

VICTORIAN STATE TRAUMA SYSTEM AND REGISTRY

ANNUAL REPORT

1 July 2023 to 30 June 2024

MONASH University

VSTR Victorian State Trauma Registry



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FOREWARD

It is now more than 25 years since Victoria implemented a state wide trauma system. A key pillar of the system has been the continuous monitoring of trauma care processes and outcomes to ensure the system delivers the best response to people who suffer serious injury. Massive changes are happening in healthcare delivery with improved imaging, monitoring, technological advances in interventions to treat critically ill patients, telehealth platforms, decision support using artificial intelligence and better integration of electronic databases to support remote management. All of these changes come with potential benefits as well as risks. Monitoring the trauma system and tracking changes in outcomes has never been more important.

In this annual report there are some significant findings indicating where our focus for improvement should be in the future. Rates of major trauma continue to increase, especially in the older frail group of patients. There is debate regarding which of these patients should be transferred to a Major Trauma Service and when it is appropriate to manage at a local health service. The models of care for this vulnerable group of patients need to be reviewed and improved to ensure that care is patient and family centred, whilst ensuring preventable morbidity and mortality is minimised. Secondary prevention of falls with targeted interventions should be facilitated, especially when patients stay in a non MTS. Most of these patients will not need transfer to an MTS, but will benefit from remote consultation and follow up using televisual platforms. Long term outcomes captured by this registry enable us to follow the trajectory of patients over time and assess the potential effectiveness of system and patient level interventions.

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In Victoria we are fortunate that the causes of major trauma are mostly related to non-intentional injury. Gunshots, stabbings and interpersonal violence remain low, with low falls and motor vehicle collisions continuing to be the major mechanisms of injury. However, there have been some changes related to increased use of ebikes and scooters. The use of these vehicles is regulated, and various interventions to reduce injury have been trialled. Monitoring the effectiveness of injury prevention interventions will be important for the community. Political support for legislated interventions will depend on solid data, to enable reduction of injuries in this vulnerable road user group.

Over the last 5 years, the long term outcomes of major trauma victims have remained fairly static overall. However, the significant reduction in functional outcomes in a risk adjusted analysis of traumatic brain injury patients is concerning. It is unclear why this is happening but many factors other than the initial management of the brain injury can influence function and quality of life after a serious brain injury. We will need a thorough review of both the initial clinical care processes and the post-acute care management to understand the drivers for this change.

We 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. Continued monitoring of the system through the registry, and analysis of changes to the system is essential for optimal trauma care in the state.

PROFESSOR PETER CAMERON
CLINICAL LEAD, VICTORIAN STATE TRAUMA REGISTRY

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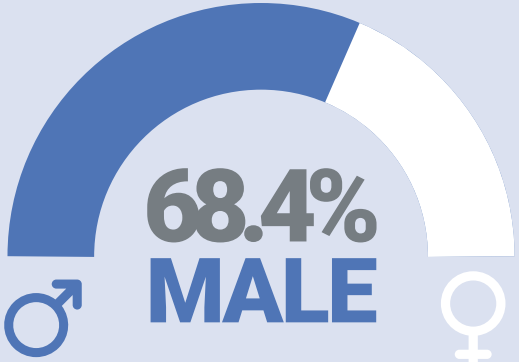
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YEAR AT A GLANCE

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

4,482 HOSPITALISED **MAJOR TRAUMA** PATIENTS
compared with 4,332 in 2022–23

33%
occurred on the **WEEKEND**



545
IN-HOSPITAL TRAUMA DEATHS

41% 8am-4pm
35% 4pm-12am

TRAUMA CASES

LOW FALLS ACCOUNTED FOR **38%** of all major trauma cases

1.1% of major trauma WAS FROM **BURNS**

36% of major trauma cases were **TRANSPORT-RELATED**

5% OF ALL HOSPITALISED major trauma patients had a **SEVERE HEAD INJURY**

Major trauma due to other transport causes including **e-scooters** has **INCREASED FROM 0.6% IN 2019-20 TO 3.0% IN 2023-24**

37% **HOME** WAS THE MOST COMMON PLACE OF INJURY

42% SUSTAINED MULTIPLE TRAUMA WITHOUT SERIOUS **NEUROTRAUMA**

6.1% **INVOLVED CYCLISTS**

DEATHS DUE TO FALLS **CONTINUE TO EXCEED** TRANSPORT-RELATED DEATHS

TRAUMA TREATMENT

92% OF TRANSFERRED PATIENTS RECEIVED DEFINITIVE CARE AT AN **APPROPRIATE TRAUMA SERVICE**

74% of major trauma patients received their **definitive care** at an **appropriate trauma service**
(as determined by the VSTS trauma triage guidelines)

The median hospital length of stay was
6.7 DAYS

422 MAJOR TRAUMA PRIMARY **HELICOPTER TRANSPORTS**
from the scene to a major trauma service

MEDIAN AMBULANCE RESPONSE TIME WAS **16 mins**


EMERGENCY

EXECUTIVE SUMMARY

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 2023-24* presents data for a five-year period (2019–20 to 2023–24), noting the effect of the COVID-19 pandemic[1,2,3] is evident for part of this reporting period.

> 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 key findings are summarised here:

- There were 4,482 major trauma patients in 2023–24 compared to 4,332 in 2022-23.
- The annual incidence of major trauma has increased significantly from 55 per 100,000 population in 2019-20 to 64 per 100,000 population in 2023-24.
- Males are over-represented in major trauma data and accounted for 68% of major trauma patients in 2023-24.
- In 2023–24, 94% of major trauma were in the blunt trauma category, 3.4% were penetrating and 1.1% were burns.
- Forty-nine percent of all major trauma cases were the result of a fall (high or low) in 2023-24, and the number of major trauma cases resulting from a low fall in older adults has increased markedly; 1,022 in 2019-20 and 1,407 in 2023-24.
- The proportion of major trauma cases due to other transport-related incidents (includes e-scooters) was 0.6% in 2019–20 and has increased to 3.0% in 2023-24.
- The proportion of major trauma cases occurring at home was 36.1% in 2019-20, increased during the COVID pandemic to 41% (2020-21) and has declined to 37% in 2023-24.
- In 2023-24, 74% of all major trauma patients, and 88% of Transport Accident Commission compensable patients, received definitive care at a Major Trauma Service, Austin Hospital for spinal care or Metropolitan Neurosurgical Service, consistent with the system guidelines.
- The risk of in-hospital mortality has not changed for major trauma patients in the past five years, while the percentage of survivors discharged to inpatient rehabilitation has decreased; 30% in 2019 and 22% in 2023-24.

[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 proportion of adult major trauma patients with a moderate to severe traumatic brain injury making a good recovery, adjusted for socioeconomic, demographic and injury factors, has decreased over time from 40% in 2018-19 to 34% in 2022-23.
- The adjusted proportion of paediatric patients experiencing a good functional outcome has increased marginally since 2018-19.
- The health-related quality of life outcomes of adult and paediatric major trauma patients has largely remained stable over the period 2018-19 to 2022-23.

Overall, the incidence of major trauma in Victoria has increased, placing a growing workload on the Victorian State Trauma System and the designated trauma services. Despite the increase in the number of people experiencing major trauma, the risk of mortality has remained stable and 88% of major trauma patients survived their injuries in 2023-24. Long-term outcomes data from the registry show the profound impacts on function and health-related quality of life following major trauma.



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).

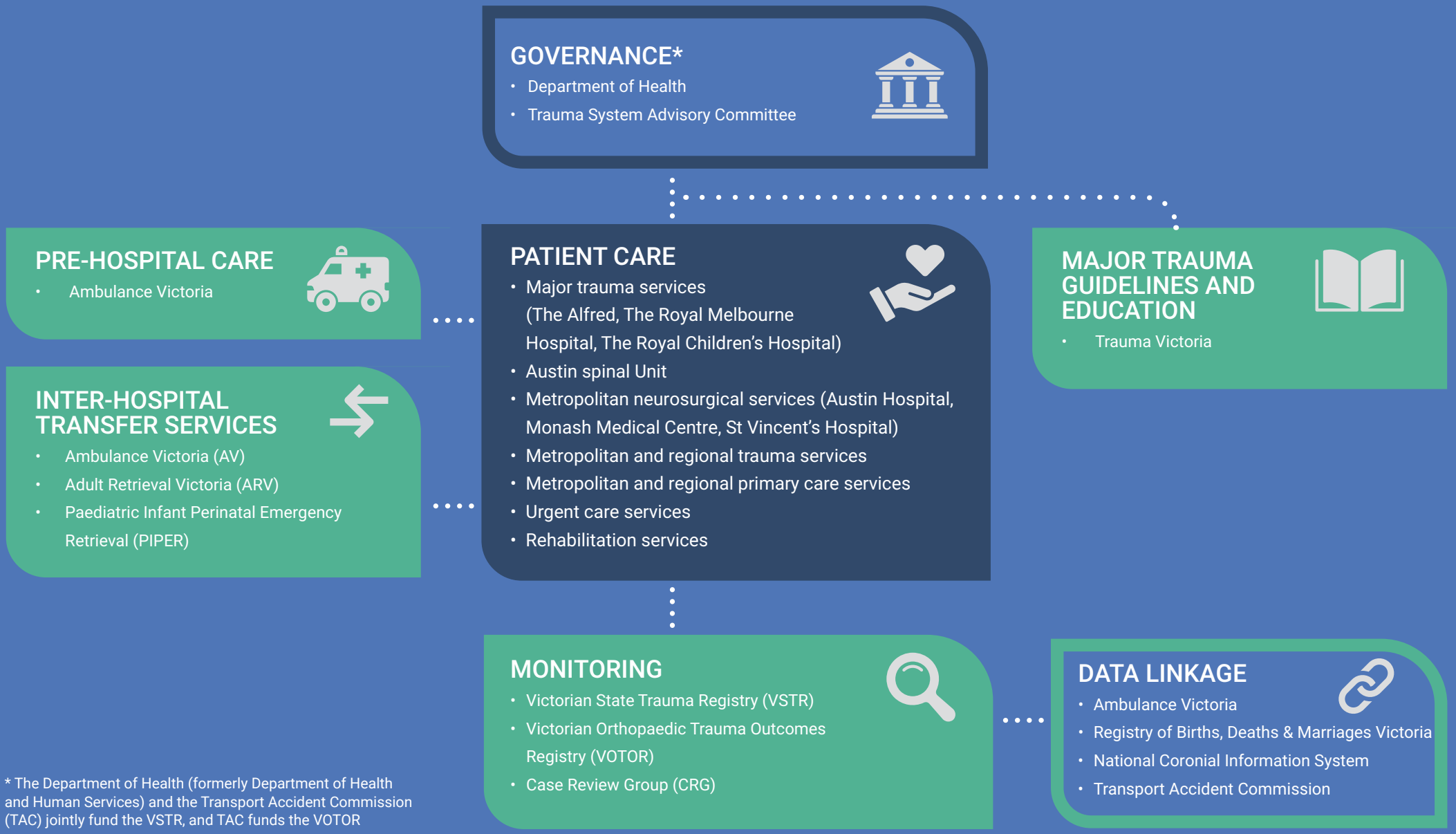
Rural and regional trauma services provide resuscitation and stabilisation of major trauma patients and organise patient transport to an MTS. They may also provide definitive care for a limited number of trauma patients where their injuries are assessed, in agreement with Adult Retrieval Victoria (ARV) or with an MTS, as not requiring inter-hospital transfer. Regional and rural trauma services provide patient transfer to an MTS through ARV. Adult Retrieval Victoria is part of Ambulance Victoria (AV) 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 a specialist trauma service. In addition to the MTS hospitals, 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. 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 2023–24 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 have 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 2023–24, the case review process identified 572 (13.9% of all major trauma cases) cases that met one or more of these criteria. There were 14.0 per cent of major trauma cases that met the CRG criteria in 2022–23 and 11.5 per cent in 2019–20. The 572 cases were reviewed by VSTORM and 40 of them were selected for presentation to the Case Review Group for discussion. High risk cases (on the CRG matrix) and cases of concern only were reviewed.

For cases with date of injury from 1 July 2023 to 30 June 2024, the Case Review Group asked health services (or Ambulance Victoria, Adult Retrieval Victoria or Paediatric Infant Perinatal Emergency Retrieval) to review 19 major trauma cases using their existing clinical governance arrangements. The Case Review Group may request an internal review or response from a health service. If the Case Review 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 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 collection of 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, including: 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.

VSTR 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.

There were 4,482 major trauma patients in 2023–24 compared with 4,332 in 2022-23.

