KCE REPORT 281S

Federaal Kenniscentrum voor de Gezondheidszorg
Centre Fédéral d'Expertise des Soins de Santé
Belgian Health Care Knowledge Centre

TOWARDS AN INCLUSIVE SYSTEM FOR MAJOR TRAUMA

SUPPLEMENT – LITERATURE REVIEW

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HEALTH SERVICES RESEARCH

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MARIA-ISABEL FARFAN-PORTET, CECILE DUBOIS, PATRIEK MISTIAEN, AUDREY CORDON, SABINE STORDEUR, KOEN VAN DEN HEEDE

COLOPHON

Title:	Towards an inclusive system for major trauma
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Other reported interests: All experts and stakeholders consulted within this report were selected because of their involvement in the topic of traumatology. Therefore, by definition, each of them might have a certain degree of conflict of interest to the main topic of this report'

Payments to speak, training remuneration, subsidised travel or payment for participation at a conference: Olivier Cornu (AAOS), Koen De Ridder (VVVS, Trauma lessons and organisation of help), Guy Putzeys (Participation to AO congress, a scientific trauma organisation)

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Emergency Medical Advisory Board, FPS Public Health)

Layout: Ine Verhulst, Joyce Grijseels

Disclaimer:

- **The external experts were consulted about a (preliminary) version of the scientific report. Their comments were discussed during meetings. They did not co-author the scientific report and did not necessarily agree with its content.**
- **Subsequently, a (final) version was submitted to the validators. The validation of the report results from a consensus or a voting process between the validators. The validators did not co-author the scientific report and did not necessarily all three agree with its content.**
- **Finally, this report has been approved by a majority of votes by the Executive Board.**
- **Only the KCE is responsible for errors or omissions that could persist. The policy recommendations are also under the full responsibility of the KCE.**

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APPENDIX REPORT

TABLE OF CONTENTS

LIST OF TABLES

1. SEARCH STRATEGY

Authors of the literature review: Maaike Langelaan (NIVEL), Nanne Bos (NIVEL), Julie Heeren (NIVEL), Janke de Groot (NIVEL)

1.1. Search strategy Pubmed

Date of last search: 26 April, 2016

5 **Search for primary studies**

Search	Query
#7	Search #6 NOT #5
#6	Search #3 NOT ("Animals"[Mesh] NOT ("Animals"[Mesh] AND "Humans"[Mesh])) Sort by: Relevance Filters: Publication date from 2012/01/01
#5	((review[tiab] OR "Review"[Publication Type] OR "Meta-Analysis as Topic"[Mesh] OR meta-analysis[tiab] OR "Meta-Analysis "[Publication Type]) AND ("Letter"[Publication Type] OR "Editorial"[Publication Type] OR "Comment"[Publication Type]))
#3	Search #1 AND #2
#2	Search "Trauma Centres"[Mesh] OR trauma centre*[tiab] OR trauma centre*[tiab] OR trauma unit*[tiab] OR trauma model*[tiab] OR trauma system*[tiab] OR trauma network*[tiab] OR trauma organization*[tiab] OR trauma organisation*[tiab] OR trauma care[tiab] OR trauma service*[tiab]
#1	Search "Multiple Trauma"[Mesh] OR trauma patient*[tiab] OR multiple trauma[tiab] OR major trauma[tiab] OR multiple fracture*[tiab] OR ((sever*[tiab] OR critical*[tiab]) AND (trauma*[tiab] OR injur*[tiab]))

Search for systematic reviews

Search	Query
#5	Search #4 AND ((review[tiab] OR "Review"[Publication Type] OR "Meta-Analysis as Topic"[Mesh] OR meta-analysis[tiab] OR "Meta-Analysis "[Publication Type]) NOT ("Letter"[Publication Type] OR "Editorial"[Publication Type] OR "Comment"[Publication Type]))
#4	Search #3 NOT ("Animals"[Mesh] NOT ("Animals"[Mesh] AND "Humans"[Mesh]))
#3	Search #1 AND #2
#2	Search "Trauma Centres"[Mesh] OR trauma centre*[tiab] OR trauma centre*[tiab] OR trauma unit*[tiab] OR trauma model*[tiab] OR trauma system*[tiab] OR trauma network*[tiab] OR trauma organization*[tiab] OR trauma organisation*[tiab] OR trauma care[tiab] OR trauma service*[tiab]
#1	Search "Multiple Trauma"[Mesh] OR trauma patient*[tiab] OR multiple trauma[tiab] OR major trauma[tiab] OR multiple fracture*[tiab] OR ((sever*[tiab] OR critical*[tiab]) AND (trauma*[tiab] OR injur*[tiab]))

1.2. Search strategy Embase

Date of last search: 26 April, 2016

Search for primary studies

No.	Query
#10	#9 AND 'conference abstract'/it
#9	#8 NOT #7
#8	#4 AND (2012:py OR 2013:py OR 2014:py OR 2015:py OR 2016:py)
#7	('meta analysis'/exp OR 'systematic review'/exp OR (meta NEAR/3 analy*):ab,ti OR metaanaly*:ab,ti OR review*:ab,ti) AND ('editorial'/exp OR 'erratum'/de OR 'letter'/exp)
#4	#3 NOT ('animal'/exp OR 'nonhuman'/exp NOT ('animal'/exp OR 'nonhuman'/exp AND 'human'/exp))
#3	#1 AND #2
#2	'emergency health service'/exp/mj NOT psychiatric:ab,ti OR 'trauma centre*':ab,ti OR 'trauma centre*':ab,ti OR 'trauma unit*':ab,ti OR 'trauma model*':ab,ti OR 'trauma system*':ab,ti OR 'trauma network*':ab,ti OR 'trauma organization*':ab,ti OR 'trauma organisation*':ab,ti OR 'trauma care':ab,ti OR 'trauma service*':ab,ti
#1	'multiple trauma'/exp OR trauma AND patient*:ab,ti OR 'multiple trauma':ab,ti OR 'major trauma':ab,ti OR 'multiple fracture*':ab,ti OR (sever*:ab,ti OR critical*:ab,ti AND (trauma*:ab,ti OR injur*:ab,ti))

Search for systematic reviews

No.	Query
#7	#4 AND ('meta analysis'/exp OR 'systematic review'/exp OR (meta NEAR/3 analy*):ab,ti OR metaanaly*:ab,ti OR review*:ab,ti) NOT ('editorial'/exp OR 'erratum'/de OR 'letter'/exp)
#4	#3 NOT ('animal'/exp OR 'nonhuman'/exp NOT ('animal'/exp OR 'nonhuman'/exp AND 'human'/exp))
#3	#1 AND #2
#2	'emergency health service'/exp/mj NOT psychiatric:ab,ti OR 'trauma centre*':ab,ti OR 'trauma centre*':ab,ti OR 'trauma unit*':ab,ti OR 'trauma model*':ab,ti OR 'trauma system*':ab,ti OR 'trauma network*':ab,ti OR 'trauma organization*':ab,ti OR 'trauma organisation*':ab,ti OR 'trauma care':ab,ti OR 'trauma service*':ab,ti
#1	'multiple trauma'/exp OR trauma AND patient*:ab,ti OR 'multiple trauma':ab,ti OR 'major trauma':ab,ti OR 'multiple fracture*':ab,ti OR (sever*:ab,ti OR critical*:ab,ti AND (trauma*:ab,ti OR injur*:ab,ti))

