusion** "We estimate an approximate 50% reduction in the risk of mortality when treatment between twelve and twenty-four hours and more than forty-eight hours is compared with treatment within twelve hours after admission; a nonsignificant reduction is estimated when treatment occurs between twenty-four and forty-eight hours.. These results provide strong empirical evidence

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
USA 2000-2004	**Characteristics** Age [y], mean ± SD IG1: 31.86 ± 13.73 IG2: 33.12 ± 15.73 IG3: 34.25 ± 15.87 IG4: 34.44 ± 16.33 CG: 33.38 ± 15.05), p=0.01 NISS, mean ± SD IG1: 27.35 ± 8.97 IG2: 27.21 ± 8.33 IG3: 29.20 ± 9.62 IG4: 32.31 ± 11.39 CG: 34.68 ± 14.05), p<0.001 GCS, mean ± SD IG1: 12.67 ± 4.22 IG2: 12.69 ± 4.14 IG3: 11.66 ± 4.75 IG4: 10.77 ± 5.13 CG: 9.68 ± 5.20), p<0.001 Maximum AIS head/neck region, mean ± SD IG1: 1.71 ± 1.65 IG2: 1.76 ± 1.69 IG3: 2.01 ± 1.68 IG4: 2.32 ± 1.83 CG: 2.50 ± 1.94), p<0.001 Number of serious associated extremity injuries, mean ± SD IG1: 1.65 ± 0.94 IG2: 1.42 ± 0.73 IG3: 1.54 ± 0.86 IG4: 1.67 ± 1.01 CG: 1.68 ± 0.96), p<0.001		**The standardized risk ratio analysis involved the use of the same treatment model as inverse probability of treatment-weighted analysis but modified weights to give the estimated proportionate risk that would have been observed if the subjects in the early treatment group (<12h) had received treatment at a later time.	in support of a delayed or ''damage-control'' approach to definitive fixation of femoral shaft fracture among patients with multisystem trauma." **Reviewers' conclusion** There is a high risk of selection bias as the group 12-24h has the lowest NISS, GCS and AIS compared to the other groups.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Bilateral fracture, proportion (SD) IG1: 0.02 (0.14) IG2: 0.00 (0.06) IG3: 0.01 (0.12) IG4: 0.02 (0.12) CG: 0.02 (0.15), p=0.03			
Morshed 2015 "Timing of Femoral Shaft Fracture Fixation Affects Length of Hospital Stay in Patients with Multiple Injuries" *The Open Orthopaedics Journal*, 2015, 9, (Suppl 1: M8) 324-331 **Study design** Comparative registry study **Aim of the study** The current study addresses the impact of timing of definitive fixation on the length of hospital stay with use of a multilevel definition of treatment time drawn from the largest available multicenter database of patients with multisystem trauma (the National Trauma Data Bank). **Setting** USA 2000-2004	**Inclusion criteria** • Age ≥16 years • closed or open fracture (or fractures) of the femoral shaft (ICD-9 821.0/ 821.01/821.1/821.11) • ISS ≥15 • definitive treatment procedure involving internal fixation of the • femur as identified by an ICD-9-CM procedure code of 78.55 (internal fixation—femur), 79.15 (closed reduction and internal fixation—femur), or 79.35 (open reduction and internal fixation—femur) **Exclusion criteria** • patient was received in transfer or was not admitted on the day of injury • record lacked information on time from admission to definitive fracture fixation,mortality status, or length of hospitalizationfracture was not definitely fixed within two weeks of admission • the patient had a negative post-operative LOS **Characteristics** Age [y], mean ± SD	**Participants** N=2,949 patients **Study groups** IG: <12h definitive fixation (N=1,685) IG: 12-24h definitive fixation (N=518) IG: 24-48h definitive fixation (N=347) IG: 48-120h definitive fixation (N=263) CG: >120h definitive fixation (N=136)	Adjusted* post-operative hospitalization for time to surgery with reference category <12h, days median difference (95% CI) 12 to 24h: -0.61 (-1.53, 0.42), p=0.2949 24 to 48h: -0.00 (-1.00, 1.47), p=0.9984 48 to 120h: 2.77 (0.54, 4.72), p=0.0080 >120h: 0.86 (-2.00, 4.15), p=0.7351 Adjusted* post-operative hospitalization for time to surgery with reference category <12h deaths excluded, days median difference (95% CI) 12 to 24h: -0.64 (-1.53, 0.3.8), p=0.2949 24 to 48h: 0.24 (-0.96, 1.61), p=0.6346 48 to 120h: 2.53 (0.27, 4.13), p=0.0167 >120h: 0.55 (-2.04, 4.08), p=0.7674 Adjusted* post-operative hospitalization for time to surgery with reference category <12h death imputed to 220 days, days median difference (95% CI) 12 to 24h: -1.18 (-1.53, 0.38), p=0.1261 24 to 48h: 0.33 (-0.91, 2.00), p=0.6708 48 to 120h: 2.28 (0.28, 4.42), p=0.0317 >120h: 0.18 (-2.63, 4.00), p=0.8899	**Level of evidence 2009** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: ? **Authors' conclusion** "We estimate a 2 to 3 day increase in the median LOS when treatment occurs between forty-eight and 120 hours after admission; a non-significant reduction is estimated when treatment occurs between twelve and twenty-four hours. These results provide strong empirical evidence in support of a delayed or "damage control" approach to definitive fixation of femoral shaft fracture among multisystem trauma patients. Our findings suggest that patients who are not adequately resuscitated by

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG1: 31.9 ± 13.7 IG2: 32.7 ± 15.8 IG3: 34.2 ± 15.9 IG4 34.5 ± 16.4 CG: 33.4 ± 15.1, p=0.01 NISS, mean ± SD IG1: 27.3 ± 8.95 IG2: 27.2 ± 8.43 IG3: 29.2 ± 9.68 IG4 32.4 ± 11.52 CG: 34.6 ± 14.03, p<0.001 GCS, mean ± SD IG1: 12.68 ± 4.21 IG2: 12.70 ± 4.11 IG3: 11.86 ± 4.61 IG4 10.86 ± 5.08 CG: 9.83 ± 5.16, p<0.00) Maximum AIS head/neck region, mean ± SD IG1: 1.71 ± 1.65 IG2: 1.76 ± 1.69 IG3: 2.01 ± 1.68 IG4 2.32 ± 1.83 CG: 2.50 ± 1.94, p<0.001 Number of serious associated extremity injuries, mean ± SD IG1: 1.64 ± 0.94 IG2: 1.39 ± 0.71 IG3: 1.50 ± 0.79 IG4 1.67 ± 1.01 CG: 1.68 ± 0.96, p<0.001 Bilateral fracture, proportion (SD)		*Adjusted for hospital arrival time, NISS, cardiovascular disease, cerebrovascular disease, number of severe (AIS >3) extremity injuries, age, maximum head region AIS, teaching status of treating facility, GCS, trauma center designation. Increased probability treatment weighted.	their 2nd hospital day should likely not undergo definitive femoral fixation until the fifth hospital day as this period corresponds to peaking of systemic inflammatory response and susceptibility to "second hit" from a major surgical intervention." **Reviewers' conclusion** There is a high risk of selection bias as the group 12-24h has the lowest NISS and AIS compared to the other groups. Furthermore, it should be noted, that AIS score and the proportion of bilateral fractures are exactly the same as in Morshed et al. 2009 (see above) even though the population differs slightly.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG1: 0.02 (0.14) IG2: 0.00 (0.06) IG3: 0.01 (0.12) IG4 0.02 (0.12) CG: 0.02 (0.15), p=0.03			
Richards 2020 "Musculoskeletal Trauma in Critically Injured Patients: Factors Leading to Delayed Operative Fixation and Multiple Organ Failure*" Anesthesia & Analgesia*: December 2020 - Volume 131 - Issue 6 - p 1781-1788 **Study design** Comparative registry study **Aim of the study** The purpose of this investigation was 2-fold: (1) Describe clinical variables that were associated with late definitive fixation in a cohort of critically injured trauma patients with femur fractures and (2) explore the association between late definitive fixation and MOF. **Setting** NR, 2009-2016	**Inclusion criteria** • age 18–89 • ISS >15 • Femur fracture repaired definitively with internal fixation • Admission to the ICU directly from the scene of injury **Exclusion criteria** • Head AIS >3 • Fewer than 2 lactate levels within 24 h of admission • ICU LOS <2 d • Femur fracture treated nonoperatively • Pathologic fractures **Characteristics** Age, median (IQR) IG: 33.4 (24.1–47.3) vs. CG: 34.0 (24.0–49.0), p=0.88 ISS, mean ± SD IG: 26.0 ± 6.9 vs. CG: 30.9 ± 9.4, p<0.001 Head AIS, median (IQR) IG: 0 (0–3) vs. CG: 1 (0–3), p=0.36 Chest AIS, median (IQR) IG: 3 (2–4) vs. CG: 3 (3–4), p=0.11 Abdominal AIS, median (IQR)	**Participants** N=279 patients **Study groups** IG: early fixation (within 24 hours of hospital admission) (N=160) CG: late fixation (≥24 hours after Admission) with temporary fixation with spanning external fixation or skeletal traction (N=119)	MOF within 28 days of injury % (95% CI) IG 11.0 (2.7-18.5) vs. CG: 42.2 (25.3-55.2) difference 31.2 (14.4-48.0), p<0.001 After adjusting for observed confounding using inverse probability weighting late fixation was associated with a 3-fold increase in the risk of MOF (HR = 3.21, 95% CI, 1.48-7.00; p<0.01)	**Level of evidence 2009** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: ? **Authors' conclusion** "Higher ISS and a greater depth of shock during the initial 24 hours of hospitalization were associated with late fracture fixation. Furthermore, late femur fracture fixation was significantly associated with 28-day MOF." **Reviewers' conclusion** There is a high risk of selection bias in the study as the late fixation group is injured more severely. Furthermore the authors report that they not reached the planned numbers. Which might be a result of

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	IG 2 (0–2) vs. CG: 2 (0–3), p=0.0001 ED GCS, mean ± SD IG: 11.4 ± 5.1 vs. CG: 11.4 ± 5.0, p=0 .9			attrition bias as more patients were excluded from the study than anticipated.
Rixen 2016 "Randomized, controlled, two-arm, interventional, multicenter study on risk-adapted damage control orthopedic surgery of femur shaft fractures in multipletrauma patients." Trials (2016) 17:47. **Study design** Randomised controlled trial **Aim of the study** This study investigates whether the use of damage control through the application of external fixation to the femoral shaft fractures in severely injured multiple trauma patients will reduce the risk of mortality as measured by the sepsis-related organ failure assessment score when compared to early IMN. **Setting** Germany, 2007-2009	**Inclusion criteria** • age ≥18 years • multiple trauma (injury of at least two body regions) with an ISS ≥16 • a femoral shaft fracture which can be treated in principle by nail or fixateur externe (surgical treatment beginning within 24 hours after trauma) • calculated probability of death between 20-60% **Exclusion criteria** • III° open fractures • refusal of one of both strategies by either the investigator or the patient, • start of internal or external fracture fixation before randomization • participation in concurrent interventional studies • pregnancy **Characteristics** Age [y], mean ± SD IG: 39.4 ± 15.3 vs. CG: 38.9 ± 15.3 Male, n (%) IG: 12 (70.5) vs. CG: 12 (75) ISS, mean ± SD IG: 39.8 ± 8.9 vs. CG: 41.4 ± 15.7	**Participants** N=30 patients **Study groups** IG: EF and secondary reamed IMN (N=17, N=16 received the allocated treatment) Secondary surgery could be performed as soon as the patients treated with external fixation were stabilized with ventilation (paO2/FiO2 >200 if ventilated or no need for ventilation), coagulation (prothrombin time >60% and platelets >60,000/µl), hemodynamics (no need for noradrenalin or adrenalin and mean arterial pressure >60 mmHg), the metabolic system (BE >-6.0 mmol/l), and furthermore showed no signs of systemic or local inflammation. CG: primary reamed nailing N=17 randomized but 1 died after randomization but before treatment (N=14 received the allocated treatment)	Maximal sepsis-related organ failure assessment score within 28 days after trauma mean ± SD IG 8.7 ± 3.8 vs. CG: 9.6 ± 5.1, p=0.510 Cumulative sepsis-related organ failure assessment score within 28 days after trauma mean ± SD IG 112.4 ± 118.8 vs. CG: 113.8 ± 166.6, p=0.254 Transfusion requirements during surgery (packed red blood cells) mean ± SD IG 4.7 ± 4.8 vs. CG: 6.6 ± 6.1, p=0.350 ICU LOS (days) mean ± SD IG 21.8 ± 13.9 vs. CG: 12.38 ± 9.9, p=0.037 Days of ventilation mean ± SD IG 15.0 ± 9.6 vs. CG: 8.6 ± 7.9, p=0.049 In-hospital LOS (days) mean ± SD IG 32.3 ± 20.2 vs. CG: 30.2 ± 18.2, p=1.0	**Level of evidence 2009** 1b **Risk of bias** Selection bias: + Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "In conclusion, the results of this randomized study reflect the ambivalence in the literature. In correspondence to the systematic review [4], we could not find advantages of the damage control concept in the treatment of femoral shaft fractures in the care of multiple trauma patients. Unfortunately, our results are not statistically significant due to the small number of included patients." **Reviewers' conclusion** The study seems to have a low risk of bias due to randomization and with that

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	GCS, mean ± SD IG 7.0 ± 3.6 CG: 8.5 ± 3.2 Calculated probability of death % (SD) IG: 31 (13) vs. CG: 30 (12)			comparable treatment groups regarding injury severity.
Steinhausen 2014 "A risk-adapted approach is beneficial in the management of bilateral femoral shaft fractures in multiple trauma patients: An analysis based on the trauma registry of the German Trauma Society". *J Trauma Acute Care Surg* 2014; 76(5): 1288-93. **Study design** Comparative registry study **Aim of the study** This study aimed to validate that a risk-adapted approach in the management of multiple trauma patients with bilateral femoral shaft fractures results in low mortality and acute morbidity on the basis of the trauma registry of the German Trauma Society. **Setting**	**Inclusion criteria** • All multiple trauma patients with bilateral femur shaft fracture were included. **Characteristics** ISS, mean ± SD IG1: 31.1 ± 15.0 IG2: 23.5 ± 12.0 IG3: 19.9 ± 10.9 CG: 35.8 ± 18.5 (IG1: vs. IG2: p<0.001) Thoracic AIS score ≥3, % IG1: 65.3 IG2: 43.2 IG3: 37.3 CG: 68.8 (IG1: vs. IG2: p=0.001) Head AIS score ≥3, % IG1: 40.4 IG2: 30.5 IG3: 16.9 CG: 43.8 (IG1: vs. IG2: p=0.12) Abdominal AIS score ≥3, % IG1: 23.8 IG2: 15.8 IG3: 18.6 CG: 34.4 (IG1: vs. IG2: p=0.13)	**Participants** N=379 patients **Study groups** IG1: DCO with bilateral EF (N=193) IG2: ETC with bilateral primary definitive osteosynthesis (N=95) IG3: ETC of one FSF and DCO of the contralateral side (mixed) (N=59) CG: no osteosynthesis (N=32)	Hospital mortality: n (%) IG1: 26 (13.5) vs. IG2: 8 (8.4) vs. IG3: 1 (1.7) vs. CG: 21 (65.6) ICU stay, days: mean ± SD IG1: 19.4 ± 25.6 vs. IG2: 11.5 ± 9.9 vs. IG3: 13.3 ± 15.1 vs. CG: 6.2 ± 7.3 (IG1: vs. IG2: p<0.001) Ventilation time, days: mean ± SD IG1: 11.6 ± 15.6 vs. IG2: 7.3 ± 9.4 vs. IG3: 11.3 ± 14.9 vs. CG: 3.5 ± 4.5 (IG1: vs. IG2: p=0.005) Ventilator-free days: mean ± SD IG1: 17.5 ± 10.8 vs. IG2: 21.2 ± 9.7 vs. IG3: 20.1 ± 9.7 vs. CG: 6.6 ± 10.9 (IG1: vs. IG2: p=0.008) OF: % IG1: 55.3 vs. IG2: 39.6 vs. IG3: 37.5 vs. CG: 40.9 (IG1: vs. IG2: p=0.020) MOF: % IG1: 40.2 IG2: 25.3 IG3: 23.2 CG: 22.7 (IG1: vs. IG2: p=0.016) Sepsis: % IG1: 21.6 vs. IG2: 12.0 IG3: 13.5 vs. CG: 0.0 (IG1: vs. IG2: p=0.081)	**Level of evidence 2009** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: ? **Authors' conclusion** "a risk-adapted approach to bilateral femoral shaft fractures resulted in low mortality and acute morbidity in our study. The clearly stable patient was reasonably treated with IMN. The unstable or potentially unstable patient was reasonably treated with DCO. An increased ISS and in particular the presence of severe thoracic injury as well as coagulopathy stratified the patients at risk and influenced decision making. When in doubt, the patient is probably not totally stable, and

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Germany, 1993-2008				the safest precaution is to use DCO as a risk adapted approach." **Reviewers' conclusion** There is a high risk of selection bias, as the group with DCO is more severely injured than that with ETC or mixed, while no osteosynthesis has the most severe injuries. GCS was supposed to be reported but does not appear in the publication. Furthermore missing (or incomplete) data limits the analysis (patients not undergoing any operation)
Stojiljković 2009 "Damage control strategy in the treatment of closed femoral shaft fractures in polytrauma patients" *ACTA FAC MED NAISS* 2009; 26 (3): 127-133 **Study design** Prospective cohort study **Aim of the study** The aim of the paper was to present the advantages of the 'damage control' strategy in the management of closed femoral	**Inclusion criteria** • Polytrauma patients • With closed femoral fractures **Characteristics** <u>Age [y], mean (range)</u> 34.27 (16-67) <u>Male gender, n (%)</u> 48 (70.59) <u>Trauma Score, n (%)</u> Stable (13-16): 13 (19.12) Borderline (9-12): 26 (38.23) Unstable and critical (1-8): 29 (42.65) <u>Bilateral femur fracture, n (%)</u>	**Participants** N=70 patients **Study groups** IG1: external fixation (via Mitković external fixator) (N=9) IG2: external fixation converting to internal fixation (N=5) CG: internal fixation (Kuntsher nail (intramedullary fixation) and self-dynamisable internal fixator by Mitkovic were used) (N=56) The fractures were temporarily managed by the skeletal traction and coxofemoral plaster cast immobilization until the surgical treatment of femoral fracture.	<u>Healing time months median</u> IG1: (SD) 6.11 (0.81) vs. CG: NR, but significant longer (p<0.005) <u>Functional assessment bad: n (%)</u> IG1: 1 (11.1) vs. IG2: 0 (0), vs. CG: 3 (5.4) <u>Functional assessment poor: n (%)</u> IG1: 1 (11.1) vs. IG2: 0 (0), vs. CG: 0 (0) <u>Functional assessment good: n (%)</u> IG1: 5 (55.6) vs. IG2: 2 (40), vs. CG: 15 (26.8) <u>Functional assessment excellent: n (%)</u> IG1: 2 (22.2) vs. IG2: 3 (60), vs. CG: 38 (67.9) <u>Pin track infection: n (%)</u> IG1: 2 (22.2) vs. IG2: 0 (0), vs. CG: 0 (0)	**Level of evidence 2009** 2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: + Detection bias: + **Authors' conclusion** "The obtained results confirm the hypothesis that early internal fixation of the femoral fractures in the polytrauma patients poses great and additional trauma for the injured, and

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
shaft fractures in poly-trauma patients. **Setting** Serbia, 1999-2006	2(2.94) Other injuries, n (%) Head injuries: 29 (42.65) Abdominal injuries: 11 (16.17) injuries of the locomotor system: 16 (23.53) Chest injuries 12 (17.65) Conversion of externalinto internal fixa-tion mean, days (range) 21.6 (21-40)		Deep pin track infection: n (%) IG1: 1 (11.1) vs. IG2: 0 (0), vs. CG: 0 (0) Early disintegration of Implants: n (%) IG1: 0 (0) vs. IG2: 0 (0), vs. CG: 1 (1.78) Nonuion: n (%) IG1: 1 (11.1) vs. IG2: 0 (0), vs. CG: 2 (3.58) Osteitis: n (%) IG1: 0 (0) vs. IG2: 0 (0), vs. CG: 1 (1.78) The presence or absence of the local complica-tions in regard to the femoral fracture manage-ment showed statistically significant difference (x =9.34 p<0.01), i.e. there were more complications which followed external skeletal fixation as the definitive treatment method. There was statistically significant difference in blood substitution during the intervention (x =18.60 p<0.005) and the postoperative blood loss through the operative wound drainage after orthopaedic intervention (x =77.53 p<0.001). Blood loss during external skeletal fixation (operative and postoper-ative) in our series was statistically significantly smaller than in the applied methods of internal fixation.	it can be safely performed after stabilizing the patient condition. External fixation stands for a safe operative method for accomplishing temporary stability of the femoral fracture in the pol-ytraumatized patients and a minimally additional op-erative trauma. However, it is associated with a number of complications and a worse functional outcome when compared to the in-ternal fixation method. Ex-ternal fixation of the femo-ral fracture in the polytrau-matized patients should be converted into internal fixa-tion when the patient's condition allows." **Reviewers' conclusion** There is a risk of selection bias due to the nature of the study. Patient charac-teristics in the study groups remain unknown.

Empfehlung 3.82

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Doukas (2013)	**Inclusion criteria**	**Participants**	**Unilateral Lower-Limb Injury**	**Level of evidence 2009**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
"The Military Extremity Trauma Amputation/Limb Salvage (METALS) Study" *J Bone Joint Surg Am.* 2013;95:138-45 **Study design** Comparative registry study **Aim of the study** The objective of this study was to examine functional outcomes and disability following major lower-extremity trauma sustained in the military and to compare the outcomes between patients treated with amputation and those treated with limb salvage. **Setting** US military (Afghanistan/Iraq), 2003-2007	active duty personnel and reservists deployed to Afghanistan or Iraq who had sustained an injury to the upper or lower limb (excluding the pelvis/acetabulum) that resulted in a major amputation (at or proximal to the hindfoot or the radiocarpal joint) or required operative treatment and revascularization, bone-grafting/bone transport, local/ free flap coverage, repair of a major nerve injury, or treatment of a complete compartment injury/compartment syndrome **Exclusion criteria** GCS <15 at discharge or spinal cord injury **Characteristics** Unilateral Lower-Limb Injury Male gender (%) IG 98.2 vs. CG: 97.0 Age (%) 18-24 years: IG 26.5 vs. CG: 24.0 25-29 years: IG 36.3 vs. 35.2 ≥30 years: IG 37.2 vs. CG: 40.8 Time to interview, month mean IG 37.4 vs. CG: 39.5 Bilateral Lower-Limb Injury Male gender (%) 98.8 Age (%)	N=324 patients **Study groups** *Unilateral Lower-Limb Injury* IG: Amputation (N=113) CG: Salvage (N=126) *Bilateral Lower-Limb Injury* IG1: Bilateral Amputation (N=39) IG2: Amputation and Salvage (N=30) CG: Bilateral Salvage (N=16)	Adjusted* SMFA scores, mean Total dysfunction: IG 21.5 vs. CG: 29.8, p<0.01 Mobility: IG 27.5 vs. CG: 37.2, p<0.01 Daily activities: IG 20.4 vs. CG: 27.9, p<0.05 Emotional status: IG 37.6 vs. CG: 47.9, p<0.01 Arm/hand function: IG 2.1 vs. CG: 8.2, p<0.01 Engaged in vigorous sports or recreational activities (%) IG 45.1 vs. CG: 26.2 With depressive symptoms (%) IG 40.7 vs. CG: 43.6 With possible/probable major depression (%) IG 13.3 vs. CG: 15.1 Screened positive for PTSD (%) IG 14.8 vs. CG: 26.8 Working/on active duty (%) IG 43.4 vs. CG: 48.0 In school (%) IG 29.2 vs. CG: 18.4 With pain interfering with daily activity (%) IG 17.1 vs. CG: 27.0 **Bilateral Lower-Limb Injury** Adjusted* SMFA scores, mean Total dysfunction: IG1: 22.2 vs. IG2: 24.0‡ vs. CG: 30.0 Mobility: IG1: 30.2 vs. IG2: 30.8‡ vs. CG: 40.3	2b **Risk of bias** Selection bias: – Performance bias: ? Attrition bias: – Detection bias: ? **Authors' conclusion** "At an average of three years postinjury, those treated with amputation appeared to have better functional outcomes than those treated with limb salvage. Prospective studies are needed to confirm these results and to determine the role that rehabilitation protocols, ancillary services, or other external factors play in determining better or worse outcomes. At the present time, data are insufficient to support the selection of amputation over limb salvage. Rather, our results underscore the importance of addressing the post-acute-care needs of both patients treated with limb salvage and those who undergo amputation." **Reviewers' conclusion** It is unclear whether patients with amputations or

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	18-24 years: 21.2 25-29 years: 37.6 ≥30 years: 41.2 Time to interview, month mean 34.8		Daily activities: IG1: 22.8 IG2: 27.5 CG: 26.8 Emotional status: IG1: 33.2‡ vs. IG2: 32.0† vs. CG: 44.4 Arm/hand function: IG1: 3.0‡ vs. IG2: 5.1 vs. CG: 10.0 Engaged in vigorous sports or recreational activities (%) IG1: 48.7 vs. IG2: 50.0 vs. CG: 31.2 With depressive symptoms (%) IG1: 25.6 vs. IG2: 23.3 vs. CG: 37.5 With possible/probable major depression (%) IG1: 10.3 vs. IG2: 6.7 vs. CG: 12.5 Screened positive for PTSD (%) IG1: 10.3 vs. IG2: 6.4 vs. CG: 12.5 Working/on active duty (%) IG1: 30.8 vs. IG2: 36.7 vs. CG: 56.2 In school (%) IG1: 17.9 vs. IG2: 6.6 vs. CG: 6.3 With pain interfering with daily activity (%) IG1: 10.3 vs. IG2: 16.7 vs. CG: 12.5 *Adjusted for the presence of Military Extremity Trauma Amputation/Limb Salvage-eligible upper-limb injury, presence of bilateral lower-limb injury, months until interview, age, military rank, intensity of combat experiences, presence of social support.	salvage were injured more severely. Moreover, there seem to be a high risk of bias as response was voluntary and potentially only those with a very good or very bad outcome took part in the survey.
AIS Abbreviated injury scale, ARDS Acute respiratory distress syndrome, ARR adjusted relative risk, BE base excess, CG: control group, CI confidence interval, DCO Damage control orthopaedics, DGU Deutsche gesellschaft für Unfallchirurgie, ED emergency department, EF Temporary external fixation, ETC Early TOTAL Care, GCS Glasgow coma scale, ICU Intensive care unit, IG intervention group,				

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
IMC Intermediate care, IMN intramedullary nailing, ISS Injury severity score, LOS length of stay, MAIS Maximum abbreviated injury scale, MOF Multiple organ failure, MV Mechanical ventilation, NISS New Injury Severity Score, NR not reported, NS not significant, OR Odds ratio, PTSD posttraumatic stress disorder, RISC II Revised injury severity score II, RR relative risk, SD Standard deviation, SDS Safe definitive surgery, SMR Standardized mortality ratio, SMFA Short Musculoskeletal Function Assessment, TC Conservative treatment				

3.12 Urogenitaltrakt

Nephrektomie, organerhaltende operative Versorgung

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
El Hechi (2020) "Contemporary management of penetrating renal trauma - A national analysis." Injury. 2020; 51(1): 32-8. **Study design** Comparative registry study (ACS Trauma Quality and Improvement Program) **Aim of the study** In this analysis of a nationwide trauma database, our primary aim is to determine the rate and predictors of failure of NOM (f-NOM) for patients with PRI. Our secondary aim is to compare outcomes between patients managed operatively and nonoperatively. **Setting** USA, 2010-2016	**Inclusion criteria** • Patients aged 16 years and older with penetrating renal trauma **Exclusion criteria** • patients who mapped onto more than one AAST injury grade, had unknown ED dispositions, or died in the ED or operating room directly from the ED **IO vs NOM** • Age [y], median (IQR) IG: 28.0 (22.0, 37.0) CG: 27.0 (22.0, 36.0), p=0.074 Male, n (%) IG: 1344 (88.9) CG: 303 (91.8), p=0.12 ISS median (IQR) IG: 25.0 (18.0, 34.0) CG:18.0 (14.0, 26.0), p<0.001 AIS Head >3 IG: 32 (2.1) CG: 13 (3.9), p=0.052 AIS Chest>3 IG: 709 (46.9) CG: 153 (46.4), p=0.86	**Participants** N=1842 patients **Study groups** IG: immediate operation (IO) (N=1512) CG1: NOM (N=330) CG2: s-NOM (N=304) CG3: f-NOM (N=26) The IO group included patients who, in the first 4 h of their admission, underwent a nephrectomy, a renorraphy, or underwent abdominal exploration with no intervention on the injured kidney. The NOM group included patients who did not undergo an abdominal exploration or an operative intervention on the kidney within the initial 4 h of admission Patients in the NOM group were either treated expectantly, received a ureteral stent, a nephrostomy, or angioembolization of the kidney In the NOM group, an abdominal exploration, a nephrectomy, or a renorraphy after 4 h of admission qualified as failure of NOM (f-NOM). NOM was considered successful (s-NOM) if abdominal exploration, nephrectomy, or renorraphy did not occur.	Severe Sepsis n (%) IG:71 (4.7) CG1:1 (0.3), p<0.001 CG2:1 (0.3) CG3: 0 (0.0), p=1.00 IG: 71 (4.7) CG2:1 (0.3), p=n.r. Length of stay [d] median (IQR) IG: 14.0 (8.0, 25.0) CG1: 6.0 (4.0, 12.0), p<0.001 CG2: 6.0 (4.0, 10.0) CG3: 20.0 (11.0, 34.0) , p<0.001 IG: 14.0 (8.0, 25.0) CG2: 6.0 (4.0, 10.0), p=n.r. Length of ICU stay [d] median (IQR) IG: 5.0 (3.0, 13.0) CG1: 3.0 (2.0, 5.0), p<0.001 CG2: 3.0 (2.0, 4.0) CG3: 6.0 (3.0, 12.0), p<0.001 IG: 5.0 (3.0, 13.0) CG2: 3.0 (2.0, 4.0), p=n.r. Ventilation [d] median (IQR) IG: 3.0 (2.0, 8.0) CG1: 2.0 (2.0, 4.0), p=0.003	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: – Attrition bias: + Detection bias: ? **Authors' conclusion** "NOM is highly successful in selected patients. Concomitant abdominal injuries and higher grade AAST injuries predict NOM failure and should be considered when selecting patients for IO or NOM." **Reviewers' conclusion** There are different significant outcomes comparing IG vs. CG1 and CG2 vs. CG3.The results should be interpreted with caution due to missing information on detection bias. Furthermore, there is a risk of selection and performance bias.

