

# Victorian State Trauma System and Registry

1 July 2013 to 30 June 2014 Summary Report





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# Victorian State Trauma System

The treatment of critically ill patients with severe injuries requires a multi-disciplinary, coordinated and integrated system of trauma care. From the time of its inception, the Victorian State Trauma System has continued to evolve and adapt to improve the delivery of trauma care in this state. Since the introduction of the Victorian State Trauma System in 2000 preventable death and disability from major trauma has reduced markedly.

Today, the Victorian State Trauma System is considered a world leader with several international jurisdictions implementing trauma systems based on the Victorian model. The department and other joint trauma system stakeholders including the Transport Accident Commission, Ambulance Victoria, Adult Retrieval Victoria and all trauma designated Victorian hospitals can be very proud of the role they play in maintaining this world leading trauma system. Today, the Victorian State Trauma System is considered the model of a high functioning and highly effective trauma system, producing unparalleled survival outcomes.

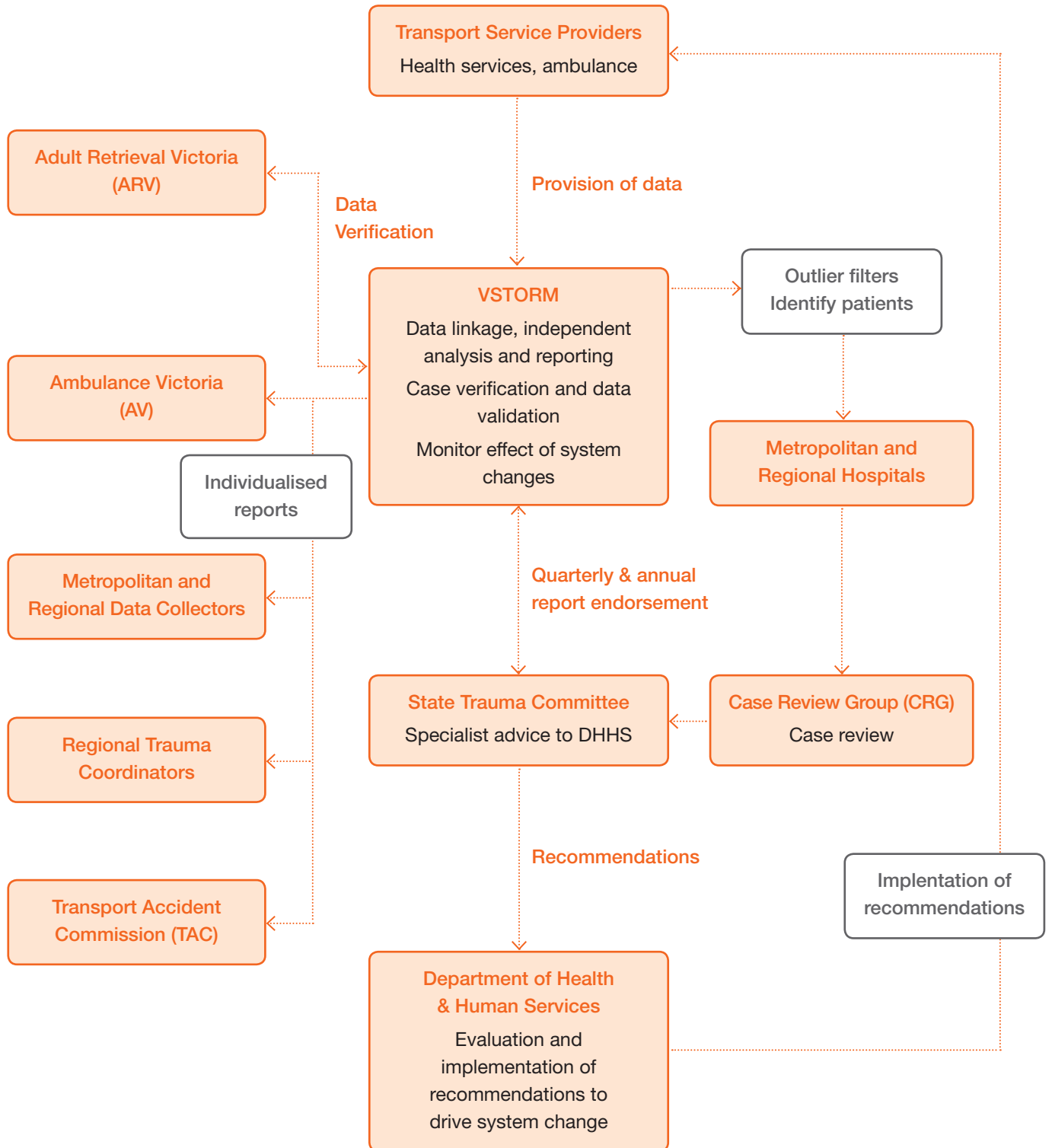
Victoria has one paediatric (The Royal Children's Hospital) and two adult (The Alfred and The Royal Melbourne Hospital) major trauma services located within metropolitan Melbourne. Metropolitan trauma and metropolitan primary care services support the greater metropolitan area. Within each of the five rural Department of Health and Human Services regions, there are a number of regional trauma, urgent care and primary care services. Each service is responsible for providing a staged level of patient care and ensuring major trauma patients receive definitive care at an appropriate trauma service within the system according to the trauma triage guidelines.

The major trauma services and the following three metropolitan health services provide neurosurgical services: Austin Hospital, St Vincent's Hospital and Monash Medical Centre. The Austin Hospital also provides specialist trauma care to patients with an isolated spinal injury. St Vincent's Hospital also provides specialist trauma care to patients with isolated injuries requiring microsurgery.

The trauma triage guidelines and a dedicated trauma advice and referral line, coordinated by Adult Retrieval Victoria (a business unit of Ambulance Victoria), have been implemented to increase the proportion of major trauma patients treated at a major trauma service, contributing to reduced patient mortality and morbidity. These guidelines have recently undergone a comprehensive, evidence-based revision. There are now 12 system-level and specialist guidelines to support health services with the early management of major trauma patients.

Further information about Victoria's state trauma system and access to the major trauma guidelines is available from <[www.health.vic.gov.au/trauma](http://www.health.vic.gov.au/trauma)>.

## Victorian State Trauma System governance structure





# Victorian State Trauma Registry

One of the key factors underpinning the success of the Victorian State Trauma System is the high-quality data provided by the Victorian State Trauma Registry, which has enabled monitoring and analysis to critically review trauma care across the state.

The Victorian State Trauma Registry provides a system-monitoring mechanism to inform service provision, with the aim of reducing preventable deaths and permanent disability from major trauma. Changes to systems of care are monitored to ensure outcomes are improving, including fewer deaths and reducing disability over time. After 14 years of operation the registry provides a rich source of data with which to assess trends in patient characteristics, management and outcomes.

The Victorian State Trauma Outcome Registry and Monitoring group (Appendix 4), based in the Department of Epidemiology and Preventive Medicine at Monash University, is responsible for the coordination and operation of the Victorian State Trauma Registry.

The Victorian State Trauma Registry collects and analyses patient information from health services managing trauma patients across the state. The registry collects information from 138 health services (Appendix 5).

The Victorian State Trauma Registry is the first trauma registry worldwide to collect long-term functional and health related quality of life outcomes of patients following hospital discharge. The registry uses experienced interviewers to telephone patients at six, 12 and 24 months post injury. In doing so, the registry is able to monitor the quality of major trauma patient survival over time, compare outcomes between patient groups and receive important information to inform our understanding of the burden of serious injury.

In looking beyond survival as a measure of trauma system effectiveness, the registry provides world-leading analysis of trauma patient functional and quality of life outcomes. These outcomes are increasingly being recognised as an indication of the quality of trauma care received.



# Executive summary

In 2013–14 there were 2,899 hospitalised major trauma patients treated at 73 health services across Victoria. This figure represents a decrease of 2.2 per cent from 2012–13. The annual rate of hospitalised major trauma patients in 2013–14 was 51 per 100,000 population, remaining stable over the past five years.

The median length of stay of major trauma patients has decreased from 7.3 days in 2009–10 to 6.6 days in 2013–14. In 2013–14 just over half of major trauma patients surviving to discharge were able to be discharged directly to home, a figure that has been achieved for the past five years, ranging from 50 per cent in 2009–10 to 51 per cent in 2013–14.

In 2013–14 91 per cent of major trauma patients with known intent received their injuries as a result of unintentional (accidental) events, six per cent from assaults and three per cent from intentional self-harm.

Forty four per cent of major trauma cases in 2013–14 were transport related compared to 42 per cent in 2009–10. The percentage of hospitalised major trauma cases due to low falls has risen from 27 per cent in 2009–10 to 29 per cent in 2013–14. In 2013–14 most low falls patients (77.3 per cent) were aged 65 years or older and the majority of this age group (63.1 per cent) sustained a head injury (AIS > 2 in the head region) as a result of the fall. The number of major trauma cases resulting from high falls (greater than 1 metre) has increased from 273 in 2009–10 to 326 in 2013–14.

The 2013–14 data confirms that the major trauma triage guidelines are predominantly being followed, with 80 per cent of major trauma patients receiving their care at an appropriately designated trauma service. This figure includes 2.3 per cent of cases definitively managed at the Austin Hospital, for specialised spinal care, and 2.7 per cent of cases involving elderly patients with isolated head injuries definitively managed at a metropolitan neurosurgical service.

Overall the percentage of major trauma patients transported directly to a major trauma service, Austin for spinal care or a metropolitan neurosurgical service from the scene, home or general practitioner has decreased from 69 per cent in 2009–10 to 66 per cent in 2013–14. While the number of direct transports has decreased there has been a corresponding increase in the number of major trauma inter-hospital transfers to a major trauma service, the Austin for spinal care and metropolitan neurological services.

The proportion of all major trauma patients with an Injury Severity Score (ISS) greater than 12 was 85 per cent; while six per cent sustained a severe head injury (Abbreviated Injury Scale (AIS) head injury severity greater than two and GCS less than nine). Motor vehicle crashes accounted for 22 per cent ( $n = 38$ ) of severe head injuries in 2013–14 compared with 24 per cent ( $n = 47$ ) in 2009–10. The percentage of cases who sustained a serious head injury (AIS head injury severity greater than two in isolation and with other injuries) has decreased over the years, accounting for 46 per cent of hospitalised major trauma patients in 2009–10 and 40 per cent in 2013–14. Injuries to multiple body regions (excluding cases with serious neurotrauma) were most prevalent in 2013–14 and have increased across the years, accounting for 33 per cent of major trauma in 2009–10 and 37 per cent in 2013–14.

During 2013–14 the overall death rate due to trauma in Victoria was 24 deaths per 100,000 population, and this has remained consistent since 2009–10 (25 deaths per 100,000 population). The major causes of death recorded on the National Coroners' Information System (NCIS) were falls (25.4 per cent), hangings (22.9 per cent) and transport-related incidents (22.1 per cent). The number of deaths due to transport-related incidents was lower than previous years. However, it must be noted that due to a high number of open cases there was a low percentage of cases with recorded cause of death for 2013–14, limiting the capacity to fully interpret trends over time.

There has been a reduction in the adjusted relative risk of in-hospital mortality over the past five years, and this is most notable in the younger age group with an ISS greater than 12. Of the hospitalised major trauma patients 11 per cent died during their hospital stay in 2013-14.

Discharge from the trauma centre represents the start of a new phase in the patient's recovery from major trauma. Long term outcomes data provides critical information about the quality of survival of major trauma patients in Victoria. Overall, paediatric major trauma patients experience better functional and quality of life outcomes when compared to adult major trauma patients.

While disability remains prevalent even 24 months following major trauma, highlighting the prolonged impact of serious injury on patients' lives, recovery continues to 24 months post-injury, particularly for function, return to work and physical health, indicating there is additional capacity for patients to improve. Age, socioeconomic status, level of education, pre-existing health conditions, and whether compensation is received for the injury were key factors predictive of longer term outcome, providing evidence that recovery is influenced by factors beyond the severity and type of injuries sustained.

The important data contained in this report provides the capacity to monitor and assess each component of the Victorian State Trauma System. Opportunities for enhancing the experience of the trauma patient across the care continuum will continue to be explored to support improvements in trauma patient management and outcomes in Victoria.

# State Trauma Committee chair foreword

It has been my pleasure to chair and participate in the State Trauma Committee throughout a busy and productive year. This year the State Trauma Committee has initiated and overseen a wide program of work covering all dimensions of trauma including prevention, response and rehabilitation.

Chairing a committee that provides leadership to a world-leading trauma system is a privilege but also a great responsibility. In guiding a committee of dedicated professionals such as the State Trauma Committee members I am committed to ensuring our collective effort to lead initiatives and continued improvements in trauma patient management and outcomes.

During the year the role of the State Trauma Committee has continued to expand as new partnerships have been forged. The formal inclusion of the Department of Health & Human Services as a road safety partner, which followed a recommendation made by the committee, will mean the State Trauma Committee will have a more direct role in contributing to road safety and the road trauma policy framework. Moreover, the shift in emphasis following the Parliamentary Inquiry into Serious Injury from Road Accidents will create more focus on major trauma from road accidents.

I would like to express my appreciation for the continued support and work of the Department of Health & Human Services Emergency and Trauma Program and the Victorian State Trauma Outcomes Registry and Monitoring group at Monash University for the research and support they provide.

Looking ahead, the State Trauma Committee will continue to work to deliver our strategic priorities such as building the trauma response capacity of rural and regional hospitals and identifying further opportunities for major trauma prevention.



**Kath Cook**  
State Trauma Committee Chair

# The State Trauma Committee

Since the introduction of the Victorian State Trauma System, the State Trauma Committee (STC) has provided an integral role in providing advice to the Minister for Health and the Department of Health on all matters relating to the VSTS, particularly system issues and identifying opportunities for improvement.

Under the guidance and leadership of the STC, the department and the Victorian State Trauma Registry undertake research and policy development to support and ensure best evidence trauma management.

Each member of the STC is appointed by the Minister for Health and brings to the committee significant specialist knowledge and experience. The membership is inclusive of all levels of health service designations and key sector stakeholders such as the Transport Accident Commission, Ambulance Victoria, the Australasian College of Emergency Medicine, the Royal Australasian College of Surgeons, rehabilitation medicine and emergency nursing.

## Chair

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### **Ms Kath Cook**

Kath is a partner at consultancy firm KPGM where she works within the National Health Care Advisory Group. Prior to this appointment Kath was CEO of Western Health. Kath has held numerous management positions within the health sector and the Department of Health in Victoria and New Zealand. As State Trauma Committee chair, Kath is committed to fostering collaboration and cohesion among trauma system stakeholders and fostering innovations to ensure the Victoria State Trauma System remains the world leader in trauma care and management.

## Members

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### **Dr Peter Archer**

Peter is the director of emergency medicine at Maroondah Hospital and holds appointments at the Royal Children's Hospital emergency department, Adult Retrieval Victoria and the Field Emergency Medical Officer program.



### **Ms Katy Fielding**

Katy is the manager of acute programs at the Department of Health & Human Services. Katy has more than 30 years' experience in health care and health care policy in both clinical and management roles. She has extensive experience in strategic reform of the health workforce. She is currently accountable for providing program and policy advice on a range of hospital programs including surgical services, critical care, maternity and newborn services, specialist clinics, emergency, trauma and adult and neonatal retrieval services.

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**Prof Mark Fitzgerald**

Mark has been the director of trauma services at Alfred Health since 2009. His other appointments include: professor of the Department of Surgery at Monash University; an Ambulance Victoria medical advisor; director and chief investigator of the Trauma Reception and Resuscitation Project at the National Trauma Research Institute; EMST/ATLS course director and instructor at the Royal Australasian College of Surgeons; and expert panel member of the Office of the Health Services Commissioner. Mark also belongs to the Health System College of Experts for the United Kingdom Medical Research Council and is a visiting professor in surgery at the Longgang Central Hospital, Shenzhen, China.



**A/Prof Rodney Judson**

Rodney is Director of Adult Major Trauma Service at The Royal Melbourne Hospital and has been Consultant General, Head & Neck Surgeon to The Royal Melbourne Hospital since 1981. He has past appointments as Divisional Director of Surgery at the Royal Melbourne Hospital and Head of Victorian Adult Burns Service at the Alfred Hospital.

Rodney is a member of a number of surgical and administrative committees including three Victorian Ministerial Advisory Committees (Victorian Surgical Consultative Council (VSCC) – Chairman of the Surgical Outcomes Information Initiative (SOII sub-group); Ministerial Advisory Committee on Surgical Services (MACSS); Member of Victorian State Trauma Committee; Chairman of Victorian State Trauma Registry Outcomes & Monitoring (VSTORM coordinating group); and Surgical Representative on Victorian Audit of Surgical Mortality (VASM) Management Committee.



**Dr Marcus Kennedy**

Marcus is the director of Adult Retrieval Victoria and adjunct clinical associate professor at the Department of Community Emergency Health and Paramedic Practice at Monash University. He is an emergency physician who has broad experience in clinical emergency care, retrieval medicine and critical care. His areas of special interest include systems design, development and improvement, and he has a successful career in health service management. He has worked across the health sector, in rural, regional, metropolitan and tertiary settings and in clinical, administrative and executive roles.

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**Dr Fergus Kerr**

Fergus represents the Australasian College of Emergency Medicine on the State Trauma Committee. He is the emergency director and medical director of the Medical and Emergency Services Clinical Unit and a consultant toxicologist at Austin Health.



**Dr Matthew Maiden**

Matt is a senior consultant in intensive care and emergency medicine at Barwon Health / Geelong University Hospital. He has held clinical roles with Adult Retrieval Victoria and major trauma centres in other Australian states. Matt's interests include pre-clinical research, outcomes following major trauma and trauma in the rural/regional setting. Matt also provides clinical advice to the Victorian State Trauma Registry in the outlier trauma case selection process.



**Dr Andrew Nunn**

Andrew is a spinal physician and director of the Victorian Spinal Cord Service. The Victorian Spinal Cord Service at Austin Health provides acute management and rehabilitation for people who sustain traumatic spinal cord injuries from Victoria, Tasmania and the Riverina of New South Wales. Andrew has a 20-year association with Monash and Melbourne universities (as well as La Trobe and Swinburne) in engineering and medicine.



**Prof John Olver**

John is a consultant physician in rehabilitation medicine and a professor in rehabilitation medicine in the Department of Medicine at Monash University. He is medical director of rehabilitation at Epworth HealthCare, where he is also manager of the Epworth Rehabilitation Acquired Brain Injury Programme. In 2008 he was appointed chair of the Clinical Institute of Rehabilitation, Mental Health & Chronic Pain Management at Epworth HealthCare and in 2009 was appointed to the Victor Smorgon Chair of Rehabilitation Medicine, Epworth HealthCare and Monash University. He is director of the Epworth-Monash Rehabilitation Medicine Research Unit, the medical research arm of Epworth HealthCare Rehabilitation. John's main research interest and a focus of publication concerns the outcomes following traumatic brain injury, through an ongoing prospective long-term outcome study conducted at Epworth Rehabilitation and now in its 30th year.

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**A/Prof Martin Richardson**

Martin represents the Australasian College of Surgeons on the State Trauma Committee. He is an orthopaedic surgeon at the Epworth Hospital and is an associate professor in the Department of Anatomy at both Melbourne and Monash universities. Martin has provided training in trauma courses, both nationally and internationally over many years.