Annual incidence of major trauma has increased since from 55 per 100,000 population in 2019-20 to 64 per 100,000 population in 2023-24 (IRR 1.03, 95% CI: 1.02, 1.05, p <0.001).

68% of major trauma patients in 2023-24 were male.

In 2023–24, 94% of major trauma were in the blunt trauma category, 3.4% were penetrating and 1.1% were burns.

49% of all major trauma cases were the result of a fall (high or low) in 2023-24.

The number of major trauma cases resulting from a low fall in older adults has increased markedly; 1,022 in 2019-20 to 1,407 in 2023-24.

The proportion of major trauma cases due to other transport-related incidents (includes e-scooters) was 0.6% in 2019–20 and has increased to 3.0% in 2023-24.

The proportion of major trauma cases occurring at home was 36.1% in 2019-20, increased during COVID to 41% (2020-21) and has declined to 37% in 2023-24.

In 2023-24, 88% 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; 30% in 2019 and 22% in 2023-24.

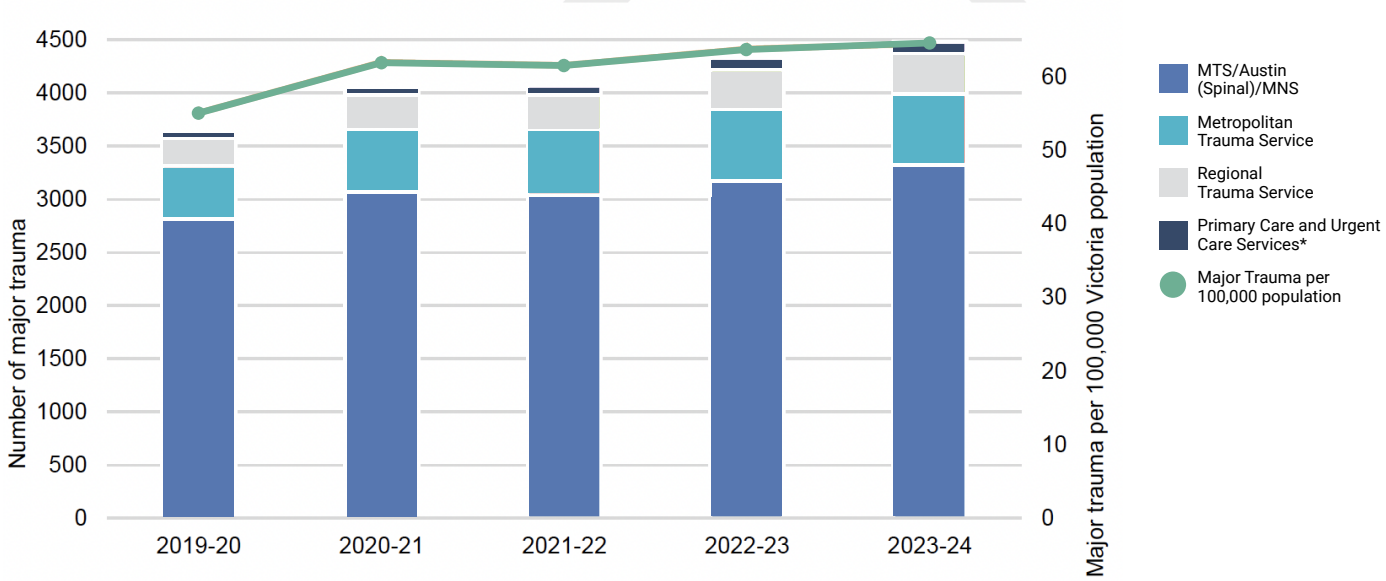
The risk of in-hospital mortality has not changed for major trauma patients in the past five years.

MAJOR TRAUMA PATIENT NUMBERS

The VSTR recorded 4,482 hospitalised major trauma patients in 2023–24 compared with 4,322 in 2022–23 and 3,642 in 2019-20 (Figure 2). The incidence of hospitalised major trauma was 64 per 100,000 population[4] in 2023-24 compared to 55 per 100,000 population in 2019–20 (Figure 2). The annual incidence of major trauma patients has increased since 2019-20 (IRR 1.03, 95% CI: 1.02, 1.05, p < 0.001). [5]

Most major trauma patients receive their definitive care at a Major Trauma Service, Austin Hospital for spinal care or a metropolitan neurosurgical service; 2,815 in 2019-20, 3,033 in 2021-22, and 3,323 in 2023-24. The number of major trauma patients receiving definitive care at a Regional Trauma Service has increased; 257 in 2019-20 and 376 in 2023-24. The number of major trauma patients receiving definitive care at a Metropolitan Trauma Service has increased from 501 to 667 in the same timeframe (Figure 2).

Figure 2: Number and annual incidence rate per 100,000 population of hospitalised major trauma patients by level of definitive care in the VSTS, 2019–20 to 2023–24



*Includes Metropolitan Primary Care Services and Regional Urgent Care Services



EPISODES OF CARE

There were 5,850 hospital care episodes for the 4,482 hospitalised major trauma patients in 2023–24. Most patients (n = 3,144; 70.1%) had only one episode of care, while 1,308 (29.2%) experienced two episodes of care and 30 (0.7%) had three episodes of care. The proportion of major trauma cases having more than one episode of care was 31% in 2019-20, and 27% in 2022-23.

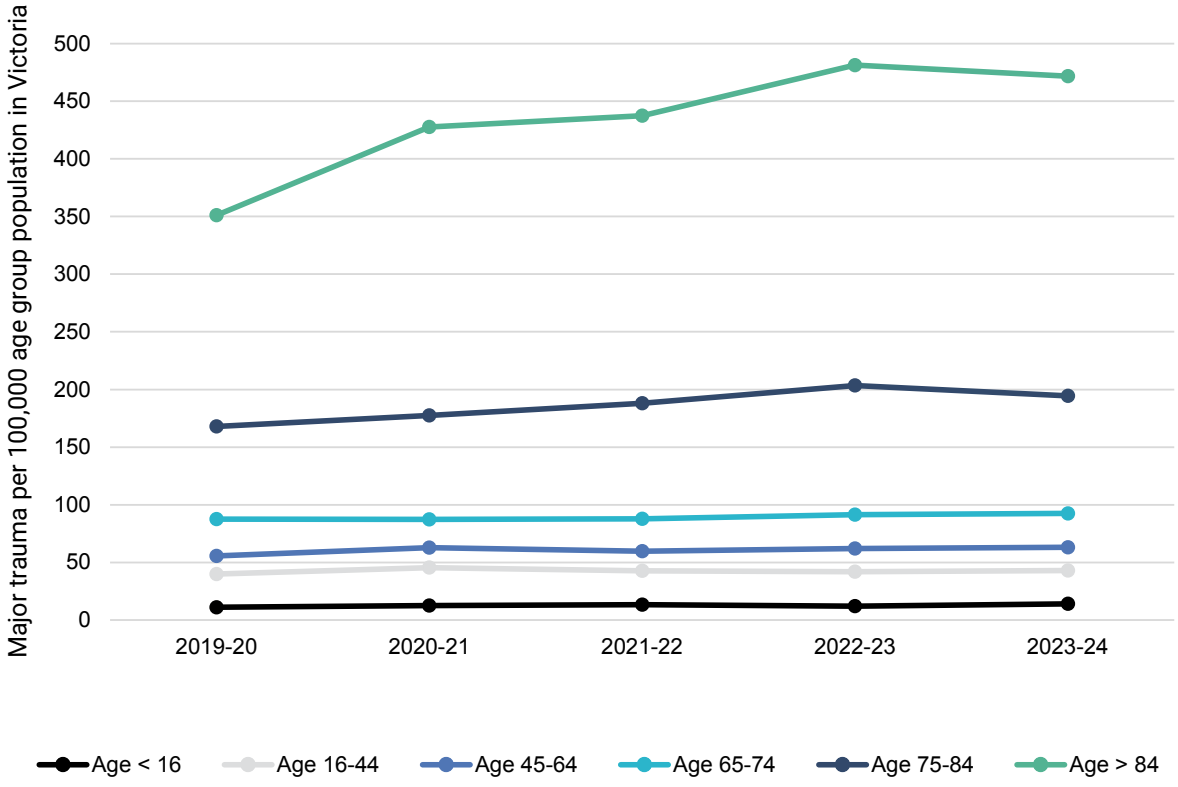
[4] This rate is based on the Australia Demographic Statistics Estimated Resident Population by Single Year of Age, Victoria population of 6,953,238 at 30 June 2024 (Australian Bureau of Statistics 2025).
[5] IRR = incidence rate ratio 95% CI = 95% confidence interval; p = probability.

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 69% of cases since 2019-20 (67.8% in 2023–24). In the 65-and-older age group, patient's sex is more evenly distributed with males accounting for 55% to 57% of cases since 2019-20 (56.7% in 2023-24).

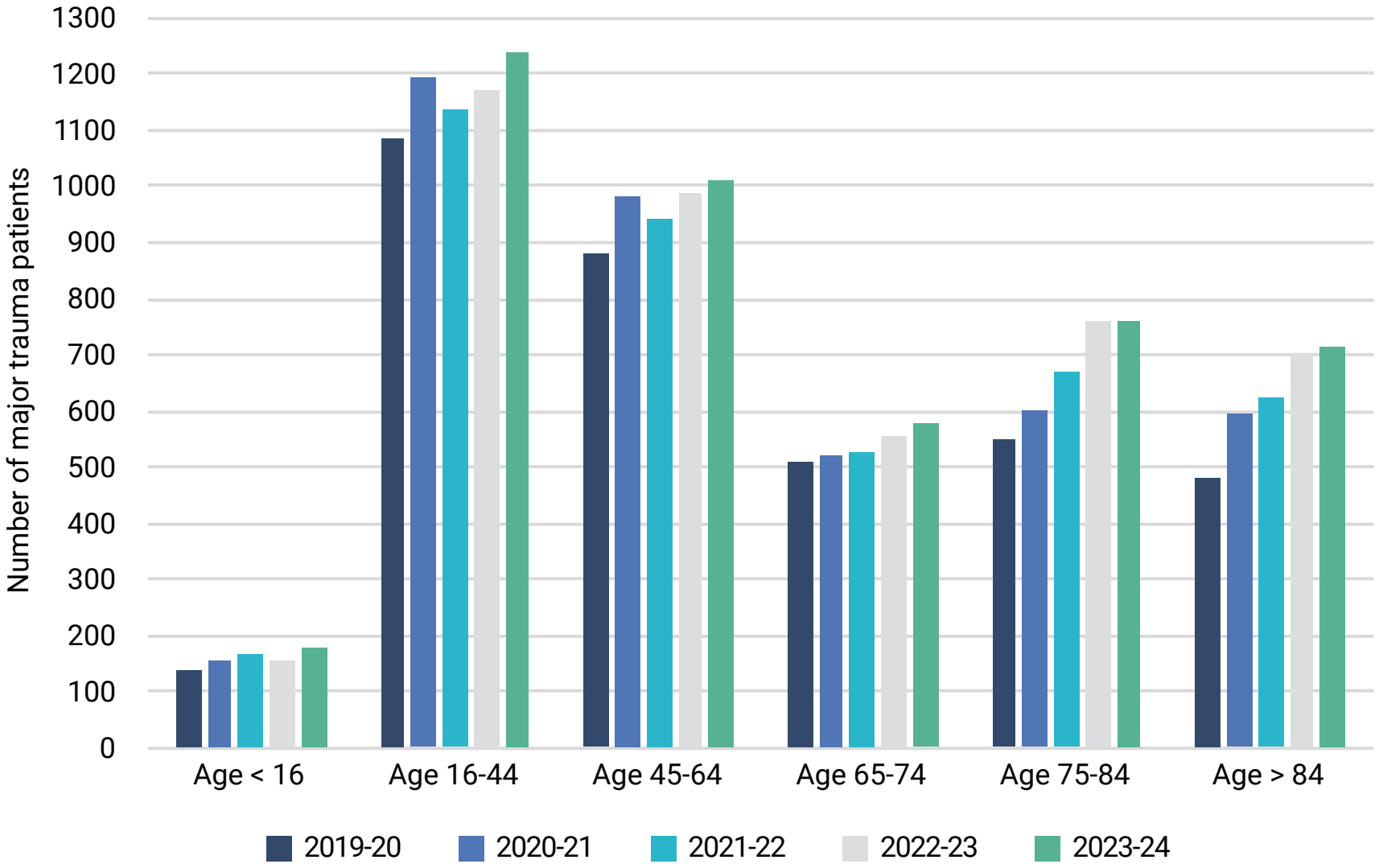
In the Victorian State Trauma System, paediatric patients are defined as aged less than 16 years, adults are aged 16 years and older and older adults are aged 65 years and older. Since 2019-20 the annual incidence of paediatric major trauma patients risen from 11.1 per 100,000 in 2019-20 to 13.2 per 100,000 in 2021–22 and to 14.0 per 100,000 in 2023-24 (IRR 1.04, 95% CI: 0.99, 1.10, p = 0.09)[6] (Figure 3b). While the incidence of major trauma in people aged 16 to 74 years has remained relatively stable over the past five years, the incidence has increased 4% per year (IRR 1.04, 95% CI: 1.02, 1.07, p=0.001) in the 75-to-84-year age group and 7% per year (IRR 1.07, 95% CI: 1.04, 1.10, p<0.001) in the group aged 85 years and over.