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
	Concomitant abdominal injuries, n (%) IC: 1315 (87.0) CG: 187 (56.7), p<0.001 Mechanism of Injury p<0.001 Gunshot Wounds IG: 1344 (88.9) CG: 195 (59.1) Stab Wounds IG: 168 (11.1) CG: 135 (40.9) Comorbidity Chronic Renal Failure IG: 2 (0.1) CG: 2 (0.6), p=0.30 Diabetes Mellitus IG: 44 (2.9) CG: 5 (1.5), p=0.20 Hypertension IG: 114 (7.5) CG: 18 (5.5), p=0.18		CG2: 2.0 (2.0, 4.0) CG3: 3.0 (2.0, 5.0), p=0.24 IG: 3.0 (2.0, 8.0) CG2: 2.0 (2.0, 4.0), p=n.r. Inpatient Morbidity n (%) IG: 482 (31.9) CG1: 37 (11.2), p<0.001 CG2: 27 (8.9) CG3: 10 (38.5), p<0.001 IG: 482 (31.9) CG2: 27 (8.9), p=n.r. Need for Dialysis n (%) IG: 42 (2.8) CG1: 0 (0.0), p<0.001 CG2: 0 (0.0) CG3: 0 (0.0), p=n.a. IG: 42 (2.8)) CG2: 0 (0.0), p=n.r. Acute Kidney Injury n (%) IG: 144 (9.5) CG1: 7 (2.1), p<0.001 CG2: 5 (1.6) CG3: 2 (7.7), p=0.098 IG: 144 (9.5) CG2: 5 (1.6), p=n.r. Urinary tract infection n (%) IG: 58 (3,8) CG1: 3 (0,9), p=0,13	

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
			CG2: 6 (2,0) CG3: 1 (3,8), p=0,44 IG: 58 (3,8) CG2: 6 (2,0), p=n.r. Ventilator associated pneumonia n (%) IG: 108 (7,1) CG1: 6 (1,8), p<0,001 CG2: 4 (1,3) CG3: 2 (7,7), p=0,074 IG: 108 (7,1) CG2: 4 (1,3), p=n.r.	
+: low risk; –: high risk; ?: unclear risk; AAST: American Association for the Surgery of Trauma; AIS: Abbreviated Injury Scale; CG: control group; d: days; ED: Emergeny department; f-NOM: failure of NOM; ICU: intensive care unit; IG: intervention group; IO: immediate operation; IQR: Interquartile Range; ISS: injury severity score; LoE: level of evidence; m: months; n.a.: not applicable; NOM: nonoperative management; n.r.: not reported; s-NOM: successfull NOM; y: years				

Therapie extraperitonealer Harnblasenrupturen

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
Anderson (2020) "Current Management of Extraperitoneal Bladder Injuries: Results from the Multi-Institutional Genito-Urinary Trauma Study (MiGUTS)." Journal of Urology. 2020; 204(3): 538-44. **Study design** Prospective cohort study **Aim of the study**	**Inclusion criteria** • patients with extraperitoneal bladder **Exclusion criteria** • patients with an intraperitoneal bladder injury component and those who died within 24 hours of admission. • died within 24 hours of hospital arrival Age [y], mean (SD) IG: 44.7 (18.6) CG: 35.0 (14.2), p<0.001	**Participants** N=157 patients **Study groups** IG: catheter drainage (N=90) CG: operative repair (N=67) Patients were grouped as either catheter drainage or operative repair based upon their initial management within the first 4 days after hospital admission.	Length of stay [d], median (IQR) IG: 12 (6-20) CG: 12 (6-21), p=0.81 Length of ICU stay [d], median (IQR) IG: 5 (3-13) CG: 6 (2-15), p=0.97 Urological complications, n (%) IG: 16 (18) CG: 11 (16), p=0.82 Orthopedic complications, n (%)	**Level of evidence** 2b **Risk of bias** Selection bias: – Performance bias: – Attrition bias: + Detection bias: ? **Authors' conclusion**

Study: Reference, aim, design, setting	Participants: selection criteria, characteristics	N Participants; Intervention (IG) vs. Control group (CG)	Main outcomes	Assessment: LoE, risk of bias; Conclusions
We studied the current management trends for extraperitoneal bladder injuries and evaluated the use of operative repair versus catheter drainage, and the associated complications with each approach. **Setting** USA, 2013-2018	<u>Male, n (%)</u> IG: 54 (60) CG: 52 (78), p=0.02 <u>ISS mean (SD)</u> IG: 28.4 (13.1) CG: 23.0 (11.2), p=0.01 <u>Concomitant injuries n (%)</u> Overall IC: 82 (91) CG: 57 (85), p=0.24 Pelvic fracture IG: 79 (89) CG: 45 (67), p<0.001 Bladder neck injury IG: 5 (6) CG: 14 (21), p=0.004 Urethral injury IG: 7 (8) CG: 8 (12), p=0.38 Colon injury IG: 6 (7) CG: 10 (15), p=0.09 Rectal injury IG: 4 (4) CG: 14 (21), p<0.001		IG: 5 (6) CG: 5 (7), p=0.74 Significant complications were defined as the presence of urological or orthopedic conditions such as pelvic infection/urinoma, persistent urinary extravasation, urinary tract fistula nonunion fractures, hardware infection or removal, and pelvic osteomyelitis.	"We found no significant difference in complications between the initial management strategies of catheter drainage and operative repair." **Reviewers' conclusion** There is no significant difference in complications between IG and CG. The results should be interpreted with caution due to missing information on detection bias. Furthermore, there is a risk of selection and performance bias.
+: low risk; –: high risk; ?: unclear risk; CG: control group; CI: Confidence Interval; d: days; ICU: intensive care unit; IG: intervention group; IQR: Interquartile Range; ISS: injury severity score; LoE: Level of evidence; m: months; n.r.: not reported; SD: standard deviation; y: years				

Appendix A6. Abgleich der Empfehlungen mit internationalen Leitlinien

Anmerkung: NICE verwendet eine zweistufige Graduierung der Empfehlungen, daher wurden die NICE Empfehlungsgrade in A bzw. B/0 übersetzt.

1 Präklinik

1.1 Stop the bleeding

Nr. GoR	Empfehlungstexte, *Kommentar zum Abgleich*
1.1.1 GPP	Aktive Blutungen sollen, soweit sie im prähospitalen Setting einer Blutstillung zugänglich sind, immer gestoppt werden.
1.1.2 GPP	Das Becken soll während der Prähospitalphase klinisch untersucht werden.
1.1.3 GoR B	Es sollte im Rahmen der klinischen Untersuchung auf Spontanschmerzen, Druckschmerzen bei vorsichtiger Palpation sowie sichtbare äußere Verletzungen als indirekte Hinweise auf eine Beckenringverletzung geachtet werden.
1.1.4 GPP	Patienten mit klinischen Anhaltspunkten für eine Beckenringverletzung oder instabiler Beckenringverletzung und hämodynamischer Instabilität sollten einen Beckengurt erhalten.
Int. LL GoR A	**NICE Major trauma – assessment and initial management, Feb 2016:** 10.2. 20. If active bleeding is suspected from a pelvic fracture after blunt high-energy trauma: •apply a purpose-made pelvic binder or (•consider an improvised pelvic binder, but only if a purpose-made binder does not fit) (p. 122-129). *Empfehlungen entsprechen sich sinngemäß; NICE detailliert Typ des Gurtes*
1.1.5 GoR A	Aktive Blutungen der Extremitäten sollen durch folgendes Stufenschema behandelt werden: 1) Manuelle Kompression 2) Kompressionsverband, wenn möglich in Kombination mit einem Hämostyptikum 3) Tourniquet
Int. LL GPP	**NICE Major trauma – assessment and initial management, Feb 2016:** 10.1. 18. Use simple dressings with direct pressure to control external haemorrhage (p. 115-117). *Empfehlungen entsprechen sich sinngemäß; NICE ohne Hämostyptikum*
Int. LL GPP	**NICE Major trauma – assessment and initial management, Feb 2016:** 10.1. 19. In patients with major limb trauma use a tourniquet if direct pressure has failed to control life-threatening haemorrhage (p. 118-122). *Empfehlungen entsprechen sich sinngemäß*
1.1.6 GPP	Wenn andere Möglichkeiten zur Blutungskontrolle bestehen, dann kann die manuelle Kompression, auch wenn sie suffizient ist, zu Gunsten des anderen Verfahrens aufgegeben werden. Repetitive Kontrollen ob die Blutung zum Stillstand gekommen ist, sollten bei manueller Kompression nicht durchgeführt werden.
1.1.7 GoR B	Kompressionsverbände sollten bei penetrierendem Trauma mit nach außen blutenden Verletzungen am Torso und an den Extremitäten angelegt werden.
1.1.8 GPP	Kompressionsverbände sollen in gleicher Weise auf akute Blutungen an Torso und an den Extremitäten nach stumpfem Trauma angewendet werden.
1.1.9 GoR A	Ein Tourniquet soll dann angewendet werden, wenn eine lebensgefährliche Blutung mit anderen Maßnahmen nicht zeitgerecht gestoppt werden kann.

Int. LL GPP	**NICE Major trauma – assessment and initial management, Feb 2016:** 10.1. 19. In patients with major limb trauma use a tourniquet if direct pressure has failed to control life-threatening haemorrhage (p. 120). *Empfehlungen entsprechen sich sinngemäß*
1.1.10 GPP	Wenn bei unzugänglichem Blutungsort zur Erstversorgung ein Tourniquet angelegt wurde, sollte, nachdem der Patient gerettet wurde und die Situation es erlaubt, die Fortsetzung der Maßnahme und ein möglicher Verfahrenswechsel kritisch geprüft werden.
1.1.11 GoR A	Bei blutenden Stichwunden, in denen der Fremdkörper bereits wieder entfernt wurde und die eine Länge von mind. 3 cm aufweisen, soll eine direkte Wundtamponade mit Chitosan erfolgen.
1.1.12 GoR B	Bei Schuss- und Explosionsverletzungen mit aktiver Blutung sollten Verbände mit Chitosan eingesetzt werden.
1.1.13 GoR 0	Zur Unterstützung der Maßnahmen des Stufenschemas können Hämostyptika auf jeder Stufe ergänzend angewendet werden.
1.1.14 GoR B	Bei Kopfschwartenverletzungen mit aktiver Blutung sollten Chitosan-Wundauflagen verwendet werden, weil damit eine schnellere und effektivere Blutungskontrolle erzielt wird.
1.1.15 GoR 0	Bei Blutungen im oberen Mittelgesichts- bzw. Nasenbereich können, alternativ zur posterioren Tamponade, pneumatische Tamponaden verwendet werden.

1.2 Atemwegsmanagement, Beatmung und Notfallnarkose

Nr. GoR	**Empfehlungstexte,** *Kommentar zum Abgleich*
1.2.1 GoR A	Bei polytraumatisierten Patienten mit Apnoe oder Schnappatmung 2.(Atemfrequenz <6/min) sollen präklinisch eine Notfallnarkose, eine endotracheale Intubation und eine Beatmung durchgeführt werden.
Int. LL GPP	**NICE Major trauma – assessment and initial management, Feb 2016:** 6. 1. Use drug-assisted rapid sequence induction (RSI) of anaesthesia and intubation as the definitive method of securing the airway in patients with major trauma who cannot maintain their airway and/or ventilation. (p. 58-65) *Empfehlungen entsprechen sich sinngemäß (NICE kombiniert Indikation mit RSI, S3-LL hier nur Indikation)*
1.2.2 GoR B	Bei polytraumatisierten Patienten sollten bei folgenden Indikationen präklinisch eine Notfallnarkose, eine endotracheale Intubation und eine Beatmung durchgeführt werden: • Hypoxie (SpO_2 <90%) trotz Sauerstoffgabe und nach Ausschluss eines Spannungspneumothorax • schweres SHT (GCS <9) • schweres Thoraxtrauma mit respiratorischer Insuffizienz (Atemfrequenz >29)
1.2.3 GPP	Veränderungen der Hämodynamik bei der prä- und innerklinischen Narkoseeinleitung sollen engmaschig kontrolliert und ggfs. frühzeitig therapiert werden.
1.2.4 GoR A	Der polytraumatisierte Patient soll vor Narkoseeinleitung präoxygeniert werden.
1.2.5 GoR B	Die innerklinische Notfallnarkose, endotracheale Intubation und Beatmung sollte durch trainiertes und erfahrenes anästhesiologisches Personal durchgeführt werden.

1.2.6 GoR A	Notfallmedizinisches Personal soll regelmäßig in der Notfallnarkose, der endotrachealen Intubation und den alternativen Methoden zur Atemwegssicherung (Maskenbeatmung, supraglottische Atemwegshilfen, Notfallkoniotomie) trainiert werden.
1.2.7 GoR A	Bei der endotrachealen Intubation des Traumapatienten soll mit einem schwierigen Atemweg gerechnet werden.
1.2.8 GoR A	Bei der Narkoseeinleitung und endotrachealen Intubation des polytraumatisierten Patienten sollen alternative Methoden zur Atemwegssicherung vorgehalten werden.
1.2.9 GoR A	Nach mehr als zwei Intubationsversuchen sollen alternative Methoden zur Beatmung bzw. Atemwegssicherung in Betracht gezogen werden.
Int. LL GPP	**NICE Major trauma – assessment and initial management, Feb 2016:** 6. 2. If RSI fails, use basic airway manoeuvres and adjuncts and/or a supraglottic device until a surgical airway or assisted tracheal placement is performed. (p. 58-65) *Empfehlungen entsprechen sich sinngemäß*
Int. LL GPP	**NICE Major trauma – assessment and initial management, Feb 2016:** 6. 3. (pre-hospital settings) Aim to perform RSI as soon as possible and within 45 minutes of the initial call to the emergency services, preferably at the scene of the incident. If RSI cannot be performed at the scene: • consider using a supraglottic device if the patient's airway reflexes are absent. • use basic airway manoeuvres and adjuncts if the patient's airway reflexes are present or supraglottic device placement is not possible • transport the patient to a major trauma centre for RSI provided the journey time is 60 minutes or less. • only divert to a trauma unit for RSI before onward transfer if a patent airway cannot be maintained or the journey time to a major trauma centre is more than 60 minutes. (p. 58-65) *Handlungsempfehlungen bei NICE konkreter*
1.2.10 GoR A	Zur Narkoseeinleitung, Atemwegssicherung, Beatmung und Führung der Notfallnarkose soll der Patient mittels EKG, Blutdruckmessung, Pulsoxymetrie und Kapnografie überwacht werden.
1.2.11 GoR A	Die Kapnometrie/-grafie soll präklinisch und innerklinisch im Rahmen der endotrachealen Intubation zur Tubuslagekontrolle und danach zur Dislokations- und Beatmungskontrolle angewendet werden.
1.2.12 GoR A	Beim endotracheal intubierten und narkotisierten Traumapatienten soll eine Normoventilation angestrebt werden.
1.2.13 GoR A	Ab der Schockraumphase soll die Beatmung durch engmaschige arterielle Blutgasanalysen kontrolliert und gesteuert werden.
1.2.14 GoR A	Bei polytraumatisierten Patienten soll zur endotrachealen Intubation eine Notfallnarkose aufgrund des immanenten Aspirationsrisikos als Rapid Sequence Induction durchgeführt werden.
Int. LL GPP	**NICE Major trauma – assessment and initial management, Feb 2016:** 6. 1. Use drug-assisted rapid sequence induction (RSI) of anaesthesia and intubation as the definitive method of securing the airway in patients with major trauma who cannot maintain their airway and/or ventilation. (p. 58-65) *Empfehlungen entsprechen sich sinngemäß (NICE kombiniert Indikation mit RSI, S3-LL hier nur RSI)*

1.2.15 GoR B	Etomidat als Einleitungshypnotikum sollte aufgrund der assoziierten Nebenwirkungen auf die Nebennierenfunktion vermieden werden. Ketamin stellt hier meistens eine gute Alternative dar.
1.2.16 GoR B	Zur endotrachealen Intubation sollte die manuelle In-line-Stabilisation unter temporärer Aufhebung der Immobilisation mittels HWS-Immobilisationsschiene durchgeführt werden.
Int. LL GPP	**NICE Spinal injury – assessment and initial management, Feb 2016:** 6. 2. At all stages of the assessment, • protect the person's cervical spine with manual in-line spinal immobilization, particularly during any airway intervention and • avoid moving the remainder of the spine (p. 53-60). *Empfehlungen entsprechen sich sinngemäß*
1.2.17 GoR B	Die Videolaryngoskopie sollte zur besseren Einstellbarkeit der Stimmbandebene und Optimierung des primären Intubationserfolges präklinisch und innerklinisch eingesetzt werden.
1.2.18 GPP	Ein präklinisch eingebrachter extraglottischer Atemweg sollte unmittelbar innerklinisch mittels Videolaryngoskop in eine endotracheale Intubation überführt werden.
1.2.19 GPP	Besteht bei der Beurteilung der korrekten Tubuslage mittels Kapnografie Unsicherheit (z.B. bei schwersten Schockzuständen, Hypothermie, CPR oder vermutetem Gerätedefekt), soll unverzüglich die Tubuslage mittels Videolaryngoskopie oder alternativ mittels Bronchoskopie kontrolliert werden.
1.2.20 GPP	Eine Koniotomie sollte in chirurgischer Technik durchgeführt werden. Besteht ein besonderer Übungsstand mit einer anderen Koniotomie-Technik, kann diese angewendet werden.
1.2.21 GPP	Bei der Intubation des Polytraumatisierten durch Video-/Laryngoskopie soll ein Führungsstab oder „Bougie" verwendet werden.

1.3 Gerinnungsmanagement und Volumentherapie

Nr. GoR	**Empfehlungstexte,** *Kommentar zum Abgleich*
1.3.1 GoR B	Bei schwer verletzten Patienten sollte eine Volumentherapie eingeleitet werden, die bei nicht beherrschbarer Blutung in reduzierter Form durchgeführt werden sollte, um den Kreislauf auf niedrig-stabilem Niveau (MAP 65 mmHg, RRsys 80 mmHg) zu halten und die Blutung nicht zu verstärken.
Int. LL GoR A	**NICE Major trauma – assessment and initial management, Feb 2016:** 10.7. 35. For patients with active bleeding use a restrictive approach to volume resuscitation until definitive early control of bleeding has been achieved. 10.7. 36. In pre-hospital settings, titrate volume resuscitation to maintain a palpable central pulse (carotid or femoral) (p. 166-174). *unterschiedliche Parameter zur Steuerung der Flüssigkeitsmenge*
1.3.2 GoR B	Bei hypotensiven Patienten mit einem vermuteten isolierten oder führenden Schädel-Hirn-Trauma sollte eine Volumentherapie mit dem Ziel der Normotension (MAP 85 mmHg, RRsys 110 mmHg) durchgeführt werden.
Int. LL GPP	**NICE Major trauma – assessment and initial management, Feb 2016:** 10.7. 38. For patients who have haemorrhagic shock and a traumatic brain injury: • if haemorrhagic shock is the dominant condition, continue restrictive volume resuscitation or • if traumatic brain injury is the dominant condition, use a less restrictive volume resuscitation approach to maintain cerebral perfusion (p. 166-174). *S3-Empfehlung formuliert spezifische Blutdruckziele, NICE offener*

1.3.3 GoR A	Bei Traumapatienten soll ein venöser Zugang gelegt werden.
Int. LL GPP	**NICE Major trauma – assessment and initial management, Feb 2016:** 10.6. 32. For circulatory access in patients with major trauma in pre-hospital settings: •use peripheral intravenous access [or •if peripheral intravenous access fails, consider intra-osseous access] (p. 159-163). *Empfehlungen entsprechen sich sinngemäß (NICE kombiniert venöse mit IO Zugängen, S3-LL hier nur venös)*
1.3.4 GoR A	Bei Traumapatienten, bei denen ein venöser Zugang nicht gelingt, soll ein intraossärer Zugang zur Infusions- und Medikamententherapie gelegt werden.
Int. LL GoR B	**NICE Major trauma – assessment and initial management, Feb 2016:** 10.6. 32. For circulatory access in patients with major trauma in pre-hospital settings: [•use peripheral intravenous access or] •if peripheral intravenous access fails, consider intra-osseous access (p. 164). *Empfehlungen entsprechen sich sinngemäß (NICE kombiniert venöse mit IO Zugängen, S3-LL hier nur IO)*
1.3.5 GoR B	Bei fehlendem Hinweis auf einen Volumenmangel sollte auf eine Volumentherapie verzichtet werden.
1.3.6 GoR 0	Bei Nichterreichen eines adäquaten Blutdrucks beim polytraumatisierten Patienten durch eine ausreichende Volumentherapie können Vasopressoren titrierend zur Kreislaufunterstützung erwogen werden.
1.3.7 GoR A	Zur Volumentherapie bei Traumapatienten sollen balancierte, isotone kristalline Vollelektrolytlösungen eingesetzt werden, welche idealerweise vorgewärmt sind.
Int. LL GoR A	**NICE Major trauma – assessment and initial management, Feb 2016:** 10.8. 39. In pre-hospital settings only use crystalloids to replace fluid volume in patients with active bleeding if blood components are not available (p. 175-185). *NICE empfiehlt vorrangig Blutprodukte, S3-LL vorrangig Kristalloide*
1.3.8 GoR 0	Balancierte Infusionslösungen mit Acetat oder Malat statt Lactat können erwogen werden.
1.3.9 GoR A	Der letalen Trias aus Hypothermie, Azidose und Koagulopathie soll bereits präklinisch durch 1. Vermeidung der weiteren Auskühlung des Patienten (Ziel: Normothermie), 2. geeignete Therapie des hämorrhagischen Schocks (Blutungskontrolle, Volumen- und Gerinnungstherapie) und 3. adäquate Oxygenierung und Ventilation (ggf. Intubation gemäß Intubationskriterien) begegnet werden.
Int. LL GoR A	**NICE Major trauma – assessment and initial management, Feb 2016:** 13.6 Minimise ongoing heat loss in patients with major trauma. (p. 246-251) *S3-Teilaspekt entspricht der NICE Empfehlung*
1.3.10 GoR B	Bei Polytraumapatienten mit manifestem oder drohendem hämorrhagischen Schock sollte zügig die Gabe von 1 g Tranexamsäure (TxA) als Bolus über 10 Minuten erfolgen.
Int. LL GoR A	**NICE Major trauma – assessment and initial management, Feb 2016:** 10.3. 21. Use intravenous tranexamic acid as soon as possible in patients with major trauma and active or suspected active bleeding (p. 129-141). *Empfehlungen entsprechen sich sinngemäß*
1.3.11 GoR 0	Bei Polytraumapatienten mit nicht beherrschbarer Blutung kann die Gabe von Fibrinogen nach Gabe von Tranexamsäure erwogen werden.