**Dr Lisa Sherry**

Lisa is a rehabilitation physician specialising in neurological rehabilitation following traumatic brain injury and spinal cord injury. She is clinical lead for the Health and Disability Group of the Transport Accident Commission and is a consultant neurological rehabilitation physician at the Royal Talbot Rehabilitation Centre, Austin Health. Lisa also lectures at the University of Melbourne.



**Dr Warwick Teague**

Warwick is the director of trauma and an academic paediatric surgeon at the Royal Children's Hospital. Previously director of trauma services at the Women's and Children's Hospital, Adelaide, Warwick has held a range of paediatric surgical and lecturing roles in the United Kingdom.



**Ms Sharon Tonkin**

Sharon is the Donald campus manager at East Wimmera Health Service and has a particular interest in supporting rural health services in the early management of trauma. Sharon has nursing experience in paediatrics, midwifery, infectious diseases and trauma.



**A/Prof Tony Walker**

Tony is a qualified intensive care paramedic and has had an extensive career in ambulance, working in a range of senior clinical governance, education and operational roles in rural and metropolitan areas.

As general manager of regional services with Ambulance Victoria, Tony is responsible for statewide operational service delivery and 4,000 operational paramedics and volunteers across Victoria. Tony also holds an adjunct appointment as the associate professor of paramedic sciences in the College of Health and Biomedicine at Victoria University, is a Fellow of Paramedics Australasia and deputy chair of the Australian Resuscitation Council Advanced Life Support Committee.



# Achievements at a glance

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The Victorian State Trauma System acknowledged as a road trauma countermeasure

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The Department of Health & Human Services joins the Road Safety Partners

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The Trauma Education Program – Trauma Victoria

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Parliamentary Inquiry into Serious Injury

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Trauma prevention – reducing serious injury and death from domestic ladder falls

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Special focus reports

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# Victorian State Trauma System achievements in 2013–14

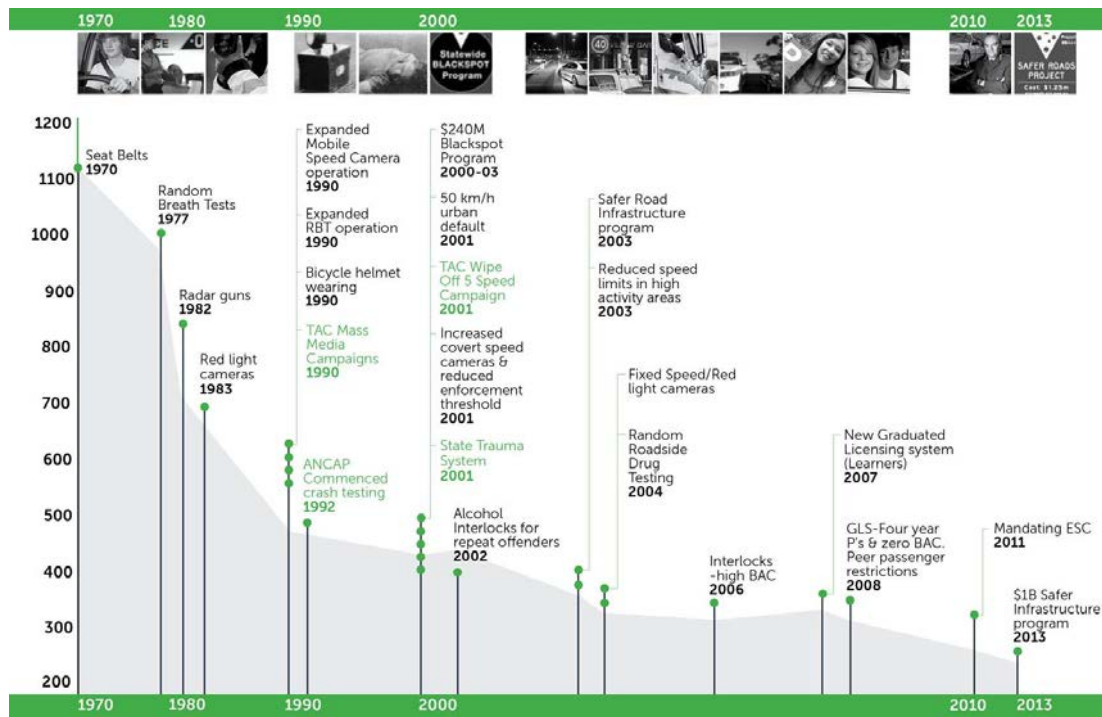
During 2014, the Victorian State Trauma System (VSTS) achieved formal recognition as an important countermeasure in reducing road trauma fatalities and disabilities.

Since the introduction of the VSTS the road toll has continued to decline and now more than 90 per cent of major trauma patients seriously injured in a road crashes receive their definitive care at a major trauma service (MTS).

While the introduction of the VSTS has been instrumental in further reducing death and disability from road trauma, its role as an extremely important countermeasure has not been acknowledged in the same way or extent as other countermeasures such as mandatory wearing of seatbelts or drink driving legislation.

In early 2014 the State Trauma Committee advocated for the formal recognition of the VSTS in reducing the road toll. This issue was raised with the Transport Accident Commission (TAC), which favourably considered the request.

The road toll countermeasure graph, which is frequently used to represent significant road trauma countermeasures, now includes the introduction of the VSTS in 2000–01.



Countermeasure graph reproduced with permission from VicRoads.

## State Trauma Committee recommends that the Department of Health & Human Services join the Road Safety Partners

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**In an important development for road safety strategy, the Department of Health and Human Services has joined the road safety partnership.**

Following a recommendation by the State Trauma Committee for greater representation on road safety committees, the Department of Health and Human Services has been welcomed into the road safety partnership of Department of Justice, VicRoads, the Transport Accident Commission and Victoria Police.

Victoria leads the Australian jurisdictions in road safety outcomes, and our results are within the top 10 countries globally; however, road trauma remains the second most significant cause of preventable death and disability in Victoria. Despite great gains being made to the road toll over the past 30 years, the road toll has begun to plateau and so too has major trauma resulting from road crashes.

The State Trauma Committee performs an integral role in monitoring road trauma and ensuring continuous improvement in the management and treatment of road trauma patients. Since the introduction of the VSTS, the burden of road transport-related serious injury and fatalities has decreased significantly.

The Victorian Government strategy on road safety includes the following elements:

- reduced fatalities and serious injuries by more than 30 per cent by 2022
- renewed focus on serious injury from road trauma
- greater focus on rural Victoria, which has the burden of road injury and fatality
- improved data linkages that can provide real-time data
- a new definition of serious injury
- more research to identify the most effective road trauma countermeasures
- new focus on the use of prescription drugs by drivers and how it relates to road trauma
- new technologies and vehicle design
- adoption of the safe system approach, which incorporates improved safety of road users, roads/roadsides, vehicles and speeds.

The shift in emphasis from fatalities to the 'hidden' toll of serious injuries brings the Department of Health & Human Services directly into this agenda. This approach also requires a focus on shared data and information, an exchange that requires strong interagency cooperation. A new emphasis on serious injury from road trauma highlighted to the State Trauma Committee the importance of greater health involvement in road safety policy.

Health involvement in the road safety partnership will help develop a strong and cohesive approach to reducing serious injury from road trauma.

## The Trauma Education Program – Trauma Victoria

In 2013 the then Department of Health funded Ambulance Victoria for a three-year period to develop a sustainable and statewide Trauma Education Program. The funding made available for this project reflects the department and State Trauma Committee's commitment to providing trauma education resources to clinicians, particularly those working outside of the Major Trauma Services.

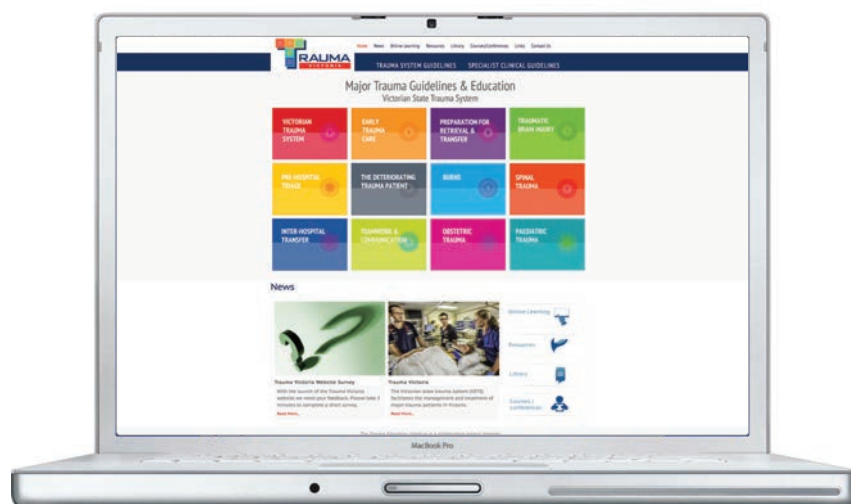
The trauma education project has been managed by Adult Retrieval Victoria, a business unit of Ambulance Victoria, within its scope as the statewide provider of coordinated, systematised clinical advice and retrieval of major trauma patients – a role that places Adult Retrieval Victoria in a strong position to understand the skill requirements of non-MTS emergency clinicians in the early management of trauma patients.

The objective of the Trauma Education Program is to enhance the performance of the VSTS by providing:

- evidence-based clinical guidelines in relation to major trauma management for clinicians working outside an MTS
- up-to-date information and education systems based on the content of statewide clinical and trauma system guidelines.

The Trauma Education Program is hosted on the Trauma Victoria website (trauma.reach.vic.gov.au), which features:

- system and clinical guidelines in support of early trauma care
- regularly updated courses and conferences on all aspects of trauma management
- links to specialist services, organisations, publications and societies involved in trauma management
- news items, which are regularly updated, regarding varying concepts, courses and general information on trauma care
- resources regarding the implementation of these guidelines in addition to providing downloadable resources such as rapid reference guidelines and the core guideline documents.



## Learning modules

A statewide web-based learning management system will be available free of charge to health service staff. Modules support each of the guidelines and engage the user through scenario-based learning and reinforcement of the key concepts. This platform allows for wide audience accessibility and the ability to complete modules in their own time. Use will be monitored and individuals will be able to accredit course completion towards continuing professional development points.



## Trauma Literature Warehouse

Trauma Victoria will provide users access to a repository of evidence-based practice resources

## Moderated remote tutorials

Utilising the concepts of the learning modules, fortnightly tutorials will be hosted by specialised clinicians working in the field of trauma. At a predetermined date and time, multidisciplinary groups or individuals will join a virtual meeting room, work through a scenario and complete a discussion of the case. This concept allows healthcare workers from all over Victoria direct access to shared learning, with each other and the expert moderator. If unable to attend the live sessions, these will be recorded and available for playback at a time suitable for the user.

## Regional simulation

Videoconferenced regional simulation and team training will also be supported via a remote expert facilitator and will involve regional and sub-regional simulation trainers. It will build capacity among simulation trainers to enhance local trauma team training programs.

## Facilitated visits

Brief rotations with MTSs for medical, nursing and allied health staff are currently being explored. Participation will aim to increase experience and familiarity in major trauma management and promote the development of clinical relationships between organisations.

## Trauma guidelines review

To support the Trauma Education Program a comprehensive review of the major trauma system and specialist guidelines has been undertaken. Twelve specialist and system-level guidelines were developed or reviewed to support awareness of key aspects of the trauma system and early trauma patient management.

Each guideline was reviewed or developed to:

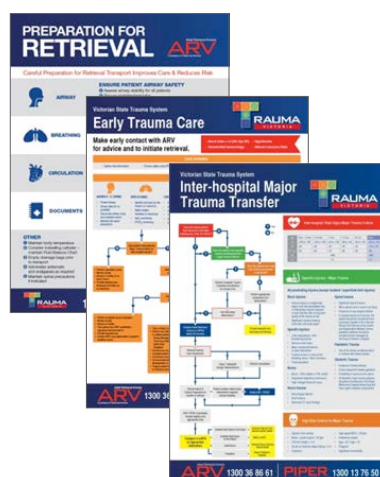
- clarify the indications for transferring major trauma patients
- clarify the mechanisms and process for advice seeking and transfer/retrieval
- increase awareness of the clinical injury criteria for transfer
- increase the application of the specialist guidelines to improve clinical practice

Of the 12 guidelines, four represent new guidelines to support teamwork, early trauma care, the deteriorating patient and preparation for retrieval. VSTS guidelines available through the Trauma Victoria website are:

- *The Victorian State Trauma System – background, objectives and function*
- *Teamwork and communication – human factors in early trauma care*
- pre-hospital triage guideline
- early trauma care guideline
- burns guideline
- traumatic brain injury guideline
- spinal trauma guideline
- paediatric trauma guideline including:
  - paediatric burns sub-guideline
  - paediatric spinal sub-guideline
  - paediatric traumatic brain injury guideline
- the deteriorating patient guideline
- obstetric trauma guideline
- inter-hospital transfer guideline
- preparation for retrieval guideline.

### Rapid reference guidelines

Included in each guideline is a one-page rapid reference guideline to provide an overview of the key management points. They are a useful summary that can be downloaded and referred to throughout the patient care episode.



## Parliamentary Inquiry into Serious Injury

Since the 1970's Victoria has achieved an enviable record in reducing road deaths. In recent years Victoria's road toll has been at record low levels. However, the road toll is only one measure of the impact of road trauma and serious injuries vastly outnumber road deaths.

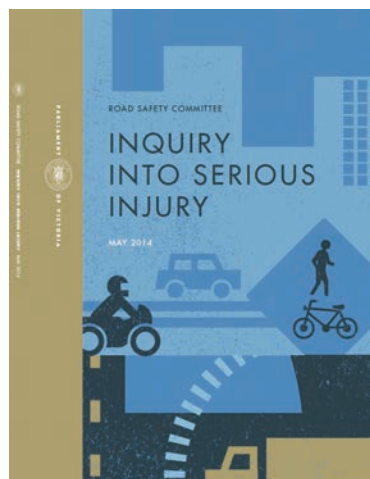
The Department of Health, in consultation with the State Trauma Committee has worked with the road safety partners to respond to the Parliamentary Inquiry into serious injury in motor vehicle accidents.

The Terms of Reference of the Inquiry were to:

- determine the appropriate methodology to identify the cost of a serious injury to the Victorian community and economy
- identify processes, including the exchange of data and information between agencies, that will facilitate accurate, consistent and timely reporting of road related serious injuries
- consider best practice definitions and measures of road related serious injury and injury severity, and recommend how road related serious injuries and their severity should be identified and reported in Victoria
- determine the correlation between reductions in fatalities and serious injuries (including for different levels of severity) resulting from different road safety countermeasures
- identify cost effective countermeasures to reduce serious injury occurrence and severity
- identify best practice in managing long term reductions in serious injury including raising the profile of the serious injury burden.

Forty-three recommendations arising from the inquiry focused on the importance of accurate, useable and accessible serious injury data, the different methods for deriving road crash costs, and improving the use of evaluations to determine the efficacy of countermeasures implemented to address road trauma.

The Parliamentary Committee proposes that a whole of government approach to road safety is urgently required with less emphasis on the traditional enforcement approach. The integration of road safety policy into broader government objectives around health, planning, justice, transport, environment and education is considered the key to significantly reducing the road toll.



## Trauma prevention – reducing serious injury and death from domestic ladder falls

Domestic ladder falls resulting in injury, major injury or death is a serious and growing public health issue. Falls from ladders are preventable. However, to date, there has been no strategic approach to raise awareness regarding domestic ladder risks and safety.

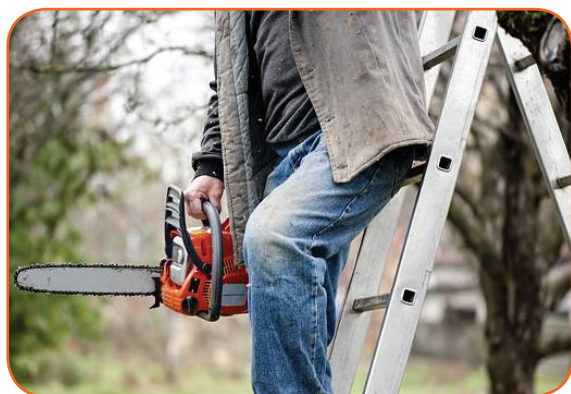
Ladder falls resulting in serious injury doubled between 2002 and 2013 and there are approximately six fatalities and 2,500 hospital-treated ladder injuries each year in Victoria. Over 90 per cent of those admitted to hospital were males, with those aged 50 years or older overrepresented. Males in the 65–85-year age group represent the majority of hospital admissions, major traumas and deaths.

In 2014 the then Department of Health contracted the Monash University Injury Research Institute to prepare a research report into domestic falls from ladders. The objective of the report was to identify opportunities to reduce ladder fall mortality and morbidity by exploring the potential for interventions that can be undertaken by government, agencies and industry. The report included a review of the existing literature on this issue, an analysis of other initiatives that have been implemented both in Australia and overseas and an analysis of hospital, major trauma and death data related to ladder falls.

Consultation was also undertaken with domestic ladder users and stakeholders such as ladder manufacturers, hardware retailers and the Australian Competition and Consumer Commission.

Significant research insights from the report included:

- Males are aware of ladder safety issues but underestimate the danger, take few precautions and are unwilling to use alternatives or request assistance.
- Domestic ladder users like doing home maintenance and are resistant to change due to wanting to maintain their independence, a desire to be fit and active, pride with DIY, and financial necessity. Ladder users are more interested in finding out how to do it safely rather than ceasing activity.
- Falls occur when ladders aren't secured properly or if people overstretch or reach (pruning) or carry things while on a ladder, disrupting their balance. Many incidents are reported on 'old' or 'modified' ladders and many new ladders don't have standard 'safe use' instructions.



Domestic ladder falls resulting in injury, major injury or death is a serious and growing public health issue. Falls from ladders are preventable. However, to date, there has been no strategic approach to raise awareness regarding domestic ladder risks and safety.



The report identifies a range of opportunities for reducing ladder falls that are centred on the following eight complementary themes:

- improving the design and mechanism of ladders for safe consumer use through reviewing the strength and stability of ladder design
- supporting improvements to ladder manufacturing standards and regulations, as well as compliance with these
- supporting safe ladder use through building design innovation and features such as gutter guards and anchor points for ladders
- improving surfaces around ladders, such as the use of anti-slip floor coverings and surface treatments to reduce injury risk from falls
- promoting the use of protective equipment when using ladders in the domestic context
- supporting public awareness of the risks and dangers of ladder use in the domestic setting through public education and resources on ladder fall prevention
- promoting alternatives to ladder use such as services and resources available to domestic ladder users within the community
- addressing the prevention of domestic ladder falls and fall injuries through multisectorial collaboration and further research as required.

The next steps will be to prioritise the identified opportunities for reducing serious injury from ladder falls and to engage stakeholders within the health sector and beyond to create an agenda for action.

## Special focus reports

During 2013–14 two special focus reports were prepared for the State Trauma Committee on Victorian State Trauma Registry (VSTR) data. These reports were *Discharge destination of major trauma patients in Victoria* and *Isolated head injury in the younger (< 65 years) major trauma patient*.

