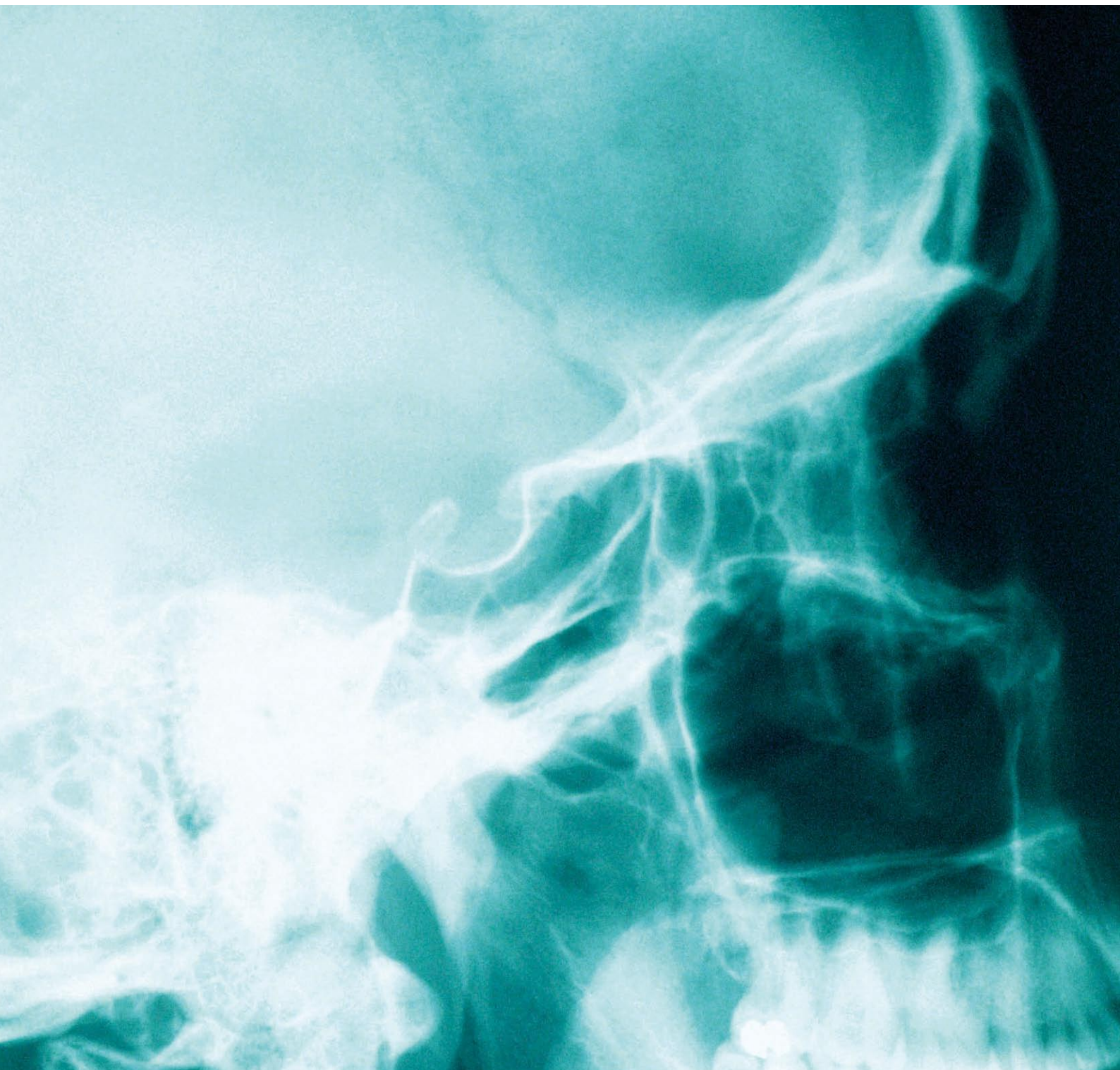


# Victorian State Trauma Registry 2005-06

Summary report



A Victorian  
Government  
initiative





**Victorian State Trauma Registry**  
**1 July 2005 to 30 June 2006**  
**Summary report**



Prepared by Monash University: Victorian State Trauma Outcome Registry and Monitoring Group.

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## Victorian state trauma system

The Department of Human Services has progressively introduced the Victorian state trauma system since 2000 to improve outcomes for patients who have experienced major trauma.

The system was introduced following the release of the Review of Trauma and Emergency Services – Victoria 1999 (ROTES) report. The report provided an extensive and comprehensive framework for the management of trauma in Victoria matching the needs of injured patients to an appropriate level of treatment, and shifting the focus from individual hospitals to a statewide system.

Victoria has one paediatric and two adult major trauma services located within metropolitan Melbourne. Metropolitan trauma and metropolitan primary care services service the greater metropolitan area. Within each of the five rural Department of Human Services regions, 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 to ensure major trauma patients receive definitive care according to the trauma triage guidelines at an appropriate trauma service within the system.

The 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 that includes complete or partial amputation; significant crush or entrapment; tissue devascularisation; multiple open injuries; and bilateral or brachial plexus injury. The Austin Hospital and St Vincent's Hospital are also metropolitan trauma services within the system.

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

**Further information is available from [www.health.vic.gov.au/trauma](http://www.health.vic.gov.au/trauma)**



## Executive summary

The Victorian state trauma system continues to improve and ensure the delivery of high-quality patient care.

The Department of Human Services commissioned the Victorian State Trauma Registry in collaboration with the Victorian Trauma Foundation. The registry's overall goal is to collect information from every hospital and health care facility managing trauma patients in Victoria. Aggregate data is presented for 2,148 major trauma patients treated at 138 hospitals during 2005-06. Data is now being collected from all health services.

This is the fifth annual report of the registry. Data collected during these five years has enabled trend monitoring in trauma incidence, severity, management and outcomes.

The overall rate of major trauma (presenting to hospitals) was 42 patients per 100,000 population. The overall major trauma death rate (both in-hospital and at-scene) was 21.9 deaths per 100,000 population. There has been a significant increase in the rate of hospitalised major trauma in Victoria from 1,406 patients in 2001-02 to 2,148 patients in 2005-06 ( $p<0.001$ ).

Overall, 11.7 per cent of all major trauma patients died after arrival at hospital. The percentage of hospitalised major trauma cases who died during their hospital stay has fallen significantly from 14.8 per cent in 2001-02 to 11.7 per cent in 2005-06 ( $p=0.008$ ).

During 2005-06, 80.7 per cent of all major trauma patients had an Injury Severity Score (ISS) greater than 15 (including those who died in hospital), and 13.0 per cent had a Glasgow Coma Score (GCS) less than nine. There has been a significant decrease in the percentage of major trauma cases with a GCS less than nine from 20.5 per cent in 2001-02 to 13.1 per cent in 2005-06 ( $p<0.001$ ).

The 2005-06 data confirms the trauma triage guidelines are being followed, with 76.6 per cent of major trauma patients receiving their care at a major trauma service and 3.1 per cent at the Austin Hospital for specialised spinal care. The remaining major trauma patients received their definitive care at a metropolitan trauma service or regional trauma service. The patterns of transfer across the system indicate patients were being transferred appropriately to a trauma service based on the trauma triage guidelines.

More patients were discharged to home (47.2 per cent) than to a rehabilitation centre (35 per cent) from their hospital of definitive care. There was a decrease in the number of patients discharged to rehabilitation centres compared with previous years. This may reflect the significant decrease in the number of very severely injured trauma patients (those with an ISS greater than 40). This has decreased significantly from 10.5 per cent in 2001-02 to 7.6 per cent in 2005-06 ( $p=0.001$ ).

The addition of more detailed outcomes data, including functional disability, has significantly improved the registry's capacity to monitor improvements in system performance. There has been a significant increase in the functional measure score of major trauma patients at discharge since 2003-04 ( $p=0.007$ ), indicating that the level of function at discharge has increased.

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

## Key data points

- A total of 2,148 major trauma patients were treated at 138 hospitals from July 2005 to June 2006.
- There has been a significant increase in the rate of hospitalised major trauma in Victoria since 2001 ( $p < 0.001$ ). Over five years, the registry has recorded a 52.5 per cent increase in major trauma from 1,406 patients in 2001–02 to 2,148 patients in 2005–06.
- There has been a significant rise in the rate of hospitalised falls-related major trauma cases since 2001–02 ( $p < 0.001$ ). In 2005–06, the rate was more than twice the rate of 2001–02 ( $p < 0.001$ ). There has also been a significant increase in the rate of deaths related to low falls since 2001–02 ( $p < 0.001$ ). Over the past three years, the rate of low falls-related deaths has doubled compared with earlier years.
- There has been a small but significant increase in the rate of hospitalised transport-related major trauma cases in 2005–06 compared with 2001–02 ( $p < 0.001$ ).
- In 2005–06, 79.7 per cent of major trauma patients received their definitive care at an appropriate trauma service based on the trauma triage guidelines.
- In 2005–06 the percentage of patients with a serious head injury was 43.8 per cent which is a significant reduction compared to 48.1 per cent in 2001–02 ( $p = 0.012$ ).
- The percentage of hospitalised major trauma cases who died during their hospital stay has fallen significantly from 14.8 per cent in 2001–02 to 11.7 per cent in 2005–06 ( $p = 0.008$ ). After adjusting for age and injury severity, there has been a significant reduction in the in-hospital death rate over the past three years, compared with 2001–02.
- The median length of stay has decreased from 8.8 days in 2001–02 to 8.0 days in 2005–06 and this is significant ( $p = 0.001$ ).
- There has been a significant increase in the functional measure score of major trauma patients at discharge since 2003–04 ( $p = 0.007$ ), indicating that the level of function at discharge has improved. Further analysis shows that the increase in function at discharge is confined to the locomotion and expression items of the functional measure. The percentage of major trauma cases who demonstrate dependence on locomotion at discharge has fallen from 35.8 per cent in 2003–04 to 28.4 per cent in 2005–06 ( $p < 0.001$ ), while dependence at discharge for expression has fallen from 8.7 per cent in 2003–04 to 6.7 per cent in 2005–06 ( $p = 0.008$ ).
- More patients were discharged to home (47.2 per cent) than to rehabilitation (35 per cent) and this is a significant increase since 2001–02 ( $p < 0.001$ ).

## About this report

This report is divided into two volumes. Volume one describes the registry and its activities and provides summary data to describe the Victorian state trauma system and the major trauma patients treated during 2005–06. The key indicators of system performance are presented and the profile of Victorian major trauma patients is described. Most of the data in this volume is presented across the whole trauma system and corresponds to patient level data. Where the data is aggregated across the trauma service levels, this aggregation is done either on the basis of episodes of care or according to information from either the first or definitive hospital of care, as appropriate. Volume one also contains a glossary of terms and description of the limitations of the registry.

