AusTQIP

CARING FOR THE SEVERELY INJURED IN AUSTRALIA

INAUGURAL REPORT OF THE AUSTRALIAN TRAUMA REGISTRY

2010 TO 2012

AUSTRALIAN TRAUMA QUALITY IMPROVEMENT PROGRAM

THE AUSTQIP COLLABORATION

(AS AT 31 AUGUST 2014)

Designated trauma centres

Australian Capital Territory

- Canberra Hospital

New South Wales

- The Children's Hospital at Westmead
- John Hunter Hospital
- John Hunter Children's Hospital
- Liverpool Hospital
- Royal North Shore Hospital
- Royal Prince Alfred Hospital
- St George Hospital
- St Vincent's Hospital
- Sydney Children's Hospital
- Westmead Hospital

Northern Territory

- Royal Darwin Hospital

Queensland

- Gold Coast University Hospital
- Mater Children's Hospital
- Princess Alexandra Hospital
- Royal Brisbane and Women's Hospital
- Royal Children's Hospital
- Townsville Hospital

South Australia

- Flinders Medical Centre
- Royal Adelaide Hospital
- Women's and Children's Hospital

Tasmania

- Royal Hobart Hospital

Victoria

- The Alfred
- Royal Children's Hospital
- Royal Melbourne Hospital

Western Australia

- Princess Margaret Hospital for Children
- Royal Perth Hospital

State trauma registries

- New South Wales Institute of Trauma and Injury Management
- Victorian State Trauma Registry

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JARROD'S STORY

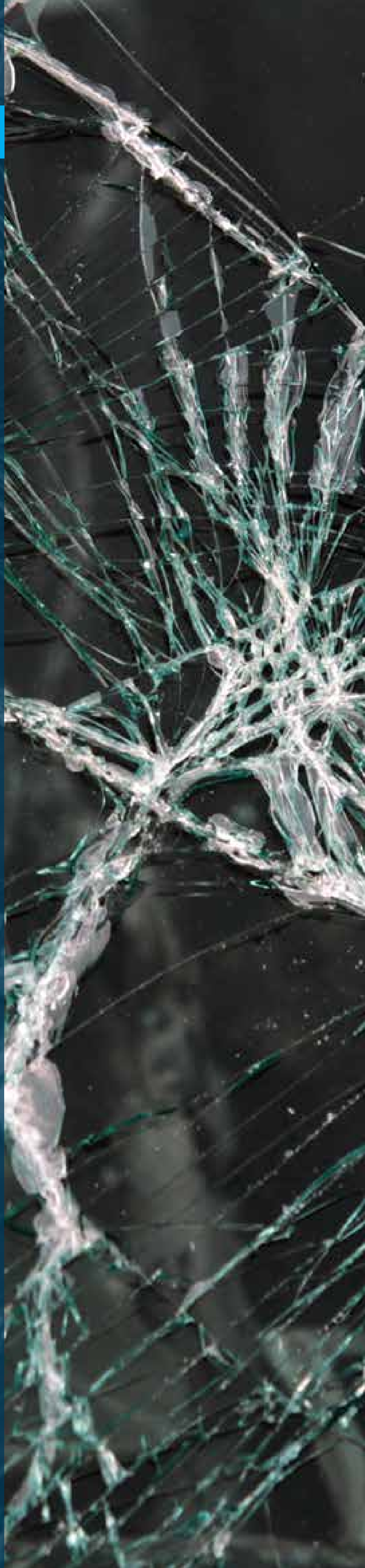
Seventeen year-old Jarrod was a passenger in a car crash that occurred on a slippery country road during a heavy rainstorm in June 2013. The driver, a close friend, died instantly.

Trapped inside the vehicle for over an hour, Jarrod was eventually cut free by ambulance officers and emergency services. Poor visibility prevented an ambulance helicopter landing at the scene, so he was driven by road ambulance to the nearest regional hospital where he was stabilised and then flown to a designated trauma centre. He had severe head injuries, and was deeply unconscious. He also had severe chest injuries, with uncontrolled internal bleeding.

Jarrod was assessed by an experienced team of doctors and nurses. He was swiftly taken into theatre where specialist surgeons, anaesthetists and theatre staff worked for many hours to relieve pressure on his brain and control the bleeding. He spent one week in Intensive Care, and another week in the dedicated trauma ward. He then spent nine weeks in a specialist rehabilitation centre before being able to return home.

In many ways Jarrod is lucky. His physical and mental abilities continued to improve and, one year on from his accident, Jarrod has resumed his pre-accident life. He is about to finish high school, has obtained his driver's licence, and is considering his career options. His father, Brett, marvels at his son's recovery, saying "the quick and decisive care Jarrod received - the **right** treatment at the **right** time – really set him up for an excellent recovery".

Jarrod's story is all too familiar. This report details over 20,000 Australians who were suddenly and unexpectedly put in harm's way, and who relied on Australia's emergency services and designated trauma centres to give them the best chance of surviving and recovering from their serious injuries.



WELCOME

On behalf of the Australian Trauma Quality Improvement Program (AusTQIP) Steering Committee, we are proud to present *Caring for the severely injured in Australia*. For the first time, we are able to present in some detail, the work of the Australian designated trauma centres that are responsible for saving injured peoples' lives by treating their injuries, and restoring their independence and productivity. This is only possible because the people working in these centres and state-based trauma registries have been committed to collaborating and sharing their activities through AusTQIP, and contributing to the new Australian Trauma Registry (ATR).

The information in this report is immensely important. Injury is a National Health Priority Area[1] – it is the leading cause of death under the age of 45[2], it is a major cause of disability and lost productivity[2], it is second only to cardiovascular disease for hospital-related expenditure[3], and it costs the Australian economy at least $18 billion every year[4].

Severely injured people don't have the immediate luxury of navigating and negotiating their preferred health care services; each injured person depends entirely on the available emergency, critical care and rehabilitation services. Injuries occur unpredictably, often far from specialist trauma hospitals, sometimes needing life-saving interventions, ending up with long complicated stays in hospital and extensive periods of rehabilitation.

The outcomes for each individual depend on the care they receive in every part of their journey. It is our professional responsibility and dedication, as clinicians, health service managers and policy-makers, to ensure that all parts of the system are providing the best care they possibly can to each patient. The system is only as good as its weakest link.

The commitment of trauma centres across the country to provide the best possible care to each injured person lies at the heart of AusTQIP, and the ATR. We believe that trauma centres and clinicians cannot do this on their own or in isolation - it can only happen if we continually learn from experience, and learn from each other, about what works best.

To do so, we need good data - about the injured, the injuries they sustain, the care they receive, and the outcomes they experience. We also need a way to share that data, reflect on what it tells us, and ways to best make use of it in improving care for the next patient. By doing this, we know that injury deaths can be reduced and the quality of recovery improved.

AusTQIP provides this capability on a national basis. It is a true collaboration among dedicated teams of people who are continually aiming to do their best to save lives and optimise recovery for people who have suffered even the most horrific injuries. This first report provides valuable information about what they do, and is a powerful tool to help optimise the care of the injured.

Professor Russell Gruen
Co-Chair

Associate Professor Kate Curtis
Co-Chair

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EXECUTIVE SUMMARY

With almost 7,000 severely injured Australians treated in hospital every year, trauma remains a significant public health problem worthy of considered investment in understanding how we can further improve survival, enhance quality of trauma care, and optimise recovery. Across Australia's eight states and territories, 27 designated trauma centres receive and care for the significant majority of these patients.

For the first time, the Australian Trauma Quality Improvement Program (AusTQIP) brings together information through its Australian Trauma Registry (ATR) about these patients, the injuries they have sustained, the care they have received, and their outcomes. In doing so, the national trauma community can better learn from each other's experience about how to ensure the best care for people injured in the future.

In this Inaugural ATR Report, 25 of the 27 designated trauma centres were able to contribute data about patients who were admitted to a designated trauma centre with an Injury Severity Score[5] (ISS) greater than 12 for the years 2010 to 2012.

The key findings are:

20,435 injured patients with an ISS greater than 12 were admitted and treated over three years
The annual average number of patients treated per designated trauma centre ranged from 32 to 989
2,051 (10%) died in hospital
The age group with the highest incidence of injury was 15-24 year olds
Males comprised 73% of all injured patients
People aged 85 years and above had the highest mortality rate (28%)
Hypotension on arrival and head injury were strongly associated with death in hospital
Blunt trauma injury, such as those caused by motor vehicle accidents, falls and being forcefully struck, was the predominant injury type (96%)
Transport was the major mechanism of injury (52%)
Falls were the largest contributor to mortality (41% of all deaths)
Being struck by an object or person was the main mechanism in intentional injury or assault cases (53%)
Three quarters (76%) of major trauma patients were transported to designated trauma centres via road ambulance services, and the remainder predominantly by helicopter or fixed-wing aerial medical services (16%)
The national median unadjusted rate for time from injury to designated trauma centre was 1.8 hours
The median unadjusted length of stay in emergency departments was 4.6 hours
The median unadjusted length of stay in intensive care units was four days
The median unadjusted length of stay in hospital was nine days

The findings of this report provide the evidence base required by the trauma community, policy makers and researchers to improve trauma care in at least three significant ways:

With a clear picture of the profile of trauma patients in Australia, we can now identify sub-groups of patients and areas of trauma care that may require focussed attention. Through AusTQIP, Australian designated trauma centres are well placed to collaborate in applying contemporary quality improvement methods and cutting edge research to address these issues.
There is some variability in trauma care worthy of more in-depth investigation to explore why differences exist and how trauma care practices in higher performing centres can be further promulgated across all designated trauma centres in Australia.
These baseline measures of serious injury in Australia mean that data is now available for the AusTQIP collaboration to work towards developing, agreeing upon, and validating measures of trauma care performance and cost, with a view to reliably monitoring trauma care quality (structures, processes and outcomes) and improving efficiency through the provision of enhanced trauma care.

SECTION 1

INTRODUCTION

Trauma care in Australia

Good trauma care is often very challenging: patients can sustain multiple injuries that require immediate or urgent treatment; they may be a long way from a specialist trauma centre; ambulance personnel often have to provide life-saving procedures at the roadside, before patients get to hospital; critical decisions are made almost every minute during their early resuscitation in hospital; and the ongoing care that patients need may involve many different types of specialists over many months or even years. Not all injured patients fully recover.

Australia is a vast nation and severely injured patients have the best chance of survival and recovery when they receive life-saving care in the field, good pre-hospital emergency care, resuscitation and management of injuries at designated trauma hospitals, and post-hospital rehabilitation to re-establish their previous levels of function and independence. These are the basic components of trauma systems, which also have protocols for triage and transport of patients, data collection to monitor and improve services, and a system of governance and financing. Figure 1 (page 8) provides key information about the context of the Australian state- and territory-based trauma services. Appendix 1 details further information, including state- and territory-based Trauma Plans and Registries.

In Australia trauma systems and trauma care services have largely been the responsibility of state and territory governments. Pre-hospital services include a range of public and private road ambulances, helicopters, and fixed wing aerial medical retrieval services. Professional ambulance paramedics provide all pre-hospital care in some states or territories, whereas in others doctors are involved in the pre-hospital care of severely injured people.

Most severely injured people are cared for at state and territory funded public hospitals that are designated trauma centres. These hospitals provide a full range of specialised medical, nursing and allied health services, ranging from emergency department reception, through inpatient diagnostics, surgery and critical care, to early rehabilitation and discharge planning.

Patients discharged from hospital who cannot immediately go home, most often are transferred to an inpatient rehabilitation facility that provides most of their physical, cognitive, nutritional and other care needs. Once back in the community, care is provided by hospital outpatient services, local doctors, nurses and allied health providers, and other community-based services.

In all states and territories, patients do not have to pay for their trauma care up-front. Most trauma care is provided through taxation revenue, and in some states and territories publicly-funded third party insurance schemes pay for the care of people injured in transport or work-related activities. Federal funding contributes directly through payments for general practitioners' services, and through some other Commonwealth Government schemes.

Australia is a vast nation and severely injured patients have the best chance of survival and recovery when they receive life-saving care in the field, good pre-hospital emergency care, resuscitation and management of injuries at designated trauma hospitals, and post-hospital rehabilitation.

Figure 1

TRAUMA CARE CONTEXT IN AUSTRALIA[6, 7]

State	Land Area (km^2) [6]	Population [7]	Number of Designated MTCs
NSW	800,642	7,465,500	10
QLD	1,730,648	4,690,900	6
WA	2,529,875	2,550,900	2
NT	1,349,129	242,200	1
TAS	68,401	514,000	1
SA	983,482	1,677,300	3
VIC	227,416	5,791,000	3
ACT	2,431	384,100	1

The Australian Trauma Quality Improvement Program (AusTQIP) and the Australian Trauma Registry (ATR)

It has been a long journey to be able to properly describe trauma care activity throughout Australia. National-level data collection about trauma care was first proposed more than 20 years ago when, in July 1993, the National Road Trauma Advisory Council recommended standardisation of trauma registries to enable "a national program for quality assurance activities"[8]. Building on the results of a trauma systems seminar held the previous year, the Royal Australasian College of Surgeons (RACS) then convened the first workshop to start developing a trauma minimum dataset for Australia and New Zealand.

Through sustained advocacy by many committed health professionals and professional organisations, especially the specialist colleges and the Australasian Trauma Society (ATS), generations of government and industry leaders have understood what it takes to improve systems of care. Through various initiatives, successive state and federal governments have, in the face of competing priorities, facilitated many developments.

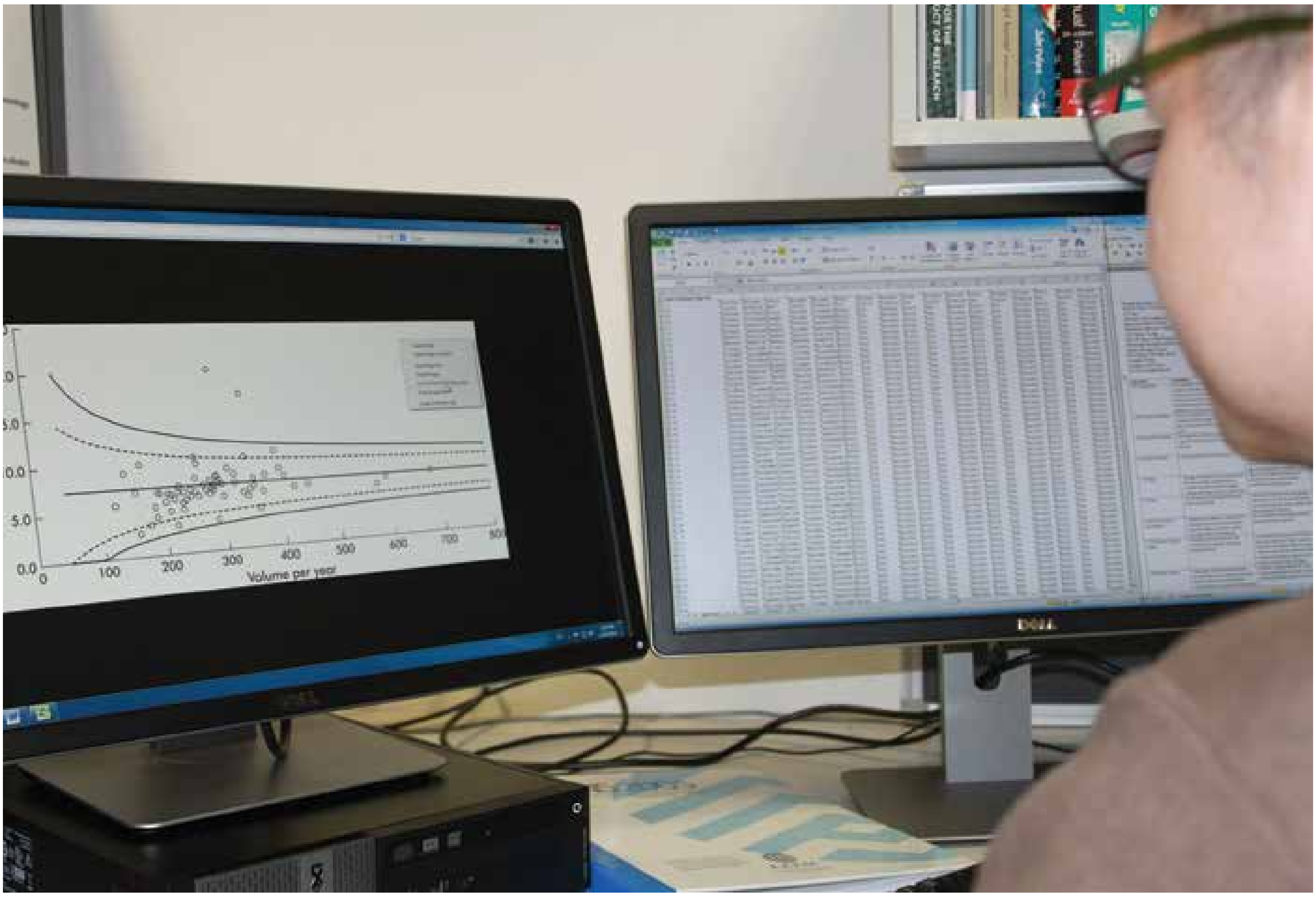
While persistence, leadership and collaboration were features of these initiatives, a key deficiency was the lack of data to allow reporting, monitoring, and comparison to ultimately improve trauma care. In November 2003 the National Trauma Registry Consortium (NTRC) was launched under the chairmanship of Associate Professor Cliff Pollard. The NTRC brought together many key stakeholders to work towards a bi-national trauma registry, amalgamating information about trauma patients routinely collected during hospital admissions throughout Australia and New Zealand. The RACS, the University of Queensland's Centre of National Research on Disability and Rehabilitation Medicine (CONROD), the ATS, and the New South Wales Institute of Trauma and Injury Management (ITIM) continued the process of developing an agreed minimum dataset specifying what information should be collected and how it should be defined. Through participation and goodwill, the NTRC produced national reports about trauma care activity from 2002 to 2005, after which funding was not continued.

In 2010, Alfred Health (through its National Trauma Research Institute (NTRI)) in Melbourne and the National Critical Care and Trauma Response Centre (NCCTRC) in Darwin committed funds to expanding on the NTRC's earlier work and create AusTQIP and the Australian Trauma Registry (ATR). While the focus of this funding was trauma care in Australia, AusTQIP's work has been closely aligned with trauma system and registry initiatives also being undertaken in New Zealand.

AusTQIP was formed with an overarching Steering Committee with representation from all states and territories, and other participating stakeholders (Appendix 2). Reporting to the Steering Committee are the AusTQIP Management Committee, the Trauma Data Working Group, and the Trauma Quality Systems Working Group. All of these committees are largely made up of people actively involved in providing trauma care and managing trauma services. The governance structure as at 31 August 2014 can be found in Appendix 3. A list of AusTQIP milestones since 2010 can be found in Appendix 4.

SECTION 2

METHODS OF DATA COLLECTION, ANALYSIS AND REPORTING



Data sources

The Australian Trauma Registry (ATR) collects information on seriously injured patients admitted to designated trauma centres in all states and territories of Australia. Designated trauma centres predominantly operate within a state- or territory-based publicly funded healthcare system (Appendix 1).

In May 2014, the AusTQIP Collaboration Agreement* was formalised, which enabled trauma data to be submitted to the ATR electronically by each participating AusTQIP trauma centre. This data is a subset of data which participating health services routinely collect. Currently the ATR receives data directly from hospital registries or, in New South Wales and Victoria, from state-based registries (see Appendix 5).

During 2010 and 2011, the Queensland Trauma Registry (QTR) received data from Queensland's designated trauma centres and this data was later electronically submitted to the ATR in preparation for this report. Following the conclusion of the QTR, data from 2012 was submitted to the ATR directly from Queensland's designated trauma centres, with the exception of Townsville Hospital and Gold Coast University Hospital, which did not have local registry collections at that time. Given that their 2012 data was unavailable, these two services were therefore excluded from this report.

In this report, South Australian data was obtained from designated trauma centres.

Data elements

ATR data is defined by the Bi-National Trauma Minimum Dataset (BNTMDS), listed in Appendix 6. The current version of this dataset (Version 1.31) can be downloaded from www.austqip.org. Data elements from existing hospital and state-based registries were mapped to the BNTMDS according to standard definitions as accurately as possible. If data elements were not already collected by existing data sources, they were not otherwise obtained by the ATR.

Data quality

Data submitted to the ATR underwent various validity checks such as date and time formats and chronology, and correct classification as per the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification[9] (ICD-10-AM) and Abbreviated Injury Scale 2005 (Updated 2008)[10] (AIS) codes prior to data processing. If data did not pass these validations, an error file was generated and a notification sent to sites submitting the data to address and correct the error, if possible.

For this report:

- All information provided by the sites is in accordance with the ATR inclusion and exclusion criteria for major trauma and definitions detailed in the BNTMDS data dictionary.
- While the data has gone through validation checks, there may still be issues with data validity for certain data elements. Where identified, these cases have been omitted.
- Where appropriate and relevant, data quality notes or exceptions are detailed throughout the report.

