VICTORIAN STATE TRAUMA SYSTEM AND REGISTRY

ANNUAL REPORT

1 JULY 2020 TO
30 JUNE 2021

MONASH University

VSTR Victorian State Trauma Registry

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Foreword

The Victorian State Trauma System is a world-leading and mature trauma system, which continues to advance quality trauma care in the state of Victoria, Australia and beyond. Central to the sustained success of the Victorian State Trauma System is its ability to characterise the nature of major trauma, care and outcomes within the system. This key attribute is afforded by the Victorian State Trauma Registry, which enables system-wide monitoring and critical analysis trauma care with the aim of reducing preventable deaths and permanent disability from major trauma.

The Victorian Department of Health (DH), Victorian Agency for Health Information (VAHI) and the Transport Accident Commission (TAC) continue to express the high value they place on the contribution of the Victorian State Trauma Registry, including through the provision of funding. With this essential support, these partners ensure and enshrine both the continued monitoring of the Victorian State Trauma System as well as the quality of improvements in trauma care outcomes the registry data informs. The registry monitors the performance of the system by collecting baseline and follow-up data at six, 12 and 24 months following injury, placing Victoria at the forefront of global monitoring and understanding of trauma patient outcomes.

This **2020–21 Annual Report**, sets out in detail the scale and scope of the challenge presented by major trauma within the Victorian State Trauma System. Whilst attributions to the wider influence of the COVID-19 pandemic and related social restrictions should be made with caution, this year's report highlights the home as the most common location for major trauma over this period, many months of which saw Victorians "stay home" to "stay safe". Consistent with this, high falls at home continue to rise, and low falls yet again account for more major trauma than even road traffic crashes. Registry data remains integral to the Victorian State Trauma System's ability to respond to familiar and emerging injury causes and settings, as well as monitor the ongoing effects of the COVID-19 pandemic.

I would like to acknowledge the expertise and data analysis provided by the Victorian State Trauma Outcomes Registry and Monitoring (VSTORM) group and associated staff at Monash University's School of Public Health and Preventive Medicine. Thank you also to wider Victorian State Trauma community, who all contribute to the function and surveillance of the system. We look forward to continuing to monitor the system through the registry, and continued improvement of the system, which will benefit all Victorians and many beyond our borders.

Associate Professor Warwick Teague

Chair, Victorian State Trauma Outcomes Registry and Monitoring (VSTORM) group

Director, Trauma Services, The Royal Children's Hospital

Clinical Lead, Burns Unit, The Royal Children's Hospital

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Year at a glance

The Victorian State Trauma System continues to improve clinical standards and patient outcomes.

3,999

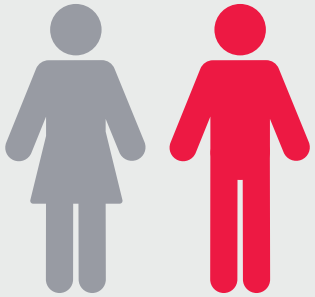
Major trauma patients in 2020–21 compared to **3,640** in 2019–20.

1,907

estimated trauma deaths in Victoria in 2020–21.

491

in-hospital trauma deaths in Victoria in 2020–21.



68.5%
male

Most (68.5%) major trauma patients were male.

32.6%
on weekends

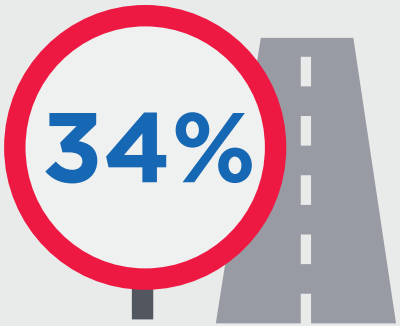
Consistent with previous years, major trauma occurred more frequently on weekends (32.6% of all cases).

50%
8 am – 4 pm

34%
4.01 pm – 12 am

Half of all major trauma cases with a known time of injury occurred between the hours of 8.00 am and 4.00 pm, and 34% of trauma cases occurred between the hours of 4.01 pm and midnight.

Trauma cases



of major trauma cases in 2020–21 were transport-related.

8%

of all cases involved cyclists.

2%

of major trauma was from burns.

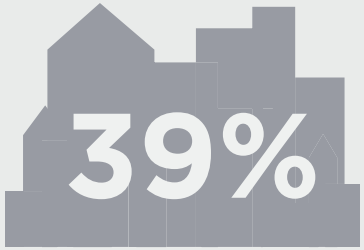
5.2%

of all hospitalised major trauma patients in 2020–21 had a severe head injury.

36%

of major trauma cases were low falls. Deaths due to falls exceeded transport-related deaths for the fifth consecutive year.

High falls at home resulting in major trauma increased over the five-year period.

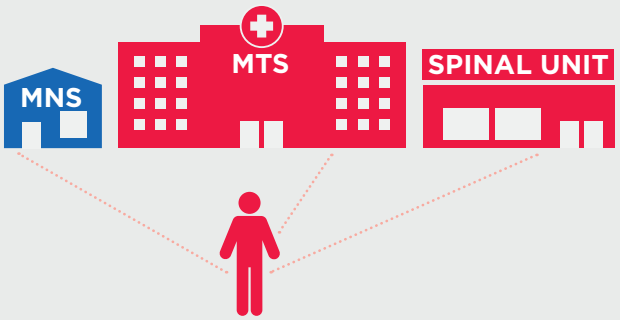


The home was the most common place of injury.

41%

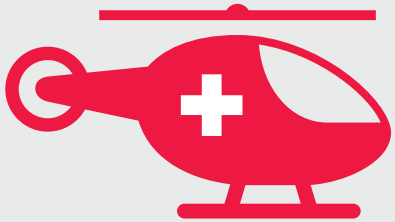
of patients in 2020–21 had sustained multiple trauma without serious neurotrauma.

Trauma treatment



76.4%

of major trauma patients received their definitive care at an appropriate trauma service.



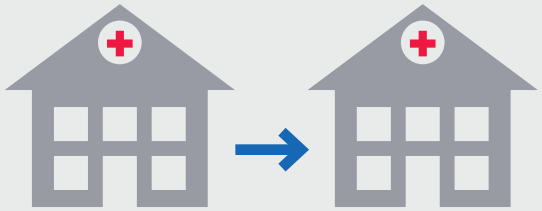
513

major trauma primary helicopter transports from the scene to a major trauma service.

The median hospital length of stay was 6.9 days in 2020–21.

91%

of transferred patients received definitive care at an appropriate trauma service.



The median inter-hospital transfer time in 2020–21 was 8.5 hours.

The median ambulance response time was 15 minutes.

Executive summary

Victoria, Australia has a regionalised trauma care system where seriously injured patients are managed in specialised trauma services adequately equipped and staffed to manage these complex patients. A whole-of-system approach, coordinating pre-hospital care, retrieval services and acute care, ensures the best chance of survival for seriously injured people. Regionalised trauma systems are now considered the global standard of care, with clear evidence of enhanced survival and better outcomes for patients.

The Victorian State Trauma System facilitates the management and treatment of major trauma patients in Victoria. The system is one of the most highly regarded trauma systems in the world, with facilities and clinicians who provide excellence in care and research. The Victorian State Trauma Registry provides a mechanism to monitor the system to inform service provision and development, with an aim to reduce preventable deaths and permanent disability from major trauma.

The *Victorian State Trauma System and Registry Annual Report 2020–21* presents data for a five-year period (2016–17 to 2020–21). The effect of the COVID-19 pandemic on injury epidemiology has been significant and reported on elsewhere.[1, 2, 3] During this reporting period, Victoria was under a state of emergency and government mandated social distancing measures. Traffic density, social/sporting activity and work patterns were affected. COVID-19 and health service access issues also impacted data collection. Derived from the average number of cases for the same quarter in previous years included in this report, there are an estimated 20 missing major trauma cases in 2020–21 (Data are incomplete for Albury Wodonga Health, Maroondah Hospital and Bairnsdale Hospital).

The number of major trauma patients in 2020–21 increased from 2019–20, however the annual incidence of major trauma patients has not changed since 2016–17. There has been no change in the annual incidence rate of major trauma patients in any age groups. The gender distribution of hospitalised major trauma patients has been stable for the past five years, with males accounting for 69–70% of cases since 2016–17.

Low falls and transport-related trauma accounted for the highest percentage of trauma cases (36% and 34% respectively in 2020–21). The number of major traumas due to a fall from a height of more than one metre occurring at a home has increased from 255 in 2016–17 to 305 in 2020–21. In 2020–21 deaths due to falls exceeded transport-related deaths for the fifth consecutive year.

Forty-one percent of patients in 2020–21 had sustained multiple trauma without serious neurotrauma. In 2020–21 5.2 percent of hospitalised major trauma patients sustained a severe head injury.

The incidence of major trauma in regional Victoria has been higher than in metropolitan Melbourne for every year of the five-year period. In 2020–21 twenty per cent of the incidents occurring in regional Victoria involved residents from outside regional Victoria. Of the incidents occurring in metropolitan Melbourne, only 4% involved residents from outside metropolitan Melbourne.

In 2020–21, the first hospital attended was a major trauma service, the Austin Hospital (for spinal care) or a metropolitan neurosurgical service for 51% of major trauma patients. Most (76.4%) major trauma patients received their definitive care at an appropriate trauma service, as determined by the Victorian State Trauma System trauma triage guidelines. For transferred patients, 91% received their definitive care at an appropriate trauma service as defined by the major trauma guidelines.

The annual incidence of all trauma deaths in Victoria has increased since 2016–17; estimated number of trauma deaths in Victoria was 1,694 in 2016–17 and 1,907 in 2020–21. This increase has been largely due to increase in low falls; 49% of all deaths in 2020–21 and 94% of these patients were aged 65 years and older.

The follow-up of major trauma patients at six, 12 and 24 months after injury provides vital information on how well patients recover from major trauma. The level of functional recovery declined slightly in adult major trauma patients in 2019–20. The proportion of paediatric (aged less than 16 years) patients experiencing a good functional outcome improved in 2019–20. Health related quality of life of adult major trauma patients has remained stable over time. In children, health-related quality of life declined slightly in 2018–19 and improved in 2019–20.

1 Christey G, Amey J, Campbell A, Smith A. Variation in volumes and characteristics of trauma patients admitted to a level one trauma centre during national level 4 lockdown for COVID-19 in New Zealand. The New Zealand medical journal 2020;133(1513):81.

2 Sutherland M, McKenney M, Elkbuli A. Vehicle related injury patterns during the COVID-19 pandemic: What has changed? The American journal of emergency medicine 2020;38(9):1710-4.

3 Chu H, Reid G, Sack A, Heryet R, Mackie I, Sen SK. Changes in burn referrals and injuries during CoVid-19. Burns 2020;46(6):1469-70.

The Victorian State Trauma System

The Victorian State Trauma System (VSTS) is widely considered the gold standard for design of trauma systems and is the model on which interstate and international trauma systems are based. Since the introduction of the VSTS in 2000, preventable death and disability from major trauma has reduced significantly. One of the key factors underpinning the success of the VSTS is the high-quality data provided by the Victorian State Trauma Registry (VSTR). The VSTR is a clinical quality registry which enables monitoring and analysis to critically review trauma care across the state.

Victoria has three major trauma services (MTS): two adult (The Alfred and The Royal Melbourne Hospital) and one paediatric (The Royal Children's Hospital). All other potential trauma-receiving hospitals are assigned a trauma designation according to clinical capacity. Victoria's regional and rural trauma services provide a first response for trauma patients within three descending levels of care: regional trauma services, urgent care services and primary care services (see Figure 1).

Rural and regional trauma services provide resuscitation and stabilisation of major trauma patients and organise patient transport to an MTS. They may also provide definitive care for a limited number of trauma patients where their injuries are assessed, in agreement with Adult Retrieval Victoria (ARV) or with an MTS, as not requiring inter-hospital transfer. Regional and rural trauma services provide patient transfer to an MTS through ARV. ARV is part of Ambulance Victoria and provides clinical coordination, retrieval and critical care services.

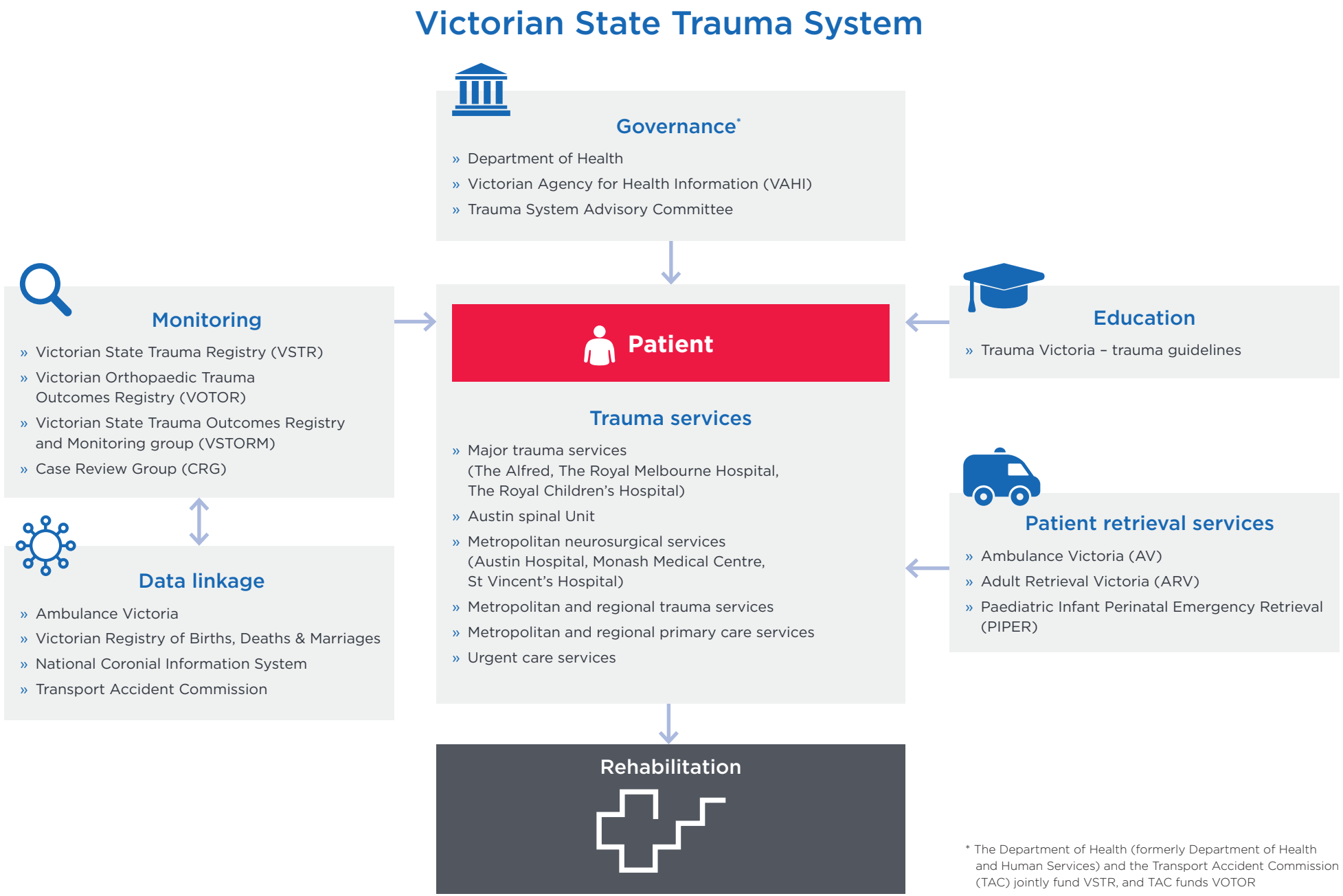
Clinical evidence indicates that major trauma patients achieve better outcomes when definitive care is provided at an MTS or a specialist trauma service. The Austin Hospital, St Vincent's Hospital and Monash Medical Centre all provide neurosurgical services for older patients (age 65 years and older) with isolated head injuries following a low fall; and the Austin Hospital provides specialist treatment for spinal cord injury and St Vincent's Hospital for isolated injuries requiring microsurgery.

The proportion of patients transferred directly to an MTS or specialist trauma service has risen significantly since the VSTS began.

In 2020–21 the VSTS was co-funded by the Department of Health and Human Services (DHHS) and the Transport Accident Commission (TAC). Following a machinery of government change, the Department of Health and Human Services was divided into the Department of Health and the Department of Families, Fairness and Housing on 1 February 2021. The Department of Health is now the co-funder of the VSTS.

More information about the VSTS and access to the major trauma guidelines is available from the Department of Health website **<www.health.vic.gov.au/trauma>.**

Figure 1: The Victorian State Trauma System



* The Department of Health (formerly Department of Health and Human Services) and the Transport Accident Commission (TAC) jointly fund VSTR, and TAC funds VOTOR

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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 CRG provides a review process of patient care and compliance with major trauma guidelines, and the focus of the group is to improve the quality of care and safety of major trauma patients.

