ANNUAL REPORT
1 JULY 2021 TO 30 JUNE 2022

AUSTRALIA
NEW ZEALAND
TRAUMA REGISTRY
Management of the
Severely Injured

ATR AUSTRALIA NEW ZEALAND TRAUMA REGISTRY

ANNUAL REPORT
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FOREWORD

It is with great pleasure that we present the Australia New Zealand Trauma Registry (ATR) 2021/22 annual report.

A key enabler to the ATR has been the funding provided by three agencies, the Australian Federal Department of Health and Aged Care, The Bureau of Infrastructure and Transport Research Economics (BITRE), and the New Zealand Accident Compensation Corporation (ACC). This year, we celebrate a 4-year funding contract with the Department of Health and Aged Care under the National Clinical Quality Registry (CQR) Program. The funding period starts July 2023 and will enable the registry to:

- Launch the ATR Portal – an interactive, secure online platform to enhance 'feedback loop' reporting to clinicians and patients.
- Increase national participation to support more sites to enter data into the ATR, with a particular focus on regional/remote communities.
- Undertake data linkage with other national collections to add to the value of the ATR data.
- Work towards better identification of specific population subsets, including indigenous status.

We understand that contributing sites and states have collected data differently over the years, however there is a growing consensus on collection and standardisation to align with agreed quality indicators - such as alcohol testing and trauma call initiation. Furthermore, we are now able to collect data for all Royal Australasian College of Surgeons (RACS) indicators at most sites, which will enable us to provide insights on trauma quality and improvement processes in our future reports. At each of the 34 participating sites, there are clinical staff, data collectors and other support staff who all make important contributions to the ATR and we thank them for their efforts. We rely on the quality of the data submitted and this helps us to identify variations in patient care for benchmarking.

The governance of the ATR has been strengthened. Agreement for a data governance group which is separate from the Board has been approved and will be comprised of multi-disciplinary membership to ensure all requests for ATR data are ethical and appropriate. The Privacy Framework for the ATR has been endorsed and has been made available on the website. Work has progressed on the transfer to the National Mutual Acceptance scheme which will, once approved, reduce the administration required for individual jurisdiction approval. These developments will allow the ATR to continue to fulfil its role as a leading clinical quality registry.

We acknowledge that there is more work ahead to optimise the value of this bi-national resource. Our goal is to have a population-based registry and we are actively working to bring on more secondary centres and non-major centres into the ATR. There are also opportunities to link with national death registry data to understand the relationship between pre-hospital and in-hospital deaths. Additionally, linkage between the ATR and routinely collected admissions data will enable better understanding of the patient journey outside the major trauma services.

At its core, the ATR is an important tool to drive quality improvement in trauma care in Australia and New Zealand. In this report we have highlighted areas where we believe there is opportunity to improve the quality of trauma care such as the special analysis on serious traumatic brain injury as well as patients who have been transferred from regional areas to a major trauma hospital. It is important to understand where unexplained variation occurs to enable effort to be targeted at addressing these variations.

This annual report is a collaborative effort by everyone involved in the collection of data and the care of the trauma patient. We acknowledge the efforts of all who have contributed to this report and in particular the Department of Health, BITRE, and the ACC, who fund this work to support quality trauma care.

Thank you to Professor Kate Curtis for years of commitment and contributions to the establishment of the ATR and exceptional service as Co-Chair of the Registry.

Finally, a huge thanks to all the dedicated nurses, doctors, paramedics, administrators, allied health workers, rehabilitators and researchers that contribute to the recovery, rehabilitation and reintegration of the severely injured.

Professor Mark Fitzgerald
Co-chair ATR Steering Committee

Ms Siobhan Isles
Co-chair ATR Steering Committee

on behalf of the ATR Board.

ATR Board Members

Professor Mark Fitzgerald

Ms Siobhan Isles

Professor Peter Cameron

Dr Don Campbell

Associate Professor Grant Christey

Professor Ian Civil

Associate Professor Daniel Ellis

Dr Yen Kim

Professor Kirsten Vallmuur

2021-22 YEAR IN REVIEW
AUSTRALIA

DEMOGRAPHICS

9,102 severely injured

median **AGE 52**

73% MALE

34% occurred on the WEEKEND

CAUSE OF INJURY

4.0% penetrating trauma

<1% BURNS

94.2% BLUNT trauma

44.9% TRANSPORT RELATED

38.6% FALLS

PLACE OF INJURY

43.1% streets & highways

31.8% home

PRE-HOSPITAL

69.5% direct from scene to definitive HOSPITAL

Median time from injury to definitive care **1hr 36mins**

HOSPITAL

Median time spent in ED **4hrs 42mins**

MEDIAN length of stay **7 days**

32.3% admitted to ICU

median ICU length of stay **4.0 DAYS**

OUTCOMES

9.4% in-hospital deaths

57.8% of deaths aged 70+

9.6% of deaths OCCURRED IN ED

65.2% discharged **home**

16.6% to rehabilitation

2021-22 YEAR IN REVIEW

NEW ZEALAND

DEMOGRAPHICS

1,734 severely injured

median AGE 48

74% MALE

36% occurred on the WEEKEND

CAUSE OF INJURY

4.5% penetrating trauma

1.3% BURNS

94.1% BLUNT trauma

47.9% TRANSPORT RELATED

32.7% FALLS

PLACE OF INJURY

46.4% streets & highways

26.6% home

PRE-HOSPITAL

76.6% direct from scene to definitive HOSPITAL

Median time from injury to definitive care **1hr 42mins**

HOSPITAL

Median time spent in ED **4hrs 43mins**

median length of stay **7.8 days**

27.0% admitted to ICU

median ICU length of stay **3.5 DAYS**

OUTCOMES

8.9% in-hospital deaths

47.4% of deaths aged 70+

10.3% of deaths OCCURRED IN ED

56.1% discharged **home**

23.0% to rehabilitation

EXECUTIVE SUMMARY

ATR and quality improvement in the Australian and New Zealand trauma system

The primary purpose of the Australia and New Zealand Trauma Registry (ATR) is to drive quality improvement across the contributing trauma systems, from the time of injury through each stage of care.

Whilst of interest to researchers, trauma services have limited ability to modify caseload and patterns. The areas where trauma services can make an impact is in the care of the seriously injured patient from the time and point of injury through pre-hospital care, hospital care, and rehabilitation. A contemporary trauma system collects data on all major trauma patients and identifies areas of unwarranted variation in processes of care and outcomes and work to address these issues.

This year we have highlighted two key areas:

Traumatic Brain Injury:

Traumatic Brain Injury (TBI) is a major public health concern worldwide [1, 2]. In Australia, TBI is a leading cause of injury-related hospitalizations and deaths, imposing a considerable burden on individuals, families, and the healthcare system [3].

The TBI burden is highlighted by the 15.1% Case Fatality Rate for subjects with TBI - approximately double the fatality rate of patients with no TBI (7.3%). The mechanism of injury for deaths in the TBI cohort were transport-related for children aged under 15 years (46.1%) and for adults aged between ≥16 and ≤69 years (60.9%). Falls accounted for 82.3% of TBI deaths in adults aged 70 years and over.

Not only a major cause of death from injury, TBI is also associated with medium and long term sequalae that determine the functional independence of survivors.

There is a scarcity of Australian and New Zealand baseline data regarding outcomes from TBI, as well as the determinants of outcomes. Identifying determinants is important both for the clinical management of individual patients and improving patient care at a system level.

For example, 4,186 (38.6%) patients had a moderate to severe TBI. However, there was variance between jurisdictions from 27.7% to 45.3%. We need to understand why.

Clinically, accurate prognostic predictions are important when communicating with patients and their families, as well as selecting treatment approaches. At a system level, these data are essential for identifying modifiable factors to improve patient care, and to inform development of strategies to ensure the most favourable patient outcomes [4].

Research work funded by the Medical Research Future Fund and the National Health and Medical Research Council is currently utilising ATR data to understand why these variances occur, what can be done to address them, and how this will reduce deaths as well as the improve survivors' rates of functional independence.

Transferred patients:

In an ideal trauma system around 80% patients would be transported direct from scene to the most appropriate hospital for definitive care, however the reality is challenging because of the vast distances needed to travel in some jurisdictions such as Western Australia and Northern Territory. In this report, 3,177 (29.3%) of patients with serious injury were transferred from the first hospital to another hospital for definitive care.

Seriously injured patients in rural areas are a cohort of concern. The data we report demonstrates that patients transferred generally have higher survival rates than those admitted directly to Major Trauma Services (MTS). It has previously been noted that rural patients admitted to metropolitan major trauma services have a survivor bias, and the ATR does not currently report those who die during transit and/or prior to arrival [5]. These prearrival deaths are recorded in Coronial datasets, and linkages with the ATR are required to fully understand what can be done to improve rural injury outcomes.

High-performing trauma systems ensure that triage criteria are in place to ensure most trauma patients are taken to the most appropriate hospital from the scene. In addition, health facilities in remote locations should have access to advice and have the capability to provide a reasonable level of care for the seriously injured for a period of time until they can be transported.

Data collection on all patients in each jurisdiction and linkages with mortality datasets are important features which the ATR is working towards. Further research is currently being undertaken to understand the processes of care and outcomes for transferred patients and to identify new technologies that may improve initial care and outcomes.

Outcomes

The Case Fatality Rate was 9.7% and has remained consistent with previous years. The risk-adjusted mortality rate indicates outliers above the 95% confidence interval in the age group 70 and over, and no outliers in the paediatric or under 70 age groups.

The discharge destination to inpatient rehabilitation between jurisdictions ranges from 7.1% to 23.5%. It is noted that many patients with TBI would benefit from inpatient rehabilitation. Further research into the variations is required to understand why this has occurred.

Data quality

The ATR contains high-quality data and recent additions will support analysis by ethnicity and other parameters. This year additional data points have been included into the minimum dataset. These include ethnicity data to determine the burden of injury and outcomes particularly for Aboriginal and Torres Strait Islanders, and processes of care such as the initiation of trauma calls.

Opportunities to improve the ATR contributions to a high-performing trauma systems include:

- Recording of intent of injury, particularly in the paediatric cohort,
- Recording of blood alcohol level,
- Population coverage of all seriously injured in each jurisdiction and as a priority in the major trauma hospitals which do not currently contribute to the ATR and
- Linking with national collections such as mortality.

In addition, benchmarking outcomes for older patients is particularly difficult as comorbidities and frailty have a significant influence on outcomes. In the future we expect to be better able to compare risk-adjusted outcomes with the addition of the "frailty index" to the data dictionary [6].