While all reasonable effort has been made to ensure accuracy of the data used at the time of reporting, there may be discrepancies with other reports published by local sources.

* The ***AusTQIP Collaboration Agreement***, which is a single, legally-binding agreement of all participating health services, defines the precise terms under which all parties participate in the collaboration, including issues such as governance, resourcing, information sharing, data collection, data submission, quality monitoring, data use and approvals, disclosure and confidentiality, publication and authorship, ethics and training requirements.

The Australian Trauma Registry (ATR) collects information on seriously injured patients admitted to designated trauma centres in all states and territories of Australia.

Patients included in the registry

Major trauma patients are defined as all patients of any age admitted to a participating hospital, and who:

- had an Injury Severity Score (ISS) >12 (based on AIS), or
- who died following injury.

Patients excluded from the registry

- Patients with delayed admissions greater than seven days after injury,
- Poisoning or drug ingestion that do not cause injury,
- Foreign bodies that do not cause injury,
- Injuries secondary to medical procedures,
- Isolated neck of femur fracture,
- Pathology directly resulting in isolated injury,
- Elderly (65 years of age or older) patients who die with superficial injury only (contusions, abrasions, or lacerations) and/or have co-existing disease that precipitates injury or is precipitant to death (e.g. stroke, renal failure, heart failure, malignancy).

Data definitions

The ATR collects ISS reported by data sources and can calculate ISS based on the AIS codes provided as a quality check. Discrepancies (7.6%) were found between reported ISS and ISS calculated by the ATR. Due to invalid or incomplete AIS codes the reported ISS was used for this report.

Emergency Department length of stay (ED LOS) is calculated by the ATR based on the date and time of arrival at the definitive care hospital to the emergency department discharge date and time. ED LOS is presented as hours.

Intensive Care Unit length of stay (ICU LOS) is based on values provided by the designated trauma centres or as reported by the state-based trauma registries. ICU LOS is presented as days.

Hospital length of stay (LOS) is from date and time of arrival at definitive care hospital to the date and time of discharge from definitive care hospital as reported. Hospital LOS is based on values provided by the designated trauma centres or as reported by the state-based registries. Hospital length of stay is presented as days.

Polytrauma is severity of AIS>2 in two or more AIS body regions.[11]

Isolated head injury is all AIS codes in the AIS head region beginning with '1xxxxx.x' included in the head/neck ISS body region, and excludes all other body regions.

Isolated spine injury is defined as all AIS codes in the AIS spine region beginning with '6xxxxx.x', and excludes all other body regions.

Other isolated injury relates to other single AIS body regions that have not been included into isolated head or isolated spine.

Hypotension is defined as patients presenting at designated trauma centres with arrival systolic blood pressure (SBP) of less than 100 mmHg[12].

External cause of injury ICD-10-AM codes were used to define causes/mechanisms of injury, injury type and injury intent. Causes of injury were based on the Center for Disease Control's External Cause of Injury and Mortality Matrix (www.cdc.gov/nchs/data/ice/icd10_transcode.pdf).

Type of injury was based on ICD-10-AM codes as previously reported[13]. Codes were mapped to injury types in the BNTMDS.

Data limitations and caveats

In this report, contributing data sources have been grouped according to their state or territory in graphs and tables. This has been done in order to illustrate the range of traumatic injuries, care and outcomes in different trauma centres and systems. It should not be seen as a comprehensive report of all major trauma patients or reflective of the entire patient population for each state/territory. In particular, patients who were managed entirely at hospitals other than a designated trauma centre, or who died without getting to hospital, were not included.

Data is based on calendar year for the period 2010 to 2012 where the date of injury is from 1 January 2010 to 31 December 2012, inclusive.

Due to the different maturity levels of collection systems, data capture rates are not complete for all years. Where data capture rates are not complete for specific data items, this information is noted in accompanying graphs and tables.

For 2010, data from January to June reported by one designated trauma centre was for ISS>15. This data was included in the analysis to ensure completeness.

Following the disbandment of the Queensland Trauma Registry in 2012, differences in the inclusion and exclusion criteria and data capture issues over the full three year period have resulted in differences in capture of eligible trauma patients. Inclusion/exclusion of major trauma patients in Queensland data may not be consistent over the full period of this report.

General data collection limitations for burns patients include:

- Data collected on major trauma patients with burns were excluded from one hospital trauma registry as this data was included in the Bi-National Burns Registry. Where this affects the data item this information is included in the footnotes.
- At five designated trauma centres, local data collection rules recognise burns as blunt trauma.

General data completeness limitations include:

- Two designated trauma centres were unable to provide data for January to June 2010 and July to December 2012.
- Due to resourcing issues, one designated trauma centre had a backlog of cases to be entered into the local registry and was unable to provide data for the complete 2012 year.
- Four hospital based trauma registries were not able to provide complete data required for this report. Consequent limitations of the data and its interpretation are indicated in the footnotes, where relevant.

For further detail, refer to Section 7: Quality of Data (Table 18).

Risk-adjusted benchmarking

Risk-adjustment is a process that allows data beyond the control of clinicians or health services to be compared without influencing factors, such as geographic distance impacting on pre-hospital transfer time, patient demographics and severity of injury.[14] In this report, the risk-adjustment model was adapted from previous work undertaken by Newgard *et al.*[15]

Specifically, the risk-adjusted mortality rate for patients 16 years of age or above was derived by adjusting the observed mortality rate for the following set of risk factors:

i. age
ii. gender
iii. mechanism of injury
iv. ISS
v. direct or indirect hospital transfer, and
vi. state/territory

To account for patient heterogeneity in the risk-adjustment modelling the entire dataset was stratified into four strata (cohorts), which are:

1. Patients ≥65 years,
2. Patients not fulfilling stratum (1), and with AIS severity ≥4 for body region head and no other severe injuries (AIS severity ≥4) in any other body region,
3. Patients not fulfilling strata (1) and (2), and with ED SBP≤100 mmHg, and
4. Patients who do not belong to any of the above three strata.

Risk-adjustment was made in each stratum independently. Within a stratum, an initial logistic regression model for observed mortality was estimated using the set of candidate risk factors. To achieve a more parsimonious model, a stepwise selection of risk factors were used. Due to their clinical importance, the risk factors of age, ISS and mechanism of injury were made mandatory. For each stratum, the final model chosen provided the predicted mortality for patients in that stratum.

The developed models were then applied to eligible patients of each designated trauma centre separately to predict mortality of each stratum at each centre. The expected mortality at each centre was the sum of the predicted mortality in each stratum. The observed (actual) mortality at each centre was then divided by the expected mortality to derive the *observed:expected ratio*. The confidence intervals around these estimates were calculated by constructing bootstrap distributions of these ratio values.[16] This method was chosen over parametric confidence intervals as observed mortalities for some trauma centres were very low with very wide confidence intervals therefore making comparisons among centres unreliable. The funnel plot for the *observed:expected ratio* was constructed under the assumption of the Poisson count of observed mortality.

Anonymity and protection from identification

The primary purpose of AusTQIP is to help improve patient care. The AusTQIP Collaboration Agreement forbids the public disclosure of information about the activity or performance of any individual trauma centre without the centre's agreement, and it specifies the ways in which such information can and cannot be used. For quality improvement purposes, the Trauma Director of each centre will be provided with a confidential report indicating where his or her centre sits in relation to other (anonymous) trauma centres.

Several measures were taken in this report to preserve anonymity and minimise the chance of identification of centres:

- States and territories are indicated by letter labels, but no absolute numbers are given, only percentages, such that the volume of cases cannot be used for the purpose of comparison between states and territories.
- Alphabetical labels used to represent states and territories have been randomly allocated and are different for each data item, therefore, while within any data item the figure and the table can be correlated, data cannot be compared between specific data items.
- Graphs by centre are ordered from lowest to highest on the data item in question, and the order of centres in one graph bears no relation to the order of centres in other graphs.
- Sample sizes or cells with counts of five or less are aggregated to the next level or supressed.

Image courtesy of Ambulance Victoria

Risk-adjustment is a process that allows data beyond the control of clinicians or health services to be compared without influencing factors, such as geographic distance impacting on pre-hospital transfer time, patient demographics and severity of injury. [14]

SECTION 3

WHO WAS INJURED AND HOW THEY WERE INJURED

Image courtesy of St John Ambulance Western Australia

Major trauma patients and mortality

(n = 20,435)

In total, there were 20,435 major trauma patients reported at Australian designated trauma centres during the period under review and 2,051 (10%) died. Table 1 shows the percentage mortality among major trauma admissions to designated trauma centres in each state/territory.

Table 1 – Major trauma patients and mortality at designated trauma centres nationally and per state/territory

State / Territory*	2010 ◆			2011			2012 ◆		
	Patients (No)	Deaths (No)	Deaths (%)	Patients (No)	Deaths (No)	Deaths (%)	Patients (No)	Deaths (No)	Deaths (%)
National	6,528	672	10.3	6,962	685	9.8	6,945	694	10.0
A			6.7			7.0			7.3
B			13.8			16.1			14.5
C			11.6			9.1			10.8
D			8.8			8.6			8.2
E			11.2			11.9			10.6
F			10.7			8.5			8.1
G			10.4			9.4			13.9
H ✤			N/A			4.0			8.0

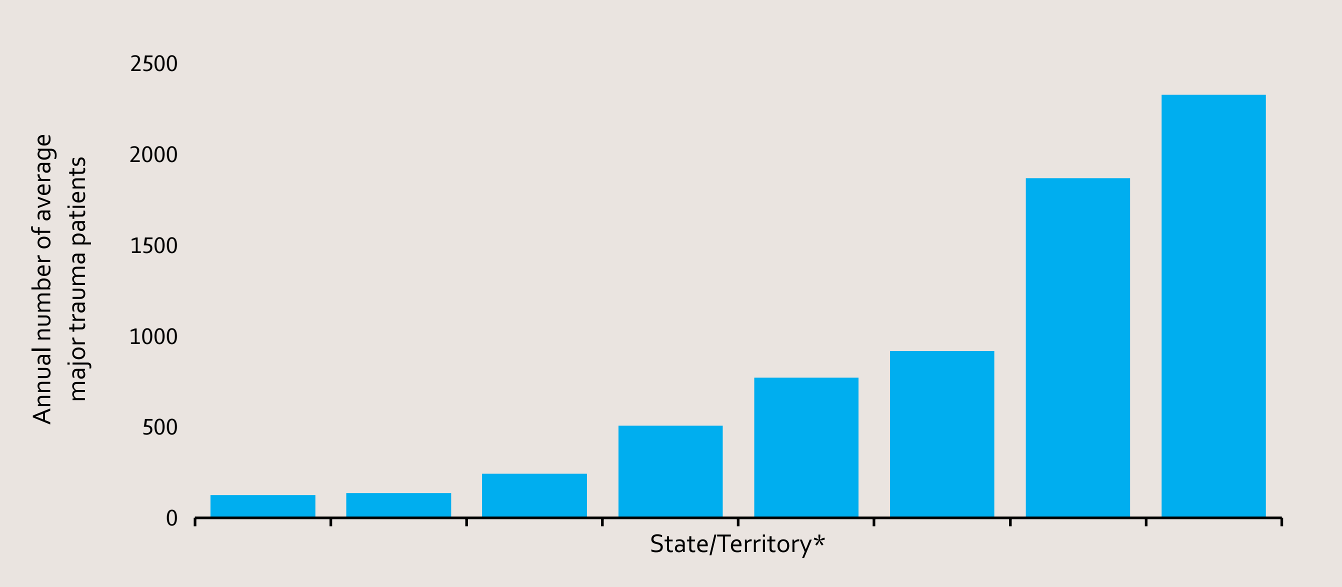
*A-H denotes de-identified data from randomly selected states and territories and is not maintained in any order from table to table.

Exceptions

Data are not comparable across years due to incompleteness of data collected and different inclusion and exclusion criteria used at the local sites at various years.

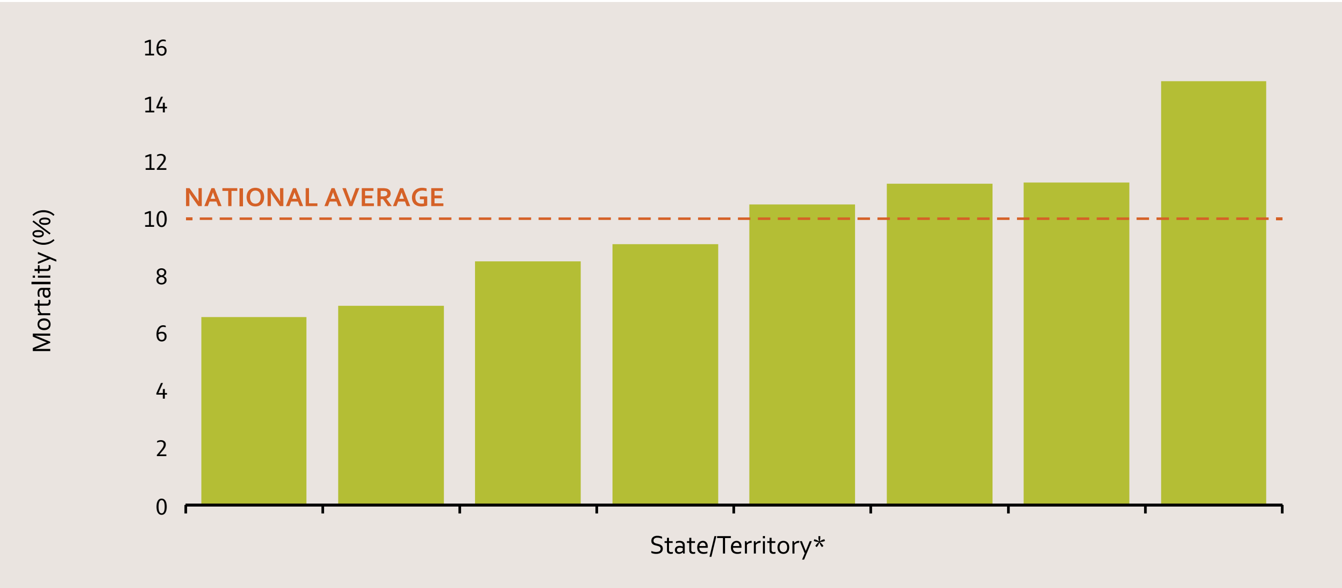
◆ Years are not comparable due to incomplete data for 2010 and 2012 received from some data sources.
✤ Data unavailable for 2010 and 6 months of 2011.

Figure 2 – Major trauma patients admitted to designated trauma centres per state/territory



*In Figure 2, states and territories have been ordered from lowest to highest and are not comparable or follow the same order.

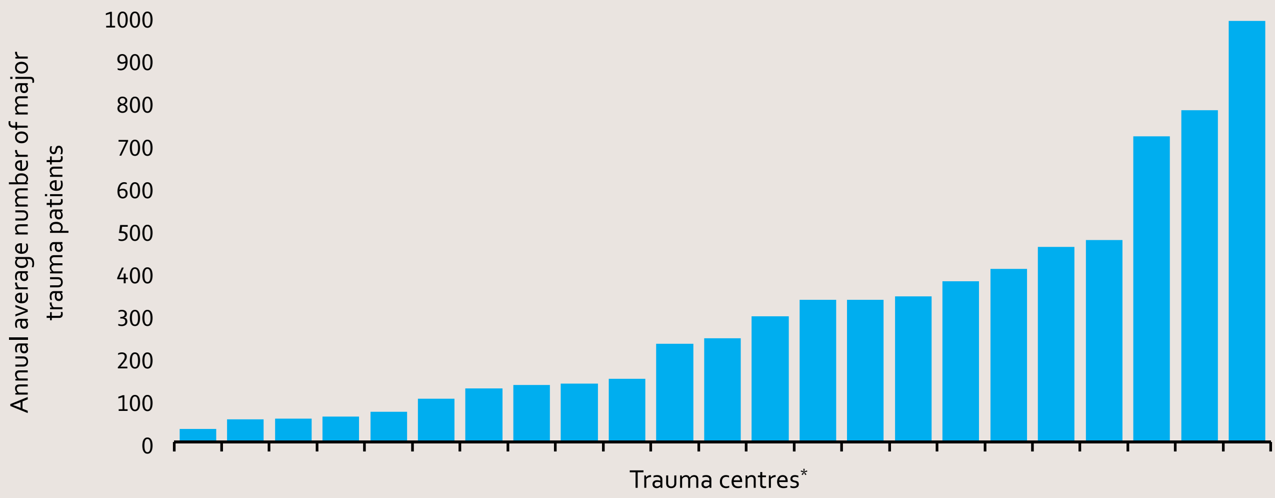
Figure 3 – Major trauma patient mortality in designated trauma centres per state/territory



*In Figure 3, states and territories have been ordered from lowest to highest and are not comparable or follow the same order.

Figure 2 shows the state/territory average of major trauma patient admissions range from 126 to 2,328 while annualised deaths ranged from 7% to 15% (Figure 3).

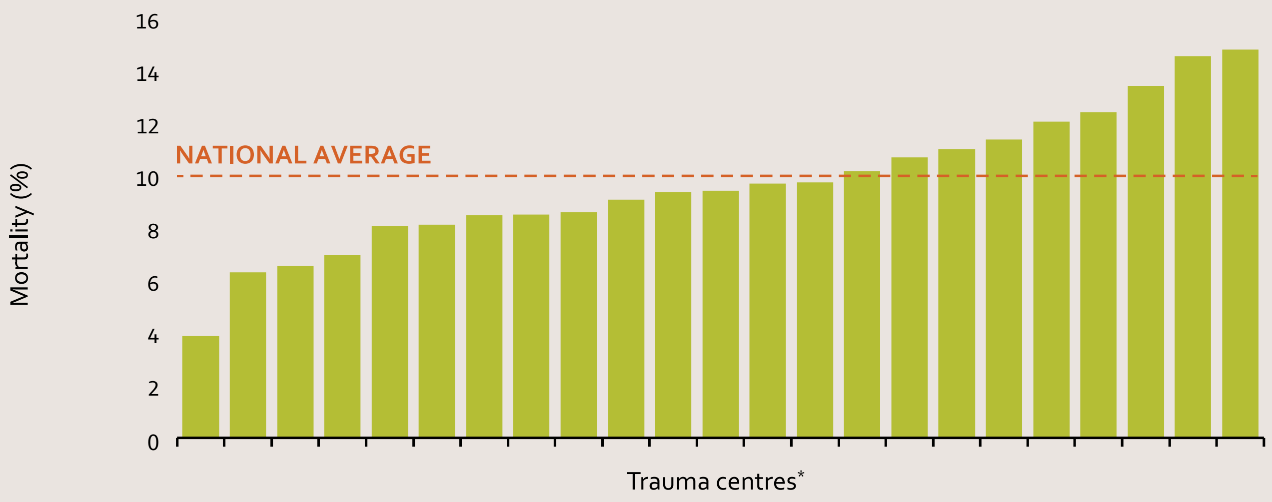
*Figure 4 – Major trauma patient admissions to designated trauma centres**



*In Figure 4, Trauma Centres have been ordered from lowest to highest and are not comparable or follow the same order.

The annual average number of patients admitted with major injuries to designated trauma centres ranged from 32 to 989 (Figure 4). Many factors influence the activity of designated trauma centres such as the nature of the state/territory trauma systems, geography, and demographic characteristics. Designated paediatric trauma centres are included and have been represented together with designated adult trauma centres in both Figure 4 and Figure 5.

*Figure 5 – Major trauma patient mortality at designated trauma centres**



*In Figure 5, states and territories have been ordered from lowest to highest and are not comparable or follow the same order.

On average 10% of major trauma patients died in hospital (Figure 5). The average annual percentage mortality at each individual trauma centre ranged from 4% to 15%.

