VICTORIAN STATE TRAUMA SYSTEM AND REGISTRY

ANNUAL REPORT

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30 JUNE 2023

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, advancing quality trauma care in 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 to reduce 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 the continued monitoring of the Victorian State Trauma System and the quality of trauma care the registry data informs. The registry monitors the system's performance 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.

The 2022–23 Annual Report presents data from before, during, and after the pandemic. A striking change during this time is the increase in the number of people aged 65 years and older admitted to hospital after a low fall. As injuries at home (for all groups) have increased far more than injuries in residential care, the causes and possible solutions may be community-based. Statistics that remain unchanged are the higher incidence of major trauma in Regional Victoria and the percentage of patients receiving their initial hospital trauma care at a Regional Trauma Service or Urgent Care Service. As trauma guidelines seek to maximise the number of patients transferred directly from the scene to a major trauma service, this could be seen as a stubborn problem that is difficult to solve, particularly while ambulance resources are stretched. However, the pandemic catalysed increased trauma specialist and retrieval service advice to rural services. Early advice reduces the time to patient retrieval and likely improves care before transport. The increased provision of remote advice demonstrates how mature trauma systems can adapt to new challenges.

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 the wider Victorian State Trauma community, all of whom 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 Tim Baker

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Emergency Physician, South West Healthcare and Portland District Health

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YEAR AT A GLANCE

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

4235

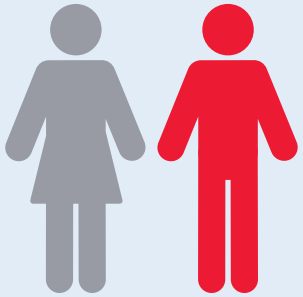
hospitalised major trauma patients in 2022–23 compared to **4066** in 2021–22.

513

in-hospital trauma deaths in Victoria in 2022–23.

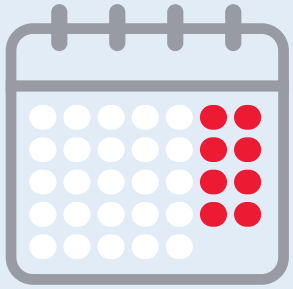
2190

estimated all trauma deaths in Victoria in 2022–23.



68.4%
male

Most major trauma patients were male.



33.6%
on weekends

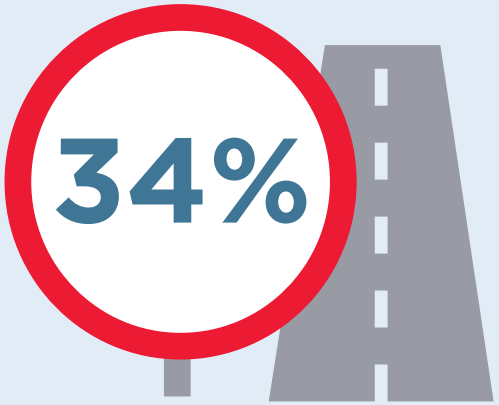
Consistent with previous years, major trauma occurred more frequently on weekends (33.6% of all cases).

51%
8 am – 4 pm

32%
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 32% of trauma cases occurred between the hours of 4.01 pm and midnight.

Trauma cases



of major trauma cases in 2022–23 were transport-related. Low falls accounted for 39% of the major trauma cases.

5.5%

of all cases involved cyclists.

1.3%

of major trauma was from burns.

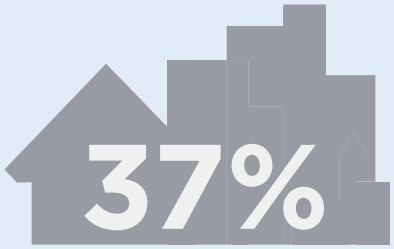
5.5%

of all hospitalised major trauma patients in 2022–23 had a severe head injury.

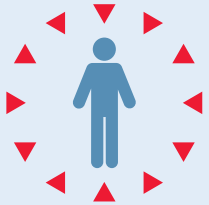
37%

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.



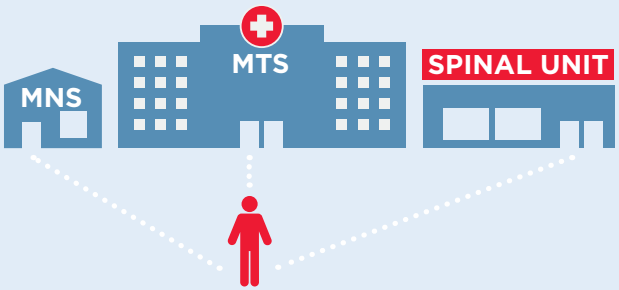
The home was the most common place of injury.



41%

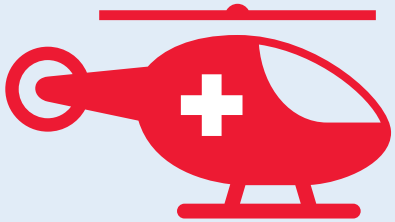
of patients in 2022–23 had sustained multiple trauma without serious neurotrauma.

Trauma treatment



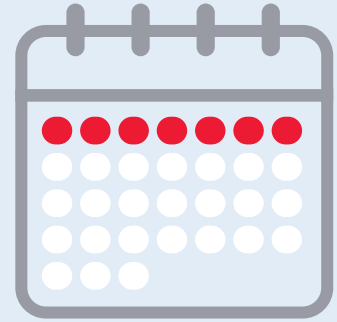
74.7%

of major trauma patients received their definitive care at an appropriate trauma service (as determined by the VSTS trauma triage guidelines).



413

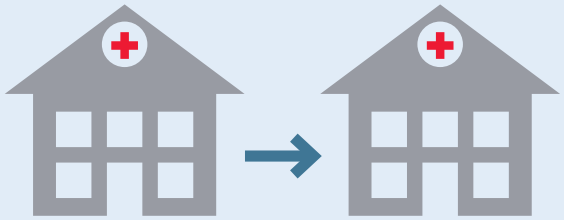
major trauma primary helicopter transports from the scene to a major trauma service.



The median hospital length of stay was 6.8 days in 2022–23.

90%

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



The median inter-hospital transfer time in 2022–23 was **10.0 hours.**

The median ambulance response time was 17 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 2022–23* presents data for a five-year period (2018–19 to 2022–23). The effect of the COVID-19 pandemic on injury epidemiology has been significant and reported on elsewhere.[1,2,3] During part of 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. Derived from the average number of cases for the same quarter in previous years included in this report, there are an estimated 61 missing major trauma cases in 2022–23 (Data are incomplete for Dandenong Hospital and Wimmera Base Hospital (Horsham)).

The number of major trauma patients in 2022–23 was similar to 2021–22; however, the annual incidence of major trauma patients has increased since 2018–19. There has been a notable increase in the annual incidence rate of major trauma patients in the older age groups (75 years and older) and this increase was particularly evident during and after the COVID-19 pandemic.

The sex distribution of hospitalised major trauma patients has been stable for the past five years, with males accounting for 67–70% of cases since 2017–18.

Low falls and transport-related trauma accounted for the highest percentage of trauma cases (39% and 34% respectively in 2022–23). The number of major trauma cases due to other transport-related incidents (includes electric scooters) increased from 25 in 2018–19 to 103 in 2022–23. The number of major trauma cases due to a fall from a height of more than one metre occurring in the home has increased from 235 in 2018–19 to 292 in 2022–23. In 2022–23 deaths due to falls exceeded transport-related deaths for the fifth consecutive year.

Forty-one percent of patients in 2022–23 had sustained multiple trauma without serious neurotrauma. In 2022–23, 5.5% 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 2022–23, 21% of the incidents occurring in regional Victoria involved residents from outside regional Victoria, this is higher than previous years. Of the incidents occurring in metropolitan Melbourne, only 6% involved residents from outside metropolitan Melbourne.

In 2022–23, the first hospital attended was a major trauma service, the Austin Hospital (for spinal care) or a metropolitan neurosurgical service (patients aged 65 years and older with an isolated head injury from a low fall) for 51% of major trauma patients. Most (74.7%) 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, 90% received their definitive care at an appropriate trauma service as defined by the major trauma guidelines.

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 annual incidence of all trauma deaths in Victoria has increased since 2018–19; estimated number of trauma deaths in Victoria was 1787 in 2018–19 and 2190 in 2022–23. This increase has been largely due to increase in low falls; 49% of all deaths in 2022–23 and 95% 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. Because the follow-up process is not yet complete for patients injured in 2022–23, the long-term outcomes section focuses on data from earlier years: 2017–18 to 2021–22 for adult and paediatric patients. The level of functional recovery decreased slightly in adult major trauma patients in 2021–22. The proportion of paediatric (aged less than 16 years) patients experiencing a good functional outcome was maintained in 2021–22 at the levels seen during the period from 2017–18 to 2020–21. Health related quality of life of adult major trauma patients has remained stable in 2021–22 similar to the levels observed over the period 2017–18 to 2020–21. In children, health-related quality of life has remained stable over the period 2018–19 to 2021–22.

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).

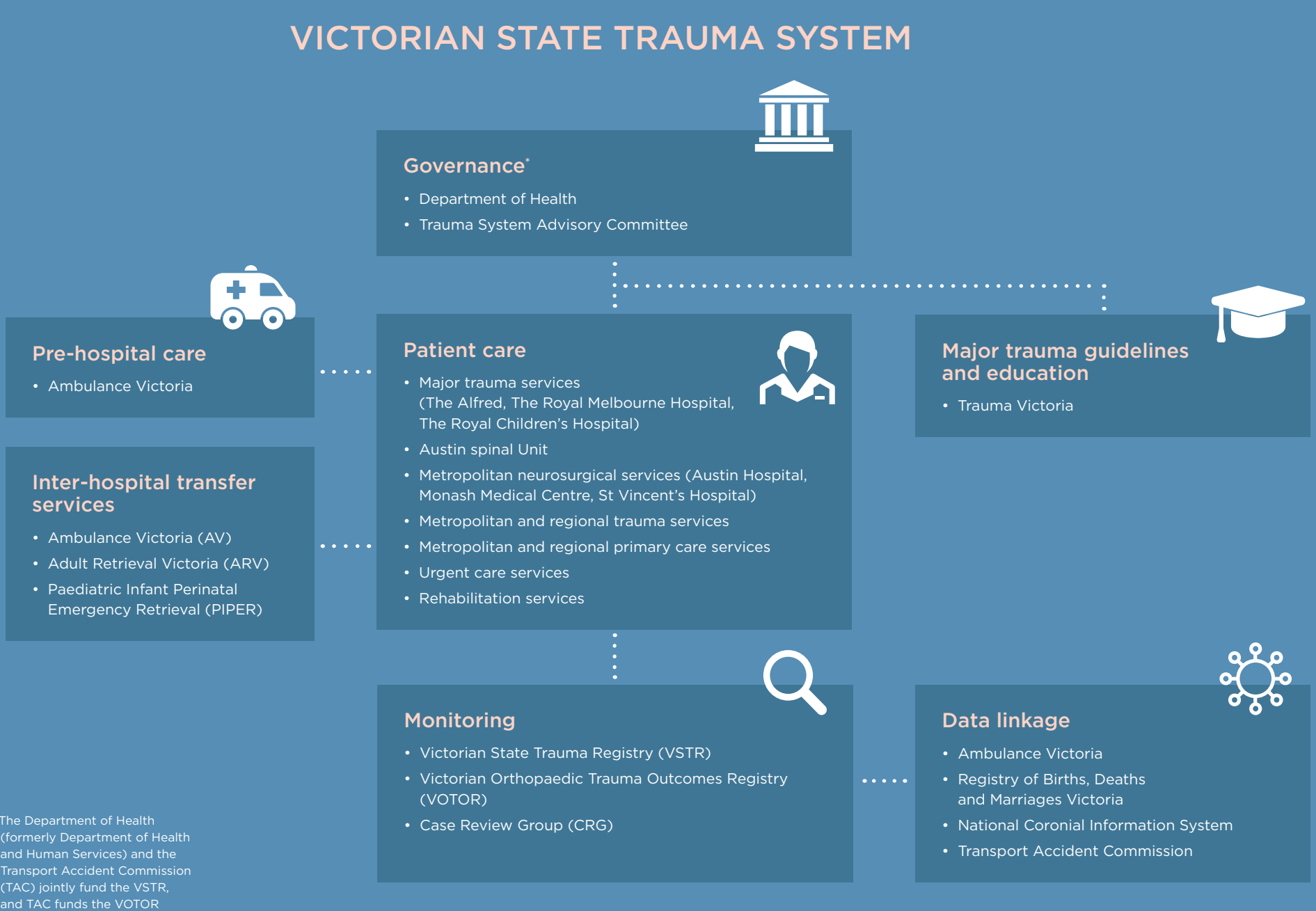
Rural and regional trauma services provide resuscitation and stabilisation of major trauma patients and organise patient transport to an MTS. They may also provide definitive care for a limited number of trauma patients where their injuries are assessed, in agreement with Adult Retrieval Victoria (ARV) 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. Paediatric Infant Perinatal Emergency Retrieval (PIPER) provides stabilisation and transfer of injured infants and children.

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 (aged 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.

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. In 2022–23 the VSTS was co-funded by the Department of Health and the Transport Accident Commission (TAC).

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 the VSTR, and TAC funds the VOTOR

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 2022–23, the case review process identified 561 (14.0% of all major trauma cases) cases that met one or more of these criteria. There were 13.8 per cent of major trauma cases that met the CRG criteria in 2021–22 and 13.5 per cent in 2018–19. The 561 cases were reviewed by VSTORM and 70 of them were 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 high risk cases (on the CRG matrix) and cases of concern only were reviewed.