Figure 3a: Age-specific annual incidence rate of hospitalised major trauma, 2019-20 to 2023–24



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

Figure 3b: Age-specific frequencies of hospitalised major trauma, 2019-20 to 2023-24

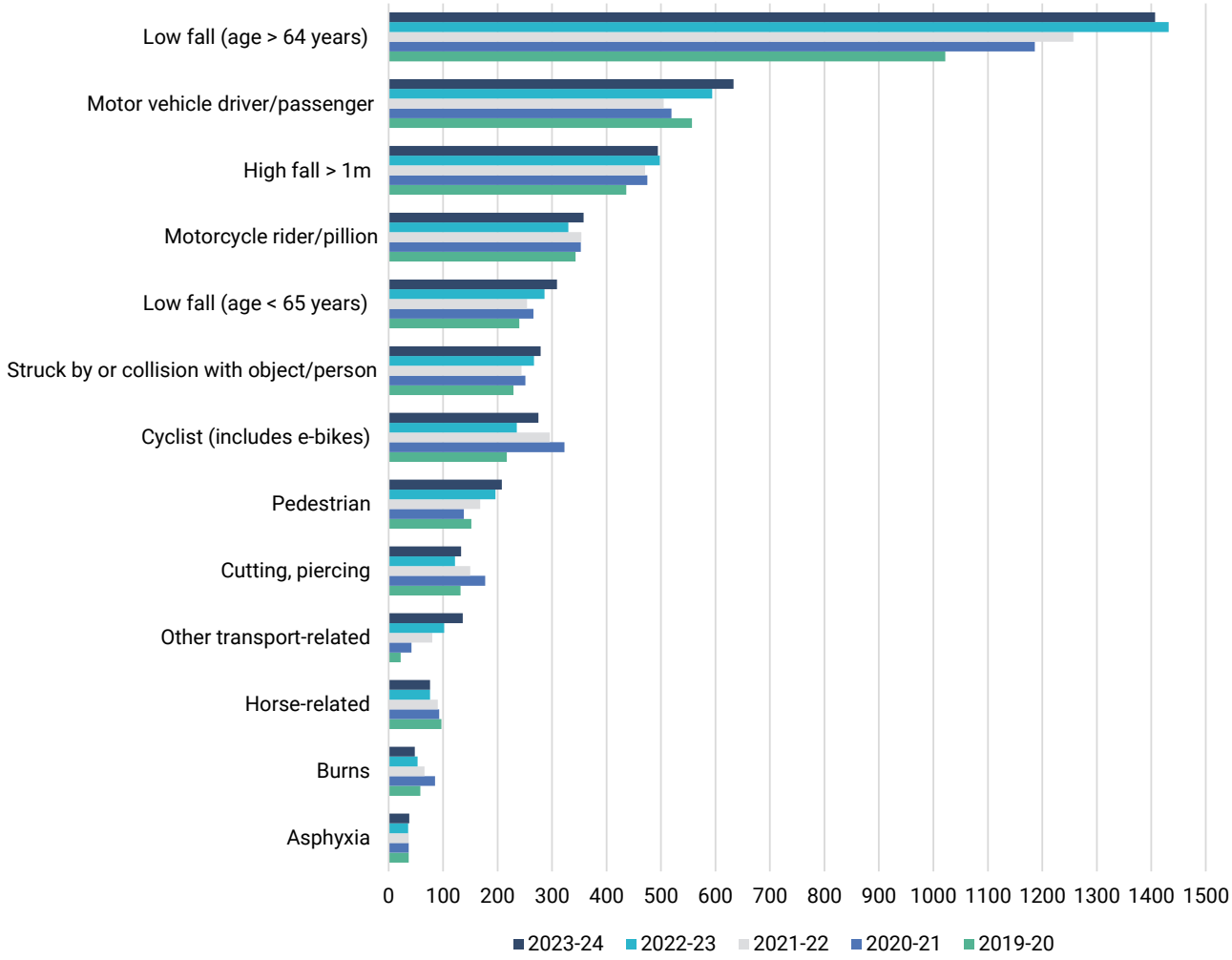


Cause of injury

The most common causes of injury are presented in Figure 4. Together, these accounted for 98% of major trauma cases in 2023-24. In 2023-24, the percentage of hospitalised major trauma patients injured in any type of fall was 49% while a low fall was the cause of 38% of all hospitalised major trauma cases. The number of major trauma cases resulting from a low fall has increased markedly in older adults in the last five years (Figure 4).

The percentage of major trauma patients injured in transport-related[7] incidents was 36% in 2023-24; were compared to 34% in 2021–22 and 39% in 2018–19. The proportion of major trauma cases due to motor vehicle incidents has risen following the decline observed during the COVID pandemic, while the proportion injured in cycling related incidents has declined following the peak observed during the pandemic. In contrast, the proportion of hospitalised major trauma cases resulting from other transport causes, including e-scooters, has increased markedly in the last five years from 0.6% (n=22) in 2019-20 to 3.0% (n=136) in 2023-24 (Figure 4).

Figure 4: The most common causes of injury of hospitalised major trauma patients, 2019-20 to 2023–24



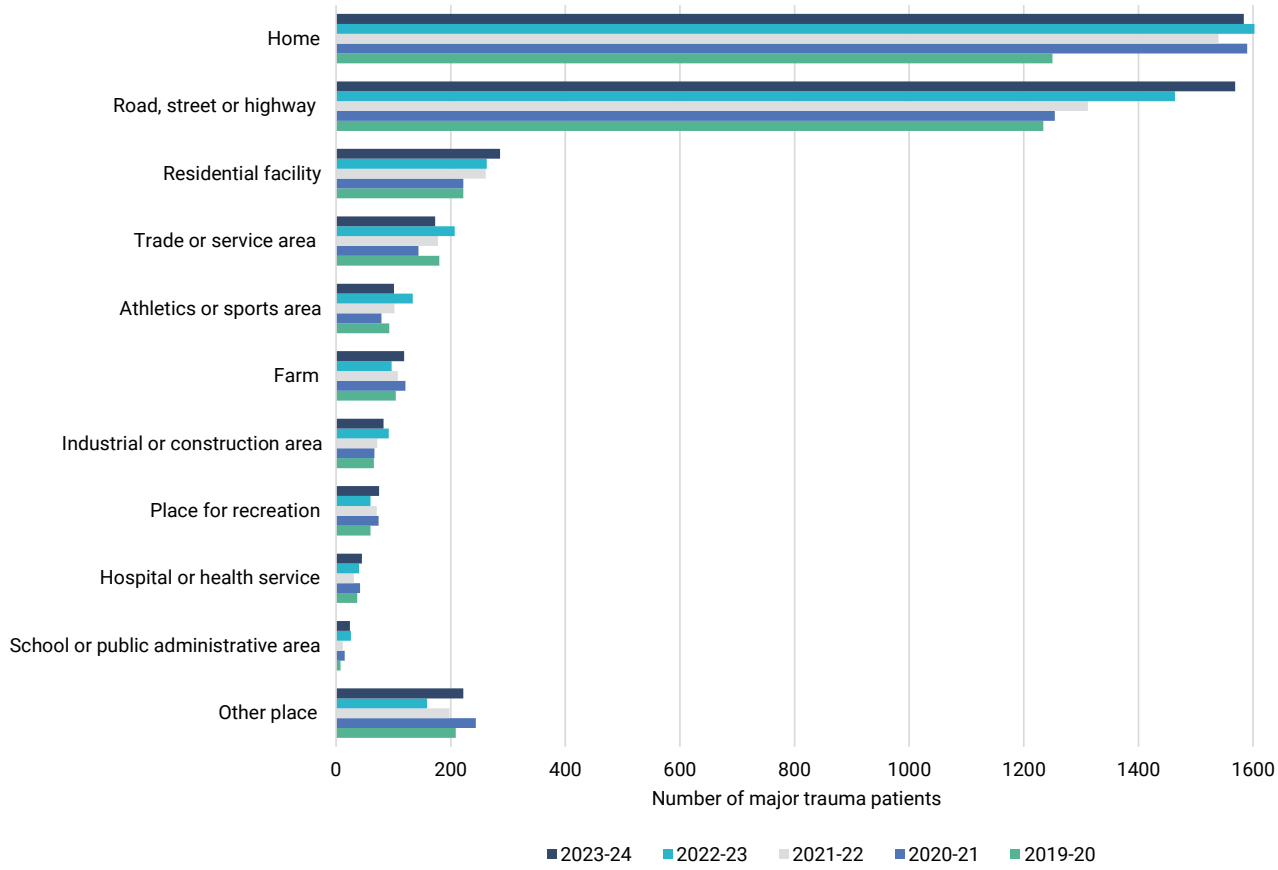
[7] Defined by Victorian Emergency Minimum Dataset (VEMD) cause codes (Motor vehicle driver, Motor vehicle-passenger, Motorcycle-driver, Motorcycle-passenger, Pedal cyclist-rider or passenger, Pedestrian or Other transport-related circumstance).

Place of injury

Consistent with the predominance of falls and transport-related causes of major trauma, the most common places of injury were the home (37.0%) and a road, street or highway (36.7%) (Figure 5a). The number of major trauma incidents occurring in and around the home has increased from 1,250 in 2019-20 to 1,581 in 2023-24 (Figure 5a), with low falls accounting for 59% (n=741) of injuries at home in 2019-20 and 66% (n=1,050) of injuries at home in 2023-24.

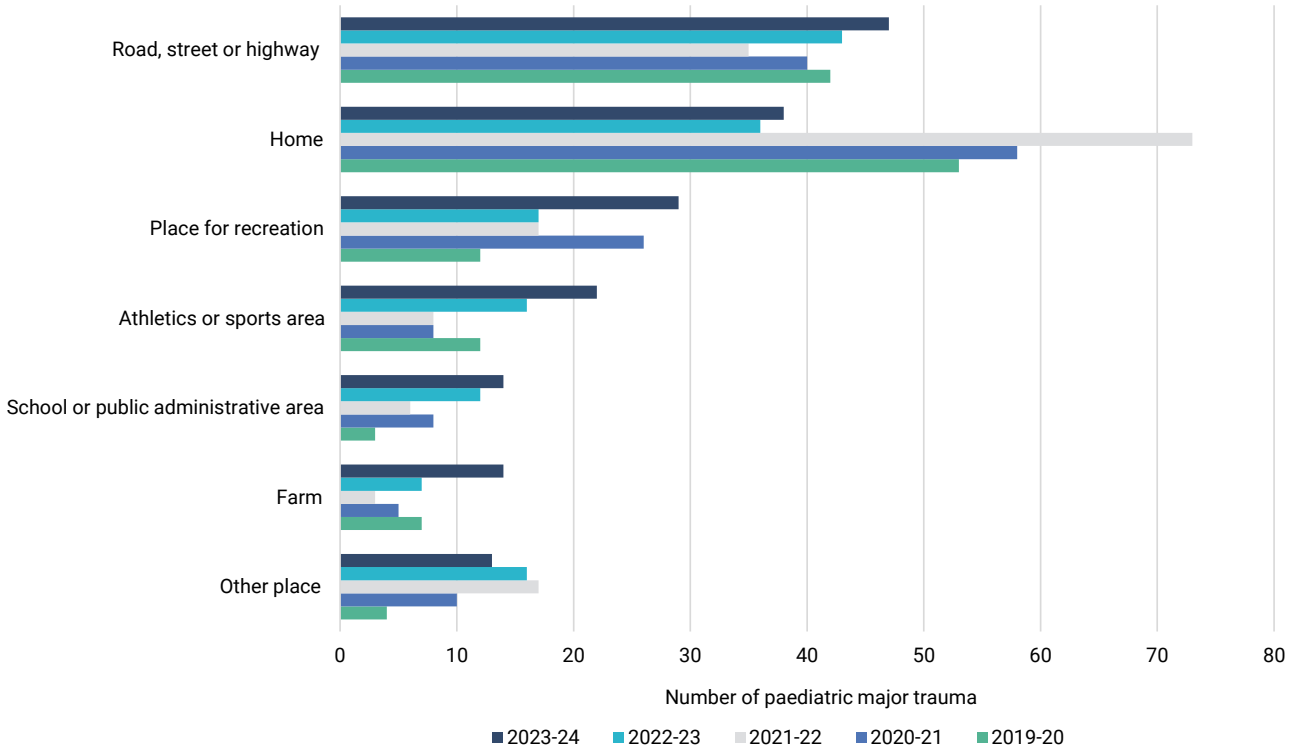
The number of major trauma incidents occurring on a road, street or highway has also increased from 1,234 in 2019-20 to 1,569 in 2023-24; the number occurring in 'other' transport-related incidents (including e-scooters) has risen from 17 in 2019-20 to 93 in 2023-24.