1.3. Cochrane Database of Systematic Reviews and Cochrane Central Register of Controlled Trials (CENTRAL)

Date of last search: 7 June, 2016

Search for primary studies and systematic reviews

Search	Query
#1	"trauma network" or "trauma care" or "trauma system" or "trauma organisation" or "trauma model" or "trauma centre" or "trauma service" or "trauma organization"
#2	MeSH descriptor: [Trauma Centres] explode all trees
#3	#1 or #2
#4	MeSH descriptor: [Multiple Trauma] explode all trees
#5	"Multiple Trauma" or "trauma patient" or "multiple trauma" or "major trauma" or "multiple fractures"
#6	#4 or #5
#7	#6 and #3

1.4. Search strategy Cinahl

5 **Search for primary studies and systematic reviews**

Search	Query
S24	(("major trauma" OR "severe trauma" OR "severely injured" OR "multiple injuries" OR "multiple fractures" OR "critically injured" OR "critical injuries") AND (S20 OR S21)) AND (S19 AND S22)
S22	("major trauma" OR "severe trauma" OR "severely injured" OR "multiple injuries" OR "multiple fractures" OR "critically injured" OR "critical injuries") AND (S20 OR S21)
S21	("major trauma" OR "severe trauma" OR "severely injured" OR "multiple injuries") OR ("multiple fractures" OR "critically injured" OR "critical injuries")
S20	multiple trauma
S19	("trauma centers" OR "trauma center" OR "trauma centre" OR "trauma centres" OR "trauma system" OR "trauma organisation" OR "trauma organization" OR "trauma network") AND (S17 OR S18)
S18	"trauma centers" OR "trauma center" OR "trauma centre" OR "trauma centres" OR "trauma system" OR "trauma organisation" OR "trauma organization" OR "trauma network"
S17	MW Trauma

1.5. Contacted experts

Table 1 – Contacted experts

Name	Institution
L. Sturms	LNAZ
S. Nijs	UZ Leuven
L. Schoonmade	VU University Amsterdam

1.6. Definition of western countries

Table 2 – List of western countries[1]

Countries	
Austria	Malta
Belgium	The Netherlands
Bulgaria	Poland
Croatia	Portugal
Cyprus	Romania
Czech Republic	Slovakia
Denmark	Slovenia
Estonia	Spain
Finland	Sweden
France	The United Kingdom
Germany	Iceland
Greece	Liechtenstein
Hungary	Norway
Ireland	Switzerland
Italy	USA
Latvia	Canada
Lithuania	Australia
Luxembourg	New Zealand

2. INCLUDED PRIMARY STUDIES

Chapter authors: Maaike Langelaan (NIVEL), Nanne Bos (NIVEL), Julie Heeren (NIVEL), Janke de Groot (NIVEL)

2.1. Characteristics of included primary studies

	Description of intervention and comparison	Country	Outcomes	Population			
				Description of patients	Specific group	Inclusion criteria	Exclusion criteria
Afifi 2015[2] [Unpublished data obtained from author]	Intervention 1: Florida level I/II TC Intervention 2: Indiana level I/II TC Comparison 1: Florida non Trauma centres Comparison 2: Indiana non-trauma centres	USA	Mortality	Subjects included all trauma children aged 1–15 years admitted in Florida and Indiana hospitals and TCs. "Trauma cases" defined by the International Classification of Diseases, ninth revision, Clinical Modification (ICD-9) diagnosis code 800.00 to 959.9 ("injury" or "poisoning").	Only paediatric patients	All trauma children aged 1–15 years.	None reported.
Ashley 2015[3]	Intervention: designated trauma centres Comparison: non-trauma centres	USA	Mortality (OR)	All severely injured trauma patients that meet the inclusion criteria.	No special group	1. Trauma patients pertains to the diagnosis codes, which were used to categorize patients into eight groups based on injury type: (1) patients with a fracture who did not experience either traumatic brain injury (TBI) or skull, and spinal cord injuries (SSCIs); (2) fractures of the skull, neck, trunk, and spinal cord injuries but excluding patients with TBI; (3) patients	Five exclusion criteria were applied to isolate potential true trauma cases from other injuries. 1. Diagnosis code; 2. episodes classified as urgent or elective; 3. elderly patients with isolated femoral fracture; 4. transfers from another short-term hospital; 5. ICISS=>0.85 (higher number is increased survival). Also non-Georgia residents were excluded.

	Description of intervention and comparison	Country	Outcomes	Population			
				Description of patients	Specific group	Inclusion criteria	Exclusion criteria
						with TBI; (4) internal injury of the thorax, abdomen, or pelvis; (5) injury of blood vessels; (6) open wounds; (7) crushing injuries; and (8) injuries to the nerves. 2. Episodes classified emergent or trauma alert, indicating need for immediate care. 3. ICISS<0.85 (lower number imply greater severity).	
Bekelis 2015[4]	Intervention: Level I TC Comparison: Level II TC	USA	In-hospital survival (mortality) after TBI	Patients with traumatic brain injury (TBI) who were transferred to a level I or level II trauma centre.	Only patients with specific diagnosis	* ICD-9_CM Codes 800.0–801.99, 803.0–804.99, or 850.0–854.19 were eligible for inclusion. * Patients older than 16 years transported to level I and II trauma centres by helicopter or ground EMS were included for analysis.	* other modes of transportation to the trauma centres, * patients who were dead on arrival to the emergency department (ED), * transfers to/from other hospitals, * incomplete record information on transport and position.
Bouzat 2013[5]	Level I trauma centre compared to level II trauma centre (descriptive)	France	30 days mortality	Patients with a non penetrating pelvic trauma with a AIS score above or equal to 3	No special group	Non penetrating pelvic trauma with an AIS score above or equal to 3	Isolated lesions of the acetabulum were not taken into account 5 patients were excluded due to the fact that the intake was done by a centre that was not part of the care network and whose premedical care was not

	Description of intervention and comparison	Country	Outcomes	Population			
				Description of patients	Specific group	Inclusion criteria	Exclusion criteria
							medicalized.
Brinck 2015[6]	Intervention: Trauma system in Germany (DGU = German Trauma Society) Comparison: Trauma system in southern Finland (HUH trauma unit)	Germany and Finland	30 days mortality, LOS, LOS ICU	TR-DGU aims to enrol all patients who reach the hospital alive and are admitted to hospital via the emergency room with subsequent intensive care unit (ICU) care, including patients who die before admission to ICU. All trauma admissions to the HUH trauma unit from 1.1.2006 onwards have been reviewed by three trauma nurses, and all patients with ISS over 15 have been included in the registry. Neither TR-THEL nor TR-DGU includes patients who died on the scene of the injury or during transport to hospital.	No special group	All trauma admissions to the HUH trauma unit from 1.1.2006 onwards have been reviewed by three trauma nurses, and all patients with ISS over 15 have been included in the registry. TR-DGU aims to enrol all patients who reach the hospital alive and are admitted to hospital via the emergency room with subsequent intensive care unit (ICU) care, including patients who die before admission to ICU. Furthermore, all patients transferred from another hospital where the initial injury severity complies to the inclusion criteria should be documented.	Neither TR-THEL nor TR-DGU includes patients who died on the scene of the injury or during transport to hospital. We excluded patients under 16 years, patients with penetrating trauma without head injury and transferred patients with isolated head injury. The patients transferred in from another hospital were included in the descriptive survival analysis but excluded from the RISC calculations due to the missing status on initial admission in these cases.
Brinck 2016[7]	Intervention: Trauma system in Germany (DGU = German Trauma Society) Comparison:	Germany	30 days mortality	Unconscious trauma patients.	Only patients with specific diagnosis	Patient with a first-measured pre-hospital GCS 3-8.	Younger than age 16 penetrating trauma without head injury transferred patients with missing baseline risk data.