For cases with date of injury from 1 July 2022 to 30 June 2023, the Case Review Group asked health services (or Ambulance Victoria, Adult Retrieval Victoria or Paediatric Infant Perinatal Emergency Retrieval) to review 49 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 and 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.

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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

- There were 4235 major trauma patients in 2022–23 compared with 4066 in 2021–22.
- Annual incidence of major trauma has increased since 2018–19 (IRR 1.03, 95% CI: 1.01, 1.05, p = 0.001).
- 68% of major trauma patients in 2022–23 were male.
- In 2022–23, 94.1% of major trauma were in the blunt trauma category, 3.4% were penetrating and 1.3% 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 2018–19, 49% in 2021–22 and 51% in 2022–23).
- The proportion of major trauma cases due to cycling incidents (includes e-bikes) was 5.4% in 2018–19, 7.3% in 2021–22 and 5.5% in 2022–23.
- The proportion of major trauma cases due to other transport-related incidents (includes e-scooters) was 0.7% in 2018–19, 1.9% in 2021–22 and 2.4% in 2022–23.
- The number of major trauma incidents occurring in and around the home has increased since 2018–19 (1174 in 2018–19, 1539 in 2021–22 and 1564 in 2022–23).
- In 2022–23, 93% 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 has decreased since 2018–19 (32% in 2018–19, 23% in 2021–22 and 23% in 2022–23).
- The estimated total number of trauma deaths has increased from 1787 in 2018–19 to 2190 in 2022–23.

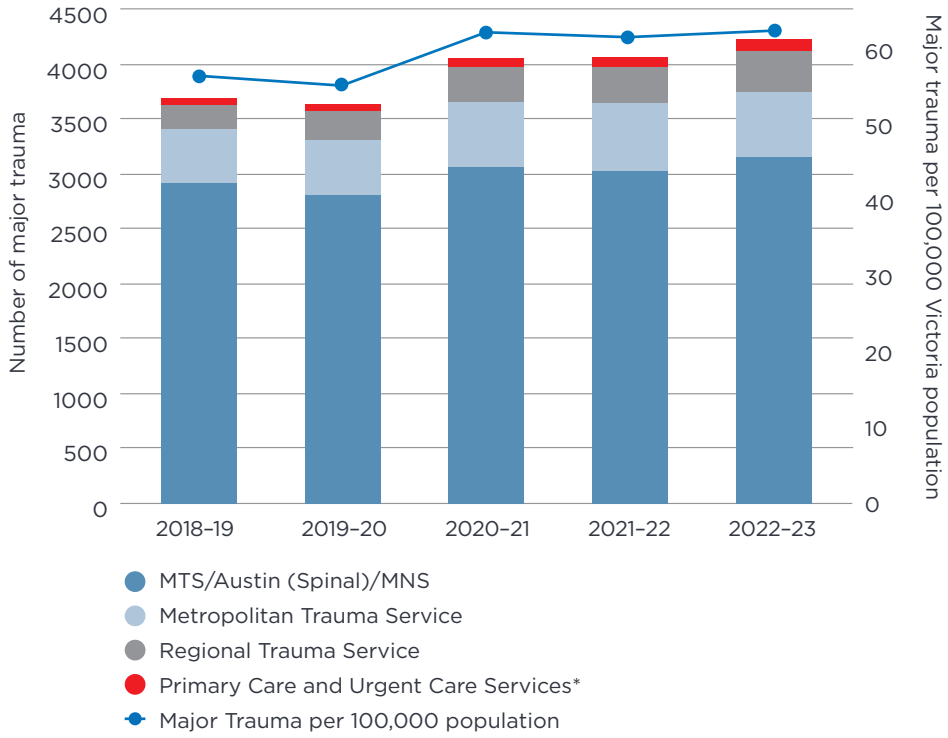
Major trauma patient numbers

In this report, data are presented for major trauma patients treated at 77 VSTS health services from 1 July 2022 to 30 June 2023 (2022–23 financial year). The VSTR recorded 4235 hospitalised major trauma patients in 2022–23 compared with 4066 in 2021–22 and 3693 in 2018–19 (Figure 2). The incidence of hospitalised major trauma was 62 per 100,000 population[4] in 2022–23 compared to 61 per 100,000 population in 2021–22 and 56 per 100,000 population in 2018–19 (Figure 2). The annual incidence of major trauma patients has increased since 2018–19 (IRR 1.03, 95% CI: 1.01, 1.05, p = 0.001).[5] The increase in major trauma numbers has predominantly been evident in the older age groups (Figure 3a) during and after the COVID-19 pandemic. The number of major trauma patients receiving definitive care at a Regional Trauma Service has increased since 2018–19 (Figure 2).

Episodes of care

There were 5432 hospital care episodes for the 4235 hospitalised major trauma patients in 2022–23. Most patients (n = 3064; 72.3%) had only one episode of care, while 1145 (27.0%) experienced two episodes of care and 26 (0.6%) had three episodes of care. The proportion of major trauma cases having more than one episode of care was 31% in 2018–19, 28% in 2021–22 and 28% in 2022–23.

Figure 2: Number and annual incidence rate per 100,000 population of hospitalised major trauma patients by level of definitive care in the VSTS, 2018–19 to 2022–23



*Includes Metropolitan Primary Care Services and Regional Urgent Care Services

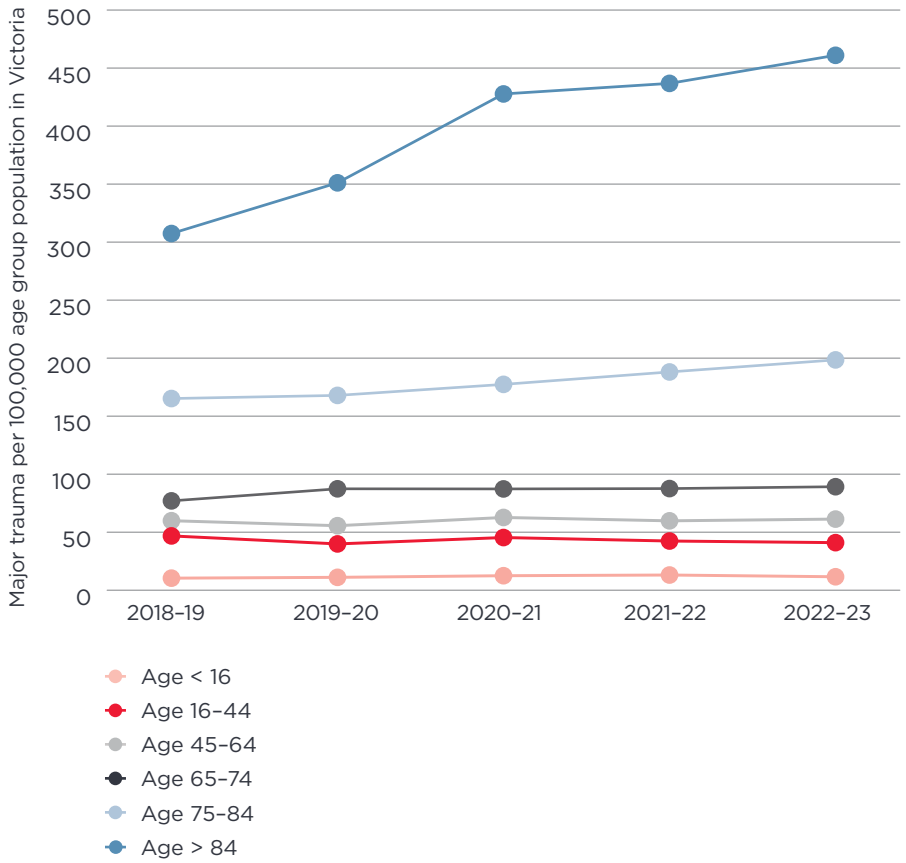
4 This rate is based on the *Australia Demographic Statistics Table 52 Estimated Resident Population by Single Year of Age, Victoria* population of 6,815,441 at 30 June 2023 (Australian Bureau of Statistics 2024).
5 IRR = incidence rate ratio 95% CI = 95% confidence interval; p = probability.

Demographic profile of major trauma patients

The sex distribution of hospitalised major trauma patients has been stable for the past five years, with males accounting for 67% to 70% of cases since 2018–19 (68.4% in 2022–23). In the 65-and-older age group, patient's sex is more evenly distributed with males accounting for 55% to 57% of cases since 2018–19 (56.9% in 2022–23).

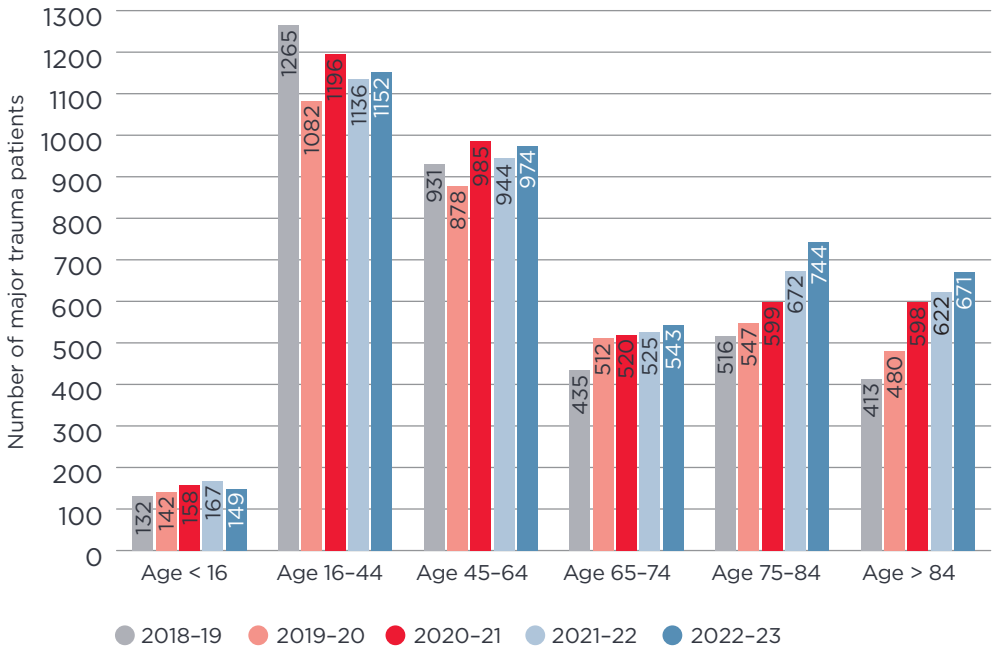
For this report, paediatric patients are aged less than 16 years, adults are aged 16 years and older and older adults are aged 65 years and older. Since 2018–19 the annual incidence of paediatric major trauma patients has not changed: 10.4 per 100,000 in 2018–19, 13.1 per 100,000 in 2021–22 and 11.6 per 100,000 in 2022–23 (IRR 1.04, 95% CI: 0.99, 1.09, p = 0.164)[6] (Figure 3a). The annual incidence rate of major trauma in the 85 years and older age group has increased; 307 per 100,000 in 2018–19, 437 per 100,000 in 2021–22 and 461 per 100,000 in 2022–23 (IRR 1.10, 95% CI: 1.07, 1.14, p < 0.001) (Figure 3a). The annual incidence rate of major trauma in the 75 to 84 years of age group has increased; 165 per 100,000 in 2018–19, 188 per 100,000 in 2021–22 and 198 per 100,000 in 2022–23 (IRR 1.05, 95% CI: 1.02, 1.08, p < 0.001) (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, 2018–19 to 2022–23



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

Figure 3b: Age-specific frequencies of hospitalised major trauma, 2018–19 to 2022–23



Cause of injury

The 13 most common causes of injury are presented in Figure 4. Together, these accounted for 98% of major trauma cases in 2022–23. The percentage of hospitalised major trauma cases due to low falls was 30% in 2018–19, 37% in 2021–22 and 39% in 2022–23. The percentage of major trauma cases due to all falls (low and high) was 42% in 2018–19, 49% in 2021–22 and 51% in 2022–23.