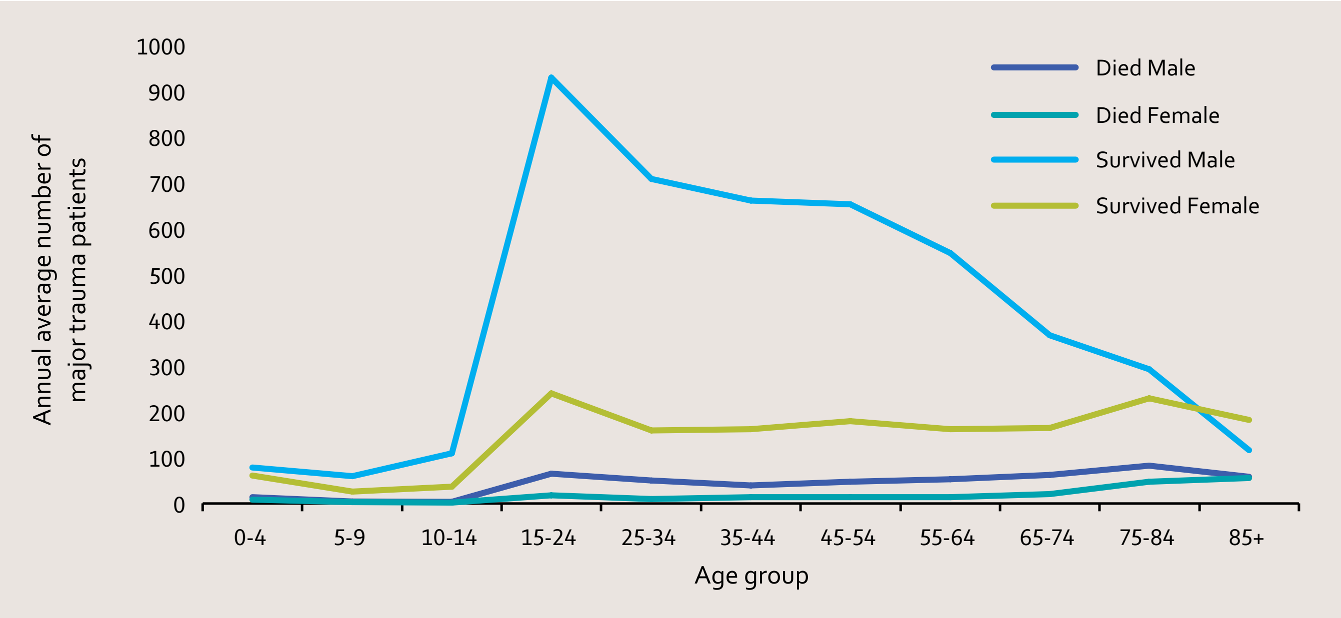
Note

Figure 4 and Figure 5 are based on actual numbers of admissions and deaths. No ranking have been applied apart from ordering from lowest to highest to present the range and diversity of patients and outcomes. The order of centres in Figure 4 is not the same as in Figure 5. Many factors influence trauma centre mortality rates include differences in case mix, age, sex, severity of injury, and existing co-morbidities. Other factors such as geography and distances to designated trauma centres can contribute to the timeliness of care provided to the severely injured, making comparisons among the designated trauma centres difficult without appropriate adjustments.

Major trauma patients and mortality by age and gender

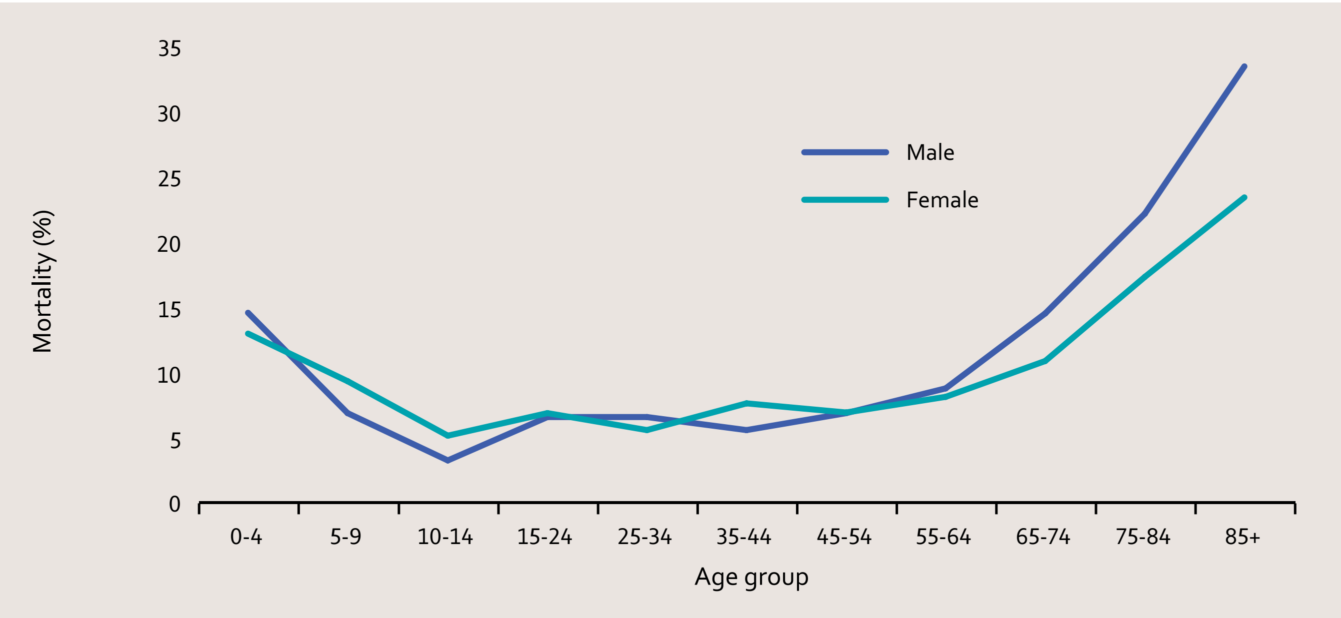
(n = 20,434)

Figure 6 – Major trauma patient admissions and mortality by age and gender



The age group most represented is between 15 to 24 years, and males were 3.8 times more likely to suffer major injuries than females (Figure 6).

Figure 7 – Major trauma patient mortality by age and gender



Males represented 73% of all injured patients. This is similar to that reported by the NTRC in 2005 at 72%.[17]

The highest mortality occurred in people aged over 85 years where there were 23% deaths for females and 33% for males (Figure 7). This data is similar to that reported by the NTRC in 2005.[17]

Exception

n=20,434. One patient was excluded from total data set as gender was unknown.

Types of Injury

(n = 20,204)

The vast majority (over 90%) of major trauma in Australia is caused by blunt injury mechanisms, such as those caused by motor vehicle accidents, falls, and being forcefully struck. Similarly, blunt injury types are responsible for over 90% of major trauma deaths. In comparison with some other countries, penetrating injuries in Australia, such as those caused by knives or guns, are relatively uncommon.

Understanding the types of injuries is important for the planning and organisation of trauma services. Penetrating injuries are frequently isolated injuries, but may cause severe organ or vessel disruption and rapid bleeding. Securing breathing and control of bleeding are often the priorities with this type of injury. Blunt injuries less often present with rapid exsanguination, but are more often associated with multiple organ failure, combinations of airway, breathing, circulatory, neurological and musculoskeletal deficiencies, and permanent physical and cognitive disabilities among survivors. Emergency responders must be prepared to deal with many possibilities in blunt-injured patients.

Table 2 – Major trauma patients and mortality for types of injury

State / Territory*	Blunt		Penetrating		Burns		Other trauma ◆	
	No. of Patients	No. of Deaths	No. of Patients	No. of Deaths	No. of Patients	No. of Deaths	No. of Patients	No. of Deaths
National	19,288 (95.5%)	1,887 (94.0%)	751 (3.7%)	93 (4.6%)	158 (0.8%)	24 (1.2%)	7 (0.0%)	✤
A	96.4%	93.1%	3.6%	6.9%	0.0%	0.0%	0.0%	0.0%
B	92.2%	100.0%	7.0%	0.0%	0.9%	0.0%	0.0%	0.0%
C	96.9%	94.8%	3.0%	5.2%	0.1%	0.0%	0.0%	0.0%
D	96.3%	90.2%	2.4%	7.8%	1.2%	2.0%	0.0%	0.0%
E	95.9%	95.5%	4.1%	4.5%	0.0%	0.0%	0.0%	0.0%
F	95.0%	92.8%	3.1%	3.3%	2.0%	3.9%	0.0%	0.0%
G	91.5%	90.0%	5.6%	4.4%	2.5%	3.1%	0.4%	2.5%
H	93.9%	96.4%	6.1%	3.6%	0.0%	0.0%	0.0%	0.0%

*A-H denotes de-identified data from randomly selected states and territories and is not maintained in any order from table to table.

Nationally, blunt trauma is the most common type of injury among major trauma patients (19,288 or 96%). This is about 27 times the number of traumas caused by penetrating injuries (751 or 4%). Blunt injuries also account for 94% of all deaths nationally (Table 2). The proportion of the different injury types presented at designated trauma centres compared to the overall state/territory total over three years show that more than 91% of cases are due to blunt injuries (Figure 8). The percentage mortality for different injury types also compared to the overall state/territory total over the three years. Similar to national figures, deaths due to injuries sustained from blunt trauma accounted for nearly all mortality (90% or more) in each state/territory (Figure 9). For example, for state/territory B all reported deaths were attributable to blunt trauma. Penetrating injuries were the second most likely cause of death.

Note

It is likely that the number of burns patients may be underestimated due to the collection by the Bi-National Burns Registry at some sites.

Definitions

◆ Other trauma include hangings, near drowning and electrocution.
✤ Data withheld due to cell suppression.

Exceptions

- n = 20,204. 231 (1.1%) patients had an injury type that was not provided or unavailable. Of these, there were 43 cases (2.1%) of death. These have been excluded.
- For 2012, burns patients were not included by one designated trauma centre.
- Five designated trauma centres include burns as blunt injury.
- Three designated trauma centres did not provide data for the category of "other trauma".

Figure 8 – Percentage of major trauma patients by types of injury

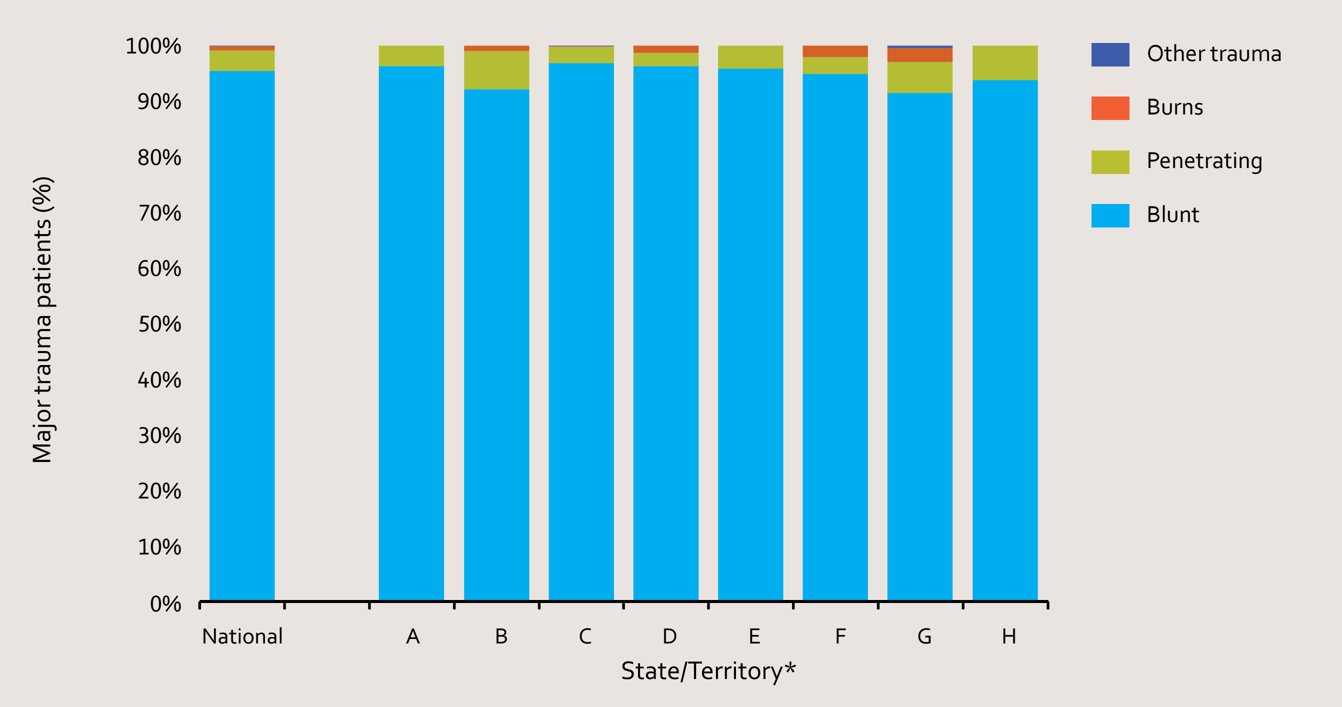
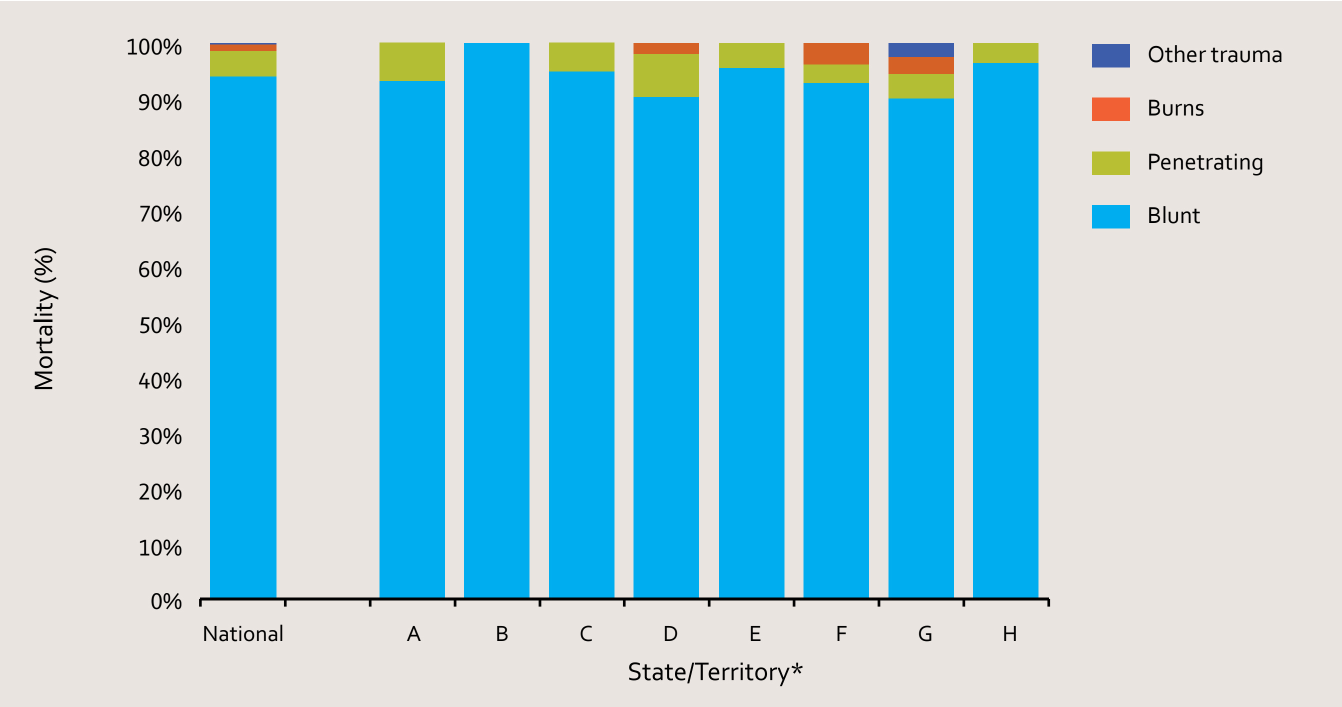


Figure 9 – Percentage mortality among major trauma patients by types of injury



*A-H denotes de-identified data from randomly selected states and territories and is comparable for Figure 8 and Figure 9, however this order is not maintained in other figures.

Mechanisms of injury

(n = 19,644)

Understanding the actual mechanism of severe injury is important for guiding injury prevention efforts, and for the planning of services. The most common mechanisms of causing severe injury were transport-related injury, closely followed by falls. Approximately half of all major trauma admissions in Australia are road transport-related. Road crashes led to 10,300 major trauma patients being treated at designated trauma centres in the three years from 2010 to 2012. Almost one third (31%) of major trauma cases were caused by falls (Table 3). However falls were more often associated with fatal injuries, as shown by the higher proportional mortality (41%), in part because older people are more often affected. In relation to some other countries, assaults, especially with sharp weapons or guns, are relatively infrequent causes of severe and fatal injuries in Australia.

Table 3 – Major trauma patients and mortality by mechanisms of injury

State / Territory*	Transport related		Fall		Struck by or against object or person		Cutting or piercing (include stabbing)	
	No. of Patients	No. of Deaths	No. of Patients	No. of Deaths	No. of Patients	No. of Deaths	No. of Patients	No. of Deaths
National	10,300 (52.4%)	747 (38.4%)	6,121 (31.2%)	795 (40.9%)	1,191 (6.1%)	62 (3.2%)	555 (2.8%)	41 (2.1%)
A	55.2%	41.8%	28.2%	33.5%	4.8%	3.2%	2.4%	0.8%
B	50.9%	44.6%	17.5%	12.5%	11.4%	8.9%	5.8%	3.6%
C	58.9%	40.6%	21.2%	36.9%	8.3%	6.9%	4.1%	1.3%
D	43.1%	32.9%	40.9%	49.2%	5.3%	2.4%	2.9%	2.0%
E	45.7%	50.0%	37.1%	50.0%	8.6%	0.0%	5.7%	0.0%
F	62.5%	39.6%	25.0%	47.9%	0.2%	0.0%	1.1%	0.0%
G	55.8%	41.9%	24.8%	29.2%	9.7%	3.5%	3.1%	5.8%
H	59.2%	43.0%	26.9%	41.4%	5.9%	2.6%	2.5%	1.0%

State / Territory*	Firearm		Fire (include hot object or substance)		Suffocation (include hanging and strangulation)		Drowning		Other mechanisms ◆	
	No. of Patients	No. of Deaths	No. of Patients	No. of Deaths	No. of Patients	No. of Deaths	No. of Patients	No. of Deaths	No. of Patients	No. of Deaths
National	143 (0.7%)	45 (2.3%)	223 (1.1%)	41 (2.1%)	207 (1.1%)	107 (5.5%)	84 (0.4%)	36 (1.8%)	820 (4.2%)	72 (3.7%)
A	0.5%	3.2%	1.8%	3.2%	1.0%	6.8%	0.5%	2.8%	5.6%	4.8%
B	0.3%	0.0%	3.7%	8.9%	4.2%	14.3%	1.9%	5.4%	4.2%	1.8%
C	1.2%	3.1%	2.4%	3.1%	1.1%	5.6%	0.1%	0.0%	2.7%	2.5%
D	0.7%	2.0%	1.0%	1.4%	0.8%	4.3%	0.6%	2.2%	4.7%	3.6%
E	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.9%	0.0%
F	2.4%	12.5%	0.0%	0.0%	2.9%	0.0%	0.6%	0.0%	5.3%	0.0%
G	0.5%	1.2%	1.2%	3.5%	1.3%	7.7%	0.5%	3.1%	3.1%	4.2%
H	0.5%	1.8%	0.4%	0.8%	0.8%	4.9%	0.2%	0.3%	3.4%	4.2%

*A-H denotes de-identified data from randomly selected states and territories and is not maintained in any order from table to table.

A similar pattern is seen across all designated trauma centres (Figure 10) and the percentages are similar to national data reported by the NTRC in 2005.[17]

Definitions

◆ Other mechanisms include injuries due to natural causes, animal, machinery, poisoning and over-exertion. This category also includes other undefined causes where ICD-10-AM codes do not fall within any of the reportable cause categories.

Exceptions

n=19,644. There were 791 (3.9%) cases where ICD-10-AM injury cause codes were not provided or unavailable. Of these, 105 cases (5.1%) were deaths.