	Description of intervention and comparison	Country	Outcomes	Population			
				Description of patients	Specific group	Inclusion criteria	Exclusion criteria
	Trauma system in southern Finland (HUH trauma unit)						
Choi 2016[8]	Comparison: all trauma patients who have been treated at our institution from January 1st 2009 to December 31st 2010 (2 years before the process of ACS verification was initiated) Intervention: all patients who have been treated from April 1st 2012 to April 30th 2014(2 years after ACS-verification)	USA	Overall mortality	All trauma patients with significant injuries admitted to the children's hospital.	Only paediatric patients	All trauma patients admitted to children's hospital.	Patients discharged from the emergency room.
Clement 2013[9]	Intervention 1: 60+ cases per year Comparison 1: <6 cases per year Comparison 2: 6-11 cases per year Comparison 3: 12-23 cases per year Comparison 4: 24-59 cases per year	USA	In-hospital mortality of centre volume per group	Patients with neurological trauma.	Only patients with specific diagnosis	Cases were identified by using ICD-9 codes with one of the injury codes: 852-852.59.	Transferred cases, into or out of the hospital. 852.29, 852.30–852.39, 852.40–852.49, and 852.50–852.59. We excluded patients with trauma to other body regions as defined by the presence of an AIS score ≥3 to limit the impact of non-neurological injuries on death.
Cole 2016[10]	Intervention 1: London Trauma System (eLoTS)	United Kingdom	Mortality within 72h from arrival	Patients with severe injuries (ISS>=16).	No special group	- Severe injury, defined by an injury severity score (ISS)	- An ISS less than 16; - A non-trauma patient

	Description of intervention and comparison	Country	Outcomes	Population			
				Description of patients	Specific group	Inclusion criteria	Exclusion criteria
	Comparison 1: National Confidential Enquiry into Patient Outcome and Death (NCEPOD; England & Wales) Intervention 2: MTCs in eLoTS Comparison 2: High-volume centres in NCEPOD					of greater than 15 - Abbreviated Injury Score (AIS 98) coding.	- A delay in presentation of greater than 72 h from injury (primarily due to repatriation from other facilities in the UK or overseas).
Deasy 2012[11]	Intervention: Major Trauma Services (MTS) in Victoria Australia (Level I equivalent) Comparison: metropolitan and rural health services in Victoria Australia	Australia	In-hospital mortality	All major trauma cases in Victoria, irrespective of where the cases receive definitive management. Major trauma is defined as the presence of at least one of the following: death after injury; admission to an Intensive Care Unit (ICU) for more than 24 h requiring mechanical ventilation; Injury Severity Score (ISS) > 15; or urgent surgery for intracranial, intrathoracic, intraabdominal injury or fixation of pelvic or spinal fractures.	Only paediatric patients	- 18 years or younger - Major trauma - Blunt trauma	None reported.
Di Bartolomeo 2014[12]	Intervention: trauma centres (3) Comparison: 11 non-trauma centres (12 -1 (excluded because of mix characteristics)	Italy	Crude mortality	All traumatic patients of the region Emilia-Romagna that fulfil the inclusion criteria.	No special group	Its inclusion criteria are traumatic injuries with Injury Severity Score (ISS) > 15 or admission to Intensive Care (ICU).	- Patients dead on arrival or early in the Emergency Room - Patients whose main mechanism of injury were burns, asphyxia or drowning and those with age < 1 year were then excluded. - Between-hospital transferred patients

	Description of intervention and comparison	Country	Outcomes	Population			
				Description of patients	Specific group	Inclusion criteria	Exclusion criteria
							- All cases from one hospital because it has mixed characteristics.
Glance 2012[13]	Intervention: Level I trauma centres Comparison: Level II trauma centres	USA	In-hospital mortality	The study population consisted of trauma patients with age greater than 16 years admitted to either Level I or Level II trauma centres in Pennsylvania.	No special group	- Age greater than 16 years - Admitted to either Level I or Level II trauma centres in Pennsylvania.	Patients with burns, hypothermia, isolated hip fractures, superficial injuries, unspecified injuries, non-traumatic mechanism of injury, and patients transferred out to another hospital.
Gomez 2015[14]	Intervention: patients transferred from any hospital to a level I or II trauma centre Comparison: those receiving definitive care at level III trauma centres (state or ACS verified)	USA	Crude mortality	Severely injured adults admitted at level 3 trauma centres or transferred to level I/II trauma centres.	Only adults, no children	- Hospitalized or died as a result of injury - Who have a diagnoses code in the 800–959.9 range, as defined by the International Classification of Diseases Ninth revision (ICD-9). - Injury severity score > 15 - Age >= 18 years.	Patients with ICD-9 codes consistent with late effects of injury (905–909.9), superficial injuries (910–924), or foreign bodies (930–939.9) are excluded. We further excluded patients with injuries due to poisoning, suffocation, drowning, overexertion, environmental causes, or burns.
Joosse 2012[15]	intervention1: Direct presentation to the level I trauma centre (TC) group Control1: secondary transport to the level I trauma centre after having	Netherlands	The percentage of groups with Glasgow Outcome Scale (GOS) 1 (dead)	Patients with Severe Traumatic Brain Injury (TBI).	Only adults, no children	Severe TBI was defined as having an Abbreviated Injury Scale of the head score of 3. underwent an emergency neurosurgical intervention performed within 6 hours after	Emergency operations were defined as a craniotomy, a craniotomy, or an operation for reduction of a depressed skull fracture. Patients solely operated for insertion of