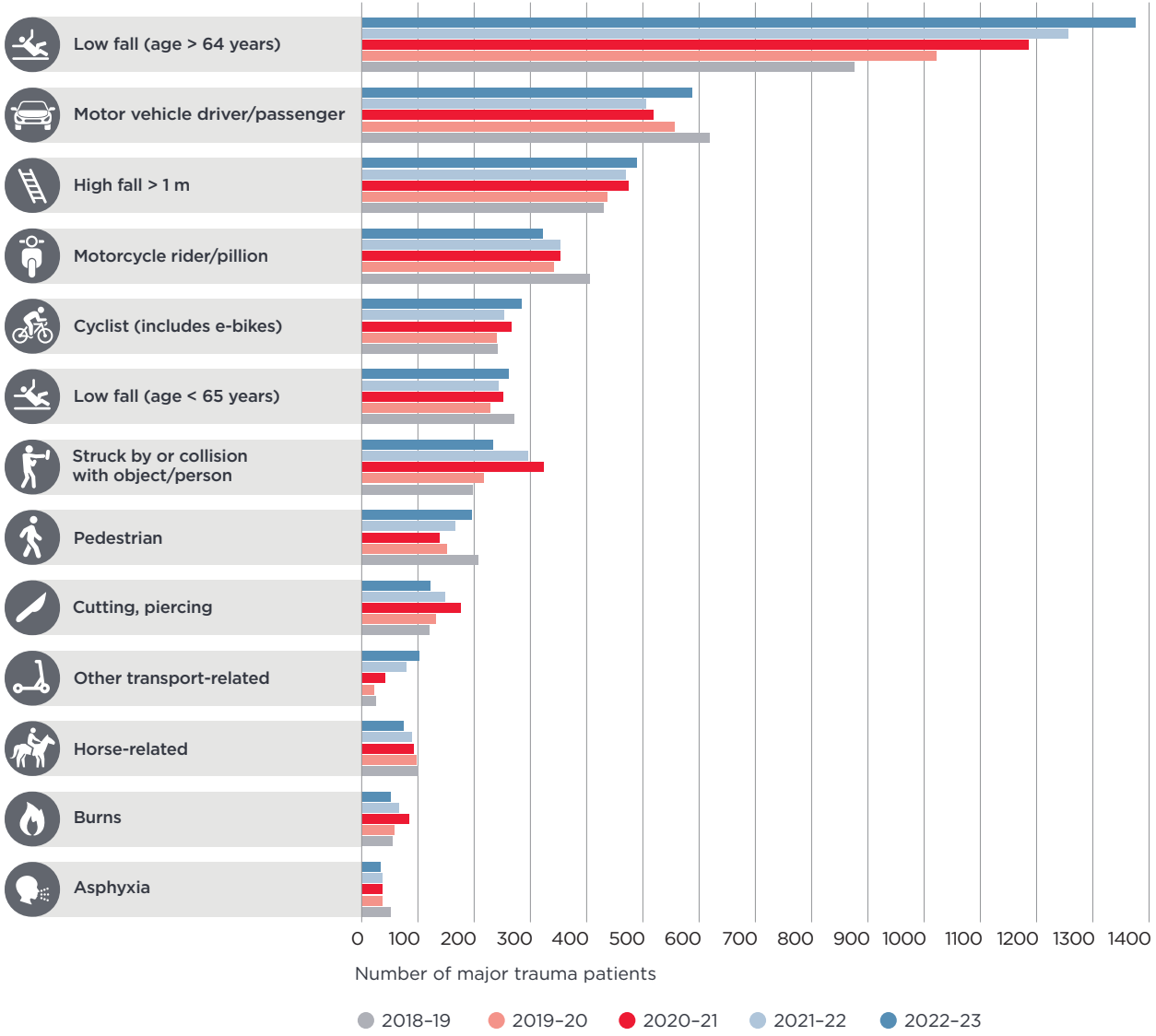
Of the major trauma cases in 2022–23, 34% were transport-related[7] compared to 34% in 2021–22 and 39% in 2018–19. The proportion of major trauma cases due to cycling incidents (includes e-bikes) was 5.4% in 2018–19, 7.3% in 2021–22 and 5.5% in 2022–23. The proportion of major trauma cases due to other transport-related incidents (includes e-scooters) was 0.7% (n = 25) in 2018–19, 1.9% in 2021–22 (n = 79) and 2.4% (n = 103) in 2022–23.

In 2022–23, most patients (82.8%) injured in a low fall were aged 65 years or older and 52% had sustained a head injury[8].

7 Defined by Victorian Emergency Minimum Dataset (VEMD) cause codes (Motor vehicle driver, Motor vehicle-passenger, Motorcycle-driver, Motorcycle-passenger, Pedal cyclist-rider or passenger, Pedestrian or Other transport-related circumstance).

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

Figure 4: The most common causes of injury of hospitalised major trauma patients, 2018–19 to 2022–23



Place of injury

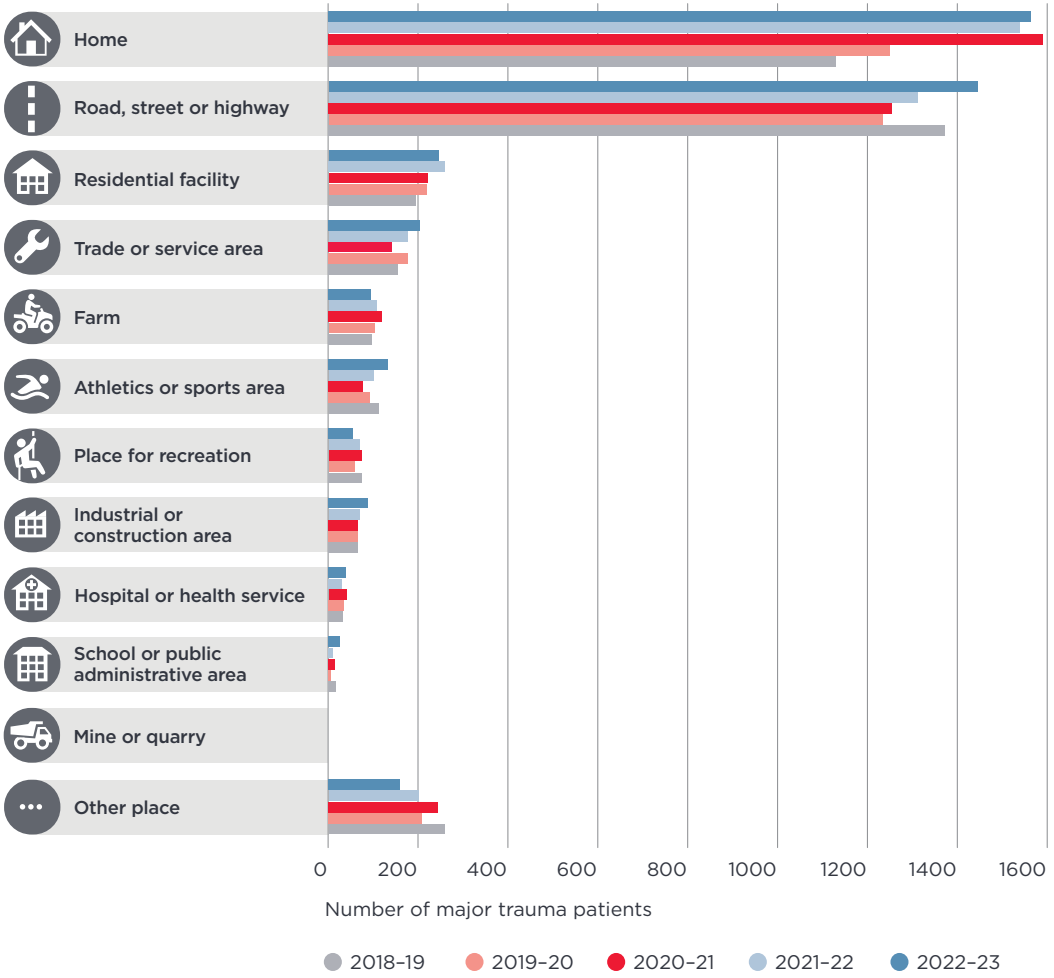
Consistent with the increase in low falls, 37% of major trauma patients were injured at home in 2022–23 (Figure 5a). The number of major trauma incidents occurring in and around the home has increased – 1174 in 2018–19, 1539 in 2021–22 and 1564 in 2022–23 (Figure 5a). There was an increase in the number of major trauma incidents occurring on a road, street or highway in 2022–23 and this was the second most common place of injury in 2022–23 (34.1%).

The number of major trauma cases due to a low fall[9] occurring in and around the home was 665 in 2018–19, 979 in 2021–22 and 1039 in 2022–23. The number of major trauma cases due to a high fall[10] occurring in and around the home has increased – 235 in 2018–19, 280 in 2021–22 and 292 in 2022–23. In and around the home, there were 98 high falls from ladders in 2018–19, 120 in 2021–22 and 119 in 2022–23. Falls from the home roof increased from 51 in 2018–19 to 58 in 2021–22 and 65 in 2022–23.

The number of major trauma cases from high falls in industrial or construction areas was 38 in 2018–19, 36 in 2021–22 and 50 in 2022–23.

The number of major trauma cases due to other transport-related incidents (including e-scooters) occurring on a road, street or highway was 10 in 2018–19, 61 in 2021–22 and 73 in 2022–23.

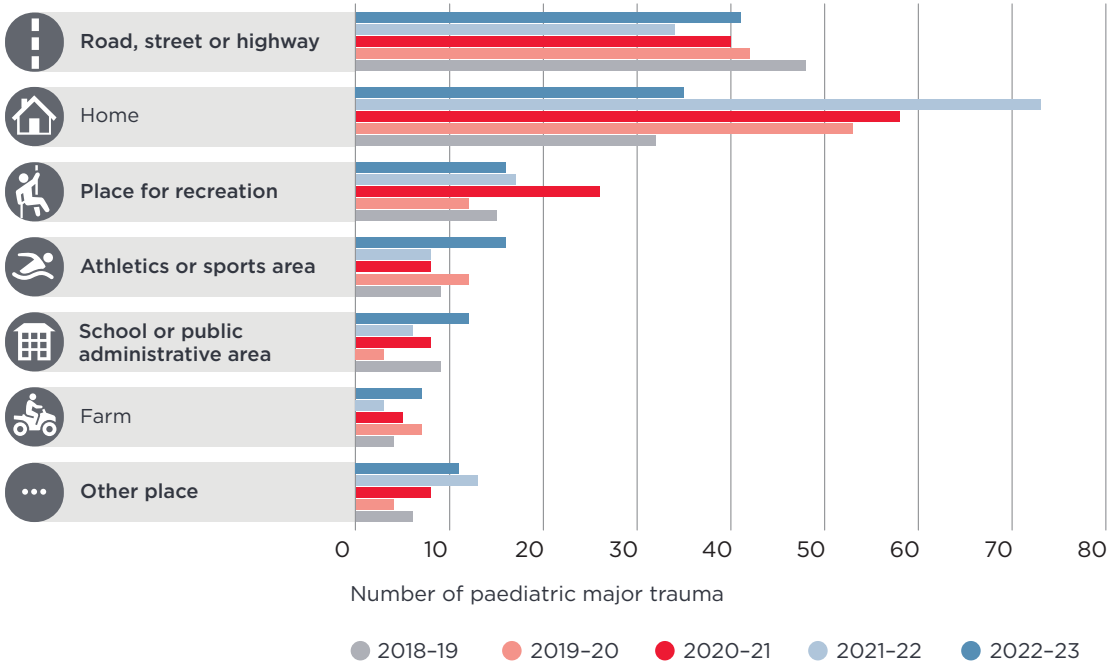
Figure 5a: The place of injury for hospitalised major trauma patients, 2018–19 to 2022–23



9 Height less than or equal to one metre.
10 Height greater than one metre.

The place of injury for paediatric major trauma patients is presented in Figure 5b. There was in increase in major trauma incidents in the home during 2020–21 and 2021–22 for the paediatric major trauma cohort; Victoria was under a state of emergency and government mandated restrictions due to the COVID-19 pandemic during this period.

Figure 5b: The place of injury for hospitalised paediatric major trauma patients, 2018–19 to 2022–23



Transport Accident Commission compensable patients

The Transport Accident Commission (TAC) is a Victorian Government-owned organisation that supports and covers the health-care costs for eligible patients injured in road transportation incidents[11]. In 2022–23, 24% of major trauma patients were identified as TAC compensable, compared to 22% in 2021–22 and 31% in 2018–19. Of the TAC-compensable patients, 93% received their definitive care at an MTS or the Austin Hospital (for spinal care) in 2022–23, and this has not changed since 2018–19.

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 2022–23 were in the blunt trauma category (94.1%), consistent with falls and road trauma being the most common causes of major trauma. Penetrating injuries were sustained by 3.4% of major trauma patients in 2022–23 compared with 4.4% in 2021–22 and 4.0% in 2018–19. Burns accounted for 1.3% of major trauma in 2022–23.

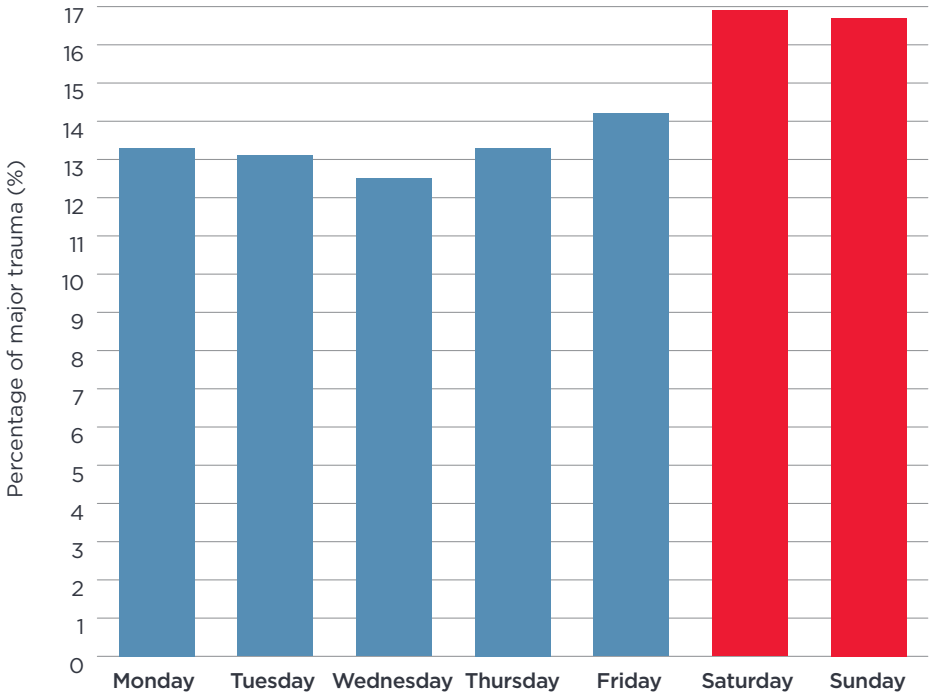
Injury intent

Overall, 90% of major trauma patients with a known intent of injury sustained their injuries from unintentional events. This has been consistent since 2018–19. In 2022–23, 5.7% of hospitalised major trauma cases with known intent resulted from assaults compared with 6.0% in 2021–22 and 6.3% in 2018–19. Intentional self-harm accounted for 3.8% of major trauma with known intent in 2022–23, 3.9% in 2021–22 and 4.3% in 2018–19.