The Case Review Group may undertake a review of major trauma cases that meet any of the following criteria:

- were transferred to a non-MTS/Austin (Spinal)/MNS
- received definitive care at a non- MTS/Austin (Spinal)/MNS
- where a time-critical inter-hospital transfer took more than six hours.

The CRG criteria has evolved to ensure identification of trauma cases where there was potential for the patient management to be inconsistent with the requirements described by the major trauma guidelines. In 2020–21, the case review process identified 485 (12.8% of all major trauma cases) cases that met one or more of these criteria. There were 11.5 per cent of major trauma cases that met the CRG criteria in both 2019–20 and 2016–17. The 485 cases were reviewed by VSTORM and 79 of them selected for presentation to the Case Review Group for discussion. Due to the increasing number of cases of coronavirus and resulting constraints within health services and the health department, for cases with date of injury from January to June 2021, high risk cases and cases of concern only were reviewed.

For cases with date of injury from 1 July 2020 to 30 June 2021, the Case Review Group asked health services (or Ambulance Victoria, Adult Retrieval Victoria or Paediatric Infant Perinatal Emergency Retrieval) to review 59 major trauma cases using their existing clinical governance arrangements. The Case Review Group may request an internal review or that a health service provide a response. If the group considers the response inadequate, further detail may be requested. Evidence of recurring issues from a health service may be escalated to the Department of Health for further action or advice, as appropriate. This process ensures a complete closing of the loop between committee review, health services a nd the department.

The trauma case review process is an important quality improvement tool of the VSTS. It is enabled by the comprehensive data that is collected by the VSTR.

The review of outlier cases aims to improve the safety and outcomes of major trauma patients by providing health services with information to evaluate the quality of care provided to trauma patients and adherence to major trauma guidelines. As well as providing health services with the opportunity to review the management of selected major trauma cases, the case review process identifies system issues and provides advice to the department.

The CRG reviews a variety of patient cohorts, and many involve: major trauma patients who receive definitive care at a non-MTS; under-recognition of the severity of injuries; use of informal communication channels; lack of contact with ARV or PIPER or delay to arrange inter-hospital transfer.

A CASE REVIEWED BY THE TRAUMA CASE REVIEW GROUP

This case is an example of cases review by the CRG. The patient met major trauma and RoTES time-critical criteria and inter-hospital transfer to an MTS took more than six hours.

The 59-year-old was riding a bicycle at approximately 30 kph on a slopping dirt road in regional Victoria when he lost control and crashed into a tree. The patient sustained a headstrike but was able to ride home where he developed difficulty breathing and left lower rib pain. The patient self-presented to the local Urgent Care Service (UCS) within one hour from the time of injury.

The patient was triaged a category 4 and placed in the Fast Track area of the waiting room. No vital signs were done at this time. Two hours and 43 minutes from arrival the patient complained of feeling unwell, had a vasovagal episode in the waiting room and was taken into a cubicle where the first vital signs were recorded; heart rate 57, blood pressure 88/58 and oxygen saturation 99% on room air. The patient was administered analgesia but one hour later he complained of further chest/rib pain. A senior medical officer reviewed the patient and performed a FAST scan which showed free intra-abdominal fluid and immediate treatment with crystalloids was commenced. 3 hours 56 minutes from arrival an urgent Pan Scan was performed. Diagnostic imaging showed a Grade 4 splenic laceration; moderate peri splenic subscapular haematoma; moderately displaced fractures of left 4 - 9 ribs; comminute fractures of the blade of left scapular extending to the inferior margin of the glenoid neck; thoracic spine burst fracture; scalp haematoma and, small left sided pleural effusion/ haemothorax. During the initial referral to Adult Retrieval Victoria (ARV), the Emergency Department (ED) team was informed an ARV team was already on site to transfer a different trauma patient and it was more appropriate for this patient to be transferred first. The patient's Injury Severity Score (ISS) was 29, which meets VSTR major trauma criteria. The patient was transferred to an MTS where he underwent embolisation of the splenic laceration and spent two days in ICU. The patient was discharged home after spending 10 days in hospital.

The 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 VSTS.

Case Review Group assessment

The CRG were concerned there was a delay in seeing a medical officer with major trauma injuries and a delay in transferring to an MTS. This feedback was communicated to the UCS and a response was requested including a request for more information on times.

The response from the UCS included that contact was made with an MTS and ARV. The majority of the delay (2 hours 43 minutes) was due to the patient waiting to be brought in to an ED cubicle during a very busy evening. The patient was initially treated as a vasovagal as their vital signs improved. They then further complained of chest and abdominal discomfort at which time they were seen by an ED HMO and consultant. The CRG reviewed the further details from the UCS and felt the response was reasonable, no further action was required.

Victorian State Trauma Registry data

The 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 VSTS.

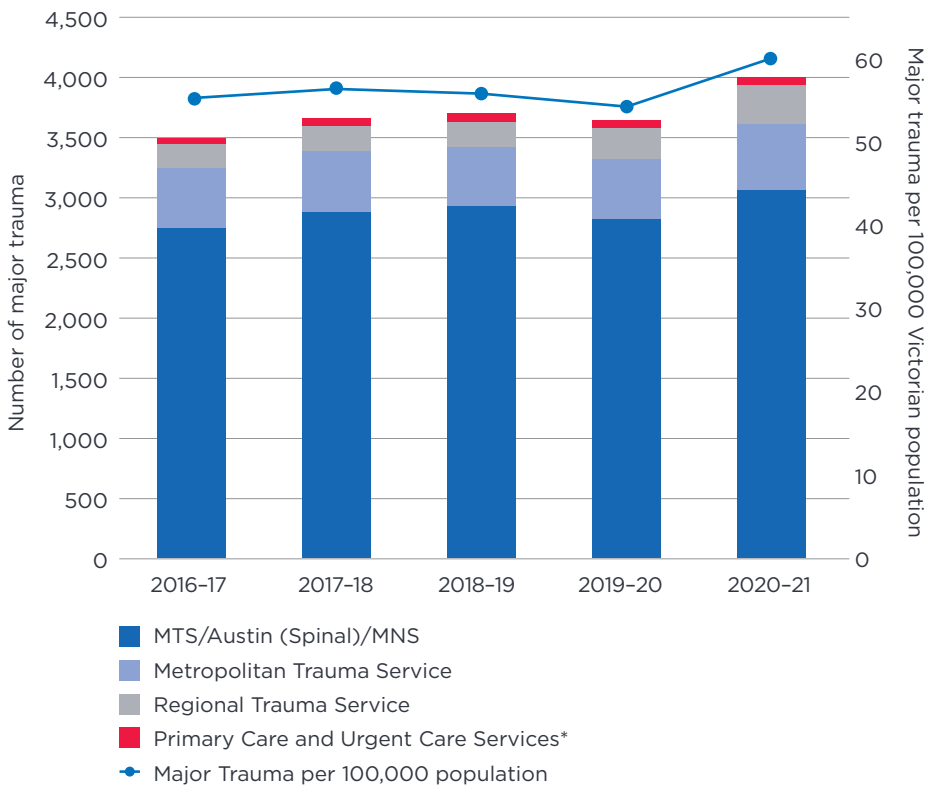
Trauma profile

- 3,999 major trauma patients in 2020–21 compared with 3,640 in 2019–20.
- Annual incidence of major trauma has not changed since 2016–17 (IRR 1.01, 95% CI: 1.00, 1.03, p = 0.14).
- 69% of major trauma patients in 2020–21 were male.
- In 2020–21, 91.4% of major trauma were in the blunt trauma category, 4.8% were penetrating and 2.2% were burns.
- There has been an increase in the proportion of major trauma cases involving falls (high and low) over the five-year period (42% in 2016–17, 47% in 2019–20 and 47% in 2020–21).
- The proportion of major trauma cases due to cycling incidents (includes e-bikes) was 4.9% in 2016–17, 6.0% in 2019–20 and 8.0% in 2020–21.
- Cutting, piercing incidents accounted for 3.2% of major trauma cases in 2016–17, 3.5% in 2019–20 and 4.4% in 2020–21.
- The number of major trauma incidents occurring in and around the home has increased since 2016–17 (1,094 in 2016–17, 1,247 in 2019–20 and 1,565 in 2020–21).
- In 2020–21, 95% of TAC-compensable patients received definitive care at an MTS or the Austin Hospital for spinal care.
- The percentage of survivors discharged to inpatient rehabilitation decreased in 2020–21 (38% in 2016–17, 30% in 2019–20 and 25% in 2020–21).
- The estimated total number of trauma deaths has increased from 1,694 in 2016–17 to 1,916 in 2020–21.
- The annual incidence of trauma mortality in Victoria has remained constant since 2016–17 (IRR 1.02, 95% CI: 1.00, 1.04, p = 0.08).

Major trauma patient numbers

In this report, data are presented for major trauma patients treated at 61 health services during the 2020–21 financial year. The VSTR recorded 3,999 hospitalised major trauma patients in 2020–21 compared with 3,640 in 2019–20 and 3,490 in 2016–17 (Figure 2). The incidence of hospitalized major trauma was 60 per 100,000 population[4] in 2020–21 compared to 54 per 100,000 population in 2019–20 (Figure 2). The annual incidence of major trauma patients has not changed since 2016–17 (IRR 1.01, 95% CI: 1.00, 1.03, p = 0.14).[5] Figure 2 shows the number of major trauma patients receiving definitive care at a Regional Trauma Service has increased since 2016–17.

Figure 2: Number and annual incidence rate per 100,000 population of hospitalised major trauma patients by level of definitive care in the VSTS, 2016–17 to 2020–21



*Includes Metropolitan Primary Care Services and Regional Urgent Care Services

Episodes of care

There were 5,124 hospital care episodes for the 3,999 hospitalised major trauma patients in 2020–21. Most patients (n = 2,824; 70.6%) had only one episode of care, while 1,143 (28.6%) experienced two episodes of care and 32 (0.8%) had three episodes of care. The proportion of major trauma cases having more than one episode of care was 31% in 2016–17, 30% in 2019–20 and 29% in 2020–21.

4 This rate is based on the *Australia Demographic Statistics Table 52 Estimated Resident Population by Single Year of Age, Victoria* population of 6,649,066 at 30 June 2021 (Australian Bureau of Statistics 2021).

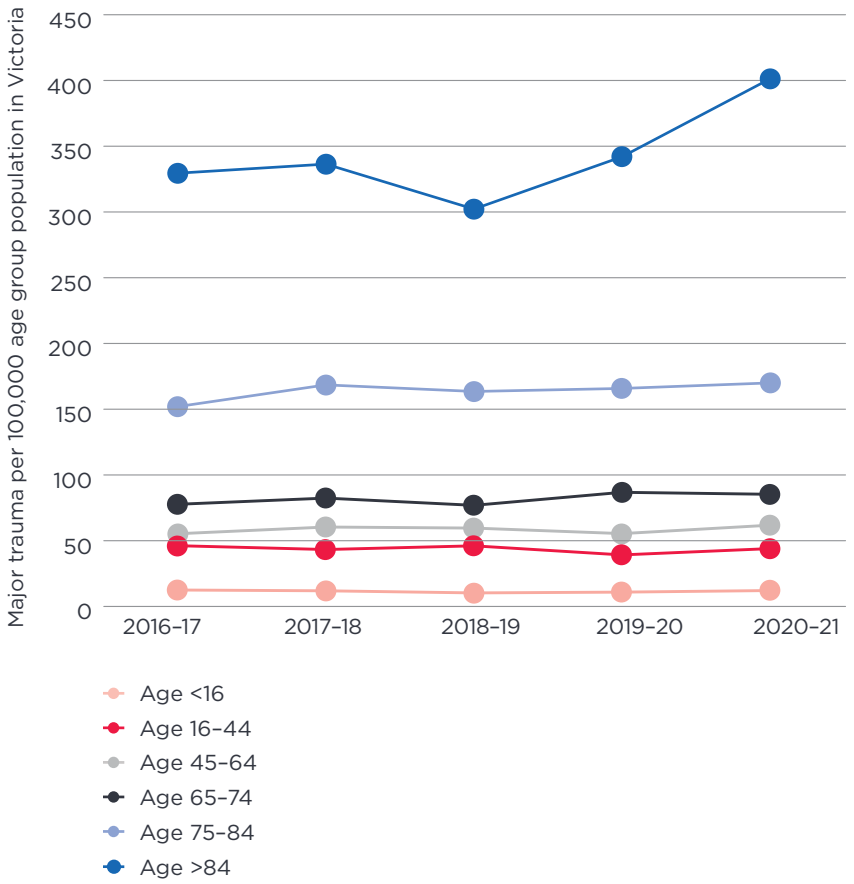
5 IRR = incidence rate ratio 95% CI = 95% confidence interval; p = probability.

Demographic profile of major trauma patients

The gender distribution of hospitalised major trauma patients has been stable for the past five years, with males accounting for 68% to 70% of cases since 2016–17 (68.5% in 2020–21). Patient gender is more evenly distributed in the 65-and-older age group, with males accounting for 53% to 58% of cases since 2016–17 (54.9% in 2020–21). International studies also indicate that, overall, males are overrepresented in the trauma cohort[6], and data from the United States suggests that this trend is not observed in the older age groups[7].

For this report, paediatric patients are aged less than 16 years and older adults are aged 65 years and older. Since 2016–17 the annual incidence rate of major trauma among people aged 16 to 44 years has not changed (IRR 0.98, 95% CI: 0.95, 1.01, p = 0.247) (Figure 3a). The annual incidence of paediatric major trauma patients not changed since 2016–17; 12.5 per 100,000 in 2016–17, 10.9 per 100,000 in 2019–20 and 12.1 per 100,000 in 2020–21 (IRR 0.99, 95% CI: 0.94, 1.04, p = 0.581) (Figure 3a). The annual incidence rate of major trauma in the 85 years and older age group has not changed; 330 per 100,000 in 2016–17, 342 per 100,000 in 2019–20 and 401 per 100,000 in 2020–21 (IRR 1.04, 95% CI: 1.00, 1.09, p = 0.054) (Figure 3a). The number of major trauma cases by age group are presented in Figure 3b.

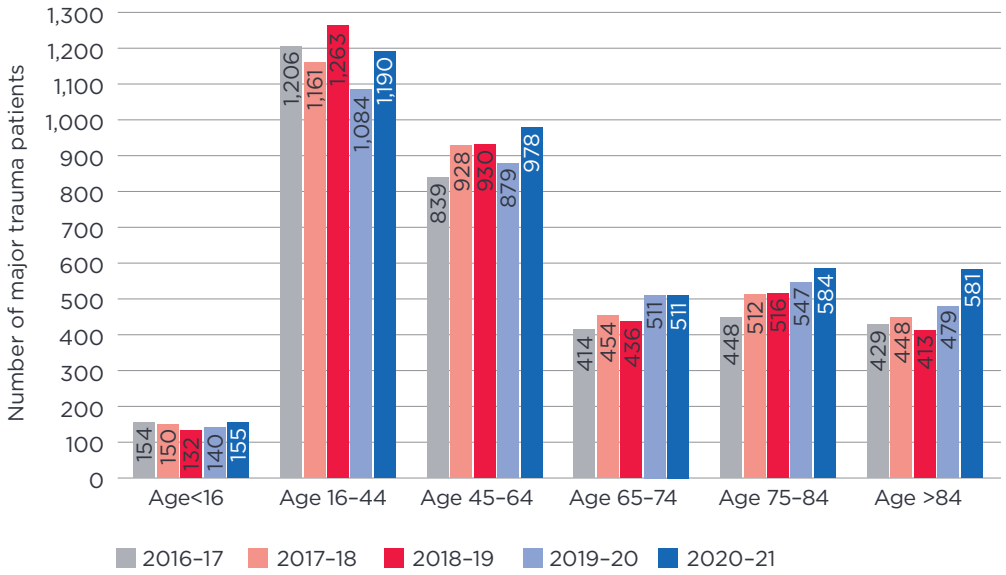
Figure 3a: Age-specific annual incidence rate of hospitalised major trauma, 2016–17 to 2020–21



6 Kehoe A, Smith JE, Edwards A, Yates D, Lecky F. The changing face of major trauma in the UK. Emergency medicine journal: EMJ. 2015; 32(12):911-5.

