Department of Health

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Victorian State Trauma Registry 2008–09

Summary report

A Victorian Government initiative

Victorian State Trauma Registry
1 July 2008 to 30 June 2009

Summary report

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The Victorian State Trauma Registry is funded by the Department of Health and the Transport Accident Commission Health Research.

Published by the Victorian Government, Department of Health, Melbourne, Victoria.
Authorised by the State Government of Victoria, 50 Lonsdale Street, Melbourne.

This document is also available in PDF format on the internet at: www.health.vic.gov.au/trauma

November 2010 (1009030)

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Victorian State Trauma System

In 2009, the Department of Human Services undertook a review of the Victorian State Trauma System (VSTS) and looked at its future directions, the results of which were published in the report *Trauma towards 2014.* This report looks at a five-year strategic framework for the continued development of the VSTS. The key priorities for the next five years include meeting the education and training needs of the trauma workforce, reviewing the triage and transfer guidelines that underpin the system, and ensuring that rehabilitation services are integrated into the VSTS. One of the key factors underpinning the success of the VSTS is the quality data provided by the Victorian State Trauma Registry (VSTR), which is used to inform system improvements.

The system has resulted in improved survival rates following major trauma, which compare very favourably with international experience. In addition, Victorian trauma patients are spending less time in hospital and more are able to go home.

Victoria has one paediatric and two adult major trauma services (MTS) located within metropolitan Melbourne. Metropolitan trauma and metropolitan primary care services cover the greater metropolitan area. Within each of the five Department of Health regions in rural Victoria, a number of regional trauma, urgent care and primary care services exist. Each service is responsible for providing a staged level of patient care and ensuring major trauma patients receive definitive care, according to the trauma triage guidelines, at an appropriate trauma service within the system.

Austin Hospital provides specialist trauma care to isolated spinal-injured patients. St Vincent's Hospital provides specialist trauma care to patients with major hand or upper-limb trauma. Austin Hospital and St Vincent's Hospital also provide metropolitan trauma services within the system.

There are three hospitals that provide metropolitan neurosurgical services, other than the MTS; Austin Hospital, St Vincent's Hospital and Monash Medical Centre.

The trauma triage guidelines and a dedicated trauma advice and referral line initiative have been implemented to increase the proportion of major trauma patients treated at a MTS, thereby reducing patient mortality and morbidity.

Further information is available from www.health.vic.gov.au/trauma

Executive summary

The Department of Health (formerly the Department of Human Services) commissioned the Victorian State Trauma Registry (VSTR), in collaboration with the Transport Accident Commission Health Research. The aim of the VSTR is to collect information about all patients from every hospital and health care facility managing trauma patients in Victoria. The VSTR presents aggregate data for 2,646 major trauma patients treated at 138 hospitals during 2008–09.

Since complete coverage was obtained in 2005–06, there has been an increase in the number of hospitalised major trauma patients in Victoria from 2,194 in 2005–06 to 2,646 in 2008–09. The overall annual rate of hospitalised major trauma in Victoria was 49 per 100,000 population[1]. This has increased substantially from 2001–02 when the annual rate was 30 per 100,000 population. Part of the observed rise can be attributed to improved case identification and complete health service participation in the VSTR over recent years.

The death rate due to major trauma in Victoria in 2008 09 was 26.8 deaths per 100,000 population. This is an increase from 2005–06 when the annual rate was 21.1 per 100,000 population. Overall, 11.5 per cent of all major trauma patients died after arrival at hospital. During 2008–09, 84.5 per cent of all major trauma patients had an Injury Severity Score (ISS) greater than 15 (including those who died in hospital), and 11.2 per cent had a Glasgow Coma Score (GCS) less than nine, indicating severe head injury.

The 2008–09 data confirms that the trauma triage guidelines are being followed, with 82.9 per cent of major trauma patients receiving care at an appropriate trauma service. This includes 2.9 per cent at the Austin Hospital for specialised spinal care, and 2.8 per cent at a metropolitan neurosurgical service. The patterns of transfer across the system indicate patients were being transferred appropriately to a trauma service, based on the trauma triage guidelines.

Consistent with previous years, the major causes of all trauma deaths were transport related (23.6 per cent), falls (low and high – 20.7 per cent) and hangings (17.5 per cent). Due to the Victorian bushfires, there was an increase in deaths from burns (16.5 per cent compared to 3.4 per cent in 2007–08). The number of deaths due to transport-related incidents was lower than previous years. The number of deaths due to low falls has increased from 2006–07 and 2007–08.

The percentage of hospitalised major trauma patients related to low falls (24.6 per cent) in 2008–09 has risen from 19.6 per cent in 2005–06. The majority of low-fall patients (81.2 per cent) were aged over 55 years. Almost one third (31.9 per cent) of patients now sustain an isolated head injury, compared with 26.5 per cent in 2001–02. This is consistent with low falls now being the most common mechanism of injury, which account for almost half (49.7 per cent) of all isolated head injuries.

The Hume and Gippsland regions have the highest incidence of hospitalised major trauma patients in regional Victoria, and a large proportion of these are transport-related, which could be attributed to the major highways and large number of tourists passing through these areas. The Southern metropolitan area, followed by the North Western metropolitan area, has the highest rates of hospitalised major trauma patients in metropolitan Melbourne. The Southern metropolitan area includes Prahran and St Kilda, and the Western Northern metropolitan area includes the central business district. Both areas also have a higher proportion of assaults, compared with Hume and Gippsland regions, and the Eastern metropolitan area. The Eastern metropolitan area has a higher proportion of low falls, which are predominantly elderly patients.

[1] This rate is based on the Australian demographic statistics for 2009 of 5,427,700 (Australian Bureau of Statistics website 2010)

Overall, there has been a significant increase in the percentage of major trauma patients transferred to the hospital of definitive care directly from the scene, from 53.7 per cent in 2001–02 to 64.6 per cent in 2008–09, indicating a change in the transport of major trauma patients.

The follow up of major trauma patients who survive to hospital discharge, is a unique attribute of the VSTR. The long-term outcomes data provides critical information about the quality of survival of major trauma patients in Victoria, and the capacity to monitor the burden of major trauma over time. The outcomes reported here highlight particular patient groups at high risk of poor outcomes. In particular, compensable cases, women, assault victims, spinal-cord injuries (SCI), isolated orthopaedic cases and multi-trauma patients with associated head injury, were more likely to report poorer functional, pain and health-related, quality-of-life outcomes. Importantly, there is some evidence from the data collected that the quality of survival is increasing over time, despite a reduction in risk-adjusted mortality in Victoria.

The data presented in this, and previous, annual reports, is a reliable basis for monitoring the system and informing changes to the system, which have contributed to improved patient outcomes.

Victorian State Trauma Registry

The *Review of Trauma and Emergency Services – Victoria 1999* (ROTES report) recognised that an effective trauma system requires formal monitoring and feedback processes. It recommended that a state trauma registry be established to ascertain the effectiveness of the system, and to provide ongoing monitoring of major trauma patients.

The Department of Human Services, in collaboration with the Victorian Trauma Foundation (now Transport Accident Commission Health Research), commissioned the development of the VSTR in 2001.

The VSTR provides a mechanism to monitor the system to inform service provision and development, with an aim to reduce preventable deaths and permanent disability from major trauma. Changes to systems of care are monitored to ensure outcomes are improving, including the reduction in deaths and disability over time.

The Victorian State Trauma Outcome Registry and Monitoring (VSTORM) group (Appendix 1), based in the Department of Epidemiology and Preventive Medicine at Monash University, coordinates the VSTR.

The VSTR collects and analyses patient information from health services managing trauma patients across the state. In 2008–09, the VSTR collected information from 138 hospitals (Appendix 2).

What was achieved during 2008–09

Improvements in outcome measures

The long-term follow up of major trauma patients who survive to hospital discharge, is a unique attribute of the VSTR, and provides important information about the quality of survival of major trauma patients in Victoria. Over the past year, further validation projects have been completed to better inform the methodologies used. The VSTR now routinely follows up patients at 12 and 24 months after injury. Recently, the EQ-5D instrument has been added to the VSTR protocols to enable improved comparisons with burden of injury data internationally. Additionally, a study investigating the validity and utility of paediatric health-related quality of life and functional outcomes instruments has recently been completed. The results of this study will be used to implement routine follow up of paediatric major trauma patients in Victoria during 2009–10.

Quality assurance

A blind audit of 50 cases from the two adult MTS was conducted for patients with a date of injury from January 1 to March 31 2009. The criteria for case selection were:

- deaths with ISS less than 15
- LOS less than or equal to 6 days with ISS greater than 15
- Patients with an AIS 6 (ISS 75) who survived
- AIS/ICD code mismatch
- ISS 16 to 25, random selection.

The VSTORM data manager checked all audit AIS coding and the audit data will be compared with the data on the VSTORM database. Individual MTS audit reports will be prepared and a meeting will be organised with the respective trauma program managers, to discuss any differences identified and update procedures as necessary.

Feedback

Through a subcommittee of the State Trauma Committee (STC), the audit filters that have been implemented at regional health services are:

- transfer to a trauma service level with a lower designation, or transfer to a non-MTS hospital (excluding spinal patients transferred to Austin Hospital and elderly low falls with isolated head injury to Austin Hospital, Monash Medical Centre and St Vincent's)
- definitive care at a non-MTS hospital (excluding spinal patients at Austin Hospital and elderly low falls with isolated head injury at Austin Hospital, Monash Medical Centre and St Vincent's Hospital, and excluding elderly low falls with injury to one body region (apart from the head)
- transfer time greater than six hours from time of arrival at the first hospital, to time of arrival at the definitive hospital
- more than one transfer.

The subcommittee has reviewed regional cases across two years and is in the process of expanding into the metropolitan health services. Identified cases will be addressed with the relevant health services. The plan for this feedback process is:

- to advise the STC of cases which require quality review and referral back to the relevant health service
- for all health services to be contacted by the Department of Health to nominate a contact person to receive this feedback
- for trends and information on de-identified cases to be coordinated with the Quality, Safety and Patient Experience Branch, Department of Health, for inclusion within the RiskWatch newsletter.

Information dissemination

During 2008–09, 12 peer-reviewed journal articles were written based on VSTR data. Five were published in 2009, four have already been published in 2010, and another three are in press in 2010. A list of publications and presentations is provided after the reference list at the end of this report.

The VSTR received requests for data from external sources, including the MTS, metropolitan trauma services, Australian Red Cross Blood Services (ARCBS) and the Monash University Accident Research Centre (MUARC). External data requests are monitored by the VSTORM Steering Committee in line with VSTORM protocols. Regular quarterly reports were provided to the Transport Accident Commission allowing comparisons between transport and work-related trauma, and the general trauma population. No patient-level identifying data has been provided to third parties.

Data from the VSTR is also being used to guide improvements in methodologies for measuring the burden of injury through the Global Burden of Disease Injury Expert Group.

How does the Victorian State Trauma Registry operate?

The VSTR incorporates patient data from across the continuum of care, including pre-hospital services and post-discharge.

Eligible patients

To ensure the VSTR captures all major trauma patients in Victoria, broad-based inclusion criteria are used. The VSTR captures trauma patients whose principal diagnosis is injury, irrespective of age, and who meet any of the VSTR criteria (Table 1). The first four criteria are based on those recommended in the ROTES report. The remaining criteria are screening filters to capture the wider population of potentially major trauma patients.

Table 1. The Victorian State Trauma Registry patient inclusion criteria

1. All deaths after injury
2. All patients admitted to an intensive care unit or high-dependency area for more than 24 hours and mechanically ventilated after admission
3. Significant injury to two or more ISS body regions (corresponding to an abbreviated injury score (AIS) of greater than two, in two or more body regions) or an ISS greater than 15
4. Urgent surgery for intracranial, intra-thoracic or intra-abdominal injury, or fixation of pelvic or spinal fractures
5. Electrical injuries, drowning, asphyxia included if admitted to an intensive care unit with mechanical ventilation for longer than 24 hours
6. All patients with injury as principal diagnosis, whose length of stay is three days or more – unless they meet exclusion criteria
7. All patients with injury as principal diagnosis, transferred or received from another hospital for further emergency care, or admitted to a high-dependency area – unless they meet exclusion criteria

Specific exclusion criteria are listed in Table 2.

Table 2. The Victorian State Trauma Registry patient exclusion criteria

1. Isolated fractured neck of femur
2. Isolated upper-limb joint dislocation, shoulder girdle dislocation (unless associated with vascular compromise) and toe/foot/knee joint dislocation – unless meets inclusion criteria 1, 2 or 4
3. Isolated closed-limb fractures only (for example, fractured femur, Colles fracture) – unless meets inclusion criteria 1, 2 or 4
4. Isolated injuries distal to the wrist and ankle only (for example, finger amputations) – unless meets inclusion criteria 1, 2 or 4
5. Soft tissue injuries only (for example, tendon and nerve injury, and uncomplicated skin injuries) – unless meets inclusion criteria 1, 2 or 4
6. Burns to less than 10 per cent of the body – unless meets inclusion criteria 1, 2 or 4
7. Isolated eyeball injury

Data capture

Data coordinators collect data at the MTS, metropolitan trauma services and metropolitan primary care services. Regional trauma data collection is the responsibility of regional trauma coordinators employed in each of the five regional areas: Barwon-South West, Gippsland, Grampians, Hume and Loddon-Mallee.

In-hospital flagging systems have been established to identify eligible patients. Data coordinators at the three MTS prospectively identify trauma patients by daily checking the hospital information system, emergency department admission records, intensive care unit admission records and ward rounds, with the trauma service. Metropolitan data collectors and regional trauma coordinators undertake retrospective data collection. Regional trauma coordinators have established individual flagging mechanisms in their hospitals of responsibility, and are notified when a regional hospital receives a trauma patient.

Trauma patients are identified by manually checking emergency department registries, by checking intensive care unit registries, or by retrospectively running reports using VAED ICD-10 codes to identify patients with injury as their principal diagnosis. These reports are set up to include length of stay, intensive care unit admission, and outcome (to identify transfers and deaths).