Volume two provides additional data for readers who are interested in further tabulations of the registry data. Many of these tabulations describe in greater detail the data according to trauma service level on the basis of episodes of care or according to information from either the first or definitive hospital of care where appropriate.

Throughout these two volumes, incomplete data from previous years has been updated. An asterisk in a table cell indicates a count of one to five cases (either patients or episodes of care).

## Victorian State Trauma Registry

The ROTES report recognised that an effective trauma system requires formal monitoring and feedback processes. It recommended 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, commissioned the development of the registry in 2001.

The registry 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 reducing 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 registry.

The registry collects and analyses patient information from health services managing trauma patients across the state. In 2005–06 the registry collected information from 138 hospitals (Appendix 2).

## What was achieved during 2005–06?

### Coverage

The registry maintained formal working relationships with previously participating health services. Eastern Health is now contributing to the registry and ethics approval for data collection from Albury Hospital was received in July 2006. Linking episodes of care across health services with ambulance and coronial data sources has meant patients can be monitored across the continuum of care and provides reliable patient tracking across the system.

### Improvements in outcome measures

Functional measure data was collected at discharge and six months following injury. Return-to-work status was also collected at six months and continues to provide a better understanding of patient outcomes.

During 2005–06 the registry evaluated functional assessment instruments and replaced the modified functional independence measure (modified FIM) with the Glasgow Outcome Scale Extended (GOS-E) at six months. This has been added to the six-month follow-up protocol for all adult major trauma patients and will be included in future reports.

### Quality assurance

Pre-hospital data completeness is checked through linkages with the Victorian ambulance services. This includes manually crosschecking pre-hospital data with ambulance data.

Progress was made establishing a secure web-based data entry system that allows direct data entry by data collectors from metropolitan and regional trauma services. This more streamlined approach to collecting data is expected to deliver significant cost efficiencies, improved data quality and timeliness to both the hospital and the registry, facilitating more prompt data analysis and reporting.

### Feedback

Regular reporting to the department and State Trauma Committee has enabled enhanced feedback to the regional and metropolitan hospitals for those patients who fall outside the quality indicators.

### Information dissemination

During 2005–06, 15 peer-reviewed journal articles were written based on registry data. Fourteen were accepted for publication and one is under consideration. A list of publications and presentations is provided at the end of this report.

The registry received requests for data from external sources including the major trauma services, metropolitan trauma services and the Metropolitan Ambulance Service. 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 and Victorian Work Cover Authority, allowing comparisons between transport and work-related trauma and the general trauma population. No patient-level identifying data have been provided to third parties.

Studies are also underway looking at the practicality of using indicators to assess quality of care in health systems. The registry has a strong collaboration with the Hong Kong Trauma Registry and comparative studies are in progress.

## How does the Victorian State Trauma Registry operate?

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

### Eligible patients

To ensure the registry captures all major trauma patients in Victoria, broad-based inclusion criteria are used. The registry captures trauma patients whose principal diagnosis is injury, irrespective of age, and who meet any of the registry 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 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, intrathoracic or intra-abdominal injury, or fixation of pelvic or spinal fractures
5. Electrical injuries, drowning and asphyxia if admitted to an intensive care unit and have 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 (such as fractured femur or Colles fracture) – *unless meets inclusion criteria 1, 2 or 4*
4. Isolated injuries distal to the wrist and ankle only (such as finger amputations) – *unless meets inclusion criteria 1, 2 or 4*
5. Soft tissue injuries only (such as 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 major trauma services, 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, Loddon Mallee and Hume.

In-hospital flagging systems have been established to identify eligible patients. Data coordinators at the three major trauma services prospectively identify trauma patients by checking the hospital information system, emergency department admission records, intensive care unit admission records and ward rounds with the trauma service daily. 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 six 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 2005-06.

From the extracted data the following injury types are excluded:

- Fracture of neck of femur or hip
- airway obstruction by foreign body
- asbestosis
- carbon monoxide poisoning
- drug or alcohol overdose
- malignancy
- medical or surgical complication
- 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, mechanism and object are extracted.

For those who meet the trauma criteria an injury type (such as transport-related, hanging and low-fall) is assigned. Transport-related incidents include motor vehicle crashes (driver or passenger), motorcycle crashes (rider or pillion passenger), bicycle crashes, pedestrian injuries, train incidents and motorised scooter collisions. Asphyxia includes suffocations and strangulations. 'Other' injury types include electrocution, and aviation, skiing and surfing incidents. Deaths from the registry

are matched with those extracted from the NCIS database. The NCIS database is then searched for registry cases not on the extracted list by matching date of death, patient's age, gender, residential address and injury type.

## Registry training

Formal training sessions and workshops are conducted regularly to ensure data is collected in a standardised format. This includes training in registry procedures, data collection/extraction processes and definitions of data variables. Data collectors are able to attend an Abbreviated Injury Scaling (AIS) course which is coordinated by the National Trauma Research Institute.

## Registry data quality assurance

Automated and manual procedures are in place to ensure 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 range. Calculation of Functional Measure scores and Glasgow Coma Scores 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 hospital site, ensuring a more prompt response by that hospital.

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 registry death records are compared against those recorded by the NCIS based at the National Coroners Information Service and the Registry of Births, Deaths and Marriages. Where possible, metropolitan and rural ambulance patient care records are checked to identify all ambulance contacts with a patient who has had a traumatic event.

**Follow-up:** Follow-ups are performed after six months to help quantify the patient's level of function post-discharge and to identify those who have died. If patients are unable to be contacted, their records are checked against the Registry of Births, Deaths and Marriages.

## **Patient confidentiality**

The registry was established under the guidelines of the National Health and Medical Research Council to ensure confidentiality and patient privacy 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 registry 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 2005–06.

### Registry coverage

An initial estimate of the number of major trauma patients in Victoria using ICD-9 conversion to ISS was 1,790 + 162 (Jackson et al., 2001). The number of major trauma patients in year five (2,148) falls outside this estimated range. Clearly there have been changes to the demographics of major trauma patients during this period. Using Victorian Admitted Episodes Dataset (VAED) discharge diagnosis from Victorian hospitals, we believe that patient coverage is greater than 95 per cent of potential cases.

### Major trauma patients

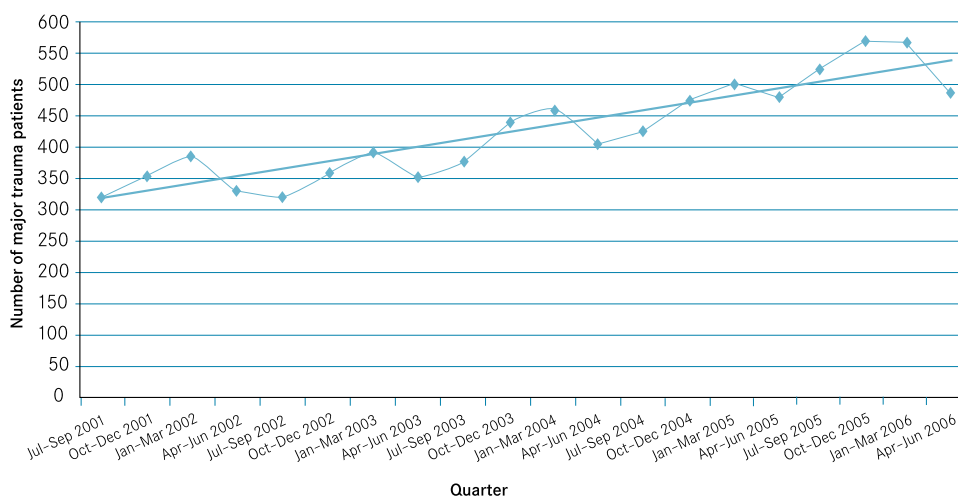
The registry recorded 2,148 hospitalised major trauma patients in Victoria over the 12-month period. The number of major trauma patients for each quarter is shown in Key indicator 1. This quarterly trend is a key indicator of the activity of trauma services over time. There were more major trauma patients during the warmer months than at any other time in the registry's operation.

There has been a significant increase in the rate of hospitalised major trauma in Victoria since 2001 ( $p < 0.001$ ). The overall annual rate of in-hospital major trauma in Victoria was 42 per 100,000 population.<sup>1</sup> The annual rate for the first year was 30, in the second year it was 28, in the third year it was 34 and in the fourth year it was 37 per 100,000 population. This may be in part due to improved case identification and complete health service participation in the registry over recent years.

#### Key indicator 1 – Number of hospitalised major trauma patients

The registry recorded 2,148 major trauma patients during 2005–06

**Figure 1: Trends in the number of hospitalised major trauma patients recorded by the registry**



<sup>1</sup> This rate is based on the Australian demographic statistics for 2006 of 5,091,700 (Australian Bureau of statistics website, 2007)

## Episodes of care

The 2,148 patients required a total of 2,876 hospital care episodes. The majority (1,463 or 68.1 per cent) required only one episode of care, 642 (29.8 per cent) experienced two episodes of care, and 43 (2 per cent) patients had three episodes of care. Forty-four per cent of patients (941 patients) required an intensive care unit admission. Thirty-one per cent of patients (666 patients) had an intensive care unit length of stay requiring mechanical ventilation of more than 24 hours.

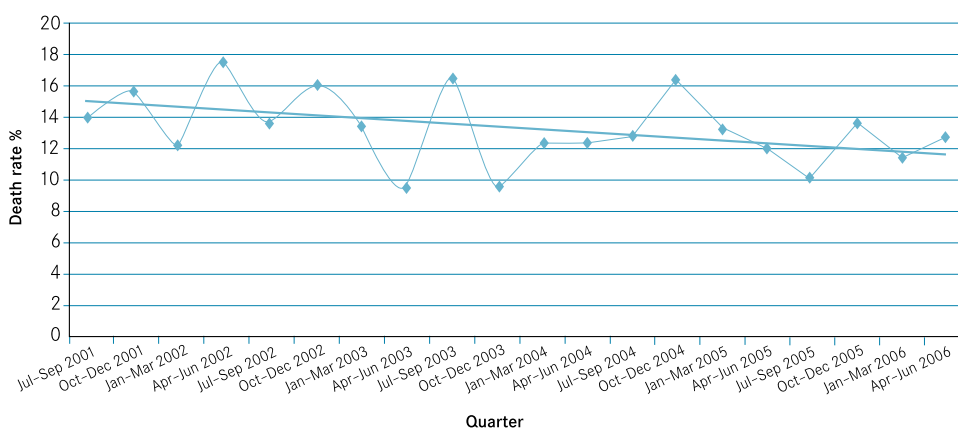
## Deaths

Overall, the registry recorded 252 deaths that correspond to an overall death rate of 11.7 per cent among the hospitalised major trauma patients. Post-discharge deaths are captured through follow-up and linkage with the Victorian Registry of Births, Deaths and Marriages and these are reported in the six-month follow-up outcomes.