Figure 10 – Percentage of major trauma patients by mechanisms of injury

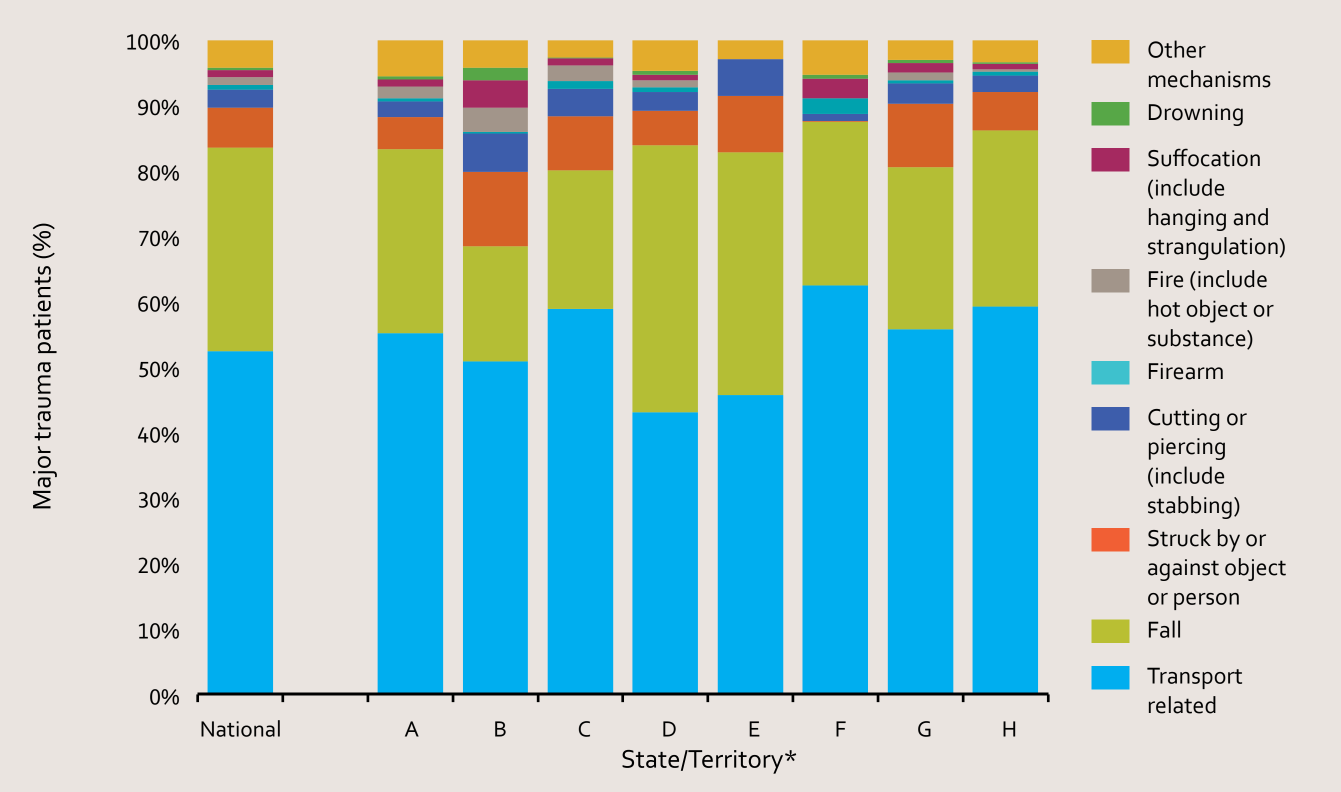
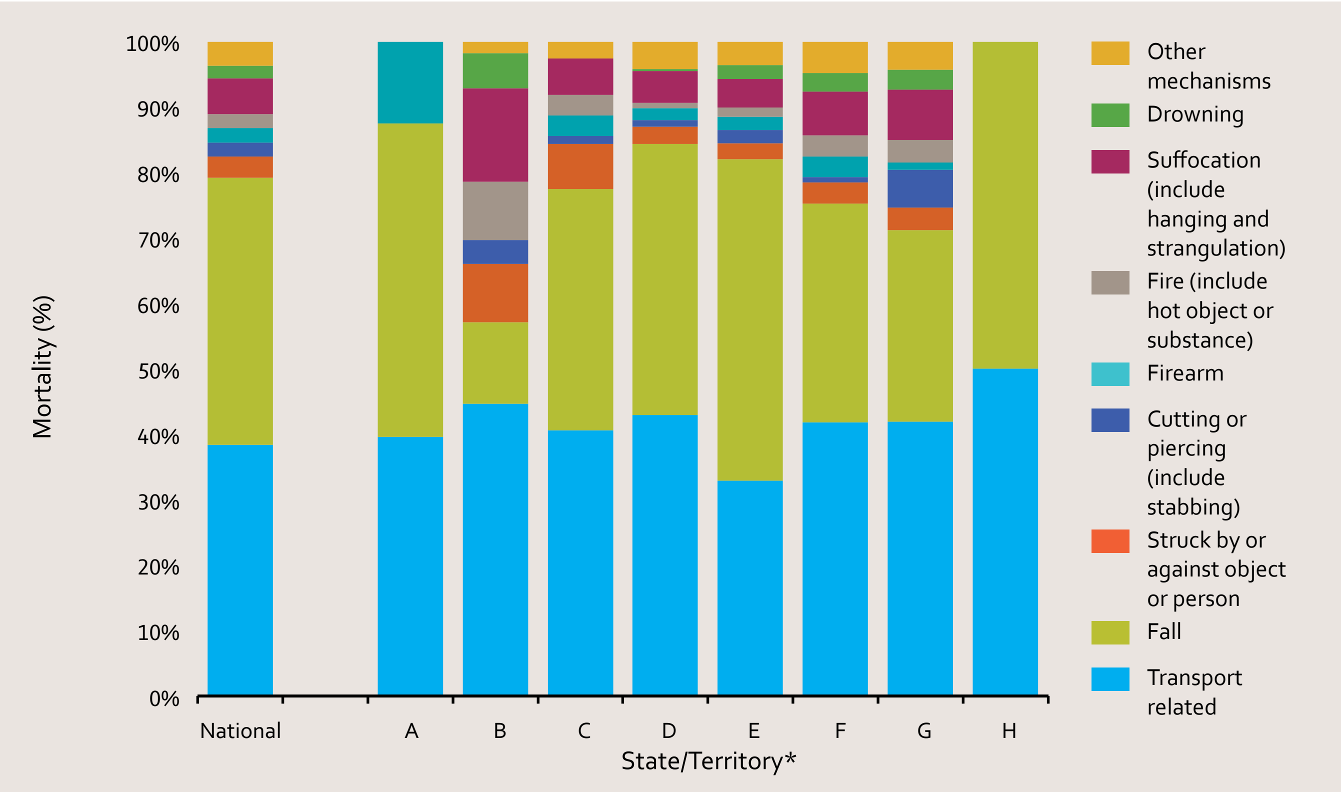


Figure 11 – Percentage mortality of major trauma patients by mechanisms of injury



*A-H denotes de-identified data from randomly selected states and territories and is comparable for Figure 10 and Figure 11, however this order is not maintained in other figures.

Variations in the relative percentages due to different injury types may be caused by differences in population demographics, especially age, as well as geographic and social factors (Figure 11).

Road transport related

(n = 7,315)

There is a specific definition of road transport related injury, which refers to motor vehicle traffic only. This information is helpful for injury prevention efforts relating particularly to road and vehicle design, and policies around provision of and payment for treatment services.

Table 4 – Major trauma patients and mortality among road transport related cases

State / Territory*	Vehicle occupant		Motorcyclist		Pedestrian		Pedal cyclist		Other transport ◆	
	No. of Patients	No. of Deaths	No. of Patients	No. of Deaths	No. of Patients	No. of Deaths	No. of Patients	No. of Deaths	No. of Patients	No. of Deaths
National	4,302 (58.8%)	311 (56.1%)	1,951 (26.7%)	104 (18.8%)	814 (11.1%)	130 (23.5%)	244 (3.3%)	9 (1.6%)	✜	0 (0.0%)
A❇	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
B	53.6%	54.3%	28.7%	20.0%	14.1%	25.1%	3.5%	0.6%	0.1%	0.0%
C	63.6%	0.0%	9.1%	0.0%	27.3%	100.0%	0.0%	0.0%	0.0%	0.0%
D	77.3%	73.3%	12.5%	13.3%	10.2%	13.3%	0.0%	0.0%	0.0%	0.0%
E	60.3%	42.9%	26.9%	29.8%	9.5%	25.0%	3.3%	2.4%	0.0%	0.0%
F	58.0%	60.7%	30.2%	10.7%	7.6%	23.2%	4.1%	5.4%	0.1%	0.0%
G	60.6%	56.4%	19.7%	8.7%	15.0%	32.9%	4.6%	2.0%	0.1%	0.0%
H	61.2%	68.9%	38.8%	31.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

*A-H denotes de-identified data from randomly selected states and territories and is not maintained in any order from table to table.

The total number major trauma cases as a result of road transport over the three years from 2010 to 2012 was 7,315 (36% of major trauma cases) of which there were 554 fatalities (27% of major trauma fatalities) (Table 4).

Vehicle occupants comprised over half (56%) of fatalities among road transport related deaths, followed by pedestrians, motorcyclists and pedal cyclists (24%, 19% and 2% of road transport related deaths, respectively). Pedestrians accounted for 24% of those who died, even though they accounted for only a tenth of all road traffic related trauma cases (Table 4).

There is significant variation between states and territories, with some categories showing no patients, which may potentially be due to data recording issues.

State/territory C recorded a much greater percentage of major trauma patients that were pedestrians, and that only pedestrians died, which is likely to be due to data recording issues.

Note

Data only applies to patients admitted to hospital and do not include all deaths as a result of motor vehicle accidents.

Definitions

◆ Other transport includes two- or three-wheeled motor vehicles, pick-up trucks, vans, heavy transport vehicles or buses, railway trains or railway vehicles, streetcars (trams) and unspecified motor vehicle traffic.

✜ Data withheld due to cell suppression.

Exceptions

❇ Data unavailable (N/A) as no further information provided for transport related mechanism of injury.

Figure 12 – Percentage of major trauma patients by road transport mechanisms

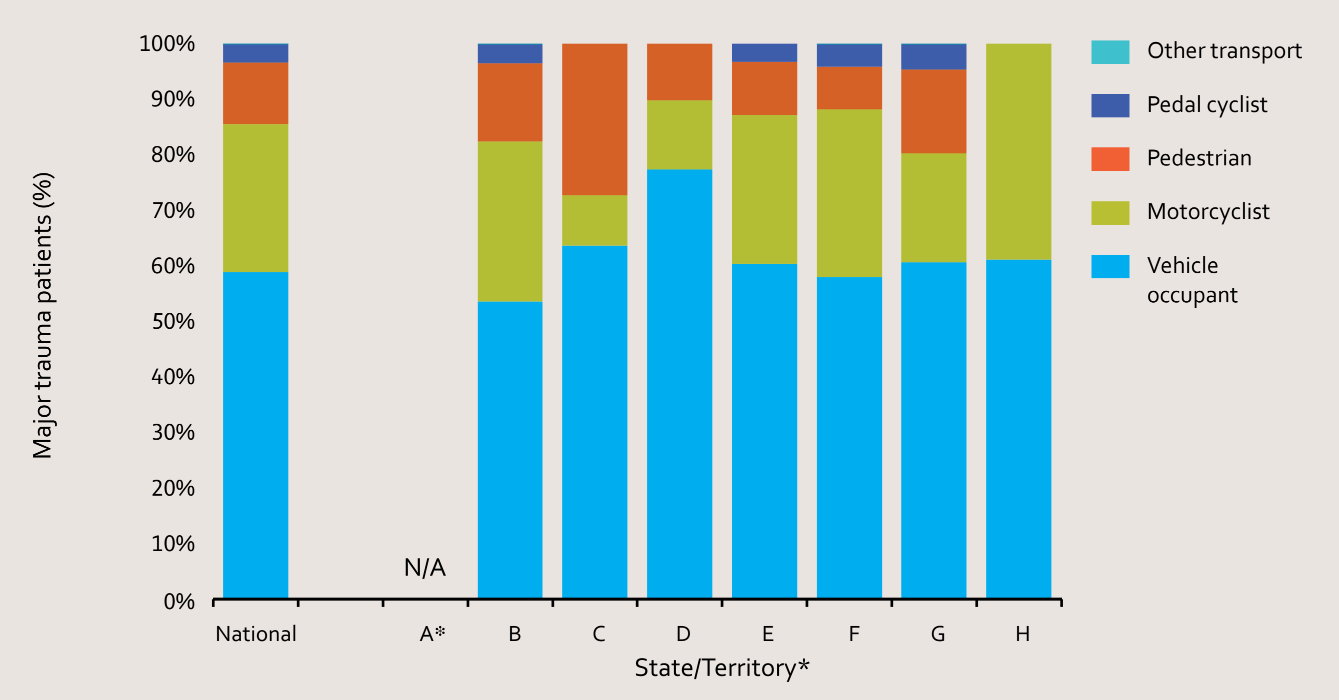
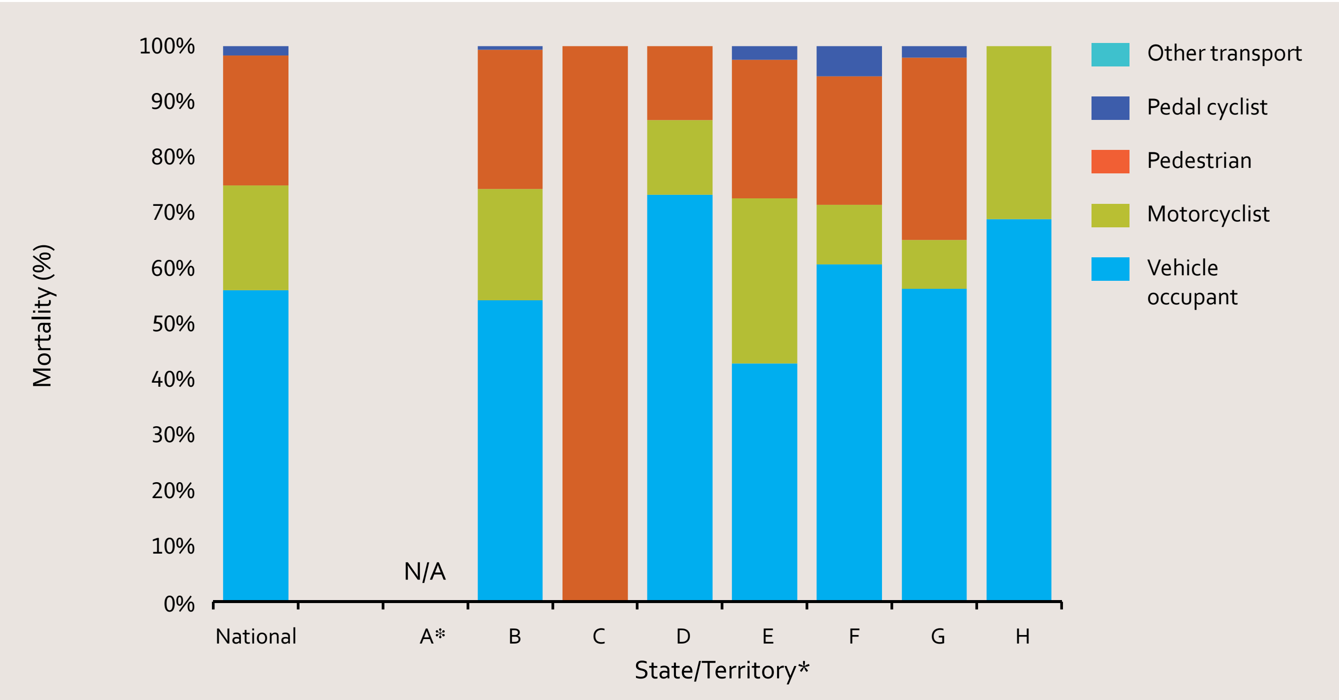


Figure 13 – Percentage mortality of major trauma patients by road transport mechanisms



*A-H denotes de-identified data from randomly selected states and territories and is comparable for Figure 12 and Figure 13, however this order is not maintained in other figures.

Exception

❇ Data unavailable (N/A) as no further information provided for transport related to mechanism of injury.

Assault related major trauma

(n = 1,603)

Assault# related injuries accounted for 1,603 (8%) of all major trauma patients admitted to designated trauma centres. Just over half (53%) of injuries from assault were due to being struck by an object or person (Table 5), and a quarter (24%) involved piercing or cutting which includes stabbing. This data is similar to the proportions published by the NTRC in 2005.[17]

Table 5 – Major trauma patients by different mechanisms of assault

State / Territory*	Transport related	Cutting or piercing (include stabbing)	Fall	Firearm	Struck by / against object or person	Suffocation (include hanging and strangulation)	Other mechanisms ◆
	No. of Patients	No. of Patients	No. of Patients	No. of Patients	No. of Patients	No. of Patients	No. of Patients
National	13 (0.8%)	387 (24.1%)	19 (1.2%)	74 (4.6%)	855 (53.3%)	8 (0.5%)	247 (15.4%)
A	0.2%	24.9%	0.0%	6.1%	46.0%	0.2%	22.6%
B❇	0.0%	15.4%	0.0%	5.1%	0.0%	0.0%	79.5%
C	0.0%	50.0%	0.0%	0.0%	50.0%	0.0%	0.0%
D	1.6%	24.1%	2.1%	3.9%	56.2%	1.8%	10.2%
E	1.2%	26.8%	0.6%	3.0%	50.6%	0.0%	17.7%
F	0.0%	27.4%	1.6%	0.0%	62.9%	0.0%	8.1%
G	0.0%	23.6%	0.6%	8.3%	63.7%	0.0%	3.8%
H	1.6%	21.3%	3.3%	2.0%	66.8%	0.0%	4.9%

*A-H denotes de-identified data from randomly selected states and territories and is not maintained in any order from table to table.

Definitions

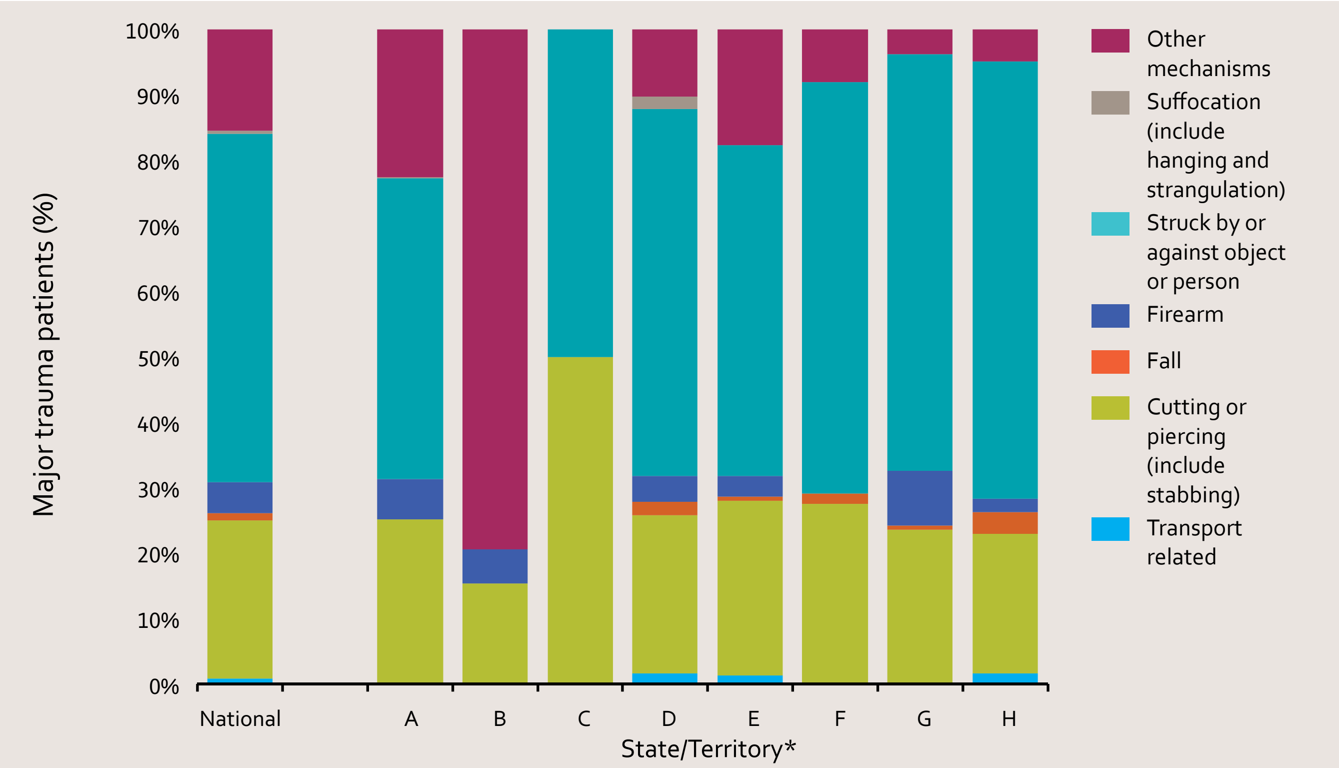
Assault includes sexual assault, maltreatment by parent (including neglect), maltreatment by spouse or partner (including domestic violence) and other unspecified assault. Intent of injury for assault was based on ICD-10-AM coded injuries X85-Y09.00 and mapped to the categories for injury intent in the BNTMDS.

◆ Other mechanisms include fire/hot object or substance, natural causes and animal. This category also includes other undefined causes where ICD-10-AM codes do not fall within any of the reportable mechanism categories.

Exceptions

n = 1,603. There were 47 (2.8%) cases where ICD-10-AM injury cause codes were not provided or unavailable. These have been excluded.
❇ No further details available for data in other mechanisms.

Figure 14 – Percentage of major trauma patients by assault mechanisms



*A-H denotes de-identified data from randomly selected states and territories and is not maintained in any order from table to table.

State/territory B recorded a large number of other mechanisms, which may be the result of a data recording issue.

SECTION 4

THE INJURIES THAT WERE SUSTAINED

Injury Severity Score

(n = 20,435)

Injury Severity Score (ISS) is an internationally-standardised approach to describing the overall severity of injury for each patient. It combines the severity of the three most significantly injured body parts. It enables comparison between populations of injured patients, and provides a standard inclusion criterion for trauma registries. The larger the number, the more severe the injury, up to a maximum of 75.