1.3.12 GoR 0	Bei Polytraumapatienten mit nicht beherrschbarer Blutung kann die Gabe von Erythrozyten- und Plasmakonzentraten (gefrorene Frischplasmakonzentrate oder lyophilisierte Plasmakonzentrate) erwogen werden, sofern die Logistik dieses erlaubt und der Transport in die Zielklinik nicht verzögert wird.
Int. LL GoR A	**NICE Major trauma – assessment and initial management, Feb 2016:** 10.8. 39. In pre-hospital settings only use crystalloids to replace fluid volume in patients with active bleeding if blood components are not available (p. 175-185). *NICE empfiehlt vorrangig Blutprodukte, S3-LL vorrangig Kristalloide*
Int. LL GoR A	**NICE Major trauma – assessment and initial management, Feb 2016:** 10.8. 41. For adults (16 or over) use a ratio of 1 unit of plasma to 1 unit of red blood cells to replace fluid volume (p. 175-185). *NICE Empfehlung definiert das Komponentenverhältnis; S3-LL nur innerklinisch*

1.4 Analgesie

Nr. GoR	Empfehlungstexte, *Kommentar zum Abgleich*
1.4.1 GoR A	Schwerverletzte Patienten sollen eine intravenöse Analgesie erhalten.
Int. LL GoR A	**NICE Major trauma – assessment and initial management, Feb 2016:** 14.2.6 64. For patients with major trauma, use intravenous morphine as the first-line analgesic and adjust the dose as needed to achieve adequate pain relief. *NICE legt sich mit einer konkreten Medikationsauswahl fest.*
1.4.2 GoR 0	Als alternative Applikationsformen für eine Analgesie bei schwerverletzten Patienten kann die intraossäre oder intranasale Gabe genutzt werden.
Int. LL GoR A	**NICE Major trauma – assessment and initial management, Feb 2016:** 14.2.6 65. If intravenous access has not been established, consider the intranasal route for atomised delivery of diamorphine or ketamine. *Empfehlungen entsprechen sich sinngemäß, NICE empfiehlt noch zusätzlich Medikamente für die i.o. oder i.n. Gabe*
1.4.3 GPP	Ansprechbare schwerverletzte Patienten sollen gefragt werden, ob sie ein Schmerzmittel wünschen.
1.4.4 GPP	Die Numeric Rating Skala ist nicht bei allen Patienten anwendbar, daher sollen Patienten alternativ nach starken oder unerträglichen Schmerzen gefragt werden.
Int. LL GPP	**NICE Major trauma – assessment and initial management, Feb 2016:** 14.1.6 (Grundsätzliche Empfehlung zu Schmerz in allen NICE guidelines): 62. Assess pain regularly in patients with major trauma using a pain assessment scale suitable for the patient's age, developmental stage and cognitive function. (p.253) *NICE formuliert allgemeiner, Anwendung einer für die Patienten geeigneten Skala empfohlen*
1.4.5 GoR A	Die Numeric Rating Skala soll genutzt werden, um die Schmerzen zu objektivieren, zu dokumentieren und den Erfolg einer Analgesie zu kontrollieren
Int. LL GPP	**NICE Major trauma – assessment and initial management, Feb 2016:** 14.1.6 (Grundsätzliche Empfehlung zu Schmerz in allen NICE guidelines): 63. Continue to assess pain in hospital using the same pain assessment scale that was used in the pre-hospital setting. (p.253)

	NICE legt sich nicht auf eine Skala fest, eine gewählte soll aber dann konsistent verwendet werden
1.4.6 GoR A	Zielwert der Analgesie soll eine Numeric Rating Skala ≤4 sein
1.4.7 GoR 0	Ergänzend können auch Vitalwerte (z.B. Atemfrequenz) als Hinweis für bestehende Schmerzen genutzt werden
1.4.8 GoR A	Fentanyl, Ketamin und Morphin weisen eine vergleichbare Effektivität auf und sollen zur Analgesie des spontanatmenden schwerverletzten Patienten zur Anwendung kommen.
Int. LL GoR A	**NICE Major trauma – assessment and initial management, Feb 2016:** 14.2.6 64. For patients with major trauma, use intravenous morphine as the first-line analgesic and adjust the dose as needed to achieve adequate pain relief. *NICE bestätigt die vergleichbaren Effekte, präferiert Morphin jedoch aus ökonomischen Gründen*
Int. LL GoR A	**NICE Major trauma – assessment and initial management, Feb 2016:** 14.2.6 66. Consider ketamine in analgesic doses as a second-line agent. *NICE bestimmt Ketamin aufgrund des Nebenwirkungsprofils und der höheren Kosten als zweite Wahl.*
Int. LL GPP	**NICE Head Injury – Triage, assessment, investigation and early management of head injury in children, young people and adults, Jan 2014:** 8.11 60. Manage pain effectively because it can lead to a rise in intracranial pressure. Provide reassurance, splintage of limb fractures and catheterisation of a full bladder, where needed. Treat significant pain with small doses of intravenous opioids titrated against clinical response and baseline cardiorespiratory measurements. (p. 174) *Teilaspekt (iv. Opioids) entspricht der S3 Leitlinie sinngemäß.*
1.4.9 GoR A	Neben einer pharmakologischen Therapie sollen physikalische Maßnahmen (z.B. Lagerung, Schienung) zur Anwendung kommen.
Int. LL GPP	**NICE Head Injury – Triage, assessment, investigation and early management of head injury in children, young people and adults, Jan 2014:** 8.11 60. Manage pain effectively because it can lead to a rise in intracranial pressure. Provide reassurance, splintage of limb fractures and catheterisation of a full bladder, where needed. Treat significant pain with small doses of intravenous opioids titrated against clinical response and baseline cardiorespiratory measurements. (p. 174) *Teilaspekt (splintage of limb fractures) entspricht der S3 Leitlinie sinngemäß*
1.4.10 GPP	Eine Analgesie soll nach entsprechender Ausbildung und Schulung unter kontinuierlicher Überwachung (z.B. EKG, Blutdruck, Atem- und Herzfrequenz, pulsoxymetrische Sauerstoffsättigung, ggf. Kapnografie) des Patienten und der Bereithaltung von Notfallequipment zur Behandlung von Komplikationen erfolgen.

1.5 Thorax

Nr. GoR	Empfehlungstexte, *Kommentar zum Abgleich*
1.5.1 GoR A	Eine klinische Untersuchung des Thorax und der Atemfunktion soll durchgeführt werden.
1.5.2 GoR B	Die Untersuchung sollte mindestens die Bestimmung der Atemfrequenz und die Auskultation der Lunge umfassen. Eine wiederholte Untersuchung sollte erfolgen.

1.5.3 GoR 0	Die Inspektion, die Palpation die Perkussion des Thorax sowie die Pulsoxymetrie und, bei beatmeten Patienten, die Überwachung des Beatmungsdrucks und der Kapnographie können hilfreich sein.
1.5.4 GoR 0	Eine Ultraschalluntersuchung des Thorax zum Nachweis bzw. Ausschluss eines Pneumothorax oder eines Perikardergusses kann durchgeführt werden.
Int. LL GoR B/0	**NICE Major trauma – assessment and initial management, Feb 2016:** 7.2. 5. Consider using eFAST (extended focused assessment with sonography for trauma) to augment clinical assessment only if a specialist team equipped with ultrasound is immediately available and onward transfer will not be delayed. 7.2. 6. Be aware that a negative eFAST of the chest does not exclude a pneumothorax (p. 66-73). *NICE-Empfehlung enthält Ergänzungen*
1.5.5 GoR A	Die Verdachtsdiagnose Pneumo- und/oder Hämatothorax soll bei einseitig abgeschwächtem oder fehlendem Atemgeräusch (nach Kontrolle der korrekten Tubuslage) oder beim Nachweis der sonografischen Zeichen gestellt werden.
Int. LL GPP	**NICE Major trauma – assessment and initial management, Feb 2016:** 7.2. 4. Use clinical assessment to diagnose pneumothorax for the purpose of triage or intervention (p. 66-73). *Empfehlungen entsprechen sich sinngemäß*
1.5.6 GoR B	Die mögliche Progredienz eines kleinen, zunächst präklinisch nicht diagnostizierbaren Pneumothorax sollte in Betracht gezogen werden.
1.5.7 GoR B	Die Verdachtsdiagnose Spannungspneumothorax sollte gestellt werden bei einseitig fehlendem Atemgeräusch bei der Auskultation der Lunge (nach Kontrolle der korrekten Tubuslage) und dem zusätzlichen Vorliegen von typischen Symptomen insbesondere einer schweren respiratorischen oder zirkulatorischen Störung.
1.5.8 GoR A	Ein klinisch vermuteter Spannungspneumothorax soll umgehend dekomprimiert werden.
Int. LL GPP	**NICE Major trauma – assessment and initial management, Feb 2016:** 7.3. 7. Only perform chest decompression in a patient with suspected tension pneumothorax if there is haemodynamic instability or severe respiratory compromise. 7.3. 9. Observe patients after chest decompression for signs of recurrence of the tension pneumothorax (p. 73-77). *NICE-Empfehlung enthält Ergänzungen*
1.5.9 GoR B	Ein durch Auskultationsbefund diagnostizierter Pneumothorax sollte bei Patienten, die mit Überdruck beatmet werden, dekomprimiert werden.
1.5.10 GoR B	Ein durch Auskultationsbefund diagnostizierter Pneumothorax sollte bei nicht beatmeten Patienten in der Regel unter engmaschiger klinischer Kontrolle beobachtend behandelt werden.
1.5.11 GoR B	Die Entlastung eines Spannungspneumothorax sollte durch eine einmalige Nadeldekompression oder eine sofortige Minithorakotomie erfolgen. Bei Nadeldekompression sollte eine chirurgische Eröffnung des Pleuraspaltes mit oder ohne Thoraxdrainage, erfolgen.
Int. LL GPP	**NICE Major trauma – assessment and initial management, Feb 2016:** 7.3. 8. Use open thoracostomy instead of needle decompression if the expertise is available, followed by a chest drain via the thoracostomy in patients who are breathing spontaneously (p. 73-77). *NICE favorisiert die offene Thorakotomie gegenüber der Nadeldekompression*
1.5.12 GoR B	Ein Pneumothorax sollte – sofern die Indikation besteht – durch eine Thoraxdrainage behandelt werden.

Int. LL GPP	**NICE Major trauma – assessment and initial management, Feb 2016:** 7.3. 8. Use open thoracostomy instead of needle decompression if the expertise is available, followed by a chest drain via the thoracostomy in patients who are breathing spontaneously (p. 73-77). *Empfehlungen entsprechen sich sinngemäß*
1.5.13 GoR B	Die Eröffnung des Pleuraraums sollte mittels Minithorakotomie erfolgen. Die Einlage der Thoraxdrainage sollte ohne Verwendung eines Trokars erfolgen.
1.5.14 GPP	Ein offener Pneumothorax sollte mittels eines geeigneten Ventilverbandes versorgt werden.
Int. LL GPP	**NICE Major trauma – assessment and initial management, Feb 2016:** 7.4. 10. In patients with an open pneumothorax: •cover the open pneumothorax with a simple occlusive dressing and •observe for the development of a tension pneumothorax (p. 77-80). *NICE widerspricht hinsichtlich der Verbandart, ergänzt noch die Überwachung*

1.6 Schädel-Hirn-Trauma

Nr. GoR	Empfehlungstexte, *Kommentar zum Abgleich*
1.6.1 GoR B	Beim Erwachsenen sollte eine arterielle Normotension mit einem systolischen Blutdruck nicht unter 90 mmHg angestrebt werden.
Int. LL GoR 0	**BTF Guidelines for the Management of Severe Traumatic Brain Injury, Sep 2016:** 15. Maintaining SBP at ≥100 mm Hg for patients 50 to 69 years old or at ≥110 mm Hg or above for patients 15 to 49 or over 70 years old may be considered to decrease mortality and improve outcomes (p. 164). *BTF LL: leicht höherer Grenzwert*
1.6.2 GoR B	Eine periphere Sauerstoffsättigung (SpO_2) unter 90% sollte vermieden werden.
1.6.3 GoR A	Die wiederholte Erfassung und Dokumentation von Bewusstseinslage, Glasgow Coma Scale und Pupillenfunktion soll erfolgen.
Int. LL GPP	**NICE Head injury – triage, assessment, investigation and early management of head injury in children, young people and adults, Jan. 2014:** 6.3. 19. Base monitoring and exchange of information about individual patients on the three separate responses on the GCS (for example, a patient scoring 13 based on scores of 4 on eye-opening, 4 on verbal response and 5 on motor response should be communicated as E4, V4, M5) (p. 84). *Empfehlungen entsprechen sich sinngemäß*
1.6.4 GoR A	Auf die Gabe von Glukokortikoiden soll verzichtet werden.
Int. LL GoR A	**BTF Guidelines for the Management of Severe Traumatic Brain Injury, Sep 2016:** 7. The use of steroids is not recommended for improving outcome or reducing ICP. In patients with severe TBI, high-dose methylprednisolone was associated with increased mortality and is contraindicated (p. 76). *Empfehlungen entsprechen sich sinngemäß*

1.6.5 GoR 0	Bei Verdacht auf stark erhöhten intrakraniellen Druck, insbesondere bei Zeichen der transtentoriellen Herniation (Pupillenerweiterung, Strecksynergismen, Streckreaktion auf Schmerzreiz, progrediente Bewusstseinstrübung), können die folgenden Maßnahmen angewandt werden: • Hyperventilation • Hypertone Kochsalzlösung • Mannitol
Int. LL	**BTF Guidelines for the Management of Severe Traumatic Brain Injury, Sep 2016:** 3. Although hyperosmolar therapy may lower intracranial pressure, there was insufficient evidence about effects on clinical outcomes to support a specific recommendation, or to support use of any specific hyperosmolar agent, for patients with severe traumatic brain injury (p. 49). *BTF gibt keine Empfehlung ab*
Int. LL GoR 0	**BTF Guidelines for the Management of Severe Traumatic Brain Injury, Sep 2016:** 5. Prolonged prophylactic hyperventilation with partial pressure of carbon dioxide in arterial blood (PaCO2) of 25 mm Hg or less is not recommended (p. 63). *BTF Empfehlung teilweise übereinstimmend mit der "kann" Formulierung*
1.6.6 GoR B	Bei perforierenden Verletzungen sollte der perforierende Gegenstand belassen werden, evtl. muss er abgetrennt werden.
1.6.7 GPP	Herausgeschlagene Zähne und Zahnfragmente sollten aufgenommen, feucht gelagert und zur Replantation ins Traumazentrum mitgebracht werden.

1.7 Wirbelsäule

Nr. GoR	**Empfehlungstexte,** *Kommentar zum Abgleich*
1.7.1 GoR A	Eine gezielte körperliche Untersuchung, inklusive der Wirbelsäule und der mit ihr verbundenen Funktionen, soll durchgeführt werden.
Int. LL GPP	**NICE Spinal injury: assessment and initial management, Feb. 2016:** 6.6.3. Assess the person for spinal injury, initially taking into account the factors listed below. Check if the person: - has any significant distracting injuries - is under the influence of drugs or alcohol - is confused or uncooperative - has a reduced level of consciousness - has any spinal pain - has any hand or foot weakness (motor assessment) - has altered or absent sensation in the hands or feet (sensory assessment) - has priapism (unconscious or exposed male) - has a history of past spinal problems, including previous spinal surgery or conditions that predispose to instability of the spine (p. 57). *NICE enthält sehr genaue Handlungsempfehlungen hinsichtlich der Untersuchung*
Int. LL GoR A	**NICE Spinal injury: assessment and initial management, Feb. 2016:** 6.6.4. Carry out full in-line spinal immobilisation if any of the factors in recommendation 3 are present or if this assessment cannot be done (p. 58). *NICE enthält eine konkrete Handlungsempfehlung bei Vorhandensein bestimmter Merkmale*

Int. LL GPP	**NICE Spinal injury: assessment and initial management, Feb. 2016:** 6.6.1. On arrival at the scene of the incident, use a prioritising sequence to assess people with suspected trauma, for example <C>ABCDE: - catastrophic haemorrhage - airway with in-line spinal immobilisation (for guidance on airway management refer to the NICE guideline on major trauma) - breathing - circulation - disability (neurological) - exposure and environment (p. 58). *Empfehlungen ähnlich, NICE empfiehlt das ABCD Schema, wird bei der S3-Leitlinie vorausgesetzt*
1.7.2 GoR A	Bei bewusstlosen Patienten soll bis zum Beweis des Gegenteils von dem Vorliegen einer Wirbelsäulenverletzung ausgegangen werden.
1.7.3 GPP	Die Halswirbelsäule soll bei der schnellen und schonenden Rettung vor der eigentlichen technischen Rettung immobilisiert werden. Die Notwendigkeit zur Sofortrettung (z.B. Feuer/Explosionsgefahr) stellt eine Ausnahme dar.
Int. LL GPP	**NICE Spinal injury: assessment and initial management, Feb. 2016:** 8.6.23. When there is immediate threat to a person's life and rapid extrication is needed, make all efforts to limit spinal movement without delaying treatment (p. 92). *Empfehlungen entsprechen sich sinngemäß*
1.7.4 GPP	Der Transport soll möglichst schonend und unter Schmerzfreiheit erfolgen.
Int. LL GoR A	**NICE Spinal injury: assessment and initial management, Feb. 2016:** 9.10.29. Transport people with suspected acute traumatic spinal cord injury (with or without column injury), with full in-line spinal immobilisation, to a major trauma centre irrespective of transfer time, unless the person needs an immediate lifesaving intervention (p. 102). *NICE bezieht sich nicht allein auf Schmerzfreiheit sondern empfiehlt auch die in-line Stabilisierung und die Auswahl eines entsprechendes Traumazentrums*
1.7.5 GoR B	Patienten mit neurologischen Ausfällen und vermuteter Wirbelsäulenverletzung sollten primär in ein geeignetes Traumazentrum transportiert werden.
Int. LL GoR A	**NICE Spinal injury: assessment and initial management, Feb. 2016:** 9.10.29. Transport people with suspected acute traumatic spinal cord injury (with or without column injury), with full in-line spinal immobilisation, to a major trauma centre irrespective of transfer time, unless the person needs an immediate lifesaving intervention (p.102). *Empfehlungen enstprechen sich sinngemäß*

Zusätzliche Empfehlungen aus internationalen Leitlinien

genauer Ablauf der Untersuchung, Indikationen zur Immobilisierung, Ausnahmen Immobilisierung

- NICE Spinal injury: assessment and initial management, Feb. 2016

1.8 Extremitäten

Nr. GoR	Empfehlungstexte, *Kommentar zum Abgleich*
1.8.1 GoR A	Stark blutende Verletzungen der Extremitäten, welche die Vitalfunktion beeinträchtigen können, sollen mit Priorität versorgt werden.
1.8.2 GoR A	Die Versorgung von Verletzungen der Extremitäten soll weitere Schäden vermeiden und die Gesamtrettungszeit beim Vorliegen weiterer bedrohlicher Verletzungen nicht verzögern.
1.8.3 GoR B	Alle Extremitäten eines Verunfallten sollten präklinisch orientierend untersucht werden.

1.8.4 GoR B	Eine auch nur vermutlich verletzte Extremität sollte vor grober Bewegung/dem Transport des Patienten ruhiggestellt werden.
1.8.5 GoR B	Grob dislozierte Frakturen und Luxationen sollten, wenn möglich und insbesondere bei begleitender Ischämie der betroffenen Extremität / langer Rettungszeit, präklinisch annähernd reponiert werden.
1.8.6 GoR B	Jede offene Fraktur sollte von groben Verschmutzungen gereinigt und steril verbunden werden.
1.8.7 GoR B	Das Amputat sollte grob gereinigt und in sterile, feuchte Kompressen gewickelt werden. Es sollte indirekt gekühlt transportiert werden.

1.9 Transport und Zielklinik

Nr. GoR	**Empfehlungstexte,** *Kommentar zum Abgleich*
1.9.1 GoR B	Die Luftrettung sollte zur präklinischen Versorgung Schwerverletzter primär eingesetzt werden. Einsatztaktische Gesichtspunkte und der Faktor Zeit sind zu berücksichtigen.
1.9.2 GoR B	Schwer verletzte Patienten sollten primär in ein geeignetes Traumazentrum eingeliefert werden.
Int. LL GPP	**NICE Major trauma - service delivery, Feb 2016:** 6.6.6. Be aware that the optimal destination for patients with major trauma is usually a major trauma centre. In some locations or circumstances intermediate care in a trauma unit might be needed for urgent treatment, in line with agreed practice within the regional trauma network (p. 48). *Empfehlungen entsprechen sich sinngemäß*
1.9.3 GPP	Bei penetrierendem Trauma des Thorax und/oder Abdomens sollte der schnellstmögliche Transport in das nächstgelegene Traumazentrum erfolgen.
1.9.4 GPP	Um Schnittstellenprobleme bei der Anmeldung, Übergabe bzw. Übernahme von schwer verletzten Patienten zu vermeiden, sollen geeignete und standardisierte Kommunikationsmethoden verwendet werden.
Int. LL GPP	**NICE Major trauma - service delivery, Feb 2016:** 7.6.10. Ensure that a senior nurse or trauma team leader receives the pre-alert information and determines the level of trauma team response according to agreed and written local guidelines (p. 54). *Empfehlungen entsprechen sich sinngemäß; NICE mit konkreter Nennung des Trauma-Leaders.*

1.10 Massenanfall von Verletzten

Nr. GoR	**Empfehlungstexte,** *Kommentar zum Abgleich*
1.10.1 GoR B	Zur Verbesserung der Triagequalität sollten Übungen oder (virtuelle) Trainings unter Anwendung verifizierter Triagesysteme und Algorithmen durchgeführt werden.
1.10.2 GPP	Ein Krankenhausalarm- und Einsatzplan soll von jeder Klinik erstellt, in der eigenen Einrichtung implementiert und regelmäßig durch Übungen evaluiert werden.
1.10.3 GPP	Die Vorbereitung der verantwortlichen Ärzte auf eine (Terror)MANV-Lage sollte durch regelmäßige Übungen oder die Absolvierung von entsprechenden Kursformaten erfolgen.

2 Schockraum

2.1 Der Schockraum: apparative Voraussetzungen

Nr. GoR	Empfehlungstexte, *Kommentar zum Abgleich*
2.5 GoR B	Die Größe des Schockraums sollte 25–50 m² (pro zu behandelnden Patienten) betragen.
2.6 GoR B	Der Schockraum, die Krankenanfahrt, die radiologische Abteilung und die OP-Abteilung sollten sich in dem gleichen Gebäude befinden. Der Hubschrauberlandeplatz sollte sich auf dem Klinikgelände befinden.

2.2 Schockraum – Team und Alarmierung

Nr. GoR	Empfehlungstexte, *Kommentar zum Abgleich*
2.2.1 GoR A	Zur Polytraumaversorgung sollen feste Teams (sog. Schockraumteams) nach vorstrukturierten Plänen arbeiten und/oder ein spezielles Training absolviert haben.
Int. LL GPP	**NICE Major trauma – service delivery, Feb 2016:** 7. 10. Ensure that a senior nurse or trauma team leader receives the pre-alert information and determines the level of trauma team response according to agreed and written local guidelines (p. 51-55). *Teilaspekt (vorstrukturierte Pläne) entspricht S3-LL*
Int. LL GoR B/0	**NICE Major trauma – service delivery, Feb 2016:** 8. 13. Ensure that multispecialty trauma teams are activated immediately in trauma units to receive patients with major trauma (p. 56-69). *Empfehlungen ähnlich; NICE bezieht sich nochmal explizit auf die schnellstmögliche Traumateam-Aktivierung*
Int. LL GoR A	**NICE Major trauma – service delivery, Feb 2016:** 8. 14. Do not use a tiered team response in trauma units (p. 56-69). *NICE: Besonderheit bei trauma units (niedrigeres Versorgungslevel als Traumazentren)*
2.2.2 GPP	Das interprofessionelle Schockraum-Team soll aus mindestens 2 Pflegekräften und mindestens 2 Ärzten bestehen, die die notfallmedizinische und notfallchirurgische Kompetenz abbilden.
2.2.3 GPP	Eine Erweiterung des Schockraum-Teams (sog. erweitertes Schockraum-Team) soll entsprechend der Versorgungsstufe des Krankenhauses jederzeit erfolgen können.
Int. LL GoR B/0	**NICE Major trauma – service delivery, Feb 2016:** 8. 16. Consider a tiered team response to receive patients in major trauma centres. This may include: - a standard multispecialty trauma team or - a standard multispecialty trauma team plus specialist involvement (for example, code red for major haemorrhage) and mobilisation of supporting departments and services such as transfusion, interventional radiology and surgery (p. 56-69). *Empfehlungen ähnlich*
2.2.4 GoR A	Bei folgenden pathologischen Befunden nach Trauma soll das Schockraumteam aktiviert werden: **A/B - Problem**

	• Atemstörungen (SpO2 <90%) /erforderliche Atemwegssicherung • AF <10 oder >29 **C - Problem** • systolischer Blutdruck <90 mmHg • Herzfrequenz >120/min • Schockindex >0,9 • Positiver eFAST **D - Problem** • GCS ≤12 **E - Problem** • Hypothermie <35,0°C
2.2.5 GoR A	Bei folgenden Verletzungen oder Maßnahmen nach Trauma soll das Schockraumteam aktiviert werden: • instabiler Thorax • Mechanisch instabile Beckenverletzung • Vorliegen von penetrierenden Verletzungen der Rumpf-Hals-Region • Amputationsverletzung proximal der Hände/Füße • Sensomotorisches Defizit nach Wirbelsäulenverletzung • prähospitale Intervention (erforderliche Atemwegssicherung, Thoraxentlastung, Katecholamingabe, Pericardiozentese, Anlage Tourniquet)
2.2.6 GoR B	Bei folgenden Verletzungen nach Trauma sollte das Schockraumteam aktiviert werden: • Frakturen von mehr als 2 proximalen großen Röhrenknochen • Verbrennungen >20% und Grad ≥2b
2.2.7 GoR B	Bei folgenden zusätzlichen Kriterien sollte das Trauma-/Schockraumteam aktiviert werden: • (Ab)Sturz aus über 3 Metern Höhe • Verkehrsunfall (VU) mit Ejektion aus dem Fahrzeug oder Fraktur langer Röhrenknochen
2.2.8 GoR B	Die Schockraumalarmierung bei geriatrischen Patienten sollte großzügig erfolgen.
2.2.9 GoR B	Die Schockraumalarmierung bei geriatrischen Patienten nach relevantem Trauma sollte zusätzlich bei einem der folgenden Parametern erfolgen: • RRsys <100mmHg • bekanntes oder vermutetes Schädel-Hirn-Trauma und GCS ≤14 • 2 oder mehr verletzte Körperregionen • Fraktur eines oder mehrerer langer Röhrenknochen nach Verkehrsunfall

2.3 Reanimation

Nr. GoR	Empfehlungstexte, *Kommentar zum Abgleich*
2.3.1 GoR A	Bei Bewusstlosigkeit und keiner oder nicht-normaler Atmung (Schnappatmung) soll unverzüglich mit einer kardiopulmonalen Reanimation begonnen werden.
2.3.2 GPP	Medizinisches Fachpersonal sollte auch gleichzeitig den Carotis-Puls tasten.
2.3.3 GoR A	Bei der Behandlung des traumatologisch bedingten Herzkreislaufstillstands soll beachtet werden, dass dieser eine andere Pathophysiologie als der nicht-traumatisch bedingte Herzkreislaufstillstand hat und sich das Vorgehen daher grundlegend unterscheidet.