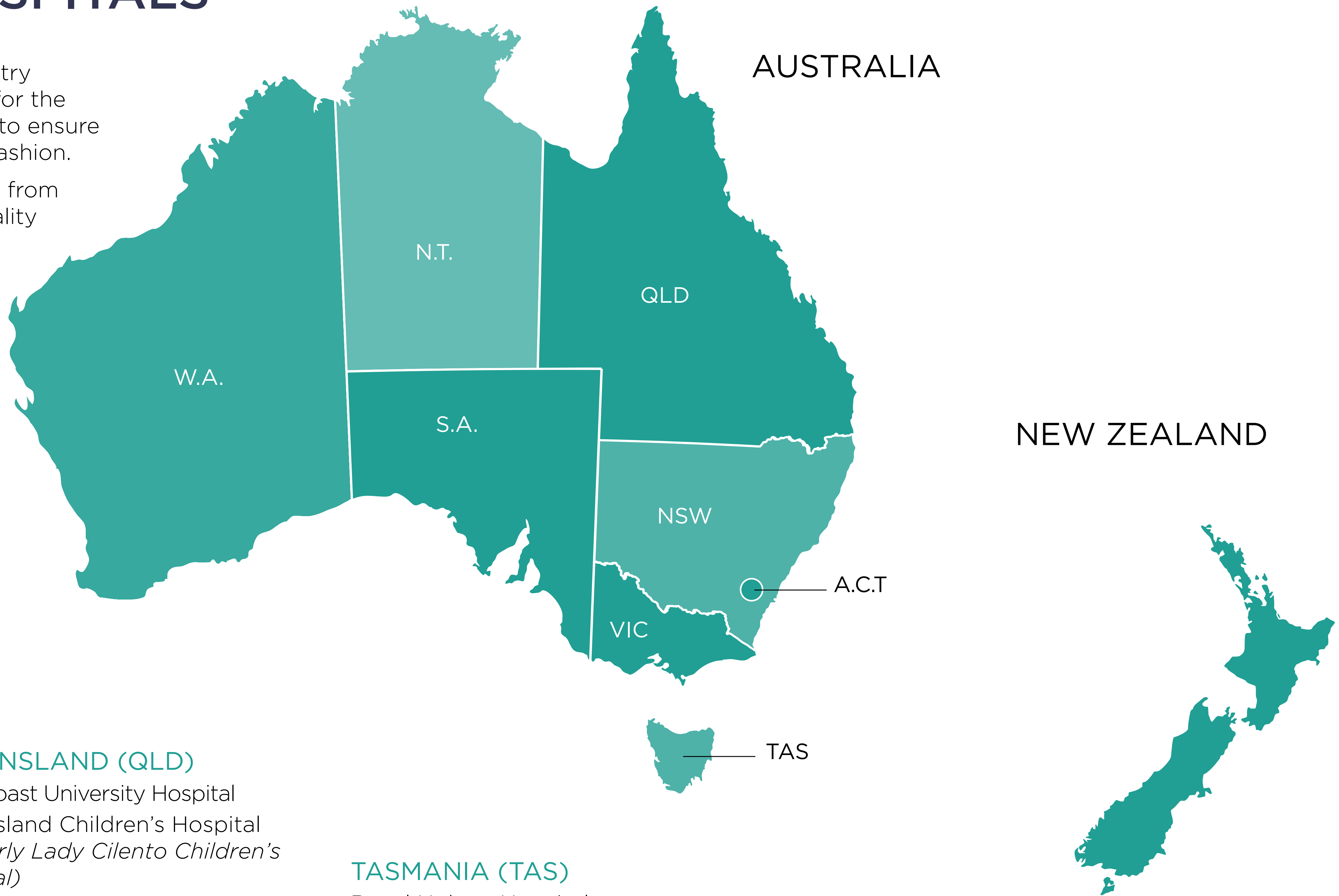
Professor Peter Cameron
University Representative
Monash University

Ancelin McKimmie
ATR Manager

CONTRIBUTING HOSPITALS

The ATR would like to thank the Trauma Registry staff from all contributing registries and sites for the invaluable work they perform on a daily basis to ensure the Registry receives quality data in a timely fashion.

The ATR has 7 years of quality Australian data from 1 July 2015 to 30 June 2022 and five years quality New Zealand data from 1 July 2017 to 30 June 2022. Sites which have commenced data submissions after these start dates are mentioned below.



JURISDICTIONS

AUSTRALIAN CAPITAL TERRITORY (A.C.T.)

Canberra Hospital

NEW SOUTH WALES (N.S.W.)

NSW data submitted by the Institute of Trauma and Injury Management (ITIM)

Children's Hospital, Westmead
John Hunter Children's Hospital
John Hunter Hospital
Liverpool Hospital
Royal North Shore Hospital
Royal Prince Alfred Hospital
St Vincent's Hospital
Sydney Children's Hospital
Westmead Hospital

NORTHERN TERRITORY (N.T.)

Royal Darwin Hospital

QUEENSLAND (QLD)

Gold Coast University Hospital
Queensland Children's Hospital *(formerly Lady Cilento Children's Hospital)*
Royal Brisbane and Women's Hospital
Townsville Hospital (from 1 January 2020)
Sunshine Coast University Hospital (from 1 October 2018)

SOUTH AUSTRALIA (S.A.)

S.A. data submitted by the S.A. Department of Health

Flinders Medical Centre
Royal Adelaide Hospital
Women's and Children's Hospital
Lyell McEwin (from 1 January 2018)

TASMANIA (TAS)

Royal Hobart Hospital (from 1 April 2020)

VICTORIA (VIC)

Victorian data submitted by the Victorian State Trauma Registry (VSTR)

Alfred Hospital
Royal Melbourne Hospital
Royal Children's Hospital

WESTERN AUSTRALIA (W.A.)

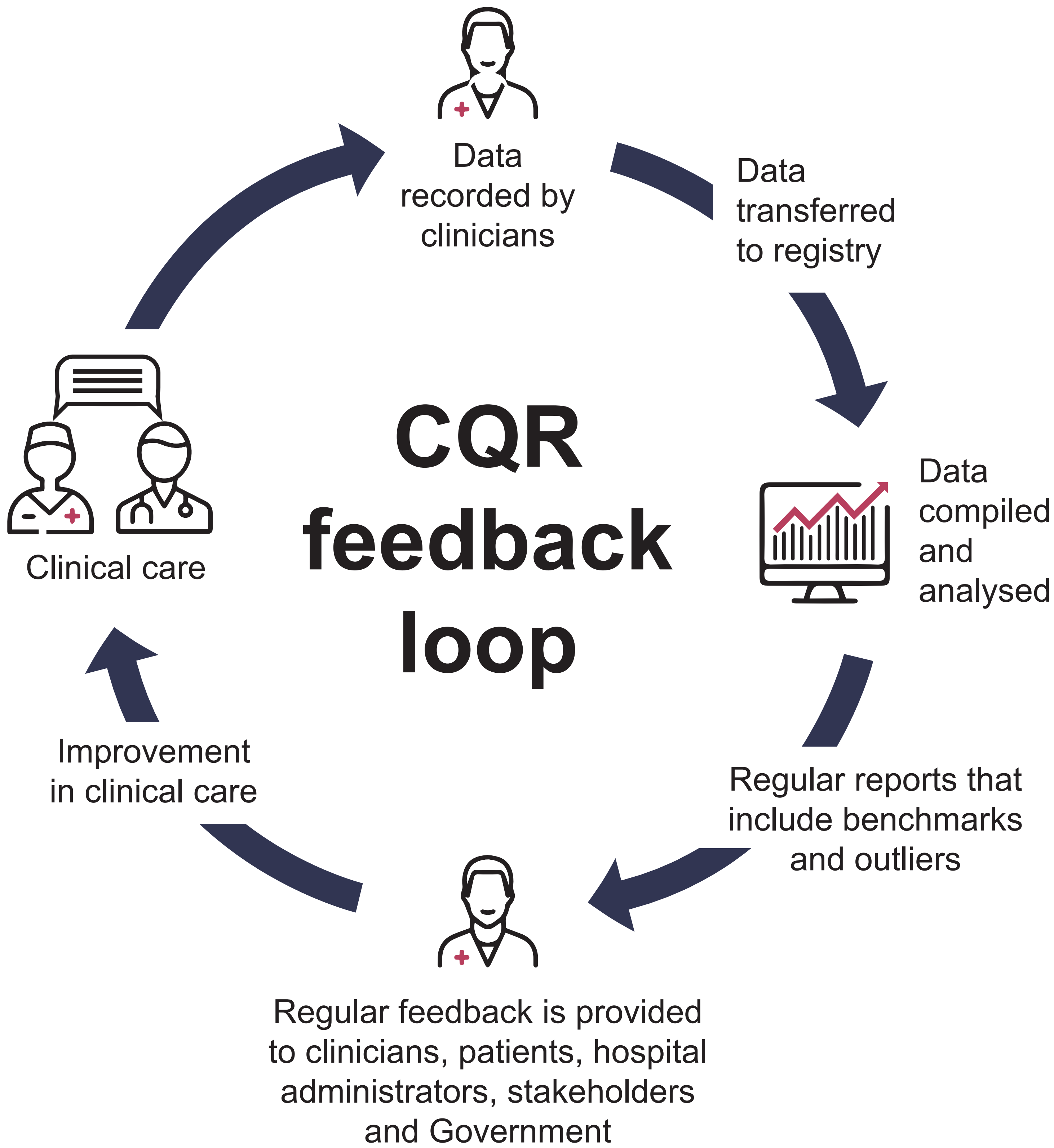
Perth Children's Hospital *(formerly Princess Margaret Hospital)*
Royal Perth Hospital

NEW ZEALAND (N.Z.)

New Zealand data submitted by the New Zealand National Trauma Network (NZMTCN)

Auckland City Hospital
Starship Hospital
Middlemore Hospital
Waikato Hospital
Wellington Regional Hospital
Christchurch Hospital
Dunedin Hospital

THE ATR AS A CLINICAL QUALITY REGISTRY



Operating since 2012, the ATR has established itself as a leading clinical quality registry (CQR). The Australian Commission on Safety and Quality in Health Care has promoted the importance of CQRs as drivers of quality improvement for over a decade, allocating trauma to the second highest priority due the high burden of disease, increasing costs and unsatisfactory outcomes associated with poor quality trauma care.

In 2016, funding for the Australian Trauma Registry was the number one recommendation from the Road Safety Senate Committee. Funding was subsequently obtained from the Department of Health and the Bureau of Infrastructure, Transport, and Regional Economics to support the registry's core responsibilities and reporting. In 2018, New Zealand joined the collaboration to become the Australia New Zealand Trauma Registry (ATR), and the registry began providing risk adjusted outcomes.

The ATR is now a leading CQR, collecting pre-hospital and in-hospital data on the most severely injured patients, defined as an Injury Severity Score (ISS) greater than 12 or death following injury, from 27 Australian and seven New Zealand level 1 trauma centres. The ATR continues to recruit sites with the purpose of capturing population-based data for the severely injured.