Data is extracted from the medical records maintained at the facilities that provided care to a major trauma patient.

Methodology for National Coroners Information System data

By running five queries based on the notification and completion types of 'Death due to external causes', 'Still enquiring' and 'Unlikely to be known', data capture is limited to those incidents in Victoria with deaths in 2008–09.

From the extracted data, the excluded injury types are:

- fractured neck of femur/fractured hip
- airway obstruction by foreign body
- asbestosis
- carbon monoxide/helium gas poisonings
- drug/alcohol overdose
- malignancy
- medical/surgical complications
- other non-traumatic incidents.

The National Coroners Information System (NCIS) number, patient's age, patient's gender, case status, case type, case intent, medical cause of death and mechanism are extracted. For those who meet the trauma criteria, an injury type (for example, transport-related, hanging, low fall) is assigned. Transport-related incidents include motor vehicle crashes – driver/passenger, motor bicycle crashes – rider/pillion passenger, pedestrians, cyclists, train incidents, and motorised scooters involved in collisions. Asphyxia includes suffocations and strangulations. 'Other' injury types include machinery (including tractors), electrocution, aviation, skiing and surfing incidents.

Victoria experienced a severe bushfire disaster on Saturday, 7 February 2009. According to Victorian Police reports, 173 people died during these bushfires. Open coroners' cases with a date of death of February 7 2009, and a postcode of death in these bushfire areas, were classified 'Burns – Bushfire' and included in the burns group. Deaths from the VSTR are matched with those extracted from the NCIS database. The database is then searched for VSTR cases not on the extracted list, by matching date of death, patient's age, gender, residential address and injury type.

Victorian State Trauma Registry training

Formal training sessions and workshops are conducted regularly to ensure data is collected in a standardised format. This includes training in VSTR procedures, data collection and extraction processes, and definitions of data variables. Data collectors are able to attend an AIS course, which is coordinated by the Department of Epidemiology and Preventive Medicine at Monash University, and the National Trauma Research Institute.

Victorian State Trauma Registry data quality assurance

Automated and manual procedures are in place to ensure that data captured is as complete and accurate as possible, through quality-control measures and data-validation rules.

Injury data: To ensure consistency, the codes for human intent, injury cause, activity, place and type, are manually cross-checked with the text being used to describe the 'incident details'.

Date/time sequence: Date/time validation checks have been built into the web-based database.

The date and time of injury must precede the date and time of admission. The date and time of the ambulance call, time to arrive at the scene, time to depart and time to arrive at hospital, must be entered in the correct sequence. If the patient is transferred through to another designated trauma service level, the dates and times of the transfer must also be entered in the correct sequence.

Clinical data: Surgery and intervention codes are checked against the description and corresponding injuries. The accuracy of the AIS code for each individual injury is also checked against the injury description.

Manually collected data is checked for completeness and accuracy before being entered. Each data collector is provided with a feedback list of common mistakes and known data collection issues, and advice on how to correct these. Validation checks are built into the web-based database to ensure clinical values are within acceptable ranges. Calculation of functional measure scores (FMS) and GCS are automated, so that known component scores are summed. Patients with missing transfers are included in the list of patients able to be viewed at each health service site, ensuring a more prompt response by that health service.

Following data entry, and prior to reporting, further data verification procedures are performed to identify extreme values that lie outside the normal range.

Checks are performed to ensure the capture of major trauma patients with participating health services. Capture-recapture methods are used to cross-reference different data sources. For example, the VSTR death records are compared to those recorded by the NCIS based at the National Coroners Information Service and the Registry of Births, Deaths and Marriages. Pre-hospital data is received from the Victorian Ambulance Clinical Information System to enable cross-checking with the VSTR.

Follow up: Follow ups are performed six and 12 months following injury to help identify patients who have died post-discharge, and to quantify their level of function, work disability and health-related quality of life at these time points. If patients are unable to be contacted, their records are checked against the Registry of Births, Deaths and Marriages.

Patient confidentiality

The VSTR was established under the guidelines of the National Health and Medical Research Council to ensure the confidentiality and privacy of patients is maintained at all times. Ethics committee approval was obtained from each hospital and health service before any data on trauma patients was collected (Appendix 2). Approval was obtained from the ethics committees of the Department of Human Services, Monash University and the National Coroners Information Service.

In accordance with the National Health and Medical Research Council guidelines, all records (hard copy and electronic) are securely stored and accessible only by authorised VSTR staff.

How many major trauma patients were there?

This section provides information about the number of major trauma patients (both patients reaching hospital and deaths at the scene of injury) in Victoria during 2008–09.

Victorian State Trauma Registry coverage

Data is collected from all health services. Coverage has been complete since the inclusion of St Vincent's and Eastern Health in 2005–06, adding 100–150 patients per year.

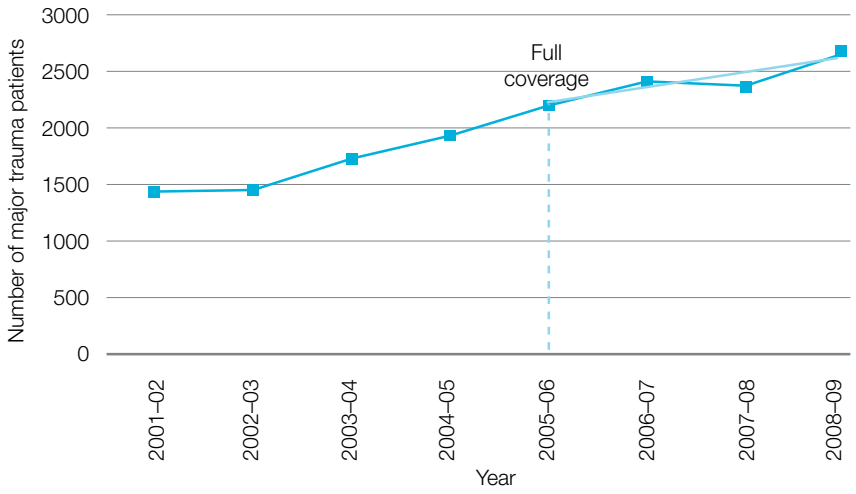
Major trauma patients

The VSTR recorded 2,646 hospitalised major trauma patients in Victoria over the 12-month period. This is an increase from 2,379 in 2007–08. The number of major trauma patients for each year is shown in Figure 1. The overall annual rate of hospitalised major trauma in Victoria was 49 per 100,000 population[2], compared to 44 in 2007–08, 46 in 2006–07 and 42 in 2005–06. Since 2001–02, there has been an average annual increase in the rate of hospitalised major trauma of 8.0 per cent (IRR 1.08, 95% CI: 1.06, 1.10, p<0.001). Since 2005–06, the first year of complete coverage, there has been an annual increase in the rate of hospitalised major trauma of 4.0 per cent (IRR 1.04, 95% CI: 1.01, 1.06, p=0.002).

Key indicator 1 – Number of hospitalised major trauma patients

The VSTR recorded 2,646 hospitalised major trauma patients in Victoria over the 12-month period. This is an increase from 2,379 in 2007–08.

Figure 1: Trends in the number of hospitalised major trauma patients recorded by the Victorian State Trauma Registry



[2] This rate is based on the Australian demographic statistics for 2009 of 5,427,700 (Australian Bureau of Statistics website 2010)

Episodes of care

The 2,646 patients required a total of 3,529 hospital care episodes. The average number of total hospital care episodes has remained stable over the eight-year period. The majority (n=1812, 68.4 per cent) had only one episode of care, 785 (29.7 per cent) experienced two episodes of care, and 49 (1.9 per cent) patients had three episodes of care. Thirty-nine per cent of patients (1,036 patients) required an intensive care unit admission. Twenty-nine per cent of patients (765 patients) had an intensive care unit stay of more than 24 hours and required mechanical ventilation.

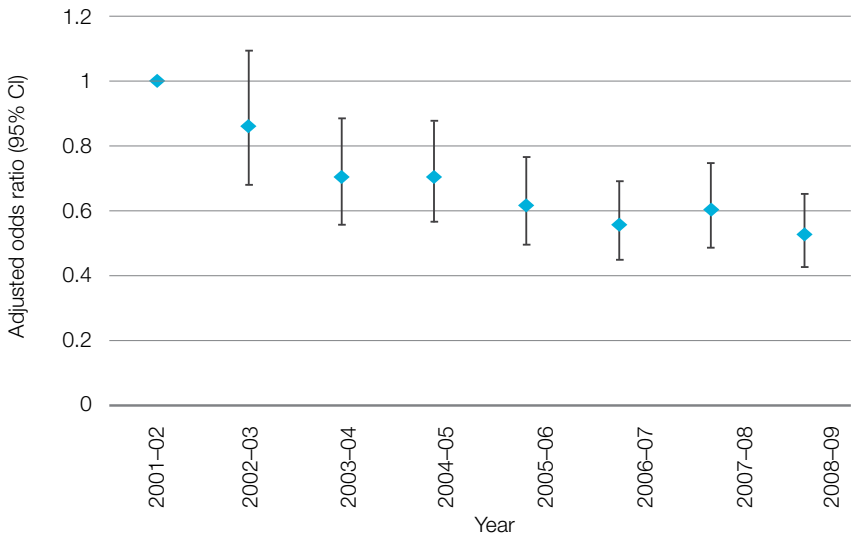
Deaths

Overall, the VSTR recorded 304 deaths, corresponding to a death rate of 11.5 per cent among hospitalised major trauma patients.

Key indicator 2 – Death rates (Overall and hospitalised major trauma)

The overall death rate due to major trauma in Victoria was 26.8 deaths per 100,000 population, and this is an increase from 21.1 per 100,000 in 2005–2006. The incidence of hospitalised major trauma deaths was 5.6 per 100,000 population (20.9 per cent of all trauma deaths)[3]. The death rate for hospitalised major trauma patients was 11.5 per cent.

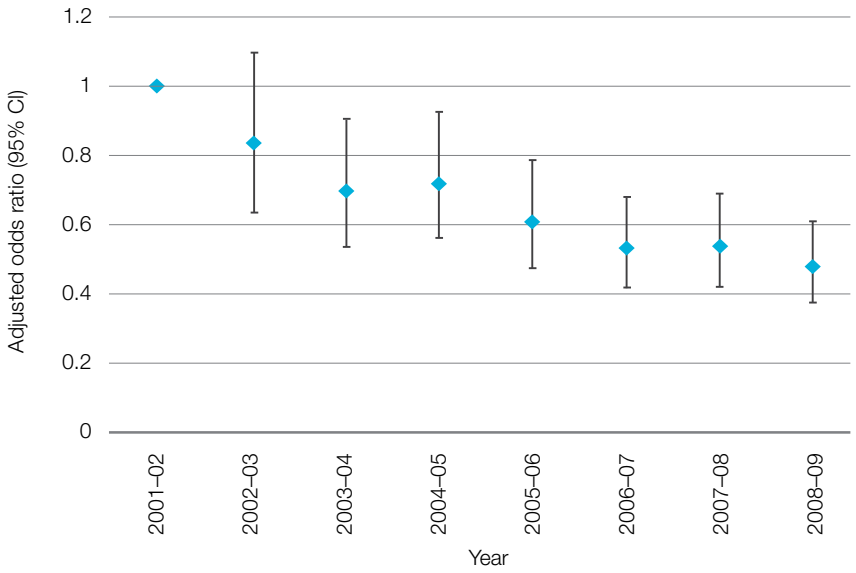
Figure 2a: Trends in the odds of in-hospital death of major trauma patients adjusted for age, ISS, head injury and mechanism



The percentage of hospitalised major trauma patients who died during their hospital stay, with an ISS greater than 15, has fallen from 14.9 per cent in 2001–02 to 9.6 per cent in 2008–09. Figure 2b shows the adjusted risk of mortality for hospitalised major trauma patients with an ISS greater than 15.

[3] This rate is based on the Australian demographic statistics for 2009 of 5,427,700 (Australian Bureau of Statistics website 2010)

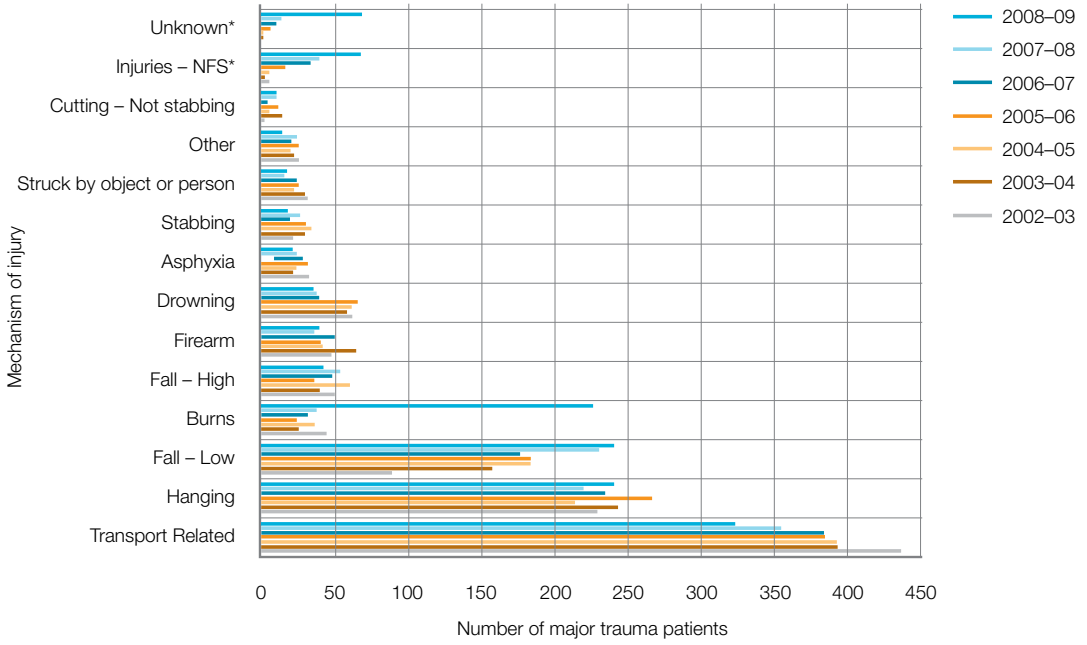
Figure 2b: Trends in the odds of in-hospital death of major trauma patients with ISS greater than 15, adjusted for injury severity, age and head injury



The NCIS was accessed to ascertain the total number of trauma-related deaths in Victoria. The NCIS recorded 1,338 trauma deaths (excluding deaths following fractured neck of femur) during 2008–09 in Victoria. The coronial investigation was closed (completed) for only 41 per cent of these deaths. Despite the increased coroner's workload due to the Victorian bushfires, the percentage of closed cases for 2008–09 is higher than for the previous year (35 per cent in 2007–08). As a result, 9.9 per cent of the trauma cases did not have a specified mechanism of injury, limiting the ability to provide accurate mechanism of injury trends. Of the 304 deaths recorded by the VSTR, 226 (74 per cent) were reported in NCIS (36 were classified as death due to natural cause). Of the remaining 78 deaths recorded by the VSTR, 64 were elderly or had significant comorbidity, and experienced low falls.