### Discharge destination of major trauma patients in Victoria

The need for improved understanding of the post-discharge care and pathways of major trauma patients, and the impact of different pathways on patient outcomes, has been identified as a priority area by the State Trauma Committee. The committee recommended developing this report to achieve a better understanding of the discharge destination of major trauma patients and how this may have changed over time. The committee recognises that the post-acute care of major trauma patients usually requires a multidisciplinary approach with multiple pathways available for patients in the Victorian healthcare system. The research for this special focus report included:

- the pattern of discharge destination for major trauma patients in Victoria and regional differences
- the factors that are important predictors of discharge to inpatient rehabilitation services
- key providers of inpatient rehabilitation services for major trauma patients and changes over time
- the association between long-term patient outcomes and discharge destination.

The findings of the special focus report included:

- Over the eight years 51 per cent of patients were discharged directly home, 42 per cent to inpatient rehabilitation and seven per cent to another location (such as aged and palliative care)
- The proportions of patients discharged to home and inpatient rehabilitation has remained relatively stable, with the exception of a significant decline in patients going to rehabilitation between 2010–11 and 2011–12 before increasing again in 2012–13.
- Given the different patient groups seen by each of the major rehabilitation centres, comparison of patient outcomes by centre was not possible in the report.
- As expected, inpatient rehabilitation patients were more severely injured, with a higher proportion of multi-trauma or severe head injuries, greater prevalence of intensive care unit (ICU) admissions and longer median hospital lengths of stay.
- The likelihood of discharge to inpatient rehabilitation increased for female patients, compensable patients, those with private health insurance and patients with comorbid conditions.
- The analysis focused on establishing the association between discharge destination and longer term patient outcomes. Severe traumatic brain injury and spinal cord patients were excluded so as not to skew the results.
- Outcomes measured include functional recovery, independent living, return to work status, pain/discomfort, mobility, personal care, undertaking usual activities and anxiety/depression.

**Post-discharge planning and rehabilitation remains a significant priority for the VSTS. Discharge from hospital can be a stressful time for many patients and a better understanding of the patient experience following discharge is required.**

Ensuring access to appropriate, quality post-injury support and rehabilitation, particularly for regional and rural Victorians, is essential for achieving the best possible outcomes.

### Isolated head injury in the younger (< 65 years) major trauma patient

This special focus report was recommended by the State Trauma Committee to better understand the definitive management of patients with an isolated head injury aged 15 to 64. Of particular interest to the State Trauma Committee were demographic and event characteristics by definitive care group and the injury severity, transport and in-hospital outcomes of each group.

- On average, there are 208 major trauma cases with isolated head injury in the 15–64-year age group per year, with approximately 80 per cent managed at the MTS hospitals.
- MTSs managed a higher proportion of:
  - road trauma and TAC-compensable cases
  - younger and male cases
  - cases from regional Victoria
  - cases with a ‘severe’ head injury according to Glasgow Coma Scale (GCS) criteria, and a higher shock index.
- There were considerable differences between the MTS-managed and patients managed at non-MTSs with respect to the flow of patients within the system and in-hospital resource usage:
  - A higher proportion of MTS cases were transferred directly from the scene of injury to definitive care and the time from injury to definitive care was lower for MTS-managed cases.
  - Where an inter-hospital transfer was used, the overall transfer time and time spent at the primary hospital was significantly lower for MTS-managed cases.
  - A higher proportion of MTS-managed cases were admitted to an ICU, but the overall length of ICU stay and ventilated time was not different when compared with metropolitan neurosurgical service cases.
  - The overall hospital length of stay was significantly shorter for MTS-managed cases and a higher proportion of MTS-managed cases were discharged to inpatient rehabilitation.
  - Adjusting for the differences in casemix, there was no difference in outcomes for patients as measured by in-hospital mortality, a functional recovery or return to work (for patients who were working prior to injury).

The State Trauma Committee will continue to monitor the management of patients aged under 65 years with isolated head injuries to ensure compliance with major trauma guidelines and best care and outcomes for this cohort of patients.



# Trauma Case Review Group

The Trauma Case Review Group (CRG) plays a critical role in the governance of the VSTS by reviewing cases that may fall outside of the major trauma guidelines. The focus of the CRG is to improve the quality and safety of major trauma care by reviewing the journey and management of these cases. The CRG is a permanent subcommittee of the State Trauma Committee and undertakes a review of de-identified cases that meet any one of the following four criteria:

- were transferred to a non-MTS
- received definitive care at a non-MTS
- were a time-critical transfer that took more than six hours
- had more than one transfer.

In 2013–14 the CRG reviewed 173 major trauma cases that met one or more of these criteria. While there is no typical case reviewed by the CRG, many involve patients who receive their definitive care at a non-MTS when the major trauma guidelines required the patient to be transferred to an MTS. Often these cases involve under-recognition of the severity of injuries, use of informal communication channels and lack of contact with Adult Retrieval Victoria.

The CRG identifies cases for referral back to health service based on a risk matrix. The risk matrix includes both system and physiological indicators which reflect the potential for increased risk to the patient. In 2013–13 64 cases were referred back to 17 health services for the purposes of internal review. Health services are requested to use existing clinical governance review processes to review the management of the patient, with particular reference to the criteria which the case met.

## A case reviewed by the Trauma Case Review Group



A 26 year-old patient presented to a regional trauma service emergency department after falling from a motorbike while not wearing a helmet. The patient sustained traumatic abdominal injuries involving a rupture of the spleen, a fractured scapula and left lung contusion equating to an Injury Severity Score (ISS) of 38. The definition of major trauma includes an ISS score greater than 12. On arrival the patient's vital signs were within normal limits. Approximately three hours after arrival the patient underwent surgery,

which involved a laparotomy and splenectomy. The regional trauma service did not make contact with either Adult Retrieval Victoria or an MTS.

Splenectomy surgery can be life-saving if the injuries are time critical or life threatening. However, if the health service had followed the transfer guidelines and contacted Adult Retrieval Victoria for advice, a discussion would have occurred to determine whether the patient's injuries were immediately life-threatening. Recent developments in trauma surgery favour conservative surgical techniques designed to preserve the spleen or kidney following rupture where it is clinically appropriate.

What else may have been done?

Early contact with Adult Retrieval Victoria would have resulted in:

- joint assessment of the clinical scenario
- discussion of the need for urgent transfer (and retrieval coordination)
- discussion with an MTS regarding clinical priorities and options.

This contact may have resulted in early transfer of this patient to an MTS, if their injuries were not immediately life threatening. Preservation of the spleen is desirable wherever possible, to avoid potential post-splenectomy complications.

Adult Retrieval Victoria is a single statewide contact and coordination point for major trauma advice (adult and paediatric), adult critical care advice, critical care bed access and retrieval of adult critical care patients.

# Victorian State Trauma Registry data

## Registry objective

The Victorian State Trauma Registry (VSTR) incorporates patient data from across the continuum of care, including pre-hospital services and patient outcomes after hospital discharge. The data from the registry provides the capacity to monitor and assess each component of the Victorian State Trauma System.

## Eligible patients

To ensure the VSTR captures all major trauma patients in Victoria, broad-based inclusion criteria are used. The VSTR captures trauma patients whose principal diagnosis is injury, irrespective of age, and who meet any of the registry criteria (Box 1) and none of the exclusion criteria (Box 2). The first four inclusion criteria are based on those recommended in the 1999 Review of Trauma and Emergency Services (RoTES) report. The remaining criteria are screening filters to capture the wider population of potentially major trauma patients.

### Box 1: The VSTR patient inclusion criteria

1. All deaths after injury
2. All patients admitted to an ICU or high-dependency area for more than 24 hours and mechanically ventilated after admission
3. Significant injury to two or more ISS body regions (an AIS of 2 or more in two or more body regions) or an ISS greater than 12
4. Urgent surgery for intracranial, intrathoracic or intra-abdominal injury, or fixation of pelvic or spinal fractures
5. Electrical injuries, drowning and asphyxia patients admitted to an ICU and having mechanical ventilation for longer than 24 hours or death after injury
6. All patients with injury as their principal diagnosis whose length of stay is three days or more – unless they meet exclusion criteria
7. All patients with injury as their principal diagnosis transferred to or received from another health service for further emergency care or admitted to a high-dependency area – unless they meet exclusion criteria

### Box 2: The VSTR patient exclusion criteria

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

## Major trauma definition

The definition of major trauma for the VSTR is adapted from the RoTES report as outlined in Box 3.

### Box 3: The VSTR major trauma definition

All trauma patients with injury as their principal diagnosis (irrespective of age) who meet any of the following criteria:

1. Death after injury
2. ISS greater than 12
3. Admission to an ICU for more than 24 hours, requiring mechanical ventilation
4. Urgent surgery for intracranial, intrathoracic or intra-abdominal injury, or for fixation of pelvic or spinal fractures
5. All trauma patients with injury as their principal diagnosis (irrespective of age) who meet any of the VSTR patient inclusion criteria

Source: Ministerial Taskforce on Trauma and Emergency Services and the Department of Human Services Working Party on Emergency and Trauma Services 1999

### Major trauma case study



In February 2012 Fen crashed his car while driving on the Mornington Peninsula. His car rolled down an embankment. The crash occurred just before midnight and he was 91 km from the closest MTS. Fen's car was badly damaged in the crash, with significant cabin intrusion. He was trapped for 50 minutes and getting him out of the car was difficult. Fen was unconscious and needed to be intubated and stabilised at the scene by ambulance paramedics. Given the seriousness of the crash and Fen's injuries, it was clear that treatment at a specialist MTS was needed. The VSTS triage guidelines were followed and he was appropriately transported by helicopter to the Royal Melbourne Hospital (RMH), arriving just after 1 am, 19 minutes after departing the scene of the crash.

At the RMH, the trauma team was activated and this team was there to receive Fen on arrival in the emergency department. Fen's injuries were serious, requiring emergency procedures including inserting two intercostal catheters to help alleviate the symptoms of his chest injuries. A brain CT scan was performed within 20 minutes of arriving at the RMH and he was transferred directly to the ICU. Investigations revealed significant injuries including a major chest injury, fractures in his spine and injuries to his spleen. He spent six days in the ICU and required surgery for his spleen and spinal injuries.

While at the RMH, Fen received the multidisciplinary care that is provided to all seriously injured patients by the MTSs. His care was integrated and coordinated by the hospital to ensure access to allied health services including physiotherapy, occupational therapy, prosthetics/orthotics, social work and dietetics. Thirteen days after the crash, Fen was discharged from the RMH to a rehabilitation centre to continue his treatment and recovery. The VSTR staff called him at six months, one and two years after injury to gather information about his recovery. Since the crash, Fen has returned to work but continues to experience problems with pain and some activities. His recovery continues.

# Trauma profile

## Trauma profile at a glance

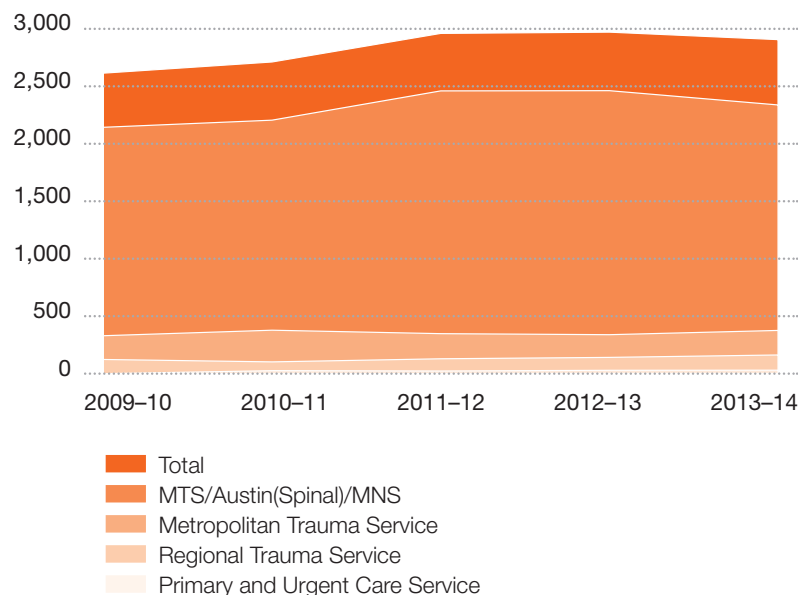
- There were 2,899 hospitalised major trauma patients in 2013–14 – a decrease of 2.2% from the previous year
- The annual incidence of major trauma has remained stable since 2009–10
- Males continue to account for 70 per cent of major trauma patients
- There has been an increase in major trauma patients aged 65 years or older
- Paediatric trauma remains low, at four per cent
- The most common cause of major trauma is transport-related, followed by low and high falls
- 91 per cent of major trauma is caused by accidental injury. Six per cent is due to assaults and three per cent due to intentional self-harm
- 80.4 per cent of major trauma patients received their definitive care at an appropriate trauma services as defined by the Victorian State Trauma System’s trauma triage guidelines

## Major trauma patient numbers

The VSTR recorded 2,899 hospitalised major trauma patients managed by the VSTS over the 2013–14 financial year. This is an increase from 2,608 in 2009–10; however, the number of hospital major trauma patients has been stable since 2010–11 (Figure 1). The annual rate of hospitalised major trauma in Victoria for 2013–14 was 51 per 100,000 population<sup>1</sup> compared with 53 per 100,000 population in 2012–13 and 49 per 100,000 population in 2009–10. Since 2009–10 the annual incidence of major trauma has not changed (incidence rate ratio 1.01, 95% CI: 1.00, 1.03,  $p = 0.144$ ).<sup>2</sup>

The VSTR recorded 2,899 hospitalised major trauma patients in Victoria over the 12-month period. This is a 2.2 per cent decrease from the 2,964 cases recorded in 2012–13.

**Figure 1: Number of hospitalised major trauma patients by level of definitive care in the Victorian State Trauma System, 2009–10 to 2013–14**



<sup>1</sup> This rate is based on Victorian population of 5,739,341 from the Australian Bureau of Statistics Regional Population Growth, Australia, 2013 (cat. no. 3218.0).

<sup>2</sup> 95% CI = 95 per cent confidence interval;  $p$  = probability

## Episodes of care and ICU stay

The 2,899 patients required a total of 8,287 hospital care episodes. The majority ( $n = 1,991$ , 68.7 per cent) of patients had only one episode of care; 864 (29.8 per cent) experienced two episodes of care and 44 (1.5 per cent) had three episodes of care. Thirty-seven per cent of patients ( $n = 1,070$ ) required an ICU admission. A quarter of the patients ( $n = 735$ ) experienced an ICU stay of more than 24 hours and required mechanical ventilation.

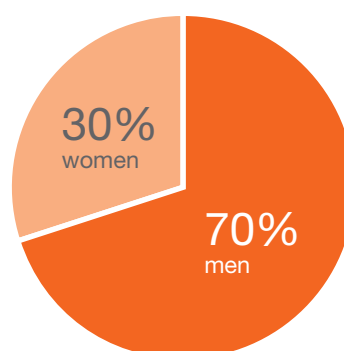
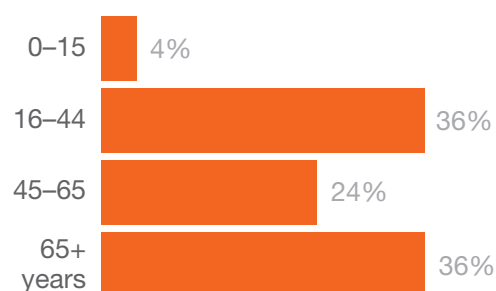
## Demographic profile of major trauma patients

The gender distribution of hospitalised major trauma patients has been stable for the last five years, with males accounting for 71 per cent of cases in 2009–10 and 70 per cent of cases in 2012–13 and 2013–14. This is consistent with global figures, which indicate that the greatest burden of injury is borne by males (Murray et al. 2012).

While major trauma patients are typically young (aged 16–44 years), the percentage of these cases has decreased from 41 per cent in 2009–10 to 38 per cent in 2012–13 and 36 per cent in 2013–14. There has been an increase in the number of major trauma patients aged 65 years or older from 32 per cent in 2009–10 to 34 per cent in 2012–13 and 36 per cent in 2013–14. This demographic change could be explained by improvements in case identification at each health service, changes in approaches to diagnosis and management among older people, and an ageing population. The percentage of paediatric (aged younger than 16 years) major trauma patients remains low, at four per cent in 2013–14.

Major trauma patients are typically young... there has been an increase in the number of major trauma patients aged 65 years or older.

The greatest burden of injury is borne by males.

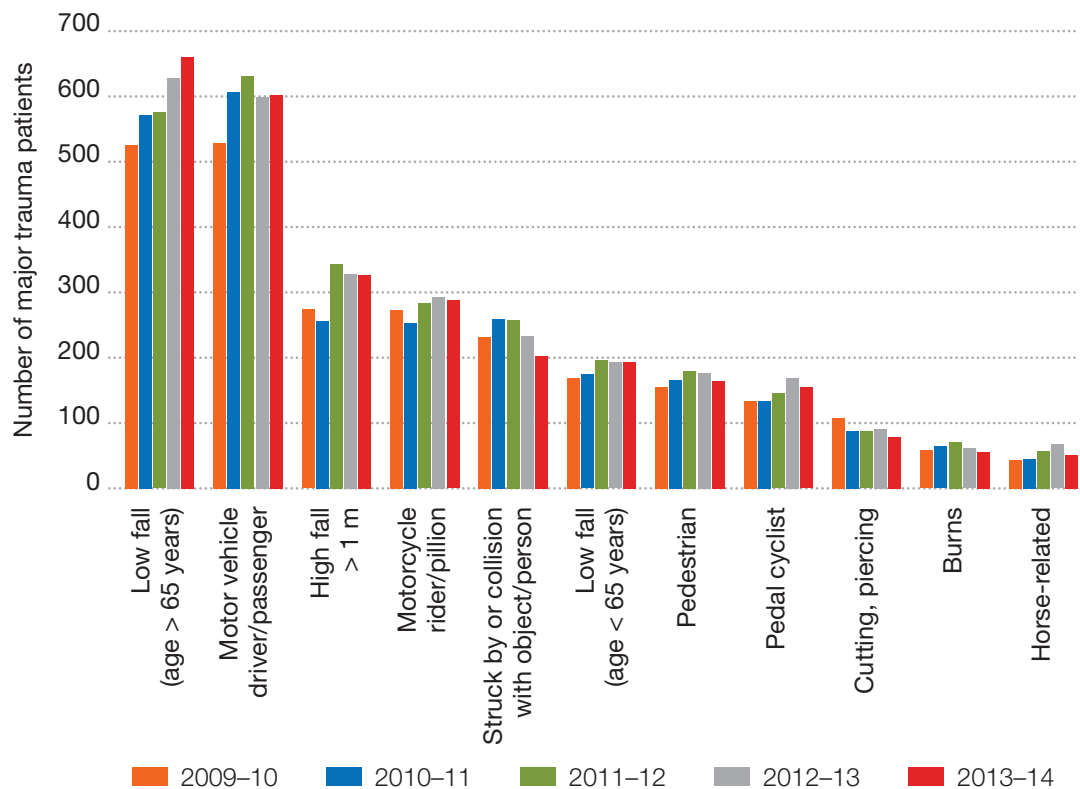




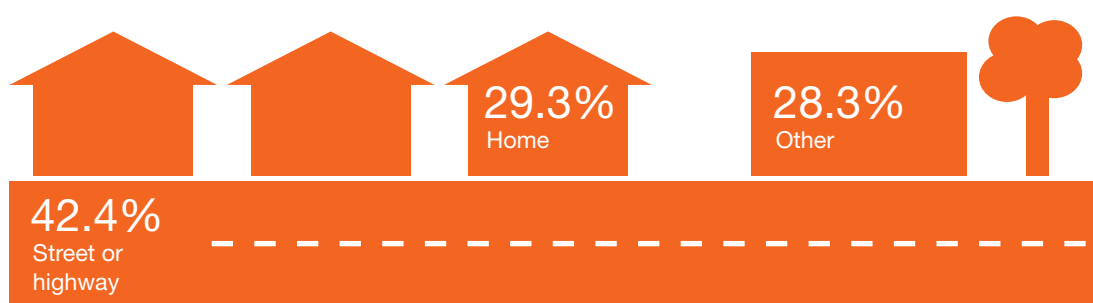
## Cause of injury

The 11 most common causes of injury are shown in Figure 2. Together these accounted for 96 per cent of major trauma cases in 2013–14. Forty-four per cent of major trauma cases in 2013–14 were transport-related compared with 42 per cent in 2009–10. The percentage of hospitalised major trauma cases due to low falls has risen from 27 per cent in 2009–10 to 29 per cent in 2013–14. In 2013–14 most low falls patients (77.3 per cent) were aged 65 years or older and the majority of this age group (63.1 per cent) sustained a head injury (AIS > 2 in the head region) as a result of the fall. The number of major trauma cases resulting from high falls (higher than one metre) has increased from 273 in 2009–10 to 326 in 2013–14. There has been a reduction in the number of major trauma cases resulting from a collision with an object or person from 231 in 2009–10 to 202 in 2013–14; in contrast there has been an increase in major trauma involving pedal cyclists from 133 in 2009–10 to 154 in 2013–14.