2.3.4 GPP	Die Reanimation des Trauma-bedingten Herz-Kreislaufstillstandes soll sich auf die sofortige, gleichzeitige Behandlung reversibler Ursachen konzentrieren und hat Vorrang vor Thoraxkompression.
2.3.5 GoR A	Während der kardiopulmonalen Reanimation sollen zeitgleich leitliniengerecht traumaspezifische reversible Ursachen des Herzkreislaufstillstandes (nach x-ABCDE-Schema; z.B. externe Blutung, Atemwegsobstruktion, ösophageale Fehlintubation, Spannungspneumothorax, Perikardtamponade und Hypovolämie) diagnostiziert, ausgeschlossen und/oder therapiert werden.
2.3.6 GPP	Bei einem Trauma-assoziierten Herzkreislaufstillstand soll ein sequentielles Vorgehen gewählt werden mit • Blutstillung (bei massiven externen Blutungen), • Atemwegssicherung, • bilaterale Pleuraraumdekompression mittels chirurgischer Minithorakotomie, • nicht-invasive externe Beckenstabilisierung, • Blutprodukte, sowie in bestimmten Konstellationen • Notfallthorakotomie zur Beseitigung einer Perikardtamponade und • proximalem Aortenclamping oder REBOA
2.3.7 GPP	Beim traumatischen Herz-Kreislaufstillstand sollen alle Maßnahmen (z.B. äußerem Druck, Hämostyptika und Tourniquets, Beckenschlinge) zur Blutungskontrolle durchgeführt werden.
2.3.8 GoR A	Wird ein Spannungspneumothorax vermutet, soll bei Patienten mit traumabedingtem Herzkreislaufstillstand eine beidseitige Entlastung mittels Minithorakotomie vorgenommen werden.
2.3.9 GoR B	Eine Notfallthorakotomie sollte bei penetrierenden thorakalen oder thorakoabdominalen Verletzungen, insbesondere nach kurz zurückliegendem Beginn des Herzkreislaufstillstandes, und initial bestehenden Lebenszeichen durchgeführt werden.
2.3.10 GoR B	Zur invasiven kontinuierlichen Blutdruckmessung sollte im Schockraum ein intraarterieller Katheter angelegt werden, ohne dass Maßnahmen zur Behebung reversibler Ursachen und Basismaßnahmen der Reanimation verzögert werden.
2.3.11 GPP	Eine innerklinische Notfallthorakotomie sollte bei nachfolgenden Indikationen (prähospitale Reanimation <10 Minuten, Herzkreislaufstillstand im Schockraum) im Rahmen eines beobachteten Herzkreislaufstillstands beim Traumapatienten eingesetzt werden.
2.3.12 GPP	Die REBOA kann im Rahmen von traumabedingter Reanimationen zur temporären proximalen Blutungskontrolle dienen.
2.3.13 GoR 0	Im Einzelfall kann bei polytraumatisierten Patienten mit therapierefraktärem Kreislaufstillstand eine extrakorporale Zirkulation und Oxygenierung erwogen werden.
2.3.14 GPP	Vor Abbruch der Reanimationsmaßnahmen sollen alle potentiell reversiblen Ursachen eines traumatischen Herzkreislaufstillstandes ausgeschlossen oder behandelt sein.
2.3.15 GoR A	Bei frustraner Reanimation nach Beseitigung möglicher traumaspezifischer, reversibler Ursachen des Herzkreislaufstillstandes soll die kardiopulmonale Reanimation beendet werden.
2.16 GoR A	Bei Vorliegen von sicheren Todeszeichen oder mit dem Leben nicht zu vereinbarenden Verletzungen soll die kardiopulmonale Reanimation nicht begonnen werden.

2.4 Gerinnungsmanagement und Volumentherapie

Nr. GoR	**Empfehlungstexte,** *Kommentar zum Abgleich*
2.4.1 GoR A	Die Trauma-induzierte Koagulopathie ist ein eigenständiges Krankheitsbild mit deutlichem Einfluss auf das Überleben. Aus diesem Grund sollen Gerinnungsdiagnostik und -therapie spätestens im Schockraum eingeleitet werden.

2.4.2 GoR A	Zur Basisdiagnostik von blutenden Schwerverletzten sollen frühzeitige und wiederholte Messungen von BGA, Quick (Prothrombinzeit), aPTT, Fibrinogen und Thrombozytenzahl sowie eine Blutgruppenbestimmung erfolgen.
2.4.3 GoR A	Im Rahmen der Schockraumversorgung von blutenden Schwerverletzten soll zur Diagnostik und Therapie der Trauma-induzierten Koagulopathie der frühzeitige Einsatz viskoelastischer Testverfahren erfolgen.
2.4.4 GoR B	Bei Patienten, die aktiv bluten, sollte bis zur chirurgischen Blutstillung eine permissive Hypotension (mittlerer arterieller Druck [MAP] ~65 mmHg, systolischer arterieller Druck ~90 mmHg), angestrebt werden.
2.4.5 GoR B	Bei Patienten (ohne kardio-pulmonale Vorerkrankungen) im hämorrhagischen Schock sollte prä-, intra- und früh-postoperativ (3-6 h) eine restriktive Flüssigkeitstherapie mit einem Ziel-MAP ~ 60 mmHg erfolgen.
Int. LL GoR A	**NICE Major trauma - assessment and initial management, Feb 2016:** 10.7. 35. For patients with active bleeding use a restrictive approach to volume resuscitation until definitive early control of bleeding has been achieved (p. 166-174). *S3-Empfehlung formuliert spezifische Blutdruckziele, NICE offener*
Int. LL GoR A	**NICE Major trauma - assessment and initial management, Feb 2016:** 10.7. 37. In hospital settings, move rapidly to haemorrhage control, titrating volume resuscitation to maintain central circulation until control is achieved (p. 166-174). *NICE Empfehlung allgemeiner formuliert*
2.4.6 GoR B	Bei der Kombination von hämorrhagischem Schock und Schädel-Hirn-Trauma (GCS <9) und/oder spinalem Trauma mit neurologischer Symptomatik sollte ein MAP von 85–90 mmHg angestrebt werden.
Int. LL GoR B	**NICE Major trauma - assessment and initial management, Feb 2016:** 10.7. 38. For patients who have haemorrhagic shock and a traumatic brain injury: • if haemorrhagic shock is the dominant condition, continue restrictive volume resuscitation or • if traumatic brain injury is the dominant condition, use a less restrictive volume resuscitation approach to maintain cerebral perfusion (p. 166-174). *S3-Empfehlung formuliert spezifische Blutdruckziele, NICE offener*
2.4.7 GoR A	Das Ausmaß und die Behandlung des Schocks soll durch wiederholte Messung von Laktat und/oder Basenüberschuss überprüft und gesteuert werden.
2.4.8 GoR B	Die Auskühlung des Patienten sollte mit geeigneten Maßnahmen vermieden und Normothermie angestrebt werden.
Int. LL GoR A	**NICE Major trauma – assessment and initial management, Feb 2016:** 13. 60. Minimise ongoing heat loss in patients with major trauma (p. 246-250). *Empfehlungen entsprechen sich sinngemäß*
2.4.9 GoR B	Durch eine geeignete und frühzeitige Schocktherapie sollte eine Azidämie vermieden werden
2.4.10 GoR B	Eine Hypokalzämie <0,9 mmol/l sollte vermieden und eine Normokalzämie angestrebt werden.
2.4.11 GoR B	Ein Massivtransfusions- und Gerinnungstherapieprotokoll sollte lokal etabliert sein.
2.4.12 GoR B	Bei einem aktiv blutenden Patienten ist die Indikation zur Transfusion individuell nach klinischen Kriterien, dem Verletzungsgrad, dem Ausmaß des Blutverlustes, der Kreislaufsituation und der Oxygenierung zu entscheiden.

	Nach hämodynamischer Stabilisierung sollte eine Normovolämie mit einem Ziel-Hb-Wert von 7–9 g/dl [4,4–5,6 mmol/l] angestrebt werden.
Int. LL GoR A	**NICE Major trauma - assessment and initial management, Feb 2016:** 10.5. 30. Use physiological criteria that include the patient's haemodynamic status and their response to immediate volume resuscitation to activate the major haemorrhage protocol (p. 148-158). *Entspricht der Empfehlung im weitesten Sinne*
2.4.13 GoR B	Wenn bei Massivblutungen Plasmavolumen ersetzt werden muss, sollte der Einsatz von therapeutischem Plasma möglichst frühzeitig erfolgen.
Int. LL GoR A	**NICE Major trauma - assessment and initial management, Feb 2016:** 10.8. 41. For adults (16 and over) use a ratio of 1 unit of plasma to 1 unit of red blood cells to replace fluid volume (p. 175-185). *NICE-Empfehlung ohne TK*
2.4.14 GoR A	Die Gerinnungsdiagnostik und -therapie soll über viskoelastische Testverfahren gesteuert werden.
2.4.15 GoR B	Die Gerinnungsdiagnostik und -therapie sollte durch eine Diagnostik der Thrombozytenfunktion ergänzt werden.
2.4.16 GoR B	Wird die Gerinnungstherapie bei Massivtransfusion durch die Gabe von therapeutischem Plasma durchgeführt, sollte ein Verhältnis von therapeutischem Plasma:EK:TK im Bereich von 4:4:1 angestrebt werden. Ansonsten sollte die Gabe von therapeutischem Plasma restriktiv erfolgen.
2.4.17 GoR A	Bei lebensbedrohlich blutenden u./o. schockierten Patienten sowie bei nachgewiesener Hyperfibrinolyse soll möglichst frühzeitig / prähospital die Gabe von 1 g Tranexamsäure (TxA) über 10 Minuten, ggf. gefolgt von einer Infusion von 1 g über 8 Stunden, erfolgen, da dies mit einem Überlebensvorteil verbunden ist.
Int. LL GoR A	**NICE Major trauma - assessment and initial management, Feb 2016:** 10.3. 21. Use intravenous tranexamic acid as soon as possible in patients with major trauma and active or suspected active bleeding (p. 129-141). *NICE-Empfehlung weniger konkret*
2.4.18 GoR B	Mehr als 3 Stunden nach dem Trauma sollte mit der Gabe von Tranexamsäure nicht mehr begonnen werden (außer bei nachgewiesener Hyperfibrinolyse).
Int. LL GoR A	**NICE Major trauma - assessment and initial management, Feb 2016:** 10.3. 22. Do not use intravenous tranexamic acid more than 3 hours after injury in patients with major trauma unless there is evidence of hyperfibrinolysis (p. 129-141). *Empfehlungen entsprechen sich sinngemäß*
2.4.19 GoR B	Da nur bei ~20% der Traumapatienten eine Hyperfibrinolyse auftritt und Tranexamsäure (TxA) bei Fehlen einer Hyperfibrinolyse schädlich ist, sollte TxA nicht automatisch jedem Verletzten appliziert werden.
2.4.20 GoR A	Bei lebensbedrohlich blutenden u./o. schockierten Patienten soll zusätzlich die Gabe von Fibrinogen (initial 3-6 g bzw. 30-60 mg/kg) erfolgen.
2.4.21 GPP	Bei lebensbedrohlich blutenden u./o. schockierten Patienten sollte zusätzlich zur Gabe von Fibrinogen die Gabe von Prothrombinkomplexkonzentrat (PPSB) erfolgen.
2.4.22 GPP	Innerhalb von 24 Stunden nach Blutungsstopp soll über Art und Beginn der Thromboseprophylaxe entschieden werden.
Int. LL	**NICE Major trauma - assessment and initial management, Feb 2016:**

GPP	10.4. 23. Rapidly reverse anticoagulation in patients who have major trauma with haemorrhage (p. 139-148). *NICE-Empfehlung bezieht sich auf die Aufhebung der Antikoagulation; S3-LL Empfehlung auf die Wiederaufnahme der Thromboseprophylaxe*
2.4.23 GPP	Die Anlage zentraler Zugänge soll, sofern sofort verfügbar, ultraschallgesteuert erfolgen.

Zusätzliche Empfehlungen aus internationalen Leitlinien

NICE Major trauma - assessment and initial management, Feb 2016:

10.8. 40. In hospital settings do not use crystalloids for patients with active bleeding (…). (p. 175-185) (GPP)

Umgang mit Patienten mit therapeutischer Antikoagulation

NICE Major trauma - assessment and initial management, Feb 2016:

10.4.6 Hospital trusts that admit patients with major trauma should have a protocol for the rapid identification of patients who are taking anticoagulants and the reversal of anticoagulation agents.

Use prothrombin complex concentrate immediately in adults (16 or over) with major trauma who have active bleeding and need emergency reversal of a vitamin K antagonist.

Do not use plasma to reverse a vitamin K antagonist in patients with major trauma.

Consult a haematologist immediately for advice on adults (16 or over) who have active bleeding and need reversal of any anticoagulant agent other than a vitamin K antagonist.

Do not reverse anticoagulation in patients who do not have active or suspected bleeding. (p. 146) (GPP)

2.5 Bildgebung

Nr. GoR	Empfehlungstexte, *Kommentar zum Abgleich*
2.5.1 GoR B	Zur Diagnostik nach stumpfem und/oder penetrierendem Thorax- und/oder Abdominaltrauma sollte eine eFAST im Rahmen des Primary Survey im Schockraum durchgeführt werden.
Int. LL GoR B	**NICE Major trauma – assessment and initial management, Feb 2016:** 9. 14. Consider immediate chest X-ray and/or eFAST (extended focused assessment with sonography for trauma) as part of the primary survey to assess chest trauma in adults (16 or over) with severe respiratory compromise (p. 85-113). *NICE Empfehlung schließt Röntgen mit ein*
2.5.2 GoR 0	Sonografische Wiederholungsuntersuchungen des Thorax und/oder Abdomens können erfolgen, wenn keine GKCT durchgeführt wurde oder zur Verlaufskontrolle bei pathologischem Befund nach durchgeführtem GKCT.
2.5.3 GoR B	Falls unklar bleibt, ob eine relevante thorakale Verletzung besteht und keine unmittelbare CT-Thorax durchgeführt werden kann, sollte eine Röntgenaufnahme des Thorax angefertigt werden.
2.5.4 GPP	Falls unklar bleibt, ob eine relevante pelvine Verletzung besteht und keine unmittelbare CT durchgeführt wird, kann eine Röntgenaufnahme des Beckens angefertigt werden.
2.5.5 GoR A	Im Rahmen der Diagnostik von Schwerverletzten soll eine zeitnahe Ganzkörper-Computertomografie* mit traumaspezifischem Protokoll durchgeführt werden, wenn keine sofort interventions-/operations- und/oder reanimationspflichtigen Situationen vorliegen und der RRsys nicht unter 60 mmHg ist. *(Kopf bis einschließlich Becken, CCT nativ)

Int. LL GoR A	**NICE Major trauma – assessment and initial management, Feb 2016:** 11.3. 50. Use whole-body CT (consisting of a vertex-to-toes scanogram followed by a CT from vertex to mid-thigh) in adults (16 or over) with blunt major trauma and suspected multiple injuries. Patients should not be repositioned during whole-body CT (p. 201-208). *Empfehlungen entsprechen sich sinngemäß*
2.5.6 GoR B	Ein Ganzkörper-CT sollte durchgeführt werden bei: • einer Störung der Vitalparameter (Kreislauf, Atmung, Bewusstsein, Neurologie). • Pathologischem Untersuchungsbefund und/oder Bildgebungsbefund von Thorax und/oder Abdomen und/oder Becken und/oder Wirbelsäule • Fraktur von mindestens 2 langen Röhrenknochen • Unfallmechanismus (Sturz >4m; Einklemmung Thorax/Abdomen)
2.5.7 GoR B	Der Computertomograph (CT) sollte im oder nahe am Schockraum lokalisiert sein.
2.5.8 GPP	Die Magnetresonanztomographie kann bei gezielten Fragestellungen (z.B. diskoligamentäre Wirbelsäulenverletzungen, morphologisches Korrelat einer Querschnittsymptomatik) in der weiterführenden Primärdiagnostik indiziert sein. Für die Durchführung einer Magnetresonanztomographie im Rahmen der Erstdiagnostik schwerverletzter/ polytraumatisierter Patienten sind umfangreiche Voraussetzungen zu erfüllen. Entsprechende Festlegungen sollten ortsbezogen in SOP's zur Verfügung stehen.

2.6 Endovaskuläre Therapie von Blutungen und Gefäßläsionen

Nr. GoR	**Empfehlungstexte,** *Kommentar zum Abgleich*
2.6.1 GPP	Die endovaskuläre Therapie von Blutungen und Gefäßläsionen sollte an einer stationären Angiographieeinheit durch eine*n endovaskuläre*n Therapeuten an hämodynamisch stabilisierten Patienten (permissive Hypotension) erfolgen.
2.6.2 GoR B	Die Diagnostik von Blutungen und Gefäßverletzungen sollte mittels einer kontrastverstärkten CT des gesamten Körpers (syn. „Polytraumaspirale" / s. Kapitel 2.18) erfolgen (siehe auch Qualitätssicherungs-Leitlinie CT: „Polytrauma" der Bundesärztekammer).
Int. LL GoR A	**NICE Major trauma – assessment and initial management, Feb 2016:** 9. 13. Imaging for haemorrhage in patients with suspected haemorrhage should be performed urgently, and the images should be interpreted immediately by a healthcare professional with training and skills in this area (p. 85-113). *NICE Empfehlung allgemeiner hinsichtlich Bildgebung*
2.6.3 GoR 0	Bei Patienten im schweren hämorrhagischen Schock aufgrund nichtkomprimierbarer Körperstammblutungen unterhalb des Zwerchfells, kann bis zur definitiven Blutungskontrolle eine endovaskuläre Ballonokklusion der Aorta (REBOA) durchgeführt werden.
2.6.4 GoR B	Eine stumpfe Verletzung der thorakalen oder abdominellen Aorta sollte endovaskulär (TEVAR/EVAR) versorgt werden. Wenn die Art der Aortenverletzung es erlaubt, sollte die Versorgung frühelektiv erst nach den ersten 24 Stunden erfolgen.
Int. LL GoR A	**NICE Major trauma – assessment and initial management, Feb 2016:** 11.5. 59. Use an endovascular stent graft in patients with blunt thoracic aortic injury (p. 215-225). *Empfehlungen entsprechen sich sinngemäß*
2.6.5 GoR B	Bei arteriellen Gefäßverletzungen wie Intimadissektion, Gefäßeinriss, AV-Fistel oder Pseudoaneurysmabildung sollte eine endovaskuläre Therapie angestrebt werden.

2.6.6 GoR B	Blutungen parenchymatöser abdomineller Organe sollten endovaskulär mittels Embolisation therapiert werden. Eine frühzeitige Embolisation kann die Mortalität senken. Milzverletzungen, die nicht sofort eine Intervention erfordern, sollten beobachtet werden und ggf. sekundär versorgt werden.
Int. LL GPP	**NICE Major trauma – assessment and initial management, Feb 2016:** 11.5. 57. Consider interventional radiology techniques in patients with solid-organ (spleen, liver or kidney) arterial haemorrhage (p. 215-225). *Empfehlungen entsprechen sich sinngemäß*

Zusätzliche Empfehlungen aus internationalen Leitlinien

NICE Major trauma – assessment and initial management, Feb 2016:

11.5. 58. Consider a joint interventional radiology and surgery strategy for arterial haemorrhage that extends to surgically inaccessible regions (p. 215-225). (GoR B)

2.7 Thorax

Nr. GoR	Empfehlungstexte, *Kommentar zum Abgleich*
2.7.1 GoR B	Eine genaue Erhebung der (Fremd-)Anamnese sollte erfolgen.
2.7.2 GoR B	Hochrasanztraumen und Verkehrsunfälle mit Lateralaufprall sollten als Hinweise auf ein Thoraxtrauma/eine Aortenruptur gedeutet werden.
2.7.3 GoR A	Eine klinische Untersuchung des Thorax soll durchgeführt werden.
2.7.4 GoR A	Eine Auskultation soll bei der körperlichen Untersuchung erfolgen.
2.7.5 GoR B	Wenn ein Thoraxtrauma klinisch nicht ausgeschlossen werden kann und keine CT-Bildgebung indiziert ist, sollte eine sonografische Bildgebung (eFAST) und ein Röntgenthorax in der Schockraumphase erfolgen.
Int. LL GoR B	**NICE Major trauma – assessment and initial management, Feb 2016:** 9. 14. Consider immediate chest X-ray and/or eFAST (extended focused assessment with sonography for trauma) as part of the primary survey to assess chest trauma in adults (16 or over) with severe respiratory compromise (p. 85-114). *NICE Empfehlung weitergehend: FAST und Röntgen als Teil des Primary Survey*
2.7.6 GoR B	Eine Spiral-CT des Thorax mit Kontrastmittel sollte bei jedem Patienten mit klinischen bzw. anamnestischen Hinweisen auf ein schweres Thoraxtrauma durchgeführt werden.
Int. LL GoR B	**NICE Major trauma – assessment and initial management, Feb 2016:** 9. 15. Consider immediate CT for adults (16 or over) with suspected chest trauma without severe respiratory compromise who are responding to resuscitation or whose haemodynamic status is normal (see also recommendation 50 on whole-body CT) (p. 85-114). *NICE: Indikation enger gefasst*
2.7.7 GoR A	Ein kontinuierliches Monitoring durch ein Dreikanal-EKG soll zur Überwachung einer etwaigen myokardialen Schädigung durchgeführt werden.
2.7.8	Bei V.a. eine stumpfe Myokardverletzung soll ein Zwölfkanal-EKG in Verbindung mit einer hsTroponin Bestimmung durchgeführt werden.

GoR A	
2.7.9 GoR A	Ein klinisch relevanter oder progredienter Pneumothorax soll initial beim beatmeten Patienten mittels Thoraxdrainage entlastet werden.
2.7.10 GoR B	Beim nichtbeatmeten Patienten sollte ein progredienter Pneumothorax mittels Thoraxdrainage entlastet werden.
Int. LL GPP	**NICE Major trauma – assessment and initial management, Feb 2016:** 8.6. 11. In patients with tension pneumothorax, perform chest decompression before imaging only if they have either haemodynamic instability or severe respiratory compromise (p. 81-84). *NICE-Empfehlung ergänzt den Zeitpunkt*
Int. LL GPP	**NICE Major trauma – assessment and initial management, Feb 2016:** 8.6. 12. Perform chest decompression using open thoracostomy followed by a chest drain in patients with tension pneumothorax (p. 81-84). *NICE empfiehlt konkret die offene Thorakotomie, S3 gibt die Technik nicht vor*
2.7.11 GoR B	Thoraxdrainagen der Größe 24–32 Charrière sollten beim instabilen Patienten und notwendiger notfallmäßiger Einlage einer Thoraxdrainage bevorzugt werden.
2.7.12 GoR B	Beim stabilen Patienten mit relevantem und progredientem Pneumothorax sollte eine kleinere Drainagegröße ≥14 Charrière gewählt werden.
2.7.13 GoR B	Ein klinisch relevanter oder progredienter Hämatothorax sollte initial mittels einer Thoraxdrainage entlastet werden.
2.7.14 GoR B	Thoraxdrainagen der Größe 24–32 Charrière sollten beim instabilen Patienten und notwendiger notfallmäßiger Einlage einer Thoraxdrainage bevorzugt werden.
2.7.15 GoR B	Beim stabilen Patienten mit relevantem Hämatothorax sollte eine kleinere Drainagegröße ≥14 Charrière gewählt werden.
2.7.16 GoR B	Eine Perikardentlastung sollte bei nachgewiesener Herzbeuteltamponade und sich akut verschlechternden Vitalparametern durchgeführt werden.
2.7.17 GPP	Bei hämodynamisch instabilen Patienten mit Thoraxtrauma sollte eine eFAST-Untersuchung zum Ausschluss einer Perikardtamponade erfolgen.
2.7.18 GPP	Eine Thorakotomie kann bei initial hohem oder persistierendem relevantem Blutverlust über die liegende Thoraxdrainage sowohl bei stabilem als auch instabilem Patienten erfolgen.
2.7.19 GPP	Alternativ zu einer Thorakotomie kann eine VATS (Videoassistierte Thorakoskopie) bei einem kardiopulmonal stabilen Patienten erfolgen.
2.7.20 GoR B	Bei Patienten mit stumpfem Trauma und fehlenden Lebenszeichen am Unfallort sollte eine Notfallthorakotomie im Schockraum nicht durchgeführt werden.

2.8 Abdomen

Nr. GoR	**Empfehlungstexte,** *Kommentar zum Abgleich*
2.8.1 GoR A	Das Abdomen soll untersucht werden, obwohl ein unauffälliger Befund eine relevante intraabdominelle Verletzung selbst beim wachen Patienten nicht ausschließt.
2.8.2 GoR B	Eine initiale fokussierte abdominelle Sonografie zum Screening freier Flüssigkeit, „Focused Assessment with Sonography for Trauma“ (FAST), sollte durchgeführt werden.
Int. LL	**NICE Major trauma – assessment and initial management, Feb 2016:**

GoR A	11.2. 48. Do not use FAST or other diagnostic imaging before immediate CT in patients with major trauma (p. 192-201). *NICE-Empfehlung widerspricht der Formulierung "initial"*
2.8.3 GoR B	Sonografische Wiederholungsuntersuchungen sollten im zeitlichen Verlauf erfolgen, wenn eine computertomografische Untersuchung nicht zeitnah durchgeführt werden kann.
2.8.4 GoR 0	Sofern die Computertomografie nicht durchführbar ist, kann eine gezielte sonografische Suche nach Parenchymverletzungen ergänzend zur FAST eine Alternative darstellen.
2.8.5 GoR A	Die Mehrschicht-Spiral-CT (MSCT) hat eine hohe Sensitivität und die höchste Spezifität im Erkennen intraabdomineller Verletzungen und soll deshalb nach Abdominaltrauma durchgeführt werden.
2.8.6 GoR B	Bei hämodynamisch aufgrund einer intraabdominellen Läsion (freie Flüssigkeit) nicht stabilisierbaren Patienten sollte unverzüglich eine Notfall- Laparotomie eingeleitet werden. Die Möglichkeit eines Schocks nicht abdomineller Ursache sollte hierbei berücksichtigt werden.
Int. LL GPP	**NICE Major trauma – assessment and initial management, Feb 2016:** 11.4. 53. Use damage control surgery in patients with haemodynamic instability who are not responding to volume resuscitation (p. 208-215). *entspricht der Empfehlung sinngemäß*

Zusätzliche Empfehlungen aus internationalen Leitlinien

NICE Major trauma - assessment and initial management, Feb 2016:

11.4. 54. Consider definitive surgery in patients with haemodynamic instability who are responding to volume resuscitation. (GPP)

11.4. 55. Use definitive surgery in patients whose haemodynamic status is normal. (GPP)

2.9 Becken

Nr. GoR	Empfehlungstexte, *Kommentar zum Abgleich*
2.9.1 GoR A	Bei Eintreffen des Patienten in der Klinik soll eine akut lebensbedrohliche Beckenverletzung ausgeschlossen werden
2.9.2 GoR A	Das Becken des Patienten soll klinisch untersucht werden.
2.9.3 GoR B	Bei Verdacht auf eine knöcherne Beckenverletzung soll eine Beckenübersichtsaufnahme oder eine Computertomografie (CT) durchgeführt werden.
2.9.4 GoR A	Bei mechanisch instabilem Beckenring und hämodynamischer Instabilität soll eine mechanische Notfallstabilisierung des Beckens vorgenommen werden.
2.9.5 GoR B	Bei einer persistierenden Blutung sollte eine Blutungskontrolle mit den geeigneten Mitteln (Packing, ggf. endovaskulärchirurgisch) erfolgen.
Int. LL GoR A	**NICE Major trauma - assessment and initial management, Feb 2016:** 11.5. 56. Use interventional radiology techniques in patients with active arterial pelvic haemorrhage unless immediate open surgery is needed to control bleeding from other injuries (p. 215-225). *NICE-Empfehlung bevorzugt endovaskuläre Therapie*

2.10 Schädel-Hirn-Trauma

Nr. GoR	Empfehlungstexte, *Kommentar zum Abgleich*
2.10.1 GoR A	Die wiederholte Erfassung und Dokumentation von Bewusstseinslage, mit Pupillenfunktion und Glasgow Coma Scale (Motorik bds.) soll erfolgen.
2.10.2 GoR A	Anzustreben sind eine Normoxie, Normokapnie und Normotonie. Ein Absinken der arteriellen Sauerstoffsättigung unter 90% soll vermieden werden.
Int. LL GoR 0	**BTF Guidelines for the Management of Severe Traumatic Brain Injury, Sep 2016:** 5. Prolonged prophylactic hyperventilation with partial pressure of carbon dioxide in arterial blood (PaCO2) of 25 mm Hg or less is not recommended (p. 63). *entspricht der Empfehlung sinngemäß*
2.10.3 GoR A	Bei bewusstlosen Patienten (Anhaltsgröße GCS ≤8) soll eine Intubation mit adäquater Beatmung (mit Kapnometrie und Blutgasanalyse) erfolgen.
2.10.4 GoR B	Beim Erwachsenen sollte eine arterielle Normotension mit einem systolischen Blutdruck nicht unter 110 mmHg angestrebt werden.
Int. LL GoR 0	**BTF Guidelines for the Management of Severe Traumatic Brain Injury, Sep 2016:** 15. Maintaining SBP at ≥100 mm Hg for patients 50 to 69 years old or at ≥110 mm Hg or above for patients 15 to 49 or over 70 years old may be considered to decrease mortality and improve outcomes (p. 164). *leicht anderer Grenzwert*
2.10.5 GoR A	Beim Polytrauma mit Verdacht auf Schädel-Hirn-Verletzung soll eine cCT durchgeführt werden.
Int. LL GPP	**NICE Head injury – assessment and early management (CG176), Jan. 2014:** 7.12. 32. The current primary investigation of choice for the detection of acute clinically important brain injuries is CT imaging of the head (p. 138). *entspricht der Empfehlung sinngemäß*
Int. LL GoR A	**NICE Head injury – assessment and early management (CG176), Jan. 2014:** 7.7. 26. For adults who have sustained a head injury and have any of the following risk factors, perform a CT head scan within 1 hour of the risk factor being identified: • • GCS less than 13 on initial assessment in the emergency department. • • GCS less than 15 at 2 hours after the injury on assessment in the emergency department. • • Suspected open or depressed skull fracture. • • Any sign of basal skull fracture (haemotympanum, 'panda' eyes, cerebrospinal fluid leakage from the ear or nose, Battle's sign). • • Post-traumatic seizure. • • Focal neurological deficit. • • More than 1 episode of vomiting. (p. 116) *NICE-LL enthält konkretere Indikationen*
Int. LL GoR A	**NICE Head injury – assessment and early management (CG176), Jan. 2014:** 7.7. 28. For patients (adults and children) who have sustained a head injury with no other indications for a CT head scan and who are having anticoagulant treatment, perform a CT head scan within 8 hours of the injury. A provisional written radiology report should be made available within 1 hour of the scan being performed. (For advice on reversal of warfarin anticoagulation in people with suspected traumatic intracranial haemorrhage, see the NICE guideline on blood transfusion.)