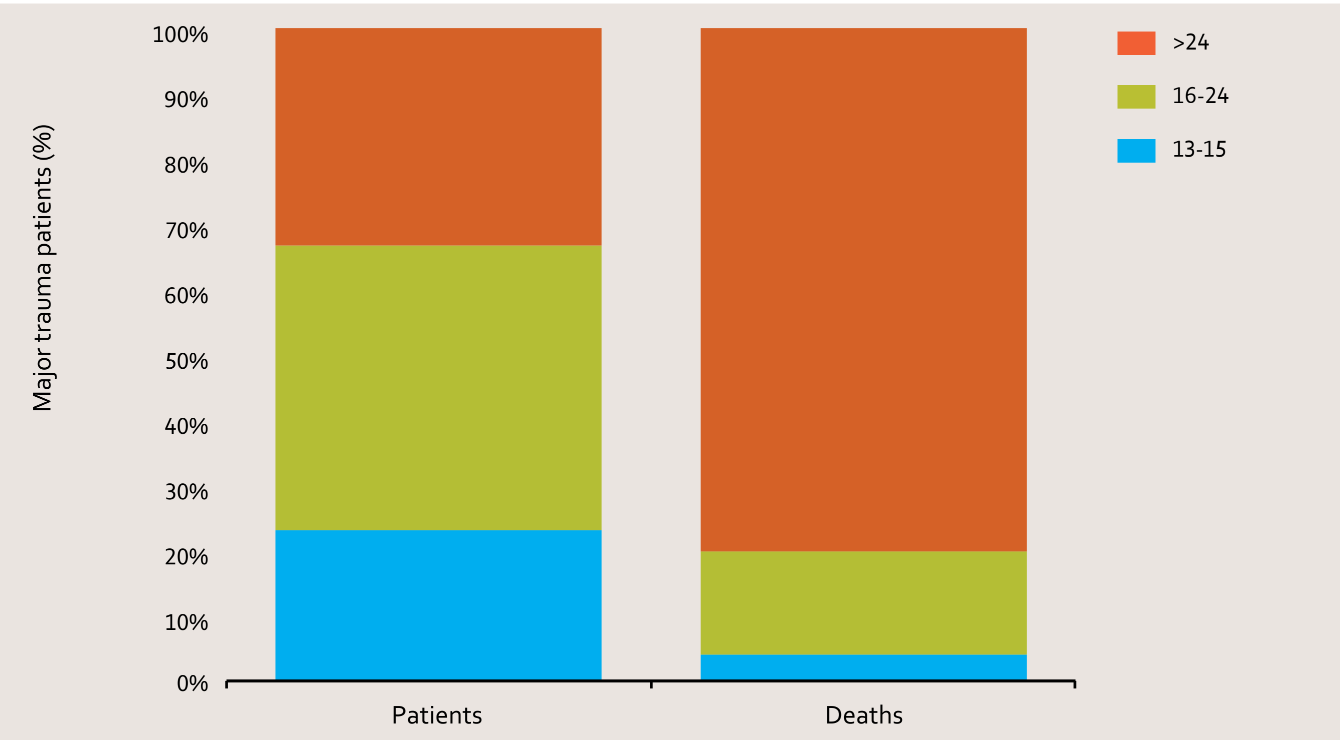
Almost half (44%) of all major trauma patients admitted to a designated trauma centre had an ISS between 16 and 24. Another one third of major trauma patients presented with an ISS>24. While lesser injured patients made up more of the trauma patient population in Australia, more severely injured patients had a higher incidence of death. The mortality among patients with ISS>24 was 80% (Table 6).

Table 6 – Major trauma patients and mortality by ISS groups

State / Territory*	ISS 13-15		ISS 16-24		ISS >24	
	No. of Patients	No. of Deaths	No. of Patients	No. of Deaths	No. of Patients	No. of Deaths
National	4,731 (23.2%)	84 (4.1%)	8,905 (43.6%)	324 (15.8%)	6,799 (33.3%)	1,643 (80.1%)
A	25.0%	6.1%	43.9%	18.0%	31.1%	75.9%
B	23.6%	3.1%	46.5%	18.8%	29.9%	78.1%
C	26.7%	4.0%	38.3%	14.3%	35.0%	81.7%
D	24.3%	2.7%	41.1%	13.8%	34.6%	83.5%
E	19.7%	22.2%	49.6%	11.1%	30.7%	66.7%
F	19.1%	2.0%	43.9%	21.6%	37.0%	76.5%
G	20.2%	3.7%	45.4%	15.3%	34.3%	81.0%
H	24.6%	1.8%	42.6%	7.1%	32.8%	91.1%

*A-H denotes de-identified data from randomly selected states and territories and is not maintained in any order from table to table.

Figure 15 – Percentage of major trauma patients and mortality by ISS groups



Single versus multiple body regions affected

(n = 9,423)

The part of the body that is injured has important ramifications for: the experiences of the patient; the urgent and longer term treatments that are necessary; the degree to which recovery is possible; for injury prevention and service planning.

Table 7 – Major trauma patients and mortality with polytrauma, isolated head, isolated spine and other aggregated single region injury

State / Territory*	Isolated spine injury ◆		Isolated head injury ✜		Other single region injury ❇		Polytrauma ▲	
	No. of Patients	No. of Deaths	No. of Patients	No. of Deaths	No. of Patients	No. of Deaths	No. of Patients	No. of Deaths
National	384 (4.1%)	23 (1.7%)	2,611 (27.7%)	458 (34.3%)	1,022 (10.8%)	125 10.8%)	5,406 (57.4%)	728 (57.4%)
A	4.6%	2.2%	38.1%	42.5%	10.7%	7.6%	46.7%	47.6%
B	2.7%	0.0%	23.3%	100.0%	17.8%	0.0%	56.2%	0.0%
C	4.2%	2.6%	31.1%	39.7%	13.4%	4.3%	51.2%	53.4%
D	4.4%	0.0%	28.2%	43.2%	17.3%	16.2%	50.1%	40.5%
E	5.4%	1.4%	18.7%	22.2%	11.1%	9.0%	64.9%	67.4%
F	3.1%	1.6%	21.3%	31.9%	8.4%	8.4%	67.1%	58.1%
G	3.7%	0.7%	16.6%	20.0%	9.7%	14.5%	70.0%	64.8%
H	0.6%	0.0%	13.3%	11.6%	27.9%	30.2%	58.2%	58.1%

*A-H denotes de-identified data from randomly selected states and territories and is not maintained in any order from table to table.

Patients with isolated head injuries alone have higher mortality (34%) than other isolated body regions (11%) combined or those with isolated spine injuries (2%). Polytrauma patients, defined as patients with two or more significantly injured body regions, have the highest mortality rate (57%) (Table 7 and Figure 16). Note this data is a subset of about half of the whole dataset.

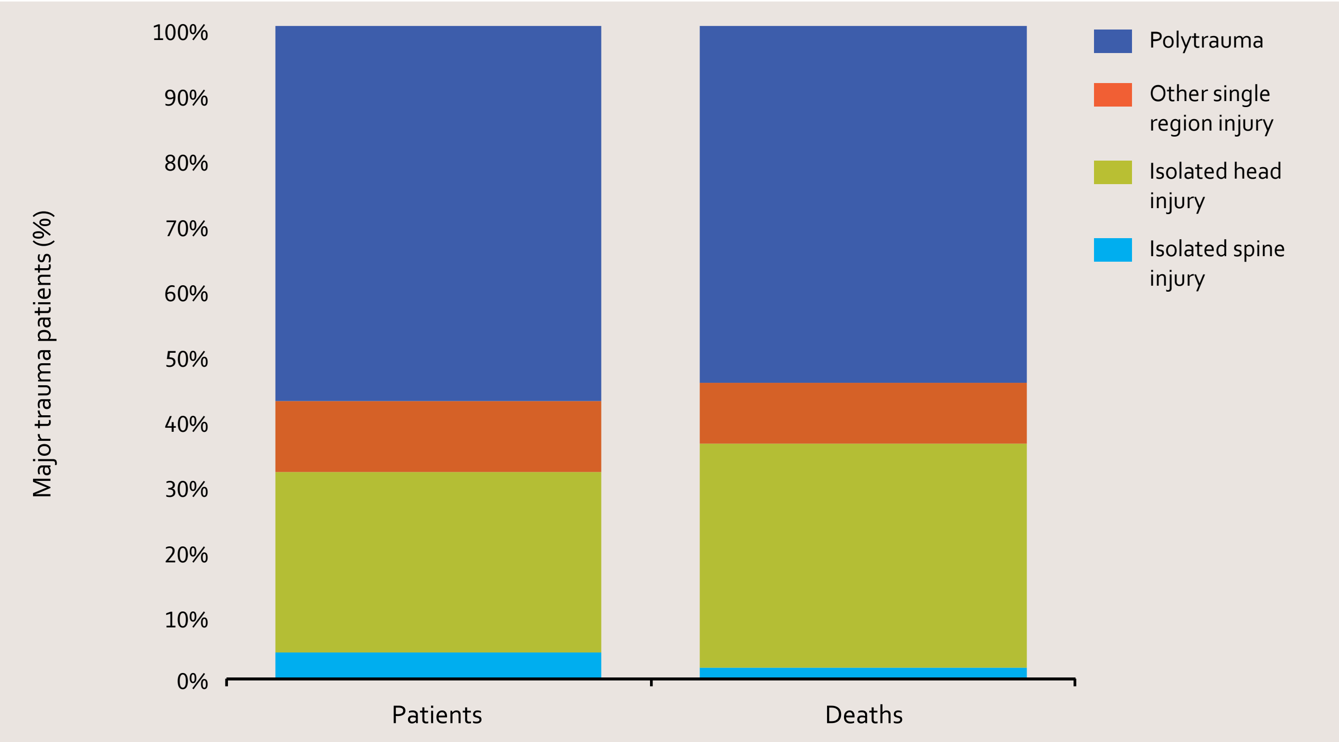
Note

For body region, it is important to remember that data is based on actual numbers as received from data sources and have not been risk-adjusted for injuries, co-morbidities or other confounding factors.

Definitions

◆ Isolated spine trauma is defined as all AIS codes in the AIS spine region beginning with "6xxxxx.x" and excludes other body regions.
✜ Isolated head injury is defined as injuries to AIS head region beginning with "1xxxxx.x" included in the head/neck ISS body region. This excludes other body regions.
❇ Other isolated trauma relates to other single AIS body regions that have not been included into isolated head or isolated spine.
▲ Polytrauma is severity of AIS>2 in two or more AIS body regions.

Figure 16 – Percentage of major trauma patients and mortality with polytrauma, isolated head, isolated spine and other aggregated single region injury



As all patients included in the registry have major injuries with an ISS>12, isolated single body-system injuries are by definition severe (AIS>4), whereas a patient with multiple injuries (polytrauma) can have multiple severe injuries to each body part.

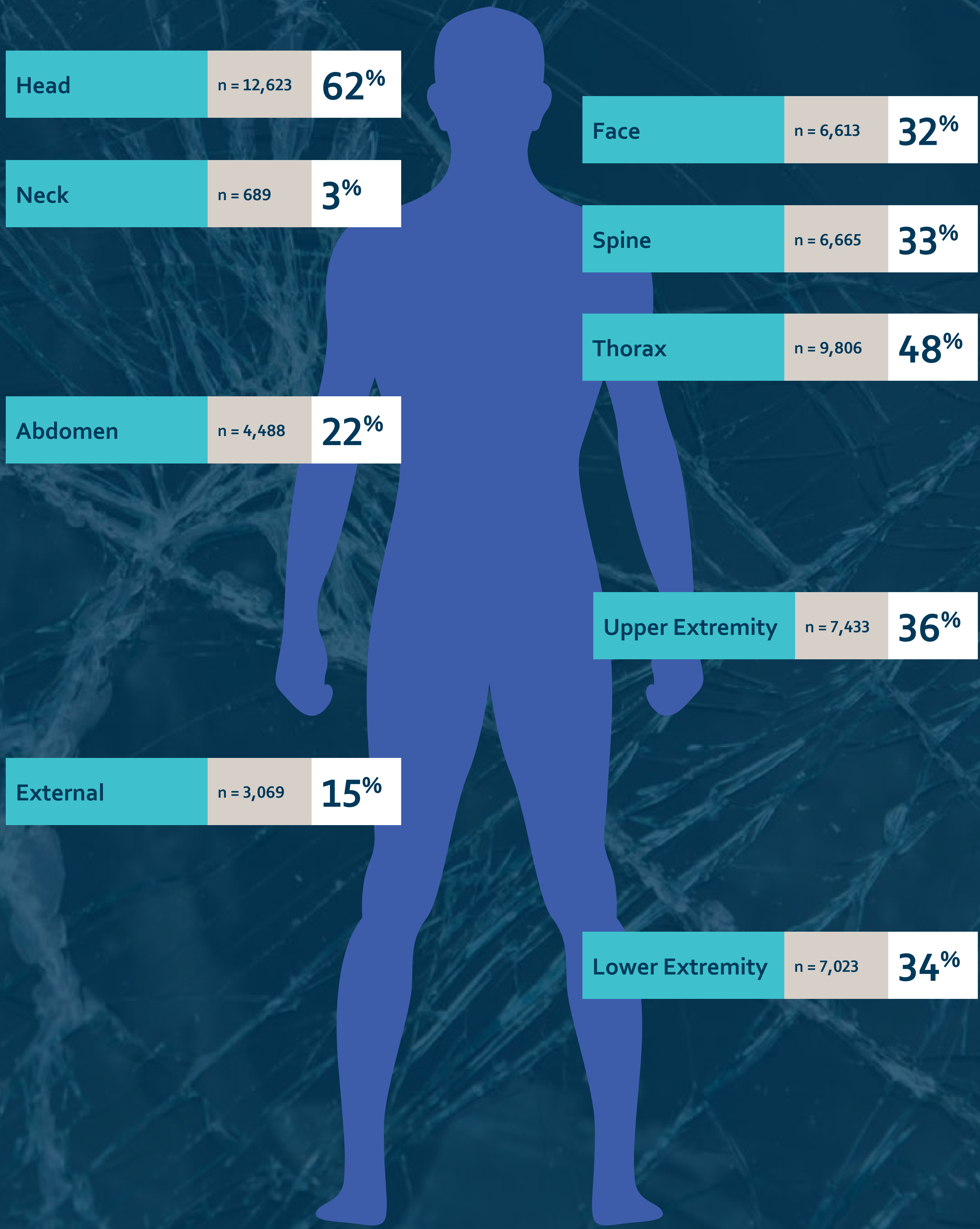
Affected body region

(n = 20,435)

Figure 17 illustrates the affected body regions among all major trauma patients admitted to designated trauma centres. Approximately two-thirds had sustained injuries to the head, approximately half had chest injuries, approximately one third had each of face, spine, upper limb and lower limb injuries, and approximately one-fifth had abdominal injuries.

Figure 17

BODY REGIONS INJURED AMONG MAJOR TRAUMA PATIENTS



Presenting signs

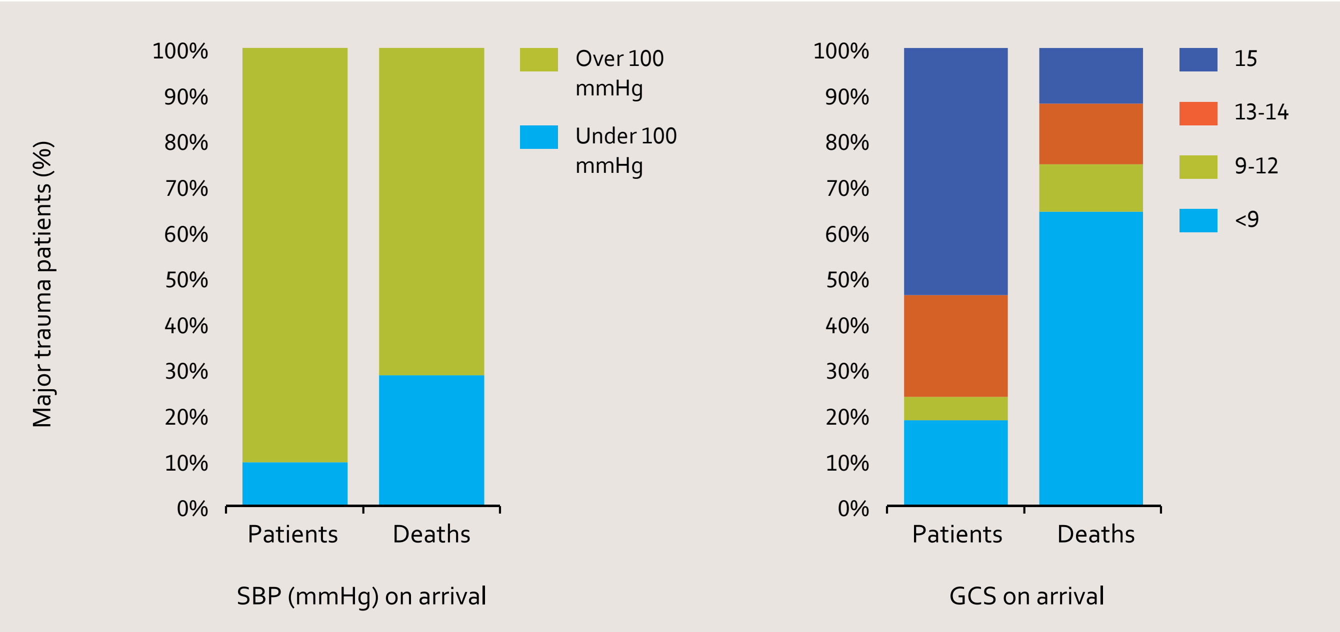
(n = 16,226 for systolic blood pressure)◆ (n = 15,316 for Glasgow Coma Scale)✤

Among major trauma patients, hypotension (defined here as systolic blood pressure (SBP) <100mmHg) on arrival at hospital is most commonly due to major bleeding, and may be a precursor to death due to blood loss if the bleeding is not controlled. Only about 75% of patients in the registry had data regarding initial SBP, of whom 10% had hypotension. Among all major trauma patients who died, however, 29% had hypotension on arrival.

Reduced conscious state, measured most often using the Glasgow Coma Scale (GCS), may be caused by a traumatic brain injury from which patients might not fully recover, especially when the brain injury is severe (often defined as GCS<9). Only about 75% of patients in the registry had data regarding initial GCS, nearly half of whom (46%) had reduced conscious state on arrival, and 19% had GCS<9. Of the patients who died, 88% had reduced conscious state on arrival, and nearly two-thirds (64%) had GCS<9.

Both hypotension (SBP<100 mmHg) and/or reduced conscious state (GCS<9), were strongly associated with in-hospital mortality.

Figure 18 – Percentage of major trauma patients and mortality by initial systolic blood pressure (SBP) and Glasgow Coma Scale (GCS) on arrival



Note

These graphs share a common theme, presenting signs.
It should be noted that this graph is only a representation and combines separate sample sizes.

Exceptions

◆ n = 16,226. There were 4,209 (20.6%) cases where SBP was unavailable, of whom 397 (19.3%) died.

✤ n = 15,316. There were 5,119 (25.1%) cases with intubation/sedation or paralysis due to drugs, or for other reasons GCS invalid/cannot be measured. Of these 538 (26.2%) died.

Table 8 – Major trauma patients and mortality by initial systolic blood pressure (SBP) on arrival

State / Territory*	SBP (mmHg)			
	Under 100		Over 100	
	No. of Patients	No. of Deaths	No. of Patients	No. of Deaths
National	1,546 (9.5%)	471 (28.5%)	14,680 (90.5%)	1,183 (71.5%)
A	10.5%	29.0%	89.5%	71.0%
B	10.4%	30.0%	89.6%	70.0%
C	11.7%	34.4%	88.3%	65.6%
D	9.2%	28.2%	90.8%	71.8%
E	6.5%	21.4%	93.5%	78.6%
F	10.4%	11.1%	89.6%	88.9%
G	N/A	N/A	N/A	N/A
H	13.8%	37.7%	86.2%	62.3%

*A-H denotes de-identified data from randomly selected states and territories and is not maintained in any order from table to table.