**Figure 2: The most common causes of injury of hospitalised major trauma patients, 2009–10 to 2013–14**

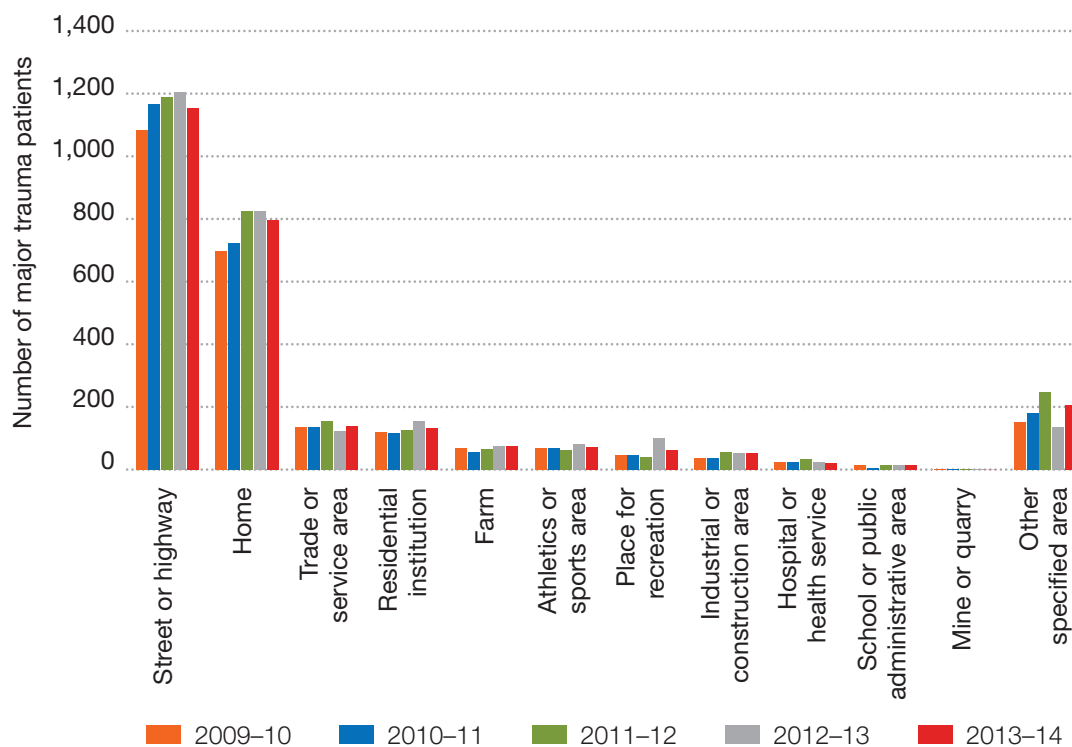


## Place of injury



Consistent with transport-related trauma being a common cause of injury, Figure 3 shows the most common place of injury was a road, street or highway (42.4 per cent). The home was the next most common place of injury (29.3 per cent). Most of the major trauma injuries that occurred at home were the result of a fall (68.7 per cent). The percentage of major trauma cases occurring at home resulting from falls from a height of more than a metre was similar to previous years: 22 per cent in 2013–14 and 21 per cent in 2009–10.

Figure 3: The place of injury of hospitalised major trauma patients, 2009–10 to 2013–14



## Transport Accident Commission compensable patients

Information was obtained from health service medical records about whether or not patients were likely to be eligible for the TAC compensation system. Overall 33 per cent of major trauma patients were recorded as TAC-compensable.

Of the TAC-compensable patients 93 per cent received their definitive care at an MTS or the Austin Hospital (for spinal care) in 2013–14; this is unchanged from 93 per cent in 2009–10. The high proportion of TAC-compensable patients who are managed at an MTS is expected given that the trauma triage guidelines suggest a low threshold for transfer to an MTS in cases involving a high-speed mechanism, despite road trauma not being a reason for transfer in itself.

## Injury type

Traumatic injury is commonly classified into blunt, penetrating or burn injury types based on the cause of injury. The vast majority of patients captured by the registry were in the blunt trauma category (93.3 per cent). Penetrating injuries were sustained by 3.6 per cent of patients and burns by 2.1 per cent. This has not changed since 2009–10 and reflects the very high proportion of major trauma patients in Victoria who sustain their injuries in transport-related incidents and falls.

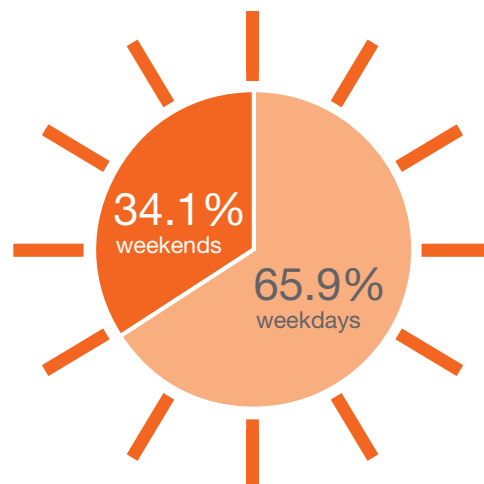
## Injury intent

Overall, 91 per cent of major trauma patients with a known intent of injury sustained their injuries from unintentional (accidental) events. This is marginally higher than the 87 per cent reported for the United States (National Trauma Data Bank 2012) and has been consistent since 2009–2010. In 2013–14, 6.0 per cent of major trauma cases resulted from assaults and this has decreased when compared with 2009–10 (8.8 per cent). Intentional self-harm accounted for 3.3 per cent of all patients in 2013–14, which is also similar to previous years.

## Time and day of injury

Consistent with previous years, major trauma occurred more frequently on weekends (34.1 per cent of all patients), particularly on Saturdays (17.5 per cent). Almost half (47.8 per cent) of all major trauma cases occurred between the hours of 8 am and 4 pm.

Injuries were most commonly sustained on the weekends and between the hours of 8 am and 4 pm.



## Location of incident

The incidence of major trauma in metropolitan Melbourne was 40 per 100,000 population and the highest incidence of hospitalised major trauma patients in regional Victoria occurred in the Hume and Gippsland regions, with rates of 77 and 67 per 100,000 population,<sup>3</sup> respectively (Table 1a). The majority of major trauma cases occurring in these regions were transport-related, as shown in Figure 4.

**Table 1a: Location of incidence of hospitalised major trauma patients in Victoria, 2009–10 to 2013–14**

Region	Major trauma per 100,000 population (adjusted per year)				
	2009–10	2010–11	2011–12	2012–13	2013–14*
Metropolitan	39.7	41.5	45.0	42.3	39.5
Loddon Mallee	40.1	41.3	32.7	47.6	52.5
Grampians	64.7	49.2	53.1	59.3	57.8
Hume**	97.0	77.4	77.1	77.5	76.7
Barwon-South Western	57.1	46.1	40.7	49.3	43.2
Gippsland	79.4	68.7	72.2	70.3	66.7

\* The injury location was not known for 251 cases and was outside Victoria for 110 cases.

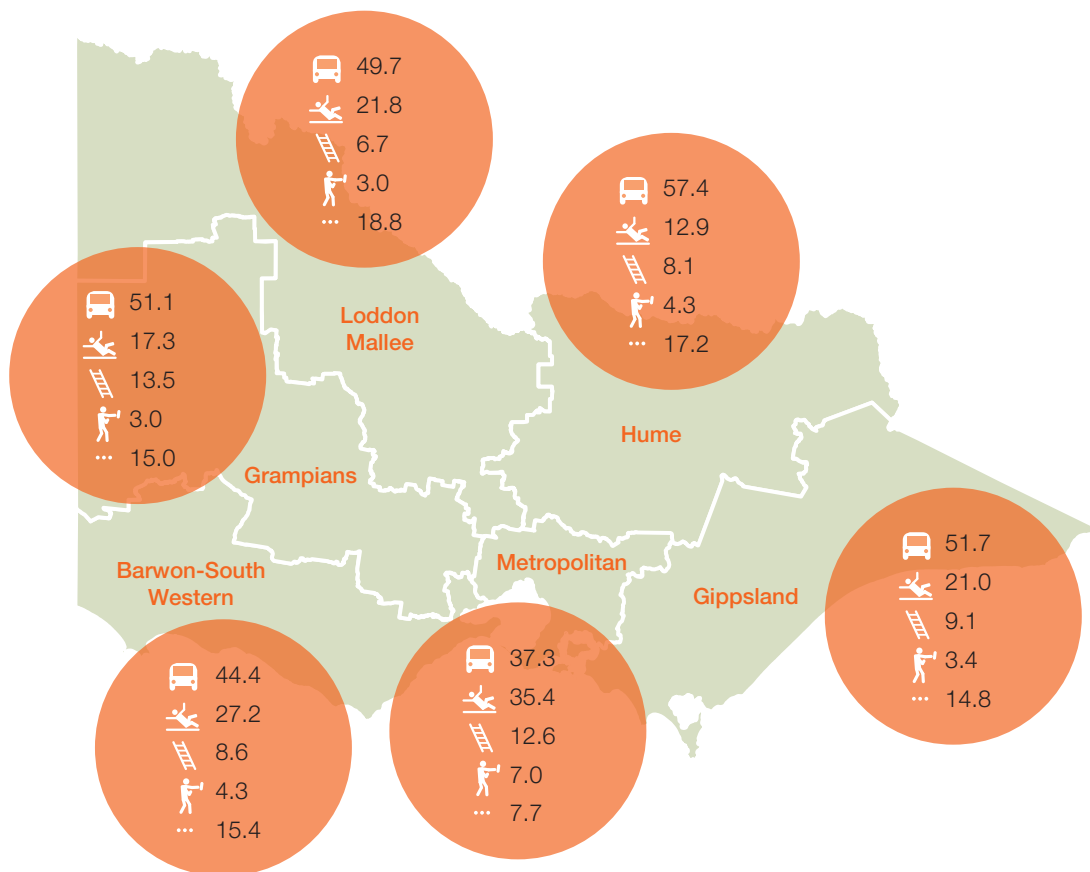
\*\* Includes population in Victoria only

**Table 1b: Location of incidence of hospitalised major trauma, 2009–10 to 2013–14**






Event postcode region	2009–10	2010–11	2011–12	2012–13	2013–14
Metropolitan Victoria	1569	1667	1810	1769	1693
Regional Victoria	795	774	859	954	845
Unknown in Victoria	162	196	206	153	251
Unknown/Other	82	68	78	88	110
<b>Total</b>	<b>2,608</b>	<b>2,705</b>	<b>2,953</b>	<b>2,964</b>	<b>2,899</b>

<sup>3</sup> This rate is based on Victoria regional populations from unpublished data provided by DHHS from the Australian Bureau of Statistics Estimated Resident Population 30 June 2013.

Figure 4: Breakdown by cause of injury and location in Victoria 2013–14



Percentage of major trauma (%)

-  Transport-related
-  Low falls
-  High falls (> 1m)
-  Assault, stabbing or firearm
-  Other

## Injuries sustained

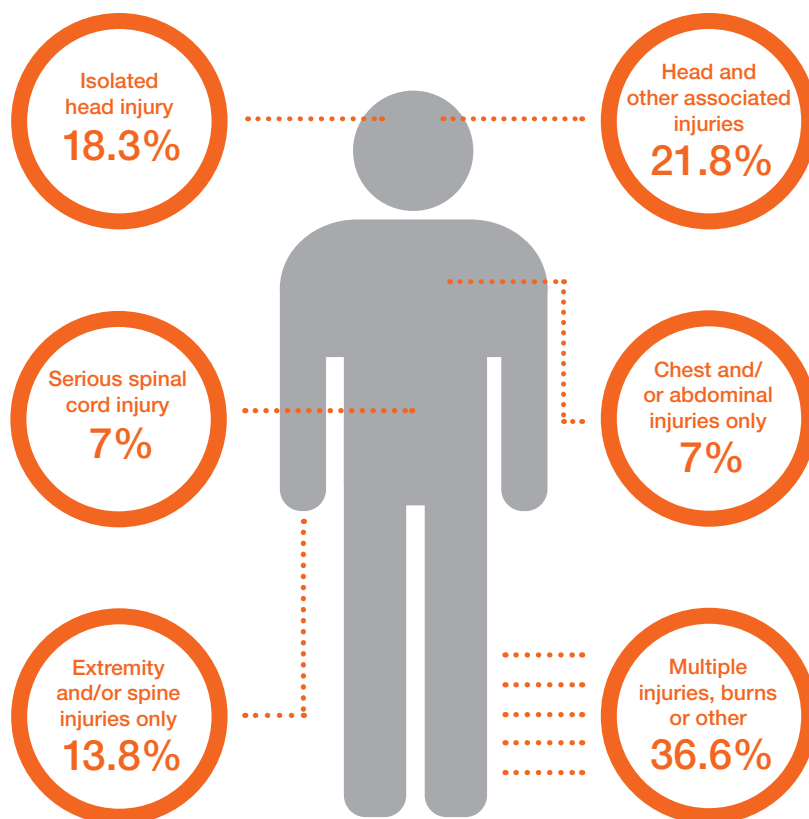


Table 2 shows the distribution of injuries sustained by major trauma patients. The most common injury group was multiple trauma (excluding serious neurotrauma), which accounted for 37 per cent of patients in 2013–14 compared with 33 per cent of major trauma patients in 2009–10. The percentage of major trauma patients who had sustained a serious head injury (either isolated or with other associated injuries) decreased from 46 per cent in 2009–10 to 42 per cent in 2010–11, and accounted for 40 per cent of hospitalised major trauma patients in 2013–14.

**Table 2: Injuries sustained by major trauma patients, 2009–10 to 2013–14**

Injury group	Percentage of major trauma patients (%)				
	2009–10	2010–11	2011–12	2012–13	2013–14
Multiple injuries, burns or other (excluding serious neurotrauma)	33.4	37.3	39.6	38.6	36.6
Head and other associated injuries	24.2	23.2	22.8	21.8	21.8
Isolated head injury	22.0	18.5	17.4	18.4	18.3
Extremity and/or spine injuries only	11.4	12.4	11.4	13.0	13.8
Chest and/or abdominal injuries only	6.3	5.9	6.0	5.5	7.0
Serious spinal cord injury	2.7	2.7	2.9	2.7	2.5

Multiple injuries, burns or other = multiple body region injuries (excluding serious neurotrauma), burns and other injuries that do not fit into any of the other groups

Head and other associated injuries = head injury with an AIS > 2 in addition to another injury

Isolated head injury = head injury with an AIS > 2 and no other injury with an AIS > 1

Extremity and/or spine injuries only = extremity injury with an AIS > 1 and/or spine injury with AIS 2 or 3 and no other injury with an AIS > 1

Chest and/or abdominal injuries only = chest and/or abdominal injury with an AIS > 2 and no other injury with an AIS > 1

Serious spinal cord injury = spinal cord injury with an AIS > 3 with or without other injuries

## Injury severity

Of all major trauma patients, 84.9 per cent had an ISS greater than 12 in 2013–14. This is a 1.4 per cent decrease from 2012–13.

Overall, the percentage of major trauma patients with an ISS greater than 12 has been consistent for the past five years – 85 per cent in 2013–14, 86 per cent in 2012–13 and 85 per cent in 2009–10. In 2013–14 the median ISS for definitive care at an MTS, Austin for spinal care or a metropolitan neurosurgical service was 17 and the median ISS for all other health services was 16.

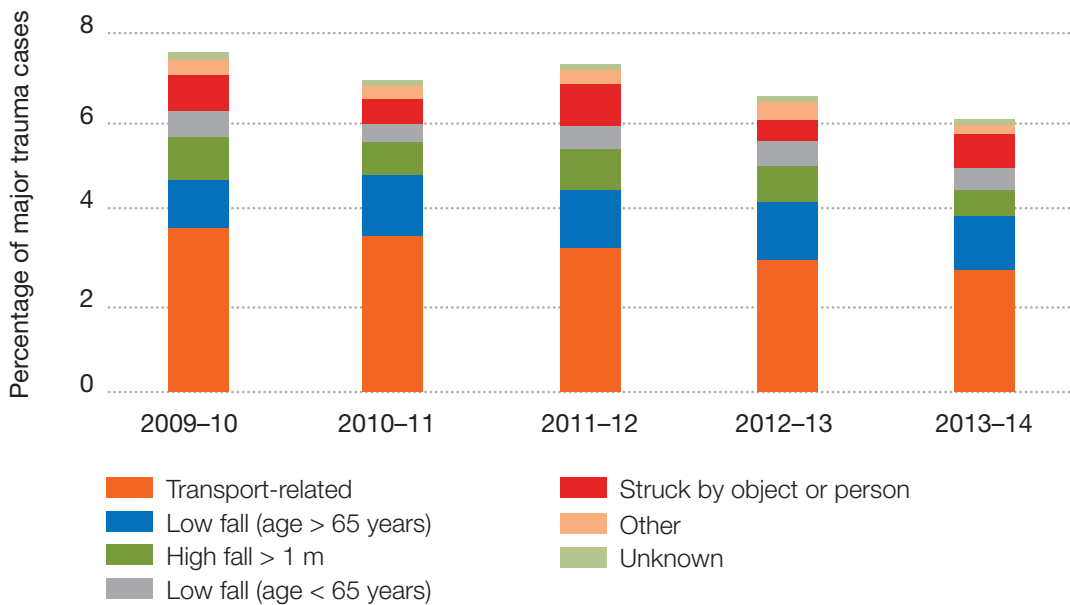
## Head injury severity

In 2013–14 the median (interquartile range) GCS on arrival at the first emergency department was 15 (13–15).

Figure 5 shows that the percentage of patients with a severe head injury, defined as an AIS head injury with a severity score greater than 2 and a GCS score less than 9 on arrival at an emergency department, has decreased from 7.5 per cent ( $n = 195$ ) in 2009–10 to 6.0 per cent ( $n = 174$ ) in 2013–14.