	Description of intervention and comparison	Country	Outcomes	Population			
				Description of patients	Specific group	Inclusion criteria	Exclusion criteria
	been diagnosed for neurosurgical intervention in other hospitals (transfer group).					admission to the AMC.	intracranial pressure monitoring devices or external ventricular drains were excluded. Patients admitted for observation but requiring a secondary emergency operation after clinical deterioration were also excluded.
Kuimi 2015[16]	Arm1: adult major trauma patients who had access to the trauma system Arm2: adult major trauma patients who had no access to the trauma system	Canada	Crude in-hospital mortality	Adult trauma patients (16–84 years of age) admitted for major injury.	Only adults, no children	- 16–84 years of age - Admitted for major injury (defined as a primary International Classification of Diseases (ICD) injury code between S00 and T14 and an ICD injury severity score (ICISS) under 0.85).	- Quebec non-residents - Patients older than 64 admitted for an isolated hip fracture, defined as a principal diagnosis of hip fracture (ICD-10 codes: S72.0, S72.1 and S72.2) with no secondary injuries of equal or greater severity.
Matsushima 2016[17]	Arm 1: patients with do not resuscitate orders (DNR) in level 1 trauma centres (intervention group) Arm2: patients with do not resuscitate orders (DNR) in level 2 trauma centres (control group)	USA	In-hospital mortality (OR)	Trauma patients with do-not resuscitate (DNR) orders.	Only adults, no children	Trauma patients with one of the following criteria: (1) hospital stay >48 h, (2) transfer from another institution, (3) admission to the ICU, and (4) in-hospital mortality. >15 years patients with do-not resuscitate (DNR) orders placed during hospital stay.	Trauma patients with isolated hip fractures, asphyxia, drowning, and hyperthermia, and or hypothermia.
Metcalfe 2014[18]	Intervention: after the launch of the	United Kingdom	Crude mortality	All patients with major trauma.	No special group	All injured patients regardless of age	Specific outcome measures such as

	Description of intervention and comparison	Country	Outcomes	Population			
				Description of patients	Specific group	Inclusion criteria	Exclusion criteria
	trauma network in England Comparison: before the launch of the trauma network in England					inpatients for >= 72h or admitted to a high dependency area or died after reaching the hospital who sustained a severe injury as defined in the TARN.	hospital and critical care length of stay excluded patients who had died, to avoid these measures being downwardly biased by the inclusion of patients who died at an early stage.
Mills 2015[19]	Intervention1: paediatric severe TBI patients level I Control 1: Paediatric severe TBI patients level II	USA	30 days mortality	Paediatric patients hospitalized with severe TBI.	Only paediatric patients	Under 18 years of age at admission, admission to the intensive care unit (ICU) for a minimum of 2 calendar days, treated for a severe TBI. Severe TBI was identified based on: (1) an Abbreviated Injury Scale (AIS) score of >= 3 and specific to head trauma (predot code beginning with 1), (2) a Glasgow Coma Scale (GCS) score < 9, and (3) a TBI-specific International Classification of Diseases (ICD-9 code on their discharge abstract (800.0–801.9, 803.0–804.9, 850.0–854.1, 950.1–950.3, 959.01, or 995.55). Patients treated in Level I and II hospitals facilities	We excluded patients with missing inclusion criteria (n = 3870), mechanism of injury (n = 236), hospital discharge status (i.e., main outcome, n = 38), those patients with penetrating injuries (n = 301), nonsurvivable injuries (AIS = 6, n = 241); and those who arrived without vital signs (n = 61).

	Description of intervention and comparison	Country	Outcomes	Population			
				Description of patients	Specific group	Inclusion criteria	Exclusion criteria
						that provide the majority of care for severe TBI injuries as both direct admissions and transfers from lower level trauma centres.	
Minei 2014[20]	Intervention: level I designated (maybe ACS) trauma centres Comparison: level II designated (maybe ACS) trauma centres	USA and Canada	28-day mortality	Patients included in the hypovolemic shock cohort and patients included in the TBI cohort.	Only patients with specific diagnosis	Patients were included in the hypovolemic shock cohort if they had out-of-hospital systolic blood pressure of 70 mm Hg or less or 71 to 90 mm Hg with a concomitant heart rate of 108 beats or more per minute. Patients were included in the TBI cohort if they had a blunt mechanism of injury and a Glasgow Coma Scale (GCS) score of 8 or less and did not meet criteria for the shock cohort. Patients who met criteria for the shock cohort and who also exhibited inclusion criteria for the TBI cohort were included in the shock cohort.	Exclusion criteria were the following: known or suspected pregnancy; age less than 15 years; out-of-hospital cardiopulmonary resuscitation; administration of more than 2000-mL crystalloid, colloid, or blood products before enrolment; severe hypothermia (<28◦C); drowning or asphyxia due to hanging; burns more than 20% total body surface area; isolated penetrating head injury; inability to obtain intravenous access; time of dispatch call received to study intervention more than 4 hours; and known prisoners. Interfacility transfers were also excluded.
Miyata 2015[21]	Intervention: Paediatric Level I (PLI) trauma centres	USA	In-hospital mortality	Severely injured trauma patients treated in paediatric trauma centres level I or level II.	Only paediatric patients	- 18 years of age or younger - With injury severity score (ISS) > 15	- Injured patients treated at other facilities before admission in the

	Description of intervention and comparison	Country	Outcomes	Population			
				Description of patients	Specific group	Inclusion criteria	Exclusion criteria
	Comparison: Paediatric Level II (PLII) trauma centres.					- Primarily treated in designated PLI or PLII trauma centres.	paediatric trauma centres - Those treated in adult trauma centres without paediatric designation.
Morrissey 2015[22]	Intervention: trauma care at a long established large Level I Trauma Centre in the USA (Massachusetts General Hospital). Comparison: trauma care provision and outcomes in a Scottish Hospital (Aberdeen Royal Infirmary)	Scotland and USA	Crude mortality	* All patients from ARI included in the STAG database from 1993 to 2002. * All patients from MGH included in the MGH trauma registry.	No special group	STAG inclusion criteria: All trauma patients who enter the hospital via an emergency department from 00:01 on 3rd January 2011 and remain in hospital for at least 3 consecutive days, excluding day of attendance • ALL trauma patients who die in hospital within 3 days of attendance • ALL trauma patients transferred into ED from another hospital , who remain in hospital for at least 3 consecutive days following attendance at initial hospital (see example above) • ALL trauma patients transferred out of the hospital within 3 days of attendance, e.g.	STAG exclusion criteria • < 13 years • Injuries older than 1 week. • Isolated burn injuries • Isolated smoke inhalation • Isolated lacerations, puncture wounds and bites, with no underlying injury • Isolated minor head injuries: no fracture and GCS >13 • Isolated Colles fractures • Isolated reduction of dislocations • Isolated facial injuries • Isolated hip fracture in patients aged 65 years or older (Any femur # that is classed as subcapital, intracapsular, intertrochanteric or basal. If the injury is described as 'proximal shaft of femur' confirmation from clinical staff

Description of intervention and comparison	Country	Outcomes	Population			
			Description of patients	Specific group	Inclusion criteria	Exclusion criteria
					patients transferred for regional care or localised specialist care, provided they have a total combined inpatient stay of at least 3 consecutive days. • ALL trauma patients managed in resus who meet the above inclusion criteria should be reviewed to determine the presence of exclusion criteria. Similar data from the same time period were obtained from the Trauma Registry at MGH	should be gained on whether the injury is being treated as subtrochanteric # (exclude) or proximal shaft of femur # (include)). • Isolated periprosthetic or pathological fractures • Isolated dislocation of prosthesis • Isolated fractured Pubic Rami in patients aged 65 years or over • Patients admitted to medical wards under the care of a physician only should be excluded. However if the patient was admitted to a medical ward as a surgical boarder, or if they were under shared care of a physician and surgeon then they should be included. • Patients entering ED with no recordable observations and declared dead within 15 minutes. • Patients with no documented Systolic B/P, RR and GCS in ED or on a patient report form (PRF)