Time and day of injury

Consistent with previous years, major trauma occurred more frequently on weekends (33.6% of all cases), particularly on Saturdays (16.9%) (Figure 6). Of all major trauma cases with a known time of injury in 2022–23, 51% occurred between the hours of 8.00 am and 4.00 pm, and 32% occurred between the hours of 4.01 pm and midnight.

Figure 6: Proportion of major trauma occurring on each day of the week, 2022–23



11 Nguyen, T. L., et al. (2020). "Prognostic Role of Demographic, Injury and Claim Factors in Disabling Pain and Mental Health Conditions 12 Months after Compensable Injury." Int J Environ Res Public Health 17(19): 7320.

Location of incident

The number of hospitalised major trauma cases by geographical location of the incident are presented in Table 1a. The incidence of major trauma in metropolitan Melbourne was stable in 2022–23 compared with the previous year (Table 1b). The incidence of major trauma in regional Victoria has been higher than metropolitan Melbourne each year (Table 1b). In 2022–23, 21 per cent of the incidents occurring in regional Victoria involved residents from outside regional Victoria; this proportion is higher than the previous year (17% in 2021–22 and 23% in 2018–19). Of the incidents occurring in metropolitan Melbourne in 2022–23, only six per cent 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 regional Victoria and low falls comprised the highest proportion of major trauma cases occurring in metropolitan Melbourne (Figure 7).

Table 1a: Number of hospitalised major trauma cases by geographical location of incident, 2018–19 to 2022–23

	Number of major trauma cases				
Region	**2018–19**	**2019–20**	**2020–21**	**2021–22**	**2022–23**
Metropolitan Melbourne	2173	2199	2401	2494	2574
Regional Victoria	1210	1179	1337	1237	1308
Unknown in Victoria	200	165	235	256	254
Outside Victoria	110	98	83	79	99

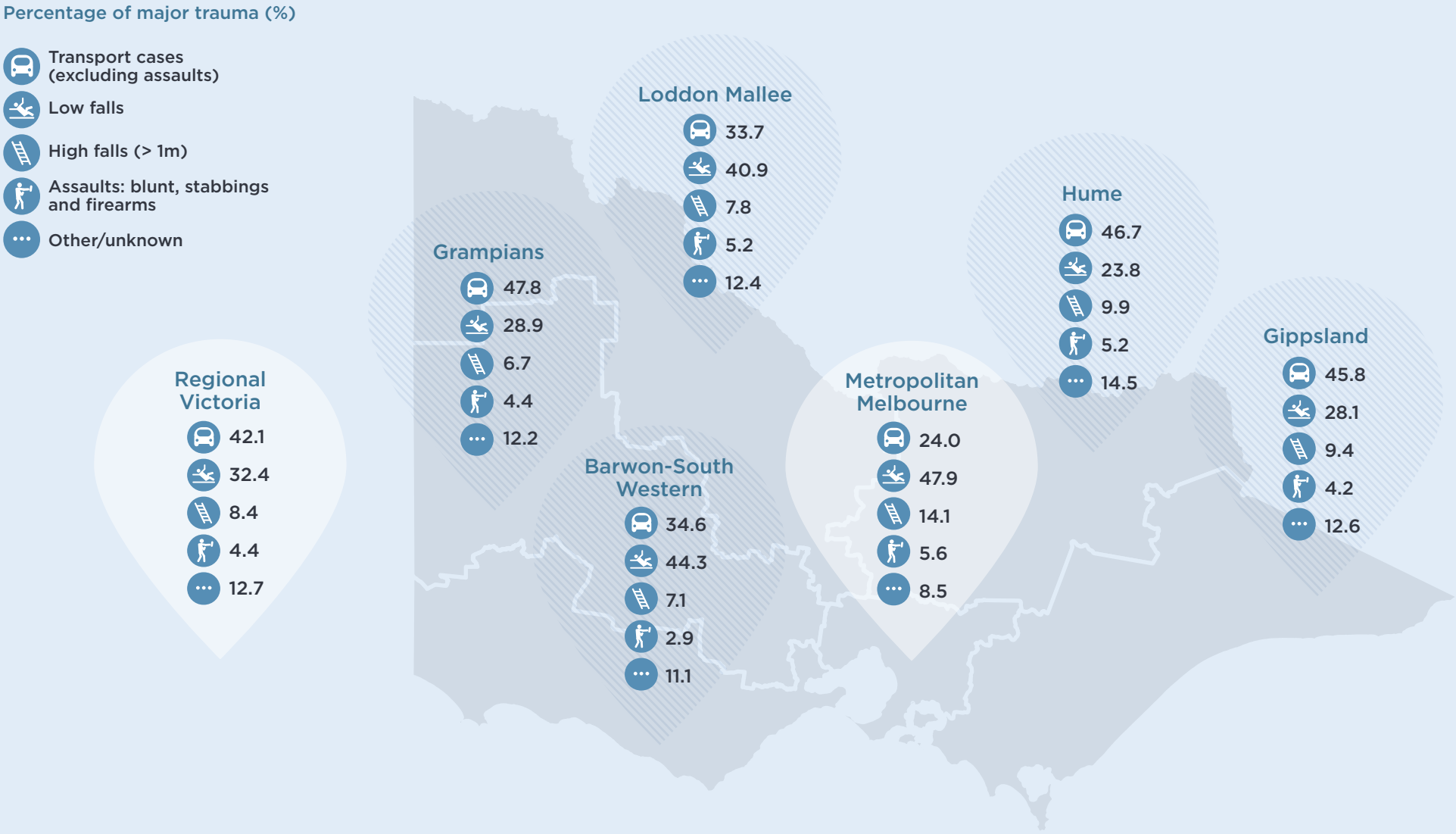
Table 1b: Incidence of hospitalised major trauma cases by geographical location of incident in Victoria, 2018–19 to 2022–23

	Major trauma per 100,000 population[13] (adjusted per year)				
Region	**2018–19**	**2019–20**	**2020–21**	**2021–22**	**2022–23***
Metropolitan Melbourne	44.1	44.2	49.1	50.4	50.3
Regional Victoria	75.2	72.1	80.7	73.7	77.0
Loddon Mallee	52.3	59.9	55.8	57.7	54.7
Grampians	79.8	68.0	76.3	72.0	67.3
Hume**	95.4	97.8	111.9	95.1	108.8
Barwon-South Western	64.9	61.7	64.2	61.6	61.7
Gippsland	92.2	78.4	105.4	89.4	100.8

* The injury location was unknown for 254 cases in Victoria and was outside Victoria for 99 cases.
** Includes population in Victoria only.

12 Defined by VEMD cause codes (Motor vehicle-driver, Motor vehicle-passenger, Motorcycle-driver, Motorcycle-passenger, Pedal cyclist-rider or passenger, Pedestrian or Other transport-related circumstance).
13 This rate is based on the Australia Demographic Statistics Table 1 Estimated Resident Population, Local Government Areas, Australia Victoria population of 6,815,441at 30 June 2023 (Australian Bureau of Statistics 2024).

Figure 7: Breakdown by cause of injury and location in Victoria 2022–23



Injuries sustained

Table 2 shows the distribution of injuries sustained by major trauma patients. Forty-one per cent of patients in 2022–23 sustained multiple trauma without serious neurotrauma. The proportion of major trauma patients who sustained a serious head injury[14] was 37% in 2018–19, 36% in 2021–22 and 37% in 2022–23 (Table 2a). The injuries sustained by paediatric major trauma patients are presented in Table 2b.

Table 2a: Injuries sustained by all major trauma patients, 2018–19 to 2022–23

	Percentage of major trauma patients (%)				
Injury group	2018–19	2019–20	2020–21	2021–22	2022–23
Multiple injuries, burns or other (excluding serious neuro-trauma)	40.4	40.0	40.7	40.9	40.6
Head and other associated injuries	21.5	21.3	20.3	21.0	21.1
Isolated head injury	16.0	16.1	15.5	15.3	15.7
Extremity and/or spine injuries only	11.6	11.4	11.9	11.6	11.8
Chest and/or abdominal injuries only	8.1	8.7	9.3	9.6	8.3
Serious spinal cord injury	2.5	2.6	2.3	1.6	2.5

Table 2b: Injuries sustained by paediatric major trauma patients, 2018–19 to 2022–23

	Percentage of major trauma patients (%)				
Injury group	2018–19	2019–20	2020–21	2021–22	2022–23
Multiple injuries, burns or other (excluding serious neuro-trauma)	25.0	28.4	32.9	29.3	29.9
Head and other associated injuries	24.2	24.8	22.8	24.0	27.2
Isolated head injury	21.2	24.1	19.6	25.7	16.3
Extremity and/or spine injuries only	8.3	3.5	7.6	1.8	5.4
Chest and/or abdominal injuries only	17.4	18.4	16.5	18.0	20.4
Serious spinal cord injury	3.8	0.7	0.6	1.2	0.7

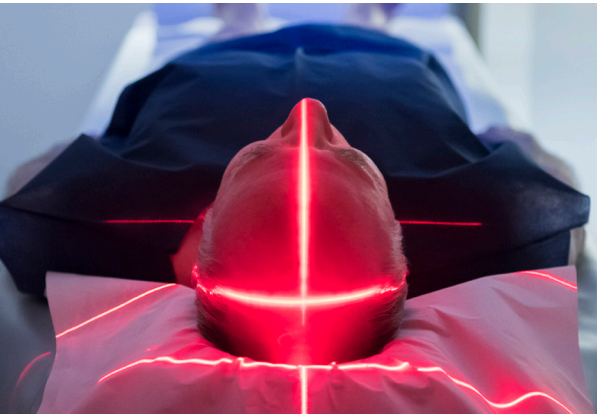
Notes:
Multiple injuries, burns or other = includes multiple body region injuries (excluding serious neurotrauma), burns and other injuries that do not fit into any of the other groups.
Head and other associated injuries = head injury with AIS severity > 2 in addition to another injury.
Isolated head 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 Abbreviated Injury Scale (AIS) severity > 2 in the head region.

Injury severity

Of all major trauma patients with a known Injury Severity Score (ISS), 89.0% had an ISS greater than 12 in 2022–23 and 87.0% had an ISS greater than 12 in 2021–22.

The percentage of major trauma patients with an ISS greater than 12 has been consistent – 89% in 2022–23, 87% in 2020–21 and 88% in 2018–19. In 2022–23, 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.



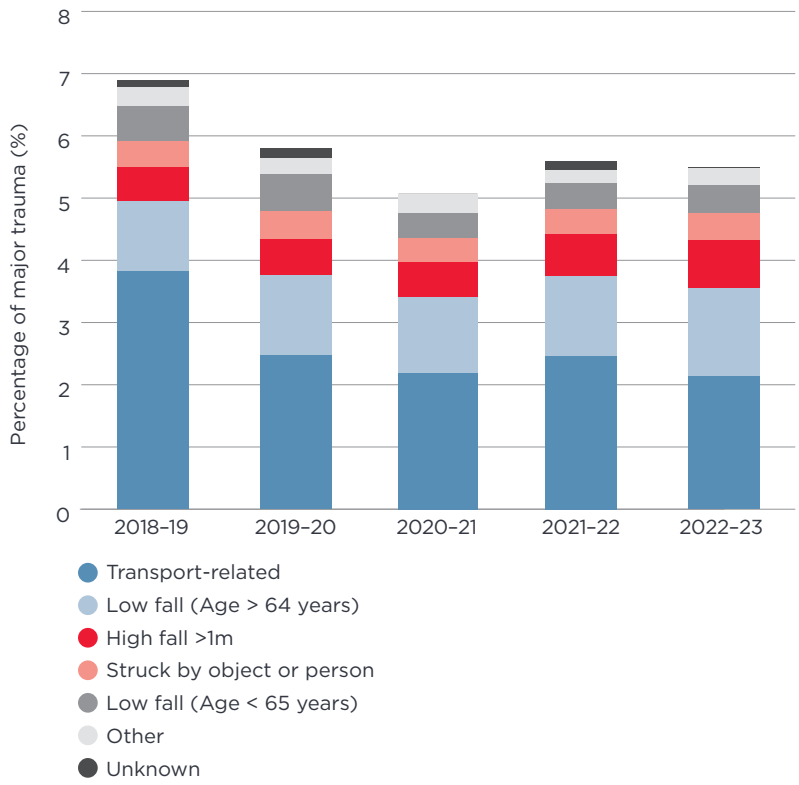
Head injury severity

Figure 8 shows that the percentage of major trauma patients with a severe head injury[15]. The proportion of major trauma patients with severe head injury was 6.9% (n = 254) in 2018–19, 5.6% (n = 227) in 2021–22 and 5.5% in 2022–23 (n = 232).

The proportion of cases with severe head injury due to transport-related incidents has decreased in recent years (Figure 8), driven by a decline in the number of cases resulting from motor vehicle crashes; 26% (n = 66) in 2018–19, 17% (n = 38) in 2021–22 and 16% (n = 38) in 2022–23. There has also been a decline in the number of severe head injury cases resulting from motorcycle crashes; 12% (n = 30) in 2018–19, 9% (n = 20) in 2021–22 and 6% (n = 15) in 2022–23.

Of all hospitalised major trauma patients in 2022–23, 5.5% had a severe head injury compared to 5.6% in 2021–22.