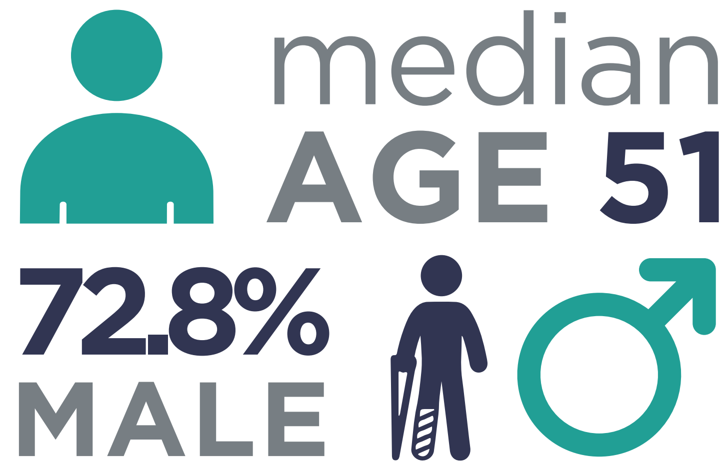
DEMOGRAPHICS

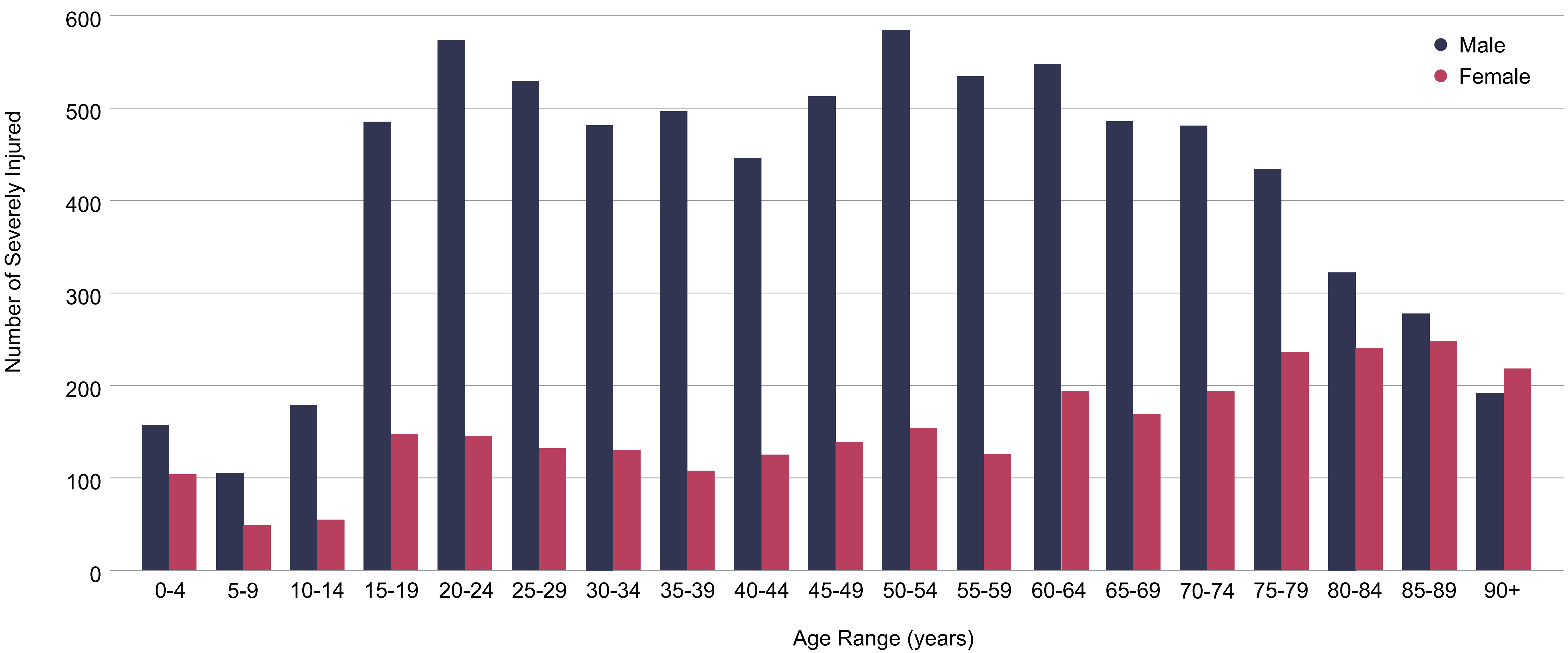
AGE AND GENDER

Incidence by age and gender showed that most severe injuries continue to involve males (72.8%). The distribution of severely injured patients according to age and gender are shown in the figure below. This is similar to the National Trauma Data Bank in the United States [7].

The median age was 51 years (IQR 30-71 years).

For males, admissions were highest in the 20-29 year and 50-56 year age groups. For females, admissions were highest in the 15-24 year and 75-89 year age groups.





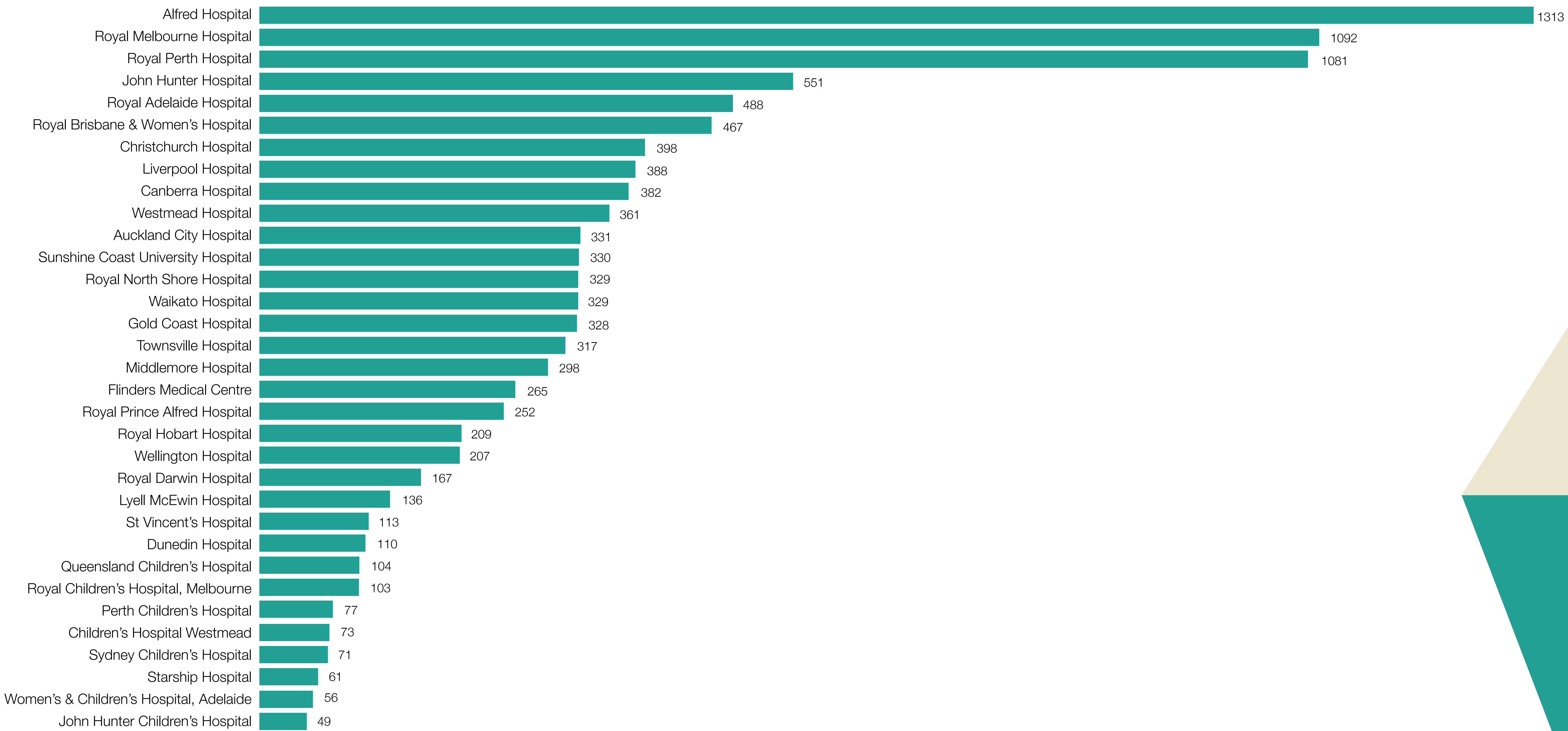
Age Group	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90+
n	259	154	233	634	719	663	612	605	573	650	741	661	744	657	677	672	563	525	410

DEMOGRAPHICS

Across the 2021-22 financial year, 10,836 episodes of severely injured were collected by the ATR. Australia provided 9,102 episodes from 26 major trauma centres and New Zealand provided 1,734 from seven trauma centres.

St George Hospital data is not included in this report as data submission for 2021/22 was incomplete. Data has not been submitted by Princess Alexandra Hospital since 2018.

Number of Severely Injured 2021-22, by Hospital



INJURY EVENT

INTENT OF INJURY

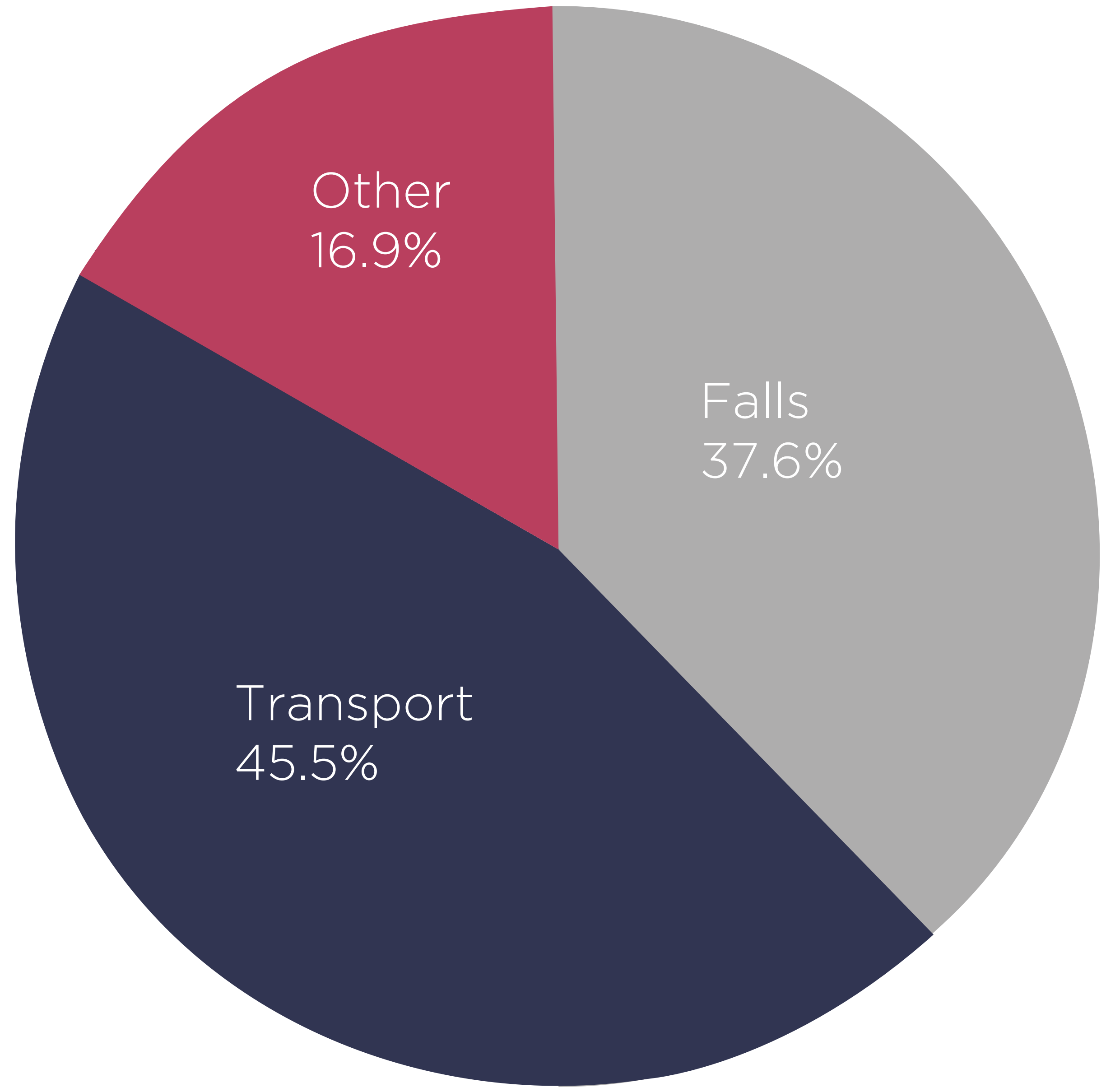
Injury intent was specified for 72.2% of all severe injuries, 96.0% of which were related to unintentional injuries. Injury intent data is not provided by New South Wales or the Northern Territory. It is anticipated that with the changeover to the updated Bi-National Trauma Minimum Data Set – which has been agreed upon by each jurisdiction – data collection for injury intent will improve in future reporting years.