	Description of intervention and comparison	Country	Outcomes	Population			
				Description of patients	Specific group	Inclusion criteria	Exclusion criteria
							• Patients whose initial reason for admission is social (specifically documented or from information gained following discussion with clinical staff) • Deaths or injury caused exclusively by asphyxia with no anatomical injuries – such as hanging, drowning, carbon monoxide poisoning • Patients for whom the only reason they are managed in resus is to carry out a procedure such as reduction of fracture etc., should not be included *Any patient with a combination of any of the above isolated injuries are excluded.
Narayan 2015[23]	Intervention 1: emergency general surgery patients treated at level 1 trauma centres Intervention 2: emergency general surgery patients treated at level 2 trauma centres Comparison 1:	USA	In-hospital mortality	Emergency general surgery patients.	Only adults, no children	Adult patients 18 years or older. From the database, a patient was classified as an emergency general surgery (EGS) patient if at least 1 of the 15 ICD-9 diagnosis codes recorded matched an American Association for the Surgery of Trauma	None.

	Description of intervention and comparison	Country	Outcomes	Population			
				Description of patients	Specific group	Inclusion criteria	Exclusion criteria
	Emergency general surgery patients treated at non trauma centres					EGS ICD-9 code.	
Odetola 2016[24]	Intervention: Paediatric spinal cord injury patients to trauma centres Control: paediatric spinal cord injury patients to non-trauma centre	USA	Mortality in percentage	Paediatric spinal cord injury patients presented to the ED (0-20 years old).	Only paediatric patients	International Classification of Diseases, ninth revision, clinical modification (ICD-9-CM) primary or secondary diagnosis codes indicative of trauma (800–959), diagnosis of SCI was ascertained using specific ICD-9-CM codes for SCI including 806.xx and 952.xx.	SCI from birth trauma (767.4) which would be more appropriately categorized as a complication of the perinatal period Records with missing ISS values, missing age, or age > 20 years.
Olufajo 2016[25]	Arm 1: geriatric trauma patients treated in level I TC. Arm 2: geriatric trauma patients treated in level II TC. Arm 3: geriatric trauma patients treated in level III or IV TC.	USA	In-hospital mortality	All geriatric trauma patients/defined as patients aged 65 years and older.	Only geriatric patients	We included patients who had admitting ICD-9-CM diagnosis codes corresponding with traumatic injuries (800-904, 910-929, and 950-959) aged 65 years and older. We restricted our analyses to patients who were treated at trauma centres.	We excluded patients who had isolated hip fractures. Patients that were transferred from or to other acute care facilities were also excluded.
Ovalle 2014[26]	Intervention: paediatric severe TBI patients to adult trauma centres with qualifications in paediatrics	USA	In-hospital mortality patients	Paediatric patients 0-17 with a diagnosis of severe TBI (AIS score >2 or in the paper also>=3)	Only paediatric patients	The study population was comprised of visits of paediatric patients who were aged 0–17 years old with a diagnosis of severe	- Dead on arrival or expired on the ED after failed resuscitation, - Patient visits at trauma centres with unknown

	Description of intervention and comparison	Country	Outcomes	Population			
				Description of patients	Specific group	Inclusion criteria	Exclusion criteria
	Comparison: paediatric severe TBI patients to adult trauma centres					TBI (defined by head maximum Abbreviated Injury Scale [27] score ≥3).	level/verification status, - Those with unknown sex - Transfer status unknown - Patient visits at PTC - Patients transferred out of a ATC/ATC-AQ.
Sathya 2015[28]	Intervention 1: ATC (adult trauma centre; ATC: ACS verification or adult state designation and no paediatric qualifications.) Intervention 2: MTC (mixed trauma centre; adult and paediatric ACS verifications or state designations.) Comparison 1: PTC (paediatric trauma centre; TC: exclusively either paediatric ACS verification or paediatric state designation.)	USA	In-hospital mortality death (crude hospital mortality)	All paediatric patients aged 18 years or younger who were hospitalized at a TQIP trauma centre.	Only paediatric patients	- Patients with either blunt or penetrating trauma with an Abbreviated Injury Score (AIS) of 2 or greater in any body region - Age 18 or younger.	- Patients with superficial injuries - Those who were transferred to another hospital or home directly from the emergency department - Those who were dead on arrival.
Vickers 2015[29] [Unpublished data obtained from author]	Intervention 1: level I TC Intervention 2: level II TC	USA	Emergency Department mortality defined as those who	Adult, major trauma patients between the ages of 18 and 64 years with a primary International Classification of Diseases, Ninth Revision (ICD-9CM), diagnosis code of 800 to 959.9 (excluding injuries from late effects	Only adults, no children	- Between the ages of 18 and 64 years - With a primary International Classification of	- Patients missing any study variables - Patients transferred to another hospital were excluded from

	Description of intervention and comparison	Country	Outcomes	Population			
				Description of patients	Specific group	Inclusion criteria	Exclusion criteria
	Comparison 1: Non-trauma centre		died in the ED for ISS 16-24	[905-909.9], superficial injuries [910-924.9], and injuries due to foreign bodies [930-939.9]).		Diseases, Ninth Revision (ICD-9CM), diagnosis code of 800 to 959.9 (excluding injuries from late effects [905-909.9], superficial injuries [910-924.9], and injuries due to foreign bodies [930-939.9]).	the study.
Wang 2013[30]	intervention1: designated trauma centres Intervention 2: designated paediatric trauma centres Comparison1: non-trauma centres Comparison 2: designated adult trauma centres	USA	In-hospital mortality	Children with serious injury discharged from California (non)-trauma centres.	Only paediatric patients	0-18 years non-scheduled admission to acute care hospitals external causes of injury codes and principal or secondary acute trauma diagnosis of ICD-9 codes: 800 to 904.9, 910 to 929.9 and 950 to 959.9.	- Children with injury codes that could result in death. - Children cared for in level III and IV TCs were eliminated when matching TC and NTC diagnoses. - Children from designated as transfer Children with sole ICD-9 codes indicating minor injuries such as sprains and strains (840–848.9), open wounds (871.9–894.1), superficial abrasions (910.0–919.8), contusion with intact skin surface (920–924.9), foreign bodies (930–939), late effects of injury (905–909) and those with trauma ICD-9 codes associated with pregnancy and

	Description of intervention and comparison	Country	Outcomes	Population			
				Description of patients	Specific group	Inclusion criteria	Exclusion criteria
							perinatal conditions. - Children with the sole diagnosis of burns (940–949). - Patients with no Ecodes.
Zacher 2015)[31]	Model 1: Intervention 1: Hospital volume=>100 Control 1: Hospital volume 1-19 Control 2: Hospital volume 20-39 Control 3: Hospital volume 40-59 Control 4: Hospital volume 60-79 Control 5: Hospital volume 80-99 Model 2: Intervention: Level I Control I: Level II Control II: Level III	Germany	In-hospital mortality, LOS ICU	German patients who were admitted to hospital between 2009 and 2013 with severe injuries.	No special group	Severe injuries; ISS of at least 16, data available for calculation of Revised Injury Severity Classification (RISC) II score.	Patients who were transferred in or out early (within the first 48 h) were excluded because Revised Injury Severity Classification (RISC) II score and outcome respectively are not available for these patients. Missing RISC-II score Inconsistent reporting.