7 Surgeons ACo. National Trauma Data Bank 2016 Annual Report [cited 2019 August 28]. Pages 6, 29 and 30]. Available from: https://www.facs.org/quality-programs/trauma/tqp/center-programs/ntdb/docpub

Figure 3b: Age-specific frequencies of hospitalised major trauma, 2016–17 to 2020–21



Cause of injury

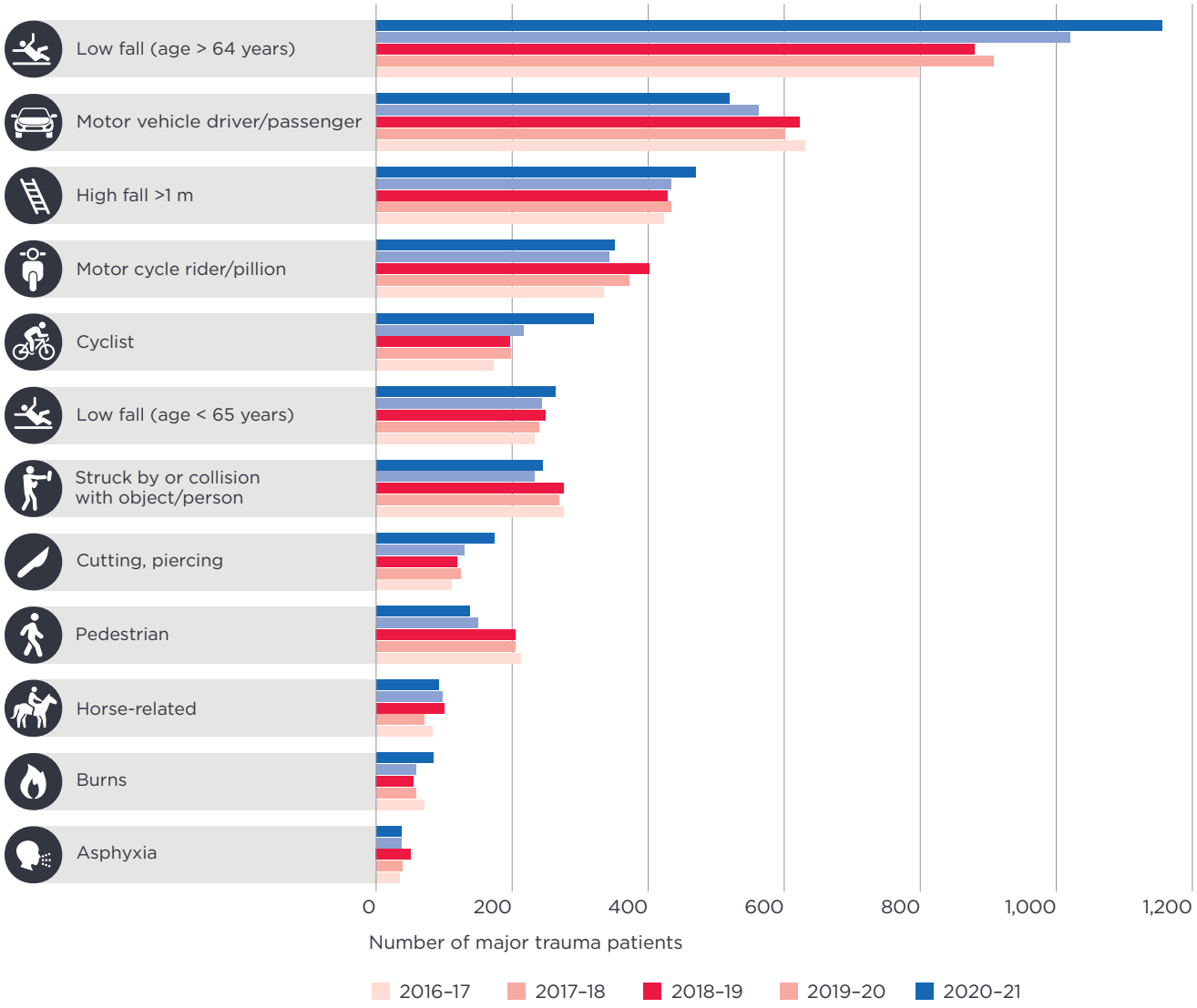
The 12 most common causes of injury are presented in Figure 4. Together, these accounted for 96% of major trauma cases in 2020–21. Of the major trauma cases in 2020–21, 34% were transport-related[8] compared to 35% in 2019–20 and 39% in 2016–17. The percentage of hospitalised major trauma cases due to low falls was 30% in 2016–17, 35% in 2019–20 and 36% in 2020–21. The percentage of major trauma cases due to all falls (low and high) was 42% in 2016–17, 47% in 2019–20 and 47% in 2020–21. The proportion of major trauma cases due to cycling incidents (includes e-bikes) was 4.9% in 2016–17, 6.0% in 2019–20 and 8.0% in 2020–21. Cutting, piercing incidents accounted for 3.2% of major trauma cases in 2016–17, 3.5% in 2019–20 and 4.4% in 2020–21.

In 2020–21 most (81.4%) patients injured in a low fall were aged 65 years or older, and 52% had sustained a head injury[9].

8 Defined by Victorian Emergency Minimum Dataset (VEMD) cause codes (MVC-Driver, MVC-Passenger, MBC-Rider, MBC-Pillion, Pedal Cyclist, Pedestrian or Other transport related).

9 Abbreviated Injury Scale (AIS) severity > 2 in the head region.

Figure 4: The most common causes of injury of hospitalised major trauma patients, 2016–17 to 2020–21



Place of injury

Consistent with the increase in low falls, 39% of major trauma patients were injured at home in 2020–21 (Figure 5a). The number of major trauma incidents occurring in and around the home has increased – 1,094 in 2016–17, 1,247 in 2019–20 and 1,565 in 2020–21 (Figure 5a). The second most common place of injury in 2020–21 was a road, street or highway (31.2%). The place of injury for paediatric major trauma cases are presented in Figure 5b.

The number of major trauma cases due to a low fall[10] occurring in and around the home was 594 in 2016–17, 740 in 2019–20 and 936 in 2020–21. The number of major trauma cases due to a high fall[11] occurring in and around the home has increased – 255 in 2016–17, 246 in 2019–20 and 305 in 2020–21. In and around the home, there were 104 high falls from ladders in 2016–17, 110 in 2019–20 and 115 in 2020–21. Falls from the home roof increased from 54 in 2016–17 to 61 in 2019–20 and 75 in 2020–21. The number of major trauma cases from high falls in industrial or construction areas was 23 in 2016–17, 46 in 2019–20 and 40 in 2020–21.

10 Height less than or equal to one metre.

11 Height greater than one metre.

Figure 5a: The place of injury for hospitalised major trauma patients place of injury, 2016–17 to 2020–21

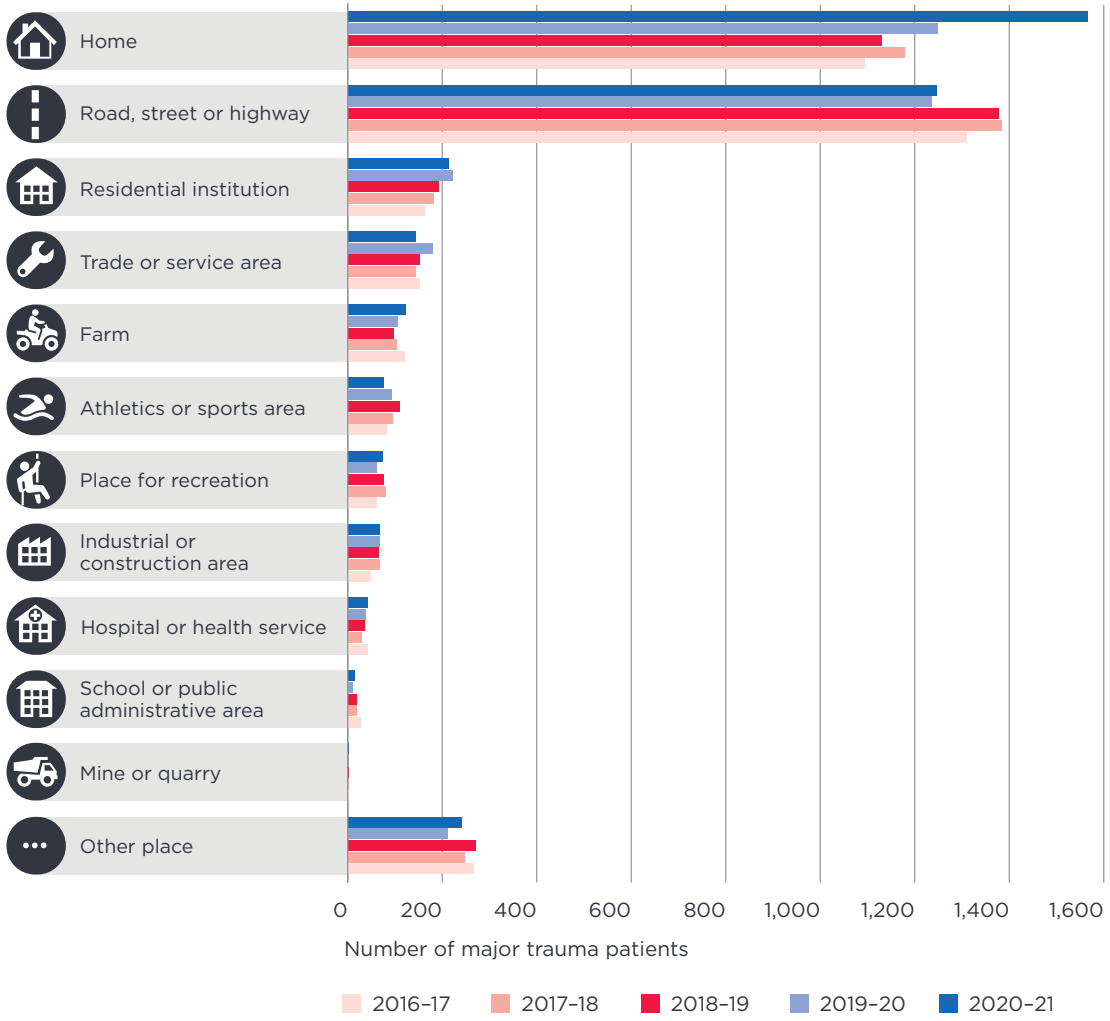
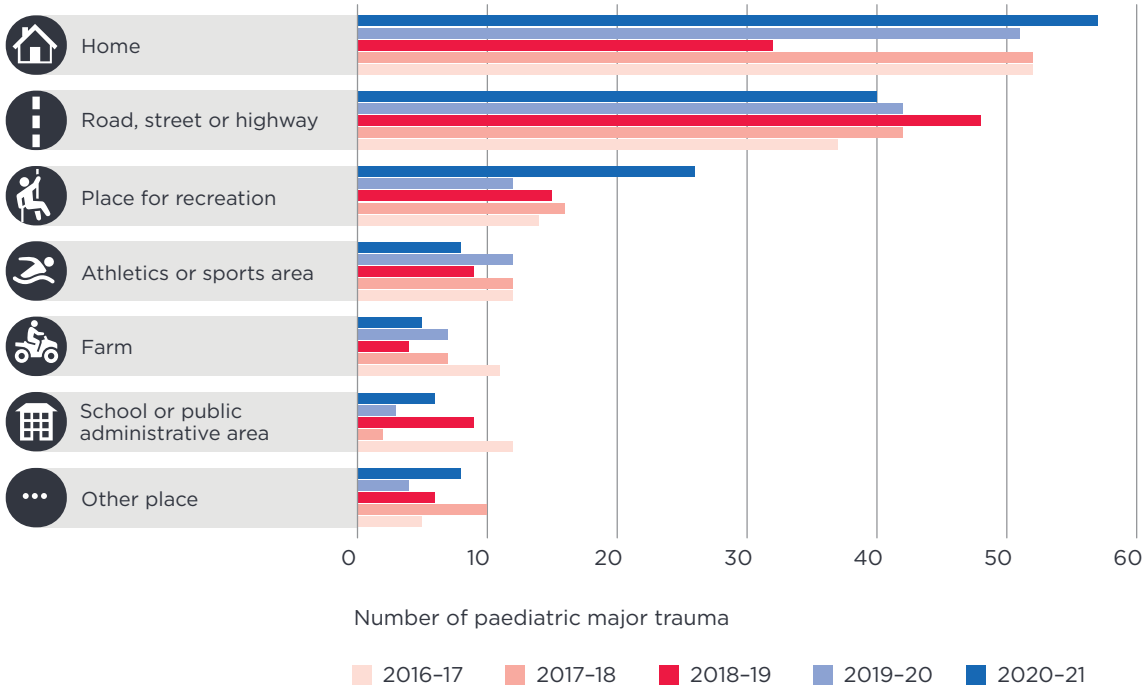


Figure 5b: The place of injury for hospitalised major trauma paediatric patients, 2016–17 to 2020–21



Transport Accident Commission compensable patients

Information was obtained from the health services about whether or not patients were likely to be eligible for the TAC compensation system. In 2020–21, 23% of major trauma patients were recorded as TAC compensable, compared to 27% in 2019–20 and 31% in 2016–17. Of the TAC-compensable patients, 95% received their definitive care at an MTS or the Austin Hospital (for spinal care) in 2020–21, and this has not changed since 2016–17.

Injury type

Traumatic injury is commonly classified into blunt, penetrating or burn injury types, based on the cause of injury. The vast majority of major trauma patients captured by the registry in 2020–21 were in the blunt trauma category (91.4%), consistent with falls and road trauma being the most common causes of major trauma. Penetrating injuries were sustained by 4.8% of patients in 2020–21 compared with 4.5% in 2019–20 and 3.9% in 2016–17. Burns accounted for 2.2% of major trauma in 2020–21.

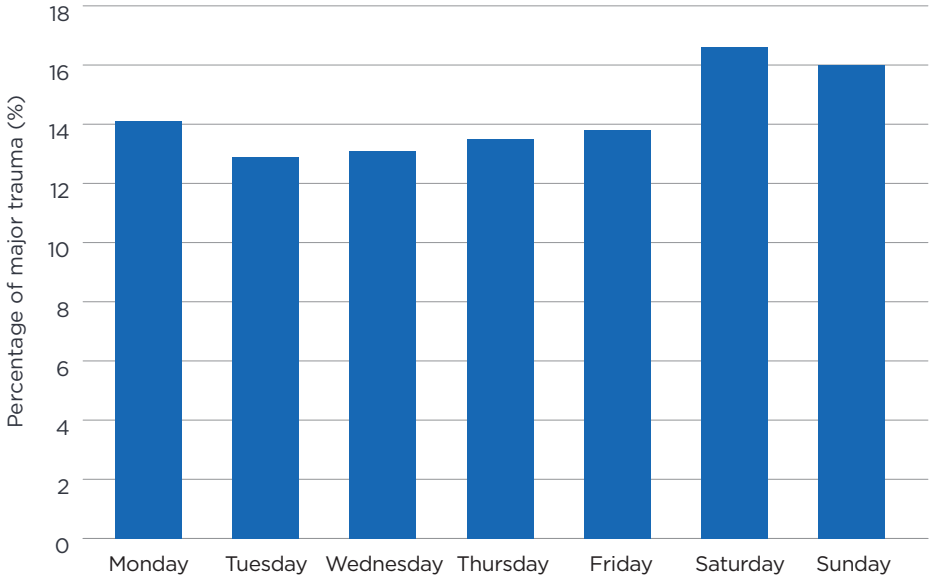
Injury intent

Overall, 89% of major trauma patients with a known intent of injury sustained their injuries from unintentional events. This has been consistent since 2016–17. In 2020–21, 7.0% of major trauma cases with known intent resulted from assaults compared with 6.5% in 2019–20 and 6.7% in 2016–17. Intentional self-harm accounted for 3.9% of major trauma with known intent in 2020–21, 3.9% in 2019–20 and 3.6% in 2016–17.

Time and day of injury

Consistent with previous years, major trauma occurred more frequently on weekends (32.6% of all cases), particularly on Saturdays (16.6%) (Figure 6). Of all major trauma cases with a known time of injury in 2020–21, 50% occurred between the hours of 8.00 am and 4.00 pm, and 34% occurred between the hours of 4.01 pm and midnight.

Figure 6: Proportion of major trauma occurring on each day of the week, 2020–21



Location of incident

The number of hospitalised major trauma cases by geographical location are presented in Table 1a. The incidence of major trauma in metropolitan Melbourne increased in 2020–21 compared with previous years (Table 1b). The incidence of major trauma in regional Victoria has increased compared with 2016–17 and has been higher than metropolitan Melbourne each year (Table 1b). In 2020–21, 20 per cent of the incidents occurring in regional Victoria involved residents from outside regional Victoria, this proportion has been consistent since 2016–17. Of the incidents occurring in metropolitan Melbourne, only 4% involved residents from outside metropolitan Melbourne.

The highest incidence of hospitalised major trauma incidents occurring in regional Victoria were in the Hume and Gippsland regions (Table 1b). Transport cases[12] (excluding assaults), comprised the highest proportion of major trauma cases occurring in these regions, except Barwon-South Western region where low falls made up the highest proportion of major trauma. (Figure 7).