The estimated number of trauma deaths in Victoria, at the scene or in hospital, was 1,452 cases; 1,374 on the NCIS (36 not identified as trauma) and 78 cases recorded in the VSTR, but not found in the system. This is an increase from previous years (1,127 in 2002–03, 1,147 in 2003–04, 1,141 in 2004–05, 1,186 in 2005–06, 1,162 in 2006–07 and 1,194 in 2007–08).

Figure 3: National Coroners Information System trauma deaths (2008–09 n=1374)



* Unknown = unknown cause of death. Injuries – NFS includes deaths as a result of injuries with mechanism not further specified.

Consistent with previous years, the major causes of death were transport-related (23.6 per cent), falls (low and high – 20.7 per cent) and hangings (17.5 per cent). Due to the Victorian bushfires, there was an increase in deaths from burns (16.5 per cent compared to 3.4 per cent in 2007–08). The number of deaths due to transport-related incidents was lower than previous years. The number of deaths due to low falls has increased from 2006–07 and 2007–08. There has been an increase in hangings compared to 2007–08 (240 compared to 221), but the number of hangings is similar to 2006–07 (235). Of the hangings with known intent, the percentage of intentional self-harm cases has remained consistent over the eight years, with 98.4 per cent in 2008–09.

As most of the patients who die from hanging, drowning or asphyxia do not reach hospital alive, these cases will generally not be included on the VSTR (only 12 attempted hangings were recorded in 2008–09). The low number of stabbings in the NCIS database is consistent with the low numbers in the VSTR. The number of deaths from stabbings for 2008–09 was lower than previous years (19 in 2008–09, 27 in 2007–08, 20 in 2006–07 and 31 in 2005–06).

The total number of paediatric (aged zero to 14 years) deaths remains consistently low with 45 in 2002–03 and 35 in 2008–09. There has been a decrease in the number of paediatric deaths resulting from transport-related incidents, from 20 in 2002–03 to 10 in 2008–09. The number of drownings is consistent with previous years, varying from six in 2002–03 to five in 2007–08.

Reason for inclusion in the Victorian State Trauma Registry

A hierarchical classification is used for patients meeting the major trauma definition for VSTR inclusion. Patients are only counted once and the hierarchical order is:

- death
- ISS greater than 15
- intensive care unit stay greater than 24 hours requiring mechanical ventilation
- urgent surgery.

For example, if the reason for a patient being classified as a major trauma patient is death, then that person is not counted within the 'ISS greater than 15', 'intensive care unit stay greater than 24 hours with mechanical ventilation' or 'urgent surgery' reason classifications, even if these criteria are also met.

For 2008–09, the distribution of the 2,646 VSTR patients according to this hierarchical classification was that:

- 11.5 per cent of patients died[4]
- 76.4 per cent of patients had an ISS greater than 15
- 5.5 per cent of patients spent more than 24 hours in an intensive care unit with mechanical ventilation
- 6.6 per cent of patients required urgent surgery.

[4] Of these, 74.7 per cent had an ISS greater than 15, an intensive care unit stay greater than 24 hours requiring mechanical ventilation, or required urgent surgery.

Demographic profile of hospitalised major trauma patients

The gender distribution of hospitalised major trauma has remained stable over the eight years of VSTR operation, with males accounting for 73 per cent of cases in 2001–02 and 71 per cent of cases in 2008–09. This is consistent with global figures, which indicate that the greatest burden of injury is borne by males (Mathers et al. 2006).

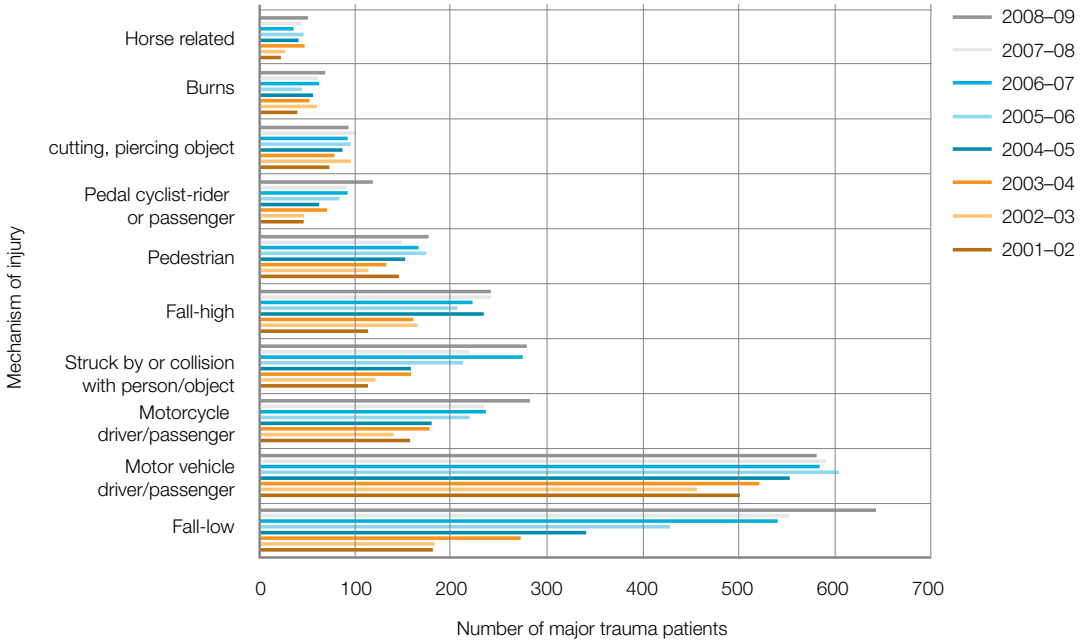
Whilst major trauma cases are typically young (46 per cent are aged 15–44 years), consistent with global burden of disease figures (Mathers et al. 2006), this has declined from 56.9 per cent in 2001–02 and 50.1 per cent in 2005–06. There has been a substantial increase in the population aged 75 years and over, from 10.3 per cent in 2001–02 to 19.1 per cent in 2008–09. This demographic change could be explained by the improved coverage of the VSTR, improvements in case identification at each health service, changes in approaches to diagnosis and management in the elderly, and an ageing population. The percentage of paediatric (aged zero to 14 years) major trauma patients remains low, at 5.5 per cent.

What are the causes and locations of the events leading to a major trauma?

The 10 most common mechanisms of injury are shown in Figure 4. Together, these accounted for 96.8 per cent of all major trauma patients. The percentage of transport-related major trauma remains stable, 45.5 per cent in 2006–07, 45.7 per cent in 2007–08 and 45 per cent in 2008–09. Motor vehicle drivers accounted for 14.7 per cent of patients. These motor vehicle drivers were most commonly male (68.5 per cent of all injured drivers) and in the age group 15–24 years (28.9 per cent of all injured male drivers). Other mechanisms of road trauma were also common, consistent with a road, street or highway being the most common location of injury. There has been a decrease in the percentage of hospitalised major trauma patients resulting from a motor vehicle, from 27.7 per cent in 2005-06 to 22.2 per cent in 2008–09.

The percentage of hospitalised major trauma patients related to low falls (24.6 per cent) in 2008–09 has risen from 19.6 per cent in 2005–06. The majority of low-falls patients (81.2 per cent) were aged over 55 years. At the broad population level, low falls in older people commonly result in a fractured neck of femur; however, the VSTR excludes patients with a fractured neck of femur as their sole injury, and only 11 of the older-falls patients had this injury in combination with other injuries.

Figure 4: The most common mechanisms of injury of hospitalised Victorian major trauma patients



The most common location for the event leading to major trauma was a road, street or highway (47.8 per cent of all major trauma patients with a known location). The home was the next most common location of injury (26.7 per cent). The majority of at-home injuries were the result of a fall (74.6 per cent). Workplace settings (including farms) were a small, but significant, location of injury (9 per cent of all patients).

Transport Accident Commission compensable patients

Information was obtained from hospital records about whether or not the patient was likely to be able to claim trauma care costs from the Transport Accident Commission. Overall, 36.7 per cent of patients were likely to be Transport Accident Commission compensable. This percentage is consistent with the proportion of transport-related trauma patients (44.9 per cent).

Almost 95 per cent (94.2 per cent) of Transport Accident Commission compensable patients received their definitive care at a MTS, or the Austin Hospital for spinal care. This has increased from 84.4 per cent in 2001–02 and 91.8 per cent in 2005–06. This is expected, given that the trauma triage guidelines suggest a low threshold for transfer to a MTS in cases involving a high-speed mechanism, despite the mechanism of injury not being a reason for transfer in itself.

Injury intent

Overall, 87.6 per cent of major trauma patients with a known intent sustained their injuries during unintentional events. This is higher than the 80 per cent reported for the United States (American College of Surgeons 2005) but 1.9 per cent lower than 2001–02. Intentional self-harm accounted for 2.8 per cent of all patients in 2008–09 and has remained stable since 2001–02, where 3.5 per cent of hospitalised major trauma patients were the result of intentional self-harm. This reflects the fact that while intentional self-harm causes many deaths (Steenkamp 2000), major injury from self-inflicted mechanisms requiring hospital care is relatively uncommon.

There has been an increase in the percentage of hospitalised major trauma patients injured as a result of an assault, from 6.5 per cent (n=89) in 2001–02 (O'Mullane 2009), to 9.3 per cent (n=241) in 2008–09.

Time and day of injury

Consistent with previous years, injuries occurred more frequently on weekends, particularly Saturday (19.2 per cent of all patients). Injuries were also more common during the hours from 8 am to 4 pm (41.1 per cent of all patients). This is consistent with previous years.

Key indicator 3 – Time and day of injury

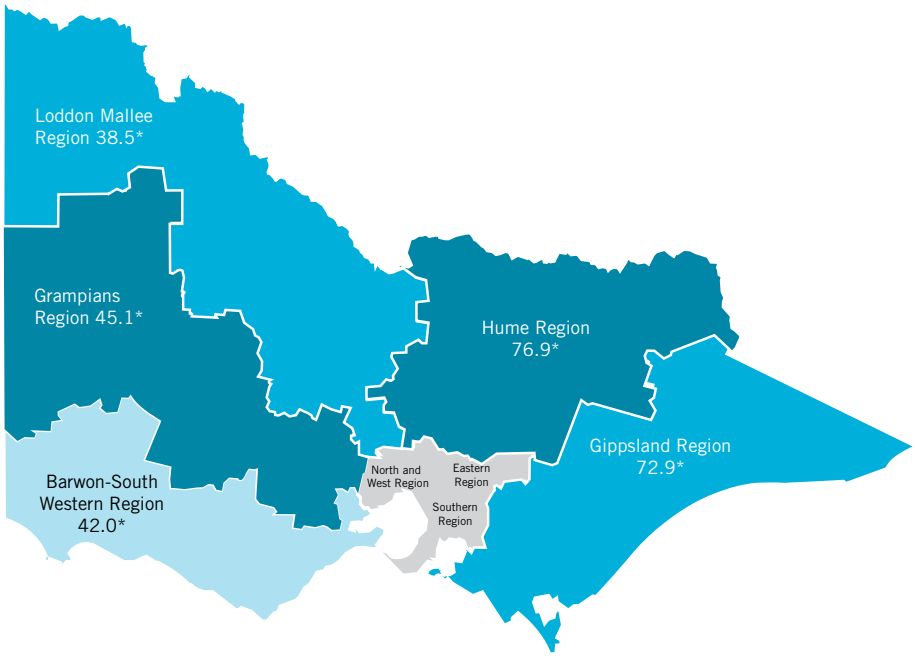
Injuries were most common on the weekends and during the hours from 8 am to 4 pm.

Location of trauma injury

Table 3 shows that injuries occurring in the Hume and Gippsland regions had the highest incidence of hospitalised major trauma patients in regional Victoria, with rates of 76.9 and 72.9 per 100,000 respectively. A large proportion (55.4 per cent and 51.4 per cent) of these injuries was transport-related, as shown in Table 4. This could be attributed to major highways and the large number of tourists who pass through these areas.

Table 5 shows that the Southern metropolitan area, followed by the North Western metropolitan area, had the highest rates of hospitalised major trauma patients in metropolitan Melbourne (54.3 and 38.4 per 100,000 respectively). The Southern metropolitan area includes Prahran and St Kilda, and the Western Northern metropolitan area includes the central business district and Docklands precinct. Table 6 shows the lower proportion in metropolitan Melbourne. There is a similarity in transport-related trauma between Southern (42.9 per cent) and North Western metropolitan (42.6 per cent). Both areas also had a higher proportion of assaults (9.3 per cent and 9.1 per cent respectively) compared with Hume and Gippsland regions (4.7 per cent and 4 per cent) and the Eastern metropolitan area (4.1 per cent). The Eastern metropolitan area has a higher proportion (36.5 per cent) of low falls, predominantly elderly major trauma patients.