3. EXCLUDED PRIMARY STUDIES

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3.1. Excluded primary studies and the first exclusion reason

Reference	Exclusion reason
Afzali 2013[32]	Wrong study design / no comparison
Aldrian 2012[33]	Wrong outcomes
Alexander 2014[34]	Wrong population
Andruszkow 2013[35]	Wrong population
Ang 2014[36]	Wrong population
Ardolino 2012[37]	Wrong publication type
Bala 2013[38]	Wrong study design / no comparison
Barr 2015[39]	Wrong population
Baudin 2016[40]	Wrong intervention
Bell 2015[41]	Wrong outcomes
Bell 2012[42]	Wrong population
Benns 2013[43]	Wrong study design / no comparison
Biber 2013[44]	Wrong population
Billeter 2014[45]	Wrong intervention
Blakemore 2012[46]	Wrong population
Blomberg 2013[47]	Wrong population
Bodanapally 2013[48]	Wrong population
Boomer 2015[49]	Wrong population
Boschin 2012[50]	Publication not available
Branco 2013[51]	Wrong population

Reference	Exclusion reason
Brice 2015[52]	Wrong intervention
Brown 2016[53]	Wrong study design / no comparison
Brown 2015[54]	Wrong intervention
Brown 2013[55]	Wrong outcomes
Bryczkowski 2014[56]	Wrong population
Buchanan 2016[57]	Wrong intervention
Bukur 2015[58]	Wrong outcomes
Bukur 2014[59]	Wrong population
Bukur 2013[60]	Wrong population
Bukur 2012[61]	Wrong population
Burström 2012[62]	Wrong population
Burström 2012[63]	Wrong population
Byrne 2016[64]	Wrong population
Calland 2016[65]	Wrong population
Carr 2014[66]	Wrong population
Carr 2013[67]	Wrong publication type
Carr 2013[68]	Wrong population
Charbit 2013[69]	Wrong publication type
Cheung 2014[70]	Wrong outcomes
Ciesla 2012[71]	Wrong study design / no comparison
Ciesla 2015[72]	Wrong study design / no comparison
Cipolle 2016[73]	Wrong population
Claridge 2013[74]	Wrong population

Reference	Exclusion reason
Clark 2012[75]	Wrong study design / no comparison
Cliffe 2014[76]	Publication not available
Cohen 2012[77]	Wrong outcomes
Cole 2015[78]	Wrong publication type
Cole 2015[79]	Wrong intervention
Cole 2013[80]	Wrong population
Collins 2014[81]	Wrong intervention
Cooper 2014[82]	Wrong population
Cooper 2012[83]	Wrong intervention
Corcostegui 2015[27]	Wrong population
Costa 2013[84]	Wrong intervention
Cox 2014[85]	Wrong population
Cox 2012[86]	Wrong population
Cudnik 2012[87]	Wrong population
Curtis 2012[88]	Wrong study design / no comparison
Deasy 2012[89]	Wrong publication type
De Jongh 2012[90]	Wrong intervention
Dela'O 2014[91]	Wrong population
Delgado 2015[92]	Wrong population
Delgado 2012[93]	Wrong population
Den Hartog 2015[94]	Wrong intervention
Denis 2013[95]	Publication not available
Desai 2014[96]	Wrong intervention
Dinh 2014[97]	Wrong intervention

Reference	Exclusion reason
Dinh 2012[98]	Wrong population
Distelhorst 2016[99]	Wrong population
Dixon 2014[100]	Wrong publication type
Do 2014[101]	Wrong population
Doucet 2013[102]	Wrong population
Drennan 2015[103]	Wrong publication type
DuVernay 2013[104]	Wrong population
Dybdal 2015[105]	Wrong population
Engbrecht 2013[106]	Wrong population
Evans 2015[107]	Wrong population
Evans 2014[108]	Wrong intervention
Farach 2015[109]	Wrong population
Fatovich 2012[110]	Wrong intervention
Faul 2012[111]	Wrong study design / no comparison
Faul 2016[112]	Wrong outcomes
Fleet 2014[113]	Wrong population
Franschman 2013[114]	Wrong intervention
Fuller 2015[115]	Wrong study design / no comparison
Funder 2016[116]	Wrong population
Gabbe 2015[117]	Wrong population
Gabbe 2012[118]	Wrong population
Garner 2012[119]	Wrong outcomes
Garwe 2012[120]	Wrong population

Reference	Exclusion reason
Geyer 2013[121]	Wrong population
Glance 2012[122]	Wrong population
Glance 2014[123]	Wrong outcomes
Glance 2012[13]	Wrong population
Gomez 2014[124]	Wrong population
Gomez 2012[125]	Wrong intervention
Gomez Jaramillo 2012[126]	Wrong outcomes
Goodmanson 2012[127]	Wrong population
Gunkel 2015[128]	Wrong intervention
Gunning 2015[129]	Wrong intervention
Haas 2012[130]	Wrong population
Hamlat 2012[131]	Wrong population
Hammer 2016[132]	Wrong population
Handel 2014[133]	Wrong population
Hannay 2014[134]	Wrong population
Hansen 2013[135]	Wrong population
Hart 2012[136]	Publication not available
Hasler 2015[137]	Wrong intervention
He 2015[138]	Wrong population
Heim 2014[139]	Wrong study design / no comparison
Heim 2014[140]	Wrong study design / no comparison
Henry 2014[141]	Wrong intervention
Hesselfeldt 2013[142]	Wrong intervention
Hesselfeldt 2012[143]	Wrong intervention

Reference	Exclusion reason
Hiza 2015[144]	Wrong population
Holst 2014[145]	Wrong publication type
Hoogerwerf 2013[146]	Wrong intervention
Hsia 2014[147]	Wrong population
Huber-Wagner 2014[148]	Wrong outcomes
Ichwan 2013[149]	Wrong study design / no comparison
Ichwan 2015[150]	Wrong population
Ingalsbe 2015[151]	Wrong intervention
Ingraham 2012[152]	Wrong population
Jain 2016[153]	Wrong intervention
Jansen 2016[154]	Wrong publication type
Janssens 2012[155]	Wrong population
Jarou 2015[156]	Wrong study design / no comparison
Jenkins 2015[157]	Wrong population
Jenkins 2013[158]	Wrong population
Jordan 2015[159]	Wrong population
Katrancha 2014[160]	Wrong population
Keijzers 2015[161]	Wrong study design / no comparison
Kelley-Quon 2015[162]	Wrong population
Kelly 2015[163]	Wrong population
Kelly 2015[164]	Wrong population
Khalil 2015[165]	Wrong population
Khorsandi 2015[166]	Wrong outcomes