TYPE OF INJURY

Bi-nationally, the dominant type of injury for 94.0% of cases was blunt injury (e.g. motor vehicle collisions, pedestrian impacts, falls, and sports injuries). Penetrating injury (e.g. stab and gunshot wounds, glass-related injuries, and impalements) accounted for 4.0% of injuries, and burns 0.9%. This is consistent with previous years.

CAUSE OF INJURY

Forty-six percent (46%) of severe injuries were transport-related, and 38% of all severe injuries were caused by falls. Combined, transport-related and falls-related injuries accounted for 84% of all severe injuries, and remain the leading cause of hospital admissions for severe injury.



Cause of Injury

INJURY EVENT

DAY OF INJURY

Approximately one third (34.2%) of severe injuries occurred on the weekend, which is consistent with previous years. Low falls remained consistent throughout the week, whereas injuries relating to motor vehicles were highest on Saturdays and motor cycle and pedal cyclist injuries peaked on the weekend.

PLACE OF INJURY

Eighty-six percent of severely injured patients had a known place of injury. Of those with a known place of injury, 43.7% occurred on the road, street or highway, followed by the home (30.8%).

The home was the most common place of injury for children aged ≤15 years (37.6%), and for adults aged ≥70 years (46.3%). The road, street or highway was the most common place of injury for all other age groups.

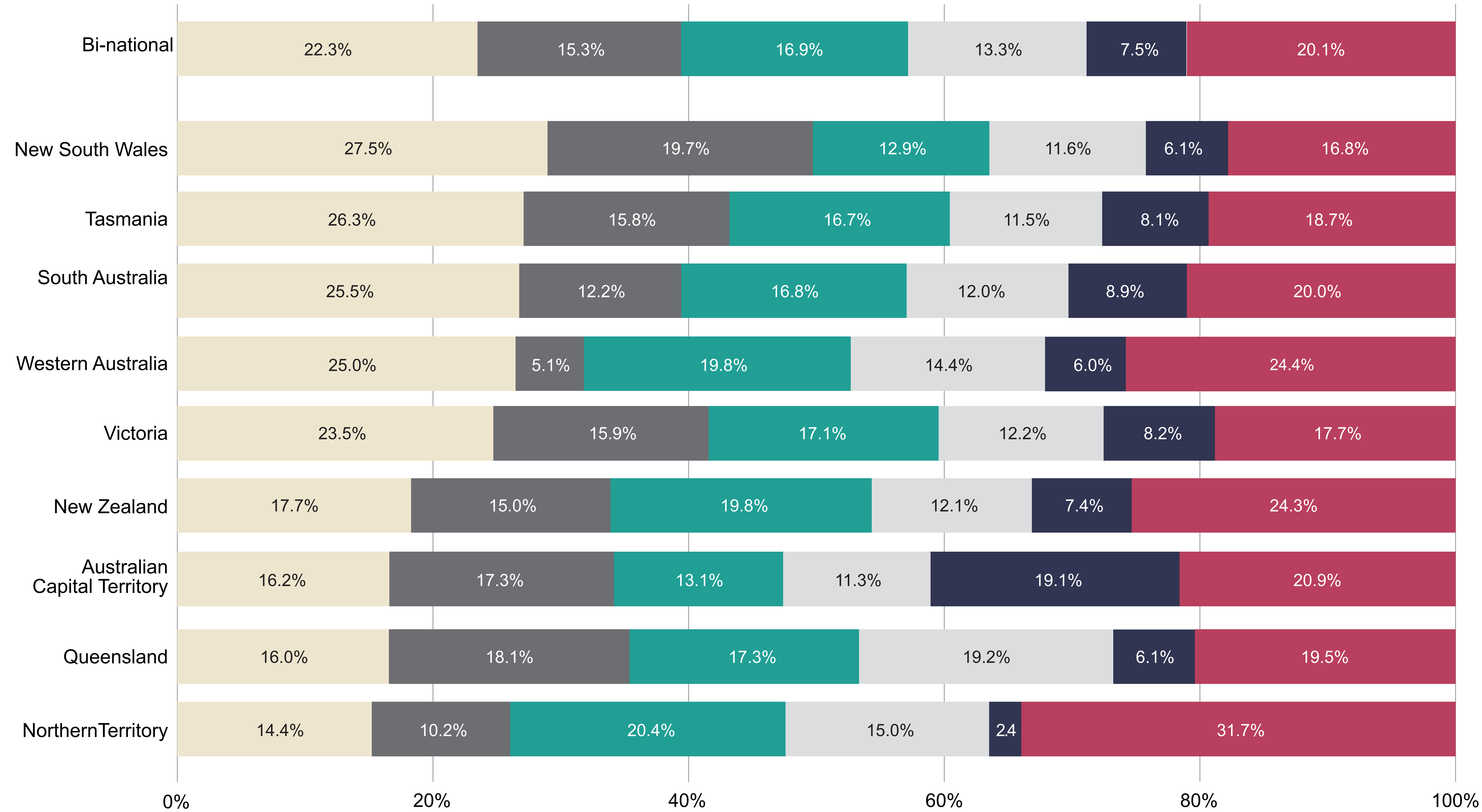
			Transport			
	High Fall	**Low Fall**	**Motor Vehicle**	**Motorcyclists**	**Pedal Cycle**	**Pedestrian**
Monday	13.6% (n=225)	13.2% (n=319)	13.3% (n=244)	8.9% (n=128)	10.9% (n=88)	10.9% (n=55)
Tuesday	12.9% (n=214)	13.5% (n=327)	12.9% (n=237)	12.2% (n=175)	8.4% (n=68)	13.5% (n=68)
Wednesday	12.2% (n=203)	14.6% (n=353)	12.2% (n=224)	9.7% (n=140)	12.7% (n=103)	14.5% (n=73)
Thursday	15.5% (n=257)	16.7% (n=360)	14.4% (n=264)	11.2% (n=161)	12.2% (n=99)	16.7% (n=84)
Friday	14.5% (n=241)	15.9% (n=360)	15.8% (n=289)	13.1% (n=188)	13.8% (n=112)	15.9% (n=80)
Saturday	17.0% (n=282)	14.5% (n=368)	17.8% (n=326)	21.6% (n=310)	22.6% (n=183)	14.5% (n=73)
Sunday	14.3% (n=238)	13.9% (n=330)	13.5% (n=247)	23.3% (n=335)	19.4% (n=157)	13.9% (n=70)
Total	100% (n=1660)	100% (n=2417)	100% (n=1831)	100% (n=1437)	100% (n=810)	100% (n=503)

INJURY EVENT

CAUSE OF INJURY BY JURISDICTIONS

Transport and falls related injuries continue to be the most common severe injuries across all jurisdictions. In 2020-21, low falls were the most prevalent cause in five of the nine jurisdictions and motor vehicle crashes were the most prevalent for two jurisdictions.

Cause of Injury by Jurisdiction



	Low Fall	Motor Vehicle	High Fall	Motorcyclists	Pedal Cyclists	Pedestrians	Other
n	2,417	1,831	1,660	1,437	810	503	2,178

INJURY

SEVERITY OF INJURY

The Injury Severity Score (ISS) is an internationally standardised approach to describing the overall severity of injury for each patient which is derived from the Abbreviated Injury Scale (AIS) 2008 [8]. Trauma patients are allocated an ISS after injury in order to determine their status as 'major trauma'. ISS is useful for predicting hospital length of stay and associated morbidity and mortality.