### Key indicator 2 – Death rates (overall and in-hospital)

The overall death rate due to major trauma in Victoria was 21.9 deaths per 100,000 population. There has been no change in the overall trauma death rate over the past five years ( $p=0.621$ ). Major trauma deaths in hospital were 4.9 per 100,000 (22.7 per cent of all major trauma deaths).<sup>2</sup> The death rate for admitted major trauma patients was 11.7 per cent.

Figure 2: Trends in the death rate of admitted major trauma patients



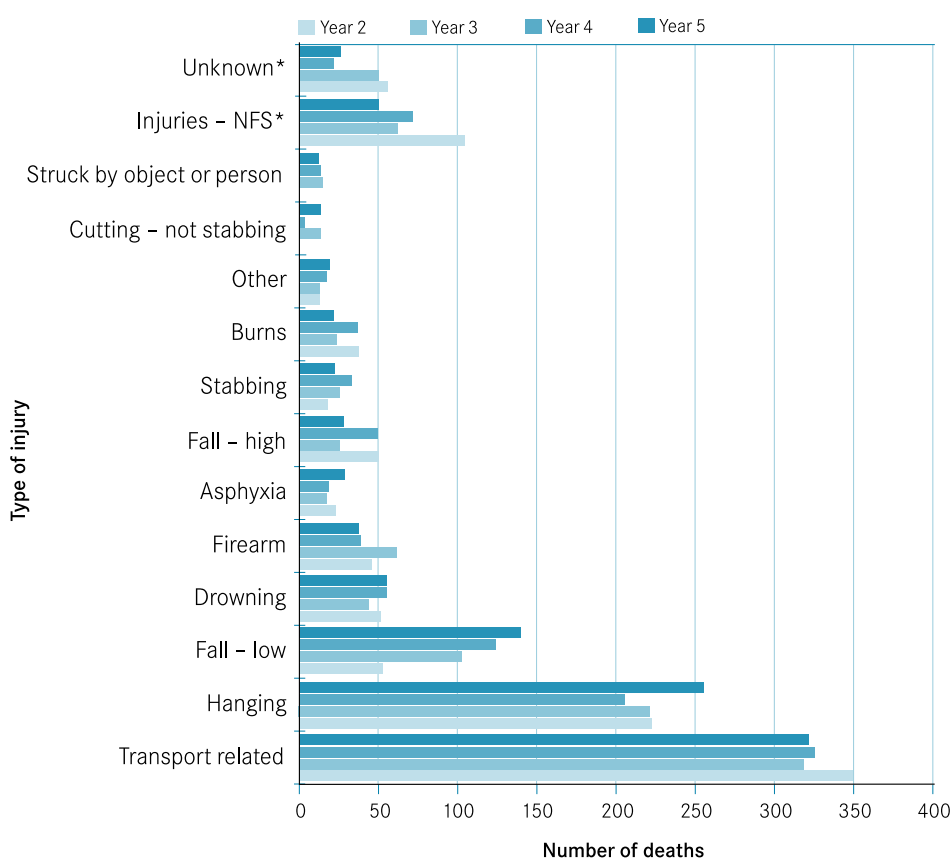
The percentage of hospitalised major trauma cases who died during their hospital stay has fallen significantly from 14.8 per cent in 2001–02 to 11.7 per cent in 2005–06 ( $p=0.008$ ).

The NCIS recorded 1,045 trauma deaths (excluding deaths following fractured neck of femurs) during 2005–06 in Victoria. Coronial investigations were completed and closed on 74.5 per cent of these deaths. Of the 252 deaths recorded by the registry, 223 (88.5 per cent) were reported in the NCIS. Of the remaining 29 deaths recorded by the registry, 23 were elderly or had significant co-morbidity and suffered low falls, possibly explaining the lack of referral to the Coroner.

<sup>2</sup> This rate is based on the Australian demographic statistics for 2006 of 5,091,700 (Australian Bureau of statistics website, 2007)

The estimated number of trauma deaths in Victoria, at the scene or in hospital, was 1,114 cases (1,045 complete on the NCIS; 40 not identified as trauma; and 29 recorded in the registry but not found on the system). This is an increase from previous years (1,039 in 2002-03, 1,001 in 2003-04 and 1,022 in 2004-05).

**Figure 3: National Coroners Information System trauma deaths**



\* 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 (31 per cent), hangings (24.7 per cent) and falls (high and low) (16.4 per cent). The number of deaths due to transport-related incidents was similar to 2003-04 and 2004-05 but lower than 2002-03 and the number of deaths due to low falls has increased from 2002-03, 2003-04 and 2004-05. Deaths and major injury from low falls were markedly increased in the elderly. This may be related to improved reporting. Despite the increase in number of deaths due to hanging from 206 in 2004-05 to 258 in 2005-06, the rate of deaths due to hanging relative to population increase remains unchanged since 2002-03 (p=0.394). Of the hangings with known intent 96.5 per cent were intentional self harm in 2004-05 and similarly 97.7 per cent were intentional self-harm in 2005-06.

As most of the patients who die from hanging, drowning or asphyxia do not reach hospital alive, these cases are generally not included in the registry (only 11 attempted hangings were recorded in 2005-06). The low number of stabbings in the NCIS database is consistent with the registry. The number of deaths due to stabbings was lower than for previous years. The overall number of deaths from penetrating injury (firearm and stabbing) was lower than previous years (64 in 2002-03, 89 in 2003-04, 76 in 2004-05 and 63 in 2005-06).

The total number of paediatric (14 years and under) deaths remains low with 41 in 2002-03, 38 in 2003-04, 35 in 2004-05 and 31 in 2005-06. There has been a decrease in the number of deaths resulting from transport-related incidents from 16 in 2002-03 and 2003-04 to eight in 2004-05 and 10 in 2005-06. The number of drownings has increased from four in 2002-03 and 2003-04 to seven in 2004-05 and 2005-06. The percentage of unintentional paediatric deaths has remained constant with 82.1 in 2002-03, 83.3 in 2003-04, 85.7 in 2004-05 and 87.5 in 2005-06.

### Reason for inclusion in the registry database

A hierarchical classification is used to classify patients as meeting the major trauma definition for registry 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 year five, the distribution of the 2,148 registry patients according to this hierarchical classification was:

- 11.7 per cent of patients died<sup>3</sup>
- 71.3 per cent of patients had an ISS greater than 15
- 5.7 per cent of patients spent more than 24 hours in an intensive care unit with mechanical ventilation
- 11.2 per cent of patients required urgent surgery.

<sup>3</sup> Of these, 75.4 per cent had an ISS greater than 15.

## Demographic profile of hospitalised major trauma patients

Consistent with other international and local trauma registries and injury surveillance systems (Neale, Kassulke and McClure, 1998; American College of Surgeons, 2005; South West Sydney Area Health Service, 2000), the majority of injured patients were male (69.4 per cent). The Australian National Trauma Registry Consortium (NTRC) Report for 2004 also showed a high number of injured male patients (73 per cent). In the 2005 National Trauma Databank (NTDB) 72.3 per cent were male. The predominance of males was consistent across all age groups. Young adults (aged 15–24 years) accounted for 19.7 per cent and 23.3 per cent were aged over 65 years. There were relatively few paediatric (aged 0–14 years) major trauma patients (6.3 per cent of the total) compared with adults. This is also consistent with the NTRC 2004 report where 21 per cent were aged 15–24 years, 20.7 per cent were aged over 65 years and 8.8 per cent were paediatric. In the 2005 Major Trauma Outcome Study, 22 per cent were aged 15 to 24 years, 17.6 per cent were aged over 65 years and 12.7 per cent were paediatric (0–14 years).

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

### Cause and location

The most common location for the event leading to major trauma was a road, street or highway (50.5 per cent of all major trauma patients with a known location). As many road trauma victims sustain serious and multiple trauma, the preponderance of this type of trauma places an increased burden on trauma service delivery. The home was the next most common location of injury (22 per cent of major trauma patients with a known location). The majority of at-home injuries were the result of a fall (63.6 per cent). Workplace settings (including farms) were a small, but significant, location of injury (7.2 per cent).

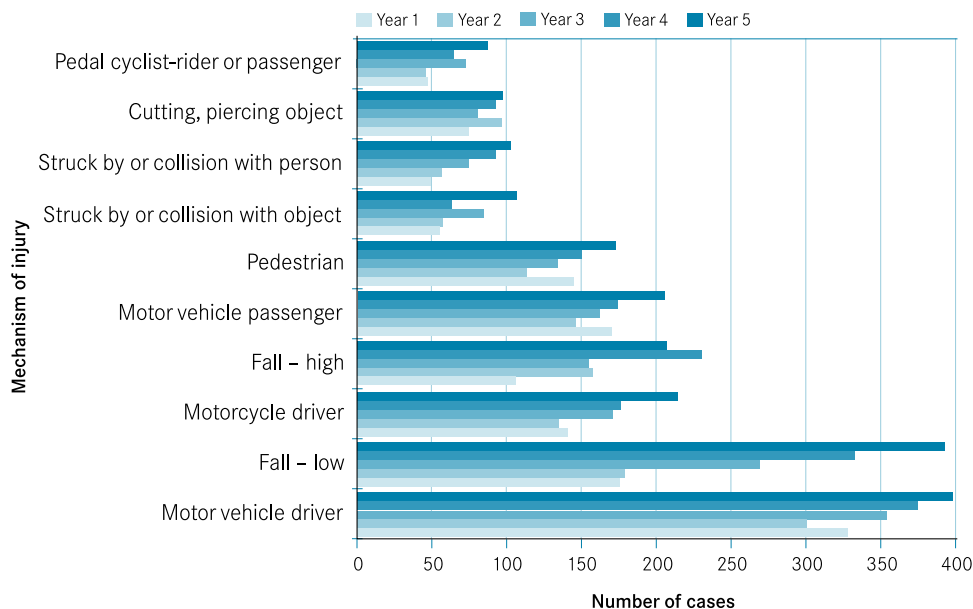
The ten most common mechanisms of injury are shown in Figure 4. Together these accounted for 91.3 per cent of all major trauma patients. Overall, 18.5 per cent of patients sustained their injury as a driver in a motor vehicle crash. These motor vehicle drivers were most commonly male (69.8 per cent of all injured drivers) and in the age group 15–24 years (30.7 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 small but significant rise in the rate of hospitalised transport-related major trauma cases in 2005–06 compared with 2001–02 ( $p < 0.001$ ).

The largest increase in the number of major trauma victims was in the low-falls group. There has been a significant rise in the rate of hospitalised low falls-related major trauma cases since 2001–02 ( $p < 0.001$ ). In 2005–06, the rate was more than twice the rate of 2001–02 ( $p < 0.001$ ).

The majority of low-fall patients (78.4 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 registry excludes patients with a fractured neck of femur as their sole injury and only 10 of the older falls patients had this injury in combination with other injuries. Education programs to decrease this preventable injury remain a high priority.