Figure 8: Proportion of major trauma patients with a severe head injury (AIS head region severity score > 2 and GCS < 9) by cause of injury, 2018–19 to 2022–23



15 Defined as an AIS head region 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 2022–23, the first hospital attended was an MTS, the Austin Hospital (for spinal care) or an MNS (patients aged 65 years and older with an isolated head injury from a low fall) for 51% of major trauma patients (Figure 9a). In 2022–23, most major trauma patients (74.7%) received their definitive care at an appropriate trauma service, as determined by the VSTS trauma triage guidelines[16] (Figure 9b). In 2022–23, the Austin Hospital provided definitive care for 2.0% of major trauma and 2.3% of patients received definitive care at a metropolitan neurosurgical service.

In 2022–23, 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 2022–23 was 88% compared to 89% in 2021–22 and 92% in 2018–19 (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 50.7% of major trauma patients and 65.2% of transport cases in 2022–23.

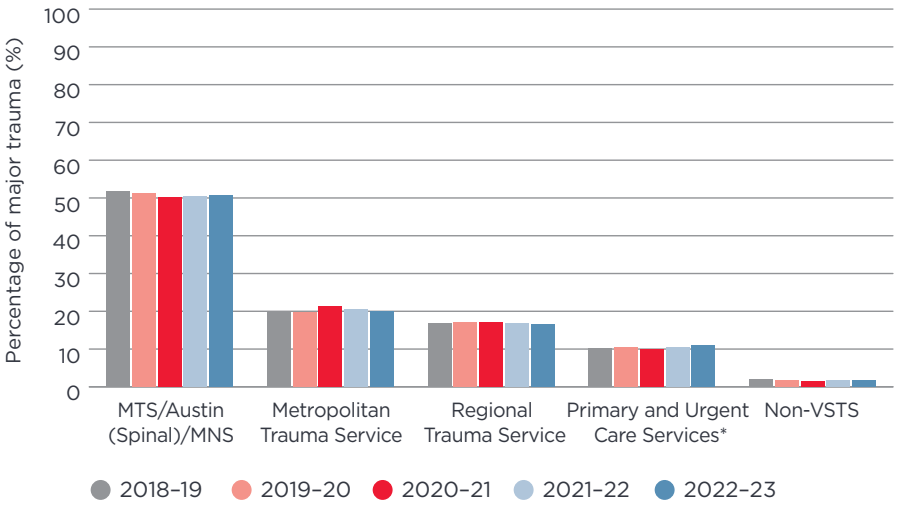
In 2022–23, 74.7% of patients received their definitive care at an appropriate trauma service, as determined by the VSTS trauma triage guidelines, compared to 74.5% in 2021–22.

For transport cases, 88.4% of patients received their definitive care at an appropriate trauma service, as determined by the VSTS trauma triage guidelines, in 2022–23 compared with 88.9% in 2021–22.

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.

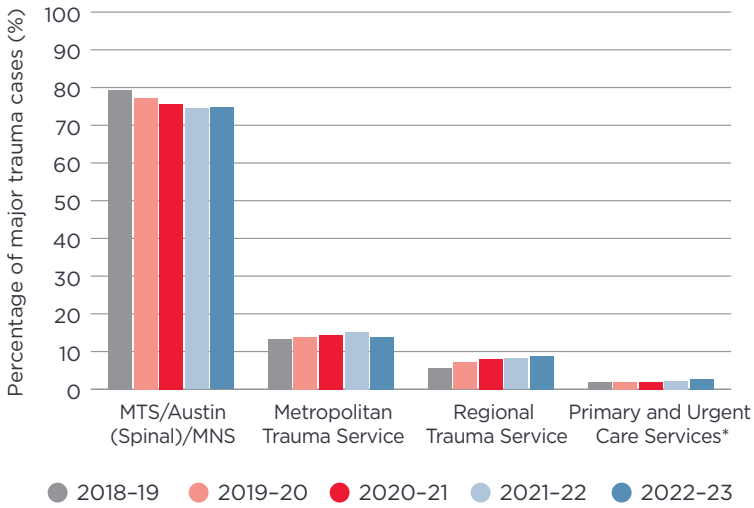
17 Defined by VEMD cause codes (Motor vehicle driver, Motor vehicle-passenger, Motorcycle-driver, Motorcycle-passenger, Pedal cyclist-rider or passenger, Pedestrian or Other transport-related circumstance).

Figure 9a: Proportion of major trauma cases by first hospital attended, 2018–19 to 2022–23



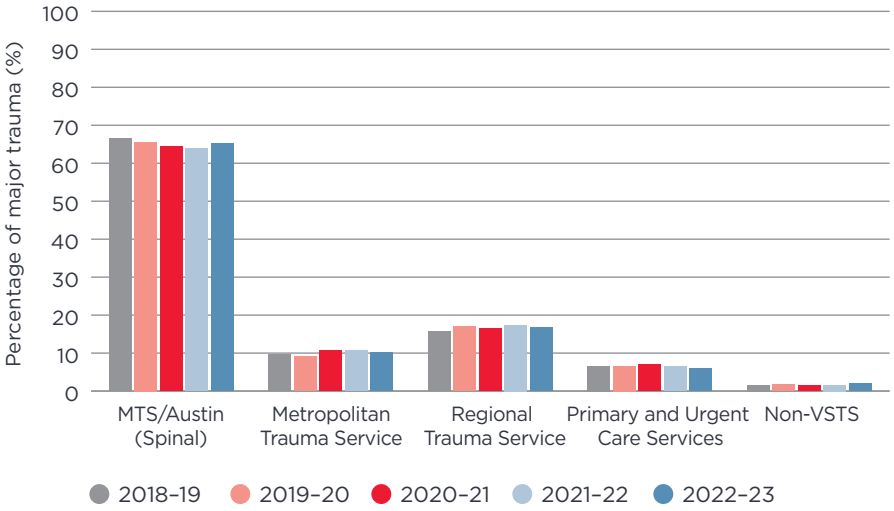
*Includes Metropolitan Primary Care Services, Regional Urgent Care Services and Regional Primary Care Services

Figure 9b: Proportion of major trauma cases by level of definitive care in the VSTS, 2018–19 to 2022–2023



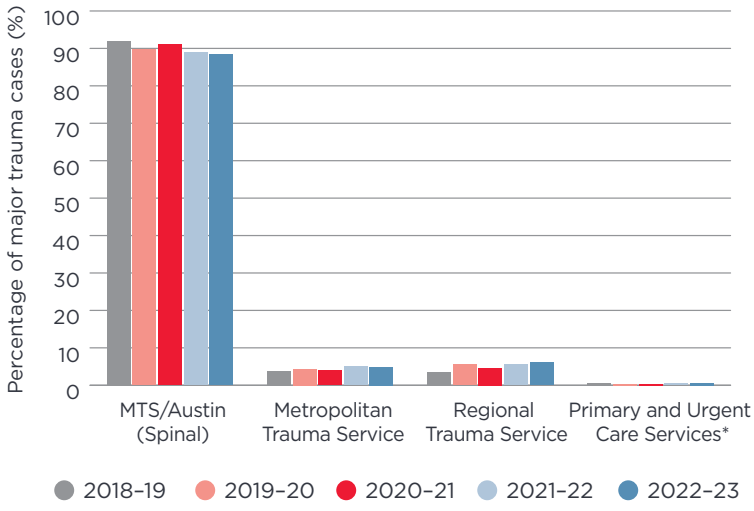
*Includes Metropolitan Primary Care Services and Regional Urgent Care Services

Figure 9c: Proportion of transport cases by first hospital attended, 2018–19 to 2022–23



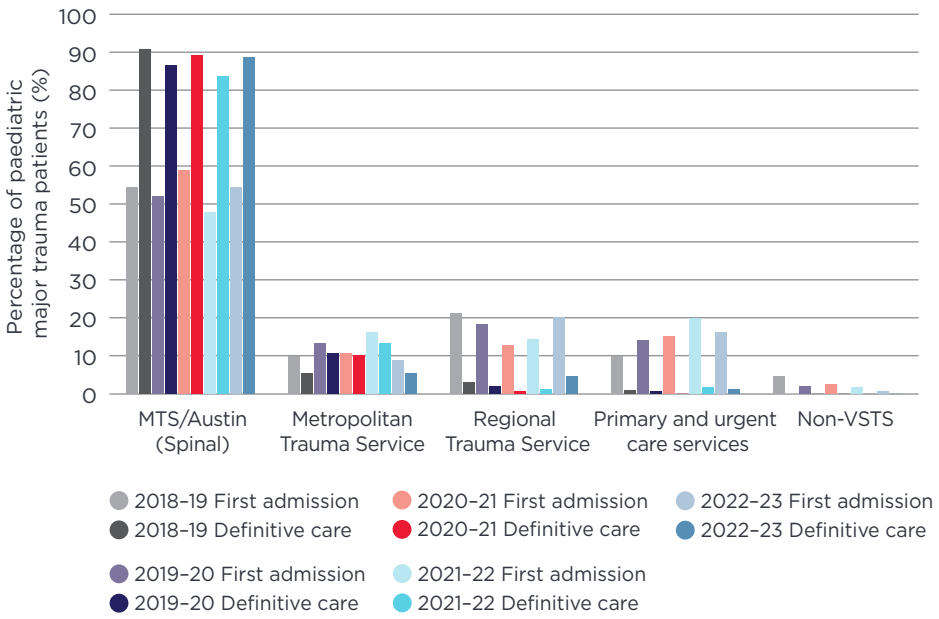
*Includes Metropolitan Primary Care Services, Regional Urgent Care Services and Regional Primary Care Services

Figure 9d: Proportion of transport cases definitively managed by level of definitive care in the VSTS, 2018–19 to 2022–23



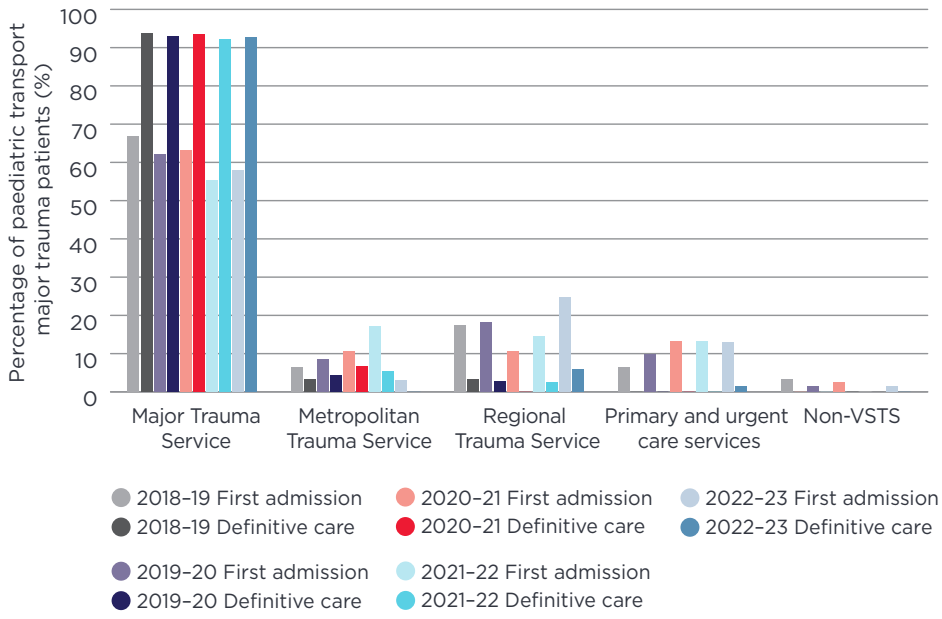
*Includes Metropolitan Primary Care Services and Regional Urgent Care Services

Figure 9e: Proportion of paediatric major trauma cases by first hospital attended and level of definitive care in the VSTS, 2018–19 to 2022–23



*Includes Metropolitan Primary Care Services and Regional Urgent Care Services

Figure 9f: Proportion of paediatric transport cases by first hospital attended and level of definitive care in the VSTS, 2018–19 to 2022–23



*Includes Metropolitan Primary Care Services and Regional Urgent Care Services

Patient triage and transportation

68% of major trauma patients were transported directly to an MTS, the Austin for spinal care or a metropolitan neurosurgical service in 2022–23.

89% of transferred patients received their definitive care at an appropriate trauma service, as defined by the major trauma guidelines, in 2022–23.

Helicopter mode of transport

The proportion of primary transports of adult major trauma patients to an MTS by a helicopter in 2022–23 (20.3%) was lower than 2021–22 (21.4%) and 2018–19 (25.9%) (Table 3).

Table 3: Major trauma primary helicopter transports from the scene to an MTS, 2018–19 to 2022–23

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)
2018–19	470 (25.9)	253 (28.7)	190 (22.0)	27 (37.0)
2019–20	445 (25.1)	231 (27.1)	182 (21.5)	32 (43.8)
2020–21	514 (26.5)	259 (27.7)	219 (24.0)	36 (38.7)
2021–22	412 (21.4)	201 (23.6)	186 (18.7)	25 (31.6)
2022–23	413 (20.3)	221 (23.1)	164 (16.4)	28 (34.6)

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 service (patients aged 65 years and older with an isolated head injury from a low fall) from the scene of injury, home or a general practitioner (GP) has been consistent; 65% in 2018–19, 68% in 2021–22 and 68% in 2022–23 (Figure 10a).

The proportion of inter-hospital transfers that were transferred to an MTS, the Austin for spinal care or a metropolitan neurosurgical service (patients aged 65 years and older with an isolated head injury from a low fall) for definitive care was 92% in 2018–19 (n = 1059), 89% in 2021–22 (n = 1002) and 90% in 2022–23 (n = 1049) (Figure 10b). In 2022–23, for major trauma admissions referred from another health service for definitive care (n=1170), there were 469 (40.1%) Ambulance Victoria road transports, 513 (43.8%) coordinated by the retrieval services (Adult Retrieval Victoria or Paediatric Infant Perinatal Retrieval Service), 24 (2.1%) Air Ambulance Victoria (10 helicopter and 14 fixed wing), 39 other (private ambulance, private car and interstate ambulance) and 125 cases where the mode of transportation was unknown.