Reference	Exclusion reason
Klein 2014[167]	Wrong population
Krammel 2012[168]	Wrong intervention
Laing 2014[169]	Wrong country
Lansink 2013[170]	Wrong population
Lansink 2013[171]	Wrong intervention
Lawson 2013[172]	Wrong study design / no comparison
Lecky 2016[173]	Wrong intervention
Lee 2015[174]	Wrong population
Leeper 2013[175]	Wrong population
Lemoyne 2013[176]	Wrong outcomes
Leonard 2015[177]	Wrong intervention
Leung 2012[178]	Wrong population
Lipley 2014[179]	Wrong publication type
Lipsky 2014[180]	Wrong population
Locke 2016[181]	Wrong intervention
Louras 2016[182]	Wrong study design / no comparison
Mabry 2015[183]	Wrong population
Mangram 2012[184]	Wrong population
Mans 2016[185]	Wrong intervention
Marinaro 2013[186]	Wrong population
Matsushima 2014[187]	Wrong population
Matsushima 2013[188]	Wrong population
Maxwell 2015[189]	Wrong population
McCoy 2013[190]	Wrong study design / no comparison

Reference	Exclusion reason
McCoy 2015[191]	Wrong population
McCullough 2014[192]	Wrong publication type
McKee 2015[193]	Wrong population
Metcalfe 2016[194]	Wrong population
Metcalfe 2016[195]	Wrong population
Michetti 2012[196]	Wrong intervention
Middleton 2012[197]	Wrong intervention
Mills 2014[198]	Wrong population
Missios 2014[199]	Wrong intervention
Mock 2012[200]	Wrong population
Mohan 2015[201]	Wrong intervention
Mooney 2013[202]	Wrong population
Moore 2016[203]	Wrong population
Moore 2015[204]	Wrong outcomes
Moore 2013[205]	Wrong population
Moore 2013[206]	Wrong population
Moore 2014[207]	Wrong population
Moore 2015[208]	Wrong study design / no comparison
Moore 2012[209]	Wrong population
Morshed 2015[210]	Wrong population
Newgard 2012[211]	Wrong intervention
Newgard 2015[212]	Wrong intervention
Newgard 2015[213]	Wrong intervention

Reference	Exclusion reason
Odetola 2015[214]	Wrong population
Ong 2014[215]	Wrong population
Pearson 2012[216]	Wrong outcomes
Pegna 2012[217]	Wrong population
Petitti 2012[218]	Wrong study design / no comparison
Putnam 2014[219]	Wrong population
Raatiniemi 2015[220]	Wrong intervention
Raj 2013[221]	Wrong intervention
Rhinehart 2013[222]	Wrong intervention
Rogers 2013[223]	Wrong intervention
Røislien 2015[224]	Wrong intervention
Rose 2012[225]	Wrong intervention
Ruchholtz 2014[226]	Wrong population
Ruscelli 2014[227]	Wrong study design / no comparison
Saltzherr 2012[228]	Wrong population
Schneppendahl 2012[229]	Wrong intervention
Schoeneberg 2014[230]	Wrong study design / no comparison
Schoeneberg 2016[231]	Wrong study design / no comparison
Schoenfeld 2012[232]	Wrong population
Schweigkofler 2015[233]	Wrong intervention
Schweigkofler 2015[234]	Wrong intervention
Seid 2012[235]	Wrong intervention
Sharma 2013[236]	Wrong intervention
Sharma 2014[237]	Wrong outcomes

Reference	Exclusion reason
Shaw 2016[238]	Wrong intervention
Sise 2014[239]	Wrong population
Smith 2013[240]	Wrong population
Stewart 2015[241]	Wrong intervention
Stiles 2015[242]	Wrong population
Sugerman 2012[243]	Wrong intervention
Swaroop 2013[244]	Wrong intervention
Tallon 2012[245]	Wrong population
Tan 2012[246]	Wrong intervention
Tarima 2015[247]	Wrong intervention
Taylor 2012[248]	Wrong intervention
Tazarourte 2013[249]	Wrong intervention
Tepas 2013[250]	Wrong outcomes
Theobald 2014[251]	Wrong intervention
Timm 2014[252]	Wrong intervention
Uleberg 2014[253]	Wrong population
Van Laarhoven 2015[254]	Wrong population
Vanni 2012[255]	Wrong population
Villegas 2012[256]	Wrong population
Vyhnanek 2012[257]	Publication not available
Waxman 2012[258]	Wrong population
Weinberg 2015[259]	Wrong study design / no comparison
Wesson 2013[260]	Wrong publication type

Reference	Exclusion reason
Whiteman 2013[261]	Wrong publication type
Wise 2014[262]	Wrong publication type
Wong 2015[263]	Wrong population
Wong 2013[264]	Wrong study design / no comparison
Woodford 2013[265]	Wrong outcomes
Zafar 2015[266]	Wrong population
Zocchi 2013[267]	Wrong population
Zocchi 2016[268]	Wrong population
Anonymous 2014[269]	Wrong study design / no comparison

4. RISK OF BIAS OF INDIVIDUAL STUDIES

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4.1. Risk of bias for secondary data analysis of RCT's

Study ID	Study design	random sequence generation	allocation concealment	blinding of participants and personnel	blinding of outcome assessment	incomplete outcome data	selective reporting	other sources of bias
Minei 2014	Secondary data analysis based on two RCTs	Low risk	Low risk	Low risk	High risk	High risk	Low risk	Low risk

4.2. Risk of bias of cohort studies and uncontrolled before-after studies

Study ID	Study design	Selection bias		Detection bias					Attrition bias
		Can selection bias sufficiently be excluded?	Are the most important confounding factors identified, are they adequately measured and are they adequately taken into account in the study design and/or analysis?	Is the exposure clearly defined and is the method for assessment of exposure adequate and similar in study groups?	Are the outcomes clearly defined and is the method for assessment of the outcomes adequate and similar in study groups?	Is the likelihood that some eligible subjects might have the outcome at the time of enrolment assessed and taken into account in the analysis?	Is the assessment of outcome made blind to exposure status?	Is the follow-up sufficiently long to measure all relevant outcomes?	Can selective loss-to-follow-up be sufficiently excluded?
Afifi 2015	Cohort study	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Ashley 2015	Cohort study	No	Yes	Yes	Yes	Yes	No	Yes	Yes
Bekelis 2015	Cohort study	No	Yes	Yes	Yes	Yes	No	Yes	Yes
Bell 2015	Cohort study	No	Yes	Yes	Yes	Yes	No	Yes	Yes
Bouzat 2013	Cohort study	No	Yes	No	Yes	No	No	Yes	No