The reasons for this are unclear but could reflect continued ageing of the population and better reporting. Falls from ladders at home continue to be an important cause of serious injury, especially in those aged over 50. There were 46 recorded in 2005-06. A recent study showed there has been a significant rise in the number of falls from ladders in Victoria, in particular for those patients over 50 years undertaking unpaid work. A targeted public health initiative is required to curb this trend.

**Figure 4: The 10 most common mechanisms of injury of hospitalised Victorian major trauma 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 for their trauma care costs from the Transport Accident Commission. Overall, 41.3 per cent of patients were likely to be Transport Accident Commission compensable. This percentage is compatible with the high proportion of road trauma patients (50.7 per cent).

Over 90 per cent (92 per cent) of Transport Accident Commission-compensable patients received their definitive care at a major trauma service or the Austin Hospital for definitive spinal care. This is expected given the trauma triage guidelines suggest a low threshold for transfer to major trauma services in cases involving a high-speed mechanism, despite mechanism of injury not being a reason for transfer in itself.

### Injury intent

Overall, 85.6 per cent of all the major trauma patients sustained their injuries during unintentional events. This is higher than the 80 per cent reported by the United States (American College of Surgeons, 2005). Intentional self-harm accounted for 3.5 per cent of all patients. This reflects the fact that while intentional self-harm causes many deaths (Steenkamp, 2000), major injury from self-inflicted violent mechanisms requiring hospital care is relatively uncommon.

From the NCIS of the closed trauma cases with known intent, the percentage of unintentional deaths was 51.8 in 2002–03 and 51.5 in 2005–06. Intentional self-harm accounted for 47.3 per cent in 2002–2003 and 42.8 per cent in 2005–06.

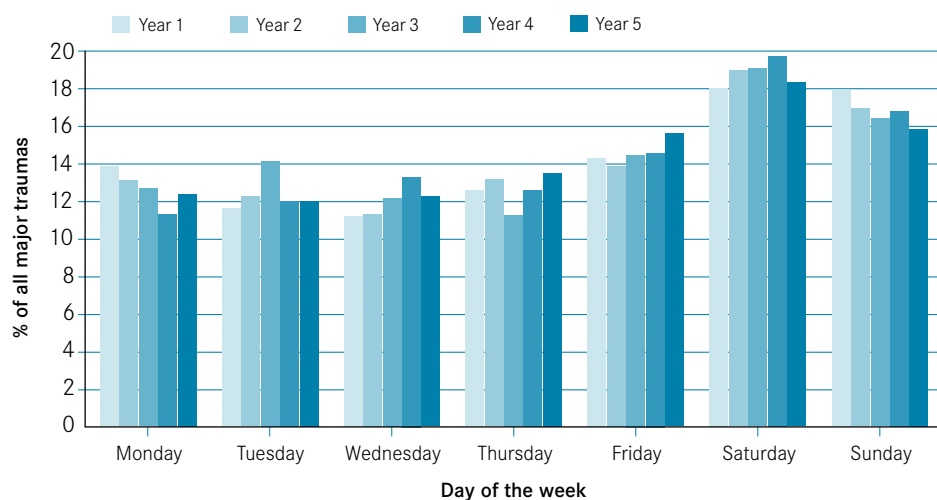
## Time and day of injury

Figure 5 shows injuries occurred more frequently on weekends, particularly Saturdays (18.4 per cent of all patients), than during the week. Injuries were also more common during the hours of 8 am to 4 pm (41.1 per cent of all patients). This is consistent with year three and year four but in contrast to year one and year two when injuries were more common during the hours of 4 pm to midnight.

### Key indicator 3 – Time and day of injury

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

**Figure 5: Day of injury for major trauma patients**



## Location of trauma injury

Figures 6 and 7 show the geographical spread of patients. These figures indicate a higher incidence of injured patients within the Gippsland region and the southern metropolitan area. This could be partly related to road conditions and tourist activity. A number of patients injured outside Victoria received definitive treatment within the system (21 injured in New South Wales, 10 injured in Tasmania and two injured in Queensland). Other studies have shown a relationship between socioeconomic status and injury rates. Further analysis is required to understand the geographical distribution.

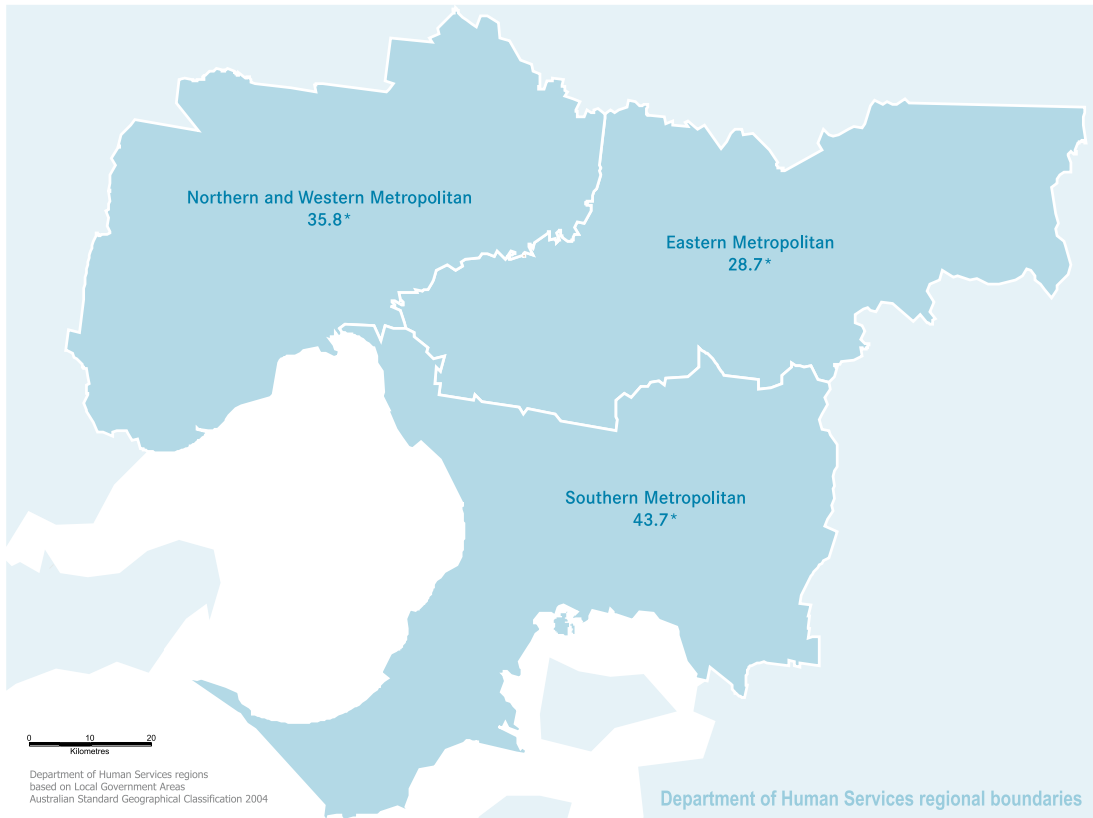
Not represented in either Figure 6 or 7, are the 199 patients (9.3 per cent) for whom the postcode of the injury was unknown.

**Figure 6: The incidence of hospitalised major trauma patients in each region of Victoria**



\* Rates are per 100,000 population.

**Figure 7: The incidence of hospitalised major trauma patients in each region of metropolitan Melbourne**



\* Rates are per 100,000 population.

## 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 registry were in the blunt trauma category (93.4 per cent). Six per cent of cases were due to a penetrating injury and two per cent were burns related. Overall this is comparable with the Australian National Trauma Registry Consortium blunt injury category (94.2 per cent). The percentage of penetrating injuries was higher than the United Kingdom (8.7 per cent compared with 2.7 per cent) (Lecky et al., 2000).

### Injury severity

#### Key indicator 4 – Overall injury severity

Of all major trauma patients, 80.7 per cent had an ISS greater than 15.

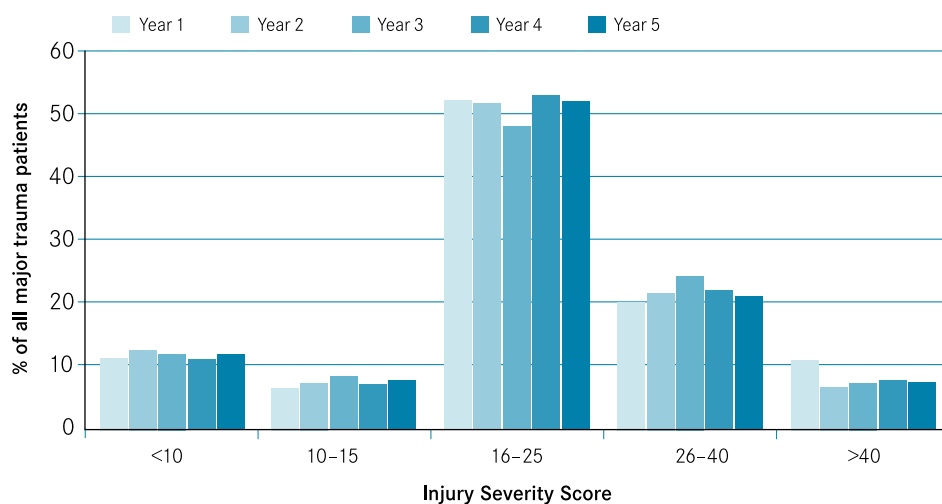
Overall, 80.7 per cent of major trauma patients had an ISS>15. This is similar to previous years. The median ISS for the first three years was 20 and in 2004–05 and 2005–06 it was 19.

The percentage of very severely injured major trauma patients (with an ISS greater than 40) has decreased significantly from 10.5 per cent in 2001–02 to 7.6 per cent in 2005–06 ( $p=.001$ ). This decrease in injury severity could reflect injury prevention initiatives, such as improved vehicle design, and public education campaigns.

The distribution of ISS shows that 52.3 per cent of the patients had ISS scores in the range 16–25. This reflects the 'ISS>15' registry inclusion criterion. Patients with an ISS<15 met the 'death', 'urgent surgery' or 'intensive care unit stay greater than 24 hours requiring mechanical ventilation' criteria.

**Table 3: Injury Severity Score of major trauma patients for each quarter**

Percentage of patients by ISS	ISS >15 (%)	ISS >40 (%)
2001–02	82.3	10.5
2002–03	79.7	6.5
2003–04	79.9	7.3
2004–05	82.3	7.8
2005–06	80.7	7.6

**Figure 8: Distribution of Injury Severity Scores**

## Multiple trauma

The 2,148 patients sustained a total of 12,056 injuries. The distribution of the number of injuries was:

- 26.2 per cent of patients had one to two injuries
- 22.0 per cent had three to four injuries
- 51.3 per cent had five or more injuries.

Transport-related trauma victims commonly sustain multiple injuries and were responsible for the majority of multi-trauma cases. Seventy-one per cent of major trauma patients with five or more injuries were transport-related.