Figure 10a: Source of major trauma to an appropriate trauma service level for definitive care, 2018–19 to 2022–23

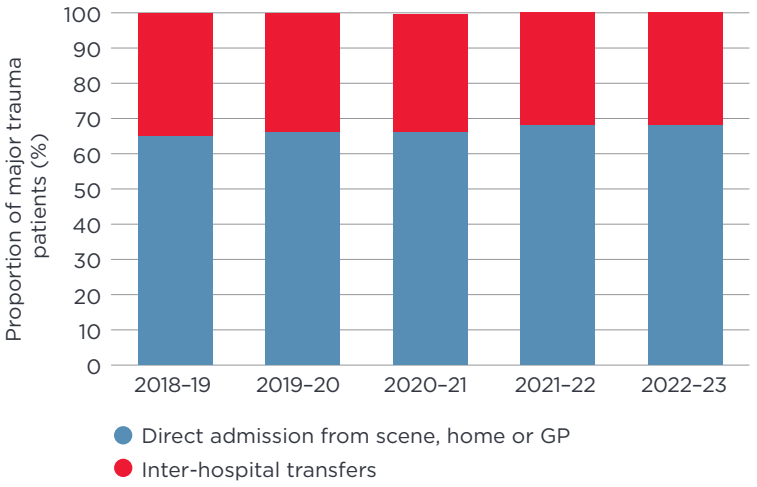
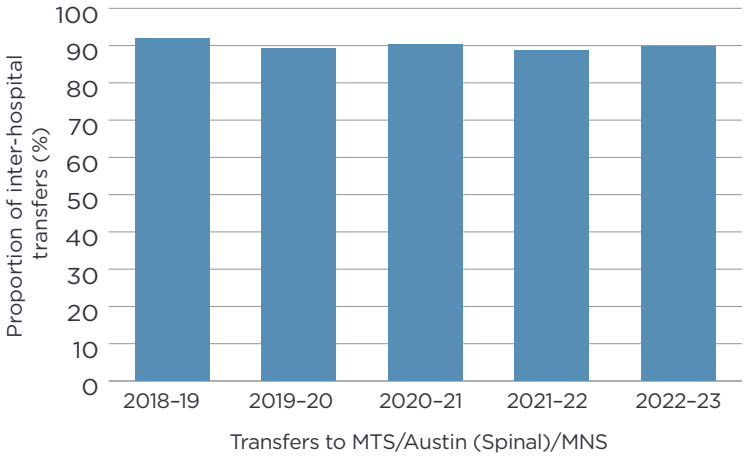


Figure 10b: Inter-hospital transfer destination compliance (according to major trauma transfer guidelines), 2018–19 to 2022–23



Since 2018–19, 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 4). 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, 2018–19 to 2022–23

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)
2018–19	2815	1823 (64.8)	885 (58.5)	864 (73.2)	74 (60.7)
2019–20	2716	1776 (65.4)	854 (60.3)	847 (72.1)	75 (60.5)
2020–21	2947	1946 (66.0)	941 (58.2)	911 (76.7)	94 (66.2)
2021–22	2883	1929 (66.9)	853 (57.9)	997 (78.5)	79 (56.0)
2022–23	3036	2045 (67.4)	958 (59.4)	1003 (78.0)	84 (61.8)

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


EMERGENCY

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] increased in 2022–23 (Table 5a).

Table 5a: Time from ambulance call to arrival at scene (response time), median and 90th percentile, 2018–19 to 2022–23

	Median response time (minutes)	90th percentile (minutes)
2018–19	14	36
2019–20	14	37
2020–21	15	45
2021–22	16	53
2022–23	17	60

2 The median pre-hospital scene time[19] has increased since 2018–19 (Table 5b).

Table 5b: Scene time (from ambulance arrival at location to depart location), median and 90th percentile, 2018–19 to 2022–23

	Median scene time (minutes)	90th percentile (minutes)
2018–19	28	78
2019–20	29	85
2020–21	31	89
2021–22	32	81
2022–23	32	82

3 The median pre-hospital time[20] in 2022–23 has increased since 2018–19 (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, 2018–19 to 2022–23

	Median pre-hospital time (minutes)	90th percentile (minutes)
2018–19	57	125
2019–20	60	131
2020–21	61	135
2021–22	61	127
2022–23	61	124

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 2018–19 (Table 5d).

Table 5d: Total time (hours – unadjusted for distance to definitive care hospital) from injury to first presentation at an MTS, Austin Hospital (for spinal care) or an MNS (includes inter-hospital transfers), median and 90th percentile, 2018–19 to 2022–23

	Available time from injury to MTS, Austin Hospital or MNS (n)	Median time to MTS, Austin Hospital or MNS (hours)	90th percentile (hours)
2018–19	2628	2.4	14.7
2019–20	2532	2.3	14.9
2020–21	2783	2.5	14.1
2021–22	2718	2.4	16.0
2022–23	2829	2.4	17.0

MNS = metropolitan neurosurgical service

5 From 2018–19 to 2022–23 there has been no change in Ambulance Victoria destination compliance, according to pre-hospital major trauma triage guidelines (Table 5e).

Table 5e: Destination compliance, according to pre-hospital major trauma triage guidelines, 2018–19 to 2022–23

	Ambulance Victoria major trauma (n)	Destination compliance (according to pre-hospital trauma triage guidelines) (%)
2018–19	2259	92.7
2019–20	2344	93.4
2020–21	2368	91.7
2021–22	2379	94.7
2022–23	2594	94.7

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 10.0 hours in 2022–23 and this has increased since 2018–19 (Table 6a).

Table 6a: Inter-hospital transfer time (excluding transfers from an MTS), median and 90th percentile, 2018–19 to 2022–23

	Inter-hospital transfer time available (n)	Median inter-hospital transfer time (hours)	90th percentile (hours)
2018–19	1027	8.5	24.9
2019–20	995	8.5	23.1
2020–21	1064	8.6	22.8
2021–22	998	9.4	28.5
2022–23	936	10.0	25.7

2 The proportion of metropolitan transfers on major trauma patients with ARV/PIPER activation increased from 2018–19 to 2021–22 and decreased in 2022–23 (Table 6b). The median time to activation of ARV/PIPER[23] has been above four hours since 2018–19 (Table 6b).

Table 6b: Time to activation of ARV or PIPER for metropolitan inter-hospital transfers (excluding transfers from an MTS) of major trauma, 2018–19 to 2022–23

	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)
2018–19	101 (21.7)	97	5.1	10.7
2019–20	120 (25.3)	88	4.1	10.7
2020–21	188 (34.9)	130	5.3	10.9
2021–22	148 (30.1)	125	4.9	11.8
2022–23	125 (23.9)	94	5.8	14.5

* 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 ARV/PIPER activation[24] for regional inter-hospital transfers of adult major trauma was 3.4 hours in 2022–23 (Table 6c). Since 2018–19, adult major trauma regional transfers coordinated by ARV have experienced shorter transfer times[25] when compared with transfers coordinated by other services (Table 6d).

Table 6c: Time to activation of ARV/PIPER for regional inter-hospital transfers of adult major trauma, 2018–19 to 2022–23

	Regional transfers with ARV/PIPER activation (n) (% of regional transfers)	Regional transfers with time to ARV/PIPER activation available (n)	Median time to ARV/PIPER activation (hours)*	90th percentile (hours)
2018–19	348 (62.9)	326	3.1	6.9
2019–20	340 (67.6)	298	2.7	7.4
2020–21	379 (73.3)	322	2.9	8.0
2021–22	367 (72.0)	302	2.9	8.3
2022–23	327 (65.4)	293	3.4	8.9

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

Table 6d: Inter-hospital transfer times with and without ARV/PIPER retrieval activation for regional transfers of adult major trauma, 2018–19 to 2022–23

	Regional transfers of adults with transfer time available (n)	Regional transfers of adults with transfer time available with retrieval activation (n)	Regional transfers of adults with retrieval activation median transfer time (hours)	Regional transfers of adults with transfer time available without ARV activation (n)	Regional transfers of adults without retrieval activation median transfer time (hours)
2018–19	542	345	8.4	197	9.7
2019–20	498	338	8.0	160	9.9
2020–21	506	371	8.0	135	9.0
2021–22	489	355	8.4	134	10.9
2022–23	477	321	9.1	156	12.1

24 Measured from time of arrival at referral hospital to retrieval activation
25 Measured from time of arrival at primary hospital to time of arrival at definitive care

The median time to activation of PIPER/ARV for paediatric major trauma was 1.5 hours in 2022–23 for regional inter-hospital transfers (Table 6e). Regional transfers of paediatric major trauma coordinated by PIPER/ARV had shorter transfer times when compared with transfers coordinated by other services in 2022–23 (Table 6f).

Table 6e: Time to activation of PIPER/ARV for regional transfers of paediatric major trauma, 2018–19 to 2022–23

	Regional transfers of paediatrics 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)
2018–19	13 (43.3)	8	2.8	7.3
2019–20	20 (52.6)	15	2.9	5.0
2020–21	32 (88.9)	22	1.9	4.3
2021–22	29 (90.6)	25	1.9	15.3
2022–23	30 (78.9)	25	1.5	4.8

*For PIPER/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 regional transfers of paediatric major trauma, 2018–19 to 2022–23

	Regional transfers of paediatrics with transfer time available (n)	Regional transfers of paediatrics with transfer time available with PIPER/ARV activation (n)	Regional transfers of paediatrics with PIPER/ARV activation median transfer time (hours)	Regional transfers of paediatrics with transfer time available without PIPER/ARV activation (n)	Regional transfers of paediatric without PIPER/ARV activation median transfer time (hours)
2018–19	30	13	7.5	17	6.4
2019–20	36	20	6.8	16	5.3
2020–21	34	31	5.4	*	*
2021–22	32	29	7.0	*	*
2022–23	30	25	7.1	5	9.5

*Denotes less than 5 cases

In-hospital indicators

1 The proportion of trauma team activation for major trauma cases transported from the scene by Ambulance Victoria or Air Ambulance Victoria with signal one (time-critical) to a Major Trauma Service (MTS) has increased since 2018–19 (Table 7a).

Table 7a: MTS trauma team activation for Ambulance Victoria signal one trauma cases with known trauma team activation status, 2018–19 to 2022–23

	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) (%)
2018–19	1764	1480	1257 (84.9)	668 (87.1)	546 (84.3)	43 (66.2)
2019–20	1711	1288	1109 (86.1)	542 (78.7)	526 (79.6)	41 (69.5)
2020–21	1869	1427	1273 (89.2)	653 (89.7)	573 (83.5)	47 (60.3)
2021–22	1869	1461	1284 (87.9)	602 (93.5)	636 (82.8)	46 (71.9)
2022–23	1976	1558	1377 (88.4)	676 (94.4)	649 (84.0)	52 (73.2)

AAV = Air Ambulance Victoria, AV = Ambulance Victoria

2 The median hospital length of stay has been consistent since 2018–19 (Table 7b).

Table 7b: Hospital length of stay, 2018–19 to 2022–23

	All major trauma (n)	Median length of stay (days)	90th percentile (days)
2018–19	3693	6.6	21.5
2019–20	3641	6.6	20.7
2020–21	4056	6.9	22.8
2021–22	4066	6.7	22.4
2022–23	4235	6.8	22.5

3 Since 2018–19, the proportion of Intensive Care Unit (ICU) admissions at the health service for definitive care has decreased and the median ICU length of stay has been consistent (Table 7c). The median mechanical ventilation hours in ICU has been consistent since 2018–19 (Table 7d).

Table 7c: ICU length of stay, 2018–19 to 2022–23

	Major trauma ICU admission at definitive care (n) (%)	Median ICU length of stay (days)	90th percentile (days)
2018–19	1314 (35.6)	4	14
2019–20	1303 (35.8)	3	14
2020–21	1453 (35.8)	4	15
2021–22	1288 (31.7)	4	16
2022–23	1276 (30.1)	4	16

Table 7d: Major trauma ICU mechanical ventilation hours for major trauma patients with an ICU admission, 2018–19 to 2022–23

	Major trauma ICU admissions with known mechanical ventilation hours (n)*	Median mechanical ventilation time (hours)	90th percentile (hours)
2018–19	1314	24	263
2019–20	1301	21	244
2020–21	1451	21	247
2021–22	1283	30	280
2022–23	1267	22	283

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

Hospital outcomes of major trauma

Discharge status

In 2022–23 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 – 32% in 2018–19, 23% in 2021–22 and 23% in 2022–23 (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 home: 1839 (55.9%) in 2018–19, 2154 (60.3%) in 2021–22 and 2282 (61.3%) in 2022–23 (Table 8).