Figure 5 also shows that the causes of severe head injury have changed over the past five years. Motor vehicle crashes accounted for 22 per cent ( $n = 38$ ) of severe head injuries in 2013–14 compared with 24 per cent ( $n = 47$ ) in 2009–10. The reduction in severe head injuries related to motor vehicle crashes could be attributed to injury prevention initiatives including reduced speed limits, speed reduction campaigns and improved car design such as airbags and anti-lock braking systems. Pedestrians and pedal cyclists comprised 14 per cent ( $n = 25$ ) of severe head injury cases in 2013–14 compared with 15 per cent ( $n = 29$ ) in 2009–10. Older major trauma patients injured in a low fall accounted for 14 per cent ( $n = 27$ ) of severe head injury cases in 2009–10 compared with 20 per cent ( $n = 35$ ) in 2013–14.

**Figure 5: Percentage of major trauma patients with a severe head injury (head AIS severity score > 2 and GCS score < 9) by cause of injury, 2009–10 to 2013–14**



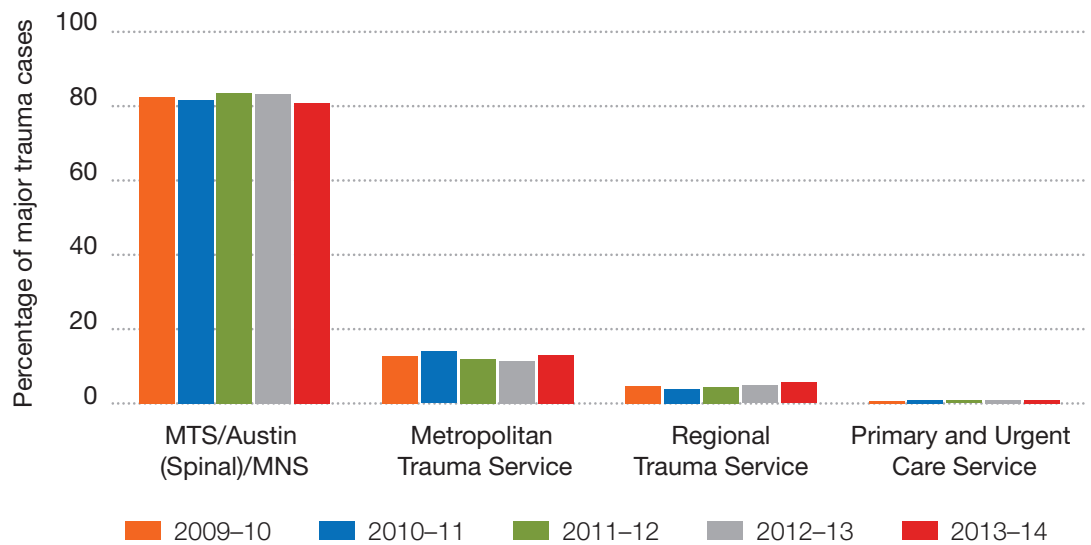


## Definitive care of major trauma patients

In 2013–14 the majority (80.4 per cent) of major trauma patients received their definitive care at an appropriate trauma service as determined by the VSTS’s trauma triage guidelines (MTS, Austin Hospital for specialised spinal care or metropolitan neurosurgical service for older patients with an isolated head injury resulting from a low fall). This is consistent with previous years (Figure 6). The 2013–14 figures include 2.3 per cent of patients who received appropriate definitive care at the Austin Hospital and 2.7 per cent of patients who received appropriate definitive care at a metropolitan neurosurgical service. As noted previously, 93 per cent of TAC-compensable patients received their definitive care at an MTS or the Austin Hospital for specialist spinal care.

A total of 80.4 per cent of patients received their definitive care at an appropriate trauma service in 2013–14. This is a decrease of 2.4 per cent from 2012–13.

**Figure 6: Proportion of major trauma cases definitively managed by level of definitive care in the Victorian State Trauma System, 2009–10 to 2013–14**



# Patient triage and transportation

## Patient triage and transportation at a glance

- 66 per cent of major trauma patients were directly transported to MTS hospitals, the Austin for spinal care or Metropolitan Neurological Services for isolated head trauma in the elderly
- 908 major trauma patients experienced an inter-hospital transfer in 2013–14
- 88.5 per cent of transferred patient received their definitive care at an appropriate trauma service as defined by the major trauma guidelines

## Direct admissions and transfers to a major trauma service

Overall the percentage of major trauma patients transported directly to a major trauma service, Austin for spinal care or metropolitan neurosurgical service from the scene of injury, home or a general practitioner (GP) has decreased from 69 per cent in 2009–10 to 66 per cent in 2013–14 (Table 3a). This could be attributed to an increase in major trauma patients inter-hospital transfers to an MTS, Austin for spinal care or MNS from 84 per cent in 2009–10 ( $n=673$ ) to 89 per cent in 2013–14 ( $n=804$ ) (Table 3b).

**Table 3a: Source of major trauma to appropriate trauma service level for definitive care, 2009–10 to 2013–14**

	Number of Major Trauma with definitive care at MTS, Austin Hospital (for spinal care) or MNS	Major trauma definitive care at MTS, Austin Hospital (for spinal care) or MNS not transferred* N (%)	Major trauma definitive care at MTS, Austin Hospital (for spinal care) or MNS transferred from referral hospital N (%)
2009–10	2,138	1,465 (68.5)	673 (31.5)
2010–11	2,200	1,536 (69.8)	664 (30.2)
2011–12	2,454	1,689 (68.8)	765 (31.2)
2012–13	2,456	1,654 (67.3)	802 (32.7)
2013–14	2,332	1,528 (65.5)	804 (34.5)

\*From the scene of injury, home or general practitioner (GP)




**Table 3b: Major trauma inter-hospital transfers to appropriate trauma service level for definitive care, 2009–10 to 2013–14**

Year	Number of Major Trauma	All major trauma transfers for definitive care N (%)	All major trauma transfers for definitive care	Transfers to MTS, Austin Hospital (for spinal care) or MNS for definitive care N (%)
2009–10	2,608	797 (30.6)	797	673 (84.4)
2010–11	2,705	769 (28.4)	769	664 (86.3)
2011–12	2,953	868 (29.4)	868	765 (88.1)
2012–13	2,964	897 (30.3)	897	802 (89.4)
2013–14	2,899	908 (31.3)	908	804 (88.5)

At The Alfred and the RMH, direct transports from the scene of injury, home or a GP were more prevalent than referrals from another health service in 2013–14 (Table 4a). In contrast, the percentage of patients referred from another health service to the Royal Children’s Hospital (RCH) was similar to the percentage of patients transported directly from the scene of injury, home or a GP.

The percentage of patients transported directly from the scene of injury, home or a GP to The Alfred has decreased from 70 per cent in 2009–10 and 64 per cent in 2013–14. The percentage of patients transported directly from the scene of injury, home or a GP to the RMH has also decreased from 76 per cent in 2009–10 to 72 per cent in 2013–14. The percentage of patients transported directly from the scene of injury, home or a GP to the RCH has also decreased from 61 per cent in 2009–10 to 52 per cent in 2013–14.

**Table 4a: Direct admissions to The Alfred, the Royal Melbourne Hospital and the Royal Children’s Hospital in 2013–14**

Hospital	Admissions <i>n</i>	Direct from scene %	Other %	Transfer from referral hospital %
 The Alfred	1,252	63.2	1.1	35.7
 The Royal Melbourne Hospital	833	68.4	3.6	28.0
 The Royal Children’s Hospital Melbourne	103	49.5	2.9	47.6
<b>Total</b>	<b>2,188</b>	<b>64.5</b>	<b>2.1</b>	<b>33.3</b>

## Helicopter mode of transport

There has been a reduction in the proportion of helicopter transports from the scene to an MTS (Table 4b).

**Table 4b: Major trauma primary helicopter transports from the scene to a major trauma service, 2009–10 to 2013–14**

Year	Helicopter transports from the scene to an MTS <i>n</i> (%)	Helicopter to The Alfred <i>n</i> (%)	Helicopter to the RMH <i>n</i> (%)	Helicopter to the RCH <i>n</i> (%)
<b>2009–10</b>	379 (26.3)	256 (31.4)	87 (15.7)	36 (48.6)
<b>2010–11</b>	374 (24.6)	231 (30.4)	110 (15.9)	33 (48.5)
<b>2011–12</b>	397 (23.8)	264 (31.0)	103 (13.7)	30 (46.9)
<b>2012–13</b>	414 (25.9)	268 (32.9)	124 (17.1)	22 (37.3)
<b>2013–14</b>	309 (20.9)	235 (28.8)	54 (8.9)	20 (36.4)

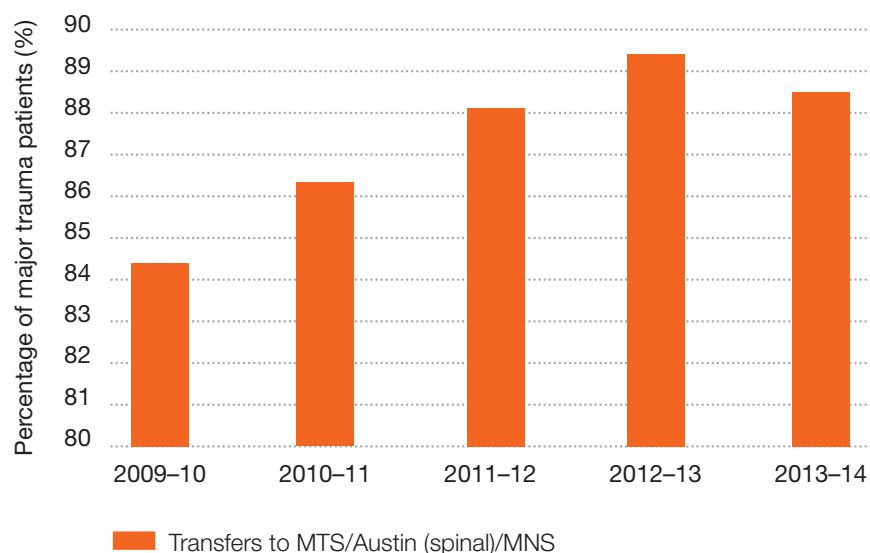
For all major trauma admissions referred from another health service for definitive care in 2013–14, there were 531 road transfers (474 by Ambulance Victoria, 53 coordinated by Adult Retrieval Victoria, four by the Victorian Paediatric Emergency Transport Service), 135 helicopter transfers (48 by Air Ambulance Victoria, 83 coordinated by Adult Retrieval Victoria, four by the Victorian Paediatric Emergency Transport Service), 186 fixed-wing transfers (60 by Air Ambulance Victoria, 120 coordinated by Adult Retrieval Victoria, six by the Paediatric Infant Perinatal Emergency Retrieval Service, 36 other (private ambulance, private car, interstate) and 20 cases where the mode of transportation to a health service was unknown.

## Transfers across the system

Appropriate and timely transfers continue to improve outcomes for the major trauma patients. Compliance with major trauma guidelines ensures the right patient to the right level of care in the shortest time.

Overall, 908 major trauma patients experienced an inter-hospital transfer in 2013–14. The majority of transferred patients (88.6 per cent) received their definitive care at an appropriate trauma service as defined by the trauma triage guidelines (Figure 7). This included 5.7 per cent of cases transferred to the Austin Hospital for specialised spinal care. A further 2.5 per cent of cases were older patients who had sustained an isolated head injury as the result of a low-fall mechanism and were transferred to a metropolitan neurosurgical service for definitive care. Regional trauma services provided initial care for 42 per cent of transferred patients.

Figure 7: Major trauma transfers across the system, 2009–10 to 2013–14



## Specialist transfers

Fifty-one paediatric (aged younger than 16 years) major trauma patients experienced an inter-hospital transfer in 2013–14. The majority of these patients (78.4 per cent) had an ISS greater than 12. Forty-seven (92.2 per cent) were transferred to the RCH.

A higher proportion of paediatric patients (44.4 per cent) with a head injury<sup>4</sup> were transferred when compared with adults (aged 16 years or older) (28.9 per cent). Most transferred patients with a head injury (279 adults and 24 paediatric patients) received their definitive treatment at an appropriate trauma service (87.1 per cent).

Of the 140 spinal cord injury<sup>5</sup> patients 52 per cent experienced an inter-hospital transfer. Ninety-seven per cent ( $n = 71$ ) were transferred for definitive care at an appropriate trauma service. Of the 23 patients who sustained both a head and spinal cord injury, 30 per cent were transferred and all were transferred to an appropriate trauma service.

4 A head injury is defined as an injury to the head with an AIS code greater than 2.

5 Spinal cord injury includes all injuries to the spinal cord in the cervical, thoracic or lumbar regions.

# Pre-hospital care and quality filters

This section describes the pre-hospital phase of care and provides quality filters associated with this care. The present filters allow some ability to review processes, but do not correlate well with outcomes. The data in this section has been historically collected however it is now timely to review the quality filters for relevance and reliability. A comprehensive review of these filters will be undertaken prior to publication of the 2014–15 summary report.

## Pre-hospital transit times

The association between pre-hospital times and patient outcomes for major trauma is not well-correlated. Recent research<sup>6</sup> suggests “swift transport is beneficial for patients suffering neurotrauma and the haemodynamically unstable penetratingly injured patient. For haemodynamically stable undifferentiated trauma patients, increased on-scene-time and total prehospital time does not increase odds of mortality. For undifferentiated trauma patients, focus should be on the type of care delivered prehospital and not on rapid transport”. In 2013–14 the median (interquartile range) time from receipt of the ambulance call until arrival at the first hospital was 68 (52–90) minutes for the 2,067 non-entrapped patients and 101 (76–136) minutes for the 210 entrapped patients. It would be expected that the entrapped patients would have longer pre-hospital transit times.

## Time at scene

The median (interquartile range) time at the scene for the 2,055 non-entrapped patients with an available scene time was 25 (17–35) minutes; for the 207 entrapped patients it was 45 (32–65) minutes. Air Ambulance Victoria transported 202 (9.8 per cent) of the non-entrapped patients and 94 (44.8 per cent) of the entrapped patients. Generally, patients serviced by Air Ambulance Victoria have a longer scene time, which reflects the severity of injuries sustained by patients who require air transport. The longer scene time is also attributed to the time taken for air transport to arrive at the location of the incident.

## Quality filters

**1. Pre-hospital time greater than one hour.** For this indicator, 61 per cent (57.5 per cent in 2009–10) of the non-entrapped patients and 92 per cent (82.3 per cent in 2009–10) of the entrapped patients in 2013–14 had a total time from receiving the ambulance call to arriving at the emergency department of more than one hour (Table 5).

**Table 5: Pre-hospital time greater than one hour, 2009–10 to 2013–14**

Year	Non-entrapped patients	Entrapped patients
2009–10	57.5	82.3
2010–11	60.0	89.0
2011–12	63.5	87.2
2012–13	64.8	88.9
2013–14	61.2	92.4

6 A.M.K. Harmsen et al 'The influence of prehospital time trauma patient outcome: A systematic review' Injury 2015.

**2. Pre-hospital scene time greater than 20 minutes.** Of the 2,039 non-entrapped blunt trauma patients, 1,923 (94.3 per cent) had a calculated scene time (the time from when the ambulance arrived to when it departed). Of these, 63 per cent (66.1 per cent in 2009–10) of patients had a scene time of more than 20 minutes in 2013–14 (Table 6).

**Table 6: Pre-hospital scene time greater than 20 minutes, 2009–10 to 2013–14**

Year	Percentage scene time greater than 20 minutes
2009–10	66.1
2010–11	65.6
2011–12	62.8
2012–13	65.3
2013–14	63.2

**3. Systolic blood pressure less than 100 mmHg on arrival and scene time greater than 10 minutes.** Of the 28 non-entrapped penetrating injury patients with a blood pressure less than 100 mmHg on arrival at the scene and a calculated scene time, 75 per cent had a scene time of more than 10 minutes in 2013–14 compared with 80 per cent in 2009–10 (Table 7). The variance in the percentage for this filter is due to the low number of cases overall, limiting the capacity to interpret trends over time.

**Table 7: Systolic blood pressure less than 100 mmHg on arrival and a scene time greater than 10 minutes, 2009–10 to 2013–14**

Year	Number of patients	Percentage of patients
2009–10	35	80.0
2010–11	22	68.2
2011–12	23	65.2
2012–13	26	57.7
2013–14	28	75.0

**1. GCS less than 9 at the scene and oxygen saturation less than 90 per cent after 10 minutes.**

Of the 164 head-injured patients with a GCS less than 9 at the scene of injury and a recorded oxygen saturation after 10 minutes in 2013–14, 17 per cent had an oxygen saturation of less than 90 per cent compared with 13 per cent in 2009–10 (Table 8). The variance in the percentages for this quality filter are due to the low number of cases overall, limiting the capacity to fully interpret trends over time.

**Table 8: GCS less than 9 at the scene and oxygen saturation less than 90 per cent after 10 minutes, 2009–10 to 2013–14**

Year	Patients with recorded O <sub>2</sub> saturation <i>n</i>	Patients with GCS < 9 and O <sub>2</sub> saturation < 90% after 10 minutes %
2009–10	136	13.2
2010–11	124	20.2
2011–12	162	9.3
2012–13	166	16.9
2013–14	164	16.5

**2. GCS less than 9 and systolic blood pressure less than 100 mmHg after 10 minutes.**

Of the 174 head-injured patients with an a pre-hospital GCS less than 9 and a recorded systolic blood pressure after 10 minutes at the scene, 14 per cent had a systolic blood pressure of less than 100 mmHg compared with 16 per cent in 2009–10 (Table 9). The variance in the percentages for this quality filter are due to the low number of cases overall, limiting the capacity to fully interpret trends over time.

**Table 9: GCS less than 9 and systolic blood pressure less than 100 mmHg after 10 minutes, 2009–10 to 2013–14**

Year	Patients with recorded systolic blood pressure <i>n</i>	Patients with GCS < 9 and systolic blood pressure < 100 mmHg after 10 minutes %
2009–10	185	16.2
2010–11	170	20.0
2011–12	183	15.8
2012–13	176	13.1
2013–14	174	14.4

# Hospital systems performance

## Emergency department quality filters

The following quality assurance filters refer to the emergency department and hospital-specific phases of major trauma patient care. The major trauma services have dedicated trauma teams comprising clinicians with a range of specialist expertise to receive major trauma patients and manage the initial response. Each major trauma service has implemented trauma team guidelines to ensure the trauma team will be activated to receive “time critical” trauma patients on arrival to the hospital. This filter describes the percentage of major trauma patients that had trauma team activation on arrival to the hospital.

### 1. Full trauma team activation at a major trauma service.

In 2013–14 the trauma team was activated for 80 per cent of all patients arriving at an MTS emergency department. This rate varied across the MTSs: 85 per cent at The Alfred, 75 per cent at the RMH and 51 per cent at the RCH<sup>7</sup> (Table 10a). MTSs activated a trauma team for 85 per cent of all patients received via transfer. This varied across the MTSs: 94 per cent at The Alfred, 78 per cent at the RMH and 35 per cent at the RCH (Table 10b). Partial activation of some team members may have occurred outside this filter.