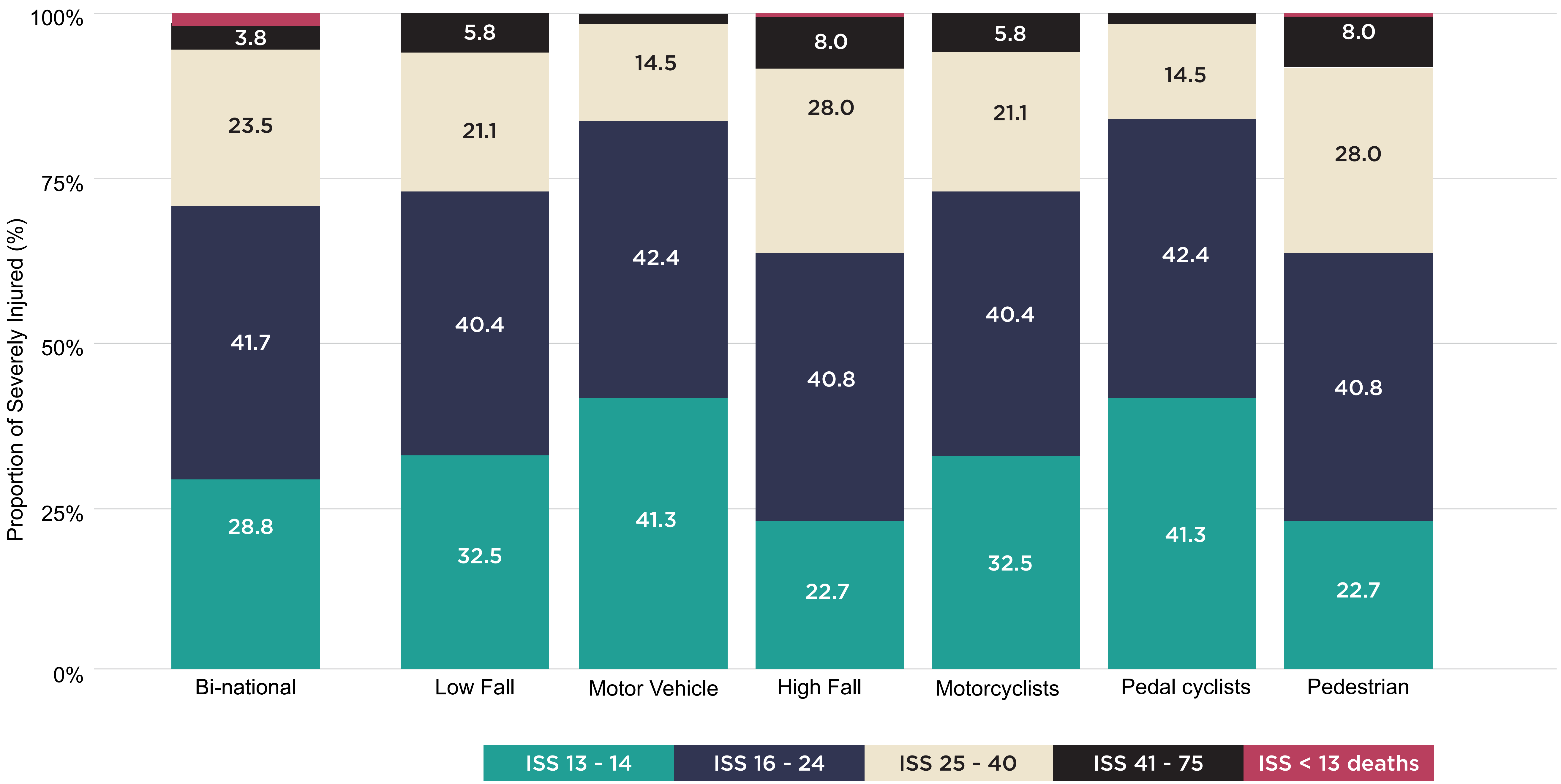
In the 2021-22 financial year, the proportion of severely injured categorised by ISS range was comparable with the previous four years. Most injuries admitted to hospital had an ISS between 16 - 24 (42%). When the cohort was broken down into gender, similar proportions by ISS range occurred. An ISS >25 was most prevalent in the low fall, high fall, and motor vehicle populations, whilst less severe injuries occurred in pedal cyclists who were hospitalised.

DEATHS WITH ISS<13

The ATR also collects data on in-hospital deaths with an ISS less than 13. For the 2021-22 financial year there were 197 patients who died with an ISS less than 13:

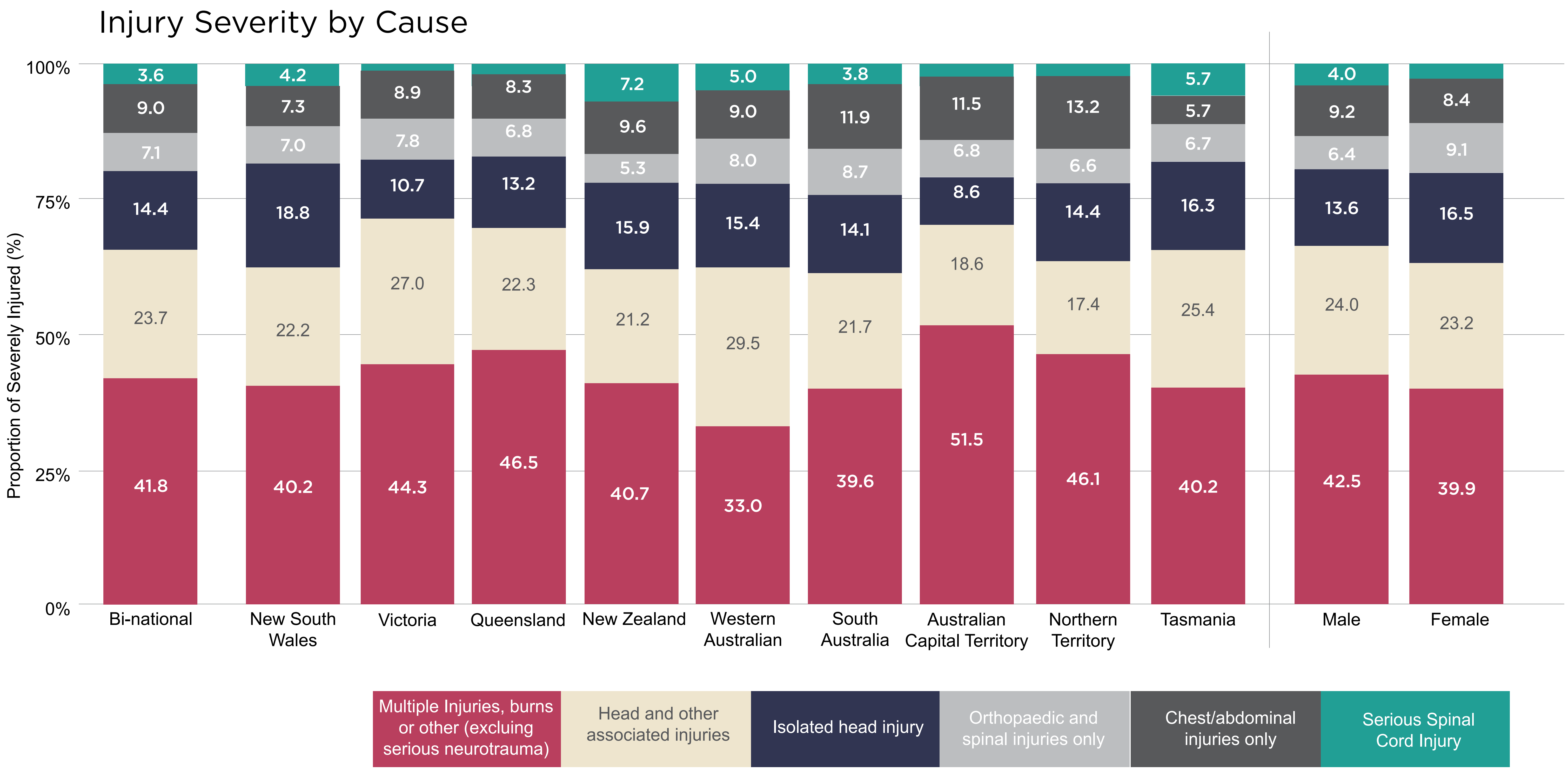
- 73% were aged ≥ 70 years
- 70% were caused by a low fall
- 9.8% died in the emergency department (n=19). The cause of death for this less severely injured group will be explored.

Injury Severity by Cause



INJURIES SUSTAINED

Multiple injuries (excluding serious neurotrauma) were the most prevalent across all jurisdictions for the severely injured, followed by 'head and other associated injuries', and 'isolated head injuries'. This is consistent with the previous annual report. Twelve patients were without AIS coding to ascertain injury severity.



Jurisdiction	Severly Injured (n)
Bi National	10,836
Victoria	2,508
New South Wales	2,187
New Zealand	1,734
Queensland	1,546

Jurisdiction	Severly Injured (n)
Western Australia	1,158
South Australia	945
Australian Capital Territory	382
Tasmania	209
Northern Territory	167

Gender	Male	Female
n	7,898	2,935

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 > 2 in addition to another injury.

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

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

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

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

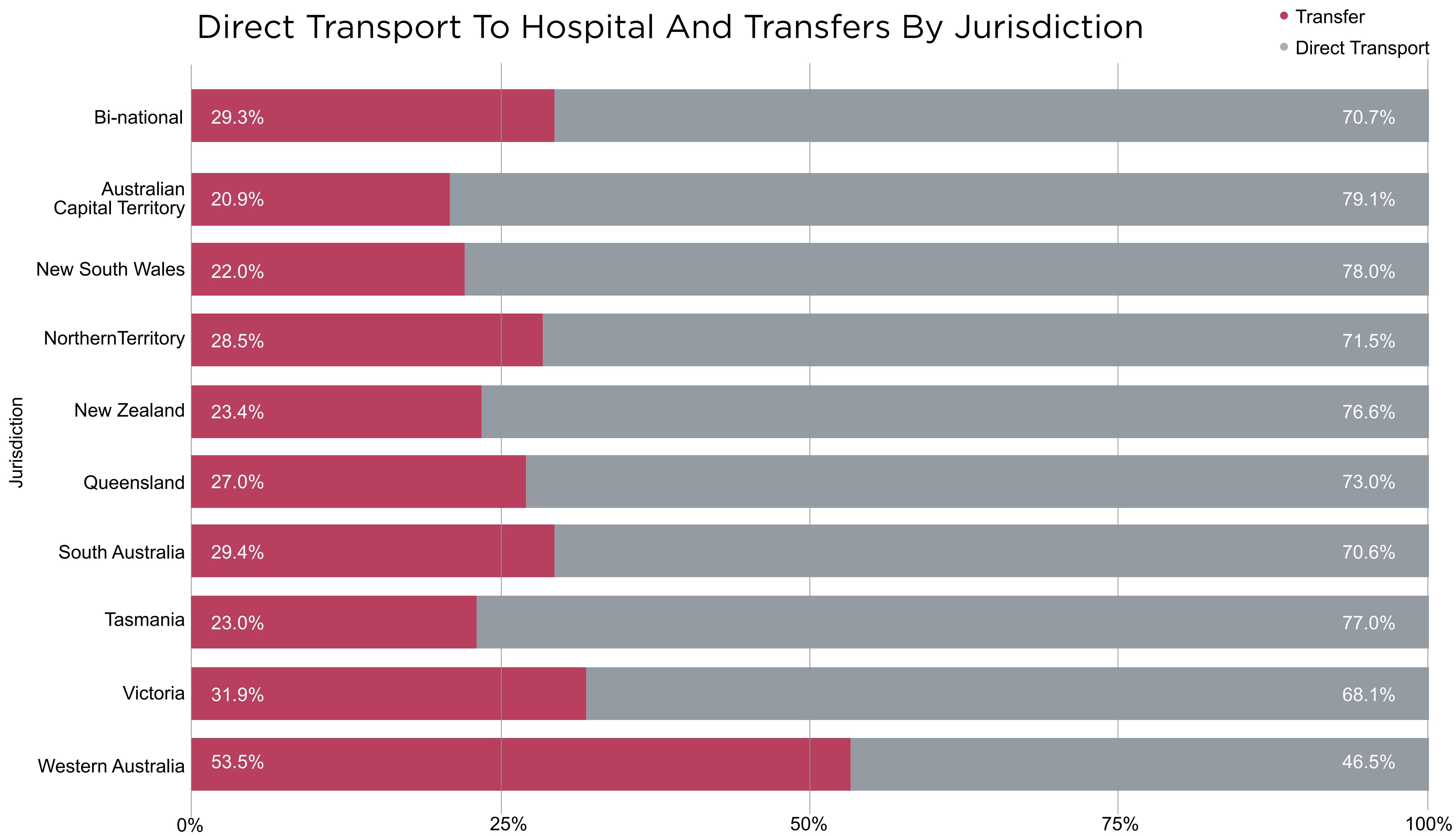
TRANSPORT TO HOSPITAL

Over two thirds (71.0%) of severely injured patients were transported from the scene to definitive care. Of those transported direct, 75.5% arrived via road ambulance, 16.1% via helicopter and 5.7% via private vehicle/walk in.