Table 8: Discharge status (excluding in-hospital deaths), 2018–19 to 2022–23

	Rehabilitation n (%)	Home n (%)	Residential aged care facility[26] n (%)	Hospital for convalescence n (%)	Other[27] n (%)	Total
2018–19	1054 (32.1)	1839 (55.9)	86 (2.6)	248 (7.5)	61 (1.9)	**3288**
2019–20	958 (29.8)	1765 (54.9)	105 (3.3)	264 (8.2)	123 (3.8)	**3215**
2020–21	891 (25.1)	2100 (59.1)	119 (3.3)	303 (8.5)	143 (4.0)	**3556**
2021–22	838 (23.4)	2154 (60.3)	151 (4.2)	276 (7.7)	155 (4.3)	**3574**
2022–23	855 (23.0)	2282 (61.3)	153 (4.1)	260 (7.0)	172 (4.6)	**3722**

26 Includes residential aged care facility that is the patient's usual residence
27 27Includes discharge against medical advice

Trauma deaths

- **In 2022–23, there were an estimated 2190 trauma deaths in Victoria.**
- **In 2022–23, the overall death rate due to major trauma in Victoria was 32 deaths per 100,000 population.[28]**
- **The annual incidence of major trauma deaths in Victoria has increased since 2018–19 (IRR 1.04, 95% CI: 1.03, 1.06, p < 0.001).[29]**
- **The major causes of all deaths in 2022–23 were low and high falls (52.0%), hangings (17.8%) and transport-related incidents (15.3%).**
- **Deaths due to falls have exceeded transport-related deaths since 2018–19.**
- **The registry recorded 513 in-hospital deaths in 2022–23.**
- **Since 2018–19, the annual incidence rate of in-hospital major trauma deaths has increased (IRR 1.05, 95% CI: 1.02, 1.08, p < 0.001).**
- **The relative risk of in-hospital death[30] for major trauma in 2022–23 has not changed compared to 2018–19.**

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.
- 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.

28 This rate is based on the *Australia Demographic Statistics Table 52 Estimated Resident Population by Single Year of Age, Victoria* population of 6,815,441 at 30 June 2023 (Australian Bureau of Statistics 2024).

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

30 Adjusted for age, ISS, head injury (AIS head region severity > 2) and cause of injury.

All trauma deaths

Based on cases identified on the NCIS and the VSTR in 2022–23 there were an estimated 2190 trauma deaths in Victoria. The estimated number of trauma deaths in Victoria was 2061 in 2021–22 and 1787 in 2018–19 (Table 9a). The overall trauma death rate in Victoria in 2022–23 was 32 per 100,000 population[31], 31 per 100,000 population in 2021–22 and 27 per 100,000 in 2018–19. The annual incidence of all trauma deaths in Victoria has increased since 2018–19 (IRR 1.04, 95% CI: 1.06, 1.05, $p < 0.001$).[32]
The Victorian Ambulance Cardiac Arrest Registry recorded 841 pre-hospital trauma deaths in 2022–23 compared with 775 in 2021–22 and 738 in 2018–19 (Table 9b).

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

Table 9a: In-hospital deaths and all trauma deaths, 2018–19 to 2022–23

	VSTR in-hospital deaths	All trauma deaths (NCIS and VSTR in-hospital deaths)*
2018–19	405	1787
2019–20	426	1845
2020–21	500	1966
2021–22	492	2061
2022–23	513	2190

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

Table 9b: Ambulance Victoria pre-hospital trauma deaths, 2018–19 to 2022–23

	Trauma deaths attended to by Ambulance Victoria*
2018–19	738
2019–20	756
2020–21	779
2021–22	775
2022–23	841

*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.

Table 10: In-transit deaths, 2018–19 to 2022–23

	In-transit deaths n
2018–19	6
2019–20	6
2020–21	5
2021–22	*
2022–23	8

*Denoted less than 5 cases
Data courtesy of Ambulance Victoria.

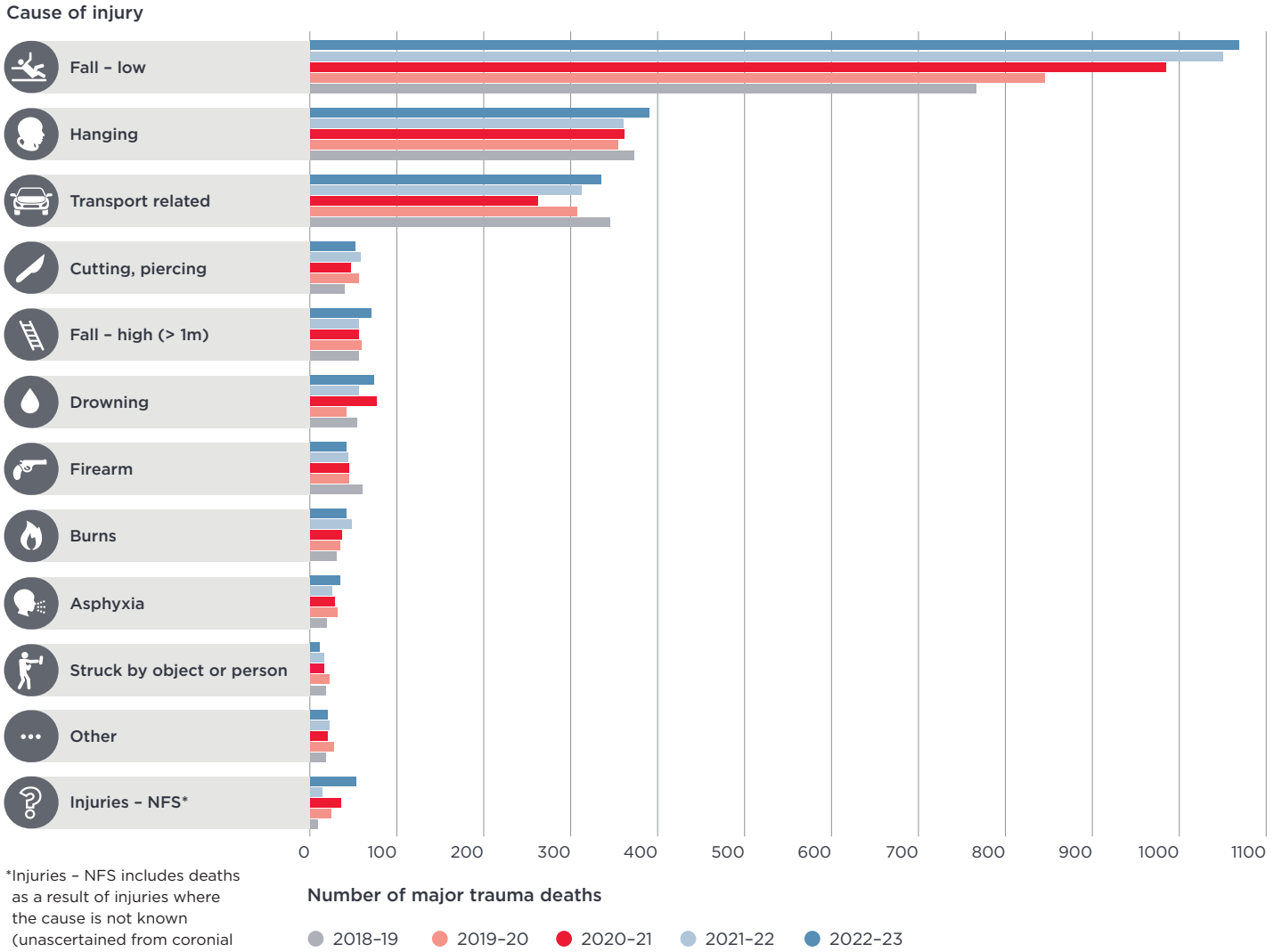
31 This rate is based on the Australia Demographic Statistics Table 1 Estimated Resident Population, Local Government Areas, Australia Victoria population of 6,815,441at 30 June 2023 (Australian Bureau of Statistics 2024).
32 95% CI = 95% confidence interval; p = probability.

Cause of injury for all trauma deaths

There were 2130 trauma deaths recorded on the NCIS, and an additional 60 cases were recorded in the VSTR but not found on the NCIS. Although only 0.5% of 2022–23 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 98% of the 2190 trauma deaths.

Falls (52.0%) were the most common cause of all injury deaths in 2022–23, followed by hangings (17.8%) and transport-related incidents (15.3%) (Figure 11). In 2022–23 low falls accounted for 49% of all trauma deaths and 95% of these patients were aged 65 years and older. There were 29 paediatric (aged less than 16 years) trauma deaths in 2018–19, 30 in 2020–21 and 29 in 2022–23. There were five hangings in the paediatric cohort in 2018–19 and less than five in 2021–22 and 2022–23. There were less than five drownings in the paediatric cohort in 2018–19, 2021–22 and 2022–23.

Figure 11: Cause of injury for all trauma deaths identified on the NCIS or the Victorian State Trauma Registry, 2018–19 to 2022–23



*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 513 in-hospital deaths in 2022–23 (12.1%) compared with 492 (12.1%) in 2021–22 and 405 (11.0%) in 2018–19 (refer to Table 9a). In 2022–23, 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 84% of these patients.

The incidence of VSTS in-hospital major trauma deaths was 7.5 per 100,000 population in 2022–23 (23.4% of all trauma deaths in Victoria) compared to 7.4 per 100,000 population in 2021–22 and 6.2 per 100,000 population in 2018–19.

The percentage of major trauma patients with an Injury Severity Score greater than 12 who died in hospital was 9.1% in 2018–19, 9.0% in 2021–22 and 9.4% in 2022–23. The relative risk of in-hospital death for major trauma patients in 2022–23, after adjustment for age, ISS, head injury severity and cause of injury, has not changed relative to 2018–19 (Table 11).

Table 11: Adjusted relative risk* of in-hospital death of major trauma patients, 2018–19 to 2022–23

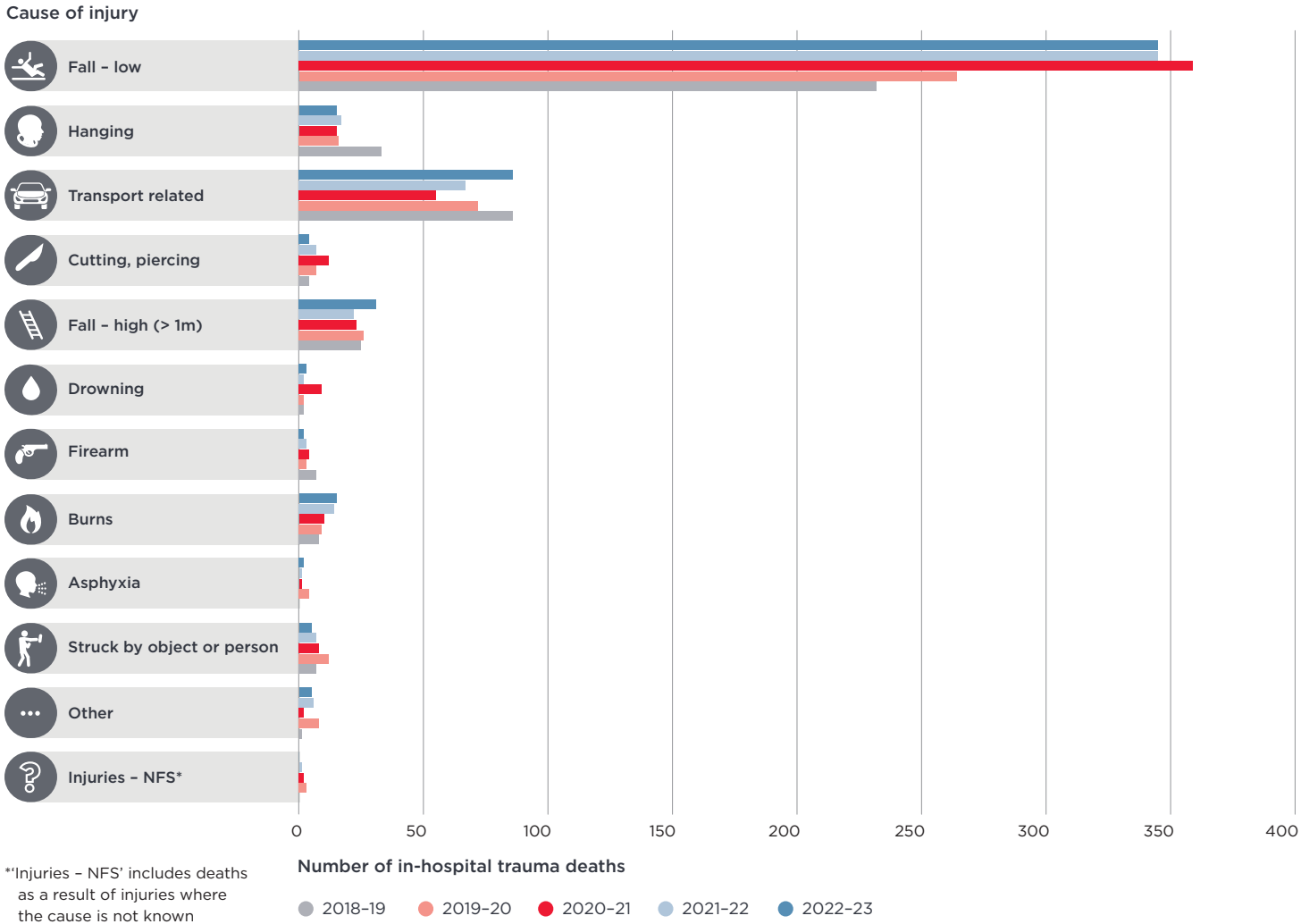
	All major trauma	ISS > 12	ISS > 12 and age < 65
	Adjusted relative risk* (95% CI)		
2018–19 (reference)	1	1	1
2019–20	0.96 (0.85, 1.09)	0.97 (0.84, 1.13)	0.92 (0.73, 1.17)
2020–21	1.01 (0.90, 1.14)	0.98 (0.85, 1.14)	0.83 (0.65, 1.07)
2021–22	0.98 (0.87, 1.11)	0.95 (0.82, 1.10)	0.75 (0.58, 0.96)
2022–23	0.93 (0.82, 1.04)	0.90 (0.78, 1.04)	0.82 (0.64, 1.03)

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

Cause of injury for VSTR in-hospital deaths

Low falls were the most common cause of injury for in-hospital deaths, accounting for 67% of the in-hospital deaths in 2022–23, 70% in 2021–22 and 57% in 2018–19 (Figure 12a). The case fatality rate of in-hospital deaths for major trauma patients injured in a low fall was 21% in 2018–19, 23% in 2021–22 and 21% in 2022–23. The in-hospital case fatality rate for transport-related major trauma was 5.9% in 2018–19, 4.8% in 2021–22 and 6.0% in 2022–23.