Figure 5a: The place of injury for hospitalised major trauma patients, 2019-20 to 2023-24



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 coinciding with the COVID-19 pandemic and substantial public health restrictions. The number of paediatric major trauma patients injured at home has markedly decreased since the end of the pandemic with 38 incidents occurring at home in 2023-24.

Figure 5b: The place of injury for hospitalised paediatric major trauma patients, 2019-20 to 2023–24





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 land transportation incidents. In 2023–24, 36% of major trauma patients were identified as TAC compensable which is consistent with previous years; however, the number of TAC compensable major trauma patients has increased from 1,298 in 2019-20 to 1,617 in 2023-24. Of the TAC-compensable patients, 86% received their definitive care at an MTS or the Austin Hospital (for spinal care) in 2023-24 compared to 90% of TAC compensable patients in 2019-20.



Injury type

Traumatic injury is commonly classified into blunt, penetrating or burn injury types, based on the cause of injury. Ninety-four percent of major trauma patients captured by the registry in 2023-24 were in the blunt trauma category, consistent with the high incidence of falls and road trauma. Penetrating injuries were sustained by 3.4% of major trauma patients in 2023-24 compared with 4.6% in 2019-20. Burns accounted for 1.1% of major trauma in 2023-24.



Injury intent

Overall, 90% of major trauma patients with a known intent of injury sustained their injuries from unintentional ('accidental') events in 2023-24 which is consistent with previous years. In 2023-24, 5.9% (n=265) of hospitalised major trauma cases were due to interpersonal violence, while 130 (2.9%) were the result of intentional self-harm.

Time and day of injury

Consistent with previous years, major trauma occurred more frequently on weekends (32.6% of all cases), particularly on Saturdays (17.4%) (Figure 6). Of all major trauma cases with a known time of injury in 2023–24, 41% occurred between the hours of 8.00 am and 4.00 pm, and 35% occurred between the hours of 4.01 pm and midnight

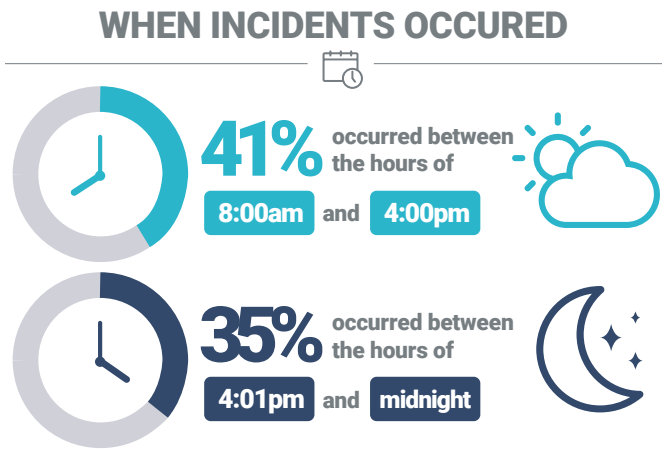
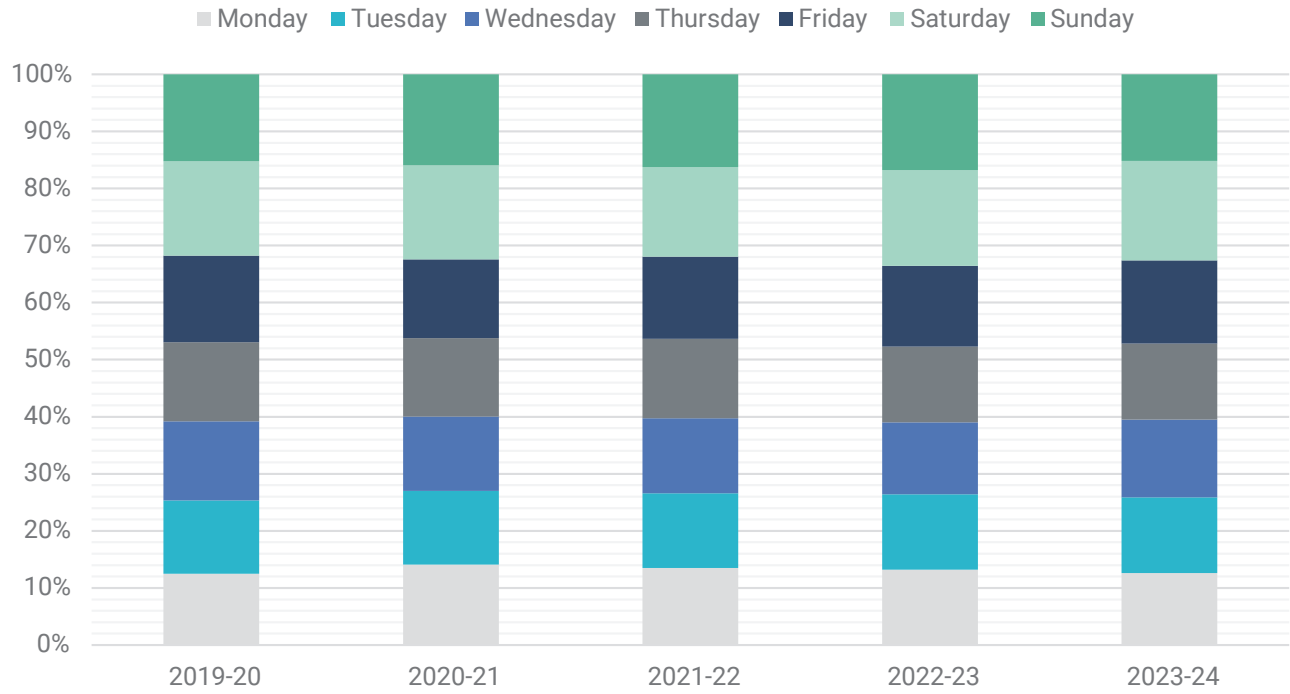


Figure 6: Proportion of major trauma occurring on each day of the week, 2019-20 to 2023-24



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). The highest incidence of hospitalised major trauma incidents occurring in regional Victoria were in the Hume and Gippsland regions (Table 1b).

Table 1a: Number of hospitalised major trauma cases by geographical location of incident, 2019-20 to 2023-24

Region	Number of major trauma cases				
	2019-20	2020-21	2021-22	2022-23	2023-24
Metropolitan Melbourne	2,199	2,401	2,497	2,649	2,537
Regional Victoria	1,179	1,338	1,232	1,322	1,412
Unknown in Victoria	184	251	274	280	429
Outside of Victoria	80	66	57	81	104

Table 1b: Incidence of hospitalised major trauma cases by geographical location of incident in Victoria, 2019-20 to 2023-24

Region	Major trauma per 100,000 population8 (adjusted per year)				
	2019-20	2020-21	2021-22	2022-23	2023-24
Metropolitan Melbourne	44.2	49.1	50.4	51.8	48.3
Regional Victoria	72.1	80.8	74.0	74.0	82.0
Loddon Mallee	59.5	55.8	58.5	55.0	69.6
Grampians	68.0	76.3	72.0	67.7	73.6
Hume**	97.8	111.9	95.4	109.1	109.6
Barwon-South Western	61.7	64.4	61.9	62.8	69.6
Gippsland	78.4	105.4	89.4	102.7	93.5

** Includes population in Victoria only.

8 This rate is based on the Australia Demographic Statistics Table 1 Estimated Resident Population, Local Government Areas, Australia Victoria population of 6,953,238 at 30 June 2024 (Australian Bureau of Statistics 2025).

Injuries sustained

Table 2 shows the distribution of injuries sustained by major trauma patients. Forty-two per cent of patients in 2023-24 sustained multi-trauma without serious neurotrauma. The proportion of major trauma patients who sustained a serious head injury[9] was 37% in 2019-20 and 2023-24, though the proportion with an isolated head injury has declined in this time (Table 2a). The injuries sustained by paediatric major trauma patients are presented in Table 2b, showing the higher prevalence of serious head injury in paediatric major trauma patients when compared to adults.

Table 2a: Injuries sustained by all major trauma patients, 2019-20 to 2023-24

Injury group	Percentage of major trauma patients (%)				
	2019-20	2020-21	2021-22	2022-23	2023-24
Multiple injuries, burns or other (excluding serious neurotrauma)	40.0	40.7	40.8	40.8	41.5
Head and other associated injuries	21.3	20.3	21.0	21.2	23.0
Isolated head injury	16.1	15.5	15.3	15.5	13.5
Extremity and/or spine injuries only	11.4	11.9	11.6	12.1	11.6
Chest and/or abdominal injuries only	8.7	9.3	9.7	8.2	8.2
Serious spinal cord injury	2.6	2.3	1.7	2.5	2.3

Table 2b: Injuries sustained by paediatric major trauma patients, 2019-20 to 2023-24

Injury group	Percentage of major trauma patients (%)				
	2019-20	2020-21	2021-22	2022-23	2023-24
Multiple injuries, burns or other (excluding serious neurotrauma)	28.4	32.9	29.2	30.3	28.0
Head and other associated injuries	24.8	22.8	24.4	27.0	25.8
Isolated head injury	24.1	19.6	25.6	15.8	19.8
Extremity and/or spine injuries only	3.6	7.6	1.8	6.6	5.5
Chest and/or abdominal injuries only	18.4	16.5	17.9	19.7	20.3
Serious spinal cord injury	0.7	0.6	1.2	0.7	0.6

Notes:

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

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

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

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

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

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

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

Injury severity

87%

OF ALL MAJOR TRAUMA PATIENTS WITH A KNOWN INJURY SEVERITY SCORE (ISS), 87% HAD AN ISS GREATER THAN 12 IN 2023-24.

The percentage of major trauma patients with an ISS greater than 12 has been consistent – 87% in 2023-24 and 88% in 2019-20. In 2023-24, 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.

[10] 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

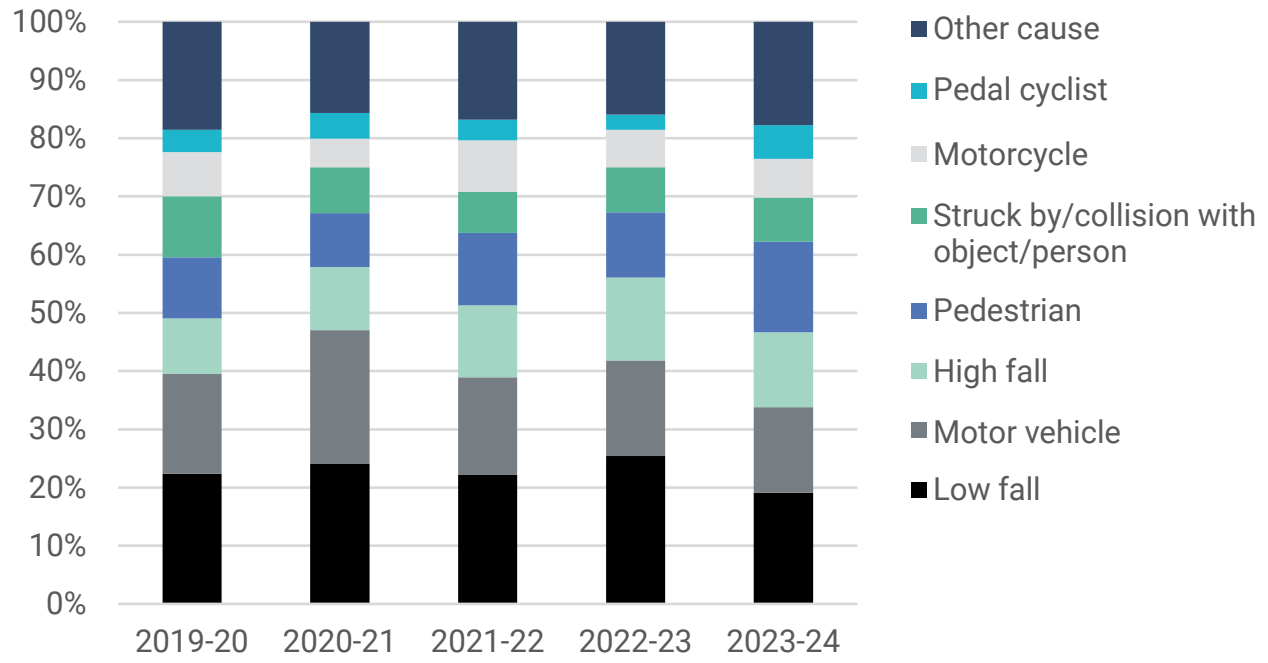
Head injury severity

Figure 7 shows that the percentage of major trauma patients with a severe head injury[10]. The proportion of major trauma patients with severe head injury was 5.8% (n=210) in 2019-20 and 5.0% in 2023-24 (n=225). Transport-related incidents were the predominant cause of major trauma with severe head injury, accounting for 48% of these cases in 2023-24 compared to 42% in 2019-20. While the proportion of major trauma patients with severe head injury caused by low falls and motor vehicle crashes declined in 2023-24, the proportion due to pedestrian and pedal cyclist incidents increased (Figure 7).