For the severely injured that arrived at a major trauma service via one or more hospitals, 58.4% were transported from the scene by road ambulance, 19.0% via private vehicle/walk-in and 4.3% via helicopter.

The majority of those who were transferred (95.8%) attended only one other hospital prior to arrival at a major trauma service. The number of patients who arrived at definitive care either directly from the scene or via a different health service varied between jurisdictions. Direct transport from the scene to hospital ranged from 46.5% to 77%.

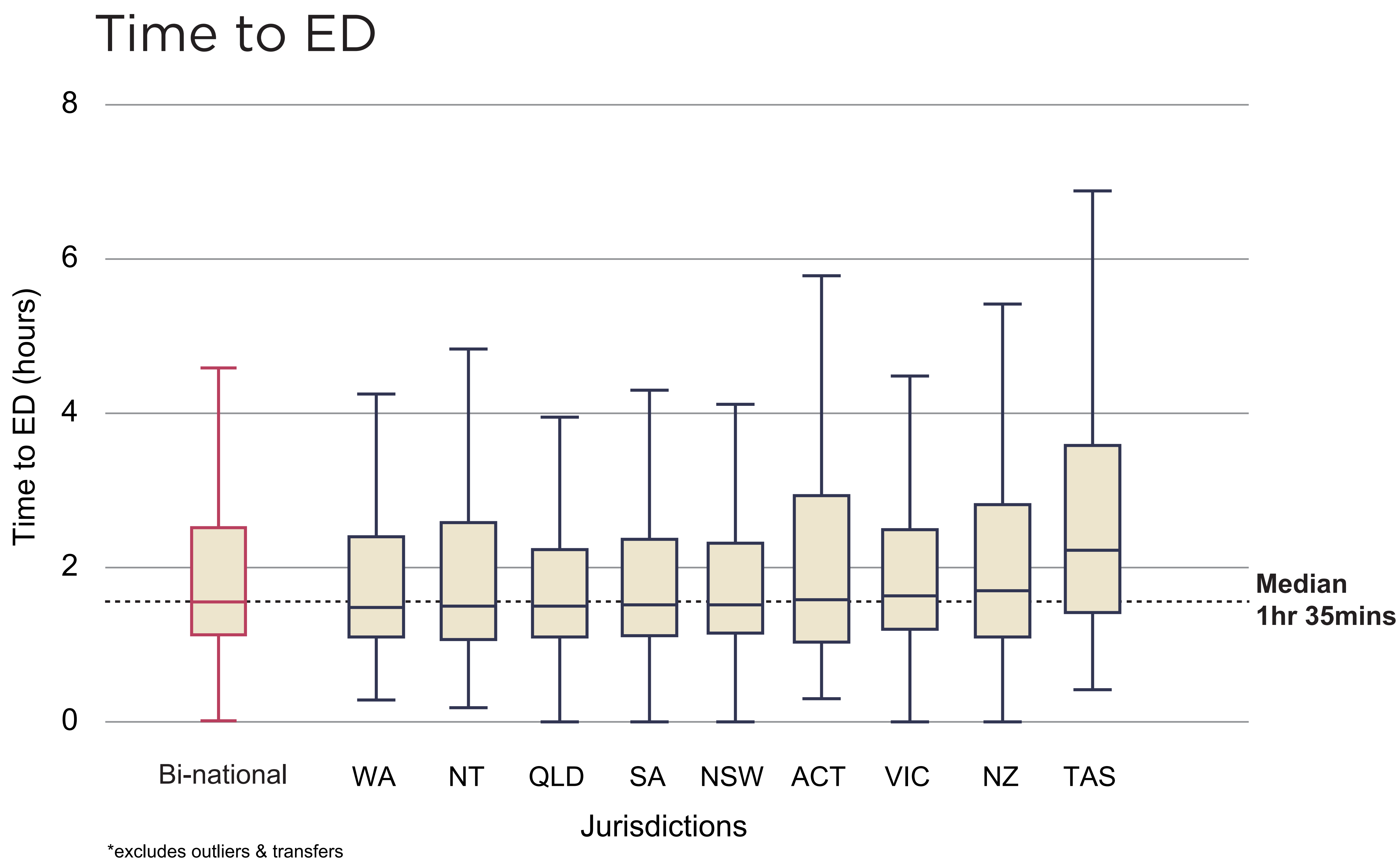
Direct Transport To Hospital And Transfers By Jurisdiction



TIME FROM INJURY TO EMERGENCY DEPARTMENT

Time to Emergency Department was analysed for patients conveyed directly from injury to definitive care. The median time from injury to definitive care was **1 hour 35 minutes**, similar to the previous financial year.

The box and whisker plots presented in this report represent the median, interquartile range and range - where the edges of the box represent the lower and upper quartiles, the line in the middle of the box is the median, and the whiskers represent the range.



* Extreme outliers are values smaller than the lower quartile minus 1.5 times the interquartile range (IQR) or values larger than the upper quartile plus 1.5 times the IQR (Tukey, 1977)

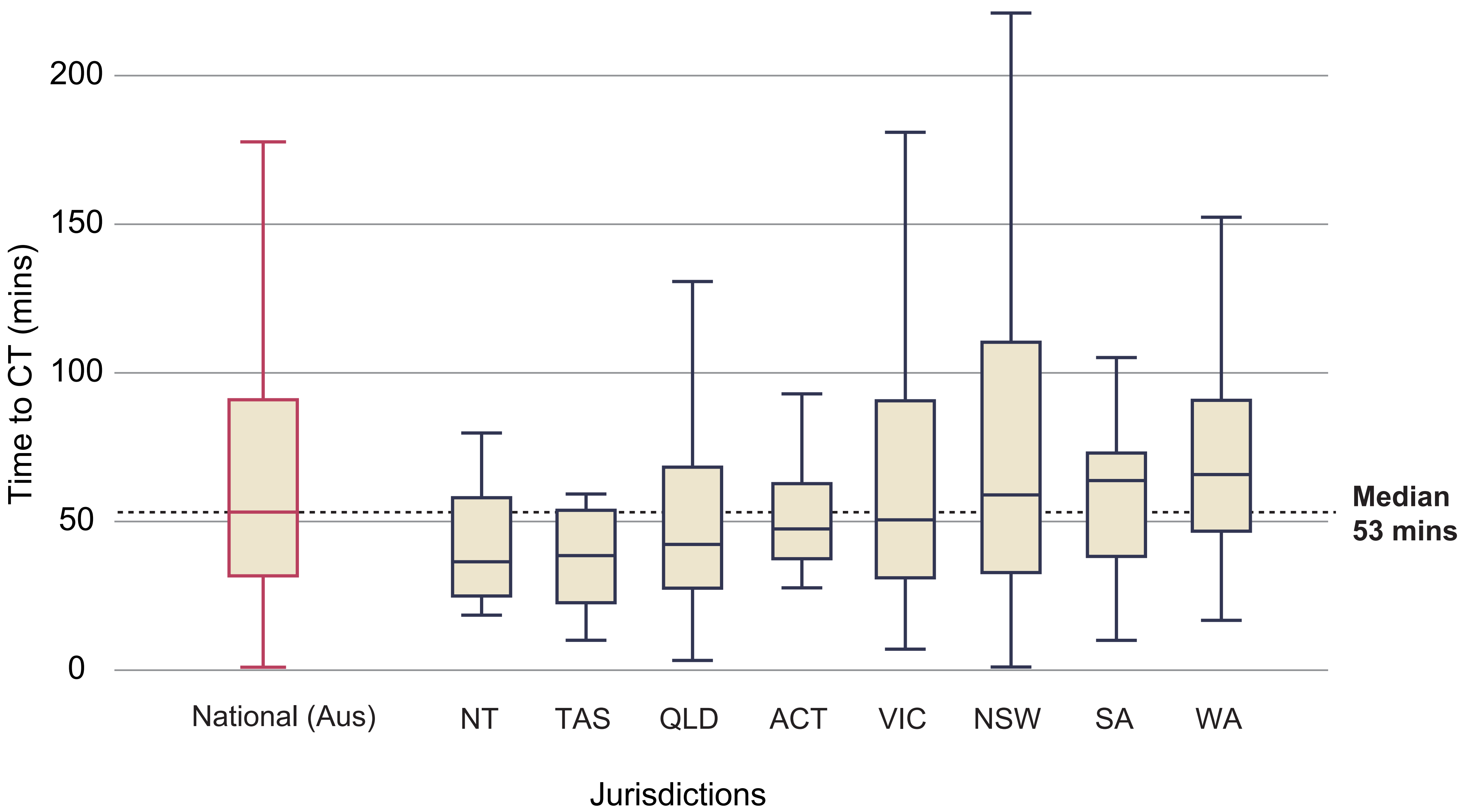
TRAUMA CENTRE CARE

TIME FROM ED ARRIVAL TO HEAD COMPUTED TOMOGRAPHY (CT)

The time to first head CT for patients with a total Glasgow Coma Scale (GCS) less than 13 was analysed by jurisdiction for Australian sites. NZ does not submit data for type of CT and is excluded from the box plot below. Sixty percent of severely injured patients in Australia received a head CT at the MTS. Most patients were direct transfers from scene to definitive care (4407 (79.9%)), receiving no prior hospital treatment. Of those arriving direct from scene, 852 (19.3%) arrived at the Emergency Department with a known total GCS less than 13.

The median time from arrival at the definitive hospital to time of head CT for patients with a total GCS less than 13 was **53 minutes** - (IQR 31 - 90 minutes). Time to Head CT has increased over the previous four years, from 44 minutes to 53 minutes.