	(p. 120) *NICE-LL beschreibt zusätzliche Indikation*
2.10.6 GoR A	Im Falle einer neurologischen Verschlechterung soll eine (Kontroll-)cCT durchgeführt werden.
2.10.7 GoR B	Bei Patienten mit Verletzungszeichen in der initialen cCT sollte eine Verlaufs-cCT innerhalb von 4-8 Stunden durchgeführt werden.
2.10.8 GoR A	Zur Behandlung des SHT soll auf die Gabe von Glukokortikoiden verzichtet werden.
Int. LL GoR A	**BTF Guidelines for the Management of Severe Traumatic Brain Injury, Sep 2016:** 7. The use of steroids is not recommended for improving outcome or reducing ICP. In patients with severe TBI, high-dose methylprednisolone was associated with increased mortality and is contraindicated (p. 76). *Empfehlungen entsprechen sich sinngemäß*
2.10.9 GoR 0	Bei Verdacht auf stark erhöhten intrakraniellen Druck, insbesondere bei Zeichen der transtentoriellen Herniation (Pupillenerweiterung, Strecksynergismen, Streckreaktion auf Schmerzreiz, progrediente Bewusstseinstrübung), können die folgenden Maßnahmen angewandt werden: • Hyperventilation • Mannitol • Hypertone Kochsalzlösung
Int. LL	**BTF Guidelines for the Management of Severe Traumatic Brain Injury, Sep 2016:** 3. Although hyperosmolar therapy may lower intracranial pressure, there was insufficient evidence about effects on clinical outcomes to support a specific recommendation, or to support use of any specific hyperosmolar agent, for patients with severe traumatic brain injury (p. 49). *BTF gibt keine Empfehlung zu hypertonen Lösungen ab*
Int. LL GoR 0	**BTF Guidelines for the Management of Severe Traumatic Brain Injury, Sep 2016:** 5. Prolonged prophylactic hyperventilation with partial pressure of carbon dioxide in arterial blood (PaCO2) of 25 mm Hg or less is not recommended (p. 63). *BTF Empfehlung zur Hyperventilation stimmt teilweise überein mit "kann"*

2.11 Wirbelsäule

Nr. GoR	Empfehlungstexte, *Kommentar zum Abgleich*
2.11.1 GoR B	Die Anamnese hat einen hohen Stellenwert und sollte erhoben werden.
2.11.2 GoR B	Im Schockraum hat die klinische Untersuchung bei Wirbelsäulenverletzungen einen hohen Stellenwert und sollte durchgeführt werden.
Int. LL GoR A	**NICE Spinal injury: assessment and initial management, Feb. 2016:** 6.6. At all stages of the assessment: • protect the person's cervical spine with manual in-line spinal immobilisation, particularly during any airway intervention and • avoid moving the remainder of the spine (p. 57). *Empfehlungen ähnlich; NICE betont nochmal die Immobisation während der Untersuchung*

Int. LL GoR A	**NICE Spinal injury: assessment and initial management, Feb. 2016:** 6.6. On arrival at the emergency department use a prioritising sequence for assessing people with suspected trauma (see recommendation 1) (p. 58). *NICE empfiehlt Priorisierung von vermuteten Wirbelsäulenverletzungen*
2.11.3 GoR B	Eine Wirbelsäulenverletzung sollte nach Kreislaufstabilisierung und vor Verlegung auf die Intensivstation durch bildgebende Diagnostik abgeklärt werden
Int. LL GoR unclear	**NICE Spinal injury: assessment and initial management, Feb. 2016:** 10.6 Imaging for spinal injury should be performed urgently, and the images should be interpreted immediately by a healthcare professional with training and skills in this area (p. 147). *Empfehlungen ähnlich; S3-Leitlinie benennt konkret Kreislaufstabilisierung, NICE allgemeiner formuliert ('urgently') hinsichtlich des Zeitpunktes, ergänzt aber Bedingungen zum Untersucher.*
2.11.4 GoR B	Für die Schockraumdiagnostik sollte bei Kreislaufstabilität je nach Ausstattung der aufnehmenden Klinik die Wirbelsäule abgeklärt werden: Vorzugsweise durch Mehrschicht-Spiral-CT von Kopf bis Becken oder ersatzweise durch konventionelle Röntgendiagnostik der gesamten Wirbelsäule (a. p. und seitlich, Densziel).
Int. LL GoR A	**NICE Spinal injury: assessment and initial management, Feb. 2016:** 10.6 Use whole-body CT (consisting of a vertex-to-toes scanogram followed by CT from vertex to mid-thigh) in adults (16 or over) with blunt major trauma and suspected multiple injuries. Patients should not be repositioned during whole-body CT (p. 148). *Empfehlungen ähnlich hinsichtlich des Ganzkörper-CT; NICE empfiehlt keine konventionelle Röntgenuntersuchung.*
2.11.5 GoR B	Im konventionellen Röntgen pathologische, verdächtige und nichtbeurteilbare Regionen sollten mit CT weiter abgeklärt werden.
2.11.6 GoR B	Im Ausnahmefall einer geschlossenen Notfallreposition der Wirbelsäule sollte diese nur nach suffizienter CT-Diagnostik der Verletzung vorgenommen werden.
2.11.7 GoR B	Eine Methylprednisolon-Gabe („NASCIS-Schema") ist nicht mehr Standard, kann aber bei neurologischem Defizit und nachgewiesener Verletzung innerhalb von 8 Stunden nach dem Unfall eingeleitet werden.
Int. LL GoR A	**NICE Spinal injury: assessment and initial management, Feb. 2016:** 16.6 Do not use the following medications, aimed at providing neuroprotection and prevention of secondary deterioration, in the acute stage after acute traumatic spinal cord injury: • Methylprednisolone • Nimodipine • Naloxone (p. 191). *NICE benennt weitere, nicht empfohlene Medikamente*

Zusätzliche Empfehlungen aus internationalen Leitlinien

Internationale Leitlinie mit zusätzlichen, detaillierten Empfehlungen zu Wirbelsäulenverletzungen:

- NICE Spinal injury: assessment and initial management, Feb. 2016

2.12 Unterkiefer und Mittelgesicht

Nr. GoR	Empfehlungstexte, *Kommentar zum Abgleich*
2.12.1 GoR B	Bei der klinischen Untersuchung des Kopf-Hals-Bereiches beim polytraumatisierten Patienten sollten Verletzungen aus funktionellen und ästhetischen Gesichtspunkten ausgeschlossen werden.
2.12.2 GoR B	Zur vollständigen Beurteilung der Situation sollten bei klinischem Anhalt für Unterkiefer- und Mittelgesichtsverletzungen weiterführende diagnostische Maßnahmen durchgeführt werden.

2.13 Hals

Nr. GoR	Empfehlungstexte, *Kommentar zum Abgleich*
2.13.1 GoR A	Die Sicherstellung der Atemwege soll bei der Therapie von Verletzungen des Halses Priorität haben.
2.13.2 GoR B	Bei Halsverletzungen mit drohender Verlegung der Atemwege sollte frühzeitig eine Intubation oder – falls dies nicht möglich ist – die Anlage eines chirurgischen Atemweges erwogen werden.
2.13.3 GoR B	Zur Feststellung von Art und Schwere der Verletzung sollte eine Computertomografie der Halsweichteile durchgeführt werden.
2.13.4 GoR B	Bei klinischem oder computertomografischem Verdacht auf eine Halsverletzung sollte eine endoskopische Untersuchung des traumatisierten Bereiches erfolgen.
2.13.5 GoR B	Bei penetrierenden Verletzungen der Arteria carotis interna bzw. Arteria carotis communis sollte eine operative Versorgung in Betracht gezogen werden. Dabei kann ein offenes chirurgisches oder ein endovaskuläres Vorgehen gewählt werden.
2.13.6 GoR 0	Bei stumpfen Verletzungen der Arteria carotis kann primär eine konservative Behandlung in Betracht gezogen werden.
2.13.7 GoR B	Sofern bei stumpfen Verletzungen der Arteria carotis ein operatives oder endovaskuläres Vorgehen gewählt wird, sollte dieses erst nach 24 Stunden erfolgen.

2.14 Extremitäten

Nr. GoR	Empfehlungstexte, *Kommentar zum Abgleich*
2.14.1 GoR B	Bei sicheren oder unsicheren Frakturzeichen sollten Extremitätenbefunde in Abhängigkeit vom Zustand des Patienten durch ein geeignetes radiologisches Verfahren (Natives Röntgen in 2 Ebenen oder CT) abgeklärt werden.
2.14.2 GoR B	Die radiologische Diagnostik sollte zu einem möglichst frühen Zeitpunkt erfolgen.
2.14.3 GoR B	Fehlstellungen und Luxationen der Extremitäten sollten reponiert und retiniert werden.
2.14.4 GoR B	Das Repositionsergebnis sollte durch weitere Maßnahmen nicht verändert werden.
2.14.5 GoR B	Bei ausreichend sicherer Information durch den Rettungsdienst sollte ein steriler Notfallverband vor Erreichen des Operationsbereiches nicht geöffnet werden.

2.14.6 GoR B	Bei fehlendem peripherem Puls (Doppler/Palpation) einer Extremität sollte eine weiterführende Diagnostik durchgeführt werden.
2.14.7 GoR B	In Abhängigkeit vom Befund und Zustand des Patienten sollte eine konventionelle arterielle digitale Subtraktionsangiografie (DSA), eine Duplexsonografie oder eine Angio-CT (CTA) durchgeführt werden.
2.14.8 GoR B	Die intraoperative Angiografie sollte bei im Schockraum nicht diagnostizierten Gefäßverletzungen der Extremitäten bevorzugt werden, um die Ischämiezeit zu verkürzen.
2.14.9 GoR 0	Bei Verdacht auf ein Kompartmentsyndrom kann die invasive Kompartmentdruckmessung im Schockraum angewendet werden.
Int. LL GoR B	**AAOS/METRC Clinical Practice Guideline on Management of Acute Compartment Syndrome, Dec. 2018:** Moderate evidence supports that intracompartmental pressure monitoring assists in diagnosing acute compartment syndrome (p.27). *Empfehlungen entsprechen sich sinngemäß*
Int. LL GoR B	**AAOS/METRC Clinical Practice Guideline on Management of Acute Compartment Syndrome, Dec. 2018:** Moderate evidence supports the use of repeated/continuous intracompartmental pressure monitoring and a threshold of diastolic blood pressure minusintracompartmental pressure >30 mmHg to assist in ruling out acute compartment syndrome (p.27). *AAOS Empfehlung benennt konkreten Grenzwert*

2.15 Hand

Nr. GoR	Empfehlungstexte, *Kommentar zum Abgleich*
2.15.1 GoR B	Die klinische Beurteilung der Hände sollte im Rahmen der Basisdiagnostik durchgeführt werden, da sie entscheidend für die Indikationsstellung zur Durchführung weiterer apparativer Untersuchungen ist.
2.15.2 GoR B	Die radiologische Basisdiagnostik sollte bei klinischem Verdacht auf eine Handverletzung die Röntgenuntersuchung von Hand und Handgelenk in jeweils 2 Standardebenen beinhalten.
2.15.3 GoR B	Bei klinischem Verdacht auf eine arterielle Gefäßverletzung sollte eine Doppler- oder Duplexsonografie durchgeführt werden.

2.16 Fuß

Keine Empfehlungen

2.17 Urogenitaltrakt

Nr. GoR	Empfehlungstexte, *Kommentar zum Abgleich*
2.17.1 GoR B	Bei der ersten orientierenden Untersuchung sollten der Meatus urethrae externus und – sofern schon einliegend – der transurethrale Blasenkatheter auf Blut hin inspiziert werden.
2.17.2 GoR B	Es sollte nach Hämatomen, Ekchymosen und äußeren Verletzungen im Bereich von Flanke, Abdomen, Perineum und äußerem Genital gesucht werden.

2.17.3 GoR B	Bei einer Kreislaufinstabilität, die eine initiale weiterführende Diagnostik unmöglich macht, und bei Unmöglichkeit einer transurethralen Blasenkathetereinlage sollte perkutan oder im Rahmen der Laparotomie (mit gleichzeitiger Exploration) eine suprapubische Harnableitung durchgeführt werden.
2.17.4 GoR B	Alle Patienten mit Hämaturie, Blutaustritt aus dem Meatus urethrae, Dysurie, Unmöglichkeit der Katheterisierung oder sonstigen anamnestischen Hinweisen (lokales Hämatom, Begleitverletzungen, Unfallmechanismus) haben ein erhöhtes Risiko urogenitaler Verletzungen und sollten einer gezielten diagnostischen Abklärung der Niere und/oder der ableitenden Harnwege zugeführt werden.
2.17.5 GoR B	Die weiterführende bildgebende Diagnostik der ableitenden Harnwege sollte durchgeführt werden, wenn eines oder mehrere der folgenden Kriterien zutreffen: Hämaturie, Blutung aus dem Meatus urethrae oder der Vagina, Dysurie und lokales Hämatom.
2.17.6 GoR B	Bei Verdacht auf eine Nierenverletzung sollte eine Computertomografie mit Kontrastmittelgabe durchgeführt werden.
2.17.7 GoR B	Falls es die Prioritätensetzung zulässt, sollten bei Patienten mit klinischen Anhaltspunkten für eine Urethraläsion eine retrograde Urethrografie und ein Zystogramm durchgeführt werden.
2.17.8 GoR B	Falls es die Prioritätensetzung zulässt, sollte bei Patienten mit klinischen Anhaltspunkten für eine Blasenverletzung ein retrogrades Zystogramm durchgeführt werden.

3 Erste OP-Phase

3.1 Thorax

Nr. GoR	**Empfehlungstexte,** *Kommentar zum Abgleich*
3.1.1 GoR 0	Je nach Verletzungslokalisation kann als Zugang eine anterolaterale Thorakotomie oder eine Sternotomie gewählt werden. Bei unklarer Verletzungslokalisation kann der Clamshell-Zugang gewählt werden.
3.1.2 GPP	Beim kardiorespiratorisch stabilen Patienten kann die VATS (Videoassisitierte Thorakoskopie) als Zugangsweg/OP-Verfahren verwendet werden.
3.1.3 GoR B	Einliegende Fremdköper sollten beim Vorliegen von perforierenden Thoraxverletzungen erst unter kontrollierten Bedingungen im OP nach Thoraxeröffnung entfernt werden.
3.1.4 GoR A	Eine penetrierende Thoraxverletzung, die ursächlich für eine hämodynamische Instabilität des Patienten ist, soll einer sofortigen explorativen Thorakotomie zugeführt werden.
3.1.5 GPP	Eine Thorakotomie kann bei initial hohem oder persistierendem relevantem Blutverlust über die liegende Thoraxdrainage sowohl bei stabilem als auch instabilem Patienten erfolgen.
3.1.6 GPP	Alternativ zu einer Thorakotomie kann eine VATS (Videoassistierte Thorakoskopie) bei einem kardiopulmonal stabilen Patienten erfolgen
3.1.7 GoR B	Wenn bei Lungenverletzungen eine Operationsindikation besteht (persistierende Blutung und/oder Luftleckage), sollte der Eingriff parenchymsparend erfolgen.
3.1.8 GoR B	Bei thorakalen Aortenrupturen sollte, wenn technisch und anatomisch möglich, die Implantation einer Endostentprothese gegenüber offenen Revaskularisationsverfahren bevorzugt werden.
3.1.9 GoR B	Bei klinischem Verdacht auf eine Verletzung des Tracheobronchialsystems sollte eine Tracheobronchoskopie zur Diagnosesicherung erfolgen.
3.1.10 GoR B	Traumatische Verletzungen des Tracheobronchialsystems sollten frühzeitig nach Diagnosestellung operativ versorgt werden.

3.1.11 GoR 0	Bei umschriebenen Verletzungen des Tracheobronchialsystems kann ein konservativer Therapieversuch unternommen werden.

3.2 Zwerchfell

Nr. GoR	**Empfehlungstexte,** *Kommentar zum Abgleich*
3.2.1 GoR B	Eine traumatische Zwerchfellruptur sollte bei Erkennung im Rahmen der Erstdiagnostik und/oder intraoperativen Feststellung zügig verschlossen werden.

3.3 Abdomen

Nr. GoR	**Empfehlungstexte,** *Kommentar zum Abgleich*
3.3.1 GoR B	In der Traumasituation sollte die Medianlaparotomie gegenüber anderen Zugangswegen bevorzugt werden.
3.3.2 GoR B	Bei kreislaufinstabilen Patienten mit komplexen intraabdominellen Schäden sollte dem Damage-Control-Prinzip (Blutstillung, Packing, temporärer Bauchdeckenverschluss/Laparostoma) gegenüber dem Versuch einer definitiven Sanierung Vorrang gegeben werden.
3.3.3 GoR B	Bei hämodynamisch stabilen Patienten mit penetrierendem Abdominaltrauma sollte bei diagnostischer Unsicherheit eine Laparoskopie durchgeführt werden, um die Rate von „nicht-therapeutischen" Laparotomien zu senken.
3.3.4 GoR B	Nach Damage-Control-Laparotomie sollte das Abdomen nur temporär und nicht mittels Fasziennaht verschlossen werden.
3.3.5 GoR B	Nach Packing intraabdomineller Blutungen sollte die Second-Look-Operation zwischen 24 und 72 Stunden nach dem Ersteingriff erfolgen.
3.3.6 GoR B	Wenn ein Laparostoma angelegt wurde, sollte ein definitiver Verschluss so früh wie möglich angestrebt werden.
3.3.7 GoR B	Beim hämodynamisch stabilen Patienten mit isolierter stumpfer Leber- oder Milzverletzung sollte ein nichtoperatives Management angestrebt werden.
3.3.8 GoR B	Wenn bei einem hämodynamisch stabilisierbaren Patienten mit Leberverletzung in einer Kontrastmittel-CT ein Hinweis auf eine arterielle Blutung besteht, sollte, wenn möglich, eine endovaskuläre Therapie durchgeführt werden oder eine Laparotomie erfolgen.
3.3.9 GoR B	Bei interventionspflichtigen Milzverletzungen sollte beim kreislaufstabilisierbaren Patienten statt einer operativen Blutstillung eine endovaskuläre Therapie erfolgen.
3.3.10 GoR B	Eine milzerhaltende Operation oder endovaskuläre Therapie sollte bei operationspflichtigen Milzverletzungen der Schweregrade 1–3 nach AAST/Moore angestrebt werden.
3.3.11 GoR B	Bei erwachsenen Patienten mit operationspflichtigen Milzverletzungen der Schweregrade 4–5 nach AAST/Moore sollte die Splenektomie gegenüber einem Erhaltungsversuch bevorzugt werden.
3.3.12 GoR A	Penetrierende Kolonverletzungen sollen durch Übernähung oder Resektion kontrolliert werden, um das Risiko für intraabdominelle Infektionen zu reduzieren.

3.4 Schädel-Hirn-Trauma

Nr. GoR	Empfehlungstexte, *Kommentar zum Abgleich*
3.4.1 GoR A	Raumfordernde intrakranielle Verletzungen sollen notfallmäßig operativ versorgt werden.
3.4.2 GoR B	Die Messung des intrakraniellen Druckes sollte bei bewusstlosen schädelhirnverletzten Patienten erfolgen.
Int. LL GoR B	**BTF Guidelines for the Management of Severe Traumatic Brain Injury, Sep 2016:** 12. Management of severe TBI patients using information from ICP monitoring is recommended to reduce in-hospital and 2-week post-injury mortality (p. 133). *Empfehlungen entsprechen sich sinngemäß*
3.4.3 GoR 0	Die operative Dekompression durch Kraniektomie und Duraerweiterungsplastik kann bei erhöhtem Hirndruck erfolgen.
Int. LL GoR B	**BTF Guidelines for the management of severe traumatic brain injury, Sep 2016 (2020 update decompressive craniectomy):** 1. A large frontotemporoparietal DC (not less than 12 x 15 cm or 15 cm diameter) is recommended over a small frontotemporoparietal DC for reduced mortality and improved neurologic outcomes in patients with severe TBI (p. 27). *BTS Empfehlung konketer und weitreichender*

Zusätzliche Empfehlungen aus internationalen Leitlinien

Internationale Leitlinien enthalten zusätzliche, konkretere Empfehlungen zum SHT:

- NICE Head Injury (CG176, partial update of NICE CG56), Jan. 2014
- BTF Guidelines for the management of severe traumatic brain injury; incl. 2020 Update of the Decompressive Craniectomy Recommendations

3.5 Wirbelsäule

Nr. GoR	Empfehlungstexte, *Kommentar zum Abgleich*
3.5.1 GoR B	Patienten mit operativ therapierbaren Wirbelsäulenverletzungen oder Fehlstellungen mit gesicherten oder anzunehmenden neurologischen Ausfällen sollten möglichst frühzeitig operiert werden, sofern es der Gesamtzustand erlaubt (idealerweise „day 1 surgery“).
3.5.2 GPP	Bei entsprechender Frakturmorphologie mit Kompression des Spinalkanals oder translatorischer Verletzung ohne Möglichkeit zum Ausschluss einer spinalen neurologischen Schädigung soll bis zum Ausschluss von einer solchen ausgegangen werden
3.5.3 GoR B	Instabile Wirbelsäulenverletzungen ohne Neurologie sollten operativ versorgt werden.
3.5.4 GoR B	Die initiale Stabilisierung sollte unter Berücksichtigung der Gesamtsituation frühzeitig erfolgen.
3.5.5 GPP	Stabilisierungen an der HWS können abhängig von der Verletzung ventral und dorsal oder in Ausnahmefällen mittels Halofixateur durchgeführt werden.
3.5.6 GPP	Bei Verletzungen der thorakalen und lumbalen Wirbelsäule sollte der dorsale Fixateur interne als primäre Operationsmethode zur Stabilisierung eingesetzt werden.

Zusätzliche Empfehlungen aus internationalen Leitlinien

Internationale Leitlinien enthalten zusätzliche, konkretere Empfehlungen zu Wirbelsäulenverletzungen:

- NICE Guideline: Spinal injury: assessment and initial management, Feb. 2016

3.6 Unterkiefer und Mittelgesicht

Nr. GoR	Empfehlungstexte, *Kommentar zum Abgleich*
3.6.1 GoR A	Bei Unterkiefer- und Mittelgesichtsverletzungen sollen eine primäre Sicherung der Atemwege und eine Blutungsstillung im Mund-, Kiefer- und Gesichtsbereich erfolgen.
3.6.2 GoR B	Weichteilverletzungen sollten im Rahmen der ersten OP-Phase versorgt werden.
3.6.3 GoR B	Es sollte eine Sofortversorgung, gegebenenfalls eine rasche Versorgung des Zahn-Alveolarfortsatz-Traumas angestrebt werden.
3.6.4 GoR 0	In Abhängigkeit von der Gesamtverletzungsschwere kann die Versorgung von Mittelgesichts- und Unterkieferfrakturen in der ersten OP-Phase oder sekundär erfolgen.

3.7 Hals

Nr. GoR	Empfehlungstexte, *Kommentar zum Abgleich*
3.7.1 GoR A	Sofern zuvor noch keine Intubation oder Tracheotomie erfolgt ist, sollen vor Einleitung einer Intubationsnarkose alle die Atemwege betreffenden Befunde gesichtet und bewertet werden.
3.7.2 GoR A	Es sollen Intubationshilfsmittel und ein Koniotomieset zur unmittelbaren Verfügung gehalten werden. „Difficult Airway"-Algorithmen sollen hierbei Beachtung finden.
3.7.3 GoR A	Eine zuvor ausgeführte Koniotomie soll operativ verschlossen werden, erforderlichenfalls soll eine Tracheotomie vorgenommen werden.
3.7.4 GoR B	Penetrierende Traumen des Ösophagus sollten innerhalb von 24 Stunden einer primär rekonstruktiven Therapie zugeführt werden.