5%

OF ALL HOSPITALISED MAJOR TRAUMA PATIENTS IN 2023-24, 5.0% HAD A SEVERE HEAD INJURY.

Figure 7: Causes of major trauma patients with a severe head injury (AIS head region severity score >2 and GCS < 9), 2019-20 to 2023-24





FIRST HOSPITAL AND DEFINITIVE CARE
OF MAJOR TRAUMA PATIENTS



In 2023-24, the first hospital attended was an MTS or the Austin Hospital (for spinal care for 49% of major trauma patients (Figure 8a). In 2023-24, most major trauma patients (74.1%) received their definitive care at an appropriate trauma service, as determined by the VSTS trauma triage guidelines[11] (Figure 8b).

In 2023-24, the first hospital attended was an MTS or the Austin Hospital (for spinal care) for 61% of transport cases[12] (Figure 8c). The percentage of transport major trauma receiving definitive care at an MTS or the Austin Hospital (for spinal care) in 2023-24 was 87% compared to 88% in 2019-20 (Figure 8d).

Figures 8e and 8f 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 or the Austin Hospital (for spinal care) for 49% of major trauma patients and 61% of transport cases in 2023-24.

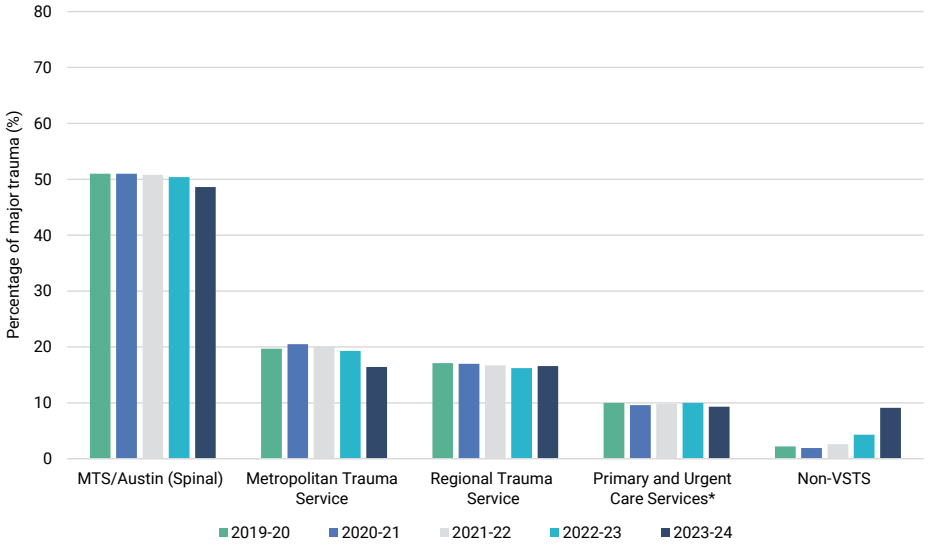
In 2023-24, 74% of patients received their definitive care at an appropriate trauma service, as determined by the VSTS trauma triage guidelines, compared with 73% in 2022-23 and 77% in 2019-20.

For transport cases, 87% of patients received their definitive care at an appropriate trauma service, as determined by the VSTS trauma triage guidelines, in 2023-24 compared with 86% in 2022-23.

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

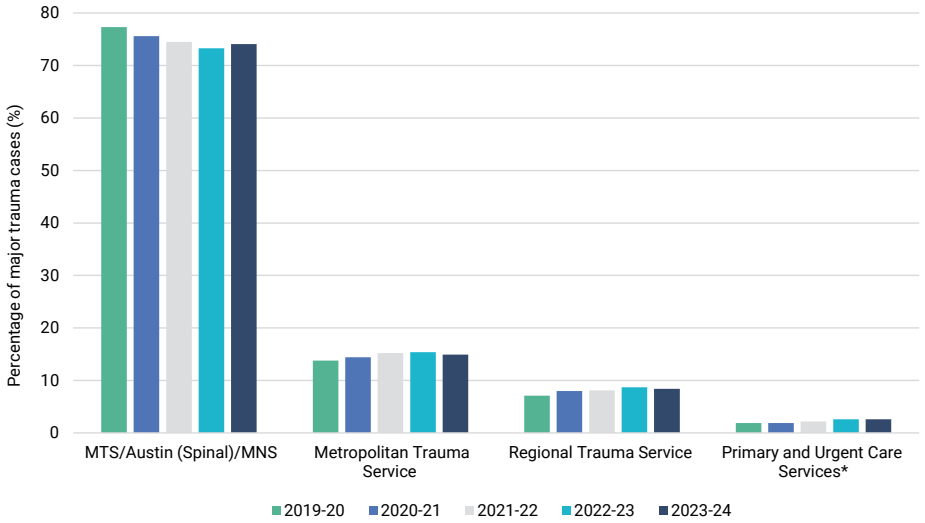
[12] Defined by VEMD cause codes (Motor vehicle driver, Motor vehicle-passenger, Motorcycle-driver, Motorcycle-passenger, Pedal cyclist-rider or passenger, Pedestrian or Other transport-related circumstance).

Figure 8a: Proportion of major trauma cases by first hospital attended, 2019-20 to 2023-24



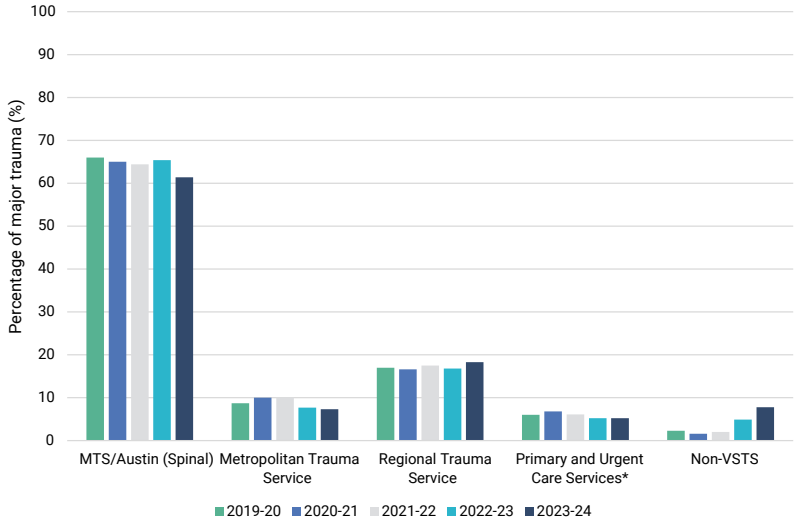
*Includes Metropolitan Primary Care Services, Regional Urgent Care Services and Regional Primary Care Services

Figure 8b: Proportion of major trauma cases by level of definitive care in the VSTS, 2019-20 to 2023-24



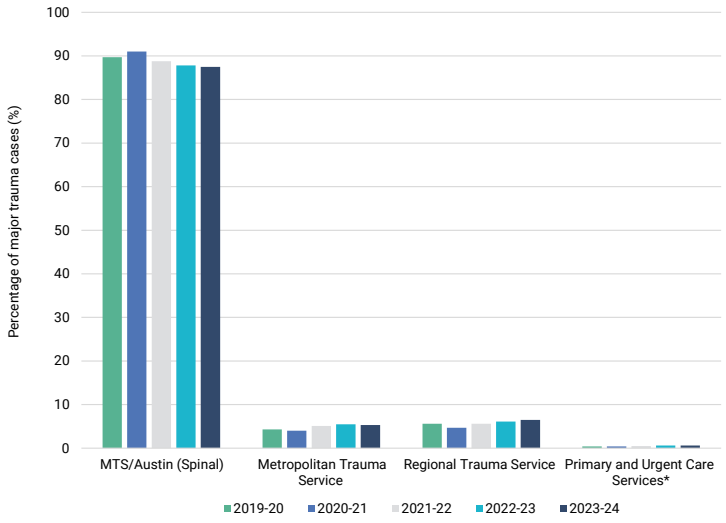
*Includes Metropolitan Primary Care Services and Regional Urgent Care Services

Figure 8c: Proportion of transport cases by first hospital attended, 2019-20 to 2023-24



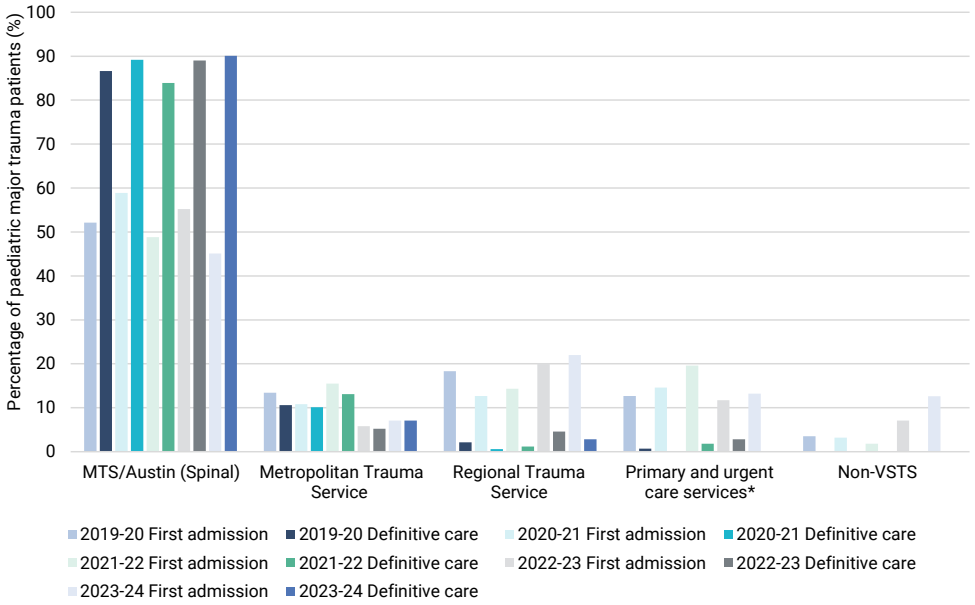
*Includes Metropolitan Primary Care Services, Regional Urgent Care Services and Regional Primary Care Services

Figure 8d: Proportion of transport cases by level of definitive care in the VSTS, 2019-20 to 2023-24