Time from ED arrival to head CT



*includes total GCS<13 & excludes outliers & transfers

* Extreme outliers are values smaller than the lower quartile minus 1.5 times the interquartile range (IQR) or values larger than the upper quartile plus 1.5 times the IQR (Tukey, 1977)

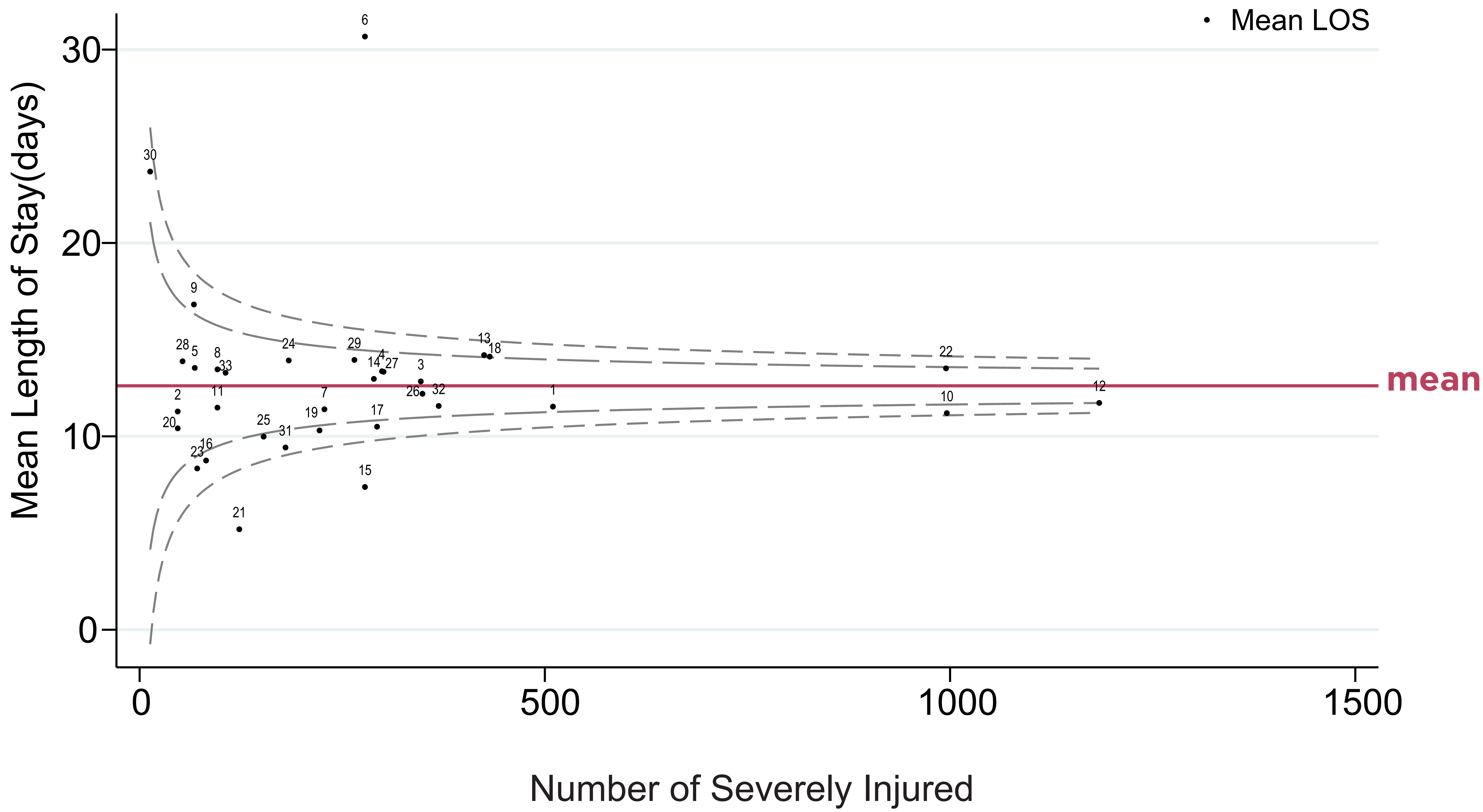
HOSPITAL LENGTH OF STAY BY HOSPITAL (LOS)

Hospital Length of Stay was compared between hospitals, before and after risk adjustment. The following risk factors were included in the model as they were found to be significant predictors: age, cause of injury, arrival Glasgow Coma Scale (GCS), highest and second highest AIS scores. Only survivors were included in the LOS analysis. After risk adjustment there was only a difference in length of stay. Please refer to Appendix A for detailed data analysis.

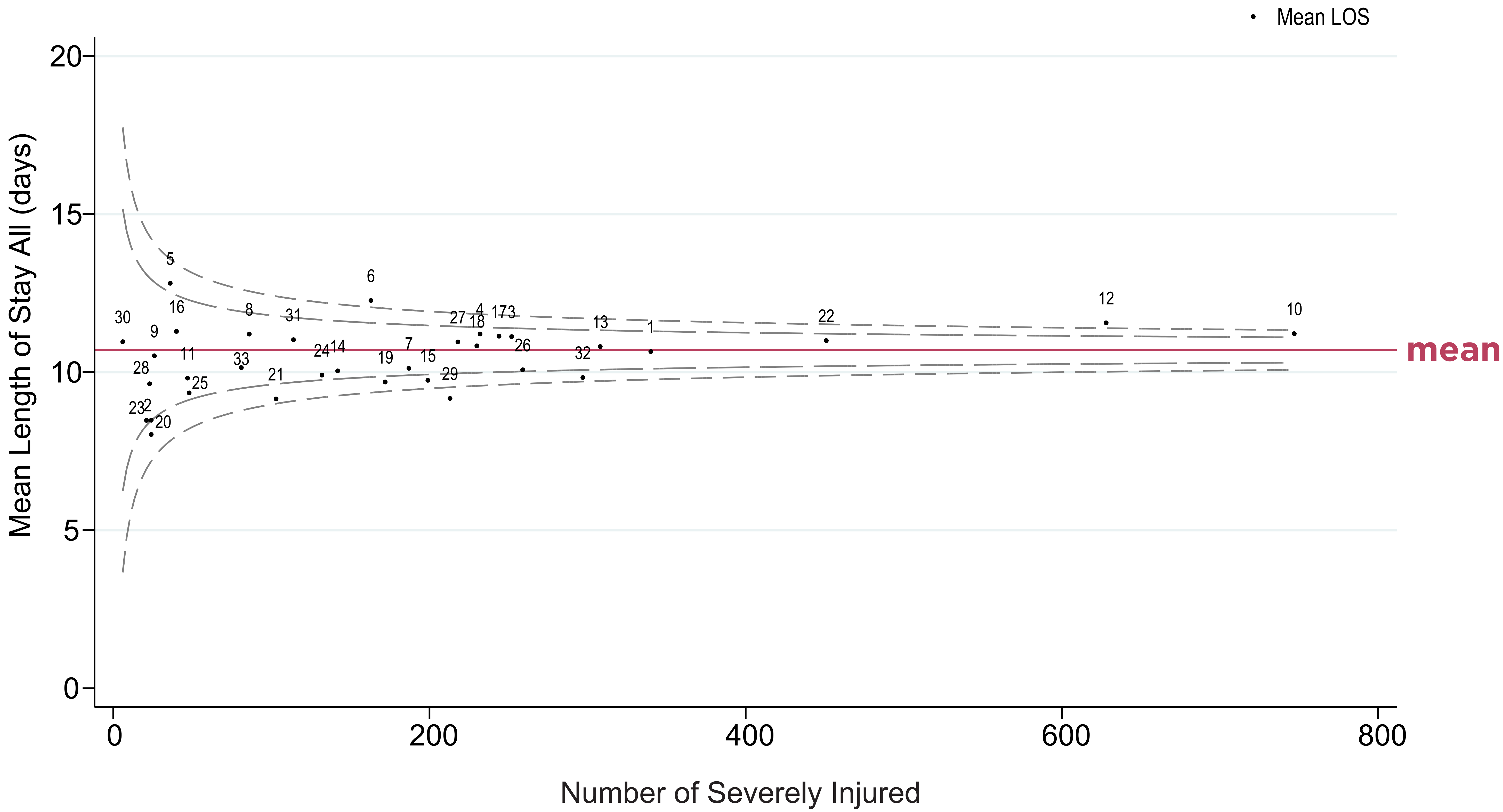
Each numbered dot represents one hospital in the funnel plots on the following pages. The funnel plots, where the aim is to identify outliers, show contours which represent two standard deviations (95% control limits) and three standard deviations (99.8% control limits) from the mean. Those outside these lines are considered outliers, with a 5% and 0.2% chance of a false positive respectively.

ID#	Hospital Name	Jurisdiction
1	John Hunter Hospital	NSW
2	John Hunter Children's Hospital	NSW
3	Liverpool Hospital	NSW
4	Westmead Hospital	NSW
5	Children's Hospital, Westmead	NSW
6	Royal North Shore Hospital	NSW
7	Royal Prince Alfred Hospital	NSW
8	St Vincent's Hospital	NSW
9	Sydney Children's Hospital	NSW
10	Royal Melbourne Hospital	VIC
11	Royal Children's Hospital	VIC
12	Alfred Hospital	VIC
13	Royal Brisbane and Women's Hospital	QLD
14	Townsville Hospital	QLD
15	Sunshine Coast University Hospital	QLD
16	Queensland Children's Hospital	QLD
17	Gold Coast Hospital	QLD
18	Royal Adelaide Hospital	SA
19	Flinders Medical Centre	SA
20	Women's and Children's Hospital	SA
21	Lyell McEwin Hospital	SA
22	Royal Perth Hospital	WA
23	Perth Children's Hospital	WA
24	Royal Hobart Hospital	TAS
25	Royal Darwin Hospital	NT
26	Canberra Hospital	ACT
27	Auckland City Hospital	NZ
28	Starship Hospital	NZ
29	Middlemore Hospital	NZ
30	Waikato Hospital	NZ
31	Wellington Hospital	NZ
32	Christchurch Hospital	NZ
33	Dunedin Hospital	NZ