Table 1a: Number of hospitalised major trauma cases by geographical location, 2016–17 to 2020–21

	Number of major trauma cases				
Region	**2016–17**	**2017–18**	**2018–19**	**2019–20**	**2020–21**
Metropolitan Victoria	2,106	2,189	2,165	2,192	2,355
Regional Victoria	1,093	1,105	1,207	1,178	1,320
Unknown in Victoria	192	244	210	171	246
Outside Victoria	99	115	109	99	78

Table 1b: Incidence of hospitalised major trauma cases by geographical location in Victoria, 2016–17 to 2020–21

	Major trauma per 100,000 population[13] (adjusted per year)				
Region	**2016–17**	**2017–18**	**2018–19**	**2019–20**	**2020–21***
Metropolitan Victoria	44.2	44.8	43.3	43.2	47.0
Regional Victoria	70.5	70.3	75.6	72.8	80.7
Loddon Mallee	47.8	51.7	52.2	60.2	55.9
Grampians	56.2	59.1	80.1	68.7	77.2
Hume**	98.9	95.2	96.3	98.8	111.0
Barwon-South Western	57.8	65.7	65.3	62.8	64.9
Gippsland	98.8	82.7	93.1	79.1	104.6

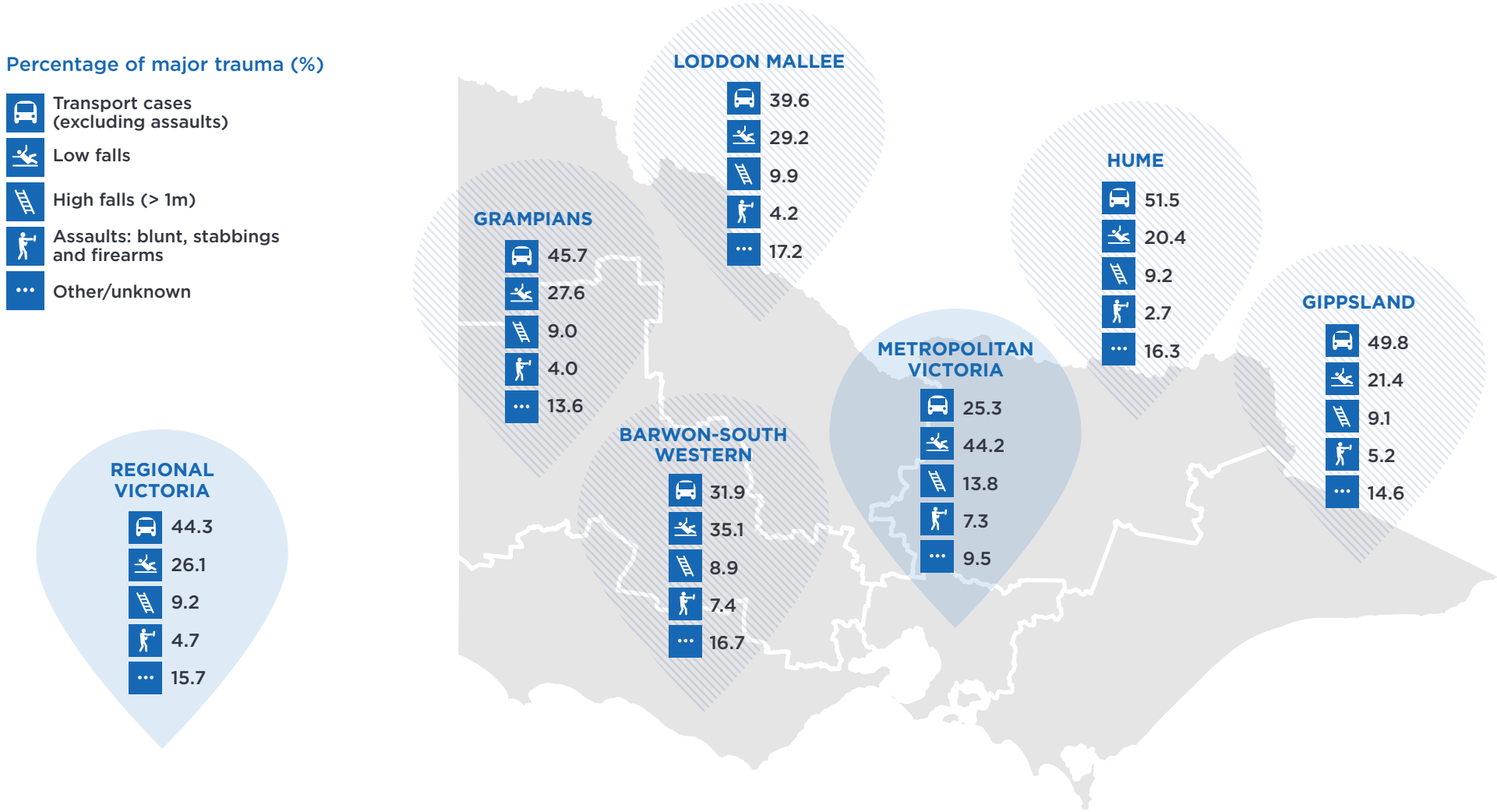
* The injury location was not known for 246 cases in Victoria and was outside Victoria for 78 cases.

** Includes population in Victoria only.

12 Defined by VEMD cause codes (MVC-Driver, MVC-Passenger, MBC-Rider, MBC-Pillion, Pedal Cyclist, Pedestrian or Other transport related) or TAC compensable funded.

13 This rate is based on the Australia Demographic Statistics Table 52 Estimated Resident Population by Single Year of Age, Victoria population of 6,649,066 at 30 June 2021 (Australian Bureau of Statistics 2021).

Figure 7: Breakdown by cause of injury and location in Victoria 2020–21



Injuries sustained

Table 2 shows the distribution of injuries sustained by major trauma patients. Forty-one per cent of patients in 2020–21 sustained multiple trauma without serious neurotrauma. The proportion of major trauma patients who sustained a serious head injury[14] was 39% in 2016–17, 37% in 2019–20 and 36% in 2020–21 (Table 2a). The injuries sustained by paediatric major trauma patients are presented in Table 2b.

Table 2a: Injuries sustained by all major trauma patients, 2016–17 to 2020–21

	Percentage of major trauma patients (%)				
Injury group	**2016–17**	**2017–18**	**2018–19**	**2019–20**	**2020–21**
Multiple injuries, burns or other (excluding serious neurotrauma)	38.5	38.3	40.4	40.0	40.6
Head and other associated injuries	22.5	22.0	21.4	21.3	20.4
Isolated head injury	16.5	15.2	16.0	16.1	15.6
Extremity and/or spine injuries only	12.4	12.8	11.6	11.3	11.8
Chest and/or abdominal injuries only	7.6	9.2	8.1	8.7	9.4
Serious spinal cord injury	2.6	2.5	2.5	2.6	2.3

Notes:

Multiple injuries, burns or other = includes 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 AIS severity > 2 in addition to another injury.

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

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

Chest and/or abdominal injuries only = chest and/or abdominal injury with AIS severity > 2 and no other injury with AIS severity > 1 in other body regions.

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

14 Head region AIS severity >2

Table 2b: Injuries sustained by paediatric major trauma patients, 2016–17 to 2020–21

	Percentage of major trauma patients (%)				
Injury group	2016–17	2017–18	2018–19	2019–20	2020–21
Multiple injuries, burns or other (excluding serious neurotrauma)	23.4	26.7	25.0	27.9	32.3
Head and other associated injuries	20.8	25.3	24.2	25.0	23.2
Isolated head injury	33.1	22.0	21.2	24.3	20.0
Extremity and/or spine injuries only	2.6	6.0	8.3	3.6	7.1
Chest and/or abdominal injuries only	16.9	20.0	17.4	18.6	16.8
Serious spinal cord injury	3.2	0.0	3.8	0.7	0.6

Notes:

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

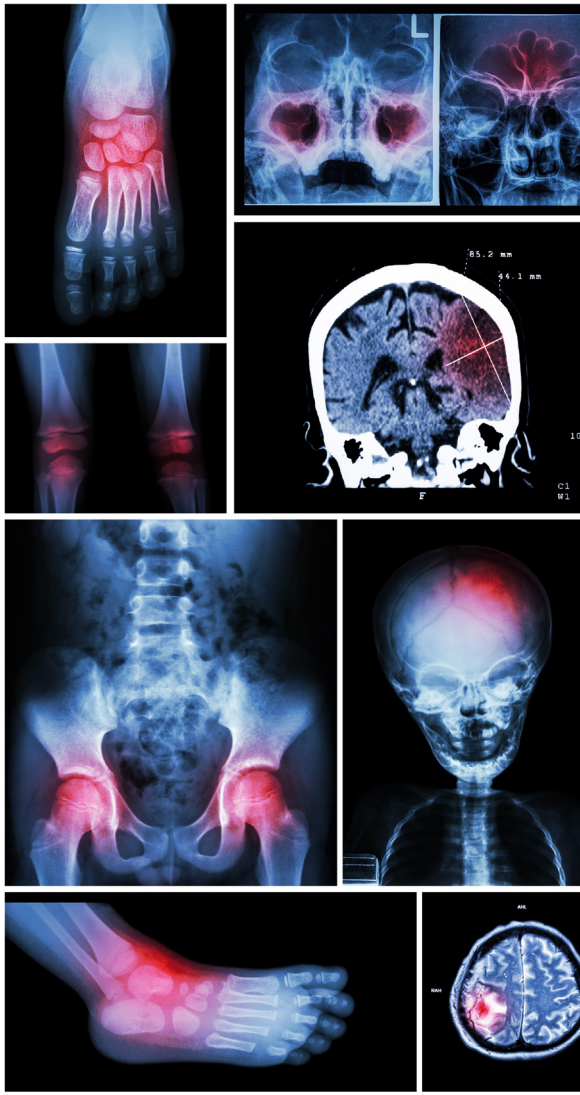
Head and other associated injuries = head injury with AIS severity > 2 in addition to another injury.

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

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

Chest and/or abdominal injuries only = chest and/or abdominal injury with AIS severity > 2 and no other injury with AIS severity > 1 in other body regions.

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



Injury severity

OF ALL MAJOR TRAUMA PATIENTS WITH A KNOWN INJURY SEVERITY SCORE (ISS), 86.1% HAD AN ISS GREATER THAN 12 IN 2020–21 AND 87.7% HAD AN ISS GREATER THAN 12 IN 2019–20.

The percentage of major trauma patients with an ISS greater than 12 has been consistent – 86% in 2020–21, 88% in 2019–20, and 86% in 2016–17. In 2020–21, the median ISS for definitive care at an MTS, the Austin for spinal care or a metropolitan neurosurgical service was 17, and the median ISS for other health services was 14.

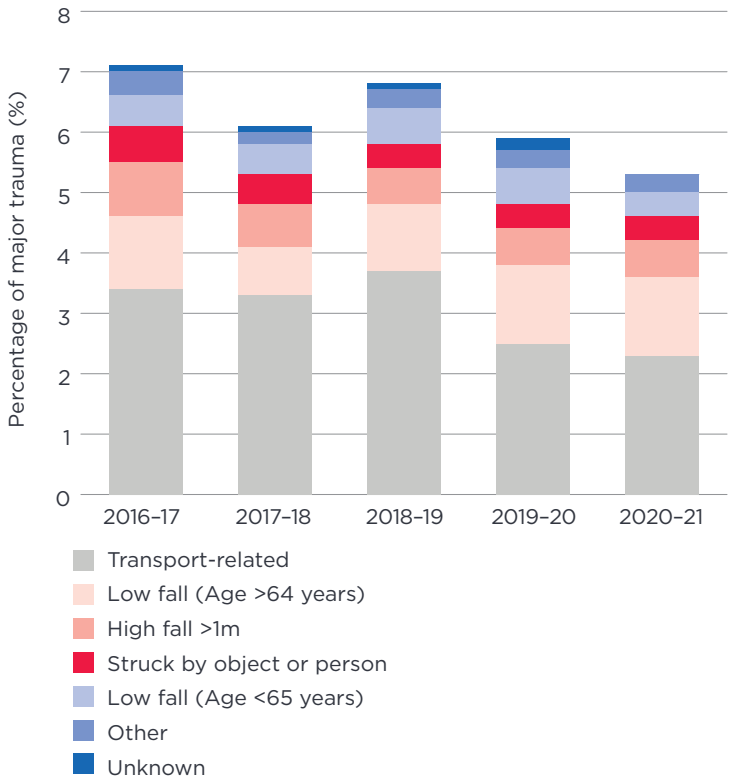
Head injury severity

Figure 8 shows that the percentage of major trauma patients with a severe head injury[15]. The proportion and number of major trauma patients with severe head injury has decreased; 7.0% (n = 245) in 2016–17, 5.9% (n = 213) in 2019–20 and 5.2% in 2020–21 (n = 207).

The proportion of cases with severe head injury due to transport-related incidents decreased in 2020–21 (Figure 8), driven by a decline in the number of cases resulting from pedestrian incidents; 14% (n = 34) in 2016–17, 10% (n = 22) in 2019–20 and 10% (n = 20) in 2020–21.

OF ALL HOSPITALISED MAJOR TRAUMA PATIENTS IN 2020–21, 5.2% HAD A SEVERE HEAD INJURY COMPARED TO 5.9% IN 2019–20.

Figure 8: Proportion of major trauma patients with a severe head injury (head AIS severity score > 2 and GCS score < 9) by cause of injury, 2016–17 to 2020–21



15 Defined as an AIS head injury severity score greater than two and a Glasgow Coma Scale (GCS) score of 3 to 8 on arrival at an emergency department (ED) or at scene if not valid on arrival at the ED

First hospital and definitive care of major trauma patients

In 2020–21, the first hospital attended was an MTS, the Austin Hospital (for spinal care) or an MNS for 51% of major trauma patients (Figure 9a). In 2020–21 most (76.4%) major trauma patients received their definitive care at an appropriate trauma service, as determined by the VSTS trauma triage guidelines[16] (Figure 9b). In 2020–21, the Austin Hospital provided definitive care for 2.3% of major trauma and 2.4% of cases received definitive care at a metropolitan neurosurgical service.

In 2020–21, the first hospital attended was an MTS or the Austin Hospital (for spinal care) for 65% of transport cases[17] (Figure 9c). The percentage of transport major trauma receiving definitive care at an MTS or the Austin Hospital (for spinal care) in 2020–21 was 91% compared to 90% in 2019–20 and 89% in 2016–17 (Figure 9d).

Figures 9e and 9f present the proportion of paediatric major trauma cases by first hospital attended and level of definitive care in the VSTR for all major trauma and transport cases respectively.

THE FIRST HOSPITAL ATTENDED WAS AN MTS, THE AUSTIN HOSPITAL (FOR SPINAL CARE) OR AN MNS FOR 50.8% OF MAJOR TRAUMA PATIENTS AND 64.8% OF TRANSPORT CASES IN 2020–21.

IN 2020–21, 76.4% OF PATIENTS RECEIVED THEIR DEFINITIVE CARE AT AN APPROPRIATE TRAUMA SERVICE, AS DETERMINED BY THE VSTS TRAUMA TRIAGE GUIDELINES, COMPARED TO 77.3% IN 2019–20.

FOR TRANSPORT CASES, 91.5% OF PATIENTS RECEIVED THEIR DEFINITIVE CARE AT AN APPROPRIATE TRAUMA SERVICE, AS DETERMINED BY THE VSTS TRAUMA TRIAGE GUIDELINES, IN 2020–21 COMPARED WITH 89.8% IN 2019–20.

16 MTS, Austin Hospital for specialised spinal care or metropolitan neurosurgical service for older adults with an isolated head injury resulting from a low fall.

17 Defined by VEMD cause codes (MVC-Driver, MVC-Passenger, MBC-Rider, MBC-Pillion, Cyclist, Pedestrian or Other transport related) or TAC compensable funded.