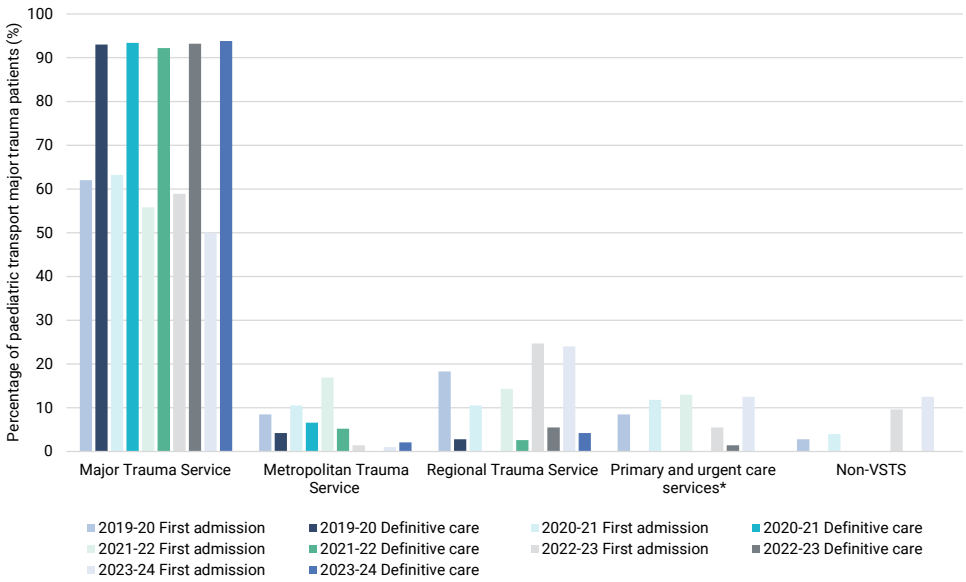
*Includes Metropolitan Primary Care Services and Regional Urgent Care Services

Figure 8e: Proportion of paediatric major trauma cases by first hospital attended and level of definitive care in the VSTS, 2019-20 to 2023-24



*Includes Metropolitan Primary Care Services and Regional Urgent Care Services

Figure 8f: Proportion of paediatric transport cases by first hospital attended and level of definitive care in the VSTS, 2019-20 to 2023-24



*Includes Metropolitan Primary Care Services and Regional Urgent Care Services

PATIENT TRIAGE AND TRANSPORTATION



85%

(n=3,420) of major trauma patients were transported from the scene of injury to hospital by Ambulance Victoria

21%

of major trauma patients transferred from the scene of injury by Ambulance Victoria were transported to hospital by helicopter





64%

of these patients were transported directly to an MTS, Austin for spinal care or MNS

92%

of transferred patients received their definitive care at an appropriate trauma service, as defined by the major trauma guidelines



Helicopter mode of transport

The proportion of major trauma patients transferred from the scene to an MTS by helicopter has decreased over time (Table 3). In 2023-24, 21% (n=422) major trauma patients were transported from the scene to an MTS by helicopter compared to 25% in 2019-20 and 26% in 2020-21. The reduction was predominantly observed for transports from the scene to The Alfred and Royal Children's Hospital.

Table 3: Major trauma primary helicopter transports from the scene to an MTS, 2019-20 to 2023-24

	Helicopter transports from the scene to an MTS n (% of all primary transports)
2019-20	445 (25.3)
2020-21	514 (26.3)
2021-22	412 (21.1)
2022-23	414 (20.0)
2023-24	422 (21.0)

	Helicopter to The Alfred	Helicopter to RMH	Helicopter to RCH
	n (% of all primary transports)		
2019-20	231 (28.1)	182 (22.3)	32 (49.2)
2020-21	259 (28.9)	219 (24.9)	36 (41.9)
2021-22	201 (24.3)	186 (19.4)	25 (35.2)
2022-23	221 (24.3)	164 (16.9)	29 (35.8)
2023-24	210 (24.7)	185 (19.6)	26 (35.1)

Direct admissions and transfers to a major trauma serviceport

The percentage of major trauma patients transported directly 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) from the scene of injury, home or a general practitioner (GP) has been consistent; 65% in 2019-20 and 64% in 2023-24 (Figure 9).

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 88% in 2019-20, 90% in 2020–21, 88% in 2021-22, 90% in 2022-23 and 92% in 2023-24. In 2023-24, for major trauma admissions experiencing an inter-hospital transfer, the proportion transferred using the State's retrieval services was 53%.

Since 2019-20, direct admissions from the scene of injury, home or a GP to an MTS for definitive care 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 for definitive care are presented in Table 4.

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

Figure 9: Source of major trauma to an appropriate trauma service level for definitive care, 2019-20 to 2023-24

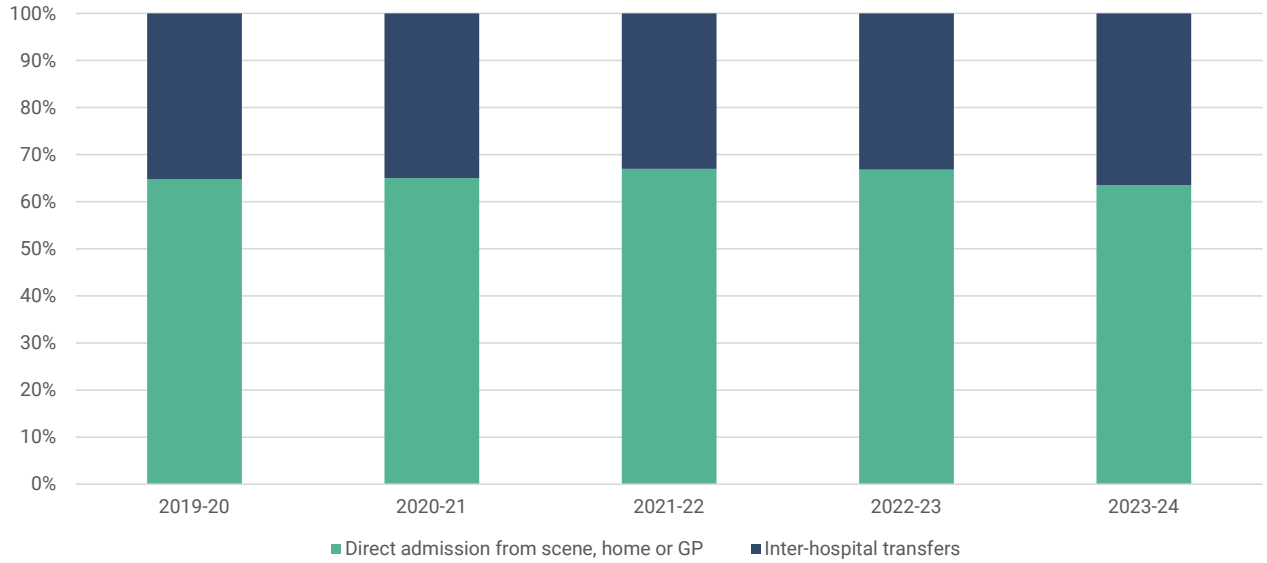


Table 4: Direct admissions from the scene, home or a GP to The Alfred, The Royal Melbourne Hospital and The Royal Children's Hospital, 2019-20 to 2023-24

	Total definitive care admissions to The Alfred, RMH and RCH	Total direct admissions for definitive care to The Alfred, RMH and RCH n (%)	Direct admissions to The Alfred n (% of definitive care admissions)	Direct admissions to RMH n (% of definitive care admissions)	Direct admissions to RCH n (% of definitive care admissions)
2019-20	2,665	1,737 (65.4)	838 (60.7)	827 (71.8)	72 (58.5)
2020-21	2,879	1,899 (66.0)	917 (58.2)	889 (76.5)	93 (65.5)
2021-22	2,842	1,908 (67.1)	846 (58.6)	982 (78.2)	80 (56.3)
2022-23	2,990	2,012 (67.3)	948 (59.9)	981 (77.4)	83 (60.1)
2023-24	3,147	1,988 (63.2)	917 (55.9)	988 (73.7)	82 (49.7)

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 and retrieval indicators

The median ambulance response time[13] has increased since 2019-20 (Table 5a).

Table 5a: Time from ambulance call to arrival at scene (response time), median and 90th percentile, 2019-20 to 2023-24

	Median response time (minutes)	90th percentile (minutes)
2019-20	14	38
2020-21	15	46
2021-22	16	54
2022-23	17	60
2023-24	16	55

The median pre-hospital scene time[14] has remained stable since 2019-20 (Table 5b).

Table 5b: Scene time (from ambulance arrival at location to depart location), median and 90th percentile, 2019-20 to 2023-24

	Median scene time (minutes)	90th percentile (minutes)
2019-20	29	85
2020-21	31	89
2021-22	32	81
2022-23	32	82
2023-24	32	84

The median pre-hospital time[15] in 2022–23 has remained stable since 2019-20 (Table 5c).

Table 5c: Total pre-hospital time (from first ambulance arrival at scene to ambulance arrival at primary hospital, includes Air Ambulance Victoria), median and 90th percentile, 2019-20 to 2023-24

	Median pre-hospital time (minutes)	90th percentile (minutes)
2019-20	60	129
2020-21	61	134
2021-22	61	127
2022-23	61	124
2023-24	61	128

[13] Measured from time of ambulance call to first ambulance arrival at scene

[14] Measured from ambulance arrival at scene to depart location time

[15] Measured from ambulance arrival at scene to primary hospital arrival

In 2023-24, 1,318 major trauma patients experienced an inter-hospital transfer within the VSTS; 45% were coordinated by ARV or PIPER (Table 5e). The proportion of inter-hospital transfers coordinated by ARV and PIPER was 70% for transfers from RTS, RPCS and UCS hospitals and 26% for patients experiencing an inter-hospital transfer from an MTS or MPCS.

Table 5e: PIPER/ARV activation, 2019-20 to 2023-24

	Total number of inter-hospital transfers from VSTS primary hospital	Total ARV/PIPER activations for transfer n (%)	Total ARV/PIPER activations for regional transfers n (%)	Total ARV/PIPER activations for metropolitan transfers n (%)
2019-20	1,074	488 (45.4)	359 (67.1)	129 (23.9)
2020-21	1,144	613 (43.6)	404 (74.0)	209 (35.0)
2021-22	1,102	559 (50.7)	387 (73.6)	172 (29.9)
2022-23	1,148	495 (43.1)	350 (68.1)	145 (22.9)
2023-24	1,318	589 (44.7)	397 (69.6)	192 (25.7)

In-hospital indicators

The median hospital length of stay for hospitalised major trauma patients has been consistent since 2019-20 (Table 6a).

Table 6a: Hospital length of stay, 2019-20 to 2023-24

	All major trauma* (n)	Median length of stay (days)	90th percentile (days)
2019-20	3,642	6.6	20.7
2020-21	4,056	6.9	22.8
2021-22	4,070	6.7	22.4
2022-23	4,332	6.8	22.3
2023-24	4,479	6.7	21.6

* Known length of stay

The proportion of major trauma patients admitted to an intensive care unit, and the length of stay in the ICU, has been largely consistent since 2019-20 (Table 6b).

Table 6b: ICU length of stay, 2019-20 to 2023-24

	Major trauma ICU admission at definitive care (n) (%)	Median ICU length of stay (days)	90th percentile (days)
2019-20	1,297 (35.7)	3	14
2020-21	1,450 (35.8)	4	15
2021-22	1,287 (31.6)	4	16
2022-23	1,294 (29.9)	4	15
2023-24	1,475 (32.9)	4	13

The median time ventilated in major trauma patients admitted to an ICU has varied over the past 5 years and was 17 hours in 2023-24 (Table 6c).

Table 6c: Major trauma ICU mechanical ventilation hours for major trauma patients with an ICU admission, 2019-20 to 2023-24

	Major trauma ICU admissions with known mechanical ventilation hours (n)*	Median mechanical ventilation time (hours)	90th percentile (days)
2019-20	1,295	21	246
2020-21	1,448	21	248
2021-22	1,282	31	280
2022-23	1,285	22	278
2023-24	1,472	17	226

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



HOSPITAL OUTCOMES OF MAJOR TRAUMA

Discharge status

In 2023-2, 61% of major trauma survivors were discharged directly to home (Table 7). The proportion of major trauma patients discharged directly to home has increased over the past five years from 55% In 2019-20 to 61% in 2023-24. The proportion discharged to inpatient rehabilitation has decreased from 30% in 2019-20 to 23% in 2023-24.

Table 7: Discharge status (excluding in-hospital deaths), 2018–19 to 2022–23

	Rehabilitation n (%)	Home n (%)	Residential aged care facility n (%)	Hospital for convalescence n (%)	Other n (%)	Total
2019-20	958 (29.8)	1,766 (54.9)	108 (3.4)	264 (8.2)	120 (3.7)	3,216
2020-21	892 (25.1)	2,099 (59.0)	121 (3.4)	303 (8.5)	141 (4.0)	3,556
2021-22	838 (23.4)	2,157 (60.3)	156 (4.4)	276 (7.7)	150 (4.2)	3,577
2022-23	864 (22.8)	2,322 (61.2)	169 (4.5)	268 (7.1)	170 (4.5)	3,793
2023-24	899 (22.8)	2,394 (60.8)	167 (4.2)	310 (7.9)	167 (4.2)	3,937

Trauma Deaths

The annual report typically includes data about pre-hospital deaths from the National Coronial Information System (NCIS). However, the 2023-24 data were not complete and available for inclusion at the time of preparation of this report. Data pertaining to in-hospital deaths only are presented.