Table 10a: Full trauma team activation at a major trauma service, 2009–10 to 2013–14

Trauma team activation at an MTS – all patients (%)				
Year	All MTSs	The Alfred	RMH	RCH
2009–10	68.9	74.3	66.4	32.8
2010–11	73.9	80.1	69.5	47.1
2011–12	76.0	81.3	73.9	38.7
2012–13	81.9	84.9	80.8	53.6
2013–14	79.5	84.8	75.2	50.5

Table 10b: Full trauma team activation at a major trauma service for patient transfers, 2009–10 to 2013–14

Trauma team activation at an MTS – patients received via transfer (%)				
Year	All MTSs	The Alfred	RMH	RCH
2009–10	66.5	79.7	55.6	8.5
2010–11	72.9	83.7	67.1	19.2
2011–12	75.6	85.7	72.4	14.5
2012–13	81.7	87.3	81.3	26.7
2013–14	84.8	93.9	78.1	34.7

7 The significantly lower percentage of major trauma patients initiating a trauma team activation at the RCH compared with the adult MTSs is affected by the fact that children have a different physiological response to injury. Paging criteria, injury patterns and transfer patterns also differ for children compared with adult trauma patients. In particular, the RCH using a specialised medical retrieval service (PETS) reduces the need for trauma team activation in many transferred cases.



## 2. No intubation in patients with a GCS less than 9 and AIS greater than 2 in ISS for the head region.

International guidelines use GCS less than nine as a criterion for tracheal intubation of patients with traumatic head injury. This filter describes the number and percentage of major trauma patients with a valid GCS less than nine on arrival to hospital and a head injury (AIS severity >2 in the head region) who were not intubated in the first 24 hours.

Across all trauma service levels, 77 non-intubated patients presented to an emergency department with a GCS less than 9 and AIS severity greater than 2 in the head region in 2013–14. Of these, 17 patients (22.1 per cent) were not intubated in the first 24 hours of treatment. Fourteen of the non-intubated patients were older, low-falls patients. It is likely that intubation may not have been indicated in these patients (Table 11).

**Table 11: No intubation in patients with a GCS less than 9 and AIS greater than 2 in ISS for the head region, 2009–10 to 2013–14**

Year	Patients with GCS < 9 and AIS > 2 on arrival to an emergency department <i>n</i>	Patients not intubated <i>n</i> (%)
2009–10	67	18 (26.9)
2010–11	74	18 (24.3)
2011–12	89	22 (24.7)
2012–13	87	20 (23.0)
2013–14	77	17 (22.1)

## 3. Patients who waited more than two hours for a head computed tomography (CT) scan.

Severe head injuries require immediate medical attention because there is a risk of secondary brain injury. This filter describes the number and percentage of major trauma patients with a serious head injury (AIS severity >2 in the head region) who had a head CT scan more than two hours after arrival at the hospital.

The time from arrival at an emergency department until receiving a head CT scan for patients with a serious head injury (AIS severity > 2 in the head region) and a known time to CT scan was more than two hours for 321 patients (31.8 per cent) (Table 12).

**Table 12: Number of patients who waited more than two hours for a head CT scan from the time they arrived at the emergency department, 2009–10 to 2013–14**

Year	Patients with serious head injury <i>n</i>	Waited > 2 hours for a head CT scan <i>n</i> (%)
2009–10	1,117	351 (32.4)
2010–11	1,024	325 (32.3)
2011–12	1,101	292 (27.1)
2012–13	1,122	351 (32.1)
2013–14	1,097	321 (31.8)

#### 4. Patients with penetrating torso trauma with haemodynamic instability (systolic blood pressure < 100 mmHg) and who waited more than one hour to go to theatre.

This filter describes the number of major trauma patients with penetrating torso trauma (AIS coded injury in the thorax or abdomen region) and haemodynamic instability (systolic blood pressure <100 mmHg) on arrival to hospital who went to the operating room more than one hour after arrival at the hospital.

There were 1,474 patients presenting with an injury to their torso region in 2013–14. Penetrating trauma occurred in 79 of these patients and 56 had surgery, all with a valid time to theatre recorded. Of these 56, 43 (76.8 per cent) had a time of more than one hour to theatre.

It is not uncommon for stable patients without obvious internal injury to be observed for a period of time to determine if surgery is necessary. This approach may result in ‘delayed’ surgery in less severely injured patients. There were 13 patients with haemodynamic instability (systolic blood pressure < 100 mmHg on arrival to a health service) (Table 13). Of these 13 patients, nine went to theatre in less than one hour.

**Table 13: Patients with penetrating torso trauma with haemodynamic instability (systolic blood pressure <100 mmHg) and who waited more than one hour to go to theatre, 2009–10 to 2013–14**

Year	Patients with an injury in their torso region <i>n</i>	Patients with penetrating trauma, surgery and a valid time to theatre <i>n</i>	Patients waiting > 1 hour to go to theatre <i>n</i>	Patients with haemodynamic instability <i>n</i>
2009–10	1,288	78	65	13
2010–11	1,357	59	47	8
2011–12	1,556	76	64	13
2012–13	1,505	62	50	18
2013–14	1,474	56	43	13

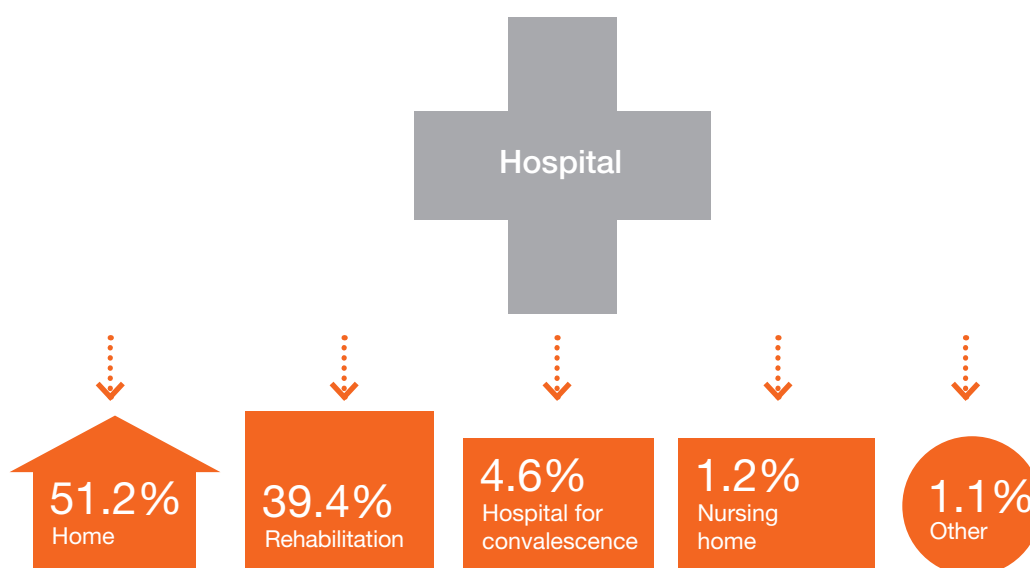
# Discharge destination of major trauma

## Length of stay

The median length of stay has decreased from 7.3 days in 2009–10 to 6.6 days in 2013–14.

## Discharge status

In 2013–14 just over half of those patients who survived to hospital discharge were discharged to their home (51.2 per cent).



In 2013–14 more than half of major trauma patients surviving to discharge were discharged directly to home. The percentage of survivors of major trauma discharged directly to home has been consistent over recent years, ranging from 50 per cent in 2009–10 to 51 per cent in 2013–14. Over the same timeframe, the percentage of major trauma survivors discharged to inpatient rehabilitation has decreased from 43 per cent in 2009–10 to 39 per cent in 2013–14 (Table 14).

**Table 14: Discharge status (excluding in-hospital deaths), 2009–10 to 2013–14**

	Home <i>n</i> (%)	Rehabilitation <i>n</i> (%)	Hospital for convalescence <i>n</i> (%)	Nursing home <i>n</i> (%)	Other <i>n</i> (%)
<b>2009–10</b>	1,135 (50.3%)	970 (43.0%)	91 (4.0%)	33 (1.5%)	29 (1.3%)
<b>2010–11</b>	1,279 (54.7%)	887 (38.0%)	88 (3.8%)	41 (1.8%)	42 (1.8%)
<b>2011–12</b>	1,388 (53.2%)	958 (36.7%)	168 (6.4%)	23 (0.9%)	70 (2.7%)
<b>2012–13</b>	1,383 (52.3%)	1,052 (39.8%)	147 (5.6%)	32 (1.2%)	31 (1.2%)
<b>2013–14</b>	1,353 (51.2%)	1,042 (39.4%)	121 (4.6%)	32 (1.2%)	29 (1.1%)

# Deaths

## Trauma deaths at a glance

- In 2013–14 there were an estimated 1,369 trauma deaths in Victoria
- There were 322 in-hospital deaths, representing 11 per cent of all hospitalised major trauma patients
- The major causes of all major trauma deaths were falls, hangings and transport-related accidents
- Deaths due to falls have exceeded transport deaths for the fourth consecutive year
- Paediatric major trauma deaths remains consistently low at 35 in 2013–14

Three different sources provide trauma death information. The Victorian State Trauma Registry in-hospital deaths and the National Coronial Information System (NCIS) are sourced to ensure all in-hospital deaths have been recorded on the registry and to identify trauma deaths at the scene. The Victorian Ambulance Cardiac Registry (VACAR) provides the number of pre-hospital deaths that Ambulance Victoria attend to.

In 2013–14 the overall death rate due to major trauma in Victoria was 24 deaths per 100,000 population;<sup>8</sup> the annual incidence of major trauma deaths in Victoria has remained consistent since 2009–10 (incidence rate ratio 0.99, 95% CI: 0.97, 1.00,  $p = 0.109$ ).<sup>9</sup> The incidence of hospitalised major trauma deaths in 2013–14 was six per 100,000 population (23.5 per cent of all trauma deaths).

## All trauma deaths

In 2013–14 there was an estimated 1,369 trauma deaths at the scene or in a hospital in Victoria based on cases recorded on the NCIS and the VSTR. The number of NCIS cases that were open without cause of death recorded in 2013–14 was significantly higher than previous years, limiting the capacity to fully interpret trends over time. The overall death rate in Victoria in 2013–14 was 24 per 100,000 population compared with 25 per 100,000 in 2012–13 and 2009–10. The annual incidence of deaths in Victoria has remained consistent since 2009–10 (0.99, 95% CI: 0.97, 1.00,  $p = 0.109$ ). The VACAR recorded 405 pre-hospital trauma deaths in 2013–14 compared with 353 in 2012–13 and 386 in 2009–10 (Table 15).

**Table 15: Ambulance Victoria pre-hospital deaths, 2009–10 to 2013–14\***

Year	Trauma deaths at scene
2009–10	386
2010–11	366
2011–12	385
2012–13	353
2013–14	405

\* Data courtesy of the Victorian Ambulance Cardiac Arrest Registry (VACAR)

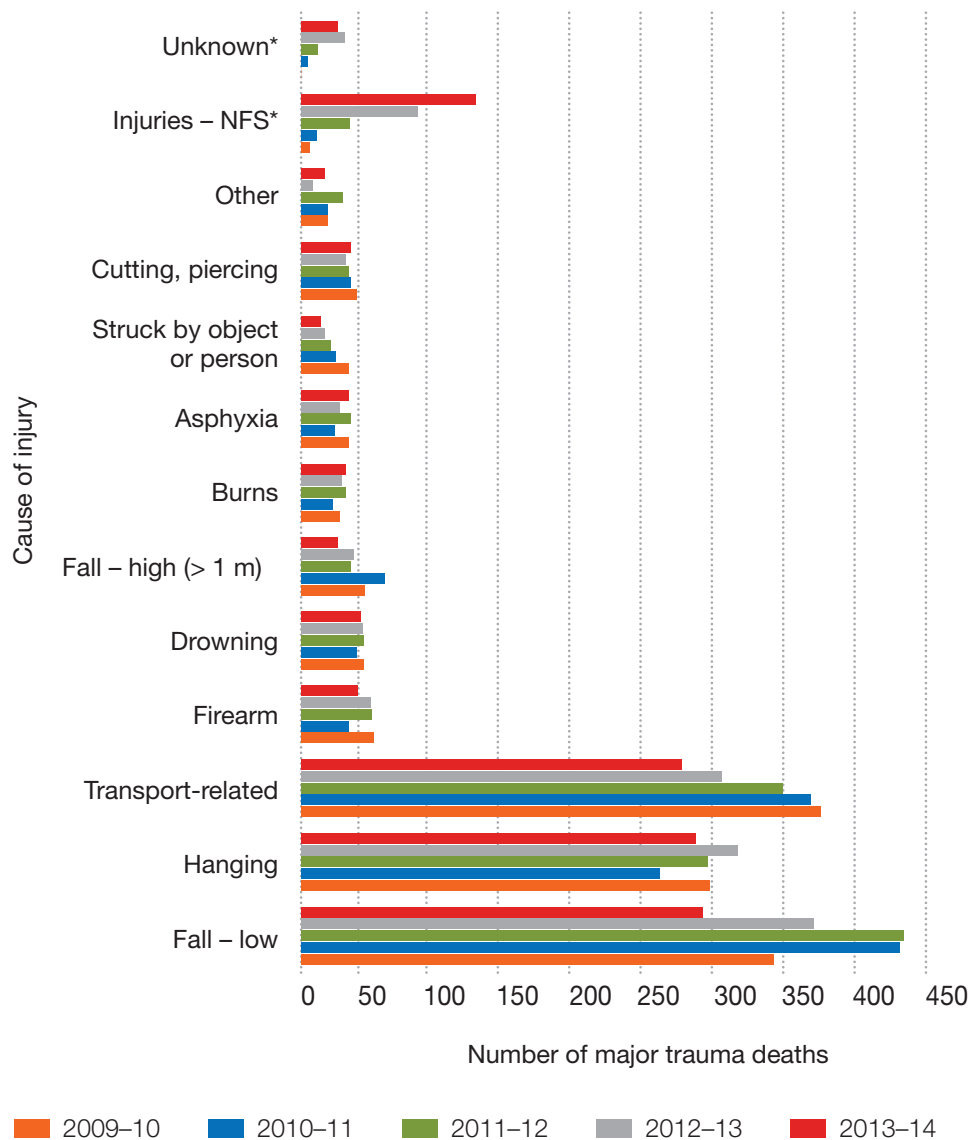
8 This rate is based on the *Regional population growth, Australia, 2013* (cat. no. 3218.0) of 5,739,341 (Australian Bureau of Statistics 2014).

9 95% CI = 95 per cent confidence interval; p = probability.

## Trauma deaths from the National Coronial Information System

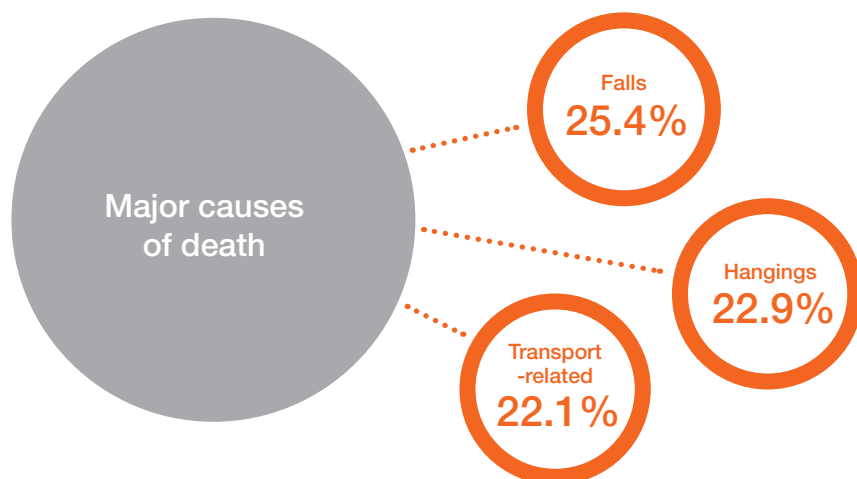
There were 1,242 deaths recorded on the NCIS (Figure 8) and an additional 127 cases were recorded in the VSTR but not found on the NCIS. Of the 322 deaths recorded by the registry, 195 (60.6 per cent) were reported in the NCIS. A specified cause of injury was available for 88 per cent of the 2013–14 trauma deaths recorded by the NCIS, which is lower than previous years (91.5 per cent in 2012–13 and 99.5 per cent in 2009–10). The percentage of closed (completed) cases for 2013–14 was lower than previous years (21.0 per cent), limiting the capacity to fully interpret trends over time.

Figure 8: National Coronial Information System trauma deaths (2013–14;  $n = 1,242$ )



\* 'Unknown' refers to an unknown cause of death (open cases).

'Injuries – NFS' includes deaths as a result of injuries where the cause is not known (open cases).



The major causes of death were falls (25.4 per cent), hangings (22.9 per cent) and transport-related incidents (22.1 per cent). The number of all transport-related deaths identified on the NCIS has decreased every year since 2009–10. The total number of paediatric (aged younger than 16 years) deaths remains consistently low – 35 in 2013–14, 31 in 2012–13 and 39 in 2009–10. The number of paediatric deaths resulting from transport-related incidents has been steady over the five years, with 12 in 2013–14, 14 in 2012–13 and 12 in 2009–10. There number of paediatric deaths due to drowning has decreased since 2009–10 (five in 2013–14, less than five in 2012–13 and 12 in 2009–10). The cause of death was not available for six paediatric deaths in 2013–14.

## In-hospital trauma deaths

The incidence of in-hospital major trauma deaths was 5.6 per 100,000 population in 2013–14 (23.5 per cent of all trauma deaths) compared with 5.7 per 100,000 population in 2012–13 (22.6 per cent of all trauma deaths) and 6.5 per 100,000 population in 2009–10 (25.7 per cent of all trauma deaths). The registry recorded 322 in-hospital deaths, which represented 11 per cent of all hospitalised major trauma patients. The percentage of hospitalised major trauma cases with an ISS greater than 12 who died during their health service stay was 10 per cent in 2013–14, nine per cent in 2012–13 and 10 per cent in 2009–10. Table 16 shows the relative risk of in-hospital death, adjusted for key confounders. There has been a reduction in adjusted relative risk of in-hospital mortality over the past five years, and this is most notable in the younger age group, with an ISS greater than 12.

**Table 16: Adjusted relative risk\* of in-hospital death of major trauma patients, 2009–10 to 2013–14**

	All major trauma	ISS > 12	ISS > 12 and age < 65
Adjusted relative risk* (95% CI)			
2009–10 (reference)	1.00	1.00	1.00
2010–11	1.20 (1.01, 1.41)	1.20 (0.99, 1.45)	1.13 (0.83, 1.55)
2011–12	0.97 (0.82, 1.15)	0.99 (0.82, 1.20)	0.76 (0.55, 1.06)
2012–13	0.82 (0.69, 0.98)	0.81 (0.66, 1.00)	0.69 (0.48, 0.99)
2013–14	0.88 (0.74, 1.05)	0.87 (0.71, 1.06)	0.67 (0.46, 0.98)

\* Adjusted for age, ISS, head injury and cause of injury

# Long-term outcomes following major trauma

## Long-term outcomes at a glance

- In 2013–14 86% of adult and paediatric patients were successfully followed up at 6 months
- Pre-existing disability and conditions, socio-economic status, age, compensable status and the type of injuries sustained all influenced whether an adult major trauma patient experienced a good functional recovery at 24 months
- Pre-existing health conditions, socio-economic disadvantage, injury compensation and increasing age are correlated with poorer recovery from major trauma
- For paediatric patients, the most important predictor of good recovery at 24 months was the type of injury sustained, with neither socio-economic or demographic factors important predictors
- At 24 months post-injury the probability of return to work ranged from 38 per cent for spinal cord injury patients to 79 per cent for major trauma patients with chest and/or abdominal injuries only

Once the patient leaves hospital, their recovery continues. The registry is able to monitor how well major trauma patients recover from their injuries by conducting standardised telephone interviews of patients (or a family member or carer if they are unable to participate directly) at six months, 12 months and 24 months after injury. Information about function, health-related quality of life, pain and return to work (if they were working before the injury) is collected during the interviews. As the follow-up process is not yet complete for patients injured from July 2012 to June 2014, this section includes data from earlier years.