Figure 5: The incidence of hospitalised major trauma patients in each region of Victoria



* Rates are per 100,000 population

Table 3: Incidence of hospitalised major trauma patients in each region of Victoria

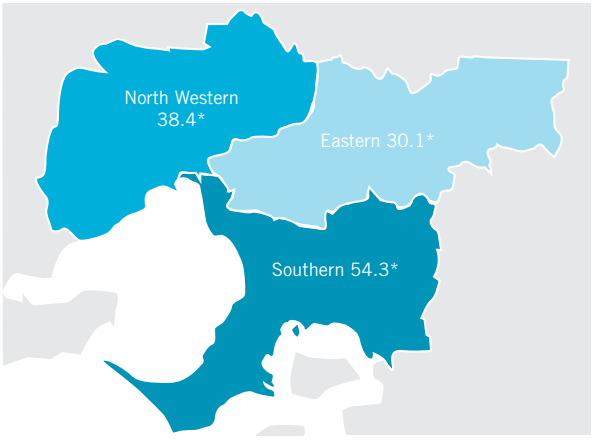
Region[5]	Rates per 100,000 population (adjusted per year)				
	2004–05	2005–06	2006–07	2007–08	2008–09
Loddon Mallee	42.9	41.0	49.8	34.1	38.5
Grampians	39.4	41.2	48.8	34.7	45.1
Hume	60.0	53.0	56.2	56.6	76.9
Barwon-South West	28.0	29.0	38.8	35.7	42.0
Gippsland	57.0	57.5	72.1	65.9	72.9

[5] The injury location was not known for 290 cases

Table 4: Breakdown by cause of injury in each region of Victoria for 2008–09

Region	Percentage				
	Transport-related	Low falls	High falls	Assault stabbing firearm	Other
Loddon Mallee	50.4	18.6	3.5	8.8	18.6
Grampians	48.9	20.2	10.6	4.3	16.0
Hume	55.4	16.6	5.2	4.7	17.6
Barwon-South West	51.0	14.7	10.5	7.7	16.1
Gippsland	51.4	16.6	9.7	4.0	18.3

Figure 6: The incidence of hospitalised major trauma patients in each region of metropolitan Melbourne



* Rates are per 100,000 population

Table 5: Incidence of hospitalised major trauma patients in each region of metropolitan Melbourne

Region	Rates per 100,000 population (adjusted per year)				
	2004–05	2005–06	2006–07	2007–08	2008–09
North Western metro[6]	28.9	35.6	35.8	39.3	38.4
Eastern metro	19.5	22.3	28.7	32.3	30.1
Southern metro	33.2	37.4	43.7	46.0	54.3

Table 6: Breakdown by cause of injury in each region of metropolitan Melbourne for 2008–09

Region	Percentage				
	Transport-related	Low falls	High falls	Assault stabbing firearm	Other
North Western metro	42.9	24.6	10.8	9.1	11.4
Eastern metro	41.3	36.5	10.2	4.1	6.8
Southern metro	42.6	27.5	9.8	9.3	10.0

[6] Includes Melbourne Central Business District

Trauma profile

Type of trauma

Traumatic injury is classified into blunt, penetrating or burn injury types, based on the mechanism of injury. The majority of patients captured by the VSTR were in the blunt trauma category (92.5 per cent). Penetrating injuries were sustained by 4.1 per cent of patients, and burns by 2.7 per cent of patients. This has remained unchanged across all years of VSTR data collection.

Injuries sustained

Table 7 shows the trend in injuries sustained by major trauma patients. Almost one third (32 per cent) of patients sustained an isolated head injury, compared to 26.6 per cent in 2001–02. This is consistent with low falls now being the most common mechanism of injury, accounting for almost half (49.7 per cent) of all isolated head injuries in 2008–09. In contrast, the percentage of patients sustaining an orthopaedic and/or other injuries, in addition to a head injury, has fallen from 20.1 per cent in 2001–02 to 18.2 per cent in 2008–09. This is consistent with the fall in motor vehicle crashes, which were the predominant mechanism of injury (32.5 per cent) of these two injury groups combined in 2008–09. Motor vehicle crashes are also the most common mechanism of injury for isolated chest/abdominal injuries, accounting for 25.2 per cent. Consistent with the fall in motor vehicle crashes, isolated chest/abdominal injuries have fallen from 19.4 per cent in 2001–02 to 17.7 per cent in 2008–09.

Table 7: Trend in injuries sustained

Injury group	Percentage of major trauma patients								Total
	2001–02	2002–03	2003–04	2004–05	2005–06	2006–07	2007–08	2008–09	
Isolated head	26.6	26.0	25.8	28.0	27.9	31.2	30.6	32.0	**28.9**
Isolated chest/ abdomen	19.4	18.5	17.5	18.1	19.7	16.4	19.7	17.7	**18.3**
Head/ orthopaedic/other	16.3	14.0	14.3	13.4	12.1	16.5	13.8	13.6	**14.2**
Isolated orthopaedic	10.7	11.4	12.4	11.2	12.3	8.3	9.6	9.3	**10.5**
Head/orthopaedic only	3.9	5.0	4.7	3.7	3.5	5.0	3.9	4.6	**4.3**
Spinal cord injury	4.8	4.1	3.8	3.9	3.3	2.9	3.0	2.3	**3.4**
Burn	2.6	4.3	3.0	2.9	2.0	2.7	2.7	2.7	**2.8**
Other/multi	15.7	16.7	18.6	18.8	19.2	17.0	16.7	17.8	**17.7**

Isolated head includes a head injury with AIS severity of three or more, and no other injury with AIS severity of two or more. Head/orthopaedic/other includes a head injury in addition to another injury, other than orthopaedic. Other/multi trauma includes everything that does not fit into one of the other groups.

Injury severity

Key indicator 4 – Overall injury severity

Of all major trauma patients, 84.5 per cent had an ISS greater than 15.

Overall, 84.5 per cent of major trauma patients had an ISS greater than 15, compared to 80.1 per cent in 2005–06. In 2008–09, the median ISS for definitive care at an appropriate trauma service was 21, and the median ISS for the non-MTS hospitals was 17. The median ISS was similar to previous years.

Head injury severity

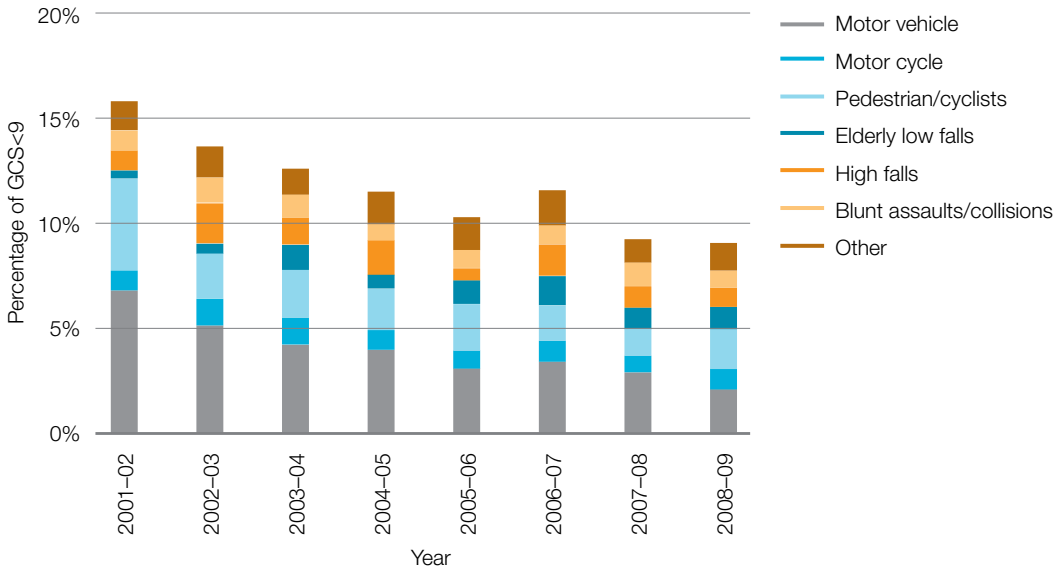
The median (range) GCS on arrival at an emergency department was 15 (3–15). Figure 7 shows that the percentage of patients with a serious head injury (AIS head injury severity greater than two and GCS less than nine on arrival at an emergency department) has fallen significantly from 15.8 per cent in 2001–02 to 9.1 per cent in 2008–09. The decrease in GCS for both car accidents and falls suggests a change in pattern of injury that will require further investigation. The inclusion of patients from smaller health services, and the inclusion of more elderly low-falls patients with subdural haemorrhages due to improved case detection, can account for some of this change.

Figure 7 also shows that the mechanism of injury has changed for this group of patients. Motor vehicle crashes accounted for only 23 per cent in 2008–09, compared with 43.1 per cent in 2001–02 and 30.1 per cent in 2005–06. Pedestrians and pedal-cyclists comprised 20.4 per cent and motor cycles 11.1 per cent of the head-injured group. Whilst the percentage of serious head injury cases sustained by elderly patients in a low-falls mechanism has increased from 2.4 per cent in 2001–02 to 11.1 per cent in 2005–06 and 11.9 per cent in 2008–09, they account for a relatively low proportion of this group of patients, compared with the major trauma population overall.

Key indicator 5 – Head injury severity

Of all major trauma patients, 9.1 per cent had a GCS less than nine and an AIS head injury severity greater than two.

Figure 7: Percentage of patients with a serious head injury (AIS greater than two and GCS less than nine) by mechanism of injury



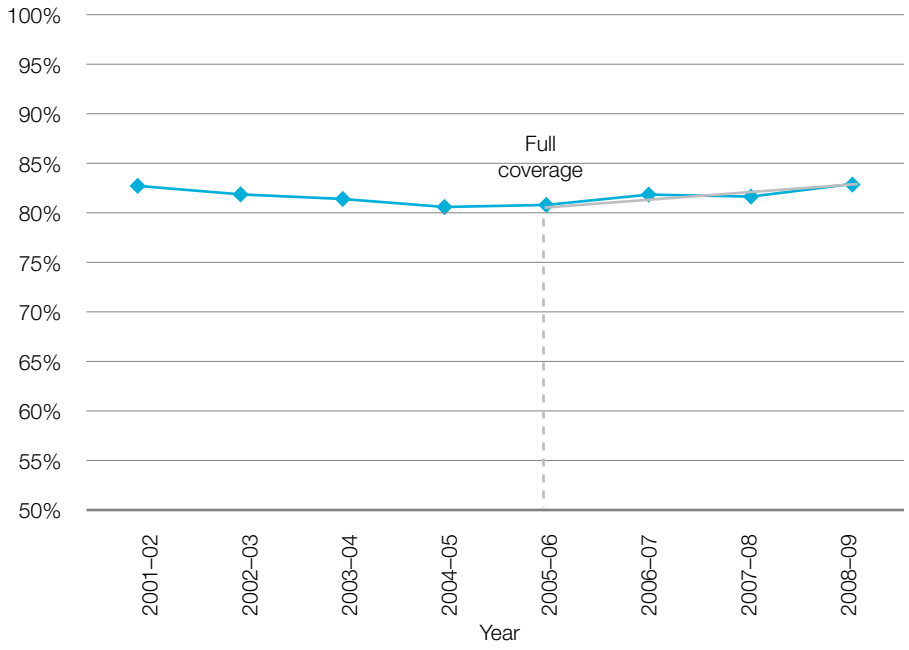
How were the patients distributed?

The majority of patients continued to receive their definitive care at an appropriate trauma service based on the trauma triage guidelines. Definitive care at an appropriate trauma service occurred for 83 per cent of patients in 2008–09, compared with 81 per cent in 2005–06 when full coverage was achieved. The 2008–09 figures include 2.9 per cent of patients definitively managed at the Austin Hospital for specialised spinal care, and 2.8 per cent who were elderly patients with an isolated head injury as the result of a low fall, and received appropriate treatment at a metropolitan trauma service with neurosurgical capabilities.

Key indicator 6 – Definitive trauma service level

83 per cent of patients received their definitive care at an appropriate trauma service.

Figure 8: Trends in appropriate trauma service



Appropriate trauma service includes MTS, Austin Hospital spinal patients and metropolitan neurosurgical services (MNS) = Austin Hospital, Monash Medical Centre, St Vincent's Hospital

Patient triage and transportation

This section describes transportation and transfers across the system.

Direct admissions and transfers to MTS

Table 8 describes the origin of patients admitted to an appropriate trauma service level. At the Royal Melbourne Hospital and The Alfred, direct admissions from the scene of injury were more common than referrals from another hospital. In contrast, transfers to The Royal Children's Hospital from a referral hospital were more common than patients being admitted directly from the scene of injury. The latter observation is as expected, given the trauma triage guidelines for paediatric trauma.

The percentage of patients transported directly from the scene to The Alfred has increased from 60.6 per cent in 2001–02 to 65.9 per cent in 2008–09. The percentage of patients transported directly from the scene to the Royal Melbourne Hospital has increased from 55.6 per cent in 2001–02 to 73 per cent in 2008–09. The percentage of patients transported directly from the scene to The Royal Children's Hospital has increased from 27.8 per cent in 2001–02 to 46.8 per cent in 2008–09. This reflects the recognition of these hospitals as MTS and improvements in pre-hospital triage, including the addition of a helipad at the Royal Melbourne Hospital site.

Overall, there has been a substantial increase in the percentage of major trauma patients transported directly to the hospital of definitive care from the scene, from 53.7 per cent in 2001–02 to 64.6 per cent in 2008–09. The change in delivery of patients to definitive care indicates a significant improvement in pre-hospital triage and transportation, potentially contributing to the decrease in risk-adjusted mortality noted earlier in this report.