The registry recorded 545 in-hospital deaths in 2023-24.

The relative risk of in-hospital death16 for major trauma in 2023-24 has not changed when compared to 2019-20.

In-hospital trauma deaths

The registry recorded 545 in-hospital deaths in 2023-24–23 (12.2%) compared with 539 (12.4%) in 2022-23 and 426 (11.7%) in 2019-20 (Table 8). The relative risk of in-hospital death has not changed in the last five years for all major trauma patients, patients with an ISS more than 12 and in patients under the age of 65 with an ISS more than 12 (Table 8).

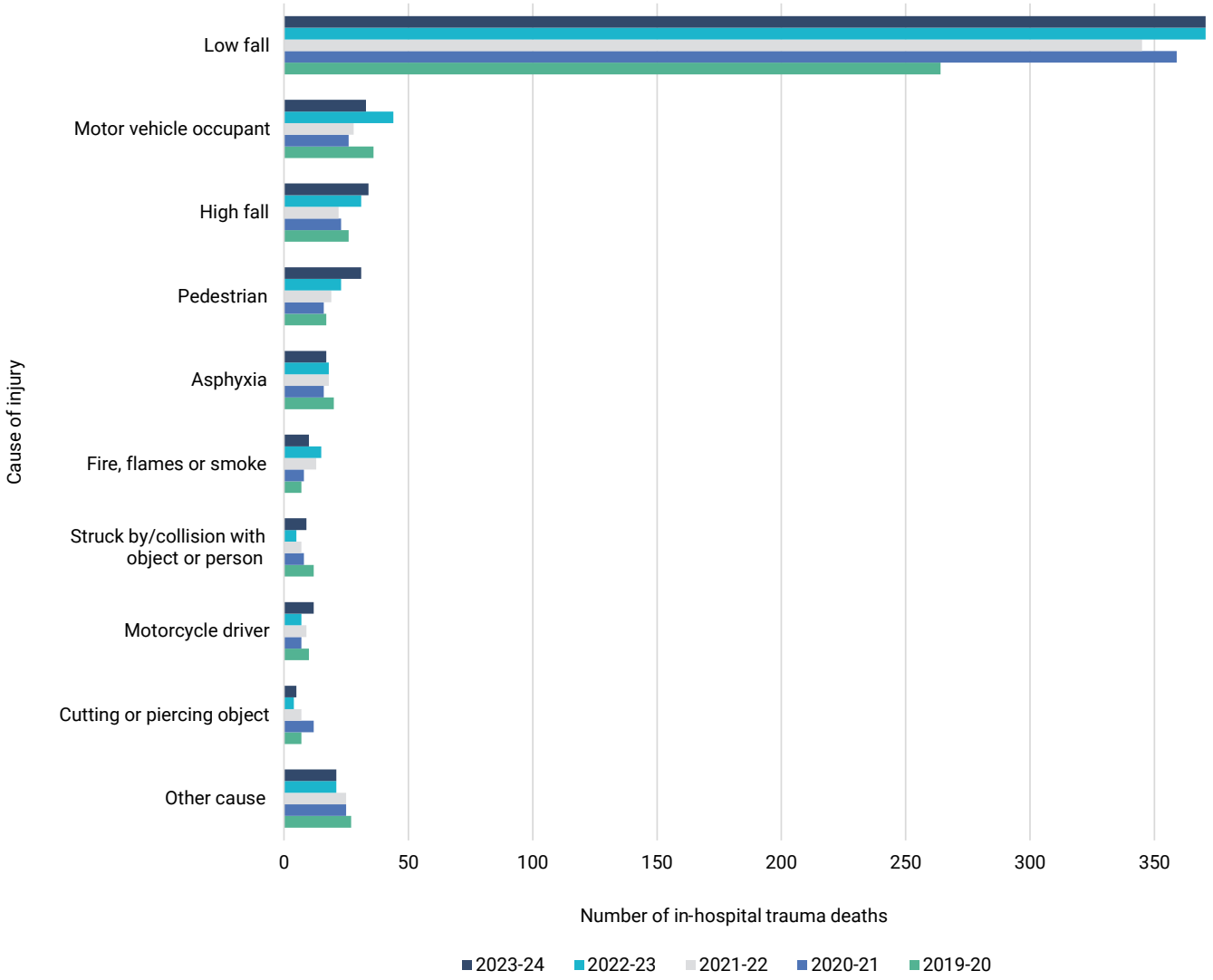
Table 8: In-hospital mortality rate and adjusted relative risk* of death of major trauma patients, 2019–20 to 2023-24

	Rehabilitation n (%)	Home n (%)	Residential aged care facility n (%)	Hospital for convalescence n (%)	Other n (%)	Total
2019-20	958 (29.8)	1,766 (54.9)	108 (3.4)	264 (8.2)	120 (3.7)	3,216
2020-21	892 (25.1)	2,099 (59.0)	121 (3.4)	303 (8.5)	141 (4.0)	3,556
2021-22	838 (23.4)	2,157 (60.3)	156 (4.4)	276 (7.7)	150 (4.2)	3,577
2022-23	864 (22.8)	2,322 (61.2)	169 (4.5)	268 (7.1)	170 (4.5)	3,793
2023-24	899 (22.8)	2,394 (60.8)	167 (4.2)	310 (7.9)	167 (4.2)	3,937

Cause of injury for VSTR in-hospital deaths

Low falls were the most common cause of injury for in-hospital deaths, accounting for 68% of in-hospital deaths in 2023-24 (Figure 10). The case fatality rate of in-hospital deaths for major trauma patients injured in a low fall was 21% in 2019-20, 23% in 2021-22, and 22% in 2023-24. The in-hospital case fatality rate for transport-related major trauma was 5.6% in 2019-20, 4.8% in 2021–22 and 5.3% in 2023-24.

Figure 10: Cause of injury for in-hospital trauma deaths, 2019-20 to 2023-24



In-hospital trauma death rate by age group

The in-hospital death rate increases for major trauma patients aged 65 years and over, and is highest in the group 85 years and older (Figure 11). There is some evidence of a decline in in-hospital mortality in patients aged 75 years and over in recent years.

Figure 11: In-hospital trauma death rate by age group, 2018–19 to 2022–23

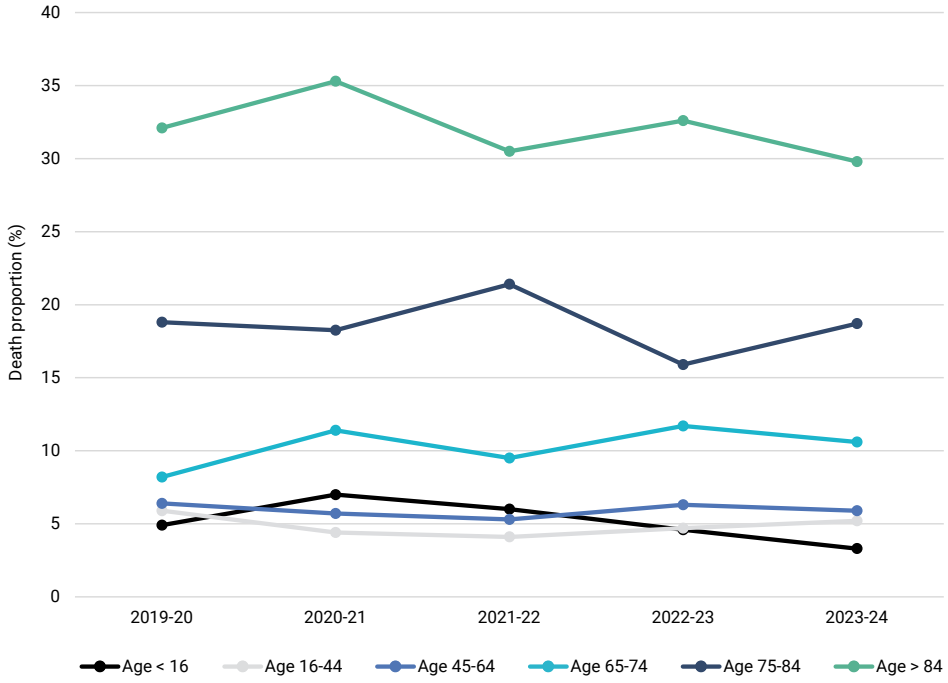
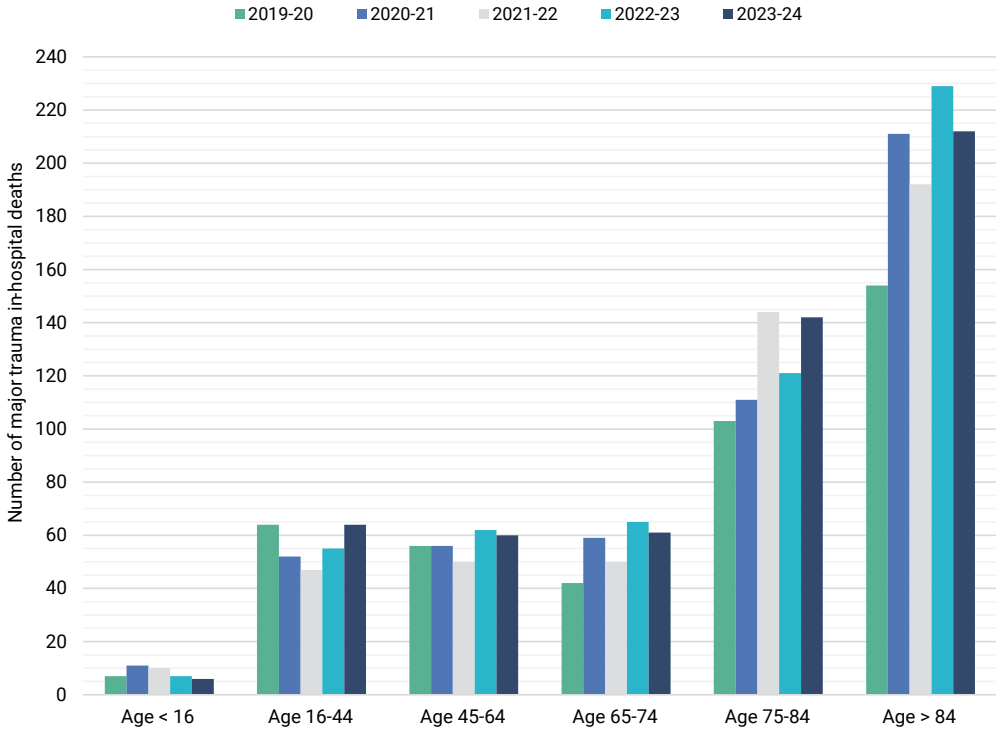


Figure 12: Number of in-hospital trauma deaths by age group, 2019-20 to 2023-24



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 proportion of adult major trauma patients with a moderate to severe TBI making a good recovery, adjusted for socioeconomic, demographic and injury factors, has decreased over time from 40% in 2018-19 to 34% in 2022-23**
- **The adjusted proportion of paediatric patients experiencing a good functional outcome has increased marginally since 2018-19.**
- **The health-related quality of life outcomes of adult and paediatric major trauma patients has largely remained stable over the period 2018-19 to 2022-23.**
- **The mean EQ-5D-5L health score in the first 24 months after injury was 0.68 in 2022-23 for adults and 0.85 for paediatric patients.**

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 2023-24, this section focuses on data from earlier years: 2018-19 to 2022-23 for adult and paediatric patients, acknowledging that not all 24-month follow-up interviews may be complete for 2022-23.

For patients injured between 1 July 2018 and 30 June 2023, 82% of adult major trauma patients were successfully followed up at six months, 81% at 12 months, while 80% were followed-up at 24 months postinjury. For paediatric major trauma patients, the follow-up rates were 86% at six months, 88% at 12 months and 91% at 24 months post-injury.