## Head injury severity

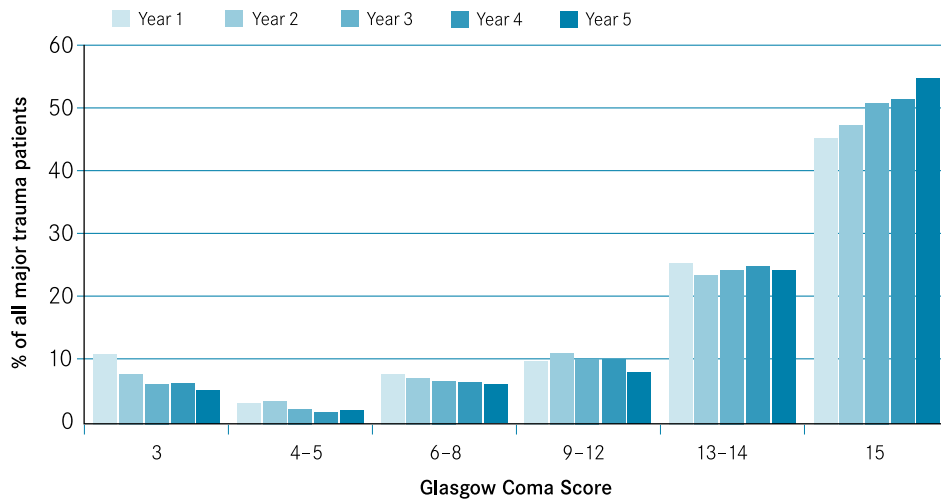
The median Glasgow Coma Score (GCS) on arrival at an emergency department was 15 (range: three to 15). Figure 9 shows the GCS of patients on arrival at an emergency department. Patients demonstrating a GCS less than nine are known to have poor outcomes.

There has been a significant decrease in the percentage of major trauma cases with a GCS less than nine since 2003-04 ( $p < 0.001$ ). The percentage of major trauma cases with a GCS less than nine has fallen from 20.5 per cent in 2001-02 to 13.1 per cent in 2005-06.

### Key indicator 5 – Head injury severity

Of all major trauma patients, 13 per cent had a GCS less than nine.

**Figure 9: The Glasgow Coma Score for all major trauma patients on arrival from scene to first emergency department<sup>4</sup>**



*4 If no GCS was recorded at an emergency department or the patient was intubated or sedated on arrival, the patient's pre-hospital GCS value was used. There were 137 patients with no GCS information. Previously, many of the more severe head injuries were not included in Figure 9 because they were intubated in the pre-hospital setting. Consequently, the registry applies the patient's pre-hospital GCS prior to intubation and now includes these cases.*

## How were the patients distributed?

The vast majority of patients received their definitive care at a major trauma service. In 2005–06, 79.7 per cent of patients received their definitive care at an appropriate trauma service based on the trauma triage guidelines. This includes 3.1 per cent at the Austin Hospital for specialised spinal care. There was a further 1.2 per cent who were elderly patients who had sustained an isolated head injury as the result of a low fall and received appropriate treatment at a metropolitan trauma service with neurosurgical capabilities.

Full data collection commenced at St Vincent's Hospital in July 2003, with retrospective data collection from April 2003, consequently impacting on figures for 2003–04, 2004–05 and 2005–06.

### Key indicator 6 – Definitive trauma service level

Trauma service level	Percentage of major trauma patients (%)				
	2001–02	2002–03	2003–04	2004–05	2005–06
MTS	78.5	78.0	75.9	74.3	76.6
Austin (spinal)	4.5	3.7	4.2	4.2	3.1
Metropolitan Neurosurgical Service*	0	0.2	0.8	1.3	1.2
MeTS	10.2	10.9	11.8	14.0	13.0
MPCS	0.0	0.1	0.1	0.1	0.7
RTS	5.5	6.3	5.3	5.3	4.8

*MTS = major trauma service; MeTS = metropolitan trauma service; MPCS = metropolitan primary care service; RTS = regional trauma service; UCS = urgent care service; PCS = primary care service*

*\*Metropolitan Neurological Service = The Austin Hospital, Monash Medical Centre, St Vincent's Hospital*

## Pre-hospital care and quality indicators

This section describes the pre-hospital phase of care and provides quality indicators associated with this care. This section is limited by the extent to which the registry data collection processes were able to capture pre-hospital care information from health service records. The registry is working closely with ambulance services to improve data capture and accuracy. Metropolitan Ambulance Service has commenced implementation of the Victorian Ambulance Clinical Information System enabling the electronic capture of data from the pre-hospital phase.

For all patients known to be directly transported by an ambulance service to the primary hospital in 2005-06 (1,774 patients<sup>5</sup>), the time and date of the received call were available for 1,615 patients (91 per cent). This compares with 68.3 per cent in 2001-02. The time and date of arrival at the hospital were available for 1,700 patients (95.8 per cent) in 2005-06 compared with 87.1 per cent in 2001-02. These figures suggest an improvement in the quality of pre-hospital data recording.

### Pre-hospital transit times

The first hour immediately after sustaining major trauma is critical to patient survival, commonly referred to as the 'golden hour'. The median time from receipt of the ambulance call until arrival at the first hospital was 55 minutes (range: 9 to 783 minutes) for non-entrapped patients and 82 minutes (range: 27 to 264 minutes) for entrapped patients.

### Time at scene

The median time at the scene for entrapped patients was 38 minutes (range: 1 to 155 minutes) and 21 minutes (range: 1 to 747 minutes) for non-entrapped patients. There was considerable variation in the times 'at scene' both within a particular ambulance service and across different services. The at-scene time was generally shorter for non-entrapped patients. Patients serviced by Air Ambulance Victoria generally had a longer scene time which may reflect the severity of injuries sustained by some patients requiring air transport. Longer scene times may be influenced by an increased reliance on air transport and aircraft availability.

### Quality assurance indicators

1. **Pre-hospital time >one hour.**  
For this indicator, 41.5 per cent (38.6 per cent last year) of the non-entrapped patients and 76.2 per cent (80.2 per cent last year) of entrapped patients had a total time from receipt of the ambulance call to arrival at an emergency department of more than one hour.
2. **Pre-hospital scene time >20 minutes.**  
1,247 (95.8 per cent) non-entrapped blunt trauma patients had a calculated scene time. Of these, 58 per cent (58.2 per cent last year) had a scene time of more than 20 minutes. Over time, scene time has increased, with more procedures being performed on-scene. Longer scene time is also influenced by an increased reliance on air transport and aircraft availability. Audit of times by the ambulance sources suggests that these are the major contributing factors for the increases.

*5 The Patient Care Record was unavailable for 72 of these patients. A further 136 patients did not have a known transporting service to the primary hospital, as referral hospital data was not available*

3. **Systolic blood pressure <100 mmHg on arrival and scene time >10 minutes.**

Of the 24 non-entrapped penetrating injury patients with a blood pressure less than 100 mmHg on arrival at the scene and a calculated scene time, 79.2 per cent had a scene time of more than ten minutes, compared with 80.8 per cent in 2004-05. The single most important determinant of penetrating trauma is time to definitive surgery. The Metropolitan Ambulance Service and Rural Ambulance Victoria have ongoing education programs to improve transit times for this group of patients.

4. **GCS<nine at scene and O2 saturation <90 per cent after ten minutes.**

Of the 146 head injured patients with a GCS less than nine at the scene of injury and a recorded oxygen saturation after ten minutes, 11.6 per cent had an oxygen saturation of less than 90 per cent. Hypoxaemia is recognised as a significant cause of secondary brain injury. The Rapid Sequence Intubation (RSI) trial is now more than 50 per cent complete and it is envisaged this will inform pre-hospital airway management best practice.

5. **GCS<nine and systolic blood pressure <100 mmHg after 10 minutes.**

Of the 194 head injured patients with an at-scene GCS less than nine and a recorded systolic blood pressure after 10 minutes at the scene, 19.6 per cent had a systolic blood pressure of less than 100 mmHg, this is significantly less than previous years. Hypotension is recognised as a significant cause of secondary brain injury. This issue is under constant review.

## Patient transfers

*This section describes the transfers across the system.*

### Direct admissions and transfers to major trauma services

Table 4 describes the origin of the patients admitted to each major trauma service. At The Royal Melbourne and The Alfred hospitals, 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 was as expected given the trauma triage guidelines for paediatric trauma. There has been a significant increase in primary transfer of major trauma cases to The Royal Melbourne Hospital since 2001-02 ( $p < 0.001$ ). The percentage of primary transfers to The Royal Melbourne Hospital has increased from 55.3 per cent in 2001-02 to 74.2 per cent in 2005-06. The percentage of primary transfers to the Royal Children's Hospital has increased from 28.3 per cent in 2001-02 to 45 per cent in 2005-06. This reflects the recognition of these hospitals as major trauma services. Despite a decrease in the percentage of major trauma cases that were secondary or tertiary transfers to the Royal Children's Hospital, 68.1 per cent in 2001-02 to 53.5 per cent in 2005-06, this was not significant ( $p = 0.220$ ).

The patient transfer patterns indicate patients were being transferred to a trauma service with a higher designation. A study in the United States showed there were better functional outcomes at discharge for severely injured patients treated at level one trauma centres compared with those treated at level two trauma centres (Demetriades, 2005). This is also demonstrated by The Consultative Committee on Road Traffic Fatalities (1997).

It has been estimated that 30-35 per cent of adult patients will be more than 30 minutes from a major trauma service and require transfer to a non-major trauma service hospital first for stabilisation prior to secondary transfer.

**Table 4: Numbers of direct admissions and transfers to each major trauma service**

Hospital	Year	Number	Direct from scene (%)	Transfer in from referral hospital (%)	Other (%)	Total (%)
The Alfred	2001-02	706	60.3	34.8	4.9	100.0
	2002-03	711	63.3	34.2	2.5	100.0
	2003-04	778	68.9	29.3	1.8	100.0
	2004-05	791	68.3	29.2	2.5	100.0
	2005-06	924	61.9	35.7	2.4	100.0
The Royal Melbourne Hospital	2001-02	284	55.3	43.3	1.4	100.0
	2002-03	297	59.3	39.1	1.6	100.0
	2003-04	412	68.0	30.6	1.4	100.0
	2004-05	536	71.3	26.7	2.0	100.0
	2005-06	592	74.2	23.8	2.0	100.0
Royal Children's Hospital	2001-02	113	28.3	68.1	3.6	100.0
	2002-03	115	39.1	58.3	2.6	100.0
	2003-04	111	39.6	59.5	0.9	100.0
	2004-05	101	43.6	55.5	0.9	100.0
	2005-06	129	45.0	53.5	1.5	100.0
Austin Hospital (spinal)	2001-02	63	28.6	66.7	4.7	100.0
	2002-03	53	1.9	96.2	1.9	100.0
	2003-04	72	5.6	93.1	1.3	100.0
	2004-05	80	2.5	97.5	0.0	100.0
	2005-06	67	10.5	80.6	8.9	100.0
Total	2001-02	1166	54.3	41.9	3.8	100.0
	2002-03	1176	57.1	40.6	2.3	100.0
	2003-04	1373	63.0	35.4	1.6	100.0
	2004-05	1508	64.2	33.7	2.1	100.0
	2005-06	1712	62.9	34.5	2.6	100.0

## Mode of transport

Overall, the most common mode of transport for direct admissions to a major trauma service was a road ambulance. There were 658 road primary transports and 284 helicopter primary transports during the reporting period. The number of helicopter primary transports has increased from 248 in 2001–02 (13.2 per cent) to 284 in 2005–06 (17.6 per cent) leading to a decrease in secondary transfer.