Table 8: Direct admissions to a major trauma service, Austin Hospital (for spinal care) or metropolitan neurological service by year

Year	Total major trauma*	Direct from scene	Percentage direct from scene
2001–02	1189	639	53.7
2002–03	1200	674	56.2
2003–04	1414	879	62.2
2004–05	1562	990	63.4
2005–06	1778	1101	61.9
2006–07	1981	1289	65.1
2007–08	1946	1255	64.5
2008–09	2196	1419	64.6

*Total major trauma received at MTS, Austin or MNS

The patient transfer patterns indicate that patients were being transferred to a trauma service with a higher designation (MacKenzie 2006). This has also been demonstrated by The Consultative Committee on Road Traffic Fatalities (McDermott 2007).

Mode of transport

The most common mode of transport for direct admissions to a MTS or the Austin Hospital (for spinal care) was a road ambulance (n=1,024). There were also 340 helicopter primary transports during the reporting period. The number of helicopter primary transports has increased from 251 in 2001–02 (17.8 per cent) to 340 in 2008–09 (24.4 per cent) contributing to a decrease in secondary transfer.

Since the opening of the helipad at the Royal Melbourne Hospital in October 2004, the number of direct air transports has risen from 1.4 per cent (n=1) to 19.4 per cent (n=103). The number of direct air transports to The Alfred has fallen from 233 in 2001–02 (54.6 per cent) to 214 in 2008–09 (28.4 per cent). The number of direct air transports to The Royal Children's Hospital was 16 in 2001–02 (53.3 per cent) and 23 (35.4 per cent) in 2008–09. For referral admissions, there were 465 road transfers (437 Ambulance Victoria (AV), 28 retrieval), 133 helicopter (77 Air Ambulance Victoria (AAV), 56 retrieval), 164 fixed wing (83 AAV, 81 retrieval), 12 air where the mode of transport was not documented (5 AAV, 7 retrieval), 53 other (private ambulance, private car, interstate) and 6 unknown retrieval.

Transfers across the system

Overall, 833 major trauma patients were transferred for definitive acute care at another health service. The majority of transferred patients (84.8 per cent) received their definitive treatment at an appropriate trauma service based on the trauma triage guidelines. This includes 8.0 per cent of cases transferred to the Austin Hospital for specialised spinal care. A further 3.2 per cent were elderly patients, who sustained an isolated head injury as the result of a low fall, and were transferred to a metropolitan neurosurgical service. Regional trauma services provided initial care for one third of patients prior to transfer to an appropriate trauma service. Complete information about all transfers and episodes of care was available for 731 of these patients (87.8 per cent)[7].

Table 9: Key indicator 7 – Transfers across the system

(833 patients)	Definitive hospital of care No. of transferred patients					
First hospital of care	**MTS**	**Austin (Spinal)**	**MNS**	**MeTS**	**MPCS**	**RTS**
MTS	*	29	-	*	-	-
Austin (Spinal)	*	-	-	-	-	-
MeTS	126	7	8	37	6	-
MPCS	60	*	*	31	*	-
RTS	241	10	12	16	*	-
RUCS	130	8	*	7	*	8
RPCS	19	-	-	-	-	*
Other	28	11	-	9	-	5

MTS = Major Trauma Service; Austin = Austin Hospital; MNS = Metropolitan Neurosurgical Service (Austin Hospital, Monash Medical Centre, St Vincent's Hospital); MeTS = metropolitan trauma service; MPCS = metropolitan primary care service; RTS = regional trauma service; RUCS = regional urgent care service; RPCS = regional primary care service. 'Other' refers to patients transferred into Victoria from interstate (38 patients) and overseas (4 patients), and those from a Victorian hospital that is not designated with the trauma system (11 patients).

[7] For all other patients, although it was possible to identify transferred patients at the receiving hospital, there was no specific information from the referring hospital. This proportion of incomplete information from the referring hospital has reduced significantly since 2001–02 (8.8 per cent for 2008–09 compared with 12.2 per cent for 2007–08, 12.4 per cent for 2006–07, 17.2 per cent for 2005–06, 23.2 per cent for 2004–05, 23.6 per cent for 2003–04, 36.3 per cent for 2002–03 and 46.9 per cent for 2001–02).

Specialist transfers

Eighty-two paediatric patients (aged zero to 14 years) were transferred for definitive acute care at another health service. The majority of these patients (67 per cent) had an ISS greater than 15. Sixty-four (78 per cent) of these patients were transferred to The Royal Children's Hospital and one was transferred to The Alfred.

On a proportional basis, more children (40.5 per cent) with head injury[8] were transferred than adults (31.8 per cent). The majority of transferred patients with a head injury (388 adults and 50 children) received their definitive treatment at an appropriate trauma service (83.6 per cent).

Of the 142 spinal cord injury patients, 54.2 per cent were transferred. The vast majority (94.8 per cent) were transferred for definitive care at an appropriate trauma service. Thirty-six patients sustained both a head and spinal cord injury. Inter-hospital transfer was required in 38.8 per cent of patients, and all but one was to an appropriate trauma service.

[8] A head injury is defined as a patient who received an injury to their head with an AIS code greater than two.

Pre-hospital care and quality indicators

This section describes the pre-hospital phase of care and provides quality indicators associated with this care. It is limited by the extent to which the VSTR data collection processes were able to capture pre-hospital care information from health service records. The VSTR is working closely with ambulance services to improve data capture and accuracy. Since Ambulance Victoria (AV) implemented the Victorian Ambulance Clinical Information System (VACIS), enabling the electronic capture of data from the pre-hospital phase, the availability and quality of pre-hospital data has greatly improved. Metropolitan data is now being received electronically from AV on a routine basis. The process for linking with the VSTR data using probabilistic linkage has been defined. An inter-rater reliability review between hospital and ambulance data sources is being undertaken to more fully utilise this data. This will also be possible for rural data in the near future.

For all patients known to be directly transported by ambulance to the primary hospital in 2008–09 (2,198 patients), the time and date of the received call were available for 1,961 patients (89.2 per cent). This compares with 68.3 per cent in 2001–02. The time and date of arrival at the hospital were available for 2,077 patients (94.5 per cent) in 2008–09, compared with 87.1 per cent in 2001–02.

Pre-hospital transit times

The first hour immediately after sustaining major trauma is critical to patient survival and is commonly referred to as the ‘golden hour’. The median (range) time from receipt of the ambulance call until arrival at the first hospital was 62 (12–788) minutes for non-entrapped patients and 89 (28–379) minutes for entrapped patients.

Time at scene

The median (range) time at the scene for entrapped patients was 36 (5–301) minutes and 24 (1–566) minutes for non-entrapped patients. Generally, patients serviced by Air Ambulance Victoria had a longer scene time, which may reflect the severity of injuries sustained by patients who require air transport.

Quality assurance indicators

1. **Pre-hospital time greater than one hour.** For this indicator, 51.9 per cent (50.7 per cent in 2007–08) of the non-entrapped patients and 85.2 per cent (82 per cent in 2007–08) of entrapped patients, had a total time from receipt of the ambulance call to arrival at emergency department of more than one hour.
2. **Pre-hospital scene time greater than 20 minutes.** 1,637 (90.3 per cent) non-entrapped blunt-trauma patients had a calculated scene time. Of these, 63.8 per cent (61.4 per cent in 2007–08) had a scene time of more than 20 minutes.
3. **Systolic blood pressure less than 100 mmHg on arrival and scene time greater than ten minutes.** Of the 22 non-entrapped penetrating injury patients with a blood pressure less than 100 mmHg on arrival at the scene, and a calculated scene time, 77.2 per cent had a scene time of more than 10 minutes, compared with 73.7 per cent in 2007–08. The single most important penetrating trauma outcome appears to be the time to definitive surgery.
4. **GCS less than nine at scene and O2 saturation less than 90 per cent after 10 minutes.** Of the 160 head injured patients with a GCS less than nine at the scene of injury, and a recorded oxygen saturation after 10 minutes, 4.4 per cent had an oxygen saturation of less than 90 per cent, compared with 5.2 per cent in 2007–08. Hypoxaemia is recognised as a significant cause of secondary brain injury.
5. **GCS less than nine and systolic blood pressure less than 100 mmHg after 10 minutes.** Of the 190 head injured patients with an at-scene GCS less than nine and a recorded systolic blood pressure after 10 minutes at the scene, 14.7 per cent had a systolic blood pressure of less than 100 mmHg. This is significantly less than in previous years (34 per cent in 2001–02, 26.7 per cent in 2002–03, 21.9 per cent in 2003–04, 21.6 per cent in 2004–05, 19.6 per cent in 2005–06 and 17.5 per cent in 2006–07), but similar to 2007–08 with 13.2 per cent. Hypotension is recognised as a significant cause of secondary brain injury.

Hospital systems performance

Emergency department quality indicators

The following quality assurance indicators refer to the emergency department and hospital-specific phases of the major trauma patient care.

1. **Trauma team activation at a major trauma service.** The trauma team was activated for 67 per cent of all patients arriving at a MTS emergency department. This rate varied across the MTS hospitals: 73.9 per cent at The Alfred, 62.6 per cent at the Royal Melbourne Hospital, 37.1 per cent at The Royal Children's Hospital.[9] MTS activated a trauma team for 58.4 per cent of all patients received via transfer. This varied across the MTS hospitals: 71.1 per cent at The Alfred, 48.9 per cent at the Royal Melbourne Hospital, and 14.1 per cent at The Royal Children's Hospital.
2. **No intubation in patients with GCS less than nine and AIS greater than two in ISS head region.** Across all trauma service levels, 78 non-intubated patients presented to an emergency department with a GCS less than nine and AIS severity greater than two in the head region. Of these, 18 patients (23.1 per cent) were not intubated during their emergency department stay. All 18 non-intubated patients were elderly low-falls patients.
3. **Length of time from arrival at an emergency department greater than two hours until a head CT scan.** The time from arrival at an emergency department until head CT scan for patients with a severe head injury (AIS severity greater than two in the head region) was more than two hours in 373 patients (33.3 per cent). The median time from arrival at the emergency department to a head CT scan was 1.3 hours at a MTS, 3.4 hours at a metropolitan neurological service, 2.2 hours at a metropolitan trauma service, and 1.1 hours at a regional trauma service. Patients considered inappropriate for transfer and/or imaging resourcing, capacity and availability may be contributing factors to wait times.
4. **Penetrating torso trauma with haemodynamic instability (systolic blood pressure less than 100 mmHg) and greater than one hour to theatre.** There were 1,270 patients with an injury to their torso region. Penetrating trauma occurred in 82 of these patients, 67 had surgery and 65 had a valid time to theatre recorded. Of these 65, 43 patients (66.2 per cent) had a time of more than one hour to theatre. It is not uncommon for stable patients without obvious internal injury to be observed for a period of time, to determine if surgery is necessary. This approach may result in 'delayed' surgery in less severely injured patients. There were 15 patients with haemodynamic instability (systolic blood pressure less than 100 mmHg on arrival). Of these, 12 (80 per cent) went to theatre in less than one hour (two died) and three (20 per cent) waited more than one hour for surgery.

[9] The significantly lower percentage of major trauma patients initiating a trauma team activation at The Royal Children's Hospital compared with the other major trauma services is affected by the fact that paging criteria, injury patterns and transfer patterns are different for children compared to adult trauma patients.

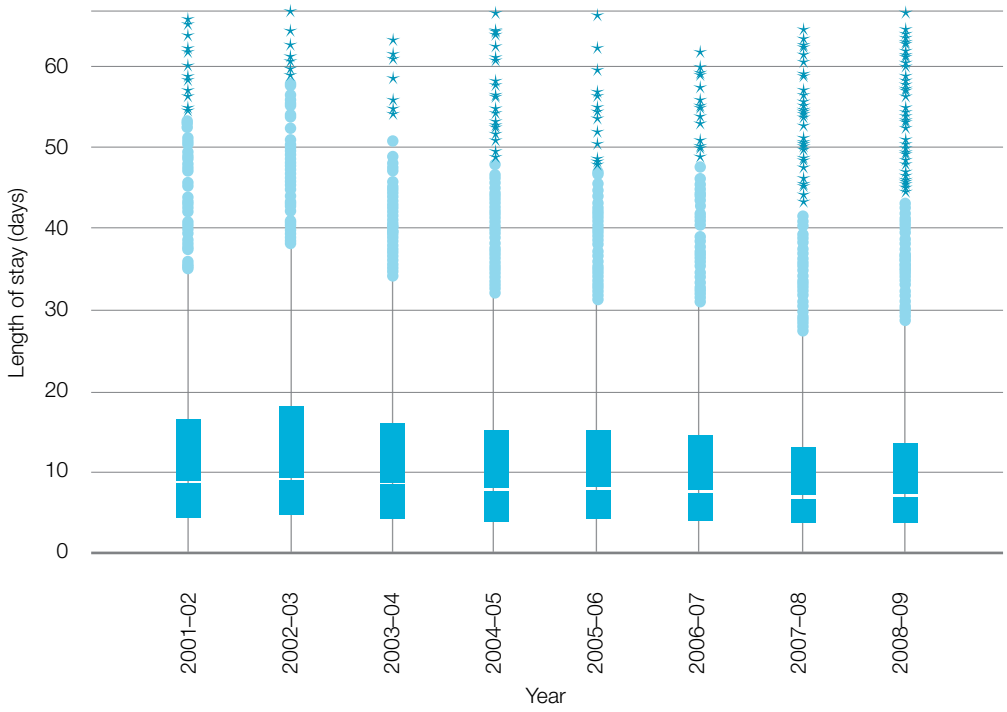
Outcomes of major trauma

This section describes patient outcomes following major trauma. Outcome measures include hospital length of stay, discharge status, functional measures at discharge, and six and 12 months post-injury. Unless otherwise stated, the data presented in this section relates to the hospital that provided definitive treatment.

Length of stay

Figure 9 shows the distribution of the length of stay for major trauma patients by year, excluding burns. There has been a decrease over the past eight years in the median length of stay from 8.8 days in 2001–02 to 7.2 days in 2008–09.