Table 9 – Major trauma patients and mortality by initial conscious state on arrival

State / Territory*	Glasgow Coma Scale							
	<9		9-12		13-14		15	
	No. of Patients	No. of Deaths	No. of Patients	No. of Deaths	No. of Patients	No. of Deaths	No. of Patients	No. of Deaths
National	2,838 (18.5%)	972 (64.2%)	800 (5.2%)	157 (10.4%)	3,399 (22.2%)	200 (13.2%)	8,279 (54.1%)	184 (12.2%)
A	11.2%	54.5%	5.5%	10.3%	23.9%	22.8%	59.4%	12.4%
B	17.3%	65.6%	5.6%	10.6%	18.2%	9.4%	59.0%	14.4%
C	20.6%	66.1%	4.4%	9.7%	25.1%	14.0%	50.0%	10.2%
D	24.3%	81.6%	5.4%	6.1%	11.3%	0.0%	59.0%	12.2%
E	20.2%	65.7%	5.9%	10.2%	21.8%	12.5%	52.1%	11.5%
F	11.4%	51.5%	5.7%	15.8%	19.5%	11.9%	63.5%	20.8%
G	21.3%	55.6%	3.7%	11.1%	22.8%	22.2%	52.2%	11.1%
H	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*A-H denotes de-identified data from randomly selected states and territories and is not maintained in any order from table to table.

SECTION 5

THE CARE PATIENTS RECEIVED

Image courtesy of Alfred Trauma Service - Alfred Health

Mode of transport to designated trauma centres

(n = 16,275)

Australia is a large country, with many sparsely-populated regions. The designated trauma centres are all located in large population centres where most Australians live. Injured people may be transported to trauma centres from the scene of the injury, or be transported from other hospitals. Road, helicopter and fixed wing vehicles are all important parts of trauma systems.

Table 10 – Major trauma patient by mode of transport to designated trauma centres

State / Territory*	Road ambulance	Helicopter ambulance	Fixed-wing ambulance	Private / Public vehicle / Taxi / Walk-in	Other transport ◆
	No. of Patients	No. of Patients	No. of Patients	No. of Patients	No. of Patients
National	12,314 (75.7%)	2,265 (13.9%)	260 (1.6%)	719 (4.4%)	717 (4.4%)
A❇	N/A	N/A	N/A	N/A	N/A
B❇	N/A	N/A	N/A	N/A	N/A
C	89.1%	7.7%	2.8%	0.2%	0.2%
D	76.6%	10.3%	1.5%	11.6%	0.0%
E	65.7%	20.0%	2.3%	1.0%	10.9%
F	31.3%	3.0%	6.7%	2.2%	56.7%
G	78.7%	17.9%	1.7%	1.6%	0.0%
H	80.4%	11.2%	0.5%	7.4%	0.6%

*A-H denotes de-identified data from randomly selected states and territories and is not maintained in any order from table to table.

Nationally, 12,314 (76%) of all patients arrived at the designated trauma centres by road ambulance (Table 10).

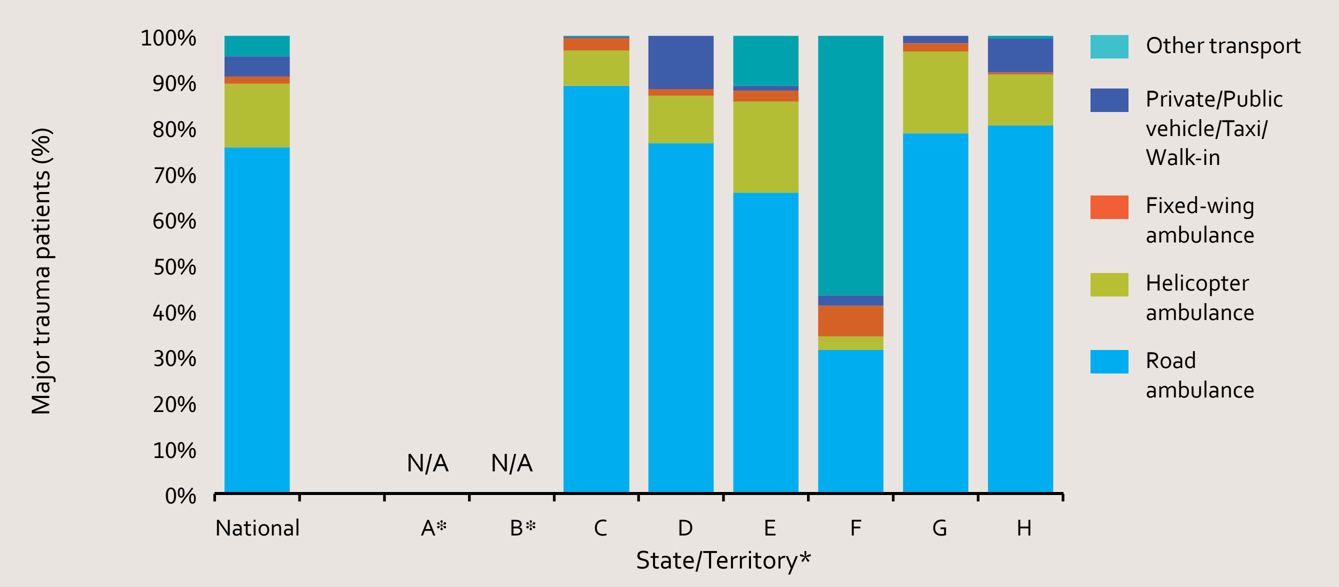
Definition

◆ Other transport includes other modes of transport which do not fit into the reportable transport mode categories, and interstate and private ambulance.

Exceptions

n = 16,275. There were 4,160 (20.4%) cases where the transport mode from scene was unknown, of which 289 (14.1%) were deaths. These have been excluded.
❇ Data for mode of transport unavailable (N/A).

Figure 19 – Percentage of major trauma patients by mode of transport to designated trauma centres



*A-H denotes de-identified data from randomly selected states and territories, however this order is not maintained in other figures

Approximately three-quarters of major trauma patients are transported to designated trauma centres by road ambulance (Figure 19). The use of aerial transport services varies by state/territory according to geography and trauma system characteristics. The large number of 'Other transport' likely refers to interstate transfers.

Transfers to designated trauma centres

(n = 19,703)

Approximately two-thirds (66%) of all major trauma patients admitted to designated trauma centres came directly from the scene of injury, the remainder were transferred from another hospital (Table 11). This is a development over recent years, during which emphasis has been placed on getting severely injured patients to the level of care that they need in the shortest time. The percentage who died was slightly higher among those directly transferred from the scene (75%), compared with those transferred from other hospitals (25%), however patients who died at other hospitals and who were never transported to a designated trauma centre are not included in these figures, so the true mortality rate of patients presenting to other hospitals is not available in the ATR.

Exception

❄ Data unavailable (N/A).

Table 11 – Major trauma patients and mortality arriving by direct admission or hospital transfer

State / Territory*	Direct		Transfer	
	No. of Patients	No. of Deaths	No. of Patients	No. of Deaths
National	12,912 (65.5%)	1,497 (74.9%)	6,791 (34.5%)	503 (25.2%)
A*	N/A	N/A	N/A	N/A
B	34.6%	61.3%	65.4%	38.7%
C	64.0%	73.3%	36.0%	26.7%
D	64.0%	75.6%	36.0%	24.4%
E	65.1%	80.4%	34.9%	19.6%
F	71.1%	76.6%	28.9%	23.4%
G	72.2%	79.3%	27.8%	20.7%
H	86.1%	77.8%	13.9%	22.2%

*A-H denotes de-identified data from randomly selected states and territories and is not maintained in any order from table to table

Figure 20 – Percentage of major trauma patients arriving by direct admission or hospital transfer

*A-H denotes de-identified data from randomly selected states and territories, however this order is not maintained in other figures.

In all states/territories at least 64% of patients arrive at designated trauma centres directly from the scene of injury (Figure 20). In one contributing state/territory approximately two-thirds of patients were transferred from another hospital (65%).

Note

State/territories have been ordered from lowest to highest. Mortality rates are based on actual data received from data sources and have not been adjusted for transfer times, injuries, co-morbidities or other confounding factors.

Exceptions

n = 19,703. There were 732 (3.6%) cases where data was not provided, of which 51 (0.7%) were deaths.
* Data unavailable (N/A).

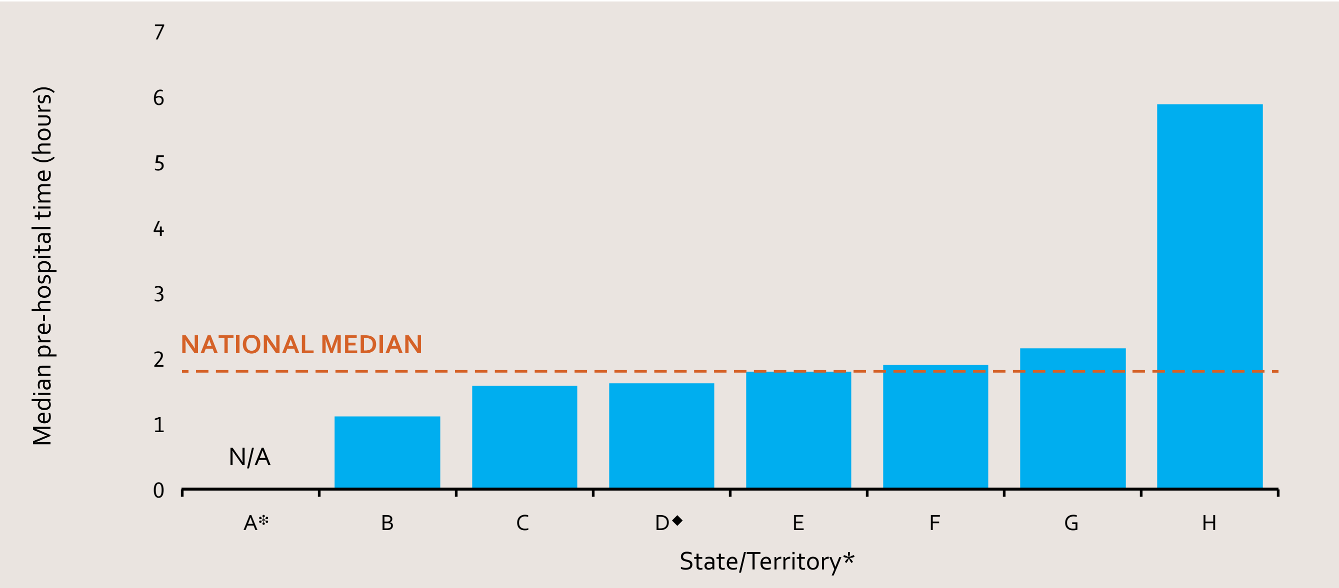
Median pre-hospital time

(n = 14,734)

Major trauma is often time-critical, and among some patients the timeliness of urgent treatments to correct airway and breathing problems, and control bleeding in particular, can affect the likelihood of survival and good recovery.

Of course in a large country like Australia, where trauma centres are concentrated in capital cities and there are sparsely populated rural centres, it is very difficult to get patients to a designated trauma centre quickly. Data was available for almost three quarters of patients in the ATR, and while the median pre-hospital time was 1.8 hours nationally, substantial variation existed between states and territories.

Figure 21 – Median time from injury to trauma centre arrival



*A-H denotes de-identified data from randomly selected states and territories, however this order is not maintained in other figures.

Table 12 – Median time from injury to trauma centre arrival

State / Territory*	Median pre-hospital time (hours)
National	1.8
A❊	N/A
B	1.1
C	1.6
D◆	1.6

State / Territory*	Median pre-hospital time (hours)
National	1.8
E	4.1
F	4.4
G	5.0
H	5.5

*A-H denotes de-identified data from randomly selected states and territories and is not maintained in any order from table to table

Notes

State/territories have been ordered from lowest to highest. Data is based on actual times from time of injury to arrival at major trauma centres and have not been adjusted for transfer times, geographical distance or other confounding factors.

Pre-hospital time varies widely according to geography, demography and the organisation of pre-hospital services. While rapid transport to major trauma centres may improve the likelihood of survival and recovery for some patients, many factors are involved and depend on local and regional circumstances.

Exceptions

n = 14,734. There were 5,701 (27.9%) cases with inadequate data. These have been excluded.
❊ Data unavailable (N/A).
◆ Data unavailable for 2010 and 2011 (N/A).

Patient intubation recorded for Glasgow Coma Scale (GCS) of less than 9

(n = 2,838)

Patients with a reduced conscious state, which may be indicative of a severe traumatic brain injury, may not be able to maintain an adequate airway and therefore sufficient blood oxygenation. This may cause secondary injury to the brain, and even death. Protection of the airway in such patients usually involves endotracheal intubation and mechanical ventilation. This may be commenced in the pre-hospital environment or in hospital. Intubation of patients with GCS<9 is sometimes used a quality indicator.

Table 13 – Major trauma patients and mortality with GCS<9 by intubation

State / Territory*	Intubated◆		Not intubated		Not stated/inadequately described	
	No. of Patients	No. of Deaths	No. of Patients	No. of Deaths	No. of Patients	No. of Deaths
National	1,023 (36.0%)	368 (37.9%)	331 (11.7%)	127 (13.1%)	1,484 (52.3%)	477 (49.1%)
A❇	N/A	N/A	N/A	N/A	N/A	N/A
B❇	N/A	N/A	N/A	N/A	N/A	N/A
C✜	64.3%	55.9%	1.9%	1.3%	33.8%	42.7%
D	37.0%	30.5%	55.5%	68.6%	7.5%	0.8%
E	37.2%	32.5%	61.6%	67.5%	1.2%	0.0%
F	89.7%	100.0%	10.3%	0.0%	0.0%	0.0%
G✜	88.7%	86.1%	0.0%	0.0%	11.3%	13.9%
H	71.4%	73.1%	28.6%	26.9%	0.0%	0.0%

*A-H denotes de-identified data from randomly selected states and territories and is not maintained in any order from table to table

National figures show that on average 36% of major trauma patients who present with GCS<9 were intubated, 12% were not, and in 52% of cases, it was unknown from the data. Among those presenting with GCS<9 and who died, 38% were intubated, 13% were not, and in 49% the intubation status was unknown. The lack of completeness of this data (Table 13, Figures 22 and 23) makes interpretation of the quality of care using this indicator impossible at this time.

Note

Overall, data for intubation is poorly reported with only 57% utility (Table 18).

Definitions

◆ Four hospital trauma registries include the use of laryngeal mask airway as intubation.

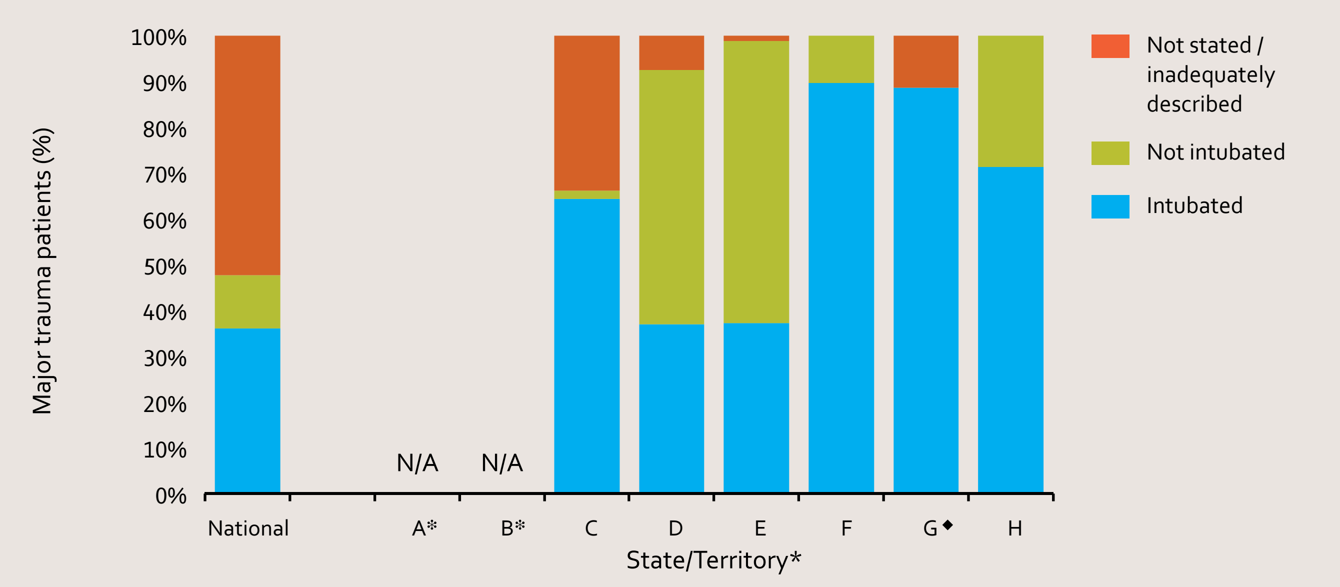
Exceptions

n = 2,838. There were 2,838 cases with GCS<9 where intubation was reported. Of these, 1,484 (52.3%) cases had unknown or unavailable intubation information.

❇ Intubation data were unavailable (N/A).

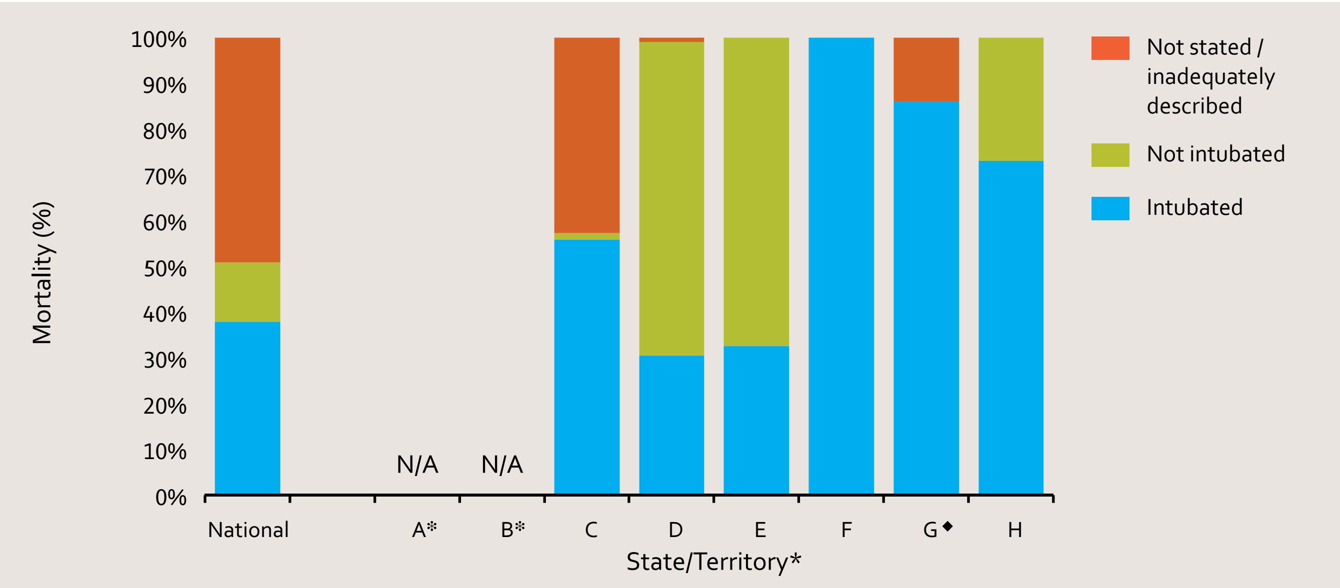
✜ Not stated, or inadequately described data were unavailable or not able to be verified for this report.

Figure 22 – Percentage of major trauma patients with GCS<9 by intubation



*A-H denotes de-identified data from randomly selected states and territories, however this order is not maintained in other figures.

Figure 23 – Percentage mortality of major trauma patients with GCS<9 by intubation



*A-H denotes de-identified data from randomly selected states and territories, however this order is not maintained in other figures.

Exceptions

❊ Intubation data unavailable (N/A).

◆ Not stated.

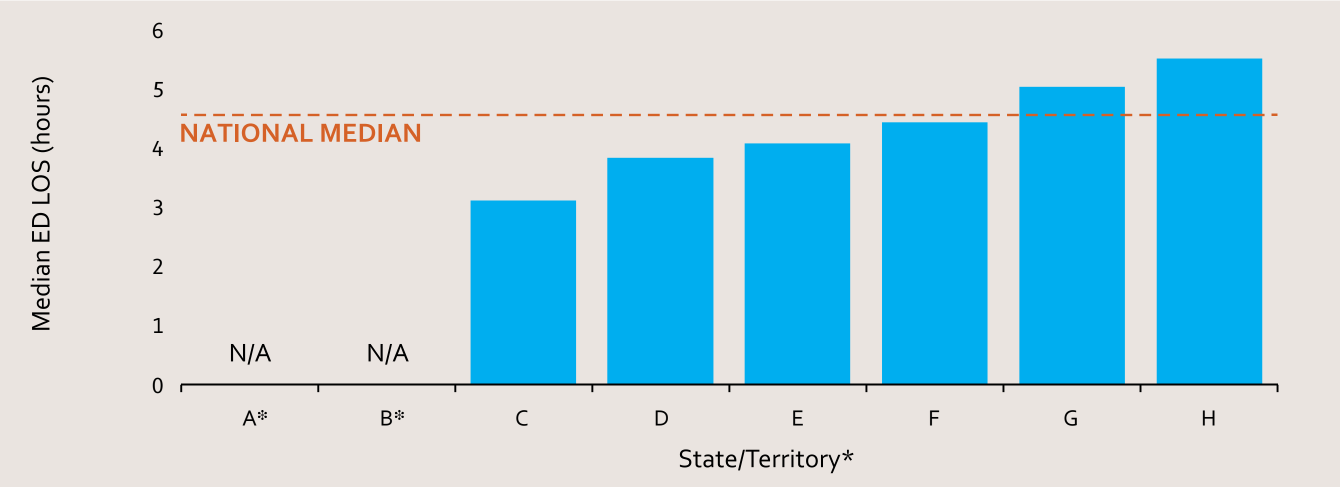
Median length of stay

(1) Emergency Department

(n = 15,913)

Length of stay in emergency departments is often used as a health service indicator, and goals are often set to move patients out of EDs efficiently. However, among trauma patients, who may be actively resuscitated in the ED, it is less clear whether shorter stays are better. The data should be interpreted according to local policies.