For referral admissions there were 271 road transfers, 87 helicopter and 72 fixed-wing transfers during 2005–06.

## Transfers across the system

Overall, 685 major trauma patients were transferred and complete information about all transfers and episodes of care was available for 567 of these patients (82.8 per cent).<sup>6</sup> The majority of transferred patients (84.7 per cent) received their definitive treatment at an appropriate trauma service based on the trauma triage guidelines. This includes 7.9 per cent to the Austin Hospital for specialised spinal care. A further 1.5 per cent were elderly patients who had sustained an isolated head injury as the result of a low fall and were transferred to a metropolitan trauma service with neurosurgical capabilities.

Regional trauma services provided the highest number of patients with initial care prior to transfer to a major trauma service.

### Key indicator 7 – Transfers across the system

(685 patients)	Definitive hospital of care No. of transferred patients						
	MTS	Austin/ St Vincent's	MNS*	MeTS	MPCS	RTS	UCS
MTS	5	15	-	*	*	-	-
Austin/St Vincent's <sup>7</sup>	-	-	-	-	-	-	-
MeTS	118	9	*	26	*	-	-
MPCS	48	-	-	25	-	-	-
RTS	207	20	*	16	*	-	-
UCS	103	*	*	9	-	11	-
PCS	10	-	-	-	-	*	-
Other	25	7	*	5	-	-	*

*MTS = major trauma service; Austin = Austin Health Service; MNS = Metropolitan Neurosurgical Service (The Austin Hospital, Monash Medical Centre, St Vincent's Hospital); MeTS = metropolitan trauma service; MPCS = metropolitan primary care service; RTS = regional trauma service; UCS = urgent care service; PCS = primary care service.*

*<sup>6</sup> 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 (17.2 per cent for 2005-06 compared with 23.2 for 2004-05, 23.6 for 2003-04, 36.3 per cent for 2002-03 and 46.9 for 2001-02). The reasons for there being no specific information from the referring hospital for 2005-06 were that information about episodes of care cannot be collected from patients treated either overseas (six cases) or interstate (24 cases), hospitals without ethics approval (15 cases) or outside of the Victorian state trauma system (nine cases). Note: 'Other' refers to patients transferred into Victoria from interstate and overseas, and those from a Victorian hospital that is not designated within the trauma system.*

*<sup>7</sup> The figures for Austin Hospital and St Vincent's Hospital only include patients that were transferred to receive definitive specialist care. Patients not requiring specialist definitive care transferred to these hospitals are included in the MeTS figures.*

## Specialist transfers

Eighty-four paediatric patients (0–14 years) were transferred through to another trauma service level. The majority of these patients (86 per cent) had an ISS greater than 15. Fifty-five (76.4 per cent) of these patients were transferred to the Royal Children’s Hospital, one was transferred to The Alfred, one to The Royal Melbourne Hospital and one to The Austin Hospital for definitive spinal care.

Table 6 summarises specialist transfers. On a proportional basis, more children (53.6 per cent) were transferred with head injury than adults (33.7 per cent). A head injury is defined as a patient who received an injury to their head with an AIS severity score greater than two. The majority of transferred patients with a head injury (334 patients) received their definitive treatment at a major trauma service (79.6 per cent).

**Table 5: Numbers of specialist transfers**

Type of trauma	Children		Adults	
	Number of patients	Percentage transferred	Number of patients	Percentage transferred
Head injury	70	52.9	857	33.7
Spinal cord injury	4	50.0	116	53.4
Both head and spinal cord injury	*	–	26	30.8

## 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. **Failure to activate trauma team at a major trauma service.**

The trauma team was activated for 64.6 per cent of all patients arriving at a major trauma service emergency department. This rate varied across the major trauma service hospitals: 70.5 per cent at The Alfred, 66.4 per cent at The Royal Melbourne Hospital, 48.1 per cent at the Royal Children's Hospital and 3.0 per cent at The Austin Hospital.<sup>8</sup>

Major trauma services activated a trauma team for 47 per cent of all patients received via transfer. This varied across the major trauma service hospitals: 54.7 per cent at The Alfred, 51.9 per cent at The Royal Melbourne Hospital, and 24.2 per cent at the Royal Children's Hospital.

2. **No intubation in patients with GCS<nine.**

Across all trauma service levels, 78 non-intubated patients presented to an emergency department with a GCS less than nine. Of these, seven patients (9 per cent) were not intubated during their emergency department stay. Of these seven patients, two were elderly low-falls patients, two were infants, one died and there were two others.

3. **Length of time from arrival at an emergency department >two hours until a head CT scan.**

The time from arrival at an emergency department until a CT scan of head-injured patients with an AIS greater than two and accurate times recorded was more than two hours in 238 patients (31.7 per cent). The longest time from emergency department to head CT scan was at the metropolitan trauma services and shortest at the regional trauma services. Patients considered inappropriate for transfer or imaging resourcing, capacity and availability may be contributing factors to wait times.

4. **Penetrating torso trauma >one hour to theatre.**

There were 1,124 patients with an injury to their torso region. Penetrating trauma occurred in 99 of these patients and 79 had full-time-to-theatre data. Of these 79, 54 patients (68.4 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.

Of the 11 patients with haemodynamic instability, one died. Of the remaining 10, five waited more than one hour for surgery.

<sup>8</sup> 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 with adult trauma patients).

## Outcomes of major trauma

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

### Length of stay

Figure 10 shows the length of stay, with a significant decrease over the past five years from 8.8 days in 2001-02 to 7.9 days in 2005-06 ( $p=0.001$ ). In 2004 the South West Sydney Area Health Service reported a median length of stay of 8.4 days. The National Trauma Registry Consortium reported a mean length of stay of 15.9 days for 2004. The mean length of stay for registry patients for 2005-06 was 11.7 days. Over the five years, 16.5 per cent of patients had a stay longer than 21 days. This decreased length of stay may reflect improved clinical practice and/or a reduction in the number of severely injured patients.

**Figure 10: Length of stay data compared with previous years**

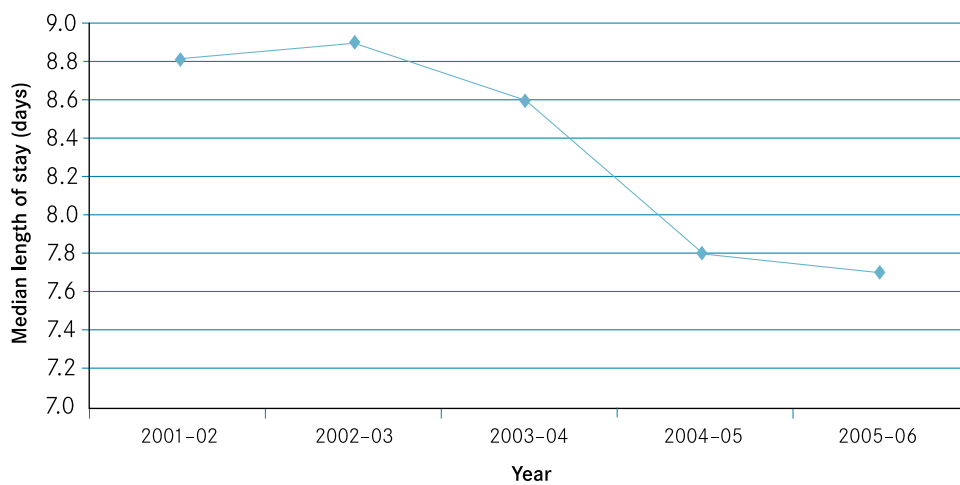
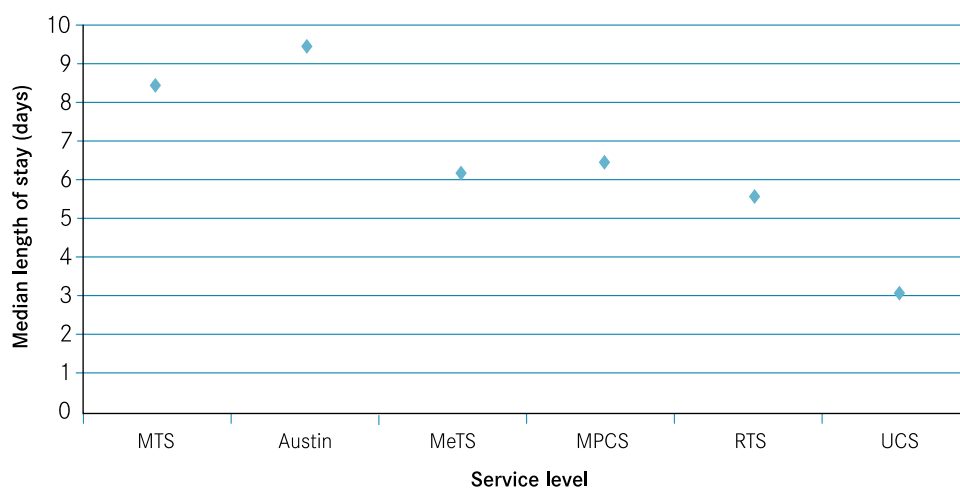


Figure 11 shows the length of stay for patients at different service levels. Length of stay is longer at the major trauma services because the patients generally require more complex care.

**Figure 11: Length of stay data by service level for year five**



## Discharge status

In 2005–06, the majority of major trauma service patients were discharged to home. There has been a significant increase in the percentage of patients discharged home, from 38.8 per cent in 2001–02 to 47.2 per cent in 2005–06 ( $p < 0.001$ ).

The percentage of patients discharged to rehabilitation has decreased and this may be due to improved outcomes at discharge or change in patient acuity.

### Key indicator 8 – Discharge status

Discharge status from definitive hospital of care	Percentage of patients				
	2001–02	2002–03	2003–04	2004–05	2005–06
Home	38.8	39.6	41.8	43.7	47.2
Rehabilitation centre	41.3	40.1	39.9	37.0	35.0
Dead	14.8	13.3	12.6	13.3	11.7
Other hospital	2.6	4.0	2.7	3.2	2.4
Other	1.9	2.6	1.9	2.1	2.5
Nursing home	0.5	0.4	0.9	0.6	0.9
Special accommodation	0.1	0.1	0.2	0.0	0.2

## Functional measure

The functional measure is used to provide an estimate of the level of function of major trauma patients at discharge from the acute hospital and six months following injury.