Study ID	Study design	Selection bias		Detection bias					Attrition bias
		Can selection bias sufficiently be excluded?	Are the most important confounding factors identified, are they adequately measured and are they adequately taken into account in the study design and/or analysis?	Is the exposure clearly defined and is the method for assessment of exposure adequate and similar in study groups?	Are the outcomes clearly defined and is the method for assessment of the outcomes adequate and similar in study groups?	Is the likelihood that some eligible subjects might have the outcome at the time of enrolment assessed and taken into account in the analysis?	Is the assessment of outcome made blind to exposure status?	Is the follow-up sufficiently long to measure all relevant outcomes?	Can selective loss-to-follow-up be sufficiently excluded?
Brinck 2015	Cohort study	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Brinck 2016	Cohort study	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Choi 2016	Uncontrolled before-after study	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Clement 2013	Cohort study	Yes	Insufficient information to answer	Yes	Yes	Yes	No	Yes	Yes
Cole 2016	Cohort study	No	No	Yes	Yes	Yes	No	Yes	Yes
Deasy 2012	Cohort study	No	Yes	Yes	Yes	Yes	No	Yes	Yes
Di Bartolomeo 2014	Cohort study	No	Yes	Yes	Yes	Yes	No	Yes	Yes
Glance 2012	Cohort study	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Gomez 2015	Cohort study	No	No	No	Yes	Yes	No	Yes	Yes
Joosse 2012	Cohort study	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Khorsandi 2015	Cohort study	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Kuimi 2015	Cohort study	No	No	Yes	No	Yes	No	Yes	Yes

Study ID	Study design	Selection bias		Detection bias					Attrition bias
		Can selection bias sufficiently be excluded?	Are the most important confounding factors identified, are they adequately measured and are they adequately taken into account in the study design and/or analysis?	Is the exposure clearly defined and is the method for assessment of exposure adequate and similar in study groups?	Are the outcomes clearly defined and is the method for assessment of the outcomes adequate and similar in study groups?	Is the likelihood that some eligible subjects might have the outcome at the time of enrolment assessed and taken into account in the analysis?	Is the assessment of outcome made blind to exposure status?	Is the follow-up sufficiently long to measure all relevant outcomes?	Can selective loss-to-follow-up be sufficiently excluded?
Matsushima 2016	Cohort study	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Metcalfe 2014	Uncontrolled before-after study	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Mills 2015	Cohort study	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Miyata 2015	Cohort study	No	No	Yes	Yes	Yes	No	Yes	Yes
Morrissey 2015	Cohort study	No	No	Yes	Yes	Yes	No	Yes	Yes
Narayan 2015	Cohort study	Yes	Insufficient information to answer	Yes	Yes	Yes	No	Yes	Yes
Odetola 2016	Cohort study	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Olufajo 2016	Cohort study	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Ovalle 2014	Cohort study	No	Yes	Yes	Yes	No	No	Yes	Yes
Sathya 2015	Cohort study	No	Yes	Yes	Yes	Yes	No	Yes	Yes
Vickers 2015	Cohort study	Yes	Yes	Yes	Yes	Yes	No	No	Yes

Study ID	Study design	Selection bias		Detection bias					Attrition bias
		Can selection bias sufficiently be excluded?	Are the most important confounding factors identified, are they adequately measured and are they adequately taken into account in the study design and/or analysis?	Is the exposure clearly defined and is the method for assessment of exposure adequate and similar in study groups?	Are the outcomes clearly defined and is the method for assessment of the outcomes adequate and similar in study groups?	Is the likelihood that some eligible subjects might have the outcome at the time of enrolment assessed and taken into account in the analysis?	Is the assessment of outcome made blind to exposure status?	Is the follow-up sufficiently long to measure all relevant outcomes?	Can selective loss-to-follow-up be sufficiently excluded?
Wang 2013	Cohort study	Yes	Insufficient information to answer	Yes	Yes	Yes	Yes	Yes	Yes
Zacher 2015 (a)	Cohort study	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes

5. INCLUDED AND EXCLUDED SYSTEMATIC REVIEWS

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5.1. Included systematic reviews

Reference	AMSTAR score	Number of included studies	Main conclusion of the reviewer
Biewener 2005[270]	**5**	**17**	6 relevant studies dealing with hospital level found a considerable lower mortality rate (19 to 42%) for patients treated primarily at a level 1 trauma center or comparable institution. Mortality rates can be lowered significantly through primary treatment at a level 1 trauma center.
Caputo 2014[271]	**7**	**19**	From this systematic review it is unclear whether an optimal volume exists, and it has not been demonstrated that the ACS criteria of a minimum of 1200 admissions and 240 severe trauma admissions improves survival.
Celso 2006[272]	**6**	**14**	A reduction in mortality in favour of the presence of a trauma system was found.
Kim 2013[273]	**7**	**50**	The systematic review of Kim 2013 showed that achieving the ACS trauma centre verification is beneficial to patient outcomes. However, the benefit of level I centres compared with level II centres, and volume of annual trauma patients to outcomes is not clear.
Mann 1999[274]	**6**	**40**	Weak evidence that organized systems of trauma care are an effective health care policy.

5.2. Excluded systematic reviews

Reference	Exclusion reason
Ardolino 2012[37]	Amstar score <5
Bledsoe 2006[275]	Amstar score <5
Botker 2009[276]	Wrong population/intervention/outcome
Bottiger 2016[277]	Wrong population/intervention/outcome
Brain trauma foundation 2000[278]	Amstar score <5

Reference	Exclusion reason
Brohi 2011[279]	Amstar score <5
Brown 2013[280]	Amstar score <5
Chiara 2003[281]	Amstar score <5
Davies 2015[282]	Amstar score <5
Eastman 2013[283]	Amstar score <5
Fingerhut 2012[284]	Amstar score <5
Galvagno 2015[285]	Wrong population/intervention/outcome
Gruen 2011[286]	Amstar score <5
Haider 2012[287]	Amstar score <5
Harmsen 2015[288]	Wrong population/intervention/outcome
Harris 2012[289]	Amstar score <5
Hildebrand 2016[290]	Wrong population/intervention/outcome
Hill 2011[291]	Wrong population/intervention/outcome
Hodgetts 2000[292]	Amstar score <5
Hulka 1999[293]	Amstar score <5
juillard 2009[294]	Amstar score <5
Jurkovich 1999[295]	Amstar score <5
Kammerlander 2010[296]	Wrong population/intervention/outcome
Kivell 1999[297]	Amstar score <5
Kortbeek 2000[298]	Amstar score <5
Kühne 2004[299]	Amstar score <5
Kwon 2014[300]	Amstar score <5
Lansink 2007[301]	Amstar score <5

Reference	Exclusion reason
Lee 2014[302]	Amstar score <5
Lendrum 2013[303]	Amstar score <5
Leppäniemi 2005[304]	Amstar score <5
Lowe 1973[305]	Amstar score <5
McCarthy 2016[306]	Amstar score <5
McDonell 2009[307]	Amstar score <5
Moylan 1988[308]	Amstar score <5
Mullins 1999[309]	Amstar score <5
Pape 2009[310]	Amstar score <5
Pfeifer 2009[311]	Amstar score <5
Pickering 2014[312]	Wrong population/intervention/outcome
Radomski 2015[313]	Amstar score <5
Rainer 2003[314]	Amstar score <5
Snooks 1996[315]	Amstar score <5
Tai 2011[316]	Amstar score <5
Williams 2012[317]	Wrong population/intervention/outcome
Zalstein 1997[318]	Amstar score <5

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