Figure 24 – Median ED LOS of major trauma patients



*A-H denotes de-identified data from randomly selected states and territories and is not maintained in any order from table to table

Table 14 – Median ED LOS of major trauma patients

State / Territory*	Median ED LOS (hours)	State / Territory*	Median ED LOS (hours)
National	4.6	National	4.6
A*	N/A	E	4.1
B*	N/A	F	4.4
C	3.1	G	5.0
D	3.8	H	5.5

*A-H denotes de-identified data from randomly selected states and territories and is not maintained in any order from table to table

The national median time major trauma patients spent in the emergency departments of designated trauma centres was 4.6 hours (Interquartile Range (IQR) 2.4-7.7) (Figure 24). Reported combined data from the designated trauma centres indicate that in most states/territories the ED LOS falls under the national median. Two states/territories were slightly above the national median time at 5.0 and 5.5 hours.

Note

States/territories have been ordered from lowest to highest. These are based on actual times as received from data sources and have not been adjusted for injury severity, co-morbidities or other confounding factors.

Definitions

ED LOS is calculated by the ATR based on the date and time of arrival at the definitive care hospital to the ED discharge date and time.

Exceptions

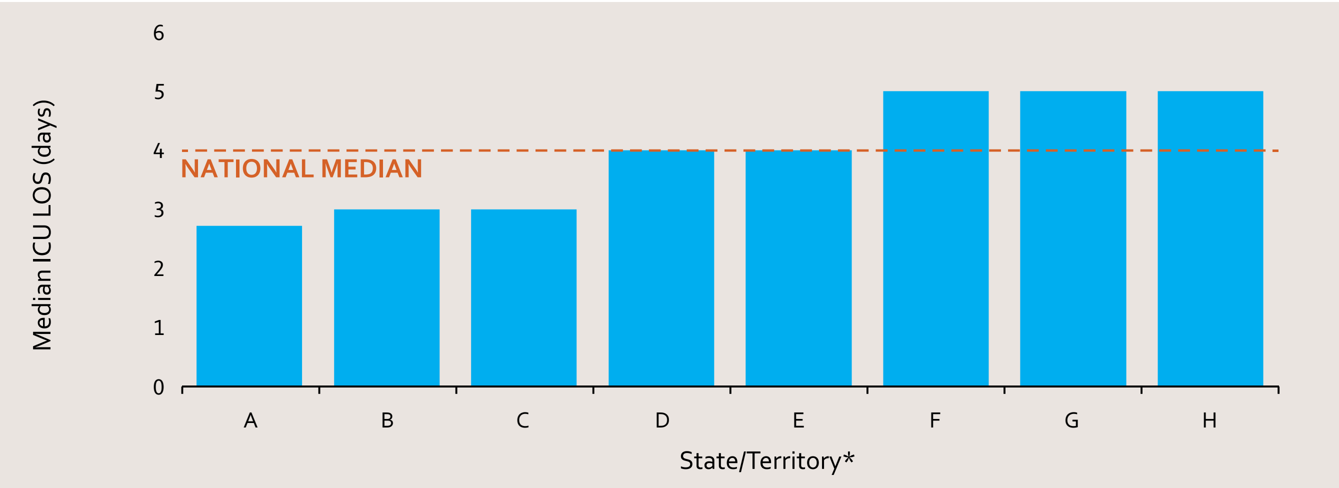
n = 15,913 ED LOS cases with inadequate data were 4,522 (28.4%). These have been excluded.
❇ ED LOS data not available (N/A).

(2) Intensive Care Unit

(n = 8,067)

Intensive care management of major trauma patients is needed for many reasons. Patients may need ongoing resuscitation, assistance with ventilation, support for organ failure, sedation, nutritional support, and so on, that can only be provided in an intensive care unit (ICU). The length of stay in an ICU is determined by the needs of the patient and the discharge policies of the unit, and the availability of step-down ward beds. Length of time in an ICU has significant bearing on the cost of a patient's treatment.

Figure 25 – Median ICU LOS of major trauma patients



*A-H denotes de-identified data from randomly selected states and territories , however this order is not maintained in other figures.

Table 15 – Median ICU LOS of major trauma patients

State / Territory*	Median ICU LOS (days)
National	4.0
A	2.7
B	3.0
C	3.0
D	4.0

State / Territory*	Median ICU LOS (days)
National	4.0
E	4.0
F	5.0
G	5.0
H	5.0

*A-H denotes de-identified data from randomly selected states and territories and is not maintained in any order from table to table

There were 10,919 (53%) reported cases where major trauma patients were admitted to ICU, 8,067 of which had ICU LOS data used in this report. When admitted to the ICU, the national median ICU LOS for major trauma patients was 4.0 days (IQR: 2.0 – 10.0) (Figure 25 and Table 15). The longest time in ICU as reported by three states/territories was one day longer than the national median (5.0 days).

Note

States/territories have been ordered from lowest to highest. These are based on actual times as received from data sources and have not been adjusted for injury severity, co-morbidities or other confounding factors.

Definitions

ICU LOS is based on the values provided by the designated trauma centres and the state-based trauma registries. ICU LOS is not calculated by the ATR.

Exceptions

n = 8,067. There were 10,919 (53.4%) ICU LOS cases of which 2,852 (26.1%) cases had data that were inadequate or not provided to calculate median ICU LOS. These have been excluded.

(3) Hospital

(n = 20,119)

Patients are discharged from hospital when they no longer need acute designated trauma centre care, or when they die. However discharge timing depends on many factors, including discharge policies of the hospital, and the availability of rehabilitation centre beds.

Figure 26 – Median hospital LOS of major trauma patient

*A-H denotes de-identified data from randomly selected states and territories and is not maintained in any order from table to table

Table 16 – Median hospital LOS of major trauma patients

State / Territory*	Median hospital LOS (days)
National	9.0
A	7.8
B	7.9
C	9.0
D	9.0

State / Territory*	Median hospital LOS (days)
National	9.0
E	9.8
F	10.0
G	11.0
H	11.0

*A-H denotes de-identified data from randomly selected states and territories and is not maintained in any order from table to table

The national median for hospital LOS was 9.0 days (IQR: 4.0-18.0) (Figure 26 and Table 16). Four states/territories had length of stay in hospital which was below the national median, while four centres were longer than the national median, with the highest 2.0 days longer than the national median.

Note

States/territories have been ordered from lowest to highest. These are based on actual times as received from data sources and have not been adjusted for injury severity, co-morbidities or other confounding factors.

Definitions

Hospital LOS is based on the values provided by the major trauma centres and the state-based trauma registries. Hospital LOS is from date and time of arrival at the definitive care hospital to the date and time of discharge from the definitive care hospital.

Exceptions

n=20,119. There were 316 (1.5%) cases with data that were inadequate or not provided to calculate median hospital LOS. These have been excluded. ICU LOS. These have been excluded.

SECTION 6

OUTCOMES OF THE INJURIES AND TRAUMA CENTRE CARE

Image courtesy of Ambulance Victoria

Risk adjusted mortality among trauma centres❇

In-hospital mortality at each centre has been adjusted for several factors to account for differences in case mix and other characteristics that could affect mortality rates. We used the process employed by the American College of Surgeons Trauma Quality Improvement Program, as described by Newgard *et al*[15]. However, the completeness of the data submitted to the ATR has limited the variables that could be entered into the model to: age, gender, injury mechanism, transfer status, ISS and state/territory.

Cohorts (strata) were identified that would have similar mortality across centres, and separate statistical models were developed for each cohort. The cohorts were: elderly patients ≥65 years of age, patients with severe head injury, patients with SBP on arrival ≤100 mmHg, and others (who do not belong to the previous three cohorts). Statistical models to predict mortality in each cohort were developed and best fit was achieved for patients 16 years and over, but not for children less than 16 years of age. Therefore, for the purposes of this report, children less than 16 years of age were excluded (as they were by Newgard *et al*[15]).

These four separate statistical models were then applied to the patients seen at each designated trauma centre, and an 'expected' mortality overall was obtained. The ratio of the observed:expected mortality was then calculated for each centre, and plotted, with 95% confidence intervals. The centres were then ordered from 'best performing' to 'worst performing' on mortality outcomes.

Our results reveal that, of the adult trauma centres, three centres had a statistically-significantly lower in-hospital mortality than expected, and three hospitals had a statistically-significantly higher in-hospital mortality than expected (Figure 27).

These results show variations between trauma centres in the rates at which patients died. This information may be helpful if we can learn what high performing centres do differently. However the accuracy to which it can be concluded where any trauma centre sits on this chart, and the confidence with which that assertion can be made, is critically dependent on the available data. Efforts to improve data quality in the future will strengthen the validity and usefulness of these analyses.

Figure 27 – Caterpillar plot for observed:expected mortality ratio for designated adult trauma centres

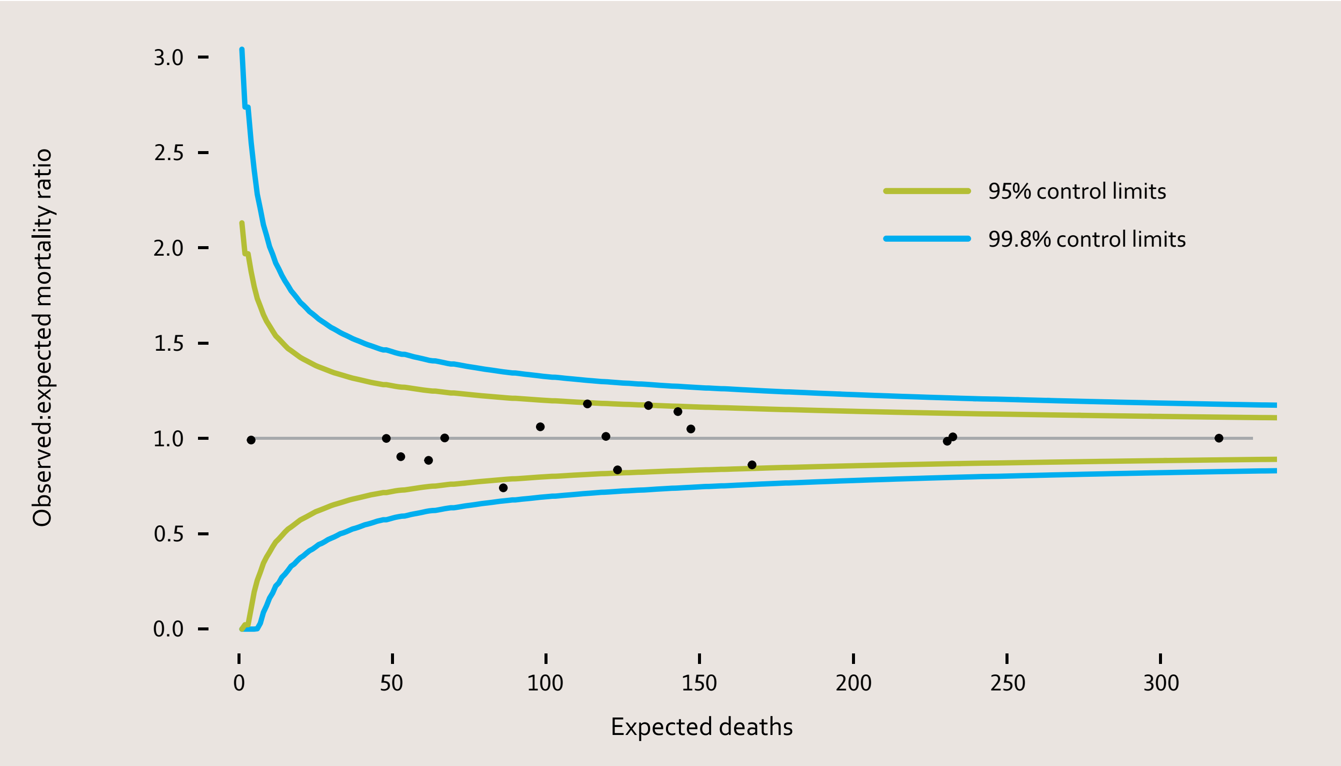
Note

❇ The comparative risk adjustment model adopted was only applied to adults (≥16 years of age).

An alternative way of presenting this information is through a funnel plot (Figure 28). Funnel plots compare indicated values with a benchmark value and shows how much uncertainty or variation there is in the range of values, and a clear picture of outliers. They avoid the ranking approach that some methods of displaying performance use (e.g. Figure 27). They are especially useful when there are small numbers of events. Points lying outside the typical funnel shape show variation that may indicate an issue worthy of further investigation. The European Collaboration for Healthcare Optimization[18] considers centres above the 95% limit in the 'alert zone' and those above the 99.8% considered as 'alarms'. Some consider funnel plots to be a superior way of comparing institutional performance, although they are potentially more difficult for the inexperienced reader to interpret[19, 20].

The funnel plot below (Figure 28) shows each designated trauma centre's observed:expected mortality ratio according to predicted mortality, and how far they deviate from the average. Boundary lines represent the upper and lower limits of variation, indicating outcomes that are two or three standard deviations of the average (horizontal line). In comparison with the caterpillar plot (Figure 27) the funnel plot shows no major outlying centres, or centres in the 'alarm' zone, and only one centre in the 'alert zone'.

Figure 28 – Funnel plot for observed:expected mortality ratio for designated adult trauma centres



Discharge destination of survivors

(n = 17,928)

Patients who survive to hospital discharge are ideally sent to an appropriate level of care. Some are able to go home, perhaps with mobility aids or other ongoing home-based treatment or support services. Others require ongoing physical or cognitive rehabilitation or other support in an inpatient facility.

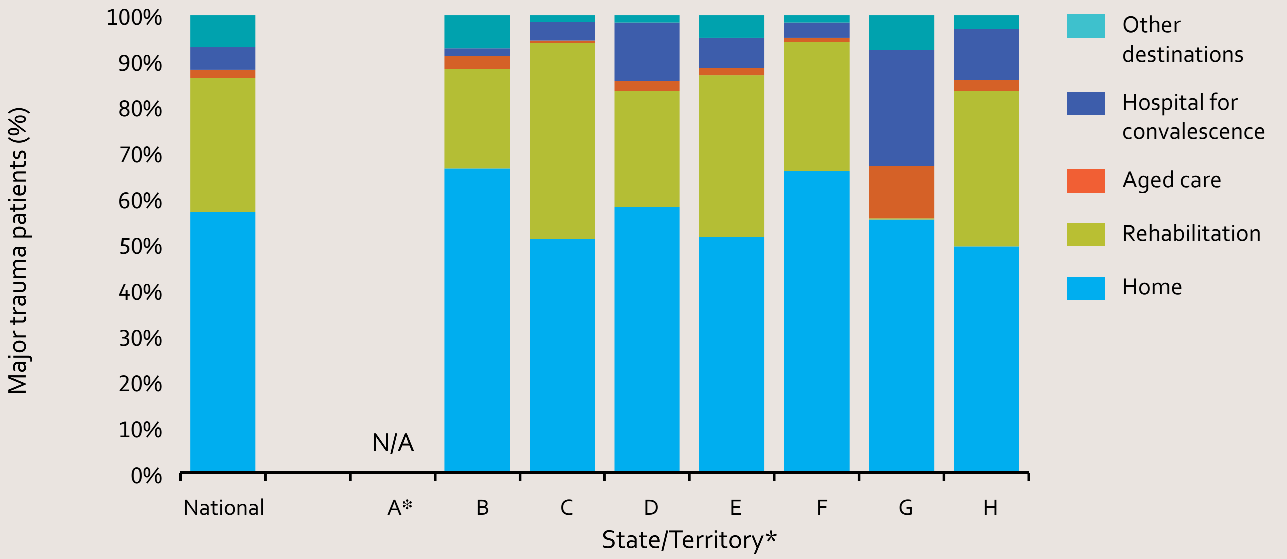
Table 17 – Major trauma patients by discharge destination

State / Territory*	Home	Rehabilitation	Aged care◆	Hospital for convalescence✤	Other destinations▲
	No. of Patients	No. of Patients	No. of Patients	No. of Patients	No. of Patients
National	10,205 (56.9%)	5,257 (29.3%)	255 (1.4%)	875 (4.9%)	1,336 (7.5%)
A❇	N/A	N/A	N/A	N/A	N/A
B	66.5%	21.7%	1.5%	1.7%	8.6%
C	51.2%	42.9%	0.5%	4.0%	1.45%
D	58.1%	25.3%	2.3%	12.7%	1.6%
E	51.6%	35.2%	1.6%	6.6%	4.9%
F	65.9%	28.3%	1.0%	3.2%	1.6%
G	55.3%	0.3%	10.7%	25.5%	8.2%
H	49.6%	33.9%	2.4%	11.1%	2.9%

*A-H denotes de-identified data from randomly selected states and territories and is not maintained in any order from table to table

The total number of patients surviving to discharge is 17,928 over the period 2010 to 2012 (Table 17) of whom more than half (57%) were discharged home. The percent discharged to home across states/territories ranged from 51% - 67% (Figure 29).

Figure 29 – Percentage of major trauma patients by discharge destination



*A-H denotes de-identified data from randomly selected states and territories , however this order is not maintained in other figures.

Definitions

◆ Aged care includes residential aged care services or nursing homes, which are not the usual place of residence.
✤ Hospital for convalescence means convalescence in either definitive care or other hospital after discharge from acute care (but not transferred as part of acute treatment).
▲ Other destinations include survivors with no known discharge destination and patients who left against medical advice.

Exceptions

n = 17,928. There were 2,048 (10.0%) in-hospital deaths and a further 459 (2.2%) cases had inadequate data. These have been excluded.
❇ Discharge destination description unavailable (N/A).