The registry commenced collecting functional measure data from adult major trauma services in quarter two of 2003-04. Table 6 shows the overall level of function at discharge as measured by the functional measure for patients since this time. The functional measure used has been adapted from the Functional Independence Measure (FIM™) for the National Trauma Databank (American College of Surgeons) and includes items related to locomotion, feeding and expression.

There has been a significant increase in the functional measure score of major trauma cases at discharge since 2003-04 ( $p=0.007$ ), indicating that the level of function at discharge has increased. Further analysis shows the increase in function at discharge is confined to the locomotion and expression items of the functional measure. The percentage of major trauma cases who demonstrate dependence on locomotion at discharge has fallen from 35.8 per cent in 2003-04 to 28.4 per cent in 2005-06 ( $p<0.001$ ), while dependence at discharge for expression has fallen from 8.7 per cent in 2003-04 to 6.7 per cent in 2005-06 ( $p=0.008$ ). There are now only a small number of undocumented scores. This has ranged from 11 per cent in quarter two of 2003-04 to 3.1 per cent in quarter four of 2005-06. The functional measure cannot be calculated for children less than seven years of age (2.3 per cent in 2003-04 and 2.8 per cent in 2005-06).

**Table 6: Functional measure at discharge**

Year and quarter	Independent +/- aid		Partial dependence		Total dependence		Deaths	
<b>2003-04</b>								
Y3 Q2	285	62.6%	44	9.7%	16	3.5%	43	9.5%
Y3 Q3	311	65.6%	46	9.7%	12	2.5%	60	12.7%
Y3 Q4	291	70.5%	47	11.3%	7	1.7%	51	12.3%
<b>2004-05</b>								
Y4 Q1	294	66.1%	59	13.2%	6	1.4%	55	12.4%
Y4 Q2	316	65.0%	62	12.8%	9	1.9%	75	15.4%
Y4 Q3	347	68.2%	42	8.2%	13	2.6%	67	13.2%
Y4 Q4	338	70.3%	44	9.1%	6	1.2%	59	12.3%
<b>2005-06</b>								
Y5Q1	385	73.2%	43	8.2%	11	2.1%	53	10.1%
Y5Q2	392	69.0%	60	10.6%	3	0.5%	75	13.2%
Y5Q3	410	72.4%	54	9.5%	8	1.4%	63	11.1%
Y5Q4	344	70.5%	39	8.0%	12	2.5%	61	12.5%

Table 7 shows the patient level of function at six months post-injury according to the functional measure for quarters one, two, three and four of 2004–05. Only patients from adult major trauma services were followed up during this period. The vast majority of patients are performing the key tasks of expression, locomotion and feeding independently.

During 2004–05 there were 287 patients who were either uncontactable<sup>9</sup> or unable to participate.<sup>10</sup> However, the percentage of uncontactable patients is reducing (from 58.1 per cent in quarter one of 2003–04 to 22.6 per cent in quarter four of 2004–05). The registry is trialling methods to improve the capture of patients followed up. The transient nature of some patients (many are young adult males of lower socioeconomic status) and some patients changing address as a result of the injury makes follow-up difficult.

**Table 7: Functional measure at six months**

Functional measure at six months	2004–05 Q3		2004–05 Q4		2005–06 Q1*	
	Count	Percentage	Count	Percentage	Count	Percentage
Independent +/- an aid	217	74.8%	220	73.1%	171	49.4%
Partial dependence	-	-	4	1.3%	4	2.0%
Total dependence	2	0.7%	1	0.3%	1	0.3%
Deaths after discharge	3	1.0%	9	3.0%	9	2.6%

\*During 2005–06 the registry evaluated functional assessment instruments and the modified functional independence measure (modified FIM) was replaced by the Glasgow Outcome Scale Extended (GOS-E) at six months. This commenced in this reporting period, therefore the functional measure was not collected for all patients and the data is incomplete. The GOS-E will be included in all future reports.

**Table 8: Returned to work status**

Work-related outcomes	2004–05 Q3	2004–05 Q4	2005–06 Q1	2005–06 Q2
Working prior to injury	71.4%	73.0%	71.4%	70.1%
Returned to work	68.9	66.2%	64.4%	68.2%

In 2005–06, 71.4 per cent of cases were working prior to injury. Of those working prior to injury, 66.9 per cent had returned to work by six months post-injury.

*9 Those patients who do not have any contact details, whose telephones have been disconnected, for whom a wrong number has been given, or who do not answer after four attempts.*

*10 Those patients who are unable to participate due to a language barrier, who have moved interstate or overseas, or who are not interested in participating*

## Unexpected deaths

TRISS is the standard international method of combining age and mechanism of injury and is used to estimate the rate of unexpected deaths (Boyd, Tolson and Copes, 1987). TRISS is an estimate of the probability of survival for individual patients. It is derived from injury severity and other measures of the patient's trauma. A TRISS less than 0.5 indicates a patient who could reasonably be expected to die.

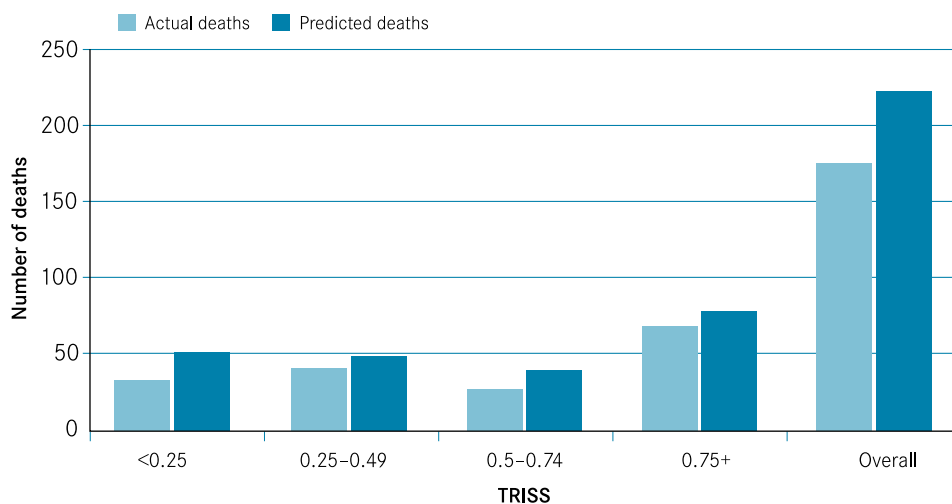
TRISS could be calculated in 98 per cent of surviving patients with blunt or penetrating injuries, and in 97.2 per cent of the deaths with blunt or penetrating injuries. The ability to calculate TRISS is lower for the deaths because of incomplete information including physiological parameters. Inadequate coronial data inhibits ISS estimation for some patients. For those patients with completed pre-hospital information, the pre-hospital physiologic parameters were utilised. Two per cent of patients did not have a valid TRISS.

Figure 12 shows a comparison of the observed and expected numbers of deaths, according to TRISS methodology. Similar to previous years, the overall observed number of deaths was significantly less than the expected number of deaths in 2005–06. In every TRISS band, the observed number of deaths was less than the expected number of deaths.

TRISS analysis is calculated for those patients with an ISS>15 as a true comparison with international norms is only possible for those with an ISS>15 because the registry has complete information on this group.

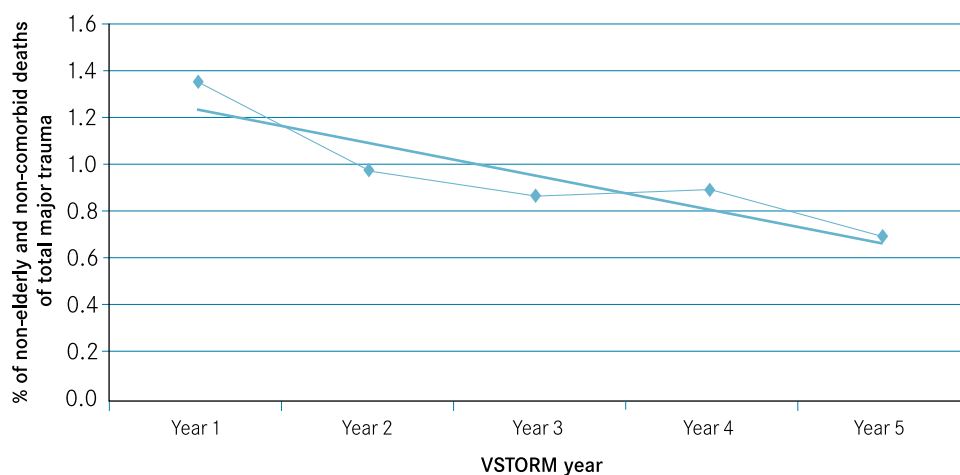
### Key indicator 9 – Observed versus unexpected deaths

**Figure 12: Comparison of the observed and expected (according to TRISS and including estimated TRISS) numbers of deaths**



There has been a downward trend in the percentage of deaths in patients with a high probability of survival ( $P_s > 0.5$ ) for patients without co-morbidity aged less than 65, shown in Figure 13.

**Figure 13: Trends in the number of non-elderly and non-comorbid preventable and potentially preventable deaths**



## Comparison of death rates with an international standard

The z-score provides a direct comparison of the 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 TRISS probability of survival.<sup>11</sup> The z-score using the Major Trauma Outcome Study for 2005–06 was 3.85 for those patients with an ISS greater than 15. In Victorian hospitals there are significantly fewer deaths in comparison to the United States cohort.

The z-score using the National Trauma Data Bank 5.0 (American College of Surgeons) for all major trauma patients with a TRISS probability of survival was 3.98 in year five for those patients with an ISS greater than 15. This indicates the state trauma system has a lower adjusted death rate in comparison to the major North American trauma centres reporting outcomes during this period. As the National Trauma Data Bank 5.0 has succeeded the Major Trauma Outcome Study as a contemporary reference database, recalculation of TRISS coefficients using the National Trauma Data Bank database is appropriate.

The w-score is an estimate of the number of lives per 100 treated patients that could have been saved or lost under the system, compared with the Major Trauma Outcome Study norms (Boyd et al., 1987). A w-score of zero indicates no difference between the two, a negative value indicates lives saved, and a positive value indicates lives lost.

Overall, and on all TRISS bands, the Victorian trauma system saved more lives than expected compared with the Major Trauma Outcome Study norms.

<sup>11</sup> See Gabbe et al., 2003 for explanation of TRISS, including its deficiencies.