Figure 9a: Proportion of major trauma cases by first hospital attended, 2016–17 to 2020–21

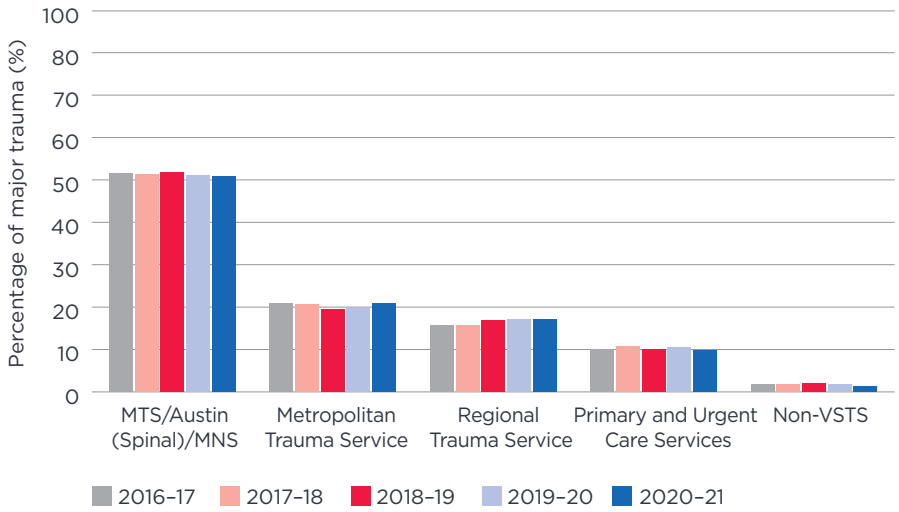


Figure 9b: Proportion of major trauma cases by level of definitive care in the VSTS, 2016–17 to 2020–21

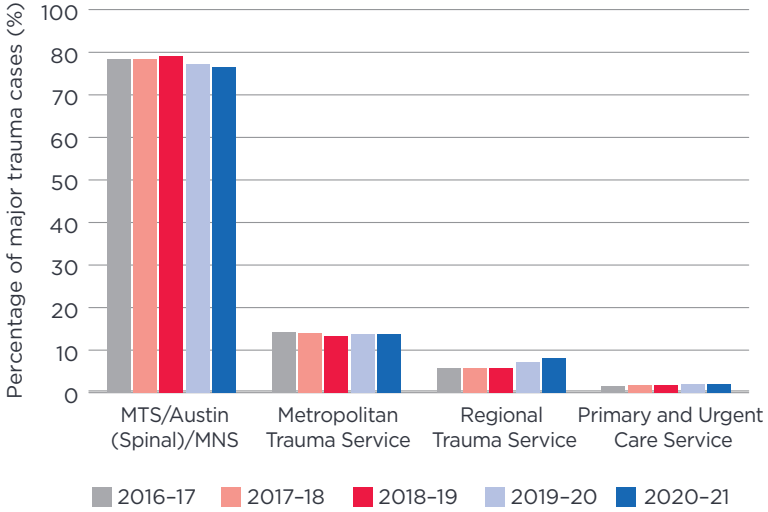


Figure 9c: Proportion of transport cases by first hospital attended, 2016–17 to 2020–21

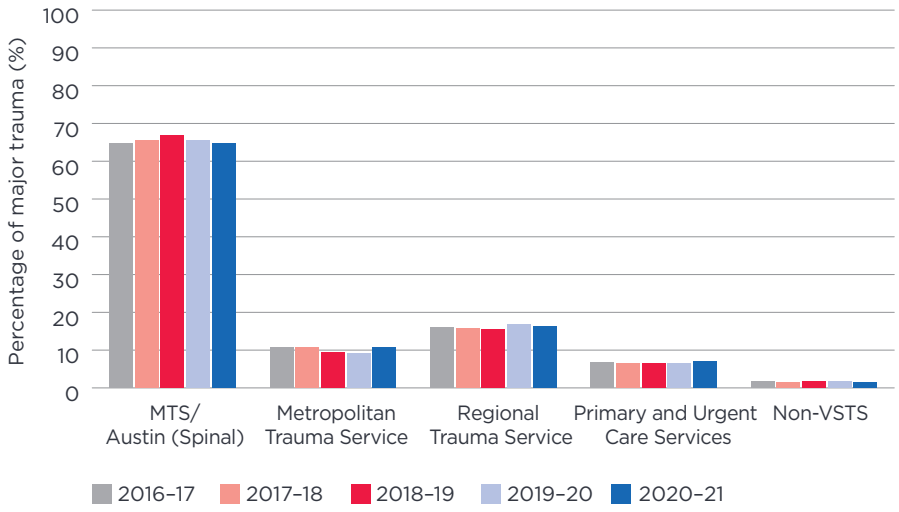


Figure 9d: Proportion of transport cases definitively managed by level of definitive care in the VSTS, 2016–17 to 2020–21

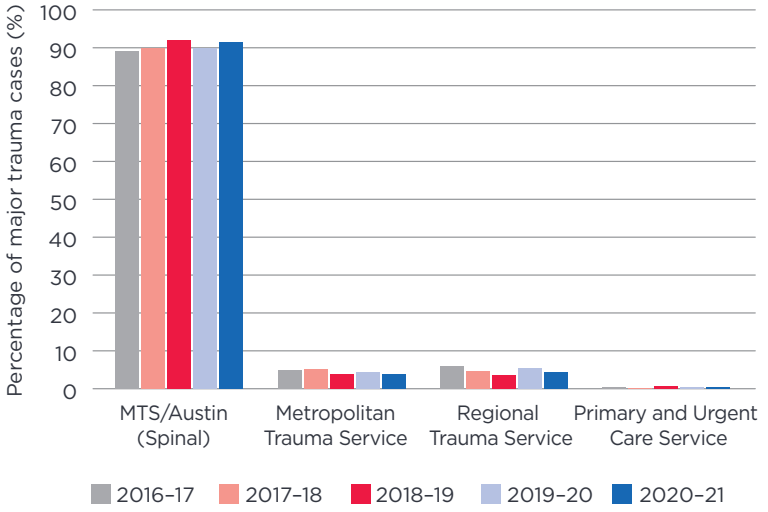


Figure 9e: Proportion of paediatric major trauma cases by first hospital attended and level of definitive care in the VSTS, 2016–17 to 2020–21

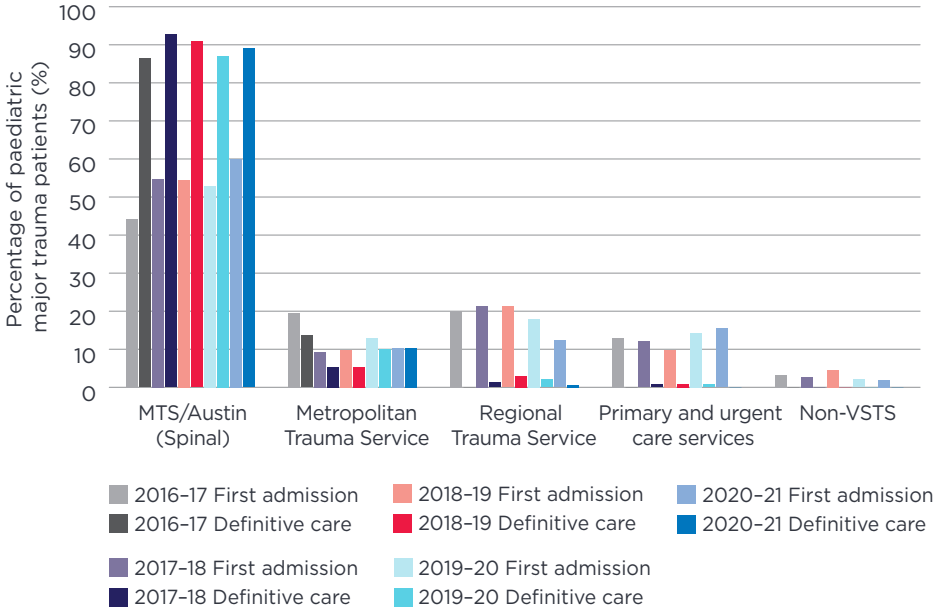
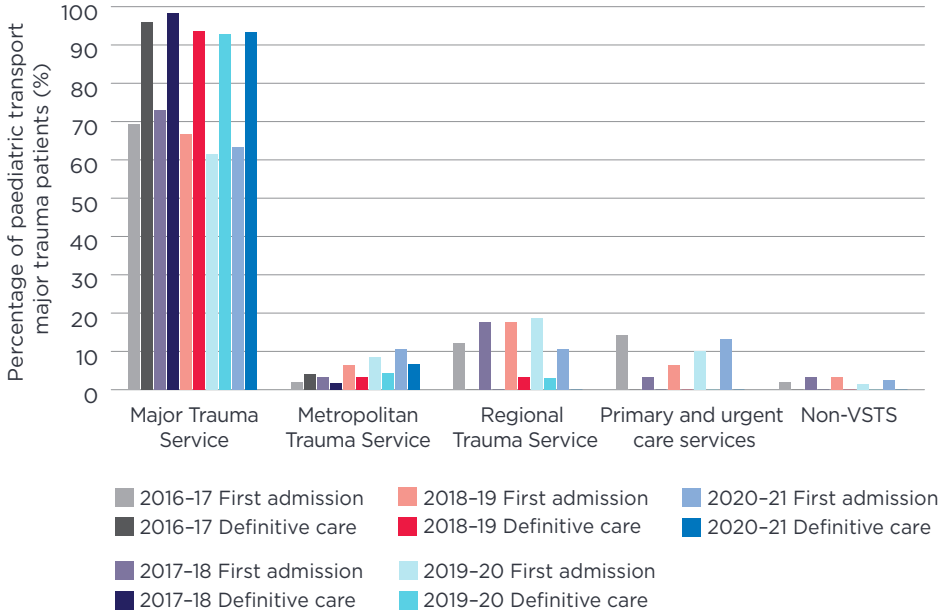


Figure 9f: Proportion of paediatric transport cases by first hospital attended and level of definitive care in the VSTS, 2016–17 to 2020–21



Patient triage and transportation

» 67% OF MAJOR TRAUMA PATIENTS WERE TRANSPORTED DIRECTLY TO AN MTS, THE AUSTIN FOR SPINAL CARE OR A METROPOLITAN NEUROSURGICAL SERVICE IN 2020–21.

» 90% OF TRANSFERRED PATIENTS RECEIVED THEIR DEFINITIVE CARE AT AN APPROPRIATE TRAUMA SERVICE, AS DEFINED BY THE MAJOR TRAUMA GUIDELINES, IN 2020–21.

Helicopter mode of transport

The proportion of primary transports to an MTS by a helicopter in 2020–21 was higher than 2019–20 and 2016–17 (Table 3).

Table 3: Major trauma primary helicopter transports from the scene to an MTS, 2016–17 to 2020–21

YEAR	Helicopter transports from the scene to an MTS n (% of all primary transports)	Helicopter to The Alfred n (% of all primary transports)	Helicopter to RMH n (% of all primary transports)	Helicopter to RCH n (% of all primary transports)
2016–17	446 (25.9)	241 (27.0)	174 (22.9)	31 (47.0)
2017–18	456 (25.4)	234 (25.3)	188 (23.9)	34 (41.5)
2018–19	469 (25.8)	253 (28.7)	189 (21.9)	27 (37.0)
2019–20	447 (25.2)	232 (27.2)	183 (21.6)	32 (43.8)
2020–21	513 (26.5)	258 (27.6)	219 (24.2)	36 (38.7)

Direct admissions and transfers to a major trauma service

The percentage of major trauma patients transported directly to an MTS, the Austin for spinal care or a metropolitan neurosurgical service from the scene of injury, home or a general practitioner (GP) has been consistent at 66% in both 2016–17 and 2018–19, and 67% in 2020–21 (Figure 10a).

The proportion of inter-hospital transfers that were transferred to an MTS, the Austin for spinal care or a metropolitan neurosurgical service for definitive care was 89% in 2016–17 (n = 957), 89% in 2019–20 (n = 990) and 91% in 2020–21 (n = 1,063) (Figure 10b). In 2020–21, for major trauma admissions referred from another health service for definitive care (n=1,174), there were 438 (37.3%) Ambulance Victoria road transports, 629 (53.6%) coordinated by the retrieval services (Adult Retrieval Victoria or Paediatric Infant Perinatal Retrieval Service), 34 (2.9%) Air Ambulance Victoria (9 helicopter and 25 fixed wing), 57 other (private ambulance, private car, interstate) and 16 cases where the mode of transportation was unknown.

Figure 10a: Source of major trauma to an appropriate trauma service level for definitive care, 2016–17 to 2020–21

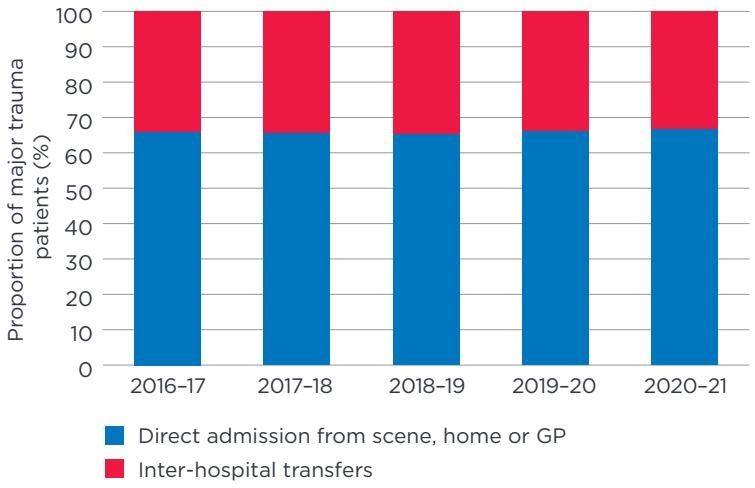
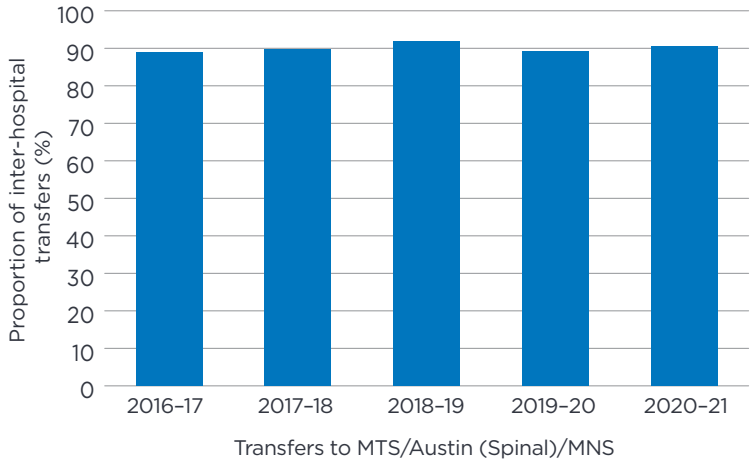


Figure 10b: Inter-hospital transfer destination compliance (according to major trauma transfer guidelines), 2016–17 to 2020–21



Since 2016–17 direct admissions from the scene of injury, home or a GP to an MTS were consistently more prevalent than referrals from another health service (Table 3). The number and proportion of major trauma patients transported directly from the scene of injury, home or a GP to The Alfred, The Royal Melbourne Hospital and The Royal Children's hospital are presented in Table 4.

Table 4: Direct admissions from the scene, home or a GP to The Alfred, The Royal Melbourne Hospital and The Royal Children's Hospital, 2016–17 to 2020–21

Year	Total major trauma presentations to The Alfred, RMH and RCH	Total direct admissions to The Alfred, RMH and RCH n (%)	Direct admissions to The Alfred n (% of major trauma presentations)	Direct admissions to RMH n (% of major trauma presentations)	Direct admissions to RCH n (% of major trauma presentations)
2016–17	2,616	1,722 (65.8)	893 (60.2)	761 (76.3)	68 (50.7)
2017–18	2,752	1,795 (65.2)	925 (59.6)	787 (74.2)	83 (59.3)
2018–19	2,810	1,821 (64.8)	884 (58.5)	863 (73.3)	74 (60.7)
2019–20	2,717	1,777 (65.4)	855 (60.3)	847 (72.1)	75 (61.0)
2020–21	2,933	1,939 (66.1)	939 (58.3)	906 (76.6)	94 (67.6)

RCH = The Royal Children's Hospital; RMH = The Royal Melbourne Hospital

Trauma system indicators

The following system indicators focus on compliance with key aspects of the established VSTS guidelines and key patient journey processes that require continuous monitoring. The indicators are intended to increase opportunities for system improvement and accountability through exploring trends associated with improvement in outcome.

Pre-hospital indicators

1 The median ambulance response time[18] decreased from 2016–17 to 2017–18, and has been stable in recent years (Table 5a).

Table 5a: Time from ambulance call to arrival at scene (response time), median and 90th percentile, 2016–17 to 2020–21

	Median response time (minutes)	90th percentile (minutes)
2016–17	16	41
2017–18	15	41
2018–19	14	37
2019–20	14	38
2020–21	15	45

2 The median pre-hospital scene time[19] increased in 2020–21 (Table 5b).

Table 5b: Scene time (from ambulance arrival at location to depart location), median and 90th percentile, 2016–17 to 2020–21

	Median scene time (minutes)	90th percentile (minutes)
2016–17	27	73
2017–18	27	77
2018–19	27	76
2019–20	29	85
2020–21	31	89

3 The median pre-hospital time[20] in 2020–21 has increased since 2016–17 (Table 5c).

Table 5c: Total pre-hospital time (from first ambulance arrival at scene to ambulance arrival at primary hospital, includes Air Ambulance Victoria), median and 90th percentile, 2016–17 to 2020–21

	Median pre-hospital time (minutes)	90th percentile (minutes)
2016–17	56	114
2017–18	56	113
2018–19	56	122
2019–20	59	129
2020–21	61	135

18 Measured from time of ambulance call to first ambulance arrival at scene
19 Measured from ambulance arrival at scene to depart location time
20 Measured from ambulance arrival at scene to primary hospital arrival

4 The total time to definitive care[21] has been relatively stable since 2016–17 (Table 5d).

Table 5d: Total time (hours – unadjusted for distance to definitive care hospital) from injury to first presentation at an MTS, the Austin or a metropolitan neurosurgical service (includes inter-hospital transfers), median and 90th percentile, 2016–17 to 2020–21

	Available time from injury to MTS, Austin Hospital or MNS (n)	Median time to MTS, Austin Hospital or MNS (hours)	90th percentile (hours)
2016–17	2,433	2.3	14.2
2017–18	2,547	2.5	15.6
2018–19	2,607	2.4	14.5
2019–20	2,520	2.3	14.7
2020–21	2,762	2.5	13.9

MNS = metropolitan neurosurgical service

5 From 2016–17 to 2019–20 there has been an improvement in Ambulance Victoria destination compliance, according to pre-hospital major trauma triage guidelines however there was a slight decline in destination compliance in 2020–21 (Table 5e).