SECTION 7

QUALITY OF THE DATA

Table 18 – Completeness of data items by data source

Data Source	Mortality %	Age %	Gender %	Injury Type %	Injury Intent %	Injury Cause %	ISS supplied from site %	AIS Codes; Integrity of supplied ISS %
1	100.0	100.0	100.0	99.5	99.6	85.6	100.0	100.0
2	97.9	100.0	100.0	100.0	100.0	100.0	100.0	85.3
3	99.8	100.0	100.0	100.0	100.0	100.0	100.0	100.0
4	90.0	100.0	100.0	90.2	98.2	90.1	100.0	100.0
5	99.6	100.0	100.0	86.2	100.0	100.0	100.0	92.4
6	98.9	100.0	99.8	100.0	99.6	99.6	100.0	100.0
7	100.0	100.0	100.0	100.0	100.0	100.0	100.0	96.6
8	95.0	100.0	100.0	99.6	100.0	100.0	100.0	99.5
9	84.9	100.0	100.0	98.3	100.0	100.0	100.0	99.0
10	92.6	100.0	100.0	99.3	99.8	99.8	100.0	99.6
11	99.4	100.0	100.0	100.0	99.9	99.7	100.0	90.6
12	100.0	100.0	100.0	100.0	100.0	100.0	100.0	98.3
13	98.5	100.0	100.0	100.0	100.0	100.0	100.0	92.6
14	100.0	100.0	100.0	95.6	99.1	87.2	100.0	100.0
15	99.0	100.0	100.0	0.0	100.0	100.0	100.0	100.0
16	63.5	66.7	66.7	57.7	64.0	13.4	66.7	66.7
17	100.0	100.0	100.0	99.3	99.4	98.2	100.0	99.9
18	99.4	100.0	100.0	99.9	100.0	100.0	100.0	99.6
19	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
20	100.0	100.0	100.0	98.5	100.0	100.0	100.0	99.6
21	99.7	100.0	100.0	99.2	99.9	99.9	100.0	98.9
22	99.8	99.8	100.0	98.7	100.0	100.0	100.0	100.0
23	94.2	100.0	100.0	100.0	100.0	100.0	100.0	100.0
ATR	**96.1**	**98.6**	**98.6**	**92.4**	**98.3**	**94.6**	**98.6**	**96.4**

Data Source	Arrival Systolic %	Arrival Total GCS %	Transport Mode %	Other Hospital Transfer %	Injury Time %	Arrival Date & Time %	Arrival Intubated %	LOS %	ICU LOS %
1	98.4	98.7	99.4	100.0	86.7	100.0	99.4	99.9	99.9
2	81.8	35.0	20.0	100.0	74.2	92.2	82.6	100.0	76.9
3	99.5	78.2	98.8	100.0	99.5	100.0	99.0	99.7	11.0
4	0.0	0.0	0.0	100.0	58.2	0.0	0.0	90.0	90.0
5	66.2	61.1	92.7	100.0	92.9	100.0	57.1	100.0	100.0
6	99.3	99.8	98.1	100.0	98.8	100.0	97.5	99.7	47.5
7	57.9	66.3	89.3	100.0	80.8	100.0	72.3	100.0	100.0
8	64.6	63.9	97.2	100.0	56.1	100.0	5.5	99.9	100.0
9	46.0	47.2	85.7	100.0	90.1	100.0	4.6	99.7	100.0
10	34.0	34.0	81.5	100.0	70.6	100.0	8.1	99.6	100.0
11	88.6	82.5	72.2	100.0	83.9	97.3	66.5	92.9	100.0
12	56.6	34.2	11.6	100.0	69.8	100.0	35.4	100.0	46.8
13	97.6	97.7	80.1	100.0	85.8	91.5	78.1	99.9	100.0
14	99.7	86.4	98.7	100.0	94.2	100.0	100.0	100.0	100.0
15	92.0	93.6	0.0	100.0	94.1	100.0	99.7	100.0	100.0
16	65.6	66.0	65.0	66.7	48.4	66.7	66.3	63.1	66.7
17	97.4	97.7	96.4	100.0	90.4	100.0	73.7	100.0	100.0
18	85.8	85.6	88.7	100.0	81.2	100.0	21.0	100.0	100.0
19	73.1	56.4	36.4	100.0	58.9	100.0	28.4	100.0	31.7
20	92.9	92.1	97.2	100.0	99.3	100.0	92.1	99.9	100.0
21	59.0	64.2	91.5	100.0	95.3	100.0	14.9	99.8	100.0
22	78.6	74.4	98.8	100.0	96.3	100.0	11.8	99.7	100.0
23	95.3	88.2	92.6	100.0	98.1	100.0	100.0	96.7	41.9
ATR	**75.5**	**70.2**	**73.4**	**98.6**	**82.8**	**93.1**	**57.0**	**97.5**	**83.1**

*Data source numbers have been randomly allocated and do not reflect the table in Appendix 5

Key:

100%	90-99%	50-89%	1-49%	0%

Data completeness

Table 18 shows the percentage completeness of a selection of data elements in the ATR used for this report. This data availability or 'heat map' was based on all available data that were not null and not default values, which had passed validation checks. Note that any data values that were coded as 'unknown' or 'unavailable' are deemed usable.

Data completeness varied greatly among the data items that were used in this report. In most cases, the information provided was of high quality. Data regarding the injury (injury type, intent, cause and severity) and demographics (age and gender) were generally well collected, available in more than 92% of cases. This summary table demonstrates that certain measures such as hospital transfers, length of stay and date of arrival were well recorded and reported, indicating their importance in monitoring the process of care and outcomes of trauma patients.

The least complete data were arrival intubation (57%) and vital signs such as SBP and GCS on arrival (70 to 76%). These data items are particularly useful in risk adjustment to benchmark performance between centres and over time. However, these data elements are difficult to collect, often requiring access to patients' medical records and clinical notes, resulting in low completion rates at local hospital registries.

This data completeness table shows that while reportable national trauma data is being collected by almost all hospital trauma registries there are still many aspects of data collection that could be improved. In the near future AusTQIP will assist designated trauma centres to strengthen the way they obtain and report this information by working together to achieve better completeness, standardise definitions and unify the way of how data is recorded and collected.

SECTION 8

FUTURE DIRECTIONS – BUILDING ON OUR POTENTIAL

Image courtesy of Ambulance Victoria

This is the first time we have had a detailed snapshot of major trauma care in Australia. It covers the years 2010 to 2012. It tells us many things about who is injured, how they are being injured, the nature of their injuries, what care they received, and the outcomes they experienced. It also tells us much about variations in presentation, processes of care, and in outcomes, between different trauma centres, and between different states and territories. This information will undoubtedly be of interest and useful to clinicians, managers, policy-makers around the country, and to the Australian community who bear the pain and the costs of severe injury.

Although comprehensive in its description of seriously injured Australians, this report provides a mere preview of what might be possible with a national dataset of this kind. The Australian Trauma Registry has great potential to:

- Provide tailored site specific reports that help individual designated trauma centres understand how the care they provide compares with national benchmarks.
- Support designated trauma centres that choose to participate in the Royal Australasian College of Surgeons Trauma Verification Program.
- Identify and prioritise opportunities to collaborate on improving trauma care through more in-depth and focussed data analyses.
- Expand our approach to performance comparison in trauma care in Australian designated trauma centres with a view to promulgating what works well and improving trauma care nationally. The intent of the AusTQIP collaboration is not to create a league table or score card system of designated trauma centres in Australia: our strong focus remains on improving survival for those who are seriously injured and giving them the best chance of recovering with a good quality of life.
- Apply risk adjustment methods to a wider range of variables to broaden the scope and utility of comparative measures.
- Develop measures (quality indicators) that can be nationally agreed and undertake the required research to ensure these measures are both valid and reliable.
- Apply health econometric methods to appropriate elements within the ATR dataset to more accurately demonstrate the true cost of trauma care and the financial value of trauma quality improvement and research efforts.
- Explore the possibility and value of data linkage with other national datasets.
- Support designated trauma centres and their health services to align trauma quality improvement and care processes to the appropriate National Safety and Quality Health Service Standards.
- Establish international benchmarking of performance with similarly established systems of trauma care. AusTQIP has already begun to explore the opportunities to gain a more detailed understanding about the processes and costs of care using this approach. On a global scale, it is possible to further learn about our own performance, when compared with other nations.
- Provide a platform to support and provide data in multi-centre collaborative research activities.
- Use the lessons learned to support other countries in developing their own systems of measuring and improving trauma care.

Through the AusTQIP collaboration, we will work with all stakeholders, including designated trauma centres themselves, governments, advocacy groups, professional colleges, including the RACS Trauma Verification Program, to promote better trauma care nationally.

Finally, the underpinning goal of AusTQIP, and the ATR, is to ensure that every severely injured patient in the future has the best chance of receiving optimal care. Data from the ATR will be essential to ensuring a state of the art, national quality improvement program in which we learn about what it is that high performing centres and services do differently, and employ ways of integrating the most effective practices. International experience tells us that, in doing so, the care provided at every centre is likely to improve.

That is our goal.

APPENDICES


PARAMEDIC
AMBULANCE
EMERGENCY
000
Image courtesy of Ambulance Victoria

APPENDIX 1

STATE AND TERRITORY BASED TRAUMA SYSTEM PROFILES AND CONTEXT

State	Land Area (km^2)[6]	Population Size[7]	Designated trauma centres	Major pre-hospital services	State Trauma Plan (or equivalent)	State and/or Hospital Trauma Registries
ACT	2,431	384,100	Canberra Hospital	ACT Ambulance Service Capital Region Retrieval Services	Works in synergy with NSW trauma system	Hospital based trauma registry
NSW	800,642	7,465,500	Children's Hospital at Westmead St George Hospital John Hunter Hospital John Hunter Children's Hospital Liverpool Hospital Royal North Shore Hospital Royal Prince Alfred Hospital St Vincent's Hospital Sydney Children's Hospital Westmead Hospital	Ambulance Service of NSW Capital Region Retrieval Services CareFlight Aeromedical and Medical Retrieval Service Newborn and Paediatric Emergency Transport Service Royal Flying Doctor Service	Selected Specialty and Statewide Service Plans Number Six (2009)	State trauma registry and some hospital based trauma registries
NT	1,349,129	242,200	Royal Darwin Hospital	CareFlight St John Ambulance NT Royal Flying Doctor Service	Works in synergy with AUSTRAUMAPLAN (2011)	Hospital based trauma registry
QLD	1,730,648	4,690,900	Royal Brisbane and Women's Hospital Princess Alexandra Hospital Mater Children's Hospital Royal Children's Hospital Brisbane Townsville Hospital Gold Coast University Hospital	Queensland Ambulance Service Retrieval Services Queensland CareFlight Royal Flying Doctor Service	A Trauma Plan for Queensland (2006)	Hospital based trauma registries and State trauma registry (disbanded mid-2012)
SA	983,482	1,677,300	Flinders' Medical Centre Royal Adelaide Hospital Women's and Children's Hospital	The SA Ambulance Service Inc. MedSTAR Royal Flying Doctor Service	Emergency and Trauma Services Implementation Plan (2000)	Hospital based trauma registries and state trauma registry (not currently operational)
TAS	68,401	514,000	Royal Hobart Hospital	Tasmanian Ambulance Service Tamanian Medical Retrieval Services	Works in synergy with Tasmanian Mass Casualty Management Plan (2010)	Hospital based trauma registry
VIC	227,416	5,791,000	The Alfred Royal Melbourne Hospital Royal Children's Hospital	Ambulance Victoria Adult Retrieval Services Victoria Paediatric Infant Perinatal Emergency Retrieval	Trauma towards 2014 – Review and future directions of the Victorian State Trauma System (2009)	State trauma registry and hospital based trauma registries
WA	2,529,875	2,550,900	Royal Perth Hospital Princess Margaret Hospital	St John Ambulance Australia (WA) Royal Flying Doctor Service	Trauma Systems and Services (2007)	Hospital based trauma registries

APPENDIX 2

THE AUSTQIP COLLABORATION AND PARTICIPATING STAKEHOLDERS

Designated trauma centres

Australian Capital Territory

- Canberra Hospital

New South Wales

- The Children's Hospital at Westmead
- John Hunter Hospital
- John Hunter Children's Hospital
- Liverpool Hospital
- Royal North Shore Hospital
- Royal Prince Alfred Hospital
- St George Hospital
- St Vincent's Hospital
- Sydney Children's Hospital
- Westmead Hospital

Northern Territory

- Royal Darwin Hospital

Queensland

- Gold Coast University Hospital
- Mater Children's Hospital
- Princess Alexandra Hospital
- Royal Brisbane and Women's Hospital
- Royal Children's Hospital
- Townsville Hospital

South Australia

- Flinders Medical Centre
- Royal Adelaide Hospital
- Women's and Children's Hospital

Tasmania

- Royal Hobart Hospital

Victoria

- The Alfred
- Royal Children's Hospital
- Royal Melbourne Hospital

Western Australia

- Princess Margaret Hospital for Children
- Royal Perth Hospital

State trauma registries

- New South Wales Institute of Trauma and Injury Management
- Queensland Trauma Registry (until June 2012)
- South Australian Trauma Registry (not currently operational)
- Victorian State Trauma Registry

Academic, government, professional and consumer organisations

- Australasian Trauma Society
- Australian Commission on Safety and Quality in Health Care
- Australian Defence Force
- Brain Injury Australia (representing consumers)
- Centre of National Research on Disability and Rehabilitation Medicine, The University of Queensland
- Monash University
- National Critical Care and Trauma Response Centre
- National Trauma Research Institute
- Royal Australasian College of Surgeons Trauma Committee

APPENDIX 3

AUSTQIP AND ATR GOVERNANCE STRUCTURE

AS AT 31 AUGUST 2014

AusTQIP Steering Committee

National Trauma Research Institute	Russell Gruen (Co-Chair)
Alfred Health Executive Sponsor	Mark Fitzgerald
National Critical Care and Trauma Response Centre Executive Sponsor	Bronte Martin
Consumer Representative	Nick Rushworth
Australian Defence Force	Michael Reade
Australasian Trauma Society	Anthony Joseph
New Zealand representative	Grant Christey
University representatives	Peter Cameron and Kate Curtis (Co-Chair)
Australian Commission on Safety and Quality in Health Care	currently vacant
Australian Trauma Quality Improvement Program	Nathan Farrow
Australian Trauma Registry	Meng Tuck Mok

State representatives

Queensland – Cliff Pollard
South Australia – Chris Clarke
Tasmania – Alicia Tucker
Australian Capital Territory – Rebekah Ogilvie
Victoria – Rodney Judson
New South Wales – Oran Rigby
Western Australia – Sudhakar Rao
Northern Territory – David Read

Management Committee

National Trauma Research Institute	Russell Gruen (Co-Chair)
University representative	Kate Curtis (Co-Chair)
Patient safety expert	Peter Cameron
Australian Trauma Quality Improvement Program	Nathan Farrow
Australian Trauma Registry	Meng Tuck Mok

International Liaison Advisory Group

National Trauma Research Institute	Russell Gruen
WHO Global Alliance for Care of the Injured	Gerard O'Reilly
United States of America	Avery Nathens
United Kingdom	Keith Willett
Canada	Tom Stelfox
Asia-Pacific Trauma Quality Improvement Network	Wittaya Chadbunchachai and Gerard O'Reilly
Europe (Utstein)	Kjetil Ringdal

Trauma Data Working Group

Australian Trauma Registry	Meng Tuck Mok (Group Leader)
Trauma dataset expert	Cameron Palmer
Registry methodologist	Gerard O'Reilly
Australian Trauma Quality Improvement Program	Nathan Farrow

State representatives

Queensland – Daryl Wall
South Australia – Debra Wood
Tasmania – Andrew Keygan
Australian Capital Territory – Rebekah Ogilvie and Kate Evans
Victoria – Sue McLellan
New South Wales – Elvis Maio
Western Australia – Maxine Burrell
Northern Territory – Kath McDermott

Trauma Quality Systems Working Group

Australian Trauma Quality Improvement Program	Nathan Farrow (Group Leader)
Quality systems expert	Cathy Balding and Marije Bosch
Human factors scientist	Stuart Dickinson and Elizabeth Grey
Australian Trauma Registry	Meng Tuck Mok

State representatives

Queensland – Kerena Grant
South Australia – Chris Clarke
Tasmania – Alicia Tucker
Australian Capital Territory – Rebekah Ogilvie
Victoria – Louise Niggemeyer, Kellie Gumm and Helen Jowett
New South Wales – Julie Evans or Angela Fischer, Sally Forrest-Horder, Alicia Jackson and Kevin Cornwall
Western Australia – Maxine Burrell
Northern Territory – Bronte Martin and Annette Holian

APPENDIX 4

MAJOR AUSTQIP MILESTONES

November 2010	Commencement of the AusTQIP program announced at NTRI's Annual Scientific Conference
August 2011	Relationships established at each designated trauma centre, including engagement with local clinicians and managers
October 2011	Comprehensive survey completed of centre- or state-based registry activities, data collection capabilities, and legal, ethical and practical issues involved in data transfer
	Publication of the *Bi-National Trauma Minimum Dataset (BNTMDS) Data Dictionary*
	Publication of report on *Baseline Audit of Trauma Quality Systems and Survey of Trauma Data Capabilities in Designated trauma centres*
March 2012	Commencement of ethics' applications and site specific governance agreements for 27 designated trauma centres
November 2012	Publication of *Progress Report 2011-2012*
	Commencement of consultations to establish Collaborative Agreement
December 2013	Completion of design, build and commissioning phase of the Australian Trauma Registry to world class security standards applicable to a clinical quality registry

April 2014	Ethics approval obtained from all research Ethics' Committees (jurisdictions) to allow data to be collected by the ATR
May 2014	Procedures for data conversion and mapping including importing interface developed from 12 disparate data sources
	Final execution of a single, legally-binding AusTQIP Collaboration Agreement by all participating health services. This agreement defines the precise terms under which all parties participate in the collaboration, including issues such as governance, resourcing, information sharing, data collection, data submission, quality monitoring, data use and approvals, disclosure and confidentiality, publication and authorship, ethics and training requirements.
	Finalisation of 27 Site Specific Agreements to support the Collaboration Agreement and allow commencement of data transfer
July 2014	Data successfully transferred from all centres and state-based registries for the years 2010 to 2012
August 2014	Site specific data cleaned, quality checks undertaken, data combined and analysed
October 2014	Inaugural Australian Trauma Registry Report (2010 to 2012) published

APPENDIX 5

ATR TRAUMA DATA SOURCES

For this report, the ATR received data files submitted by hospital based trauma registries or via state trauma registries as secondary data custodians, unless where indicated. In total, there were 23 hospital-based data sources/registries representing 25 major trauma services*.

State	Hospital Trauma Service Registry	State Registry
ACT	Canberra Hospital	
NSW	The Children's Hospital at Westmead John Hunter Children's Hospital John Hunter Hospital Liverpool Hospital Royal North Shore Hospital Royal Prince Alfred Hospital St George Hospital St Vincent's Hospital✣ Sydney Children's Hospital Westmead Hospital✣	New South Wales Institute of Trauma and Injury Management
TAS	Royal Hobart Hospital	
VIC	The Alfred Royal Children's Hospital Royal Melbourne Hospital	Victorian State Trauma Registry
NT	Royal Darwin Hospital	
QLD	Mater Children's Hospital Princess Alexandra Hospital Royal Brisbane and Women's Hospital Royal Children's Hospital	Queensland Trauma Registry◆
SA	Flinders Medical Centre Royal Adelaide Hospital Women's and Children's Hospital	
WA	Princess Margaret Hospital for Children Royal Perth Hospital	

*As at 31 August 2014, there are currently 27 Australian designated trauma centres. Townsville Hospital (Queensland) has not been included in this report due to the unavailability of a local data registry. Gold Coast University Hospital (Queensland) has only recently become a designated trauma centre and has not contributed data towards this report.

Note

✣ Data submitted directly by trauma service.
◆ Provided data from 2010 to 2011.

APPENDIX 6

BI-NATIONAL TRAUMA MINIMUM DATASET FOR AUSTRALIA AND NEW ZEALAND - CORE DATA ITEMS

(V.1.31, AUGUST 2013)

Institution	Date & Time of Arrival at Definitive Care Hospital
Trauma Number	Pulse on Arrival
Incident number	Systolic BP on Arrival
Date of birth	First Spontaneous Respiratory Rate
Age	Temperature on Arrival
Sex	GCS Eye on Arrival
Pre-injury Co-morbidities	GCS Voice on Arrival
Date & Time of Injury	GCS Motor on Arrival
Injury Cause	Total GCS on Arrival
Dominant Injury Type	CPR on arrival?
Postcode of Injury	Blood Transfusion on Arrival?
Injury Intent	Patient Intubated?
Place of Injury Occurrence	Date & Time Patient Intubated
Activity Engaged in when Injured	Respiratory Qualifier on Arrival
Injury Event Description	Blood Alcohol Concentration on Arrival
Safety Devices Used	First Measured Arterial Base Excess
Mode of Transport from Scene	First Measured INR
Date & Time of Ambulance Arrival at Patient	ED Discharge Date & Time
Transfer from Other Hospital?	Disposition After ED
Referring Hospital	Diagnosis made >24 hours after arrival?
Date & Time of Arrival at Referring Hospital	Date & Time CT Performed
Date & Time of Departure from Referring Hospital	CT type
Mode of Transport from Referring Hospital to Definitive Care Hospital	Operative Procedures in OR
Pre-hospital Blood Transfusion?	Operation Date & Time
Pre-hospital CPR?	Number of days on ventilator
Pre-hospital Cardiac Arrest?	AIS Injury Codes
First Pulse	Date & Time of Discharge from Definitive Care
First Systolic BP	Discharge Destination from Acute Care
First Spontaneous Respiratory Rate	Injury Severity Score
First Temperature	New Injury Severity Score
First GCS Eye	Length of Stay
First GCS Voice	Length of ICU Stay
First GCS Motor	Severe Complication?
First Total GCS	

Download the full data dictionary at www.austqip.org.

ABBREVIATIONS

AIS	Abbreviated Injury Scale 2005 (Update 2008)
ATR	Australian Trauma Registry
ATS	Australasian Trauma Society
AusTQIP	Australian Trauma Quality Improvement Program
Bi-NBR	Bi-National Burns Registry
BNTMDS	Bi-National Trauma Minimum Dataset of Australia and New Zealand
CONROD	Centre of National Research on Disability and Rehabilitative Medicine
ED	Emergency Department
ED LOS	Emergency Department Length of Stay
GCS	Glasgow Coma Scale
ICD-10-AM	International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification
ICU	Intensive Care Unit
ICU LOS	Intensive Care Unit Length of Stay
IQR	Interquartile Range
ISS	Injury Severity Score
ITIM	New South Wales Institute of Trauma and Injury Management
LOS	Length of stay
mmHg	Millimetres mercury
NCCTRC	National Critical Care and Trauma Response Centre
NTRC	National Trauma Registry Consortium
NTRI	National Trauma Research Institute
RACS	Royal Australasian College of Surgeons
QTR	Queensland Trauma Registry
SBP	Systolic Blood Pressure

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National Critical Care and Trauma Response Centre

AlfredHealth

ntri national trauma research institute

Further information about this report can be obtained from:

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