Figure 9: Length of stay by year



Discharge status

> Key indicator 8 – Discharge status
>
> In 2008–09, the majority of patients (49.3 per cent) were discharged home.

In 2008–09, the majority of MTS patients were discharged home. There has been an increase in the percentage of patients discharged home, from 39.3 per cent in 2001–02 to 49.3 per cent in 2008–09.

The percentage of patients discharged to inpatient rehabilitation has decreased, and this may be due to improved outcomes at discharge or change in patient acuity. It may also reflect increased use of rehabilitation in the home.

Long-term outcomes following major trauma

Long-term telephone follow up of major trauma patients who survived to hospital discharge, is a unique attribute of the VSTR. All adult major trauma patients have been followed up at six months following injury since 2005–06, and at 12 months since 2006–07. The primary outcome measure used since 2005–06 is the patient's level of function according to the Glasgow Outcome Scale – Extended (GOS-E). The GOS-E classifies patients into eight levels of function, from death to upper good recovery. A score of five (lower moderate disability) or above indicates independent living, while a score of eight (upper good recovery) indicates a complete return to normal occupational and social activities, without any residual deficits related to their injury. The GOS-E can be administered by proxy if the patient is not able to participate in the interview. Return to work (for those working prior to injury) has also been collected since follow up of major trauma patients commenced.

During 2006–07, additional instruments were added to the follow-up interview. The 12-item Short Form health survey (SF-12) was added to capture information about health-related quality of life and has both a mental component summary score (MCS-12) and a physical component summary score (PCS-12). A numerical rating scale (NRS) was also added to the interview to collect information about pain. The NRS asks the patient to rate their level of pain from zero (no pain at all) to 10 (worst possible pain). Both the SF-12 and the NRS are administered to the patient only.

For the purposes of this report, six-month GOS-E and return-to-work data for the years 2005–06 to 2008–09 is reported, while pain and SF-12 data is reported for 2006–07 to 2008–09. Functional (GOS-E), return-to-work and SF-12 data is reported for 2006–07 to December 2008 for the 12-month time point. Only adult patients (aged≥18 years) were included in these analyses.

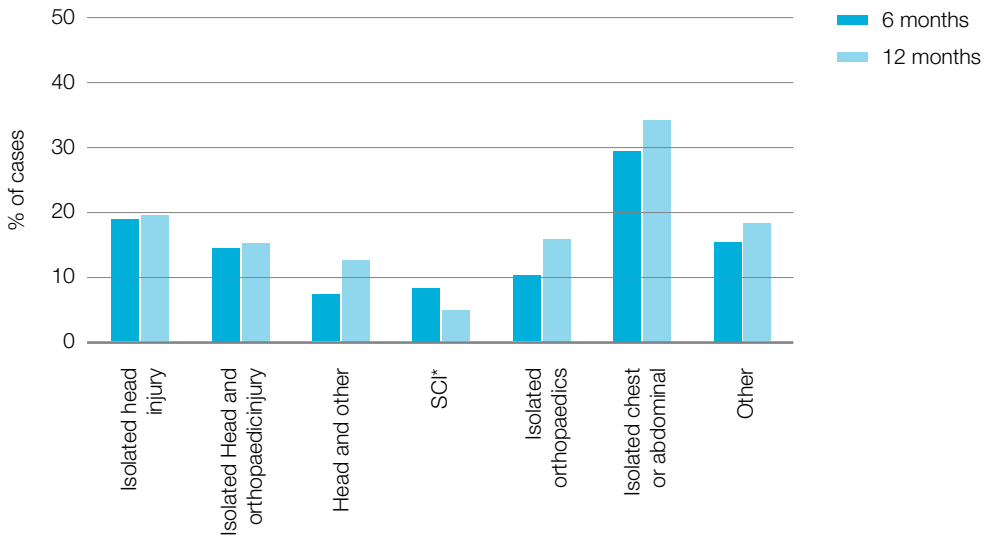
The percentage of survivors to hospital discharge who were successfully followed up six months after injury, increased significantly from 68.7 per cent in 2005–06 to 86.9 per cent in 2008–09 ($p<0.001$), through improved follow-up protocols and procedures. The follow-up rates at 12 months following injury have also risen significantly from 83.3 per cent in 2006–07 to 87.9 per cent in 2008–09 ($p=0.002$). The most common reasons for an inability to complete the follow-up interviews were an inability to contact the patient despite repeated attempts (32.5 per cent), incorrect contact details (35 per cent), and disconnected phone numbers (9.5 per cent). Less than 10 per cent of patients lost to follow up are through refusal to participate in the interview. Independent predictors of loss to follow up are consistent at six months and 12 months. Younger major trauma patients ($p<0.001$), patients with a cutting/piercing injury mechanism ($p=0.014$), less severely injured patients according to the ISS ($p=0.028$), and patients injured in intentional injury events (predominantly assaults) ($p<0.001$) were more likely to be lost to follow up. Consistent with these findings, patients with isolated chest or abdominal injuries were also more likely to be lost to follow up.

Since 2005–06, major trauma patients successfully followed up at six months have increased in age ($p<0.0001$), and a higher percentage are the result of a low-fall mechanism ($p=0.013$), resulting in a greater prevalence of isolated head injuries ($p<0.001$) and a lower percentage of compensable and road trauma patients, hence multi trauma, over this period. Since 2006–07, the profile of major trauma patients successfully followed up at 12 months has not changed. Multivariate analyses were performed to identify independent predictors of 6- and 12-month outcomes, and the results are presented in the following sections.

Functional outcomes (GOS-E)

The percentage of major trauma patients classified as living independently at six months using the GOS-E scale was 63 per cent, and this was unchanged at 12 months. The percentage of cases who had fully recovered (GOS-E upper good recovery) increased from 15 per cent at six months to 20 per cent at 12 months following injury. Figure 10 shows the percentage of major trauma cases classified as fully recovered at six and 12 months following injury by injury group. All groups, except SCI, showed an improvement over time. The percentage of SCI cases classified as fully recovered reflects the inclusion of cord contusions and incomplete cord syndromes in this group, as no cases with a complete cord injury demonstrated a full recovery on the GOS-E scale. The lower percentage of SCI with a GOS-E score of eight at 12 months reflects a bias in the follow up of this group. Because of long hospital lengths of stay, the data for SCI cases generally is submitted late to the VSTR, and only a small proportion of cases are able to be followed up at the six-month time point. Overall, SCI, multi-trauma patients, and those with isolated orthopaedic injuries, reported the lowest rates of full recovery across the major trauma population.

Figure 10: Percentage of fully recovered cases by injury group at six months and 12 months



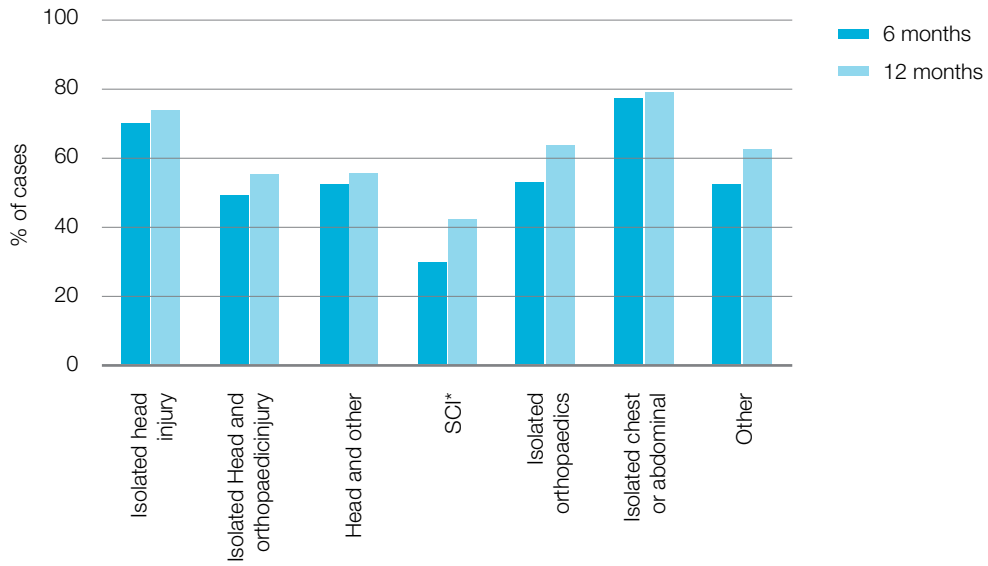
* Follow up for SCI cases may be influenced by the delayed submission of data to the VSTR

The key predictors of recovery at 12 months (according to the GOS-E instrument) were age, compensation status, discharge destination, injury intent, ISS and the injury group. Increasing age ($p<0.001$) and ISS ($p<0.001$) were associated with significantly lower odds of a complete recovery at 12 months. Assault victims ($p<0.001$), and compensable cases ($p<0.001$), were less likely to have recovered fully by 12 months, compared to unintentional and non-compensable cases, respectively. Patients who had sustained a SCI ($p=0.001$), or isolated orthopaedic injuries ($p=0.003$), demonstrated significantly lower odds of a return to full function compared to isolated head injury cases, while cases who had sustained an isolated chest or abdominal injury were more likely to have recovered than isolated head injury cases ($p<0.001$). Independent of injury severity and other patient factors, patients discharged to inpatient rehabilitation ($p<0.001$), or to a destination other than home ($p<0.001$), demonstrated lower odds of a full recovery when compared to patients discharged directly home. Compared to 2006–07, major trauma patients who survived to discharge in 2007–08 and 2008–09, were more likely to have recovered, although this was only significant for 2007–08 ($p=0.039$).

Return to work

Approximately 63 per cent of major trauma cases surviving to hospital discharge, reported working or studying prior to injury. The overall return to work rate for these cases was 60 per cent at six months, and 66 per cent at 12 months, following injury. The prevalence of return to work in each injury group, for those working prior to injury, is shown in Figure 11. The return to work rate was highest for cases sustaining isolated chest or abdominal injuries, followed by isolated head injury cases. SCI, isolated orthopaedic and multi-trauma patients had the lowest return to work rates. All injury groups reported higher return-to-work rates at the 12-month time point.

Figure 11: Return to work by injury type at six months and 12 months



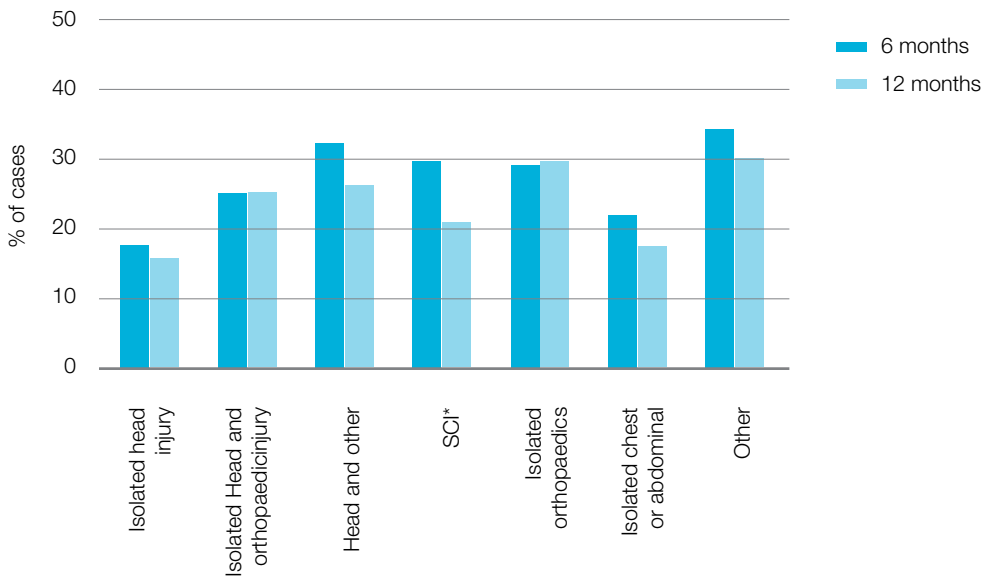
Consistent with the predictors of functional recovery, age, compensable status, discharge destination, injury group, ISS, mechanism of injury and injury intent, were significant independent predictors of return to work at 12 months, where patients were working or studying prior to injury. Increasing age ($p<0.001$) and ISS ($p<0.001$) were associated with lower odds of return to work. Assault victims ($p<0.001$) and compensable cases ($p<0.001$), were at lower odds of returning to work by 12 months than unintentional and non-compensable cases, respectively. SCI ($p<0.001$) and isolated orthopaedic trauma ($p=0.020$) demonstrated lower odds of return to work, while cases with isolated chest and abdominal injuries were more likely to have returned to work than isolated head injury cases. Cases injured in motorcycle ($p=0.009$) and pedal-cyclist ($p=0.011$) incidents were more likely to have returned to work at 12 months than patients injured in motor vehicle crashes.

Independent of injury severity and other patient factors, patients discharged to inpatient rehabilitation ($p<0.001$), or to a destination other than home ($p<0.001$), demonstrated lower odds of return to work at 12 months when compared to patients discharged directly home. The return-to-work rates were consistent across the three-year period.

Pain

The level of persistent pain experienced by major trauma survivors has been collected at follow up since 2006–07. A pain score of five or above indicates moderate to severe pain. The prevalence of moderate to persistent pain was 26 per cent at six months, and 23 per cent at 12 months, following injury. Figure 12 shows the percentage of cases reporting moderate to severe pain at six and 12 months following injury according to injury group. The prevalence of moderate to severe pain was lowest amongst cases with isolated head injury, and cases who had sustained isolated chest or abdominal injuries, while the prevalence was highest in multi-trauma patients, and cases involving orthopaedic injury. Cases with orthopaedic injuries (isolated or with associated head injury) did not report improvement in pain from six to 12 months.