For patients injured between July 2007 and June 2013, 86 per cent of adult major trauma patients were successfully followed up at six and 12 months, while 83 per cent were followed up at 24 months post-injury. Follow-up of paediatric major trauma patients commenced in March 2010 with 86 per cent followed up at six months, 87 per cent at 12 months and 81 per cent at 24 months post-injury.

The following sections describe the functional, return to work and quality-of-life outcomes of major trauma patients in Victoria, how these outcomes change with time post-injury and the key factors that influence each outcome. Also discussed is whether patients in recent years are experiencing better outcomes than their predecessors.

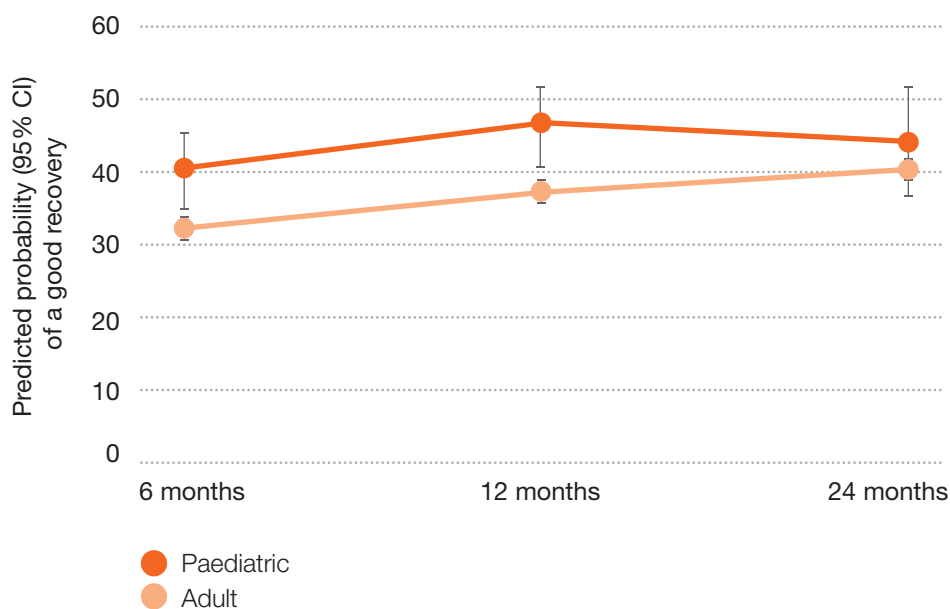
## Functional outcomes

To measure functional outcome at follow-up, the Glasgow Outcome Scale – Extended (GOS-E) score is used for adults and the King's Outcome Scale for Closed Head Injury (KOSCHI) is used for children. Both the GOS-E and KOSCHI are used to score the patient's level of function on an eight-point scale from death through to an upper good recovery (GOS-E) or intact recovery (KOSCHI). Patients who record a good recovery for this measure have largely returned to their pre-injury level of function with few, or no, residual problems.

Taking into account factors such as age, gender, pre-existing health conditions, pre-injury disability, compensable status, severity/types of injuries, level of socioeconomic disadvantage, remoteness of the patient's residence and mechanism of injury, the probability of experiencing a good recovery at each time point can be predicted for a typical major trauma patient. The predicted probability of a good recovery increased substantially for adult major trauma patients from six months to 12 months to 24 months post-injury (Figure 9). For paediatric patients, there was improvement from six months to 12 months post-injury, with the probability of a good recovery plateauing at 24 months (Figure 9).

Since 2007–08, the predicted probability of a good recovery in adult patients has been stable for adult patients at each time point – 32 per cent in 2007–08 and 2012–13 at six months, 38 per cent in 2007–08 and 2012–13 at 12 months, and 41 per cent in 2007–08 and 40 per cent in 2011–12 at 24 months. For paediatric cases, the predicted probability of a good recovery at six months has risen from 27 per cent in 2010–11 to 35 per cent in 2012–13, decreased from 57 per cent in 2010–11 to 46 per cent in 2012–13 at 12 months, and remained stable at 49 per cent for 2010–11 and 2011–12 at 24 months.

**Figure 9: Predicted probability (95% CI) of a good recovery for major trauma patients adjusted for socioeconomic, demographic and injury factors**



At 24 months post-injury, the factors that influence whether a major trauma patient experiences a good recovery differed for adult and paediatric patients. For paediatric patients, the most important factor influencing functional outcome was the type of injury sustained, with patients experiencing chest and abdominal injuries only, experiencing the highest probability of recovery, followed by those with isolated head injuries and children who experienced only orthopaedic injuries. Socioeconomic and demographic factors were not important predictors of functional outcome in children.

In contrast, pre-existing disability, socioeconomic status, age, pre-existing conditions, compensable status and the types of injuries sustained all influenced whether an adult major trauma patient experienced a good functional recovery at 24 months. The probability of experiencing a good recovery was highest at 57 per cent for major trauma patients who experienced injuries to the chest and/or abdomen only and lowest for a typical major trauma patient with spinal cord injury (20 per cent) or orthopaedic injuries only (24 per cent). Increasing age, the presence of pre-existing medical, mental health, drug or alcohol conditions reduced the probability of a good functional outcome. The probability of a good functional outcome increased for patients who were privately insured or covered by Medicare (compared with TAC-compensable patients) and also increased with greater socioeconomic advantage.

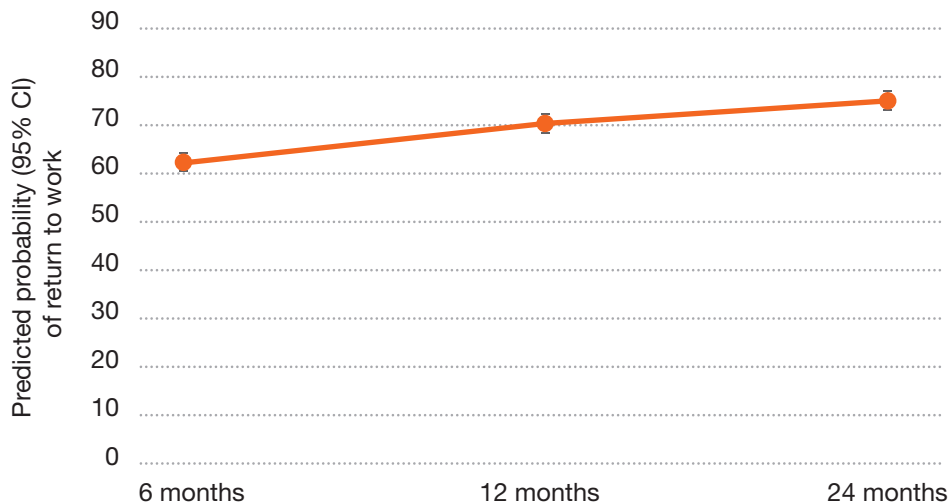


## Return to work

Sixty per cent of major trauma cases surviving to hospital discharge reported working or studying prior to injury. Return to work information is collected for patients who reported working prior to their injury. Return to schooling in paediatric patients is captured as part to the health-related quality-of-life measure used in children.

Taking into account factors such as age, gender, pre-existing health conditions, pre-injury disability, compensable status, severity/types of injuries, level of socioeconomic disadvantage, remoteness of the patient's residence, level of education and mechanism of injury, the probability of returning to work at each time point can be predicted for a typical major trauma patient. Consistent with functional recovery outcomes, the predicted probability of returning to work increased from six months to 12 months to 24 months (Figure 10). Since 2009–10, the predicted probability of returning to work in adult patients has decreased marginally from 73 per cent to 64 per cent at six months, from 71 per cent to 68 per cent at 12 months and from 78 per cent to 72 per cent at 24 months post-injury.

**Figure 10: Predicted probability (95% CI) of a returning to work for major trauma patients adjusted for socioeconomic, demographic and injury factors**



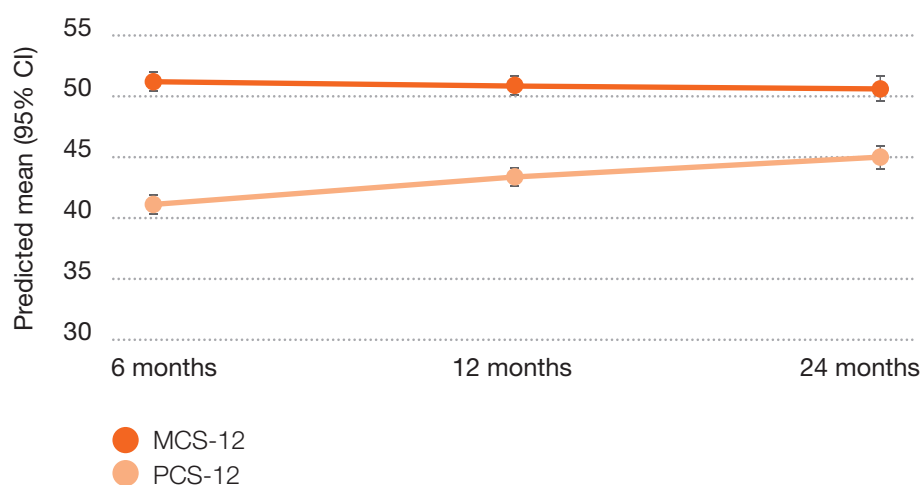
At 24 months post-injury, the probability of returning to work ranged from 38 per cent for spinal cord injury patients to 79 per cent for major trauma patients who experienced injuries to the chest and/or abdomen only. Women were less likely than males to return to work at 24 months, and the probability of return to work decreased by five to 10 per cent with each decade of increasing age. The probability of return to work was 33–50 per cent lower for patients with pre-existing mental health, drug or alcohol conditions, or severe pre-existing medical conditions, respectively. Education below university level reduced the probability of return to work, potentially reflecting differences in the nature of occupation of these patient groups. The probability of return to work at 24 months increased for patients who were privately insured or covered by Medicare (compared with TAC-compensable patients).

## Health-related quality of life

In adults, the SF-12 provides a measure of a patient's physical and mental health status, and is divided into a physical component summary (PCS-12) score and a mental component summary (MCS-12) score. In children, the Pediatric Quality of Life Inventory (PedsQL) is administered to measure the child's quality of life from the parents' perspective. The responses to the PedsQL are used to generate physical health and psychosocial health summary scores. The summary scores range from 0 to 100, with higher scores representing better function.

Taking into account factors such as age, gender, pre-existing health conditions, pre-injury disability, compensable status, severity/types of injuries, level of socioeconomic disadvantage, remoteness of the patient's residence and mechanism of injury, the predicted mean PCS-12 and MCS-12 at each time point can be predicted for a typical adult major trauma patient. The predicted mean physical health (PCS-12) for major trauma patients increased from 41 at six months to 43.5 at 12 months to 45 at 24 months. In contrast, there was no change in mental health (MCS-12) scores with time post-injury (Figure 11).

**Figure 11: Predicted mean (95% CI) PCS-12 and MCS-12 scores of major trauma patients adjusted for socioeconomic, demographic and injury factors**



The predicted mean physical health score from the SF-12 at 24 months post-injury has risen from 44 in 2009–10 to 45 in 2012–13 for a typical major trauma patient, although the mean remains well below the Australian population mean score of 49. In contrast to the physical health scores, the predicted mean mental health score of the SF-12 for a typical major trauma patient has not changed from 2009–10 (50.8) to 2012–13 (50.7) compared with the Australian population mean of 52.

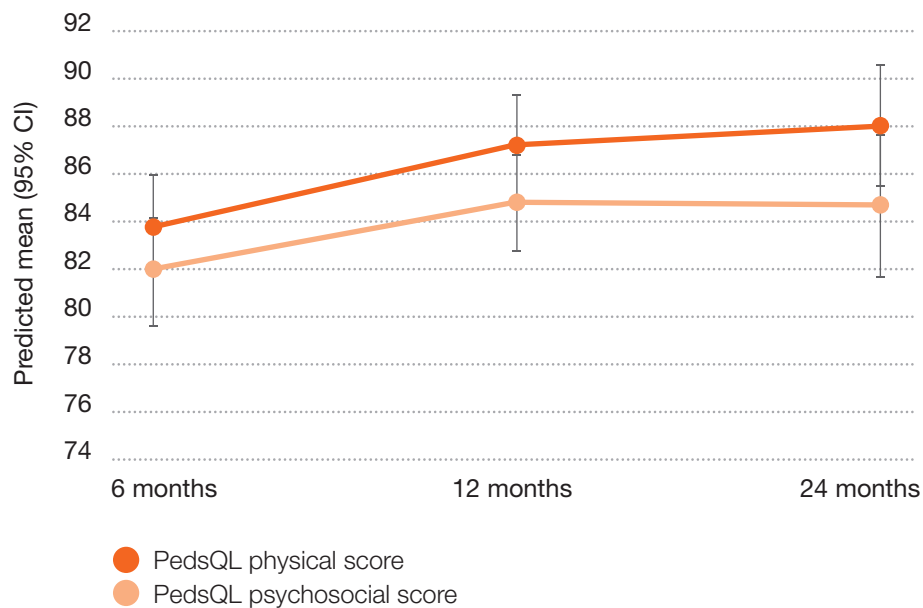
The major factors influencing physical health in adult major trauma patients at 24 months are largely consistent with functional outcomes and return to work. Older age, female gender, receiving compensation for the injury, lower levels of education, higher socioeconomic disadvantage and pre-existing medical, mental health, alcohol or drug conditions increased the likelihood of poorer physical health at 24 months. Taking into account these factors, spinal cord injured patients and patients who had sustained only orthopaedic injuries demonstrated the lowest mean physical health scores at 24 months.

The factors influencing mental health outcomes at 24 months differed when compared with physical health outcomes. While receiving compensation for the injury, higher socioeconomic disadvantage and the presence of pre-existing mental health, drug or alcohol conditions increased the likelihood of poorer mental health outcomes. The relationship between age and mental health, however, differed. Unlike the probability of a better outcome declining with increasing age, major trauma patients aged 25–54 years experienced lower mental health outcomes, while older patients reported much better mental health.

Taking into account factors such as age, gender, pre-existing health conditions, compensable status, severity/types of injuries, level of socioeconomic disadvantage, remoteness of the patient's residence and mechanism of injury, the predicted mean physical and psychosocial summary scores of the PedsQL at each time point can be predicted for a typical paediatric major trauma patient. The predicted mean physical health score for major trauma patients increased from six months to 12 months, with only a small increase from 12 to 24 months post-injury. The predicted mean physical health score for paediatric major trauma patients at 24 months post-injury (87.9) was consistent with the expected mean for healthy children (86.6). Psychosocial scores improved for paediatric major trauma patients from six months to 12 months before plateauing at 24 months post-injury (Figure 12), with the mean score at 24 months (84.6) lower than the mean psychosocial score for health children (89.3).

The factors influencing health-related quality-of-life outcomes in children were clearer for physical health outcomes in paediatric major trauma patients with older age, whether compensation was received for the child's injuries and the type of injury impacting on this outcome.

**Figure 12: Predicted mean (95% CI) physical and psychosocial scores of the PedsQL for paediatric major trauma patients adjusted for socioeconomic, demographic and injury factors**



## Summary of long-term outcomes

Discharge from a trauma service represents the start of a new phase in a patient's recovery from major trauma. The long-term outcomes information provides critical information about the quality of survival of major trauma patients in Victoria, allows the capacity to monitor the burden of major trauma over time, and assists in identifying groups that are a greater risk of poorer outcomes. Overall, paediatric major trauma patients experience better functional and quality-of-life outcomes when compared with adult major trauma patients, and a number of key factors influencing patient outcome were identified.

Disability remains prevalent even 24 months following major trauma, highlighting the prolonged impact of serious injury on patients' lives. However, the data presented in this report shows that recovery continues to 24 months post-injury, particularly for function, return to work and physical health, suggesting there is additional capacity to improve. Age, socioeconomic status, level of education, pre-existing health conditions and whether compensation is received for the injury were key factors predictive of longer term outcome, providing evidence that recovery is influenced by factors beyond the severity and type of injuries sustained. Further patient follow-up beyond two years post-injury is needed to better understand when patients fully recover or transition to permanent disability. Similarly, further information about how socioeconomic and other factors influence longer term outcomes is needed. Both of these issues are the focus of the REcovery after Serious Trauma – Outcomes, Resource use and patient Experiences (RESTORE) project.

The RESTORE study is funded by the National Health and Medical Research Council of Australia. RESTORE is using both longitudinal quantitative and qualitative methods to study approximately 2,500 major trauma survivors. The study is using routinely collected population-based registry data, data linkage and participant interviews to describe participant outcomes and experiences in the first 5 years after injury. The quantitative study data will establish the pattern of recovery following major trauma, predictors of patient-reported outcomes, and highlight patients at risk of poor outcome. The qualitative data will describe the challenges experienced by seriously injured people in the Australian context, exploring factors that contribute to participant outcomes. In addition, the qualitative data will enable identification of treatment and disability service needs, and provide valuable insights into individual, social and environmental factors that impact on the ability to access services and information. The longitudinal nature of the study will provide evidence of change in functioning and quality of life, and patient priorities and experiences over time. The results of this project could reduce the burden of non-fatal injury and improve the lives of people living with the consequences of severe injury, such as through the development of targeted service delivery.

# Limitations and data caveats

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

## Hospital capture

All health services within the Victorian state trauma system are now contributing to the registry.

## Hospital records

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

## Data presentation

Generally, data are reported for either 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 are taken exclusively from these hospitals' records, excluding cases with missing information. Because of the lack of complete data, the specific trauma service-level analyses have fewer patients than the analyses of all patients.

## National Coronial Information System data

The number of closed cases and cases with cause of death recorded on the NCIS was significantly lower this year compared with previous years, limiting the capacity to fully interpret trends over time.

# Appendix 1: Victorian State Trauma Registry data methodology

Data coordinators collect data at the major trauma services. Metropolitan trauma services, metropolitan primary care services and regional trauma data collection is the responsibility of data collectors employed by Monash University. There are regional data collectors based in each of the five rural regions: Barwon-South Western, Gippsland, Grampians, Hume and Loddon Mallee.

Formal training sessions are provided to data collectors, including one-on-one onsite training when they are appointed, and group training sessions at the Department of Epidemiology and Preventive Medicine at Monash University. The training includes VSTR procedures, data collection/extraction processes and definitions of data variables. The VSTR data manager also provides ongoing support and advice. This ensures data is collected in an accurate and standardised format. Data collectors are encouraged to attend the Injury Scaling: Uses and Techniques (Abbreviated Injury Scale) course, which is coordinated by the Association for the Advancement of Automotive Medicine, the NSW Institute of Trauma and Injury Management and the Department of Epidemiology and Preventive Medicine at Monash University.

In-hospital flagging systems identify eligible patients. Data coordinators at the major trauma services identify likely trauma patients meeting the VSTR criteria by checking the hospital information system, emergency department admission records, ICU admission records and ward rounds daily. Metropolitan and regional data collectors undertake retrospective data collection.