Table 5e: Destination compliance, according to pre-hospital major trauma triage guidelines, 2016–17 to 2020–21

	Ambulance Victoria major trauma (n)	Destination compliance (according to pre-hospital trauma triage guidelines) (%)
2016–17	2,396	89.4
2017–18	2,278	93.0
2018–19	2,259	92.7
2019–20	2,344	93.4
2020–21	2,368	91.7

Data courtesy of Ambulance Victoria.

21 Measured from time of injury to first presentation at an MTS, the Austin Hospital for spinal care or a metropolitan neurosurgical service

Inter-hospital transfer indicators

1 Overall, the median inter-hospital transfer time[22] to definitive care was 8.5 hours in 2020–21, similar to previous years (Table 6a).

Table 6a: Inter-hospital transfer time (excluding from an MTS), median and 90th percentile, 2016–17 to 2020–21

	Inter-hospital transfer time available (n)	Median inter-hospital transfer time (hours)	90th percentile (hours)
2016–17	977	8.4	22.2
2017–18	1,031	8.6	22.0
2018–19	1,024	8.5	23.8
2019–20	993	8.4	22.6
2020–21	1,027	8.5	21.4

2 The proportion of metropolitan transfers with ARV/PIPER activation has increased from 2016–17 to 2020–21 (Table 6b). The median time to activation of ARV/PIPER[23] has been above four hours since 2017–18 (Table 6b).

Table 6b: Time to activation of ARV or PIPER (measured from time of arrival at referral hospital) for metropolitan transfers (excluding transfers from an MTS), 2016–17 to 2020–21

	Metropolitan (excluding from MTS) transfers with ARV/PIPER activation (n) (% of metro transfers)	Metropolitan transfers with time to ARV/PIPER activation available (n)	Median time to ARV/PIPER activation (hours)*	90th percentile (hours)
2016–17	86 (17.8)	78	3.8	10.3
2017–18	106 (20.9)	99	4.7	15.0
2018–19	101 (21.8)	97	5.1	10.7
2019–20	120 (25.3)	87	4.4	10.7
2020–21	188 (35.3)	127	5.3	11.1

*For ARV activation prior to arrival at health service, the time is defaulted to zero.

22 Measured from time of arrival at primary hospital to time of arrival at definitive care hospital.

23 Measured from time of arrival at health service to retrieval activation.

The median time to activation of ARV[24] for adult major trauma was 2.9 hours in 2020–21 for regional transfers (Table 6c). Since 2016–17, adult major trauma regional transfers coordinated by ARV have experienced shorter transfer times when compared with transfers coordinated by other services (Table 6d).

Table 6c: Time to activation of ARV for adult major trauma regional transfers, 2016–17 to 2020–21

	Regional transfers with ARV activation (n) (% of regional transfers)	Regional transfers with time to ARV activation available (n)	Median time to ARV activation (hours)*	90th percentile (hours)
2016–17	313 (66.0)	294	3.0	7.3
2017–18	318 (62.8)	300	2.7	6.7
2018–19	348 (63.0)	326	3.1	6.9
2019–20	340 (67.6)	298	2.7	7.3
2020–21	376 (73.2)	307	2.9	7.9

*For ARV activation prior to arrival at health service, the time is defaulted to zero.

Table 6d: Inter-hospital transfer times (measured from time of arrival at primary hospital to time of arrival at definitive care) with and without retrieval activation for adult regional transfers, 2016–17 to 2020–21

	Adult regional inter-hospital transfers with transfer time available (n)	Adult regional inter-hospital transfers with transfer time available with ARV activation (n)	Adult regional transfers with ARV activation median transfer time (hours)	Adult regional inter-hospital transfers with transfer time available without "ARV activation (n)	Adult regional inter-hospital transfers without ARV activation median transfer time (hours)
2016–17	465	306	8.6	159	8.8
2017–18	495	313	8.6	182	9.7
2018–19	541	345	8.4	196	9.6
2019–20	497	337	7.9	160	9.8
2020–21	483	356	7.8	127	9.0

24 Measured from time of arrival at referral hospital to ARV activation

The median time to activation of PIPER/ARV for paediatric major trauma was 1.8 hours in 2020–21 for regional transfers (Table 6e). Except for 2017–18, regional transfers coordinated by PIPER/ARV for paediatric major trauma have not had shorter transfer times when compared with transfers coordinated by other services (Table 6f).

Table 6e: Time to activation of PIPER/ARV for regional transfers, 2016–17 to 2020–21

	Regional transfers with PIPER/ARV activation (n) (% of regional transfers)	Regional transfers with time to PIPER/ARV activation available (n)	Median time to PIPER/ARV activation (hours)*	90th percentile (hours)
2016–17	19 (45.2)	9	0.6	3.6
2017–18	22 (57.9)	8	0.3	4.3
2018–19	13 (43.3)	8	2.8	7.3
2019–20	18 (48.6)	14	3.0	5.0
2020–21	30 (88.2)	20	1.8	5.8

*For ARV activation prior to arrival at health service, the time is defaulted to zero.

Table 6f: Inter-hospital transfer times (measured from time of arrival at primary hospital to time of arrival at definitive care) with and without retrieval activation for paediatric regional transfers, 2016–17 to 2020–21

	Paediatric regional inter-hospital transfers with transfer time available (n)	Paediatric regional inter-hospital transfers with transfer time available with PIPER/ARV activation (n)	Paediatric regional transfers with PIPER/ARV activation median transfer time (hours)	Paediatric regional inter-hospital transfers with transfer time available without PIPER/ARV activation (n)	Paediatric regional inter-hospital transfers without PIPER/ARV activation median transfer time (hours)
2016–17	40	19	6.9	21	6.8
2017–18	38	22	6.5	16	8.2
2018–19	30	13	7.5	17	6.4
2019–20	35	18	6.8	17	5.5
2020–21	32	29	5.3	*	*

* Denotes less than 5 cases

In-hospital indicators

1 The proportion of known MTS trauma team activation for Ambulance Victoria or Air Ambulance Victoria signal one (time-critical) trauma cases was lower in 2020–21 compared with 2016–17 (Table 7a).

Table 7a: MTS trauma team activation for Ambulance Victoria signal one trauma cases with known trauma team activation status, 2016–17 to 2020–21

	Total AV or AAV to MTS (n)	Total signal one AV or AAV to MTS (n)	Total AV signal one with MTS trauma team activation n (%)	The Alfred (n) (%)	The Royal Melbourne Hospital (n) (%)	The Royal Children's Hospital (n) (%)
2016–17	1,650	1,259	1,176 (93.4)	666 (96.0)	475 (90.8)	35 (77.8)
2017–18	1,719	1,373	1,205 (87.8)	654 (91.6)	494 (84.2)	57 (79.2)
2018–19	1,764	1,483	1,254 (84.6)	667 (86.3)	544 (83.3)	43 (66.2)
2019–20	1,712	1,292	1,111 (86.0)	543 (77.1)	526 (79.7)	42 (70.0)
2020–21	1,858	1,426	1,269 (89.0)	652 (88.2)	570 (83.5)	47 (60.3)

AAV = Air Ambulance Victoria; AV = Ambulance Victoria

2 The median hospital length of stay has been consistent since 2016–17 (Table 7b).

Table 7b: Hospital length of stay, 2016–17 to 2020–21

	All major trauma (n)	Median length of stay (days)	90th percentile (days)
2016–17	3,490	6.5	21.9
2017–18	3,653	6.9	22.7
2018–19	3,691	6.6	21.5
2019–20	3,640	6.6	20.7
2020–21	3,999	6.9	22.8

3 **Since 2016–17, the proportion of ICU admissions at the health service for definitive care and the median ICU length of stay has been consistent (Table 7c). Table 7d shows the median mechanical ventilation hours since 2016–17.**

Table 7c: ICU length of stay, 2016–17 to 2020–21

	Major trauma ICU admission at definitive care (n) (%)	Median ICU length of stay (days)	90th percentile (days)
2016–17	1,251 (35.9)	3	14
2017–18	1,295 (35.5)	3	14
2018–19	1,310 (35.5)	4	14
2019–20	1,299 (35.7)	3	14
2020–21	1,440 (36.0)	4	15

Table 7d: Major trauma ICU mechanical ventilation hours for major trauma patients with an ICU admission, 2016–17 to 2020–21

	Major trauma ICU admissions with known mechanical ventilation hours (n)*	Median mechanical ventilation time (hours)	90th percentile (hours)
2016–17	1,248	25	237
2017–18	1,291	21	228
2018–19	1,310	24	264
2019–20	1,297	21	246
2020–21	1,438	21	248

* Number of ICU admissions with known ventilation hours (includes zero)

Hospital outcomes of major trauma

Discharge status

In 2020–21 more than half of the major trauma patients surviving to discharge were discharged directly to home. Across the five years, the percentage of patients discharged to an inpatient rehabilitation facility has decreased – 38% in 2016–17, 30% in 2019–20 and 25% in 2020–21 (Table 8). It should be noted that the VSTR does not collect information about rehabilitation in the home. There has been a notable increase in the number and percentage of patients discharged to a hospital for convalescence: 122 (4.0%) in 2016–17, 262 (8.2%) in 2019–20 and 293 (8.4%) in 2020–21 (Table 8).

Table 8: Discharge status (excluding in-hospital deaths), 2016–17 to 2020–21

	Rehabilitation n (%)	Home n (%)	Nursing home n (%)	Hospital for convalescence n (%)	Other n (%)
2016–17	1,158 (38.0)	1,604 (52.6)	94 (3.1)	122 (4.0)	72 (2.4)
2017–18	1,118 (34.3)	1,765 (54.2)	88 (2.7)	239 (7.3)	45 (1.4)
2018–19	1,053 (32.0)	1,859 (56.6)	86 (2.6)	248 (7.5)	40 (1.2)
2019–20	955 (29.7)	1,804 (56.1)	103 (3.2)	262 (8.2)	90 (2.8)
2020–21	877 (25.0)	2,146 (61.2)	112 (3.2)	293 (8.4)	80 (2.3)

Trauma deaths

- **In 2020–21 there were an estimated 1,907 trauma deaths in Victoria.**
- **In 2020–21 the overall death rate due to major trauma in Victoria was 29 deaths per 100,000 population.[25]**
- **The annual incidence of major trauma deaths in Victoria has increased since 2016–17 (IRR 1.02, 95% CI: 1.004, 1.034, p = 0.014).[26]**
- **The major causes of all deaths in 2020–21 were low and high falls (51.5%), hangings (18.7%) and transport-related incidents (12.8%).**
- **Deaths due to falls have exceeded transport-related deaths since 2016–17.**
- **The registry recorded 491 in-hospital deaths in 2020–21.**
- **The incidence of in-hospital major trauma deaths in 2020–21 was 7.4 per 100,000 population.**
- **Since 2016–17 the annual incidence rate of in-hospital major trauma deaths has not changed (IRR 1.02, 95% CI: 0.97, 1.06, p = 0.472).**
- **The relative risk of in-hospital death[27] for major trauma and major trauma cases with an ISS>12 in 2020–21 has not changed compared to 2016–17.**

Information about traumatic deaths is provided by three different sources:

- The Victorian Ambulance Cardiac Arrest Registry provides the number of pre-hospital trauma deaths that are attended by Ambulance Victoria.
- The VSTR provides information about in-hospital deaths and the National Coronial Information System (NCIS) is sourced to identify deaths at the scene or after acute care.
- The NCIS also provides further information about the Victorian in-hospital deaths and ensures all trauma deaths at VSTS hospitals have been recorded on the VSTR.

25 This rate is based on the *Australia Demographic Statistics Table 52 Estimated Resident Population by Single Year of Age, Victoria* population of 6,649,066 at 30 June 2021 (Australian Bureau of Statistics 2021).
26 95% CI = 95% confidence interval; p = probability
27 Adjusted for age, ISS, head injury (AIS head region severity > 2) and cause of injury.

All trauma deaths

In 2020–21 there were 1,907 trauma deaths in Victoria based on cases recorded on the NCIS and the VSTR. The estimated number of trauma deaths in Victoria was 1,820 in 2019–20 and 1,694 in 2016–17 (Table 9a). The overall trauma death rate in Victoria in 2020–21 was 29 per 100,000 population,[28] 27 per 100,000 in 2019–20 and 27 per 100,000 in 2016–17. The annual incidence of all trauma deaths in Victoria has increased since 2016–17 (IRR 1.02, 95% CI: 1.004, 1.034, p = 0.014).[29] The Victorian Ambulance Cardiac Arrest Registry recorded 779 pre-hospital trauma deaths in 2020–21 compared with 756 in 2019–20 and 725 in 2016–17 (Table 9b).

Table 9a: In-hospital deaths and all trauma deaths, 2016–17 to 2020–21

	VSTR in-hospital deaths	All trauma deaths (NCIS and VSTR in-hospital deaths)*
2016–17	440	1,694
2017–18	398	1,677
2018–19	405	1,787
2019–20	426	1,820
2020–21	491	1,907

* NCIS data courtesy of the Department of Justice and Community Safety, Victoria.

Table 9b: Ambulance Victoria pre-hospital trauma deaths, 2016–17 to 2020–21

	Trauma deaths attended to by Ambulance Victoria*
2016–17	725
2017–18	724
2018–19	738
2019–20	756
2020–21	779

* Data courtesy of the Victorian Ambulance Cardiac Arrest Registry. Due to the coding used by the registry, there may be an underestimate of the number of asphyxia cases.

The number of trauma deaths in transit from the scene being transported by Ambulance Victoria was low in all years (Table 10).

Table 10: In-transit deaths, 2016–17 to 2020–21

	In-transit deaths n
2016–17	*
2017–18	8
2018–19	6
2019–20	6
2020–21	5

* Denotes less than 5 cases

Data courtesy of Ambulance Victoria.

28 This rate is based on the *Australia Demographic Statistics Table 52 Estimated Resident Population by Single Year of Age, Victoria* population of 6,649,066 at 30 June 2021 (Australian Bureau of Statistics 2021).

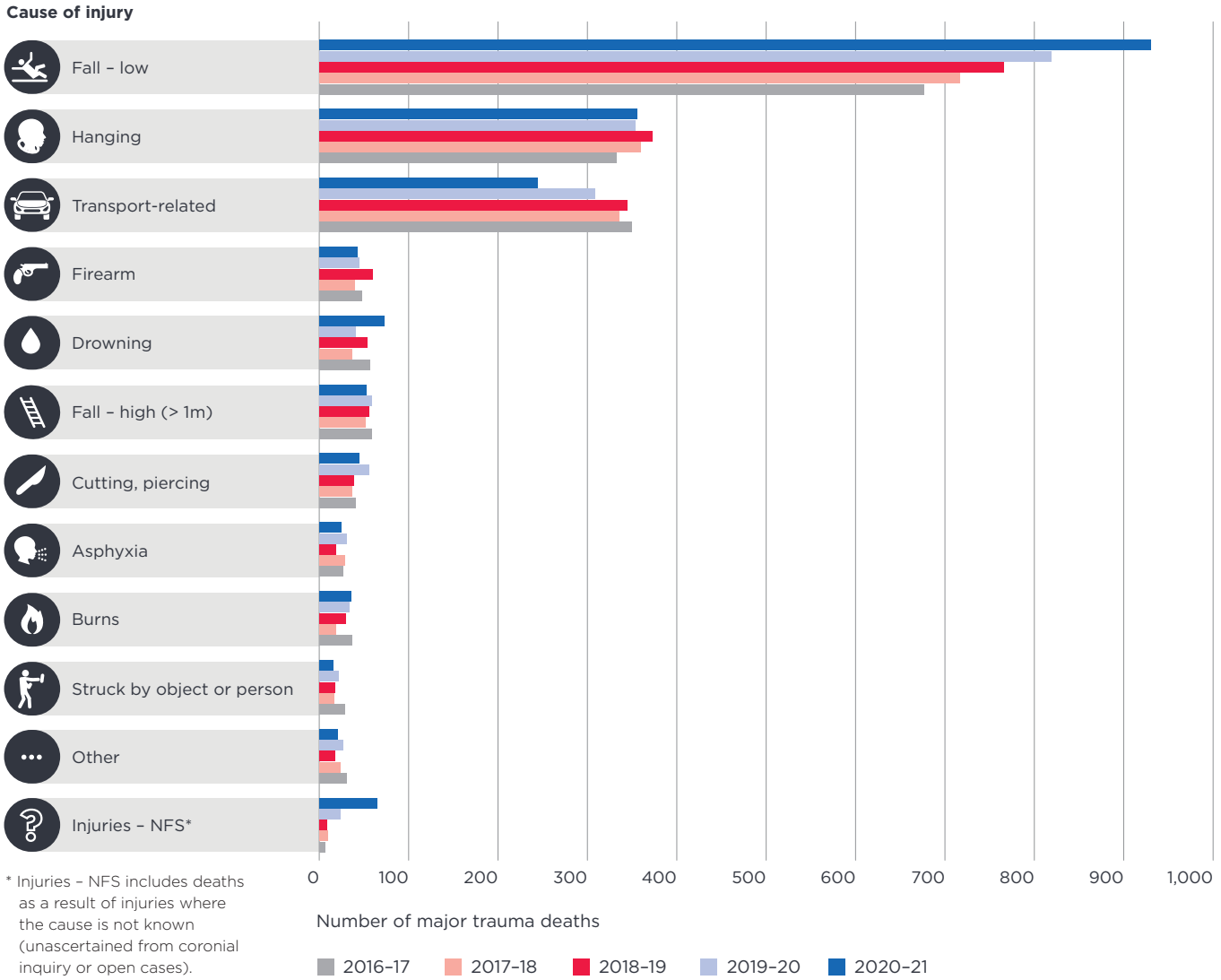
29 95% CI = 95% confidence interval; p = probability.