3.8 Obere Extremitäten

Nr. GoR	Empfehlungstexte, *Kommentar zum Abgleich*
3.8.1 GoR B	Die operative Versorgung von Frakturen langer Röhrenknochen der oberen Extremitäten sollte frühzeitig erfolgen.
3.8.2 GoR B	Die Entscheidung zur Amputation oder zum Extremitätenerhalt bei Schwerstverletzung der oberen Extremität sollte als Individualentscheidung vorgenommen werden. Hierbei spielen der lokale und allgemeine Zustand des Patienten die entscheidende Rolle.
Int. LL GoR B	**AAOS/METRC Clinical Practice Guideline on Limb Salvage or Early Amputation, Dez. 2019:** The Physician team should evaluate overall burden of injury and patient physiology when considering if initial limb salvage is advisable (p. 21). *Empfehlungen entsprechen sich sinngemäß*

3.8.3 GoR 0	In seltenen Fällen und bei extrem schweren Verletzungen kann eine Amputation empfohlen werden.
Int. LL GPP	**AAOS/METRC Clinical Practice Guideline on Limb Salvage or Early Amputation, Dez. 2019:** In the absence of reliable evidence, the workgroup suggests the physician team should prioritize patient survival in the limb reconstruction vs. amputation decision. Limb specific damage control (i.e. temporizing) measures or immediate amputation should be considered when further attempts at definitive salvage will increase risk of mortality (p. 21). *Empfehlung konkreter*
3.8.4 GoR B	Die operative Versorgung oder endovaskuläre Versorgung von Gefäßverletzungen sollte, sofern es die Schwere der Gesamtverletzung zulässt, frühestmöglich, d.h. direkt nach Behandlung der vital bedrohenden Verletzungen, erfolgen.
3.8.5 GoR B	Verletzungen mit Nervenbeteiligung sollten in Abhängigkeit von der Art des Nervenschadens zusammen mit der Stabilisierung versorgt werden.

3.9 Hand

3.9.1 GoR B	Geschlossene Frakturen und Luxationen sollten in der ersten OP-Phase vorzugsweise konservativ behandelt werden.
3.9.2 GoR A	Luxationen sollen in der ersten OP-Phase reponiert und retiniert werden.
3.9.3 GoR B	Bei offenen Frakturen und Luxationen sollten ein primäres Débridement und eine Stabilisierung durch Drähte oder Fixateur externe erfolgen.
3.9.4 GoR A	Bei perilunärer/n Luxation/sfrakturen soll die Reposition in der ersten OP-Phase, erforderlichenfalls offen, vorgenommen werden.
3.9.5 GoR A	Die Indikationsstellung zur Replantation soll sich an der Gesamtverletzungsschwere nach dem Grundsatz „life before limb" orientieren.
Int. LL GoR B	**AAOS/METRC Clinical Practice Guideline on Limb Salvage or Early Amputation, Dec. 2019:** In the absence of reliable evidence, the workgroup suggests the physician team should prioritize patient survival in the limb reconstruction vs. amputation decision. Limb specific damage control (i.e. temporizing) measures or immediate amputation should be considered when further attempts at definitive salvage will increase risk of mortality (p.21). *Empfehlungen entsprechen sich sinngemäß*
3.9.6 GoR B	Dabei (Indikationsstellung) sollten der Lokalbefund und patientenabhängige Faktoren berücksichtigt werden.
3.9.7 GoR B	Wie auch bei isolierten Handverletzungen sollte eine Replantation besonders bei Verlust des Daumens, mehrerer Finger oder bei Amputation in Höhe von Mittelhand/Handwurzel/Handgelenk sowie bei allen kindlichen Amputations-verletzungen angestrebt werden.
3.9.8 GoR B	Einzelne Finger sollten bei Amputation proximal des Superficialis-Sehnenansatzes (Mittelgliedbasis) nicht replantiert werden.
3.9.9 GoR B	Die Entscheidung zur Durchführung aufwendiger Erhaltungsversuche an der Hand ist eine Individualentscheidung. Sie soll die Gesamtverletzungsschwere und die Schwere der Handverletzung berücksichtigen.
Int. LL GoR B	**AAOS/METRC Clinical Practice Guideline on Limb Salvage or Early Amputation, Dec. 2019:**

	The Physician team should evaluate overall burden of injury and patient physiology when considering if initial limb salvage is advisable (p.21). *Empfehlungen entsprechen sich sinngemäß*
3.9.10 GoR B	In der ersten OP-Phase sollten Débridement und knöcherne Stabilisierung durchgeführt werden.
3.9.11 GoR B	Die Erstbehandlung ausgedehnter Haut-Weichteil-Schäden sollte ein gründliches Débridement mit anschließendem Feuchthalten der nicht primär verschließbaren Wundflächen beinhalten.
3.9.12 GoR B	Thermisch/chemisch geschädigte, vollständig avitale Hautareale sollten initial débridiert werden.
3.9.13 GoR B	Bei tiefreichender und großflächiger thermischer/chemischer Schädigung sollte eine Escharotomie analog zum Vorgehen beim Kompartmentsyndrom durchgeführt werden.
3.9.14 GoR B	Aufwendige Sehnennähte sollten nicht primär durchgeführt werden.
3.9.15 GoR 0	Bei vermuteten geschlossenen Nervenverletzungen kann auf aufwendige diagnostische Maßnahmen oder operative Freilegungen primär verzichtet werden.
3.9.16 GoR B	Die operative Rekonstruktion offener Nervenverletzungen sollte als verzögerte primäre Naht durchgeführt werden.
3.9.17 GoR 0	Bei klinischem Verdacht auf ein Kompartmentsyndrom der Hand kann eine apparative Druckmessung vorgenommen werden.
Int. LL GoR B	**AAOS/METRC Clinical Practice Guideline on Management of Acute Compartment Syndrome, Dec. 2018:** Moderate evidence supports that intracompartmental pressure monitoring assists in diagnosing acute compartment syndrome (p.27). *Empfehlungen entsprechen sich sinngemäß*
3.9.18 GoR A	Beim Vorliegen eines manifesten Kompartmentsyndroms an der Hand soll die Fasziotomie umgehend erfolgen.
Int. LL GPP	**AAOS/METRC Clinical Practice Guideline on Management of Acute Compartment Syndrome, Dec. 2018:** In the absence of reliable evidence, it is the opinion of the work group that fasciotomy technique (e.g. one vs two incision, placement of incisions) is less important than achieving complete decompression of the compartments of the affected extremity (p.44). *Empfehlungen entsprechen sich sinngemäß; AAOS Empfehlung betont Entlastung des Kompartments, Technik hier zweitrangig; S3-Leitlinie benennt auch keine konkrete Technik*

3.10 Untere Extremitäten

Nr. GoR	**Empfehlungstexte,** *Kommentar zum Abgleich*
3.10.1 GoR B	Bei isolierten und multiplen Frakturen der unteren Extremität sollte beim stabilen Zustand des Patienten eine primär-definitive osteosynthetische Versorgung angestrebt werden.
3.10.2 GoR B	Bei Patienten, deren Zustand nicht als stabil beurteilt wird, sollte eine primär temporäre Versorgung angestrebt werden.
3.10.3 GoR B	Zur definitiven Versorgung einer Femurschaftfraktur polytraumatisierter Patienten sollte die Verriegelungsmarknagelung als Operationsverfahren der Wahl durchgeführt werden.

3.10.4 GoR A	Luxationen der unteren Extremität sollen zum frühestmöglichen Zeitpunkt reponiert und retiniert werden.
3.10.5 GoR A	Bei der operativen Versorgung sowohl geschlossener als auch offener Frakturen der unteren Extremität soll eine perioperative Antibiotikaprophylaxe erfolgen.
3.10.6 GoR B	Die operative oder endovaskuläre Versorgung von Gefässverletzungen der unteren Extremität sollte, sofern es die Schwere der Gesamtverletzung zulässt, frühestmöglich d.h. direkt nach der Behandlung der vital bedrohenden Verletzungen, erfolgen.
3.10.7 GoR A	Beim Kompartmentsyndrom der unteren Extremität sollen die sofortige Kompartmententlastung und Fixation einer begleitenden Fraktur erfolgen.
Int. LL GPP	**AAOS/METRC Clinical Practice Guideline on Management of Acute Compartment Syndrome, Dez. 2018:** In the absence of reliable evidence, it is the opinion of the work group that operative fixation (external or internal) should be performed for initial stabilization of long bone fractures with concomitant acute compartment syndrome requiring fasciotomy (p. 50). *Empfehlungen entsprechen sich sinngemäß*
3.10.8 GoR B	Die Entscheidung zum Extremitätenerhalt oder zur Amputation bei Schwerstverletzung der unteren Extremität sollte als Individualentscheidung vorgenommen werden. Hierbei spielen der lokale und allgemeine Zustand des Patienten die entscheidende Rolle.
Int. LL GoR B	**AAOS/METRC Clinical Practice Guideline on Limb Salvage or Early Amputation, Dez. 2019:** The Physician team should evaluate overall burden of injury and patient physiology when considering if initial limb salvage is advisable (p. 21). *Empfehlungen entsprechen sich sinngemäß*
Int. LL GoR B	**AAOS/METRC Clinical Practice Guideline on Limb Salvage or Early Amputation, Dez. 2019:** Physicians should consider the cumulative injury burden (soft tissue, vascular, nerve, bone, joint) of the limb when counseling patients on anticipated outcomes of and making recommendations on when to pursue limb salvage or amputation treatment (p. 21). *AAOS/METRC Empfehlung enthält ergänzende Details*

Zusätzliche Empfehlungen aus internationalen Leitlinien

Internationale Leitlinien mit zusätzlichen, konkreteren Empfehlungen zu Extremitätenverletzungen:

- AAOS/METRC Clinical Practice Guideline on Management of Acute Compartment Syndrome, Dez. 2018
- AAOS/METRC Clinical Practice Guideline on Limb Salvage or Early Amputation, Dez. 2019

3.11 Fuß

Nr. GoR	Empfehlungstexte, *Kommentar zum Abgleich*
3.11.1 GoR A	Beim Vorliegen eines manifesten Kompartmentsyndroms des Fußes soll die Fasziotomie umgehend erfolgen.
Int. LL GPP	**AAOS/METRC Clinical Practice Guideline on Management of Acute Compartment Syndrome, Dec. 2018:** In the absence of reliable evidence, it is the opinion of the work group that fasciotomy technique (e.g. one vs two incision, placement of incisions) is less important than achieving complete decompression of the compartments of the affected extremity (p.44).

	Empfehlungen entsprechen sich sinngemäß; AAOS Empfehlung betont Entlastung des Kompartments, Technik hier zweitrangig; S3-Leitlinie benennt auch keine konkrete Technik
3.11.2 GoR 0	Bei klinischem Verdacht auf ein Kompartmentsyndrom des Fußes kann eine apparative Druckmessung vorgenommen werden.
Int. LL GoR B	**AAOS/METRC Clinical Practice Guideline on Management of Acute Compartment Syndrome, Dec. 2018:** Moderate evidence supports that intracompartmental pressure monitoring assists in diagnosing acute compartment syndrome (p. 27). *Empfehlungen entsprechen sich sinngemäß; S3-Leitlinie benennt Empfehlungen für jeweils konkrete anatomische Region (hier Fuß), AAOS allgemeiner gehalten.*
3.11.3 GoR B	Die Entscheidung zur Amputation am Fuß sollte als Individualentscheidung vorgenommen werden.
Int. LL GoR B	**AAOS/METRC Clinical Practice Guideline on Limb Salvage or Early Amputation, Dec. 2019:** The Physician team should evaluate overall burden of injury and patient physiology when considering if initial limb salvage is advisable (p. 6). *Empfehlungen entsprechen sich sinngemäß*
3.11.4 GoR 0	Die Replantation des Fußes kann beim Polytrauma generell nicht empfohlen werden.
3.11.5 GoR B	Luxationen und Luxationsfrakturen der Fußwurzeln und des Mittelfußes sollten so früh wie möglich reponiert und stabilisiert werden.

3.12 Urogenitaltrakt

Nr. GoR	Empfehlungstexte, *Kommentar zum Abgleich*
3.12.1 GoR B	Schwerste Nierenverletzungen (Grad V nach AAST-Klassifikation) sollten operativ exploriert werden.
3.12.2 GoR B	Bei Nierenverletzungen <Grad V sollte bei stabilen Kreislaufverhältnissen ein primär konservatives Vorgehen eingeleitet werden.
3.12.3 GoR 0	Sofern andere Verletzungen eine Laparotomie erforderlich machen, können mittelschwere Nierenverletzungen des Grades III oder IV operativ exploriert werden.
3.12.4 GoR 0	Eine arterielle Nierengefäßverletzung kann durch eine endovaskuläre Therapie versorgt werden.
3.12.5 GoR B	Je nach Art und Schwere der Verletzung und Begleitverletzungen sollte eine Nierenverletzung organerhaltend versorgt werden.
3.12.6 GoR B	Die primäre Nephrektomie sollte den Grad V Verletzungen vorbehalten sein.
3.12.7 GoR B	Intraperitoneale Harnblasenrupturen sollten chirurgisch exploriert werden.
3.12.8 GoR B	Extraperitoneale Harnblasenrupturen ohne Beteiligung des Blasenhalses sollten konservativ durch Harnableitung therapiert werden.
3.12.9 GoR B	Komplette Rupturen der Urethra sollten in der ersten OP-Phase durch suprapubische Harnableitung therapiert werden.

3.12.10 GoR 0	Die Harnableitung kann durch eine Harnröhrenschienung ergänzt werden.
3.12.11 GoR B	Sofern eine Beckenfraktur oder eine andere intraabdominelle Verletzung eine Operation ohnehin notwendig macht, sollten Urethrarupturen in derselben Sitzung versorgt werden.

3.13 Thermische Hautverletzung und Verbrennung

Nr. GoR	**Empfehlungstexte,** *Kommentar zum Abgleich*
3.13.1 GPP	Beim zusätzlichen Vorhandensein einer Brandverletzung beim Schwerverletzten gelten die gleichen präklinischen Behandlungsprioritäten.
3.13.2 GPP	Verbrennungsverletzungen beim Schwerverletzten sollten nicht gekühlt werden.
3.13.3 GPP	Der Schwerverletzte mit Brandverletzung sollte in das nächstgelegene Traumazentrum transportiert werden. Bei gleicher Erreichbarkeit ist ein Traumazentrum mit assoziiertem Brandverletztenzentrum vorzuziehen.
3.13.4 GPP	Beim zusätzlichen Vorhandensein einer Brandverletzung beim Schwerverletzten sollen die gleichen Behandlungsprioritäten im Schockraum gelten.
3.13.5 GPP	Bei Verbrennungen im Stammbereich, die die Atemmechanik beeinträchtigen, soll unverzüglich eine Escharotomie durchgeführt werden.
3.13.6 GPP	Bei Verbrennungen der Extremitäten, die die Perfusion beeinträchtigen, soll zeitnah eine Escharotomie durchgeführt werden.
3.13.7 GPP	Nach Stabilisierung der Vitalfunktionen und notwendiger operativer Erstversorgung soll der schwer brandverletzte Patient in ein Brandverletztenzentrum mit assoziiertem überregionalem Traumazentrum verlegt werden.

Appendix B. Interessenkonflikte

Tabelle zur Erklärung von Interessen und Umgang mit Interessenkonflikten

Im Folgenden sind die Interessenerklärungen als tabellarische Zusammenfassung dargestellt sowie die Ergebnisse der Interessenkonfliktbewertung und Maßnahmen, die nach Diskussion der Sachverhalte von der der LL-Gruppe beschlossen und im Rahmen der Konsensuskonferenz umgesetzt wurden.

Leitlinienkoordination: Bieler, Dan
Leitlinie: Polytrauma / Schwerverletzten-Behandlung
Registernummer: 187/023

	Tätigkeit als Berater*in und/oder Gutachter*in	Mitarbeit in einem Wissenschaftlichen Beirat (advisory board)	Bezahlte Vortrags-/oder Schulungs-tätigkeit	Bezahlte Autor*innen-/oder Coautor*innenschaft	Forschungs-vorhaben/ Durchführung klinischer Studien	Eigentümer*innen-interessen (Patent, Urheber*innen-recht, Aktienbesitz)	Indirekte Interessen	Von COI betroffene Themen der Leitlinie, Einstufung bzgl. der Relevanz, Konsequenz
Priv.-Doz. Dr. med. Achatz, Gerhard	Nein	Nein	AUC Akademie der Unfallchirurgie	Nein	Traumaregister der AUC Akademie der Unfallchirurgie	Nein	Mitglied: Deutsche Gesellschaft für Unfallchirurgie: - AG EKTC - NIS, Wissenschaftliche Tätigkeit: - Allgemeine und Spezielle Verletztenversorgung, Schwerverletztenversorgung - Schulter- und Ellenbogengelenk	Kapitel MANV (gering), Limitierung von Leitungsfunktion Kapitel MANV
Prof. Dr. med. Albrecht, Thomas	Siemens Healthineers	Nein	Pharmacept, SIRTEX	Nein	Boston Scientific	Nein	Wissenschaftliche Tätigkeit: Onkologische Leberinterventionen, Drug Eluting Devices für periphere Interventionen, Wissenschaftliche Tätigkeit: Interventionsradiologie, Body Imagin	kein Thema (keine), keine
Prof. Dr. med. Bader, Werner	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: DEGUM, Sprecher des Arbeitskreises Mammasonographie und Mitglied des erweiterten Vorstandes der DEGUM, Mitglied: Mitglied der	kein Thema (keine), keine

	Tätigkeit als Berater*in und/oder Gutachter*in	Mitarbeit in einem Wissenschaftlichen Beirat (advisory board)	Bezahlte Vortrags-/oder Schulungs-tätigkeit	Bezahlte Autor*innen-/oder Coautor*innenschaft	Forschungs-vorhaben/ Durchführung klinischer Studien	Eigentümer*innen-interessen (Patent, Urheber*innen-recht, Aktienbesitz)	Indirekte Interessen	Von COI betroffene Themen der Leitlinie, Einstufung bzgl. der Relevanz, Konsequenz
							AGO, Wissenschaftliche Tätigkeit: Zertifiziertes Gynäkologisches Krebszentrum Urogynäkologie, Schwerpunkt Operative Gynäkologie	
Dr. Barbara, Prediger	Nein	Nein	Nein	Nein	MD Bund	Nein	Mitglied: Mitglied deutsches Netzwerk Versorgungsforschung	kein Thema (keine), keine
Dr. med. Becker, Lars	Nein	Nein	Arbeitsgemeinschaft für Osteosynthesefragen (AO)	Nein	Nein	Nein	Mitglied: Mitglied Deutsche Gesellschaft für Unfallchirurgie, Mitarbeit Sektion NIS, Mitglied: Mitglied Deutsche Gesellschaft für Schulter- und Ellenbogenchirurgie, Mitglied: Mitglied Arbeitsgemeinschaft für Osteosynthesefragen, Instruktor auf OP-Kursen, Wissenschaftliche Tätigkeit: Schockraumalarmierungskriterien sowie Thoraxtrauma der Sektion NIS, Wissenschaftliche Tätigkeit: Polytraumaversorgung, Thoraxtrauma, Alterstraumatologie, Beteiligung an Fort-/Ausbildung: Arbeitsgemeinschaft für Osteosynthesefragen, Instruktor auf OP-Kursen	kein Thema (keine), keine
Becker, Tobias	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: Deutsche Gesellschaft für Fachkrankenpflege und Funktionsdienste e.V. Mitglied stellv. Landesbeauftragter Bayern Sprecher der Landesbeauftragten, Mitglied: Deutsche Interdisziplinäre Vereinigung für	kein Thema (keine), keine

	Tätigkeit als Berater*in und/oder Gutachter*in	Mitarbeit in einem Wissenschaftlichen Beirat (advisory board)	Bezahlte Vortrags-/oder Schulungs-tätigkeit	Bezahlte Autor*innen-/oder Coautor*innenschaft	Forschungs-vorhaben/ Durchführung klinischer Studien	Eigentümer*innen-interessen (Patent, Urheber*innen-recht, Aktienbesitz)	Indirekte Interessen	Von COI betroffene Themen der Leitlinie, Einstufung bzgl. der Relevanz, Konsequenz
							Intensiv- und Notfallmedizin Mitglied, Beteiligung an Fort-/Ausbildung: Fächerübergreifende Arbeitsgruppe der Deutschen Krankenhausgesellschaft e.V. Konzeption der DKG Empfehlung für pflegerische Weiterbildungen, Beteiligung an Fort-/Ausbildung: Unterarbeitsgruppe der Deutschen Krankenhausgesellschaft e.V. Konzeption der DKG Empfehlung für die Weiterbildung Notfallpflege, Beteiligung an Fort-/Ausbildung: Unterarbeitsgruppe der Deutschen Krankenhausgesellschaft e.V. Konzeption der DKG Empfehlung für die Weiterbildung Intensiv-/Anästhesiepflege	
Prof. Dr. med. Bender, Andreas	Nein	Nein	EverPharma	Nein	BMBF, EU/FP7	Nein	Mitglied: Mitglied des Vorstandes Deutsche Gesellschaft für Neurorehabilitation, Mitglied: Mitglied Deutsche Gesellschaft für Neurologie Koordinator Leitlinie Hypnotisch Ischämische Enzephalopathie, Wissenschaftliche Tätigkeit: Neurologische Rehabilitation Neurologische Intensivmedizin	kein Thema (keine), keine
Dr. med. Till	Nein	Nein	Nein	Nein	Nein	Nein	Nein	kein Thema (keine), keine

	Tätigkeit als Berater*in und/oder Gutachter*in	Mitarbeit in einem Wissenschaftlichen Beirat (advisory board)	Bezahlte Vortrags-/oder Schulungs-tätigkeit	Bezahlte Autor*innen-/oder Coautor*innenschaft	Forschungs-vorhaben/ Durchführung klinischer Studien	Eigentümer*innen-interessen (Patent, Urheber*innen-recht, Aktienbesitz)	Indirekte Interessen	Von COI betroffene Themen der Leitlinie, Einstufung bzgl. der Relevanz, Konsequenz
Berk								
Prof. Dr. med. Bernhard, Michael	Nein	Nein	Nein	Nein	INDEED in Kooperation mit der Charité, Forschungsförderung durch die Björn Steiger Stiftung, AKTIN, Forschungsförderung durch BINZ Stiftung, Forschungsförderung durch die DGINA	Nein	Mitglied: Deutsche Gesellschaft für Anästhesiologie und Intensivmedizin (DGINA), Mitglied: Deutsche Sepsisgesellschaft (DSG), Mitglied: Deutsche Gesellschaft für Interdisziplinäre Notfall- und Akutmedizin (DGINA), Mitglied: Arbeitsgemeinschaft Notärzte in Nordrhein-Westfalen (AGNNW), Mitglied: Deutsche Vereinigung für Intensiv- und Notfallmedizin (DIVI), Wissenschaftliche Tätigkeit: Zentrale Notaufnahme, Klinische Akut- und Notfallmedizin, Notfallmedizin, Schockraum, Beteiligung an Fort-/Ausbildung: Fortbildungsveranstaltung der Zentralen Notaufnahme des Universitätsklinikums Düsseldorf, Beteiligung an Fort-/Ausbildung: Düsseldorfer Triple ED Day	kein Thema (keine), keine
Priv.-Doz. Dr. med. Bieler, Dan	privaten und den gesetzlichen Unfallversicherungen	Nein	AUC GmbH, bikmed GmbH	AUC GmbH	Nein	Nein	Mitglied: Deutsche Gesellschaft für Unfallchirurgie, Mitglied: Deutsche Gesellschaft für Chirurgie, Mitglied: Deutsche Gesellschaft für Wehrmedizin und Wehrpharmazie, Mitglied: Sprecher Arbeitskreis TraumaRegister DGU, Mitglied: Boardmitglied Sektion Notfall-, Intensivmedizin und Schwerverletztenversorgung, Mitglied: AG Einsatz-,	Kapitel MANV (gering), Limitierung von Leitungsfunktion Kapitel MANV

	Tätigkeit als Berater*in und/oder Gutachter*in	Mitarbeit in einem Wissenschaftlichen Beirat (advisory board)	Bezahlte Vortrags-/oder Schulungs-tätigkeit	Bezahlte Autor*innen-/oder Coautor*innenschaft	Forschungs-vorhaben/ Durchführung klinischer Studien	Eigentümer*innen-interessen (Patent, Urheber*innen-recht, Aktienbesitz)	Indirekte Interessen	Von COI betroffene Themen der Leitlinie, Einstufung bzgl. der Relevanz, Konsequenz
							Katastrophen- und Taktische Chirurgie der DGU, Wissenschaftliche Tätigkeit: Traumaversorgung, Schwerverletztenversorgung, chirurgische. Versorgungsprinzipien, Bildgebung beim Trauma, Wissenschaftliche Tätigkeit: Unfallchirurgischer Oberarzt an einem Maximalversorger, Beteiligung an Fort-/Ausbildung: Auc GmbH, bikmed GmbH, TDSC-Mitentwickler, TDSC-Direktor, ATLS-Direktor	
Priv.-Doz. Dr. med. Braun, Sebastian	Nein	Nein	Nein	Nein	Nein	Nein	Wissenschaftliche Tätigkeit: -OP-Koordination -Perioperative Aspekte Vsizeralchirurgie -Kinderanästhesie , Beteiligung an Fort-/Ausbildung: -Airway-Workshop; kliniksintern -Vorlesung BLS, ACLS im Rahmen des studentischen Curriculums -Medizinische Notfälle beim Zahnarzt (11.5.2019) --> Airway-Workshop/BLS, ACLS ohne Honorar	kein Thema (keine), keine
Dr. med. Braunschweig, Rainer	Philips	Philips	Nein	Nein	Nein	Nein	Mitglied: AG MSK der Deutschen Röntgengesellschaft, Wissenschaftliche Tätigkeit: muskulo-skelettale Bildgebung, Wissenschaftliche Tätigkeit: msk-Bildgebung	Rückfrage über die Höhe der Honorare für Philips wurde mit der Angabe > € 3000/Jahr beantwortet, daher liegt ein moderater Interessenskonflikt für Bildgebung/Großgerätediagnostik vor. (moderat), Stimmenthaltung

	Tätigkeit als Berater*in und/oder Gutachter*in	Mitarbeit in einem Wissenschaftlichen Beirat (advisory board)	Bezahlte Vortrags-/oder Schulungs-tätigkeit	Bezahlte Autor*innen-/oder Coautor*innenschaft	Forschungs-vorhaben/ Durchführung klinischer Studien	Eigentümer*innen-interessen (Patent, Urheber*innen-recht, Aktienbesitz)	Indirekte Interessen	Von COI betroffene Themen der Leitlinie, Einstufung bzgl. der Relevanz, Konsequenz
								kein Thema (noch nicht bewertet), keine
Breuing, Jessica	Nein	Nein	St. Anna Klinik Wuppertal	Nein	AWMF, Leitlinienprogramm Onkologie, ÄZQ, Bundesverband Prostatakrebs Selbsthilfe e.V., Frauenselbsthilfe Krebs, Ärztliches Zentrum für Qualität in der Medizin, Deutsche Gesellschaft für Sportmedizin und Prävention e.V.	Nein	Mitglied: Deutsches Netzwerk Evidenzbasierte Medizin e.V. (Mitglied), Mitglied: Deutsche Gesellschaft für Ernährung e.V. (Mitglied)	kein Thema (keine), keine
Dr. med. Düsing, Helena	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: Mitglied der Sektion NIS der DGU, Mitglied: Instruktor ATLS	kein Thema (keine), keine
Prof. Dr. med. Franke, Axel	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: NSB der DGU, NIS der DGU, AG EKTC der DGU	Kapitel MANV (gering), Limitierung von Leitungsfunktion Kapitel MANV
Prof. Dr. med. Friemert, Benedikt	privaten und den gesetzlichen Unfallversicherungen	Nein	AUC GmbH, bikmed GmbH	Nein	Nein	Nein	Mitglied: Deutsche Gesellschaft für Unfallchirurgie - Präsident der Gesellschaft 2022, Mitglied: Deutsche Gesellschaft für Chirurgie, Mitglied: Deutsche Gesellschaft für Wehrmedizin und Wehrpharmazie, Mitglied: Leiter der AG Einsatz-, Katastrophen- und Taktische Chirurgie der DGU, Wissenschaftliche Tätigkeit: Traumaversorgung,	Kapitel MANV (gering), Keine leitende Funktion im Kapitel MANV