Figure 12: Cases reporting pain at six months and 12 months



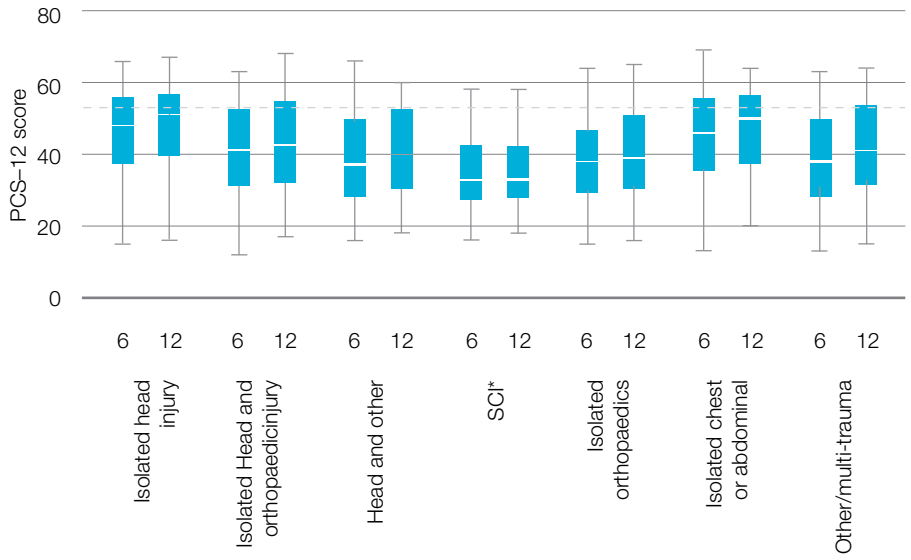
Independent predictors of reporting moderate to severe persistent pain at 12 months following injury were age, gender, compensable status, discharge destination, injury group and mechanism of injury. Increasing age was associated with higher odds of reporting moderate to persistent pain ($p=0.039$), as was female gender ($p<0.001$), and compensable cases ($p<0.001$). Adjusting for injury severity and demographic factors, the multi-trauma patients involving head injury ($p=0.033$) and isolated orthopaedic trauma cases ($p<0.001$) were more likely to report moderate to severe persistent pain than isolated head-injury cases.

Major trauma cases injured in pedal-cyclist incidents were less likely to report moderate to severe pain 12 months after injury than motor vehicle crash victims ($p=0.021$). Assault victims were more likely to report moderate to severe pain at 12 months than unintentional injury cases ($p=0.004$), while cases discharged to inpatient rehabilitation were also at elevated odds of reporting moderate to severe pain compared to patients discharged directly home from definitive care ($p=0.028$). There was a trend to improved pain outcomes over time. Compared to cases from 2006–07, major trauma patients in 2007–08 ($p=0.001$) and 2008–09 ($p=0.141$) demonstrated lower odds of reporting moderate to severe pain.

Physical health (PCS-12)

The mean (SD) PCS-12 score for major trauma survivors six months following injury was 41.8 (12.9), significantly below the Australian population norm of 48.9 (10.2) (t=21.4, p<0.00001). At 12 months post-injury, PCS-12 scores remained significantly below population norms (43.5 vs. 48.9, t=15.7, p<0.0001). Figure 13 shows the distribution of PCS-12 scores across injury groups and time points. Physical health scores were lowest for SCI, isolated orthopaedic injury, and head and orthopaedic injury cases (Figure 13). The median physical health scores were below the population median for all injury groups at all time points (Figure 13).

Figure 13: PCS-12 scores by injury groups at six months and 12 months

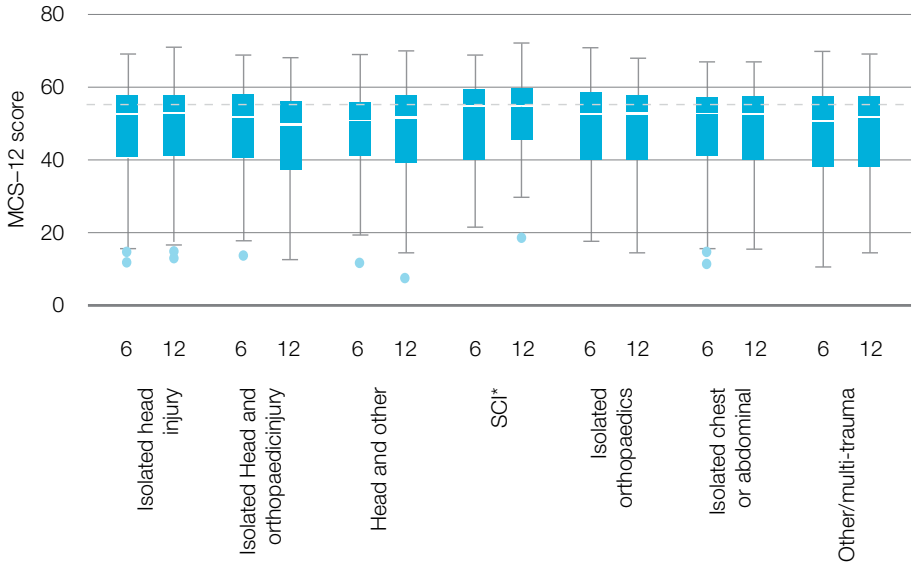


Consistent with the general population, increasing age (p<0.001) and female gender (p=0.002) were independent predictors of poorer physical health scores. Aside from age and gender, compensable status, mechanism of injury, discharge destination, the ISS, intent of injury, injury group, and the level of service the patient was definitively managed at, were significiant independent predictors of physical health outcomes. Compensable cases (p<0.001), and patients injured in an assault (p<0.001), were significantly more likely to report lower PCS-12 scores than non-compensable and unintentional injury cases, respectively. Physical health outcomes were better at 12 months for pedal cyclists (p=0.031), and worse for high-fall victims (p=0.010), when compared to motor vehicle crash victims. Physical health scores at 12 months were significantly lower for patients discharged to an inpatient rehabilitation centre (p<0.001) or to a destination other than home (p<0.001), when compared to patients discharged directly to home from definitive care. A higher ISS was predictive of poorer physical health (p<0.001), while definitive management at a MTS hospital was predictive of better physical health 12 months following injury (p=0.012). All injury groups reported physical health scores significantly below the isolated head injury group, except for cases who had sustained isolated chest or abdominal injuries. PCS-12 scores were higher for 2007–08 and 2008–09, compared to 2006–07, though this was not significant.

Mental health (MCS-12)

The mean (SD) MCS-12 scores of major trauma survivors was 48.7 (12.2) at six months following injury; significantly lower than the 52.4 (8.8) of the Australian population (t=11.8, p<0.0001). At 12 months following injury, the mean (SD) MCS-12 score was 48.5 (12.1), still significantly below Australian population norms (t=11.9, p<0.0001). Figure 14 shows the distribution of MCS-12 scores across injury groups and time points. In contrast to physical health outcomes, mental health scores were highest for SCI injuries, with a median consistent with population norms (Figure 14).

Figure 14: MCS-12 scores by injury groups at six months and 12 months



Results of the multivariate analysis identified gender, compensable status, injury group, intent of injury and year, as significant independent predictors of mental health outcomes at 12 months. Consistent with population norms, women were more likely to report poorer mental health scores than males (p<0.001). The compensable patient group was more likely to report lower mental health scores than non-compensable patients (p<0.001), while victims of intentional self-harm (p=0.007) and assault (p<0.001) were more likely to report poorer mental health at 12 months when compared to patients injured in unintentional events. Consistent with other patient outcomes, there was evidence of improvement in mental health outcomes over time. Compared to 2006–07, patients injured in 2007–08 (p=0.048) and 2008–09 (p=0.027) were more likely to report better mental health outcomes.

Summary

Overall, the follow up of major trauma patients who survive to hospital discharge is a unique attribute of the VSTR. The long-term outcomes information provides critical information about the quality of survival of major trauma patients in Victoria, and the capacity to monitor the burden of major trauma over time. The outcomes reported here highlight particular patient groups at high risk of poor outcomes. In particular, compensable cases, women, assault victims, SCI, isolated orthopaedic cases and multi-trauma patients with associated head injury, were more likely to report poorer functional, pain and health-related quality-of-life outcomes. Importantly, there is some evidence from the data collected to date, that the quality of survival is increasing over time, despite a reduction in the risk-adjusted mortality in Victoria.

Unexpected deaths

Key indicator 9 – Observed versus unexpected deaths

In 2008–09, the z-score using the National Trauma Data Bank 5.0 for all major trauma patients with an ISS greater than 15 was 4.8.

Comparison of death rates with an international standard

The z-score provides a direct comparison of observed death rates with those that would be predicted based on the international standard derived from the *Major trauma outcome study* (1995). The z-score can only be calculated for patients with a known Trauma Score - Injury Severity Score (TRISS) probability of survival.[10]

The z-score using the National Trauma Data Bank (NTDB) 5.0 (American College of Surgeons) for all major trauma patients with a TRISS probability of survival, was 4.8 in 2008–09 for patients with an ISS greater than 15. This indicates that the VSTS has a lower adjusted death rate in comparison to the major North American trauma centres reporting outcomes during this period. The NTDB 5.0 has succeeded the Major trauma outcome study as a contemporary reference database, so calculation of TRISS coefficients using the NTDB database is more appropriate.

[10] See Gabbe et al. 2003 for explanation of TRISS, including its deficiencies.

Limitations and data caveats

The information presented in this report provides data for ongoing monitoring of the VSTS.

Hospital capture

All health services within the VSTS are now contributing to the VSTR.

Hospital records

Patients for whom information on all episodes of care was not available, limits the dataset. Every attempt is made to collect this information from the hospital, the Victorian Ambulance Clinical Information System or the NCIS Database. Where missing data is related to the patient care record, this information is requested directly from the ambulance service.

Trauma Score – Injury Severity Score

TRISS can be used to measure the performance of the system in terms of death rates. Currently, the value of TRISS for monitoring the VSTS is limited by the number of patients for whom no value can be calculated. As is usual practice, the TRISS probability of survival has been calculated from variables recorded at the definitive emergency department. Where a patient had no emergency department TRISS value, the patient's pre-hospital TRISS value was used. The major reason for an inability to calculate TRISS in the more seriously injured patients and deaths was pre-hospital intubation. An estimate of pre-intubation GCS was able to be made in most cases, using single imputation techniques.

Data presentation

Generally, data is reported either for all patients (across the trauma service) or broken down according to trauma service level. In the former data tabulations, information is obtained on all patients. When patients are presented according to their hospital of first care or definitive care, the data is taken exclusively from these hospitals' records, excluding cases with missing information. Because of the lack of complete data, the trauma service level-specific analyses have fewer patients than the analyses of all patients.

Conclusions

The VSTR enables monitoring of the VSTS, and analysis of eight years of data shows the benefits of a system-based approach to trauma care. The data in this report confirms that the trauma triage guidelines are being followed, with 82.9 per cent of major trauma patients receiving their care at an appropriate trauma service, including care at the Austin Hospital for specialised spinal care and at a metropolitan neurosurgical service. The patterns of transfer across the system indicate patients were being transferred appropriately to a trauma service based on the trauma triage guidelines. There has also been a continued increase in the percentage of major trauma patients transferred directly to the hospital of definitive care from the scene, indicating a change in the transport of major trauma patients, from 61.9 per cent in 2005–06 to 64.6 per cent in 2008–09.

Since complete coverage was obtained in 2005–06, there has been an increase in the number of hospitalised major trauma patients in Victoria, and the death rate per 100,000 population has also increased. In 2008–09, there was also an increase in the number of major trauma deaths from burns due to the Victorian bushfires. The percentage of hospitalised major trauma patients related to low falls continues to rise, and the majority of low-fall patients were aged over 55 years. Low falls are now the most common mechanism of injury.

The follow up of major trauma patients who survive to hospital discharge is a unique attribute of the VSTR. The long-term outcomes information provides critical information about the quality of survival of major trauma patients in Victoria, and the capacity to monitor the burden of major trauma over time. The outcomes reported here highlight particular patient groups at high risk of poor outcomes. Importantly, there is some evidence from the data collected to date that the quality of survival is increasing over time, despite a reduction in the risk-adjusted mortality in Victoria.

The VSTR is a valuable monitoring tool and the ongoing support and development of this VSTR, including the continued monitoring of the outcomes of major trauma patients and the further development of feedback processes, will ensure the continued improvement of trauma care in Victoria.

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Glossary

Abbreviated Injury Scale (AIS)	A numerical method for ranking and comparing injuries by severity and for standardising the terminology used to describe injuries. It is a measure of the threat to life of an injury. The scale ranges from one (minor injury) to six (maximum severity). AIS=6 and AIS=5 scores represent 'maximum severity' and 'critical' injuries respectively.
Coronial cases	A coronial case is a case recorded on the National Coroners Information System (NCIS) database. The database has information about every death reported to an Australian coroner since July 2000 (January 2001 for Queensland). Each coronial case is assigned a case number in the coronial database. As long as a case is under investigation, it is marked as 'open', which means no identifying information is available. When an investigation is finished, the case is marked as 'closed' and the identifying information is available.
Functional measure (FM)	A measure that has been used to measure the degree of disability during the medical rehabilitation, discharge and follow up of trauma patients. The FM has been adapted from the Functional Independence Measure (FIMTM) by the National Trauma Database (American College of Surgeons). The FM includes three items (self-feeding, communication and locomotion), scored using a four-point ordinal scale. The use of this modified version of the FIMTM has not been validated to date.
Glasgow Coma Score (GCS)	A measure of the level of the consciousness of a patient and an indicator of the severity of a head injury. The scale ranges from three (unconscious) to 15 (normal functioning), with a score of less than nine usually indicating a severe head injury. When this variable is used for calculating trauma scores, as a default, the emergency department GCS values are used. If there is no GCS recorded at the emergency department, or the patient was intubated or sedated on arrival, the patient's pre-hospital GCS value is used.
Glasgow Outcome Scale – Extended (GOS-E)	The GOS-E enables patients to be classified into broad categories of functional level, taking into account the domains of consciousness, independence in the home, independence outside the home, work, social and leisure activities, family and friendships, and return to normal life.
Hospital of definitive care	For each patient, this is defined as the hospital at the highest service level within the tiered trauma system structure where the patient was treated.
Injury Severity Score (ISS)	Used to define injury severity for comparative purposes and a useful tool for evaluating trauma outcomes. It incorporates both anatomical and severity indices and is derived from the Abbreviated Injury Scale for anatomic regions. The ISS has been demonstrated to be an important predictor of injury severity and mortality. The scale ranges from one (minor injury) to 75 (mortal injury). Generally, an ISS greater than 15 is taken to be indicative of major trauma, because mortality in this group has been shown to be more than 10 per cent.
Maximum AIS	Used as a proxy measure of injury severity. For each patient, AIS scores for all injuries are ranked from lowest to highest. The maximum AIS is the highest AIS given to any of the injuries sustained by a patient, regardless of body region.