Cause of injury for all trauma deaths

There were 1,835 trauma deaths recorded on the NCIS, and an additional 72 cases were recorded in the VSTR but not found on the NCIS. Although only 1.9% of 2020–21 cases on the NCIS were closed, there was sufficient information available to determine if the death was trauma-related, and a specified cause of injury was available for 97% of the 1,907 trauma deaths.

Low and high falls (51.5%) were the most common cause of all injury deaths in 2020–21, followed by hangings (18.7%) and transport-related incidents (12.8%) (Figure 11). In 2020–21 low falls accounted for 49% of all trauma deaths and 94% of these patients were aged 65 years and older. There were 33 paediatric (aged less than 16 years) trauma deaths in 2016–17, 32 in 2019–20 and 40 in 2020–21. The number of hangings in the paediatric cohort was less than five in 2016–17, 11 in 2019–20 and 7 in 2020–21. Drownings in the paediatric cohort increased from six in 2016–17 to 15 in 2020–21.

Figure 11: Cause of injury for all trauma deaths identified on the NCIS or Victorian State Trauma Registry, 2016–17 to 2020–21



* Injuries – NFS includes deaths as a result of injuries where the cause is not known (unascertained from coronial inquiry or open cases).

In-hospital trauma deaths

The registry recorded 491 in-hospital deaths in 2020–21 (12.3%) compared with 426 (11.7%) in 2019–20 and 440 (12.6%) in 2016–17 (refer to Table 9a). In 2020–21, 76% of major trauma patients who died in hospital were 65 years of age or older, and the cause of injury was a low fall for 87% of these patients.

The incidence of in-hospital major trauma deaths was 7.4 per 100,000 population in 2020–21 (25.6% of all trauma deaths in Victoria) compared to 6.4 per 100,000 population in 2019–20 and 7.0 per 100,000 population in 2016–17. Since 2016–17, the annual incidence rate of in-hospital major trauma deaths has not changed (IRR 1.02, 95% CI: 0.97, 1.06, p = 0.472)[30].

The percentage of major trauma patients with an Injury Severity Score greater than 12 who died in hospital was 10.3% in 2016–17, 9.6% in 2019–20 and 9.3% in 2020–21. The relative risk of in-hospital death for major trauma patients in 2020–21, after adjustment for age, ISS, head injury severity and cause of injury, has not changed relative to 2016–17 (Table 11).

Table 11: Adjusted relative risk* of in-hospital death of major trauma patients, 2016–17 to 2020–21

	All major trauma	ISS > 12	ISS > 12 and age < 65
	Adjusted relative risk* (95% CI)		
2016–17 (reference)	1	1	1
2017–18	0.84 (0.74, 0.94)	0.84 (0.72, 0.96)	0.86 (0.68, 1.09)
2018–19	0.88 (0.78, 0.99)	0.91 (0.79, 1.05)	1.00 (0.79, 1.26)
2019–20	0.84 (0.74, 0.95)	0.87 (0.75, 1.02)	0.91 (0.72, 1.17)
2020–21	0.89 (0.79, 1.00)	0.90 (0.78, 1.03)	0.82 (0.64, 1.07)

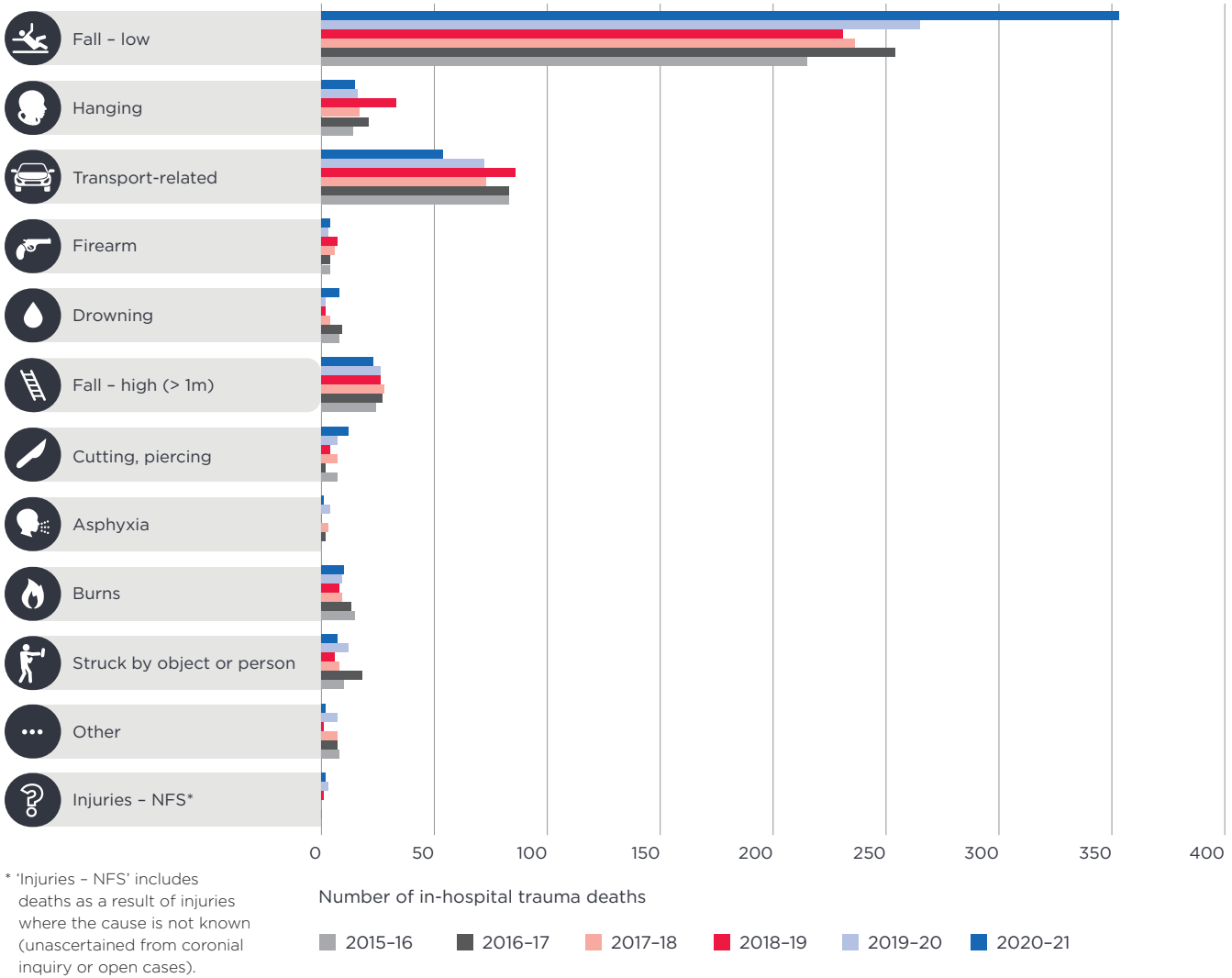
*Adjusted for age, ISS, head injury and cause of injury

30 95% CI = 95% confidence interval; p = probability

Cause of injury for VSTR in-hospital deaths

Low falls were the most common cause of injury for in-hospital deaths, accounting for 72% of the in-hospital deaths in 2020–21, 62% in 2019–20 and 55% in 2016–17 (Figure 12a). The case fatality rate of in-hospital deaths for major trauma patients injured in a low fall was 22% in 2016–17, 21% in 2019–20 and 25% in 2020–21. The in-hospital case fatality rate for transport-related major trauma was 6.1% in 2016–17, 5.6% in 2019–20 and 4.0% in 2020–21.

Figure 12a: Cause of injury for in-hospital trauma deaths, 2016–17 to 2020–21



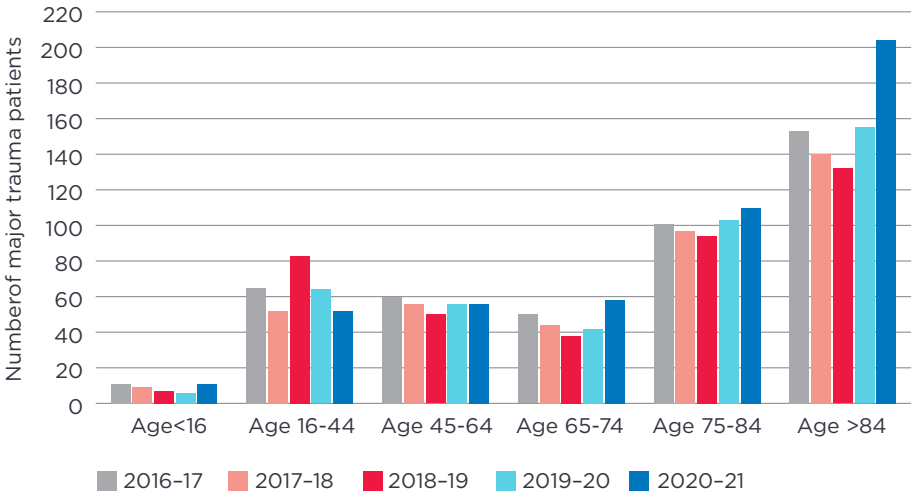
* 'Injuries – NFS' includes deaths as a result of injuries where the cause is not known (unascertained from coronial inquiry or open cases).

In-hospital trauma death rate by age group

The in-hospital death rate for major trauma patients 85 years or older was 36% in 2016–17, 32% in 2019–20 and 35% in 2020–21 (Figure 12b).
The number of in-hospital deaths by age group are presented in Figure 12c.

Figure 12b: In-hospital trauma death rate by age group, 2016–17 to 2020–21

Figure 12c: Number of in-hospital trauma deaths by age group, 2016–17 to 2020–21



Long-term outcomes following major trauma

- **THE FOLLOW-UP OF MAJOR TRAUMA PATIENTS AT SIX, 12 AND 24 MONTHS AFTER INJURY PROVIDES VITAL INFORMATION ON HOW WELL PATIENTS RECOVER FROM MAJOR TRAUMA.**
- **THE LEVEL OF FUNCTIONAL RECOVERY DECLINED SLIGHTLY IN ADULT MAJOR TRAUMA PATIENTS IN 2019–20.**
- **THE PROPORTION OF PAEDIATRIC PATIENTS EXPERIENCING A GOOD FUNCTIONAL OUTCOME IMPROVED IN 2019–20.**
- **THE HEALTH-RELATED QUALITY OF LIFE OF ADULT MAJOR TRAUMA PATIENTS HAS REMAINED STABLE OVER TIME.**
- **IN CHILDREN, HEALTH-RELATED QUALITY OF LIFE DECLINED SLIGHTLY IN 2018–19 AND IMPROVED IN 2019–20.**

Once a 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 their family member or carer if they are unable to participate directly, at six months, 12 months and 24 months after injury. Information about function and health-related quality of life, among other outcomes, is collected during the interviews. As the follow-up process is not yet complete for patients injured in 2020-21, this section focuses on data from earlier years: 2015–16 to 2019–20 for adult and paediatric patients, acknowledging that not all 24-month follow-up interviews may be complete for 2019–20.

For patients injured between 1 July 2015 and 30 June 2020, 84% of adult major trauma patients were successfully followed up at six months, while 83% were followed up at 12 months and 81% were followed-up at 24 months post-injury. For paediatric major trauma patients, the follow-up rates were 88% at six months, 89% at 12 months and 89% at 24 months post-injury.

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.

The predicted proportion of adult major trauma patients making a good recovery, adjusted for socioeconomic, demographic and injury factors, showed a slight decline in 2019–20 when compared with previous years (Figure 13). The proportion of paediatric patients experiencing a good functional outcome showed an overall improving trend when compared with 2015–16 (Figure 14).

Figure 13: Predicted probability (95% CI) of a good recovery for adult major trauma patients adjusted for socioeconomic, demographic and injury factors, 2015–16 to 2019–20

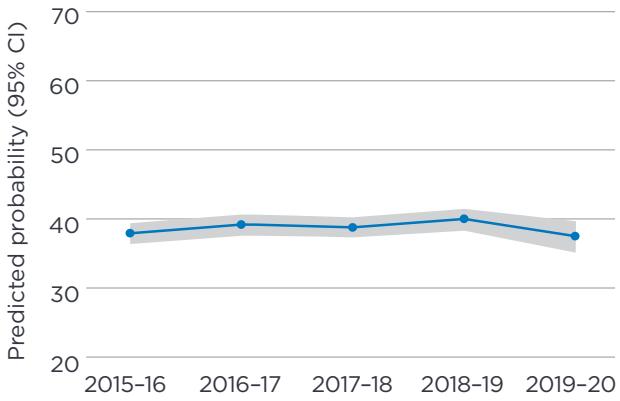
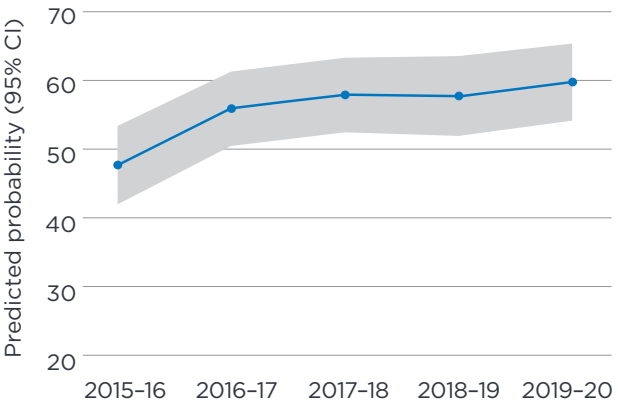


Figure 14: Predicted probability (95% CI) of a good recovery for paediatric major trauma patients adjusted for socioeconomic, demographic and injury factors, 2015–16 to 2019–20



Health-related quality of life

The EQ-5D-5L is used to measure health-related quality of life for adults while the EQ-5D-Y-5L is used for children. Higher EQ-5D-5L and EQ-5D-Y-5L summary scores represent better health status. The EQ-5D-Y-5L is administered to children aged 8 to 15 years. Prior to July 2018, the Pediatric Quality of Life Inventory (PedsQL) was used for children. The PedsQL summary scores from previous years were mapped to the EQ-5D-Y-5L summary scores to enable comparison across the years.

The health-related quality of life outcomes of adult major trauma patients in 2019–20 was unchanged when compared to 2015–16 (Figure 15). In children, health-related quality of life declined slightly in 2018–19 and improved in 2019–20 (Figure 16). The apparent decline from 2018–19 could be due to the change in measurement instrument, and challenges associated to mapping between instruments.

Figure 15: Predicted mean (95% CI) EQ-5D-5L summary score of adult major trauma patients adjusted for socioeconomic, demographic and injury factors, 2015–16 to 2019–20

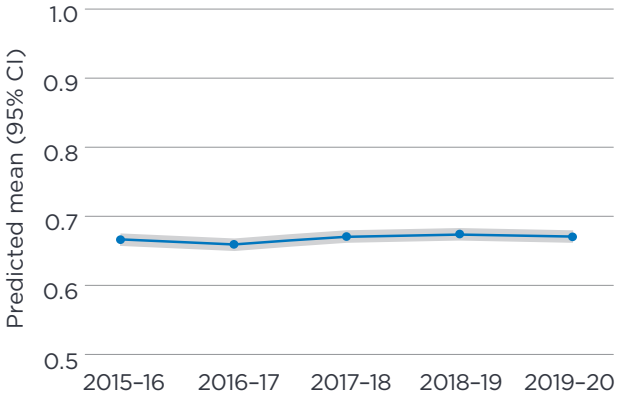
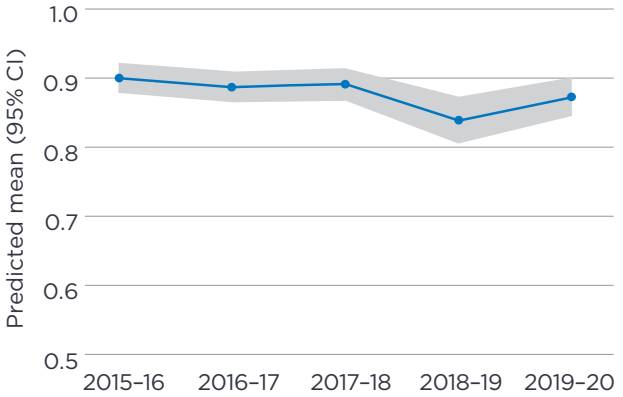


Figure 16: Predicted mean (95% CI) EQ-5D-Y-5L summary score for paediatric major trauma patients adjusted for socioeconomic, demographic and injury factors, 2015–16 to 2019–20



Limitations and data caveats

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

Hospital capture

All health services within the VSTS are now contributing to the 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 pre-hospital patient care record, this information is requested directly from the ambulance service.