Figure 12a: Cause of injury for in-hospital trauma deaths, 2018–19 to 2022–23



*'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 32% in 2018–19, 31% in 2021–22 and 32% in 2022–23 (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, 2018–19 to 2022–23

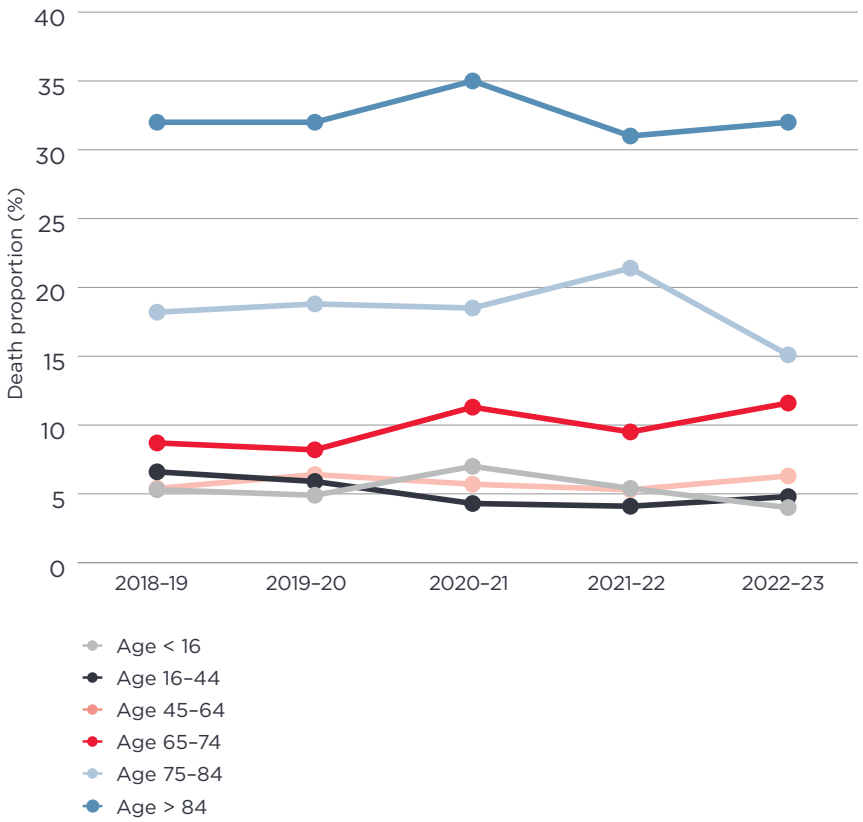
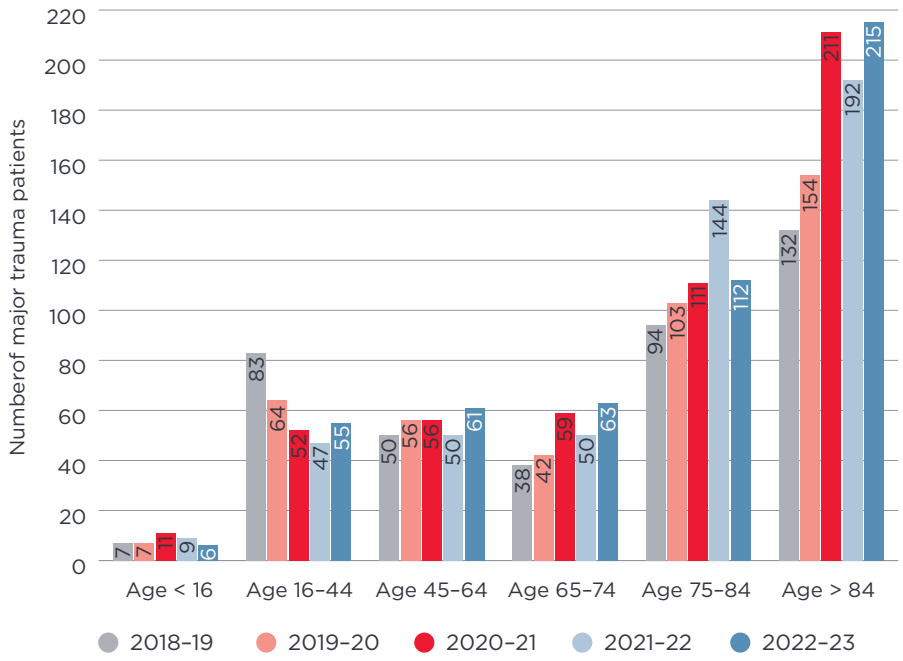


Figure 12c: Number of in-hospital trauma deaths by age group, 2018–19 to 2022–23



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 decreased slightly in adult major trauma patients in 2021–22.**
- **The proportion of paediatric patients experiencing a good functional outcome was maintained in 2021–22 at the levels seen during the period from 2017–18 to 2020–21.**
- **The health-related quality of life of adult major trauma patients has remained stable in 2021–22 similar to the levels observed over the period 2017–18 to 2020–21.**
- **In children, health-related quality of life has remained stable over the period 2018–19 to 2021–22.**

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. Online follow-up commenced for adults with date of injury from 1 April 2020. Information about function and health-related quality of life, among other outcomes, is collected during the interviews. Because the follow-up process is not yet complete for patients injured in 2022–23, this section focuses on data from earlier years: 2017–18 to 2021–22 for adult and paediatric patients, acknowledging that not all 24-month follow-up interviews may be complete for 2021–22.

For patients injured between 1 July 2017 and 30 June 2022, 82% of adult major trauma patients were successfully followed up at six months and at 12 months, while 81% were followed-up at 24 months post-injury. For paediatric major trauma patients, the follow-up rates were 86% at six months, 89% at 12 months and 91% 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 probability of adult major trauma patients making a good recovery, adjusted for socioeconomic, demographic and injury factors, showed a slight overall increase in 2020–21 when compared with 2019-20 (Figure 13). The probability of paediatric patients experiencing a good functional outcome has continued to increase slightly each year over the period from 2016–17 to 2020–21 (Figure 14).

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 2021–22 was unchanged when compared to 2020–21 and has declined slightly since 2017-18. Overall, health-related quality of has remained stable over the five-year period of this report (Figure 15). In children, health-related quality of has decreased slightly in 2020–21 compared to 2019–20 (Figure 16). The apparent lower levels observed for the four years since 2018–19 could be due to the change in measurement instrument, and challenges associated to mapping between instruments.

Figure 13: Predicted probability (95% CI) of a good recovery for adult major trauma patients adjusted for socioeconomic, demographic and injury factors, 2017–18 to 2021–22

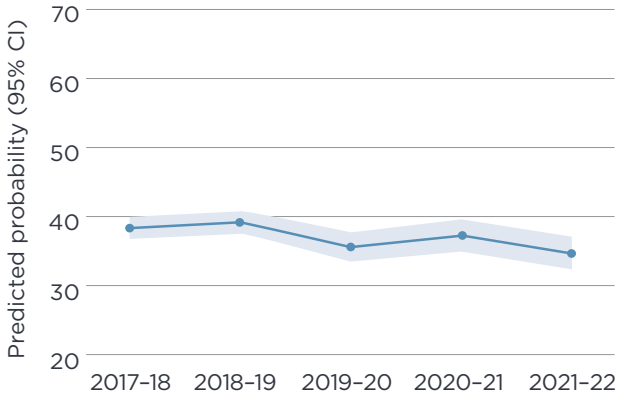


Figure 14: Predicted probability (95% CI) of a good recovery for paediatric major trauma patients adjusted for socioeconomic, demographic and injury factors, 2017–18 to 2021–22

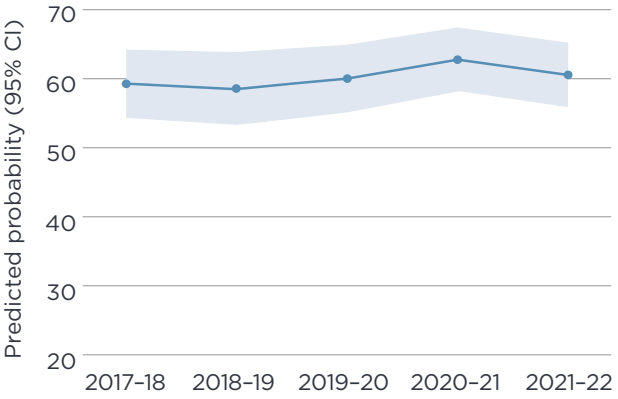


Figure 15: Predicted mean (95% CI) EQ-5D-5L summary score of adult major trauma patients adjusted for socioeconomic, demographic and injury factors, 2017–18 to 2021–22

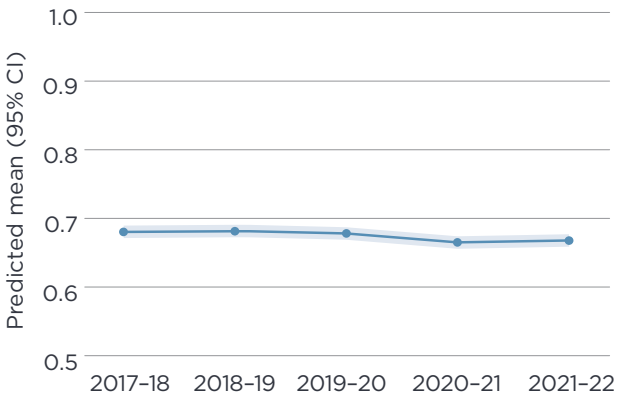
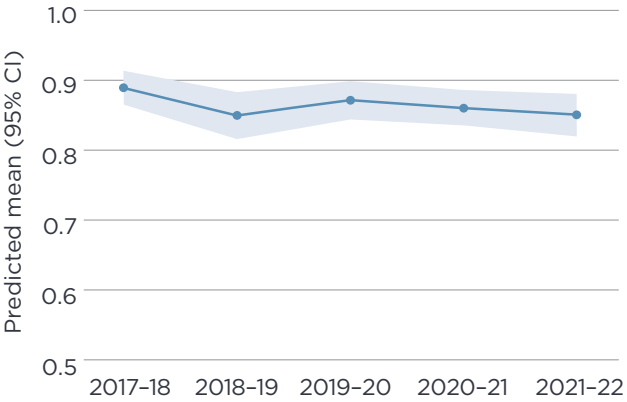


Figure 16: Predicted mean (95% CI) EQ-5D-Y-5L summary score for paediatric major trauma patients adjusted for socioeconomic, demographic and injury factors, 2017–18 to 2021–22



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 (January 2021 for Queensland) is stored within the system.

By running queries in the NCIS based on external and still enquiring case type notifications between 1 July 2022 and 31 August 2023, 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, 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. Data collectors are 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. Linkage with the Registry of Births, Deaths and Marriages (BDM) identifies patients who have died following hospital discharge to ensure that their family members are not contacted.

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 2022 to 30 June 2023 were:

- Professor Belinda Gabbe (Head, Victorian State Trauma Registry, Monash University)
- Professor Peter Cameron (Chief Investigator, Victorian State Trauma Registry, Monash University)
- Associate Professor Ben Beck (Chief Investigator, Victorian State Trauma Registry, Monash University)

Members of the VSTORM Steering Committee from 1 July 2022 to 30 June 2023, 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:

- Professor Belinda Gabbe (Head, VSTORM)
- Professor Peter Cameron (Chief Investigator, VSTORM)
- Associate Professor Tony Walker (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)
- Dr Jennie Ponsford (Director, Monash-Epworth Rehabilitation Research Centre)
- Dr Bruce Bartley (Emergency Department, University Hospital Geelong)
- Professor Karen Smith (Manager, Research and Evaluation, Ambulance Victoria)
- Professor 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)
- Mr Jason McClure (Director, Adult Retrieval Victoria)
- Ms Cassie Citroen (Senior Manager, Strategy and Research, TAC)
- Dr Troy O'Brien (FACEM, University Hospital Geelong)
- Dr Stuart Lewena (Director of Emergency Medicine, RCH)
- Dr Beth Costa (Lead Evidence and Evaluation, TAC)

Attendees:

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

APPENDIX 5: Health services with ethics committee approval, July 2022 to June 2023

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 2023, 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 Children's Hospital
	Monash Health: Dandenong Hospital
	Eastern Health: Maroondah Hospital
	St Vincent's Health: St Vincent's Hospital Melbourne
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 2022 to June 2023

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.

Major trauma service	
The Alfred	Jane Ford (Trauma program manager)
	Zoe Cheung
	Kimberley Lindsay
	Alana Daweleby
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
	Mr Zachary Smith
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 Mary-Louise Van Dyk
St Vincent's Hospital	Ms Mary-Louise Van Dyk
Footscray Hospital	Mrs Kerrie Russell

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	Raelene M Beckman
Gippsland Region	Sharon Klim
Grampians Region	Narelle Cottrell
	Cassandra Quick
Hume Region	Les Lambert
	Leanne Shoen
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 < 60bpm or > 120bpm
- 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 < 60bpm or > 120bpm
- 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% 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
BDM	Registry of Births, Deaths and Marriages
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
VOTOR	Victorian Orthopaedic Trauma Outcomes Registry
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