Trauma patients are identified retrospectively by running reports using the Victorian Admitted Episodes Dataset ICD-10-AM codes to identify patients with injury as their principal diagnosis. These reports are set up to include each patient's age, length of stay, ICU admission and outcome (to identify transfers and deaths). The VSTR also provides quarterly lists of identified transfers to and from individual health services.

Data is extracted from the medical records maintained at the facilities that provided care to the major trauma patient. The VSTR uses the 2008 version of the Abbreviated Injury Scale (AIS), with all patients injured from 1 July 2010 coded using the new version. Patients injured prior to this were coded in AIS 1998 but have been mapped forward to AIS 2008 to enable accurate comparisons. Introduction of the AIS 2008 has had little effect on the number of patients classified as major trauma.

## Appendix 2: Methodology for extracting National Coronial Information System data

The National Coronial Information System (NCIS) is a national web-based data storage and retrieval system for Australian coronial cases. Information about deaths reported to an Australian coroner since July 2000 is stored within the system.

By running a single query in the NCIS based on all case type notifications between 1 July 2013 and 31 August 2014 the Victorian State Trauma Registry (VSTR) limits its data capture to deaths in Victoria in the relevant timeframe.

From the extracted data, the following injury types are excluded:

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

Data fields extracted are the NCIS number, the patient's age, the patient's gender, case status, case type, case intent, medical cause of death, cause of injury, postcode of the patient's residence and postcode of where the injury occurred. For those who meet the trauma criteria, an injury cause (such as transport-related collision, hanging or low fall) is assigned. Transport-related incidents include those involving a motor vehicle, motorcycle, pedestrian, bicycle, mobility scooter or motorised bicycle. The 'other' injury causes include machinery (such as tractors), electrocution, aviation, skiing and surfing incidents. Asphyxia includes suffocation and strangulation-related deaths.

Deaths recorded on the VSTR are matched with those extracted from the NCIS database. The NCIS database is also searched for VSTR cases not on the extracted list by matching the date of birth, date of death, residential postcode and injury type.

# Appendix 3: Victorian State Trauma 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.

**Pre-hospital data:** The VSTR works closely with Ambulance Victoria to improve pre-hospital data capture and accuracy. Since Ambulance Victoria implemented the Victorian Ambulance Clinical Information System, enabling the data from the pre-hospital phase to be captured electronically, the availability and quality of pre-hospital data has greatly improved. The process for linking with VSTR data using probabilistic linkage has been defined.

**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 and time validation checks have been built into the web-based database. The date and time the injury occurred must precede the date and time of admission. The date and time of the ambulance call, time of arrival at the scene, time of departure from the scene and time of arrival at the health service must be entered in the correct sequence. If the patient is transferred 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 Abbreviated Injury Scale code for each individual injury is also checked against the injury description.

Manually collected data is checked for completeness and accuracy, including AIS coding for all injuries. Each data collector is provided with a feedback list of common errors and known data collection issues, plus advice on how to correct these. Validation checks are built into the web-based database to ensure clinical values are within acceptable ranges. The Glasgow Coma Scale (GCS) is calculated automatically by the sum of known component responses. Patients with missing transfer data are included in the list of patients to be reviewed by the data collectors at the relevant health service.

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

Checks are performed to ensure major trauma patients are captured by participating health services. Capture-recapture methods are used to cross-reference different data sources. For example, the VSTR death records are compared against those recorded by the National Coronial Information System. Pre-hospital data is received from the Victorian Ambulance Clinical Information System to enable cross-checking with the registry. Inter-hospital transfer tasking and mode are cross-checked with the Adult Retrieval Victoria database.

**Follow-up:** Follow-ups are performed at six, 12 and 24 months after injury to identify patients who have died post-discharge and to quantify their level of function, any work disability, any pain and their health-related quality of life at these time points.



## Patient confidentiality

The VSTR was established under the National Health and Medical Research Council's *National statement on ethical conduct in human research* to ensure confidentiality and patient privacy are maintained at all times. Ethics committee approval was obtained from each health service before any data on trauma patients was collected (Appendix 5). Approval was also obtained from the Department of Health, Monash University and the Department of Justice ethics committees.

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

# Appendix 4: The Victorian State Trauma Outcome Registry and Monitoring group

The VSTORM group (based at the Department of Epidemiology and Preventive Medicine at Monash University) coordinates the Victorian State Trauma Registry.

The VSTORM chief investigators for 1 July 2013 to 30 June 2014 were:

- Prof. Peter Cameron (Head of the Victorian State Trauma Registry, Monash University)
- Prof. John McNeil (Head of School of Public Health and Preventive Medicine, Monash University)
- Prof. Belinda Gabbe (National Health and Medical Research Council Career Development Fellow, Department of Epidemiology and Preventive Medicine, Monash University).

Members of the VSTORM Steering Committee from 1 July 2013 to 30 June 2014, all of whom have expertise in epidemiology, trauma management or related areas, were:

- Chair: Prof. Rodney Judson (Director of Trauma, The Royal Melbourne Hospital)
- Prof. Peter Cameron (Head, VSTORM)
- Ms Diana Zimmermann (Senior Project Officer, Emergency and Trauma Program, Department of Health)
- Ms Diane Gill (Executive Officer, The Royal Melbourne Hospital)
- Dr Marcus Kennedy (Director, Adult Retrieval Victoria)
- Dr Michael Geluk (Emergency Physician, Austin Health)
- Prof. Mark Fitzgerald (Director, Trauma Services, The Alfred)
- Dr Simon Young (Director of Emergency Medicine, The Royal Children's Hospital)
- Dr Ben McKenzie (Emergency Physician, Bendigo Health Care Group)
- Prof. Jennie Ponsford (Director, Monash-Epworth Rehabilitation Research Centre)
- Dr Bruce Bartley (Emergency Department, The Geelong Hospital)
- A/Prof. Tony Walker (Executive General Manager, Quality and Education Services, Ambulance Victoria)
- A/Prof. Karen Smith (Manager, Research and Evaluation, Ambulance Victoria)
- Mr David Attwood (Senior Manager, Claims Research, Strategy and Performance, TAC)
- Mr Peter Trethewey (Chief Executive Officer, AQA Victoria Ltd).

## Appendix 5: Health services with ethics committee approval July 2013 to June 2014

The collection of patient-level data from each of the 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 Coronial Information System (for trauma-related deaths).

Approval for trauma data collection has also been actively sought from all Victorian State Trauma System health services (public and private) in metropolitan, regional and rural areas. As at 30 June 2014, registry data collection was approved at the 138 health services listed in the following table.

Trauma service level	Hospital
<b>Major trauma service</b>	Alfred Health: The Alfred
	The Royal Children's Hospital
	The Royal Melbourne Hospital
<b>Metropolitan trauma service</b>	Austin Health: Austin Hospital
	Eastern Health: Box Hill Hospital
	Northern Health: The Northern Hospital
	Peninsula Health: Frankston Hospital
	Monash Health: Monash Medical Centre, Clayton Campus
	Monash Health: Dandenong Hospital
	Eastern Health: Maroondah Hospital
	St Vincent's Health
Western Health: Western Hospital	
<b>Metropolitan primary care service</b>	Bayside Health: Sandringham and District Memorial Hospital
	Eastern Health: The Angliss Health Services
	Epworth Hospital
	Knox Private Hospital
	Mercy Public Hospitals Inc.: The Mercy Hospital Werribee
	Peninsula Health: Rosebud Hospital
	Monash Health: Monash Medical Centre, Moorabbin Campus
	Monash Health: Monash Medical Centre, Casey Campus
	Western Health: Sunshine Hospital
Western Health: Williamstown Hospital	

## Barwon-South Western Region

### Regional trauma service

Barwon Health: The Geelong Hospital

South West Healthcare (Warrnambool Campus)

Western District Health Service (Hamilton)

### Urgent care service

Casterton Memorial Hospital

Colac Area Health (Colac)

Hesse Rural Health Service (Winchelsea)

Lorne Community Hospital

Moyne Health Services (Port Fairy)

Otway Health and Community Service (Apollo Bay)

Portland District Health

South West Healthcare (Camperdown Campus)

Timboon and District Healthcare Service

### Primary care service

Balmoral Bush Nursing Centre

Cobden District Health Service

Colac Area Health (Birregurra Community Health Centre)

Dartmoor and District Bush Nursing Centre Inc.

Hesse Rural Health Service (Rokewood)

Hesse Rural Health Service (Beeac)

Heywood Rural Health

South West Healthcare (Lismore)

Terang and Mortlake Health Service (Mortlake)

Western District Health Service (Merino)

Western District Health Service (Penshurst)

<b>Gippsland Region</b>	
<b>Regional trauma service</b>	Latrobe Regional Hospital
<b>Urgent care service</b>	Bairnsdale Regional Health Service
	Bass Coast Regional Health (Wonthaggi)
	Central Gippsland Health Service (Sale)
	Gippsland Southern Health Service (Leongatha)
	Gippsland Southern Health Service (Korumburra)
	Orbost Regional Health
	South Gippsland Hospital (Foster)
	West Gippsland Healthcare Group (Warragul)
	Yarram and District Health Service
<b>Primary care service</b>	Buchan Bush Nursing Centre
	Cann Valley Bush Nursing Centre
	Dargo Bush Nursing Centre Inc.
	Ensay Bush Nursing Service Inc.
	Gelantipy District Bush Nursing Centre
	Heyfield Hospital Inc.
	Neerim District Soldiers Memorial Hospital
	Omeo District Hospital
	Swifts Creek Bush Nursing Centre Inc.

## Grampians Region

### Regional trauma service

Ballarat Health Services: Ballarat Base Hospital

Wimmera Health Care Group: Wimmera Base Hospital

### Urgent care service

East Grampians Health Service (Ararat)

East Wimmera Health Service (St Arnaud)

Edenhope and District Memorial Hospital

Hepburn Health Service (Daylesford)

Stawell Regional Health

West Wimmera Health Service (Nhill)

Rural Northwest Health (Warracknabeal)

St John of God Hospital Ballarat

### Primary care service

Ballan District Health and Care

Beaufort and Skipton Health Service (Beaufort)

Beaufort and Skipton Health Service (Skipton)

Djerriwarrh Health Services (Bacchus Marsh)

Dunmunkle Health Services (Rupanyup)

East Wimmera Health Service (Birchip)

East Wimmera Health Service (Charlton)

East Wimmera Health Service (Donald)

East Wimmera Health Service (Wycheproof)

Elmhurst Bush Nursing Centre

Hepburn Health Service (Creswick)

Lake Bolac Bush Nursing Centre

Rural Northwest Health (Hopetoun)

West Wimmera Health Service (Kaniva)

West Wimmera Health Service (Jeparit)

West Wimmera Health Service (Rainbow)

Wimmera Health Care Group (Dimboola)

Woomelang Bush Nursing Centre

<b>Hume Region</b>	
<b>Regional trauma service</b>	Albury Wodonga Health: Albury Base Hospital
	Goulburn Valley Health (Shepparton)
	Northeast Health Wangaratta
<b>Urgent care service</b>	Alexandra District Hospital
	Alpine Health (Bright)
	Alpine Health (Mt Beauty)
	Alpine Health (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 (Corryong)
	Albury Wodonga Health (Wodonga)
	Yarrowonga District Health Service
Yea and District Memorial Hospital	
<b>Primary care service</b>	Beechworth Health Service
	Euroa Health Inc.
	Falls Creek Medical Centre
	Mt Buller Medical Centre
	Mt Hotham Medical Centre
	Nagambie Medical Centre
	Tallangatta Health Service
	Violet Town Bush Nursing Centre
	Walwa Bush Nursing Centre

Loddon Mallee Region	
Regional trauma service	Bendigo Health Care Group: Bendigo Hospital
	Mildura Base Hospital
Urgent care service	Castlemaine Health (Mt Alexander)
	Cohuna District Hospital
	Echuca Regional Health
	Kerang and District Hospital
	Kyabram and District Health Service
	Kyneton District Health Service
	Maryborough District Health Service
	Swan Hill District Health
Primary care service	Boort District Health
	Dingee Bush Nursing Centre Inc.
	Heathcote Health (Mclvor)
	Inglewood and Districts Health Service
	Lockington and District Bush Nursing Centre Inc.
	Maldon Hospital
	Mallee Track Health and Community Service
	Robinvale District Hospital and Health Service
Rochester and Elmore District Health Service	



## Hospital Trauma Designations

Under the integrated Victorian State Trauma System model, every trauma receiving and potential trauma receiving hospital is allocated a trauma designation.

Trauma designations in the Victorian State Trauma System are Major Trauma Services, Metropolitan Trauma Services, Metropolitan Primary Care Services, Regional Trauma Services and Urgent Care Services.

Each service is responsible for providing a staged level of patient care and ensuring major trauma patients are triaged according to the Major Trauma Guidelines.

Trauma designations were determined by criteria established by the Review of Trauma and Emergency Services (ROTES) report in 1999 and will be the subject of review in 2015–16.

### **Major Trauma Service (MTS)**

The Major Trauma Services provide definitive care to most major trauma patients either through primary triage or secondary transfer and deliver leadership and support to the system. MTS hospitals provide expert care to major trauma patients from resuscitation through to acute and post acute phases of care.

### **Metropolitan Trauma Service (MeTS)**

Metropolitan Trauma Services provide a second level of trauma service delivery to the Major Trauma Services and stabilise patients who cannot be transported directly to MTS hospitals within 45 minutes. Three MeTS hospitals are designated Metropolitan Neurosurgical Services and also provide neurological services to older major trauma patients (65 years and over) who have sustained an isolated head injury as a result of a low fall.

### **Metropolitan Primary Care Service (MPCS)**

Metropolitan Primary Care Services are designated either due to significant resource limitations for trauma resuscitation or their close proximity to a higher designated trauma service. These services will be bypassed for Metropolitan Trauma Services where travel time to a MTS hospital is greater than 45 minutes.

### **Regional Trauma Service (RTS)**

Regional Trauma Services are located in major regional centres and provide a regional focus for the management of major trauma patient and receive trauma patients from surrounding areas. Regional Trauma Services provide resuscitation and stabilisation of major trauma patients prior to their transfer to an MTS.

### **Urgent Care Services (UCS)**

Urgent Care Services operate in small rural communities where higher levels of trauma care are not accessible. Urgent Care Services provide initial resuscitation and limited stabilisation of patients who are outside of 45 minutes travel time to an RTS.

### **Regional Primary Care Service (RPCS)**

Regional Primary Care Services include isolated hospitals that provide limited emergency care on occasions.

## Appendix 6: Case Review Group quality audit filters

- Major trauma transfers to a service with a lower designation or transfer to a non-major trauma service (excluding spinal patients transferred to the Austin Hospital and older patients with an isolated head injury from a low fall to the Austin Hospital, Monash Medical Centre and St Vincent's Hospital).
  - Modified filter implemented for cases with a date of injury from 1 January 2014. As per current filter, but patient must also have altered observations, which are defined as any of the following (at first hospital or scene if not available):
    - SBP < 100 mmHg
    - O<sub>2</sub> saturation < 97 per cent
    - pulse rate < 60 bpm or > 120 bpm
    - GCS motor = 1
    - GCS verbal < 5.
- Major trauma patients who receive definitive care at a non-major trauma service (excluding spinal patients at the Austin and older patients with an isolated head injury from a low fall at the Austin, Monash Medical Centre and St Vincent's Hospital) excluding older patients (aged 65 years or older) with a low fall ( $\leq 1$  m) injury to only one body region (apart from the head).
  - Modified filter implemented for cases with date of injury from 1 January 2014. As per current filter, but patient must also have altered observations, which are defined as any of the following (at first hospital or scene if not available):
    - SBP < 100 mmHg
    - O<sub>2</sub> saturation < 97 per cent
    - pulse rate < 60 bpm or > 120 bpm
    - GCS motor = 1
    - GCS verbal < 5.
- Major trauma time-critical (RoTES criteria\*) patients with a transfer time longer than six hours from their time of arrival at the first health service to the time of arrival at the definitive health service.
- Major trauma with more than one transfer.
  - Filter not implemented for cases with date of injury after 31 December 2013.

\* Time-critical RoTES criteria: Cases are considered 'time critical' if any of these vital signs below are recorded on the VSTR pre-hospital or on arrival at the first hospital:

	Adult	Child (< 16 years)
<b>Respiratory rate</b>	< 10 or > 30/minute	< 15 or > 40/minute
<b>Cyanosis (not recorded on VSTR)</b>	Present	Present
<b>Blood pressure</b>	< 90 mmHg	< (75 + age of child in years)
<b>Conscious state</b>	GCS < 13	GCS < 15

# 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 an injury poses. The scale ranges from 1 (minor injury) to 6 (maximum severity). AIS = 6 and AIS = 5 scores represent 'maximum severity' and 'critical' injuries, respectively.

## **Coronial cases**

Cases recorded on the National Coronial 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 'open', which means no identifying information is available. When an investigation is finished, the case is marked 'closed' and the identifying information is available.

## **Glasgow Coma Scale (GCS)**

A measure of a patient's level of consciousness and an indicator of the severity of a head injury. The scale ranges from 3 (unconscious) to 15 (normal functioning), with a score less than 9 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 in the emergency department or the patient was intubated or sedated on arrival, the patient's pre-hospital GCS value is used.

## **Glasgow Outcome Scale-Extended (GOS-E)**

The GOS-E enables patients to be classified into broad categories of functional level, taking into account the domains of consciousness, independence in the home, independence outside the home, work, social and leisure activities, family and friendships, and return to normal life.

## **Hospital of definitive care**

For each patient, this is defined as the hospital at the highest service level within the tiered trauma system structure where the patient was treated.

## **Injury Severity Score (ISS)**

Used to define injury severity for comparative purposes and is 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 1 (minor injury) to 75 (mortal injury). Generally, an ISS greater than 15 is taken to be indicative of major trauma because mortality in this group has been shown to be more than 10 per cent.

## **Maximum AIS**

Used as a proxy measure of injury severity. For each patient, AIS scores for all injuries are ranked from lowest to highest. The maximum AIS is the highest AIS given to any of the injuries sustained by a patient, regardless of body region.

### **Trauma service level**

A tier in the Victorian trauma service's trauma system structure. Different complexities of care are provided at each level, with the metropolitan trauma service providing the highest complexity of care. The metropolitan 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. 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.

### **Victorian Admitted Episodes Dataset (VAED)**

A database maintained by the Victorian Department of Health & Human Services that records details of all hospital admissions across the state.

### **VSTORM**

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

## References

Australian Bureau of Statistics 2014, *Regional population growth, Australia, 2012–13* (cat. no. 3218.0), Population Estimates by Local Government Area (ASGS 2013), 2003 to 2013 viewed 5 March 2015 at <<http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3218.02012-13?OpenDocument>>.

Ministerial Taskforce on Trauma and Emergency Services and the Department of Human Services Working Party on Emergency and Trauma Services 1999, *Review of trauma and emergency services – Victoria 1999*, Victorian Department of Human Services, Melbourne.

Murray C, Vos T, Lozano R, et al. 2012, 'Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990–2010: a systemic analysis for the Global Burden of Disease Study 2010', *The Lancet*, vol. 380, no. 9859, pp. 2297–2223.

National Trauma Data Bank 2012, *2012 report*, American College of Surgeons, Chicago.

Road Safety Victoria 2013, *Victoria's road safety strategy 2013–2022*, State Government of Victoria, Melbourne.