**Table 9: W-score**

TRISS group	Number	W-score
<0.25	58	-26.9
0.25-0.49	42	-7.88
0.50-0.74	108	-10.82
0.75+	1,416	-.65

### Death among patients not transferred to a major trauma service

Five of the 82 patients not transferred to a major trauma service died within an hour of arrival at hospital. The 77 surviving patients had a median age of 85 years, a median ISS of 16, and a median length of hospital stay of 3.8 days (range: 0-31.2 days). Sixty were aged 75 or over (77.9 per cent) and 61 of these had experienced low falls (79.2 per cent).

## Limitations and data caveats

The information presented in this report provides data for ongoing monitoring of the Victorian trauma system.

### Hospital capture

All Victorian health services are now contributing to the registry. Ethics approval from Albury Hospital was received in July 2006 and their data will be included in future reports.

Complete information about all transfers and episodes of care was available for 567 of the 685 transferred patients (82.8 per cent). 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 (17.2 per cent for 2005-06 compared with 23.2 for 2004-05, 23.6 for 2003-04, 36.3 per cent for 2002-03 and 46.9 for 2001-02). The reasons for there being no specific information from the referring hospital for 2005-06, were that information about episodes of care cannot be collected from patients treated either overseas (six cases) or interstate (24 cases), hospitals without ethics approval (15 cases) or outside of the Victorian state trauma system (nine cases).

### 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, Victorian Ambulance Clinical Information System or National Coroner Information Systems Database. Where missing data is related to the patient care record this information is requested directly from the ambulance service.

### TRISS

The TRISS can be used to measure the performance of the system in terms of death rates. Currently, the value of TRISS for monitoring the Victorian state trauma system 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 serious patients and deaths was pre-hospital intubation.

### 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 from these hospitals' records exclusively, 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 overall rate of major trauma (presenting to hospitals) was 42 patients per 100,000 population and the death rate (both in-hospital and at-scene) was 21.9 deaths per 100,000 population. There has been no change in the overall trauma death rate over the past five years ( $p=0.621$ ).

Data is presented on 2,148 major trauma patients treated at 138 hospitals over the year.

There has been a significant increase in the rate of hospitalised major trauma in Victoria since 2001-02 ( $p>0.001$ ). However, the percentage of hospitalised major trauma cases who died during their hospital stay has fallen significantly from 14.8 per cent in 2001-02 to 11.7 per cent in 2004-05 ( $p=0.008$ ).

There has been a small but significant increase in the rate of hospitalised transport-related major trauma cases in 2005-06 compared with 2001-02 ( $p<0.001$ ). There has been a significant rise in the rate of hospitalised low falls-related major trauma cases since 2001-02 ( $p<0.001$ ). There has also been a significant rise in the rate of deaths related to low falls since 2001-02 ( $p<0.001$ ). Over the past three years the rate of low falls-related deaths has doubled compared to earlier years.

Of all major trauma patients according to the ROTES definition, 80.7 per cent had an ISS $>15$ , and 13 per cent had a GCS less than nine. There has been a significant decrease in the percentage of major trauma cases with a GCS less than nine since 2003-05 ( $p<0.001$ ).

The data confirms that the trauma triage guidelines are predominantly being followed. There were 76.6 per cent of all major trauma patients receiving their definitive care at a major trauma service and 3.1 per cent were treated at the Austin Hospital for specialised spinal care. A further 1.2 per cent were elderly patients who had sustained an isolated head injury as the result of a low fall and received appropriate treatment at a metropolitan trauma service with neurosurgical capabilities.

Length of stay is longer at the major trauma service hospitals and specialist spinal unit because the patients these hospitals treat have sustained more severe injuries and need more complex care.

More patients were discharged to home than to a rehabilitation centre from their hospital of definitive care.

Adjusting for injury severity, the system is functioning at a high level. Functional measures at discharge and six months show only a small number of severely disabled patients.

The registry has an important role in identifying and monitoring those patients whose treatment does not follow the trauma triage guidelines. This information is then fed back to the system resulting in improved outcomes.



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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.
Charlson Comorbidity Index	Assigns weights (0–6) to co-morbid conditions and has been used to predict mortality and morbidity in cohorts of hospitalisations. The index has been modified to be based on ICD-9 codes <sup>12</sup> and ICD-10 codes.
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 gauge 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 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.

<sup>12</sup> *Librero, J, Peiro, S and Ordinana, R 1999, 'Chronic comorbidity and outcomes of hospital care: length of stay, mortality, and readmission at 30 and 365 days', Journal of Clinical Epidemiology, vol. 52, pp. 171–9.*

Glasgow Outcome Scale – Extended (GOS-E)	The GOSE-E enables patients to be classified into broad categories of functional level, taking into accounts 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, all 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	<p>A tier in the Victorian trauma service's trauma system structure. Different complexities of care are provided at each level, with the major trauma services providing the highest complexity of care. Major trauma services 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.</p> <p>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.</p>
TRISS	<p>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.</p>
Victorian Admitted Episodes Dataset (VAED)	<p>A database maintained by the Victorian Department of Human Services, which records details of all hospital admissions across the state.</p>
VSTORM	<p>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.</p>
w-score	<p>A score used to describe the difference in the number of deaths between the test dataset and the normative dataset in clinically relevant terms. The w-score estimates the number of deaths more or less than expected per 100 patients treated.</p>
z-score	<p>A score used to compare a dataset with the international Major Trauma Outcome Study 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.</p>

## Appendix 1: The VSTORM group

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

The VSTORM chief investigators were:

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

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

Other members of the 2005-06 VSTORM Steering Committee, 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 Kossman (Director of Trauma Surgery, The Alfred Hospital; 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 Hospital)
- Mr Tony Walker (Manager Operations, Rural Ambulance of Victoria)
- Mr Owen Williamson (Senior Lecturer, Department of Epidemiology and Preventive Medicine, Monash University).

Ms Mimi Morgan (Project Coordinator), Mr Andrew Hannaford (Trauma Information Systems Manager) and Ms Sue McLellan (Data Coordinator) prepared this report.

## Appendix 2: Hospitals and health services with ethics committee approval for the period July 2005 to June 2006

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 registry was initially obtained from the Department of Human Services and Monash University ethics committees and has also been granted by the National Coroners Information System (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 2006, registry data collection was approved at the 138 hospitals and health services listed in the following table.

Trauma service level	Hospital
<b>Major trauma service</b>	The Alfred
	Royal Children's Hospital
	The Royal Melbourne Hospital
<b>Metropolitan trauma service</b>	Austin Health
	Dandenong Hospital
	Eastern Health (Angliss, Box Hill, Maroondah)
	Monash Medical Centre (Clayton)
	Mornington Peninsula Hospital (Frankston)
	The Northern Hospital
	St Vincent's Hospital
	Western Health (Footscray)
<b>Metropolitan primary care service</b>	Epworth Hospital
	Mayne Health (Knox Private Hospital)
	Monash Medical Centre (Moorabbin, Casey)
	Mornington Peninsula Hospital (Rosebud)
	Sandringham and District Memorial Hospital
	Western Health (Sunshine)
	The Mercy Hospital, Werribee
	Williamstown Hospital
<b>Barwon South West Region</b>	
<b>Regional trauma service</b>	Barwon Health – Geelong Hospital
	South West Health Care (Warrnambool)
	Western District Health Service (Hamilton)
<b>Urgent care service</b>	Casterton Memorial Hospital
	Colac Community Health Services (Colac)
	Coleraine District Health Services
	Hesse Rural Health Service (Winchelsea)
	Lorne Community Health
	Moyne Health Services
	Otway Health and Community Services
	Portland and District Hospital
	South West Health Care (Camperdown)
	Terang and Mortlake Health Service (Terang)
	Timboon and District Healthcare Service
<b>Primary care service</b>	Balmoral Bush Nursing Centre
	Cobden District Health Services
	Colac Community Health Services (Birregurra)
	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)

<b>Loddon Mallee Region</b>	
<b>Regional trauma service</b>	Bendigo Health Care Group
	Ramsay Health Care – Mildura Base Hospital
<b>Urgent care service</b>	Cohuna District Hospital
	Echuca Regional Health
	Kerang and District Hospital
	Kyabram and District Memorial Community Hospital
	Kyneton District Health Service
	Maryborough District Health Service
	Swan Hill District Hospital
<b>Primary care service</b>	Boort District Hospital
	Dingee Bush Nursing Centre Inc.
	Inglewood and District Health Service
	Lockington and District Bush Nursing Centre
	Mallee Track Health and Community Service
	Managatang and District Hospital
	Mclvor Health and Community Services
	Mt Alexander Hospital
	Robinvale District Health Services
	Rochester and Elmore District Health Service
	Sea Lake and District Health Service Inc.
<b>Gippsland Region</b>	
<b>Regional trauma service</b>	New Latrobe Regional Hospital
<b>Urgent care service</b>	Bairnsdale Regional Health Service
	Bass Coast Regional Health (formerly Wonthaggi and District Hospital)
	Central Gippsland Health Service (Sale)
	Gippsland Southern Health Service (Leongatha, Korumburra)
	Orbost Regional Health
	South Gippsland Hospital
	Warley Hospital
	West Gippsland Health Care Group (Warragul)
	Yarram and District Health Service
<b>Primary care service</b>	Buchan Bush Nursing Association
	Cann Valley Bush Nursing Centre
	Dargo Bush Nursing Centre Inc.
	Gelantipy District Bush Nursing Centre Inc.
	Heyfield Hospital Inc.
	Mallacoota Medical Centre
	Neerim District Soldiers Memorial Hospital
	Omeo District Hospital
	Swift's Creek Bush Nursing Centre Inc.

<b>Grampians Region</b>	
<b>Regional trauma service</b>	Ballarat Health Services
	Wimmera Health Care Group (Horsham)
<b>Urgent care service</b>	East Grampians (Ararat)
	East Wimmera Health Service (St Arnaud)
	Edenhope and District Memorial Hospital
	Hepburn Health Service (Daylesford)
	Rural Northwest Health (Hopetoun, Warracknabeal)
	Stawell Regional Health
	St John of God Health Care Ballarat
	West Wimmera Health Service (Nhill)
<b>Primary care service</b>	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
	Hepburn Health Service (Creswick)
	Lake Bolac Bush Nursing Centre
	Wimmera Health Care Group (Dimboola)
<b>Hume Region</b>	
<b>Regional trauma service</b>	Goulburn Valley Health (Shepparton)
	Wangaratta District Base Hospital
<b>Urgent care service</b>	Alpine Health (Bright, Mt Beauty, Myrtleford)
	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
	Wodonga Regional Health Service
	Yarrawonga District Health Service
	Yea and District Memorial Hospital
<b>Primary care service</b>	Beechworth Health Service
	Chiltern Bush Nursing Hospital
	Euroa Hospital
	Falls Creek Medical Centre
	Mt Hotham Medical Centre
	Nagambie Hospital Inc.
	Tallangatta Hospital
	Violet Town Bush Nursing Centre
	Walwa Bush Nursing Hospital