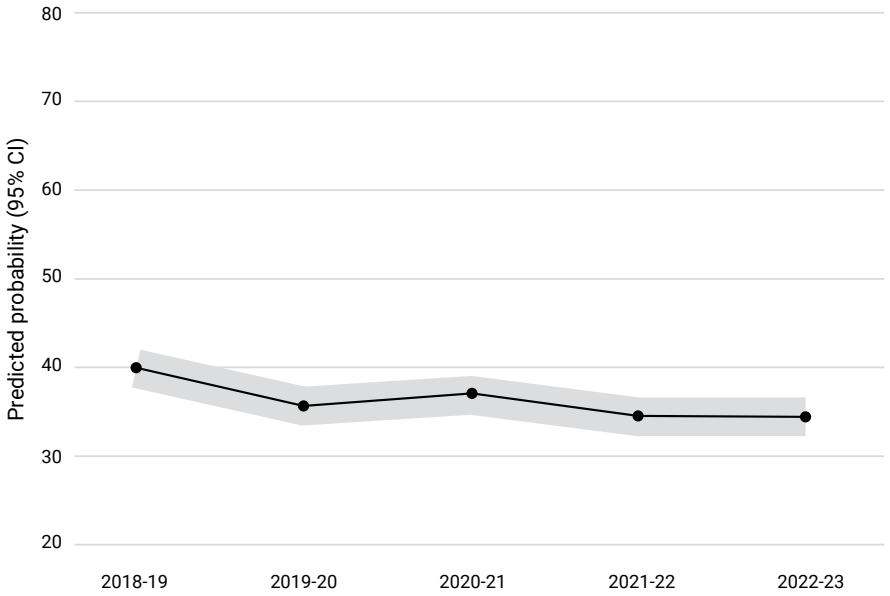
Functional outcomes

ADULTS WITH MODERATE TO SEVERE TRAUMATIC BRAIN INJURY (TBI)

To measure functional outcome in adult patients with a moderate to severe TBI (AIS score of 3 to 6 in the head region), the Glasgow Outcome Scale-Extended (GOS-E) score is used for adults. The GOS-E is used to score the patient's level of function on an eight-point scale from death through to an upper good recovery. 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 with a moderate to severe TBI making a good recovery, adjusted for socioeconomic, demographic and injury factors, has decreased over time from 40% in 2018-19 to 34% in 2022-23 (Figure 13).

Figure 13: Predicted probability (95% CI) of a good recovery for adult major trauma patients adjusted for socioeconomic, demographic and injury factors, 2018-19 to 2022-23

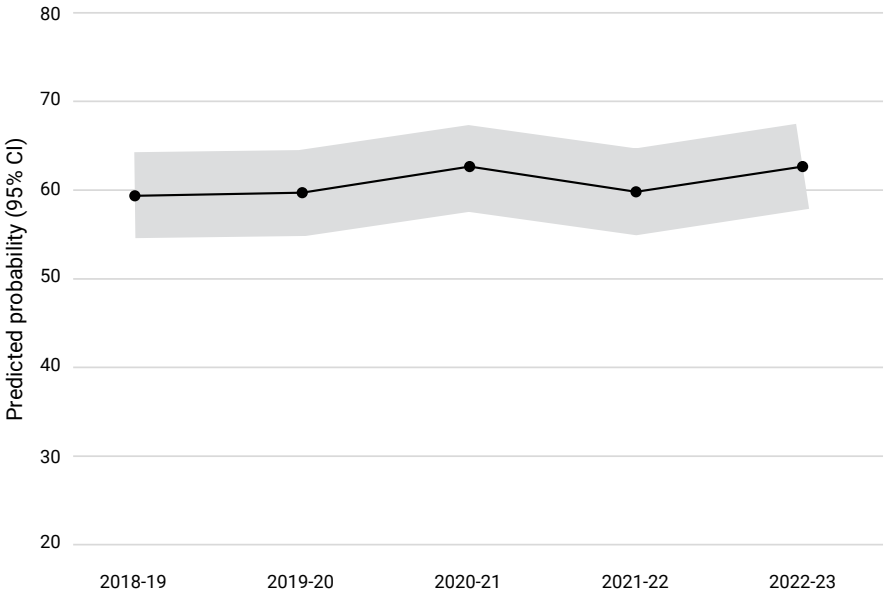


PAEDIATRIC MAJOR TRAUMA PATIENTS

The King's Outcome Scale for Closed Head Injury (KOSCHI) is used for children to measure overall level of function. The KOSCHI is used to score the patient's level of function on an eight-point scale from death through to 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 probability of paediatric patients experiencing a good functional outcome has increased marginally since 2018-19 (Figure 14).

Figure 14: Predicted probability (95% CI) of a good recovery for paediatric major trauma patients adjusted for socioeconomic, demographic and injury factors, 2018-19 to 2022-23



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. The EQ-5D-5L summary score represents a person's healthrelated quality of life with 0 representing a health state equivalent to death, 1 representing perfect health and less than 1 representing a health state worse than death.

The health-related quality of life outcomes of adult and paediatric major trauma patients has largely remained stable over the period 2018-19 to 2022-23 (Figure 15 and Figure 16). The mean EQ-5D-5L health score in the first 24 months after injury was 0.68 in 2022-23 for adults and 0.85 for paediatric patients.

Figure 15: Predicted mean (95% CI) EQ-5D-5L summary score of adult major trauma patients adjusted for socioeconomic, demographic and injury factors, 2018–19 to 2022–23

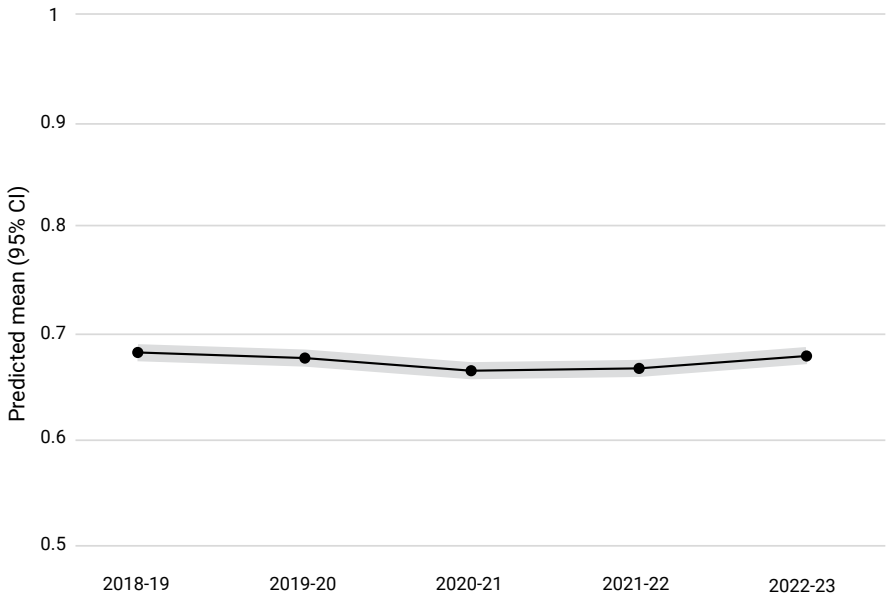
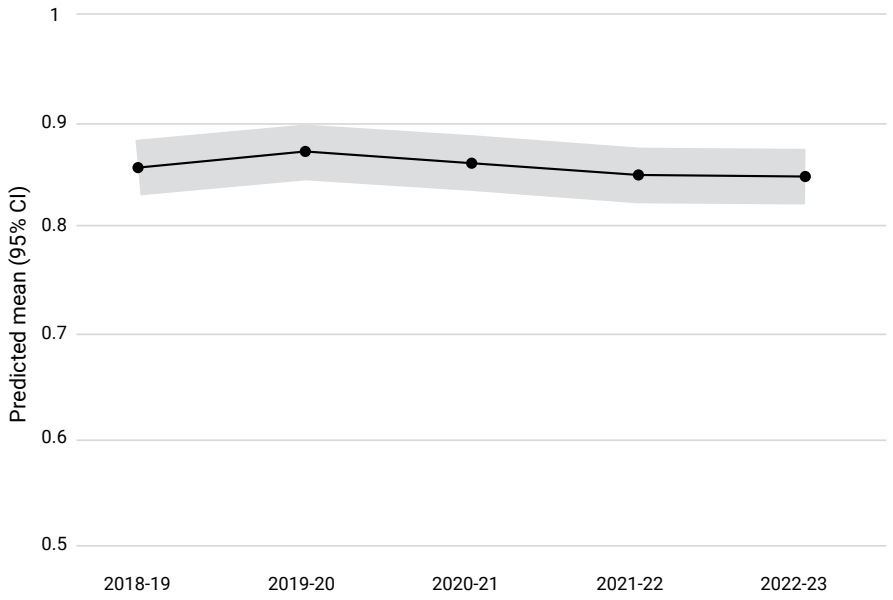


Figure 16: Predicted mean (95% CI) EQ-5D-Y-5L summary score for paediatric major trauma patients adjusted for socioeconomic, demographic and injury factors, 2018-19 to 2022-23



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. There were insufficient closed cases on the NCIS to enable inclusion in this report for the 2023-24 year.

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:
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 postdischarge 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 3:
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 2023 to 30 June 2024 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 2023 to 30 June 2024, 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 Ben Beck (Chief Investigator, VSTORM)
- Ms Louise Kelly (Senior Project Officer, Clinical Registries, Victorian Agency for Health Information)
- Dr Gabby O'Connor (Emergency Physician, Austin Health)
- Professor Jennie Ponsford (Director, Monash-Epworth Rehabilitation Research Centre)
- Dr Bruce Bartley (Emergency Department, University Hospital Geelong)
- Professor Mark Fitzgerald (Director of Trauma Services, The Alfred)
- Mr Peter Trethewey (Chief Executive Officer, AQA Victoria Ltd) - resigned December 2023
- Associate Professor Tim Baker (Director, Centre for Rural Emergency Medicine)
- Mr David Read (Head of Trauma, The Royal Melbourne Hospital)
- Ms Beth Costa (Lead Evidence and Evaluation Strategy, Sectors and Research, TAC)
- Ms Cassie Citroen (Senior Analyst, Analytics Governance and Strategy, TAC) - resigned August 2023
- Dr Troy O'Brien (FACEM, University Hospital Geelong)
- Dr Stuart Lewena (Director of Emergency Medicine, RCH)
- Mr Jason McClure (JM) (Director, Adult Retrieval Victoria) - resigned November 2023

Attendees:

- Ms Sue McLellan (Trauma Registry Data Manager, VSTORM)
- Ms Pam Hayes (Senior Research Officer, VSTORM)

APPENDIX 4:
TRAUMA RECEIVING HEALTH SERVICES 2019-20 TO 2023-24

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. Provision of the data to the registry is mandatory for trauma-receiving hospitals in the Victorian State Trauma System. The Registry operates under the approval of Department of Health and Human Services and Monash University human research ethics committees and has also been granted approval by the Department of Justice Human Research Ethics Committee for access to the National Coronial Information System for trauma-related deaths.

Trauma service level	Hospital
Major trauma service	Bayside 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
	Western Health: Footscray Hospital
Metropolitan primary care service	Bayside Health: Sandringham and District Memorial Hospital
	Eastern Health: Angliss Hospital
	Epworth HealthCare: Epworth Richmond
	Knox Private Hospital
	Mercy Public Hospitals Inc: The Mercy Hospital Werribee
	Peninsula Health: Rosebud Hospital
	Monash Health: Monash Medical Centre, Moorabbin Campus
	Monash Health: Monash Medical Centre, Casey Campus
	Western Health: Sunshine Hospital
	Western Health: Williamstown Hospital

BARWON-SOUTH WESTERN REGION

Trauma service level	Hospital
Regional trauma service	Barwon Health: The Geelong Hospital
	South West Healthcare (Warrnambool Campus)
	Western District Health Service (Hamilton)
	Casterton Memorial Hospital
Urgent care service	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
	Balmoral Bush Nursing Centre
	Cobden District Health Service
	Colac Area Health (Birregurra Community Health Centre)
	Dartmoor and District Bush Nursing Centre Inc.
Primary care service	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

Trauma service level	Hospital
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

Trauma service level	Hospital
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
	Ballan District Health and Care
Primary care service	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

Trauma service level	Hospital
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
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

Trauma service level	Hospital
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 5:
MTS TRAUMA PROGRAM MANAGERS AND VSTR DATA COLLECTORS, JULY 2023 TO JUNE 2024

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
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	Electronic data
The Northern Hospital	Sharon Klim
Frankston Hospital	Miss Erin Magee
Monash Medical Centre	Amanda Hulley
Monash Children's Hospital	Amanda Hulley
Dandenong Hospital	Electronic data
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
Hume Region	Les Lambert
Loddon Mallee Region	Mrs Patricia Allieu
	Narelle Cottrell
VSTR Outcomes Coordinator	Ms Melissa Hart
VSTR Outcomes Coordinator	Ms Bek Skahill
	Outcomes data collection staff

APPENDIX 6:
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
Conscious state	GCS <13	GCS <15

APPENDIX 7: 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

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VSTR Victorian State Trauma Registry

MONASH University

TAC Transport Accident Commission

VICTORIA State Government