Major Trauma Outcome Study (MTOS)	A retrospective descriptive study of injury severity and outcome, coordinated through the American College of Surgeons' Committee on Trauma. Since 1982, this database has been continually updated and now contains 730,000 cases from 268 trauma centres across 36 states. The MTOS database is the international standard against which all other trauma databases are often compared.
Revised Trauma Score (RTS)	An injury severity measure that is derived from the Glasgow Coma Scale, systolic blood pressure and respiratory rate. Reliance on the respiratory rate and the GCS prevents calculation of the RTS for intubated patients. In such cases, the RTS is calculated from information taken at the scene prior to intubation. The raw RTS ranges from zero to 12, with higher values suggesting a more stable patient. The RTS can be weighted for research and prediction purposes. The maximum weighted RTS is 7.84, corresponding to a stable patient. RTS less than two is associated with a 70 per cent or more predicted probability of death (Senkowski & McKenney 1999).
Trauma service level	A tier in the VSTS's trauma system structure. Different complexities of care are provided at each level, with the MTS providing the highest complexity of care. The MTS are The Alfred, the Royal Melbourne Hospital and the Royal Children's Hospital. Metropolitan trauma service hospitals are at the second tier of the state trauma service for metropolitan Melbourne. Metropolitan primary care service hospitals are at the third and lowest tier of the state trauma service for metropolitan Melbourne. A regional trauma service is a hospital at the highest tier of the state trauma service in rural and regional Victoria. Urgent care service hospitals are at the second tier of this service and primary care service hospitals are at the third and lowest tier.
Trauma Score - Injury Severity Score (TRISS)	An estimate of the probability of survival of individual patients. It is derived from the patient's age, the Revised Trauma Score, the mechanism of injury and the Injury Severity Score. The TRISS probability of survival is calculated from variables recorded at the definitive emergency department. When the TRISS probability of survival components are missing from the emergency department records, the patient's pre-hospital parameters are used.
Victorian Admitted Episodes Database	A database maintained by the Victorian Department of Health, which records details of all hospital admissions across the state.
VSTORM	The Victorian State Trauma Outcome Registry and Monitoring (VSTORM) group, which coordinates the Victorian State Trauma Registry and is based at the Department of Epidemiology and Preventive Medicine at Monash University.
Z-score	A score used to compare a dataset with the international Major Trauma Outcome Study (MTOS) standard to determine whether the actual number of survivors recorded in the test dataset is equivalent to the predicted number of survivors in the MTOS dataset. Values greater than two standard deviations are indicative of a significant difference between the databases, with a positive value indicating more survivors than expected and a negative value indicating fewer survivors than expected.

List of acronyms

AV	Ambulance Victoria
AAV	Air Ambulance Victoria
AIS	Abbreviated Injury Score
ARCBS	Australian Red Cross Blood Services
FMS	Functional Measure Scores
GCS	Glasgow Coma Score
GOS-E	Glasgow Outcome Scale – Extended
ISS	Injury Severity Score
MCS-12	Mental component summary score
MNS	Metropolitan neurological services
MTS	Major trauma services
MUARC	Monash University Accident Research Centre
NCIS	National Coroners Information System
NRS	Numerical Rating Scale
NTDB	National Trauma Data Bank
PCS-12	Physical component summary score
ROTES	Review of Trauma & Emergency Services – Victoria 1999
SCI	Spinal cord injury
SF-12	12-item short form
STC	State Trauma Committee
TRISS	Trauma Score – Injury Severity Score
VACIS	Victorian Ambulance Clinical Information System
VSTORM	Victorian State Trauma Outcome Registry and Monitoring
VSTR	Victorian State Trauma Registry
VSTS	Victorian State Trauma System

Appendix 1

The VSTORM group

The VSTORM group based at the Department of Epidemiology and Preventive Medicine at Monash University coordinates the VSTR.

The VSTORM chief investigators for 1 July 2008 – 31 December 2008 were:

- Professor Peter Cameron (Head, Victorian State Trauma Registry, Department of Epidemiology and Preventive Medicine, Monash University)
- Professor John McNeil (Head, Department of Epidemiology and Preventive Medicine, Monash University)
- Dr Belinda Gabbe (National Health and Medical Research Council Population Health Research Fellow, Department of Epidemiology and Preventive Medicine, Monash University).

All chief investigators are also members of the VSTORM Steering Committee.

Other members of the VSTORM Steering Committee from 1 July 2008 to 31 December 2008, all of whom have expertise in epidemiology, trauma management or related areas, include:

- Mr Bill Barger (Manager, Metropolitan Ambulance Service Victoria)
- Dr Stephen Bernard (Deputy Director of ICU, Dandenong Hospital)
- Dr Warwick Butt (Staff Specialist in Intensive Care, Royal Children's Hospital)
- Mr Alex Currell (General Manager Strategic Planning, Metropolitan Ambulance Service Victoria)
- Dr David Eddey (Director of Emergency Medicine, The Geelong Hospital)
- Mr Andrew Hannaford (Trauma Information Systems Manager, Victorian State Trauma Registry)
- Associate Professor Rodney Judson (Director of Trauma, Royal Melbourne Hospital)
- Professor Thomas Kossmann (Director of Trauma Surgery, The Alfred; Director of National Trauma Research Institute (Alfred Campus))
- Ms Sue McLellan (Data Coordinator, Victorian State Trauma Registry)
- Ms Mimi Morgan (Project Coordinator, Victorian State Trauma Registry)
- Dr Karen Smith (Project Manager, Strategic Planning, Metropolitan Ambulance Service)
- Ms Ann Sutherland (Research Nurse, Victorian State Trauma Registry)
- Dr Jason Winnett (Trauma Surgeon, The Alfred)
- Mr Tony Walker (Manager Operations, Rural Ambulance of Victoria)
- Mr Owen Williamson (Senior Lecturer, Department of Epidemiology and Preventive Medicine, Monash University)
- Mr Cameron Willis (PhD Student, Department of Epidemiology and Preventive Medicine, Monash University).

The VSTORM chief investigators from 1 January 2009 to 30 June 2009 were:

– Professor Peter Cameron (Head, Victorian State Trauma Registry, Department of Epidemiology and Preventive Medicine, Monash University)

– Professor John McNeil (Head, Department of Epidemiology and Preventive Medicine, Monash University)

– Dr Belinda Gabbe (National Health and Medical Research Council Population Health Research Fellow, Department of Epidemiology and Preventive Medicine, Monash University).

Other members of the VSTORM Steering Committee from 1 January 2009 to 30 June 2009, all of whom have expertise in epidemiology, trauma management or related areas, were:

– Professor Rodney Judson (Director of Trauma, The Royal Melbourne Hospital

– Ms Bernadette McDonald (Acting Assistant Director, Access and Metropolitan Performance, Department of Human Services)

– Ms Diane Gill (Executive Officer, Royal Melbourne Hospital)

– Dr Marcus Kennedy (Director, Adult Retrieval Victoria)

– Dr Fergus Kerr (Director of Emergency Medicine, Austin Health)

– Professor Russell Gruen (Director, National Trauma Research Institute)

– Dr Simon Young (Director of Emergency Medicine, Royal Children's Hospital)

– Dr Sol Zalstein (Director, Emergency, Bendigo Health Care Group)

– A/Prof Jennie Ponsford (Director, Monash–Epworth Rehabilitation Research Centre)

– Dr Bruce Bartley (Emergency Department, Geelong Hospital)

– A/Prof Tony Walker (Executive General Manager, Quality and Education Services, Ambulance Victoria)

– Mr Alex Currell (General Manager, Strategic Planning, Ambulance Victoria)

– Dr Alex Collie (Director, Victorian Neurotrauma Initiative)

– Mr Peter Trethewey (Chief Executive Officer, AQA Victoria Ltd).

Appendix 2

Hospitals and health services with ethics committee approval for the period July 2008 to June 2009

Collection of patient-level data from each of the hospitals and health services is conducted under strict National Health and Medical Research Council guidelines and national and Victorian privacy legislation.

Ethics committee approval for the VSTR was initially obtained from the Department of Human Services and Monash University ethics committees and has also been granted by the NCIS (for trauma-related deaths).

Approval for trauma data collection has also been actively sought from all Victorian hospitals and major health services (public and private) in both metropolitan and regional and rural areas. As at 30 June 2009, VSTR data collection was approved at the 138 hospitals and health services listed in the following table.

Trauma service level	Hospital
Major trauma service	The Alfred
	Royal Children's Hospital
	Royal Melbourne Hospital
Metropolitan trauma service	Austin Health (Austin Hospital)
	Southern Health (Dandenong Hospital)
	Eastern Health (Box Hill Hospital, Maroondah Hospital)
	Southern Health (Monash Medical Centre, Clayton Campus)
	Peninsula Health (Frankston)
	Northern Health (The Northern Hospital)
	St Vincent's Hospital (Melbourne) Ltd
	Western Health (Footscray Hospital)
Metropolitan primary care service	Eastern Health (Angliss Hospital)
	Epworth Hospital
	Knox Private Hospital
	Southern Health (Monash Medical Centre, Moorabbin Campus; Monash Medical Centre, Casey Campus)
	Peninsula Health (Rosebud Hospital)
	Bayside Health (Sandringham and District Memorial Hospital)
	Western Health (Sunshine Hospital)
	Werribee Mercy Hospital
	Western Health (Williamstown Hospital)

Barwon-South West region	Hospital
Regional trauma service	Barwon Health Network (Geelong Hospital)
	South West Health Care (Warrnambool Campus)
	Western District Health Service (Hamilton)
Urgent care service	Casterton Memorial Hospital
	Colac Area Health (Colac)
	Hesse Rural Health Service (Winchelsea)
	Lorne Community Hospital
	Moyne Health Services
	Otway Health and Community Services
	Portland District Health
	South West Health Care (Camperdown Campus)
	Terang and Mortlake Health Service (Terang)
	Timboon and District Healthcare Service
Primary care service	Balmoral Bush Nursing Centre
	Cobden District Health Services
	Colac Area Health (Birregurra Community Health Centre)
	Coleraine District Health Services
	Dartmoor and District Bush Nursing Centre Inc.
	Hesse Rural Health Service (Rokewood, Beeac)
	Heywood Rural Health
	South West Health Care (Lismore)
	Terang and Mortlake Health Service (Mortlake)
	Western District Health Service (Penshurst)

Loddon Mallee region	
Regional trauma service	Bendigo Health Care Group
	Ramsay Health Care (Mildura Base Hospital)
Urgent care service	Cohuna District Hospital
	Echuca Regional Health
	Kerang District Health
	Kyabram and District Health Service
	Kyneton District Health Service
	Maryborough District Health Service
	Swan Hill District Hospital
Primary care service	Boort District Hospital
	Dingee Bush Nursing Centre Inc.
	Inglewood and District Health Service
	Lockington and District Bush Nursing Centre Inc.
	Mallee Track Health and Community Service
	Managatang and District Hospital
	McIvor Health and Community Services
	Mt Alexander Hospital
	Robinvale District Health Services
	Rochester and Elmore District Health Service
	Sea Lake and District Health Service Inc.

Grampians region	
Regional trauma service	Ballarat Health Services
	Wimmera Health Care Group (Horsham)
Urgent care service	East Grampians Health Service (Ararat)
	East Wimmera Health Service (St Arnaud)
	Edenhope and District Hospital
	Hepburn Health Service (Daylesford)
	Stawell Regional Health
	St John of God Health Care Ballarat
	West Wimmera Health Service (Nhill)
Primary care service	Ballan and District Soldiers' Memorial Bush Nursing Hospital
	Beaufort and Skipton Health Service (Beaufort, Skipton)
	Djerriwarrh Health Services
	Dunmunkle Health Services
	East Wimmera Health Service (Birchip, Charlton, Donald, Wycheproof)
	Elmhurst Bush Nursing Centre Inc.
	Harrow Bush Nursing Centre Inc.
	Hepburn Health Service (Creswick)
	Lake Bolac Bush Nursing Service
	Wimmera Health Care Group (Dimboola)
	Rural Northwest Health (Hopetoun, Warracknabeal)

Hume region	
Regional trauma service	Albury Wodonga Health (Albury Campus)
	Goulburn Valley Health (Shepparton)
	Northeast Health Wangaratta
Urgent care service	Alpine Health (Bright Hospital, Mt Beauty Hospital, Myrtleford Hospital)
	Benalla and District Memorial Hospital
	Cobram District Hospital
	Kilmore and District Hospital
	Mansfield District Hospital
	Nathalia District Hospital
	Numurkah District Health Service
	Seymour District Memorial Hospital
	Upper Murray Health and Community Services
	Albury Wodonga Health (Wodonga Campus)
	Yarrawonga District Health Service
	Yea and District Memorial Hospital
Primary care service	Beechworth Health Service
	Euroa Hospital
	Nagambie hospital Inc.
	Tallangatta Health Service
	Violet Town Bush Nursing Centre
	Walwa Bush Nursing Centre