Data presentation

Generally, data is 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 primary 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

Court appointed staff in each jurisdiction are responsible for coding and closing cases in the NCIS. The volume of cases available in the NCIS to third parties conducting research is impacted by the timeliness of case closure. This contributed to a very low number of closed cases recorded on the NCIS compared with previous years. The low number of closed cases restricts the search for all VSTR in-hospital deaths and limits the capacity to fully interpret trends over time. NCIS access is limited to deaths in Victoria and some of the VSTR in-hospital deaths did not occur in Victoria and were therefore not identified.

APPENDIX 1: Victorian State Trauma Registry data methodology

Data managers and trauma registry staff collect data at the major trauma services. Metropolitan trauma services, metropolitan primary care services and regional health services data collection are the responsibility of data collectors employed by Monash University. There are regional data collectors based in each of the five rural regions: Barwon-South West, 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 Victorian State Trauma Registry procedures, data collection/extraction processes and definitions of data variables. The registry data manager also provides ongoing support and advice. This ensures data are 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 (USA), 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 registry criteria by checking the hospital information system, emergency department admission records and intensive care unit admission records. Metropolitan and regional data collectors undertake retrospective data collection.

Trauma patients are identified retrospectively by running reports using the Victorian Admitted Episodes Database's International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification (ICD-10-AM) codes to identify patients with injury as their principal diagnosis. These reports are set up to include each patient's length of stay, intensive care unit admission and outcome. Deaths in an emergency department and transfers out of an emergency department are identified by a report from the emergency department. The registry also provides quarterly lists of identified transfers to and from individual health services.

Data are extracted from the medical records maintained at the facilities that provided care to a major trauma patient. The registry uses the 2008 updated version of AIS 2005 (AIS 2008), with all patients injured from 1 July 2010 coded using this version.

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 and New Zealand coronial cases. The NCIS is managed by the Department of Justice and Community Safety, Victoria. Information about deaths reported to an Australian coroner since July 2000 is stored within the system.

By running queries in the NCIS based on all case type notifications between 1 July 2020 and 31 August 2021, the Victorian State Trauma Registry 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 or isolated fractured hip
- airway obstruction by a foreign body
- asbestosis
- carbon monoxide or helium gas poisonings
- drug/alcohol overdose
- malignancy
- medical/surgical complications
- hypothermia only and other non-traumatic incidents.

Data fields extracted are the NCIS number, the patient's age, the patient's sex, case status, case type and intent, medical cause of death, cause of injury, underlying ICD-10-AM code, postcode of the patient's residence and postcode of where the injury and death 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, electrocution and aviation, skiing and surfing incidents. Asphyxia includes suffocation and strangulation-related deaths.

Deaths recorded on the registry are matched with those extracted from the NCIS database. The NCIS database is also searched for registry 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 Victorian State Trauma Registry works closely with Ambulance Victoria to improve pre-hospital data capture and accuracy. Since Ambulance Victoria implemented the Victorian Ambulance Clinical Information System, which enables 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 registry 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. The ICD-10-AM and Australian Classification of Health Interventions procedure codes are checked to ensure accuracy and completeness of surgical procedures and anatomical injuries.

Manually collected data are checked for completeness and accuracy. Each data collector is provided with a feedback list of common errors and known data collection issues, including 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 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 registry death records are compared with the National Coronial Information System death records. Pre-hospital data set 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 Victorian State Trauma Registry 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 and Human Services, Monash University and the Department of Justice Human Research 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 VSTORM group

The Victorian State Trauma Registry Outcomes and Monitoring (VSTORM) group, based at the School of Public Health and Preventive Medicine at Monash University, coordinates the registry.

The VSTORM chief investigators for 1 July 2020 to 30 June 2021 were:

- Prof. Belinda Gabbe (Head, Victorian State Trauma Registry, Monash University)
- Prof. Peter Cameron (Chief Investigator, Victorian State Trauma Registry, Monash University)
- Dr Ben Beck (Chief Investigator, Victorian State Trauma Registry, Monash University)

Members of the VSTORM Steering Committee from 1 July 2020 to 30 June 2021, all of whom have expertise in epidemiology, trauma management or related areas, were:

Chair: Professor Warwick Teague (Director, Trauma Service, The Royal Children's Hospital)

Membership:

- Prof. Belinda Gabbe (Head, VSTORM)
- Prof. Peter Cameron (Chief Investigator, VSTORM)
- Assoc. Prof. Tony Walker (ⱡ Chief Executive Officer, Ambulance Victoria)
- Ms Louise Kelly (Senior Project Officer, Clinical Registries, Victorian Agency for Health Information)
- Dr Gabby O'Connor (Emergency Physician, Austin Health)
- Prof. Ed Oakley (Deputy Chief Medical Officer, Safer Care Victoria)
- Dr Jennie Ponsford (Director, Monash-Epworth Rehabilitation Research Centre)
- Dr Bruce Bartley (Emergency Department, The Geelong Hospital)
- Prof. Karen Smith (Manager, Research and Evaluation, Ambulance Victoria)
- Mr David Attwood (Lead Operational Management & Data, TAC)
- Prof. Mark Fitzgerald (Director of Trauma Services, The Alfred)
- Mr Peter Trethewey (Chief Executive Officer, AQA Victoria Ltd)
- Associate Professor Tim Baker (Director, Centre for Rural Emergency Medicine)
- Mr David Read (Head of Trauma, The Royal Melbourne Hospital)
- Ms Helen Steenbergen (Senior Manager Trauma Lodgement & Back to Work Rapid Recovery, TAC)
- Ms Robyn Canning (Lead Research Operational Management and Data Research Strategy, Risk & Performance, TAC
- Ms Olivia Pantelidis (Senior Manager Health, TAC)

Attendees:

- Ms Sue McLellan (Trauma Registry Data Manager, VSTORM)
- Ms Mimi Morgan (Project Manager, VSTORM)
- Dr Ben Beck (Chief Investigator, VSTORM)

APPENDIX 5: Health services with ethics committee approval, July 2020 to June 2021

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 Health and Human Services and Monash University ethics committees and has also been granted by the Department of Justice Human Research Ethics Committee for access to 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 2021, registry data collection was approved at the 138 health services listed in the following table.

Trauma service level	Hospital
Major trauma service	Alfred Health: The Alfred
	The Royal Children's Hospital
	The Royal Melbourne Hospital
Metropolitan trauma service	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
	Sisters of Charity Australia: St Vincent's Hospital Melbourne
	Western Health: Footscray Hospital
Metropolitan primary care service	Bayside Health: Sandringham and District Memorial Hospital
	Eastern Health: Angliss Hospital
	Epworth HealthCare: Epworth Richmond
	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.
	Harrow Bush Nursing Centre
	Heywood Rural Health
	Skipton Hospital
	South West Healthcare (Lismore)
	Terang and Mortlake Health Service (Mortlake)
	Western District Health Service (Merino)
	Western District Health Service (Penshurst)

Gippsland Region	
Regional trauma service	Latrobe Regional Hospital (Traralgon)
Urgent care service	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)
Primary care service	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 (Horsham)
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)
	Beeac and District Hospital
	Djerriwarrh Health Services (Bacchus Marsh)
	Dunmunkle Health Services (Rupanyup)
	East Wimmera Health Service (Birchip)
	East Wimmera Health Service (Charlton)
	East Wimmera Health Service (Donald)
	Elmhurst Bush Nursing Centre
	Hepburn Health Service (Creswick)
	Lake Bolac Bush Nursing Centre
	Hesse Rural Health Service (Rokewood)
	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

Hume Region	
Regional trauma service	Albury Wodonga Health: Albury Base Hospital
	Goulburn Valley Health (Shepparton)
	Northeast Health Wangaratta
Urgent care service	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)
	Yarrawonga District Health Service
	Yea and District Memorial Hospital
Primary care service	Beechworth Health Service
	Euroa Health Inc.
	Falls Creek Medical Centre
	Mt Buller Medical Centre
	Mt Hotham Medical Centre
	Nagambie Medical Centre
	Tallangatta Health Service
	Walwa Bush Nursing Centre

Loddon Mallee Region	
Regional trauma service	Bendigo Health Care Group: Bendigo Hospital
	Mildura Base Public 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.
	East Wimmera Health Service (Wycheproof)
	Heathcote Health (McIvor)
	Inglewood and Districts Health Service
	Lockington and District Bush Nursing Centre Inc.
	Maldon Hospital
	Mallee Track Health and Community Service
	Ouyen Hospital
	Robinvale District Health Services
	Rochester and Elmore District Health Service

APPENDIX 6: MTS Trauma program managers and VSTR data collectors, July 2020 to June 2021

The MTS Trauma program managers, VSTR data collectors and VSTR Outcomes coordinators and outcomes data collectors are listed in the table below and are thanked for their contribution to the VSTR.

Hospital	Data collector
Major trauma service	
The Alfred	Jane Ford (Trauma program manager)
	Zoe Cheung
	Sharon O'Brien
The Royal Children's Hospital	Helen Jowett (Trauma program manager)
	Dr Cameron Palmer
The Royal Melbourne Hospital	Kellie Gumm (Trauma program manager)
	Roselyn Santos
	Ms Vesna Stanovic
	Christina Cicuto
	Mrs Stephanie Torney
	Mrs Amretha Adiyodi
Metropolitan trauma service	
Austin Hospital	Kathryn McIlroy
Box Hill Hospital	Ms Joanne Lillie
The Northern Hospital	Sharon Klim
Frankston Hospital	Miss Erin Magee
Monash Medical Centre	Amanda Hulley
Monash Children's Hospital	Amanda Hulley
Dandenong Hospital	Ms Claire Easto
Maroondah Hospital	Ms Joanne Lillie
St Vincent's Hospital	Ms Mary-Louise Van Dyk
Footscray Hospital	Mrs Kerrie Russell

Hospital	Data collector
Metropolitan primary care service	
Sandringham and District Memorial Hospital	Ms Mary-Louise Van Dyk
Angliss Hospital	Ms Mary-Louise Van Dyk
Epworth Richmond	Sharon Klim
The Mercy Hospital Werribee	Sharon Klim
Rosebud Hospital	Miss Erin Magee
Monash Medical Centre, Moorabbin Campus	Amanda Hulley
Casey Hospital	Amanda Hulley
Sunshine Hospital	Mrs Kerrie Russell
Williamstown Hospital	Mrs Kerrie Russell
Barwon-South Western Region	Christine Sherwell
Gippsland Region	Ms Carrie Thirlwall
	Sharon Klim
Grampians Region	Narelle Cottrell
	Cassandra Quick
Hume Region	Les Lambert
Loddon Mallee Region	Mrs Patricia Allieu
	Narelle Cottrell
VSTR Outcomes Coordinator	Ms Melissa Hart
VSTR Outcomes Coordinator	Ms Amanda Brown
	Outcomes data collection staff

APPENDIX 7: Case Review Group quality audit filters

1. Major trauma patients who were transferred to a non-major trauma service (excluding spinal patients to the Austin and older patients with an isolated head injury from a low fall to the Austin, Monash Medical Centre and St Vincent's), excluding older patients (aged 65 years or older or patients with limiting or life-threatening comorbidity) with a low fall (≤ 1 metre) injury to only one body region (apart from the head).

Modified filter implemented for cases with a date of injury from 1 January 2014. As per the current filter, the patient must also have altered observations, which are defined as any of the following (at first available hospital or scene if not available):

- SBP < 100mmHg
- oxygen saturation < 97%
- pulse rate < 60 bpm or > 120 bpm
- GCS motor = 1
- GCS verbal < 5.

2. 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), excluding older patients (aged 65 years or older or patients with limiting or life-threatening comorbidity) with a low fall (≤ 1 metre) injury to only one body region (apart from the head).

Modified filter implemented for cases with a date of injury from 1 January 2014. As per the current filter, the patient must also have altered observations, which are defined as any of the following (at first available hospital or scene if not available):

- SBP < 100mmHg
- oxygen saturation < 97%
- pulse rate < 60 bpm or > 120 bpm
- GCS motor = 1
- GCS verbal < 5.

3. Major trauma time-critical (Review of Trauma and Emergency Services criteria*) patients with a transfer time longer than six hours from the time of arrival at the first health service to the time of arrival at the definitive health service.

* Time-critical Review of Trauma and Emergency Services criteria: cases are considered 'time critical' if any of the vital signs below are recorded on the Victorian State Trauma Registry at the primary hospital or, if invalid or unavailable, first recorded pre-hospital vital signs:

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

APPENDIX 8: Eligible patients

To ensure the registry captures all major trauma patients in Victoria, broad-based inclusion criteria are used. The registry captures trauma patients whose principal diagnosis is injury, irrespective of age, and who meet any of the registry criteria (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 report. The remaining criteria are screening filters to capture the wider population of potentially major trauma patients.

Box 1: The Victorian State Trauma Registry patient inclusion criteria

1. All deaths after injury
2. All patients admitted to an intensive care unit or high-dependency area for more than 24 hours and mechanically ventilated after admission
3. Significant injury to two or more ISS body regions (an AIS of 2 or more in two or more body regions), partial and full thickness burns of 20–29% total body surface area (TBSA) or an ISS greater than 12
4. Urgent surgery for intracranial, intrathoracic or intraabdominal injury, or fixation of pelvic or spinal fractures
5. Electrical injuries, drowning and asphyxia patients admitted to an intensive care unit and having mechanical ventilation for longer than 24 hours or death after injury or ISS greater than 12
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 Victorian State Trauma Registry patient exclusion criteria

1. Isolated fractured neck of femur
2. Isolated upper limb joint dislocation, shoulder girdle dislocation (unless associated with vascular compromise) and toe/foot/knee joint dislocation – unless meets inclusion criteria 1, 2 or 4
3. Isolated closed-limb fractures only (for example, fractured femur, Colles' fracture) – unless meets inclusion criteria 1, 2 or 4
4. Isolated injuries distal to the wrist and ankle only (for example, finger amputations) – unless meets inclusion criteria 1, 2 or 4
5. Soft tissue injuries only (for example, tendon and nerve injury and uncomplicated skin injuries) – unless meets inclusion criteria 1, 2 or 4
6. Burns to less than 10% of the body – unless meets inclusion criteria 1, 2 or 4
7. Isolated eyeball injury
8. Isolated stable pelvic ring fractures – unless meets inclusion criteria 1, 2 or 4 (from date of injury 1 July 2017)
9. Isolated acetabular fractures not further specified – unless meets inclusion criteria 1, 2 or 4 (from date of injury 1 July 2017)
10. Isolated lumbar or thoracic spine vertebral body fractures – unless meets inclusion criteria 1, 2 or 4 (from date of injury 1 July 2017)
11. Isolated single rib fractures, two rib fractures or fractures of the sternum – unless meets inclusion criteria 1 or 2 (from date of injury 1 July 2017)

Major trauma definition

The definition of major trauma for the Victorian State Trauma Registry is adapted from the Review of Trauma and Emergency Services (RoTES) report as outlined in Box 3.

Box 3: The Victorian State Trauma Registry 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 intensive care unit for more than 24 hours, requiring mechanical ventilation
4. Urgent surgery for intracranial, intrathoracic or intraabdominal injury, or for fixation of pelvic or spinal fractures
5. Partial or full thickness burns with a total body surface area (TBSA) of ≥20%

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

List of abbreviations

AIS	Abbreviated Injury Scale
ARV	Adult Retrieval Victoria
EQ-5D	EuroQol
GCS	Glasgow Coma Scale
GOS-E	Glasgow Outcome Scale – Extended
GP	General Practitioner
ICU	Intensive Care Unit
IRR	Incidence Rate Ratio
ISS	Injury Severity Score
KOSCHI	King's Outcome Scale for Closed Head Injury
MTS	Major trauma service
NCIS	National Coronial Information System
PedsQL	Pediatric Quality of Life Inventory
PIPER	Paediatric Infant Perinatal Emergency Retrieval
TAC	Transport Accident Commission
VSTORM	Victorian State Trauma Outcomes Registry and Monitoring group
VSTR	Victorian State Trauma Registry
VSTS	Victorian State Trauma System

VSTR
Victorian State Trauma Registry

MONASH University

TAC Transport Accident Commission

VICTORIA State Government