	Tätigkeit als Berater*in und/oder Gutachter*in	Mitarbeit in einem Wissenschaftlichen Beirat (advisory board)	Bezahlte Vortrags-/oder Schulungs-tätigkeit	Bezahlte Autor*innen-/oder Coautor*innenschaft	Forschungs-vorhaben/ Durchführung klinischer Studien	Eigentümer*innen-interessen (Patent, Urheber*innen-recht, Aktienbesitz)	Indirekte Interessen	Von COI betroffene Themen der Leitlinie, Einstufung bzgl. der Relevanz, Konsequenz
							Schwerverletztenversorgung, chirurgische. Versorgungsprinzipien, , Wissenschaftliche Tätigkeit: Unfallchirurgie und Orthopädie, Beteiligung an Fort-/Ausbildung: Auc GmbH, bikmed GmbH, TDSC-Mitentwickler, TDSC-Direktor, ATLS-Instruktor	
Prof. Dr. med. Germer, Christoph	Nein	Nein	Nein	Nein	Nein	Nein	Nein	kein Thema (keine), keine
Dr. Gooßen, Käthe	Nein	Nein	Deutsche Krebsgesellschaft e.V.	Nein	Deutsche Gesellschaft für Sportmedizin und Prävention e.V.	Bayer AG, Bayer AG	Mitglied: Deutsches Netzwerk Evidenzbasierte Medizin e.V. (Mitglied), Wissenschaftliche Tätigkeit: Methoden der evidenzbasierten Medizin Erstellung systematischer Reviews Leitlinienmethodik	kein Thema (keine), keine
Prof. Dr. Gräsner, Jan-Thorsten	Weimann-Emergency, Gerichtsgutachten	Weimann-Emergency Seacare	Weinmann Zoll Fresenius Seacare	Thieme Springer Elsevier	HALLIGeMED, Ministerium für Gesundheit und Ministerium für Inneres des Landes Schleswig-Holstein, BBK DAMP Stiftung BINZ Stiftung BMBF	Nein	Wissenschaftliche Tätigkeit: Notfalllmedizin Reanimationsversorgung Katastrophenschutz, Wissenschaftliche Tätigkeit: Notfallmedizin, Beteiligung an Fort-/Ausbildung: Direktor des Instituts für Rettungs- und Notfalllmedizin	kein Thema (keine), keine
PD Dr. med. Gümbel, Denis	Nein	Nein	Nein	Nein	Nein	Nein	Nein	kein Thema (keine), keine
Dr. med. Güsgen, Christoph	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: DGCH DGAV BDC	kein Thema (keine), keine

Dr. Gooßen, Käthe	Nein	Nein	Deutsche Krebsgesellschaft e.V.	Nein	Deutsche Gesellschaft für Sportmedizin und Prävention e.V.	Bayer AG, Bayer AG	Mitglied: Deutsches Netzwerk Evidenzbasierte Medizin e.V. (Mitglied), Wissenschaftliche Tätigkeit: Methoden der evidenzbasierten Medizin Erstellung systematischer Reviews Leitlinienmethodik	kein Thema (keine), keine
PD Dr. med. Hanken, Henning	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: Mitglied und Lehrkörper der AOCMF, Wissenschaftliche Tätigkeit: Resorbierbare Osteosynthesesysteme auf Magnesiumbasis, Wissenschaftliche Tätigkeit: Versorgung von Traumata im klinischen Alltag	kein Thema (keine), keine
Prof. Dr. med. Hartensuer, Rene	Spineart, Spineart	Nein	Brainlab, medi, Sanofi, AEKWL, AUC	Thieme	Nein	Nein	Mitglied: Sektion Notfallmedizin, Intensivmedizin und Schwerverletztenversorgung (NIS) DGU - Schriftführer, Mitglied: Leitlinienkommission der Deutschen Wirbelsäulengesellschaft - Mitglied, Mitglied: Ethikkommission der AEKWL - Mitglied, Wissenschaftliche Tätigkeit: Biomechanik Wirbelsäule Telemedizin Schwerverletztenversorgung Beckenchirurgie, Wissenschaftliche Tätigkeit: Wirbelsäulenchirurgie Beckenchirurgie Gelenk-Rekonstruktion Schwerverletztenversorgung Telemedzizin	Wirbelsäule (gering), Limitierung von Leitungsfunktion
Prof. Dr. med. Helm, Matthias	Nein	Nein	Nein	Nein	Nein	Nein	Nein	kein Thema (keine), keine
Dr. med. Herath, Steven	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: Deutsche Gesellschaft für Unfallchirurgie, Vorsitzender der AG Becken, Mitglied:	kein Thema (keine), keine

Dr. Gooßen, Käthe	Nein	Nein	Deutsche Krebsgesellschaft e.V.	Nein	Deutsche Gesellschaft für Sportmedizin und Prävention e.V.	Bayer AG, Bayer AG	Mitglied: Deutsches Netzwerk Evidenzbasierte Medizin e.V. (Mitglied), Wissenschaftliche Tätigkeit: Methoden der evidenzbasierten Medizin Erstellung systematischer Reviews Leitlinienmethodik	kein Thema (keine), keine
							Deutsche Gesellschaft für Unfallchirurgie, Stv. Vorsitzender der AG Becken, Mitglied: Mitglied AO Trauma Deutschland, Wissenschaftliche Tätigkeit: Becken- und Acetabulumchirurgie, Knochenheilung, Wissenschaftliche Tätigkeit: Becken- und Acetabulumchirurgie, Beteiligung an Fort-/Ausbildung: Organisation und Programmgestaltung AO Trauma Homburger Beckenkurses	
Hertwig, Miriam	Nein	Nein	Nein	Nein	Nein	Nein	Wissenschaftliche Tätigkeit: Employment as medical doctor in trauma surgery and emergency medicine (full-time) before changing to IFOM which means beeing actively involved in patient care., Wissenschaftliche Tätigkeit: Employment as medical doctor in emergency medicine while working for IFOM as additional part-time job (6h per week) which means beeing actively involved in patient care.	kein Thema (keine), keine
Hess, Simone	Nein	Nein	Nein	Nein	Nein	Nein	Nein	kein Thema (keine), keine
PD Dr. med. Hilbert-Carius, Peter	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: DGAI, Wissenschaftliche Tätigkeit: Polytraumaversorgung, TIC, REBOA, HEMS, Wissenschaftliche Tätigkeit: Anästhesie, Notfallmedizin, Traumaversorgung	kein Thema (keine), keine

Dr. Gooßen, Käthe	Nein	Nein	Deutsche Krebsgesellschaft e.V.	Nein	Deutsche Gesellschaft für Sportmedizin und Prävention e.V.	Bayer AG, Bayer AG	Mitglied: Deutsches Netzwerk Evidenzbasierte Medizin e.V. (Mitglied), Wissenschaftliche Tätigkeit: Methoden der evidenzbasierten Medizin Erstellung systematischer Reviews Leitlinienmethodik	kein Thema (keine), keine
Prof. Dr. med. Hildebrand, Frank	Stryker	Eur Society for Trauma and Emergency medicine , DFG Fachkollegium	Nein	Nein	DFG, Bundesministerium der Verteidigung, PAION	keine	Mitglied: DGU und DGOU: Erweiterter Vorstand ESTES: Advisory Board AO: Wissenschaftlicher Beirat, Wissenschaftliche Tätigkeit: Polytrauma Frakturheilung Beckenfrakturen Wirbelsäulenfrakturen, Wissenschaftliche Tätigkeit: Allgemeine Traumaversorgung Beckenfrakturen Rekonstruktion posttraumatischer Fehlstellungen, Beteiligung an Fort-/Ausbildung: Wissenschaftliche Leitung von Kursen der Arbeitsgemeinschaft Osteosynthese und des Bunds Deutscher Chirurgen , Persönliche Beziehung: keine	kein Thema (keine), keine
Dr. med. Hinck, Daniel	Nein	Nein	Akademie für Unfallchirurgie	Thieme/Springer Verlag	Speed Care Mineral	Nein	Mitglied: Deutsche Gesellschaft für Gefäßchirurgie und Gefäßmedizin Vereinigung Norddeutscher Chirurgen, Wissenschaftliche Tätigkeit: Hämostase, Beteiligung an Fort-/Ausbildung: Akademie für Unfallchirurgie	kein Thema (gering), Limitierung von Leitungsfunktion
Priv.-Doz. Dr. med. Horst, Klemens	Nein	Nein	bikmed, AUC, AO	Nein	Nein	Nein	Mitglied: DGU, Sektion Chirurgische Forschung, DVSE, AO, ESTES, Wissenschaftliche Tätigkeit: Korrelation von Frakturen obere Extremitäten und thorakalen Begleitverletzungen ,	kein Thema (keine), keine

Dr. Gooßen, Käthe	Nein	Nein	Deutsche Krebsgesellschaft e.V.	Nein	Deutsche Gesellschaft für Sportmedizin und Prävention e.V.	Bayer AG, Bayer AG	Mitglied: Deutsches Netzwerk Evidenzbasierte Medizin e.V. (Mitglied), Wissenschaftliche Tätigkeit: Methoden der evidenzbasierten Medizin Erstellung systematischer Reviews Leitlinienmethodik	kein Thema (keine), keine
							Wissenschaftliche Tätigkeit: Polytraumaversorgung, Extermitätenversorgung, Beckenversorgung, Hüftendoprothetik , Beteiligung an Fort-/Ausbildung: Kongresssekretär 23. chirurgische Forschungstage der Sektion Chirurgische Forschung der Deutschen Gesellschaft für Chirurgie	
Priv.-Doz. Dr. med. Hossfeld, Björn	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: Sprecher der Sektion Notfall- und Katastrophenmedizin der Deutschen Interdisziplinären Vereinigung für Intensiv- und Notfallmedizin der DIVI, Mitglied: 2. Sprecher der Arbeitsgruppe Taktische Medizin des Wissenschaftlichen Arbeitskreises Notfallmedizin der Deutschen Gesellschaft für Anästhesiologie u. Intensivmedizin (DGAI), Wissenschaftliche Tätigkeit: Autor der S1-Leitlinie Prähospitales Atemwegsmanagement und der Handlungsempfehlung Prähospitale Narkose beim Erwachsenen, Wissenschaftliche Tätigkeit: Atemwegsmanagement, Blutungskontrolle, Luftrettung, Notfallmedizin, taktische Medizin , Beteiligung an Fort-/Ausbildung: Betreiber der Internetseite news-papers.eu	kein Thema (keine), keine
Prof. Dr. med. Huber-	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: DGU, DGOU, VBC, Wissenschaftliche Tätigkeit:	kein Thema (keine), keine

Dr. Gooßen, Käthe	Nein	Nein	Deutsche Krebsgesellschaft e.V.	Nein	Deutsche Gesellschaft für Sportmedizin und Prävention e.V.	Bayer AG, Bayer AG	Mitglied: Deutsches Netzwerk Evidenzbasierte Medizin e.V. (Mitglied), Wissenschaftliche Tätigkeit: Methoden der evidenzbasierten Medizin Erstellung systematischer Reviews Leitlinienmethodik	kein Thema (keine), keine
Wagner, Stefan							Schwerverletztenversorgung, Wissenschaftliche Tätigkeit: Wirbelsäulenchirurgie, Beckenchirurgie, Frakturversorgung, Schwerverletztenversorgung, Navigation und Robotic	
Priv.-Doz. Dr. med. Hußmann, Björn	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: Deutsche Gesellschaft für Unfallchirurgie Mitglied der Sektion Notfall-Intensiv und Schwerstverletztenversorgung (NIS) Mitglied Arbeitskreis Traumaregister, Wissenschaftliche Tätigkeit: Schwerverletztenversorgung präklinische Volumentherapie beim Schwerstverletzten, Wissenschaftliche Tätigkeit: Polytrauma Alterstrauma Becken, Wirbelsäule, Beteiligung an Fort-/Ausbildung: Weiterbildungsbefugter Facharzt Orthopädie und Unfallchirurgie und Spezielle Unfallchirurgie Ärztekammer Nordrhein Studentische Lehre Universitätsklinikum Düsseldorf	kein Thema (keine), keine
Priv.-Doz. Dr. med. Högel,	keine	nein	Nein	Nein	klinischen Studien im Berich Wirbelsäule	Nein	Mitglied: Mitglied DGOU, Beteiligung an Fort-/Ausbildung:	kein Thema (keine), keine

Dr. Gooßen, Käthe	Nein	Nein	Deutsche Krebsgesellschaft e.V.	Nein	Deutsche Gesellschaft für Sportmedizin und Prävention e.V.	Bayer AG, Bayer AG	Mitglied: Deutsches Netzwerk Evidenzbasierte Medizin e.V. (Mitglied), Wissenschaftliche Tätigkeit: Methoden der evidenzbasierten Medizin Erstellung systematischer Reviews Leitlinienmethodik	kein Thema (keine), keine
Florian					und Rückenmarkverletzung		Lehrauftrag TU München, Persönliche Beziehung: keine	
Dr. med. Imach, Sebastian	Nein	Nein	Rimasys GmbH	Nein	Nein	Nein	Wissenschaftliche Tätigkeit: u.a Atemwegsmanagement in der Luftrettung, Trainingskonzepte des Atemwegsmanagement, Wissenschaftliche Tätigkeit: Schulter- und Ellenbogenchirurgie, Wissenschaftliche Tätigkeit: Schwerverletztenversorgung	kein Thema (keine), keine
Dr. med. Jensen, Kai Oliver	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: Sektion NIS, Mitglied: Sektion ATZ, Mitglied: DGU, Mitglied: SGC, Mitglied: SICOT, Mitglied: FMH, Mitglied: VSAO, Wissenschaftliche Tätigkeit: Polytrauma, Alterstraumatologie, Registerforschung, Wissenschaftliche Tätigkeit: Polytrauma, untere Extremität	kein Thema (keine), keine
Kaltwasser, Arnold	Novo	BBraun, Springer Verlag Zeitschrift Med Klinik , Thieme Verlag Zeitschrift Intensiv	Hochschulen (HAW, Nürnberg, Berlin)und Kliniken , Fa. Avanos, Orion Pharma, Convatec	Nein	Nein	Nein	Mitglied: DIVI, DGF (stellv. Landesbeauftragter BaWü), Netzwerk Frühmobilisation, Deutsches Delir Netzwerk (Beirat), Wissenschaftliche Tätigkeit: Intensivmedizin und - pflege, Wissenschaftliche Tätigkeit: Intensivmedizin, Beteiligung an Fort-/Ausbildung: Fachbereichsleitung Intensivpflege und Anästhesie, Notfallpflege	kein Thema (keine), keine
Kamp, Oliver	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: Deutsche Gesellschaft für Unfallchirurgie, Sektion NIS	kein Thema (keine), keine

Dr. Gooßen, Käthe	Nein	Nein	Deutsche Krebsgesellschaft e.V.	Nein	Deutsche Gesellschaft für Sportmedizin und Prävention e.V.	Bayer AG, Bayer AG	Mitglied: Deutsches Netzwerk Evidenzbasierte Medizin e.V. (Mitglied), Wissenschaftliche Tätigkeit: Methoden der evidenzbasierten Medizin Erstellung systematischer Reviews Leitlinienmethodik	kein Thema (keine), keine
Prof. Dr. med. Kanz, Karl-Georg	Nein	Nein	Nein	Nein	Nein	Nein	Nein	kein Thema (keine), keine
Dr. med. Kildal, Daniela	Nein	Nein	Nein	Thieme-Verlag, Springer-Verlag, Lehmanns Verlag	Universitätsklikum Ulm	Nein	Mitglied: DRG, AG MSK, Wissenschaftliche Tätigkeit: Patientenzufriedenheit, Aufklärung, Polytrauma CT, Wissenschaftliche Tätigkeit: diagnostische Radiologie	kein Thema (keine), keine
Prof. Dr. med. Klar, Ernst	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: Deutsche Gesellschaft für Chirurgie	Keine
Prof. Dr. Kleber, Christian	Siemens HealthCare, CSL Behring	CSL Behring	CSL Behring, AOTrauma	Nein	ADAC Stiftung	CD8+ T cell subset as marker for prediction of delayed fracture healing	Mitglied: Deutsche Gesellschaft für Unfallchirurgie, Mitglied: AOTrauma, Mitglied: DIVI, Wissenschaftliche Tätigkeit: Schwerstverletztenversorgung Posttraumatische Immunantwort Frakturheilung Verkehrsunfallforschung Notfallmedizin, Wissenschaftliche Tätigkeit: Schwerverletztenversorgung Becken- und Acetabulumchirurgie Komplexe Knochen- und Gelenkrekonstruktion Septische Chirurgie/Pseudarthrose Notfallmedizin	kein Thema (keine), keine
Prof. Dr. med. Kneser, Ulrich	Mediwound Germany	Nein	Nein	Nein	Nein	Nein	Mitglied: Vorstandsmitglied der Deutschen Gesellschaft für Verbrennungsmedizin (DGV)	kein Thema (keine), keine
Prof. Dr. med. Kobbe, Phillip	Nein	Nein	Medtronic, K2M/Stryker,	Nein	Nein	Nein	Mitglied: DGU, Mitglied: DWG, Mitglied: Eurospine,	kein Thema (keine), keine

Dr. Gooßen, Käthe	Nein	Nein	Deutsche Krebsgesellschaft e.V.	Nein	Deutsche Gesellschaft für Sportmedizin und Prävention e.V.	Bayer AG, Bayer AG	Mitglied: Deutsches Netzwerk Evidenzbasierte Medizin e.V. (Mitglied), Wissenschaftliche Tätigkeit: Methoden der evidenzbasierten Medizin Erstellung systematischer Reviews Leitlinienmethodik	kein Thema (keine), keine
			Peter Brehm				Wissenschaftliche Tätigkeit: Wirbelsäulenchirurgie, Wissenschaftliche Tätigkeit: Wirbelsäulen- und Beckenchirurgie, Beteiligung an Fort-/Ausbildung: Leiter der Weiterbildungskommission der DWG	
Koensgen, Nadja	Nein	Nein	Nein	Nein	Nein	Nein	Nein	kein Thema (keine), keine
Dr. med. Kolibay, Felix	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: Vorstandsmitglied DAKEP e.V.	kein Thema (keine), keine
Kugler, Charlotte	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: Mitglied bei Gesundheitskollektiv Berlin e.V. (Einsatz für gemeinnützige Stadtteilorientierte Primärmedizinische Zentren), Mitglied: Mitglied bei Gesundheitskollektiv Berlin e.V. und SoliMed Köln e.V. (Einsatz für gemeinnützige Stadtteilorientierte Primärmedizinische Zentren), Wissenschaftliche Tätigkeit: Versorgungsforschung, Zentralisierung und Regionalisierung, Erstellung systematischer Übersichtsarbeiten, Wissenschaftliche Tätigkeit: Mitarbeit in der AG Partizipative Versorgungsforschung des Deutschen Netzwerks für Versorgungsforschung	kein Thema (keine), keine
König, Marco	Nein	Nein	Nein	Nein	Nein	Nein	Nein	Keine

Dr. Gooßen, Käthe	Nein	Nein	Deutsche Krebsgesellschaft e.V.	Nein	Deutsche Gesellschaft für Sportmedizin und Prävention e.V.	Bayer AG, Bayer AG	Mitglied: Deutsches Netzwerk Evidenzbasierte Medizin e.V. (Mitglied), Wissenschaftliche Tätigkeit: Methoden der evidenzbasierten Medizin Erstellung systematischer Reviews Leitlinienmethodik	kein Thema (keine), keine
Prof. Dr. med. Kühne, Christian	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: Deutsche Gesellschaft für Unfallchirurgie	kein Thema (keine), keine
Prof. Dr. Lefering, Rolf	Akademie der Unfallchiurgie (AUC GmbH), European Journal of Trauma and Emergency Surgery	Nein	Nein	Nein	Nein	Nein	Nein	kein Thema (keine), keine
Prof. Dr. med. Lehnhardt, Marcus	Nein	Nein	Nein	Nein	Nein	Nein	Nein	kein Thema (keine), keine
Prof. Dr. med. Lendemans, Sven	Nein	Nein	Nein	Nein	Nein	Nein	Nein	Keine
Dr. med. Lier, Heiko	Nein	Nein	CSL Behring, Ferring Arzneimittel, Werfen	Nein	Nein	Nein	Mitglied: DGAI, BDA, DIVI, ESAIC, Wissenschaftliche Tätigkeit: Gerinnungstherapie	kein Thema (gering), Limitierung von Leitungsfunktion
Priv.-Doz. Dr. med. Luis, Kluth	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: Leiter der Arbeitsgruppe Trauma and Reconstructive Urology working party der Young Academics of Urology (YAU) der European Association of Urology (EAU), Wissenschaftliche Tätigkeit: Mein Schwerpunkt ist die Diagnostik, Behandlung und die Outcome Analyse von Patienten mit Harnröhrenstrikturen , Wissenschaftliche Tätigkeit: Leiter	kein Thema (keine), keine

Dr. Gooßen, Käthe	Nein	Nein	Deutsche Krebsgesellschaft e.V.	Nein	Deutsche Gesellschaft für Sportmedizin und Prävention e.V.	Bayer AG, Bayer AG	Mitglied: Deutsches Netzwerk Evidenzbasierte Medizin e.V. (Mitglied), Wissenschaftliche Tätigkeit: Methoden der evidenzbasierten Medizin Erstellung systematischer Reviews Leitlinienmethodik	kein Thema (keine), keine
							der Rekonstruktion Urologie mit Schwerpunkt Harnröhrenchirurgie, Beteiligung an Fort-/Ausbildung: Leiter der Rekonstruktion Urologie mit Schwerpunkt Harnröhrenchirurgie	
Prof. Dr. med. Maegele, Marc	Abott, CSL Behring, IL-Werfen, Astra Zeneca	Abott, CSL Behring, IL-Werfen	CSL Behring, IL-Werfen, Astra Zeneca	Astra Zeneca	CSL Behring	Nein	Mitglied: Deutsche Gesellschaft für Unfallchirurgie (DGU), Wissenschaftliche Tätigkeit: Posttraumatische Störungen der Blutgerinnungsfunktion, Wissenschaftliche Tätigkeit: Polytraumamanagement	kein Thema (gering), Limitierung von Leitungsfunktion
Markewitz, Andreas	Biotronik	TÜV Süd	Deutschlandfunk	Thieme	Nein	Nein	Mitglied: DGTHG, Herzchirurgie DIVI, Intensiv- und Notfallmedizin DGWMP, Militärmedizin DGK, Herzmedizin, Wissenschaftliche Tätigkeit: Herzchirurgie, Intensivmedizin, kardiale Rhythmusimplantate, Wissenschaftliche Tätigkeit: entfällt, da Pensionär, Beteiligung an Fort-/Ausbildung: entfällt, Persönliche Beziehung: keine	kein Thema (keine), keine
Prof. Dr. med. Matthes, Gerrit	Nein	Nein	ATLS Deutschland, BVOU	Nein	OPED GmbH	Nein	Mitglied: Deutsche Gesellschaft für Unfallchirurgie e.V.: Präsidumsmitglied, Leiter der Sektion Notfallmedizin, Intensivmedizin und Schwerverletztenversorgung, Wissenschaftliche Tätigkeit: Schwerverletztenversorgung, Wissenschaftliche Tätigkeit: Versorgung sämtlicher Verletzungen des	kein Thema (keine), keine

Dr. Gooßen, Käthe	Nein	Nein	Deutsche Krebsgesellschaft e.V.	Nein	Deutsche Gesellschaft für Sportmedizin und Prävention e.V.	Bayer AG, Bayer AG	Mitglied: Deutsches Netzwerk Evidenzbasierte Medizin e.V. (Mitglied), Wissenschaftliche Tätigkeit: Methoden der evidenzbasierten Medizin Erstellung systematischer Reviews Leitlinienmethodik	kein Thema (keine), keine
							Bewegungsapparates, Beteiligung an Fort-/Ausbildung: ATLS Deutschland- Mitglied des Boards	
Priv.-Doz. Dr. med. Matthias, Fröhlich	Nein	Nein	AEKNO	Nein	Nein	Nein	Mitglied: DGOU, Wissenschaftliche Tätigkeit: Posttraumatisches Multiorganversagen, Wissenschaftliche Tätigkeit: Schwerverletztenversorgung Revisionstraumatologie Notfallmedizin	kein Thema (keine), keine
Prof. Dr. med. Mauer, Uwe Max	Nein	Nein	Nein	Nein	Nein	Nein	Nein	kein Thema (keine), keine
Prof. Dr. Mentzel, Hans-Joachim	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: Gesellschaft für Pädiatrische Radiologie (GPR) Präsident, Wissenschaftliche Tätigkeit: Kinder- und Jugendradiologie, Wissenschaftliche Tätigkeit: Kinder- und Jugendradiologie, Beteiligung an Fort-/Ausbildung: Kinderradiologische Fortbildungen der DRG, Persönliche Beziehung: nein	kein Thema (keine), keine
Meyer, Nora	Nein	Nein	Nein	Nein	Nein	AstraZeneca, BioNTech , Moderna, Pfizer	Mitglied: Deutsche Gesellschaft für Epidemiologie(DGEpi)	kein Thema (keine), keine
Dr. med. Michael, Caspers	Nein	Nein	Nein	Nein	Nein	Nein	Nein	kein Thema (keine), keine
Dr. med. Mörsdorf,	Nein	Nein	Nein	Nein	Nein	Nein	Nein	kein Thema (keine), keine

Dr. Gooßen, Käthe Philipp	Nein	Nein	Deutsche Krebsgesellschaft e.V.	Nein	Deutsche Gesellschaft für Sportmedizin und Prävention e.V.	Bayer AG, Bayer AG	Mitglied: Deutsches Netzwerk Evidenzbasierte Medizin e.V. (Mitglied), Wissenschaftliche Tätigkeit: Methoden der evidenzbasierten Medizin Erstellung systematischer Reviews Leitlinienmethodik	kein Thema (keine), keine
Priv.-Doz. Dr. med. Nestler, Tim	Nein	Nein	Janssen	s. pubemd	Bundeswehr, Bundeswehr, Bundeswehr, B. Braun, SwDGU-Forschungsförderung	Nein	Mitglied: Deutsche Gesellschaft für Urologie (DGU) European Association of Urology (EAU) Südwestdeutsche Gesellschaft für Urologie (SWDGU) Nordrheinwestfälische Gesellschaft für Urologie (NRWGU) Deutsche Hodentumorstudiengruppe (German Testicular Cancer Study Group GTCSG) German Society of Residents in Urology GeSRU e.V. Deutsche Gesellschaft für Wehrmedizin und Pharmazie (DGWMP), Wissenschaftliche Tätigkeit: Hodentumor- und Prostatakarzinomforschung, Wissenschaftliche Tätigkeit: Uroonkologie	kein Thema (keine), keine
Prof. Dr. med. Neudecker, Jens	Nein	Nein	Nein	Nein	Nein	Nein	Nein	Keine
Dr. med. Nohl, André	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: Mitglied Sektion NIS, DGU Mitglied DIVI Mitglied AGNNW, Wissenschaftliche Tätigkeit: Polytraumaversorgung, Wissenschaftliche Tätigkeit: Ambulanz, Notarztdienst, ärztlicher Leiter Rettungsdienst, Beteiligung an Fort-/Ausbildung:	kein Thema (keine), keine

Dr. Gooßen, Käthe	Nein	Nein	Deutsche Krebsgesellschaft e.V.	Nein	Deutsche Gesellschaft für Sportmedizin und Prävention e.V.	Bayer AG, Bayer AG	Mitglied: Deutsches Netzwerk Evidenzbasierte Medizin e.V. (Mitglied), Wissenschaftliche Tätigkeit: Methoden der evidenzbasierten Medizin Erstellung systematischer Reviews Leitlinienmethodik	kein Thema (keine), keine
							Organisation von Schockraumfortbildungen, Reanimationstrainings, QM Zirkel Notfallmedizin, LNA Fortbildungen, NA Fortbildungen	
Dr. med. Nothacker, Monika	IQWiG, Nein	ja	Berliner Urologische Gesellschaft , DAG Selbsthilfe, Berlin School of Public Health	Nein	Deutsche Forschungs-gemeinschaft (DFG), Deutsche Krebsgesellschaft (DKG), Netzwerk Universitätsmedizi , BMG	nein	Mitglied: - Deutsche Netzwerk Evidenzbasierte Medizin (Sprecherin Fachbereich Leitlinien bis 2018) - Deutsche Krebsgesellschaft (einfaches Mitglied bis 12/2020) - Guidelines International Network/GRADE Working Group, Wissenschaftliche Tätigkeit: Leitlinien. Priorisierung von Leitlinienempfehlungen (Gemeinsam Klug Entscheiden),Qualitätsindikatoren , Wissenschaftliche Tätigkeit: keine klinische Tätigkeit , Beteiligung an Fort-/Ausbildung: Leitlinienseminare für Leitlinienentwickler/-berater im Rahmen des Curriculums für Leitlinienberater der AWMF, Persönliche Beziehung: nein	kein Thema (keine), keine
Dr. med. Osche, David	Nein	Nein	Nein	Nein	Nein	Nein	Nein	kein Thema (keine), keine
Dr. Özkurtul, Orkun	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: Mitglied Sektion NIS, DGU Wissenschaftliche Tätigkeit: Polytraumaversorgung, Wissenschaftliche Tätigkeit: Notarztdienst,	kein Thema (keine), keine
Pelz, Sabrina	Nein	Nein	Lehraufträge	Avanos	Nein	Nein	Mitglied: DGF Beauftragte	kein Thema (keine), keine

Dr. Gooßen, Käthe	Nein	Nein	Deutsche Krebsgesellschaft e.V.	Nein	Deutsche Gesellschaft für Sportmedizin und Prävention e.V.	Bayer AG, Bayer AG	Mitglied: Deutsches Netzwerk Evidenzbasierte Medizin e.V. (Mitglied), Wissenschaftliche Tätigkeit: Methoden der evidenzbasierten Medizin Erstellung systematischer Reviews Leitlinienmethodik	kein Thema (keine), keine
			Hochschulen Hamburg, Nürnberg, Dozententätigkeiten an Weiterbildungsstätten Hamburg, Reutlingen, Vortragstätigkeiten Bibliomed, Vortragstätigkeit KAI	Vortragstätigkeit			Internnationales, Mitglied: EfCCNa (DGF) Representative Germany, Mitglied: DIVI Sektion Pflege stv. Sektionssprecherin, Mitglied: DN ANP APN g.e.V. Vorstandsmitglied Nationale Kontakte und Projekte, Mitglied: Deutsches Delirnetzwerk e.V. Vorstandsmitglied, Wissenschaftliche Tätigkeit: Reviewerin Pflegewissenschaft unentgeltlich	
Univ.-Prof. Dr. Perl, Mario	Siemens, Siemens, Stryker	Nein	Fördervereins Rettungsdienst Krumbach	Nein	Nein	Nein	Mitglied: Vorstandsmitglied Vereinigung Süddeutscher Orthopäden und Unfallchirurgen VSOU, Mitglied: Vorstandsmitglied Vereinigung Leitender Orthopäden und Unfallchirurgen VLOU	kein Thema (gering), Limitierung von Leitungsfunktion
Prof. Dr. Pieper, Dawid	Nein	Nein	MDS e.V.	Nein	MDS e.V., BZgA e.V.	Nein	Wissenschaftliche Tätigkeit: Methodenforschung, Evidenzbasierung, Versorgungsforschung	kein Thema (keine), keine
Prof. Dr. med. Rammelt, Stefan	KLS Martin	Nein	AO Foundation	Nein	Nein	Nein	Mitglied: Vorstandsmitglied Deutsche Assoziation für Fuß Sprunggelenk, Mitglied Deutsche Gesellschaft für Unfallchirurgie, American Orthopaedic Foot Ankle Society, Wissenschaftliche Tätigkeit: Fuß- und Sprunggelenkchirurgie, Beteiligung an Fort-/Ausbildung:	kein Thema (keine), keine

Dr. Gooßen, Käthe	Nein	Nein	Deutsche Krebsgesellschaft e.V.	Nein	Deutsche Gesellschaft für Sportmedizin und Prävention e.V.	Bayer AG, Bayer AG	Mitglied: Deutsches Netzwerk Evidenzbasierte Medizin e.V. (Mitglied), Wissenschaftliche Tätigkeit: Methoden der evidenzbasierten Medizin Erstellung systematischer Reviews Leitlinienmethodik	kein Thema (keine), keine
							AO-Kurse	
Dr. med. Reske, Stefan	RöFo - Röntgen Fortschritt	Nein	Vorträge für die Strahlenschutzkursstätte Nürnberg, Breitenfeldstr. 46, 91126 Schwabach	Nein	anderen Wissenschaftlern	Nein	Mitglied: Deutsche Röntgengesellschaft e.V., AG Muskuloskelettale Diagnostik und AG Physik und Technik; Sächsische radiologische Gesellschaft e.V. , Wissenschaftliche Tätigkeit: Polytrauma-Ganzkörper-CT (unter Berücksichtigung aller Facetten), Traumadiagnostik, Notfalldiagnostik, Muskuloskelettale Diagnostik , Wissenschaftliche Tätigkeit: Siehe wissenschaftliche Tätigkeiten; zuständiger Oberarzt für radiologische Notfalldiagnostik und MSK-Diagnostik in meiner Klinik, Beteiligung an Fort-/Ausbildung: Jahrestagung SRG und TGRN 2021; multiple Vorträge in den vergangenen 10 Jahren zum Thema Polytrauma-GKCT im Rahmen verschiedener Weiterbildungen	kein Thema (keine), keine
Prof. Dr. med. Rickels, Eckhard	Schlichtungsstelle Norddeutsche Ärztekammern	ZNS-Hannelore-Kohl-Stiftung	Nein	Nein	Nein	Nein	Mitglied: DGNC, DIVI,BDNC, DGNI, Wissenschaftliche Tätigkeit: SHT, Neurotraumatologie, Wissenschaftliche Tätigkeit: Neurochirurgie, Beteiligung an Fort-/Ausbildung: Fortbildungskommision DIVI, Persönliche Beziehung: keine	kein Thema (keine), keine
Prof. Dr. med. Ruchholtz,	Fa. Zimmer Biomet	Nein	Nein	Nein	Nein	Nein	Nein	kein Thema (keine), keine

Dr. Gooßen, Käthe	Nein	Nein	Deutsche Krebsgesellschaft e.V.	Nein	Deutsche Gesellschaft für Sportmedizin und Prävention e.V.	Bayer AG, Bayer AG	Mitglied: Deutsches Netzwerk Evidenzbasierte Medizin e.V. (Mitglied), Wissenschaftliche Tätigkeit: Methoden der evidenzbasierten Medizin Erstellung systematischer Reviews Leitlinienmethodik	kein Thema (keine), keine
Steffen								
Priv.-Doz. Dr. med. Ruf, Christian	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: Deutsche Gesellschaft für Urologie Südwestdeutsche Gesellschaft für Urologie , Wissenschaftliche Tätigkeit: Keimzelltumoren des Hodens S3 Leitlinie Hodentumoren (Steuergruppe, Kapitelverantwortlich) Urotraumatologie militärisch, Wissenschaftliche Tätigkeit: Uroonkologie, Beteiligung an Fort-/Ausbildung: German Society of Residents in Urology	kein Thema (keine), keine
Prof. Dr. med. Sascha, Flohé	Nein	Nein	AUC	Nein	Nein	Nein	Mitglied: Deutsche Gesellschaft für Unfallchirurgie Vorstand der Fachgesellschaft, Wissenschaftliche Tätigkeit: Traumaversorgung/Scherstverletztenversorgung	kein Thema (keine), keine
Prof. Dr. Schmittenbecher, Peter	Nein	Nein	DGKCH DGU AO Trauma	Elsevier-Verlag	AO-CID	Nein	Mitglied: Mitglied DGKCH, DGU, Wissenschaftliche Tätigkeit: Kindertraumatologie, Wissenschaftliche Tätigkeit: allgemeine Kinderchirurgie incl. Polytrauma-Behandlung	kein Thema (keine), keine
Dr. med. Schreyer, Christof	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: Deutsche Gesellschaft für Thoraxchirurgie	kein Thema (keine), keine
PD Dr. med.	DePuySynthes	AO Foundation,	AUC, NAW	Nein	Nein	Nein	Mitglied: CWIS Chest Wall Injury	kein Thema (keine), keine

Dr. Gooßen, Käthe	Nein	Nein	Deutsche Krebsgesellschaft e.V.	Nein	Deutsche Gesellschaft für Sportmedizin und Prävention e.V.	Bayer AG, Bayer AG	Mitglied: Deutsches Netzwerk Evidenzbasierte Medizin e.V. (Mitglied), Wissenschaftliche Tätigkeit: Methoden der evidenzbasierten Medizin Erstellung systematischer Reviews Leitlinienmethodik	kein Thema (keine), keine
Schulz-Drost, Stefan		Technical commission, Thoracic expert group	Berlin				Society , Mitglied: ESTES, Wissenschaftliche Tätigkeit: multiple Publikationen zum Thoraxtrauma, Verletzungen knöcherne Brustwand, Deformitäten, Klavikulaverletzungen uvm. in Deutschen und internationalen Fachjournalen, Wissenschaftliche Tätigkeit: komplettes Spektrum der Unfallchirurgie, Polytraumaversorgung, Thoraxtrauma, Beteiligung an Fort-/Ausbildung: Instruktor AO Kurse, Beteiligung an Fort-/Ausbildung: diverse Thoraxtrauma Symposien, zB. ESTES, Basel ChestWall Course, Persönliche Beziehung: Ehefrau Melanie Schulz-Drost, Sanitätsoffizier, Tätigkeit im BMVg	
Prof. Dr. med. Schwab, Robert	Nein	Wissenschaftlicher Beirat der Bundesärztekammer	DSTC, ASSET und DGAV-Kurs-Instruktor / Direktor	Nein	Nein	Nein	Mitglied: Mitglied der DGCH, DGAV, Vorsitzender der CAH, American College of Surgeons, DGWMP, DHG, EURHS, , Wissenschaftliche Tätigkeit: Notfallchirurgie, Traumachirurgie, Hernienchirurgie, Militärchirurgie, Laparosotma, endokrine Chirurgie, Ausbildung und Training in der Chirurgie, ÄQM,, Wissenschaftliche Tätigkeit: Direktor der Klinik für Allgemein-, Viszeral- und Thoraxchirurgie in einem Krankenhaus der	kein Thema (keine), keine

Dr. Gooßen, Käthe	Nein	Nein	Deutsche Krebsgesellschaft e.V.	Nein	Deutsche Gesellschaft für Sportmedizin und Prävention e.V.	Bayer AG, Bayer AG	Mitglied: Deutsches Netzwerk Evidenzbasierte Medizin e.V. (Mitglied), Wissenschaftliche Tätigkeit: Methoden der evidenzbasierten Medizin Erstellung systematischer Reviews Leitlinienmethodik	kein Thema (keine), keine
							Maximalversorgung, URTZ, SAV ..., Persönliche Beziehung: ---	
PD. Dr. med. habil. Schweigkofler, Uwe	Nein	Nein	Nein	Nein	Nein	Nein	Wissenschaftliche Tätigkeit: Polytraumaversorgung Rettungsmedizin Beckenverletzungen, Wissenschaftliche Tätigkeit: Schwerverletztenversorgung in einem ÜRTZ Tätigkeit in der Luftrettung	kein Thema (keine), keine
PD Dr. med. Schöneberg, Carsten	Nein	Nein	Arbeitsgemeinschaft Osteosynthesefragen (AO) Alterstraumatologie	Nein	Nein	Nein	Mitglied: Mitglied in der Arbeitsgemeinschaft für Osteosynthesefragen (AO) Mitglied der Deutschen Gesellschaft für Unfallchirurgie (DGU) Sektion Alterstraumatologie der DGU, Wissenschaftliche Tätigkeit: Polytraumaversorgung Alterstraumatologie, Wissenschaftliche Tätigkeit: Unfallchirurgie	kein Thema (keine), keine
Prof. Dr. med. Siemers, Frank	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: DGH, DGPRÄC, DGV, ISBI, DGCh, BDC, Wissenschaftliche Tätigkeit: Plastische und Handchirurgie, Verbrennung, Wunde, Wissenschaftliche Tätigkeit: Plastische und Handchirurgie, Verbrennung, Wunde	kein Thema (keine), keine
Dr. med. Spering, Christopher	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: Deutsche Gesellschaft für Unfallchirurgie, Wissenschaftliche Tätigkeit: Polytrauma und Becken, Wissenschaftliche Tätigkeit:	kein Thema (keine), keine

Dr. Gooßen, Käthe	Nein	Nein	Deutsche Krebsgesellschaft e.V.	Nein	Deutsche Gesellschaft für Sportmedizin und Prävention e.V.	Bayer AG, Bayer AG	Mitglied: Deutsches Netzwerk Evidenzbasierte Medizin e.V. (Mitglied), Wissenschaftliche Tätigkeit: Methoden der evidenzbasierten Medizin Erstellung systematischer Reviews Leitlinienmethodik	kein Thema (keine), keine
							Traumaversorgung, Beteiligung an Fort-/Ausbildung: Lehrtätigkeit an der Universitätsmedizin Göttingen	
Priv.-Doz. Dr. med. Sprengel, Kai	Nein	DePuy Synthes	Silony Medical, Nuvasive, Medtronic, AUC - Akademie der Unfallchirurgie GmbH	Nein	Nein	Nein	Mitglied: Deutsche Gesellschaft für Unfallchirurgie: Aktives Mitglied Sektion NIS und Arbeitsgruppe TraumaRegister, Mitglied Nicht-Ständiger Beirat, Mitglied: Deutsche Gesellschaft für Orthopädie und Unfallchirurgie: Aktives Mitglied Sektion Wirbelsäule und AG Osteoporotische Frakturen, Wissenschaftliche Tätigkeit: Polytraumaversorgung, Wissenschaftliche Tätigkeit: Becken- und Wirbelsäulentraumatologie, Wissenschaftliche Tätigkeit: Osteoporotische Frakturen von Wirbelsäule und Becken, Wissenschaftliche Tätigkeit: Polytraumaversorgung, Wissenschaftliche Tätigkeit: Becken- und Wirbelsäulentraumatologie, Beteiligung an Fort-/Ausbildung: AO Spine, Beteiligung an Fort-/Ausbildung: Fortbildungsveranstaltungen der Klinik für Traumatologie und des Interdisziplinären Wirbelsäulenzentrums am Universitätsspital Zürich	kein Thema (moderat), Stimmenthaltung
Prof. Dr. med.	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: Leiter der Kommission	kein Thema (keine), keine

Dr. Gooßen, Käthe	Nein	Nein	Deutsche Krebsgesellschaft e.V.	Nein	Deutsche Gesellschaft für Sportmedizin und Prävention e.V.	Bayer AG, Bayer AG	Mitglied: Deutsches Netzwerk Evidenzbasierte Medizin e.V. (Mitglied), Wissenschaftliche Tätigkeit: Methoden der evidenzbasierten Medizin Erstellung systematischer Reviews Leitlinienmethodik	kein Thema (keine), keine
Strasser, Erwin							Klinische Hämotherapie der DGTI (Deutsche Gesellschaft für Transfusionsmedizin und Immunhämatologie), Wissenschaftliche Tätigkeit: - Habilitation über Apherese, Hämotherapie und Zelltherapie - Wissenschaftliche Publikationen über Hämotherapie und Gerinnung, Wissenschaftliche Tätigkeit: Oberarzt der Transfusionsmedizinischen und Hämostaseologischen Abt. - Hämotherapie - Gerinnungsdiagnostik (Laborleiter) und Gerinnungstherapie (Patientenversorgung, klinische Konsile für Blutungsfälle und Thromboembolien (Antikoagulaiton), Beteiligung an Fort-/Ausbildung: Lehre Transfusionstherapie, Gerinnungsdiagnostik und -Therapie am Universitätsklinikum Erlangen Ärztliches Qualitätsmanagement für QBH, Bayer. Landesärztekammer Berufsverband der Transfusionsmediziner (BDT) Fortbildungen , Persönliche Beziehung: keine	
PD Dr. med. Struck, Manuel	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: Deutsche Gesellschaft für Anästhesiologie und Intensivmedizin e.V.	kein Thema (keine), keine

Dr. Gooßen, Käthe	Nein	Nein	Deutsche Krebsgesellschaft e.V.	Nein	Deutsche Gesellschaft für Sportmedizin und Prävention e.V.	Bayer AG, Bayer AG	Mitglied: Deutsches Netzwerk Evidenzbasierte Medizin e.V. (Mitglied), Wissenschaftliche Tätigkeit: Methoden der evidenzbasierten Medizin Erstellung systematischer Reviews Leitlinienmethodik	kein Thema (keine), keine
apl. Prof. Dr. med. univ. Suda, Arnold	Nein	Nein	Nein	Nein	Nein	Nein	Nein	kein Thema (keine), keine
Dr. med. Teuben, Michel	Nein	Nein	Nein	Nein	Nein	Nein	Wissenschaftliche Tätigkeit: Immunomodation nach Polytrauma, Wissenschaftliche Tätigkeit: Chirurgie, unfallchirurgie	kein Thema (keine), keine
Dr. med. Thiel, Burkhard	Nein	Nein	Nein	Nein	Nein	Nein	Wissenschaftliche Tätigkeit: Thoraxchirurgie	kein Thema (keine), keine
Dr. med. Trentzsch, Heiko	Dt. Gesetzliche Unfallversicherung e.V. (DGUV), Peer Reviewer u.a. für die Zeitschriften " Der Unfallchirurg", "European Journal of Trauma and Emergency Surgery", "Notfall + Rettungsmedizin"	Nein	Akademie der Unfallchirurgie (AUC), bikmed - Bildungsinstitut für Kompetenz in der Medizin GmbH, Bayerische Landesärztekammer	Georg Thieme Verlag KG, Springer-Verlag GmbH	DGU e.V.	Nein	Mitglied: Deutsche Gesellschaft für Unfallchirurgie (DGU) e.V. Stellv. Leiter der Sektion Notfall-, Intensivmedizin und Schwerverletztenversorgung (Sektion NIS), Mitglied: Deutsche Gesellschaft für Chirurgie (DGCH) e.V. Mitglied, Mitglied: Deutsche Gesellschaft zur Förderung der Simulation in der Medizin e. V. (DGSIM) Mitglied, Mitglied: Arbeitsgemeinschaft der in Bayern tätigen Notärzte und Notzärztinnen e.V. (AGBN) Mitglied, Mitglied: Berufsverband der Deutschen Chirurgen e.V. (BDC) Mitglied, Wissenschaftliche Tätigkeit: Schwerverletzenversorgung in Prähospital- und Schockraumphase,	kein Thema (keine), keine

Dr. Gooßen, Käthe	Nein	Nein	Deutsche Krebsgesellschaft e.V.	Nein	Deutsche Gesellschaft für Sportmedizin und Prävention e.V.	Bayer AG, Bayer AG	Mitglied: Deutsches Netzwerk Evidenzbasierte Medizin e.V. (Mitglied), Wissenschaftliche Tätigkeit: Methoden der evidenzbasierten Medizin Erstellung systematischer Reviews Leitlinienmethodik	kein Thema (keine), keine
							Versorgungsforschung Rettungsdienstliche Versorgung, Registerforschung (TraumaRegister DGU), medizinsche Simulation, Wissenschaftliche Tätigkeit: Prähospitale Notfallversorgung, Beteiligung an Fort-/Ausbildung: INM: Ausbildung und Trainig im Bereich Schwerverletztenversorgung vor allem Prähospitalphase und Schockrauversorgung, studentische Lehre, Post-Graduierte, Interdispziplinär und Interprofessionell., Beteiligung an Fort-/Ausbildung: Akademie der Unfallchirurgie (AUC), bikmed - Bildungsinstitut für Kompetenz in der Medizin GmbH: Tätigkeit als ATLS-Kurs-DIrektor und ATLS-Instruktor sowie Instruktor in HOTT-Kursen, Beteiligung an Fort-/Ausbildung: Bayersische Landesärztekammer: Referent im Notarztkurs	
Prof. Dr. med. Wagner, Hans-Joachim	Nein	Nein	Nein	Nein	Nein	Nein	Nein	kein Thema (keine), keine
Dr. med. Wagner, Frithjof	Nein	Nein	Nein	Nein	Nein	Nein	Mitglied: 1)Deutsche Gesellschaft für Unfallchirurgie DGU 2) Arbeitsgemeinschaft bayerischer Notärzte AGBN 3) Akademie Unfallchirurgie der DGU, Wissenschaftliche Tätigkeit: Oberarzt Unfallchirurgie	kein Thema (keine), keine

Dr. Gooßen, Käthe	Nein	Nein	Deutsche Krebsgesellschaft e.V.	Nein	Deutsche Gesellschaft für Sportmedizin und Prävention e.V.	Bayer AG, Bayer AG	Mitglied: Deutsches Netzwerk Evidenzbasierte Medizin e.V. (Mitglied), Wissenschaftliche Tätigkeit: Methoden der evidenzbasierten Medizin Erstellung systematischer Reviews Leitlinienmethodik	kein Thema (keine), keine
							in einem Maximalversorgenden Krankenhaus, Beteiligung an Fort-/Ausbildung: Akademie Unfallchirurgie der DGU Nationaler ATLS Direktor	
Wahlen, Sarah	Nein	Nein	Nein	Nein	Nein	Nein	Nein	kein Thema (keine), keine
Dr. med. Waldfahrer, Frank	BAST	Nein	Hennig-Arzneimittel, Dr. Willmar Schwabe, HNO-Update	Nein	Nein	Nein	Wissenschaftliche Tätigkeit: HNO-Intensivmedizin, Schwindel, Begutachtung, Wissenschaftliche Tätigkeit: HNO-Intensivmedizin, Schwindel, LEhre, Weiterbildung, Begutachtung	kein Thema (keine), keine
Prof. Dr. Waydhas, Christian	Ich persönlich nicht. Ob die Einrichtung an der ich arbeite solche Zuwendungen erhalten hat entzieht sich meiner Kenntnis	Schriftführung der Fachzeitschrift Notfall+Rettungsmedizin Ob die Einrichtung an der ich arbeite solche Zuwendungen erhalten hat entzieht sich meiner Kenntnis	Sedana Medical AB	Nein	Sedana Medical AB	Ich persönlich nicht. Ob die Einrichtung an der ich arbeite solche Zuwendungen erhalten hat entzieht sich meiner Kenntnis	Mitglied: Mitglied des Präsidiums der DIVI, Stv. Sprecher der Sektion Qualität und Ökonomie, Delegierter zur S3-Leitline Volumentherapie beim Intensivpatienten, Mitglied: Mitglied der Deutschen Gesellschaft für Unfallchirurgie, Leiter des Arbeitskreises Traumaregister, Delegierter zur S3-Leitlinie Schwerstverletztenversorgung, Mitglied: Mitglied weitere Fachgesellschaften (Deutsche Gesellschaft für Chirurgie, American Association for the Surgery of Trauma, Mitglied: Schriftführer der Fachzeitschrift Notfall+Rettungsmedizin des Springer Verlags GmbH (siehe auch oben), Wissenschaftliche Tätigkeit: Polytrauma, Intensivmedizin,	kein Thema (keine), keine

Dr. Gooßen, Käthe	Nein	Nein	Deutsche Krebsgesellschaft e.V.	Nein	Deutsche Gesellschaft für Sportmedizin und Prävention e.V.	Bayer AG, Bayer AG	Mitglied: Deutsches Netzwerk Evidenzbasierte Medizin e.V. (Mitglied), Wissenschaftliche Tätigkeit: Methoden der evidenzbasierten Medizin Erstellung systematischer Reviews Leitlinienmethodik	kein Thema (keine), keine
							Qualitätssicherung , Wissenschaftliche Tätigkeit: Operative Intensivmedizin, Beteiligung an Fort-/Ausbildung: keine, Persönliche Beziehung: keine	
Weise, Alina	Nein	Nein	Nein	Nein	Nein	Nein	Nein	kein Thema (keine), keine
Prof. Dr. med. Wurmb, Thomas	keine	kein	Nein	Thieme Buch Referenz Notfallmedizin	1. Unibund Würzburg 2. G-BA Innovationsfond	keine	Mitglied: 1 DAKEP e.V. Krankenhaus Alarm- und Einsatzplanung Vorstandsmitglied 2 DGAI e.V. 2. Sprecher Wissenschaftlicher AK Notfallmedizin 3 AGBN e.V. Vorstandsmitglied 4 BAND e.V. Vorstandsmitglied 5 BRK Chefarzt Kreisverband WÜRZBURG, Wissenschaftliche Tätigkeit: Notfall- und Katastrophenmedizin mit diversen Publikationen Beteiligung an Fort-/Ausbildung: Entfällt, Persönliche Beziehung: Keine	kein Thema (keine), keine
Prof. Dr. med. Zenk, Johannes	entfällt	entfällt	Firma Storz Tuttlingen, Update GmbH	Nein	keine	keine	Mitglied: Deutsche Gesellschaft für Hals-Nasen-Ohrenheilkunde, Kopf- und Halschirurgie , Mitglied: DEGUM, Mitglied: Deutsche Gesellschaft für Endoskopie und bildgebende Verfahren, Wissenschaftliche Tätigkeit: Sonographie, Bildgebung, Sepichledrüsen,	kein Thema (keine), keine

Dr. Gooßen, Käthe	Nein	Nein	Deutsche Krebsgesellschaft e.V.	Nein	Deutsche Gesellschaft für Sportmedizin und Prävention e.V.	Bayer AG, Bayer AG	Mitglied: Deutsches Netzwerk Evidenzbasierte Medizin e.V. (Mitglied), Wissenschaftliche Tätigkeit: Methoden der evidenzbasierten Medizin Erstellung systematischer Reviews Leitlinienmethodik	kein Thema (keine), keine
							Onkologie, Wissenschaftliche Tätigkeit: Sonographie im HNO-Bereich, Onkologie, Kopf-Hals-Chirurgie, Ohrchirugie , Beteiligung an Fort-/Ausbildung: HNO-Update, Persönliche Beziehung: keine	

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