Unadjusted Hospital Length of Stay By Hospital



Risk-Adjusted Hospital Length of Stay By Hospital

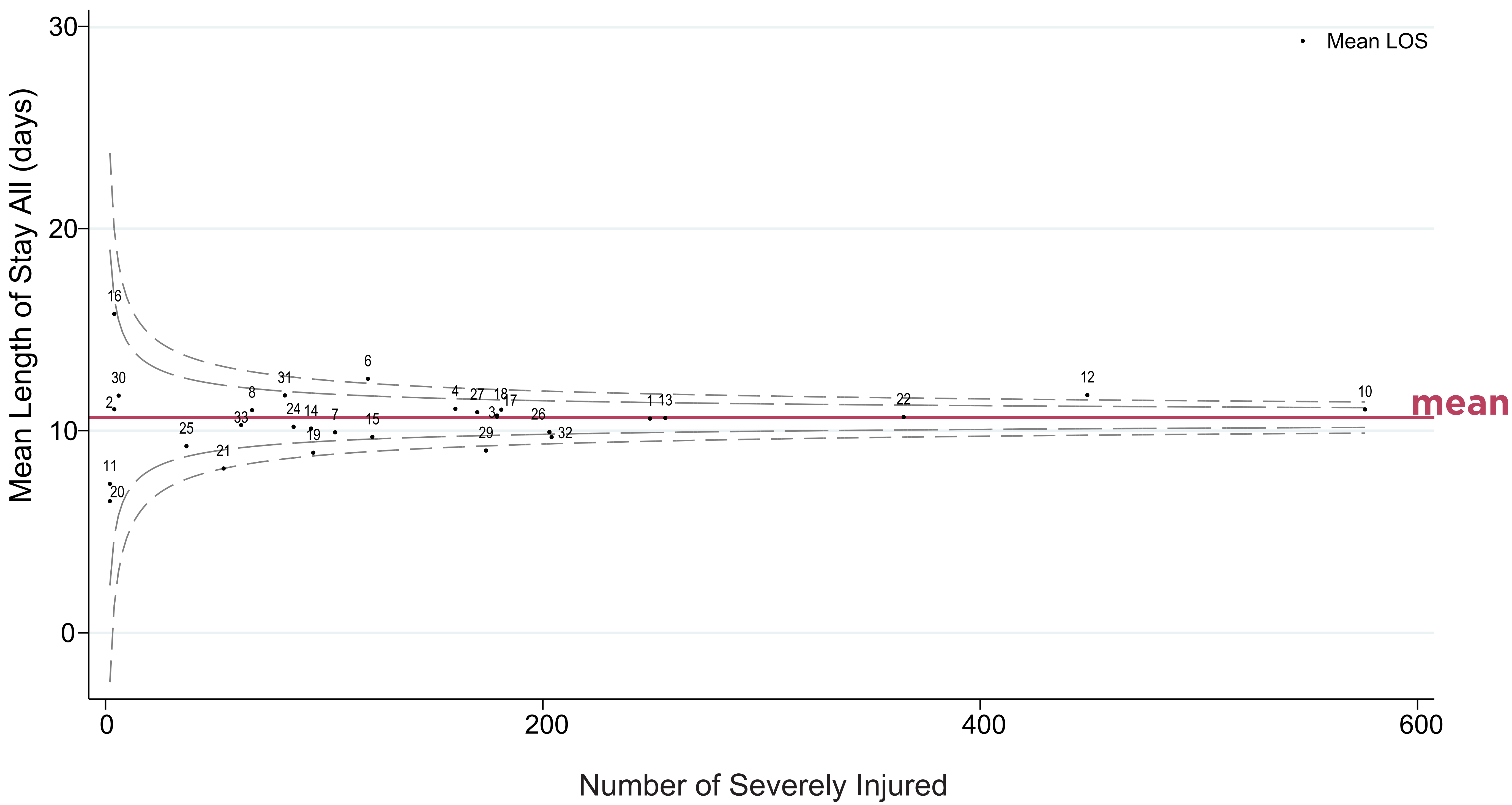


Among all age groups. Excludes transfers & includes only blunt injuries and among survivors

RISK-ADJUSTED HOSPITAL LENGTH OF STAY (LOS) BY AGE GROUPS

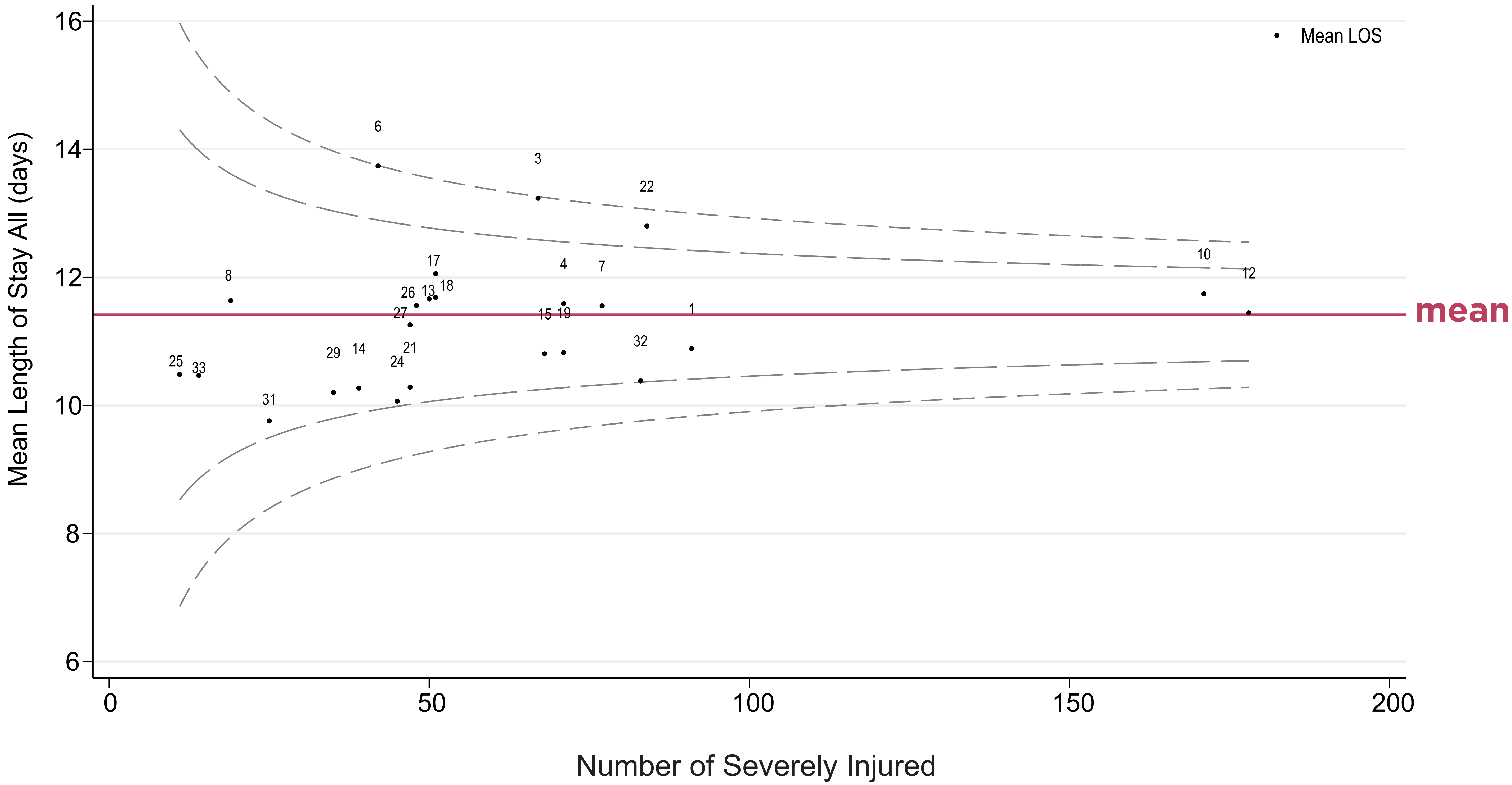
The unadjusted bi-national median (IQR) hospital LOS was 7.0 (3.5-13.8) days. When hospitals were risk adjusted there was a maximum 1-2 days difference between hospitals apart from hospital 6, which is unlikely to be clinically significant. Reasons for variations in hospital length of stay will be reviewed. Each numbered dot represents one hospital in the funnel plots below. The funnel plots, where the aim is to identify outliers, show contours which represent two standard deviations (95% control limits) and three standard deviations (99.8% control limits) from the mean. Those outside these lines are considered outliers, with a 5% and 0.2% chance of a false positive respectively.

Mean Length of Stay Adults (Aged ≥16 and ≤70 years)



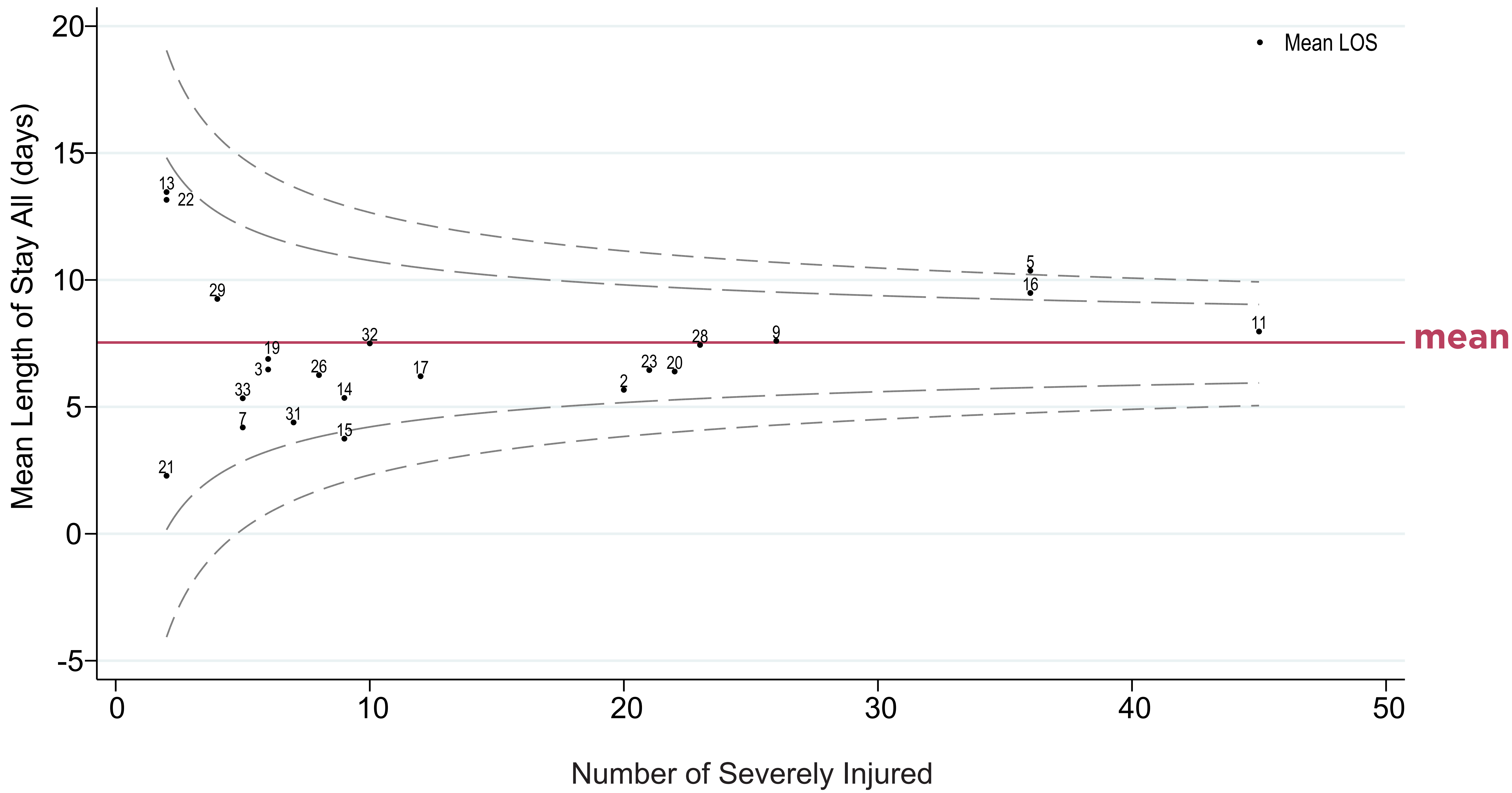
Among age group 16-69 yrs. Excludes transfers & includes only blunt injuries and among survivors

Mean Length of Stay Older Adults (Aged ≥70 years)



Among age group 70+ years. Excludes transfers & includes only blunt injuries and among survivors

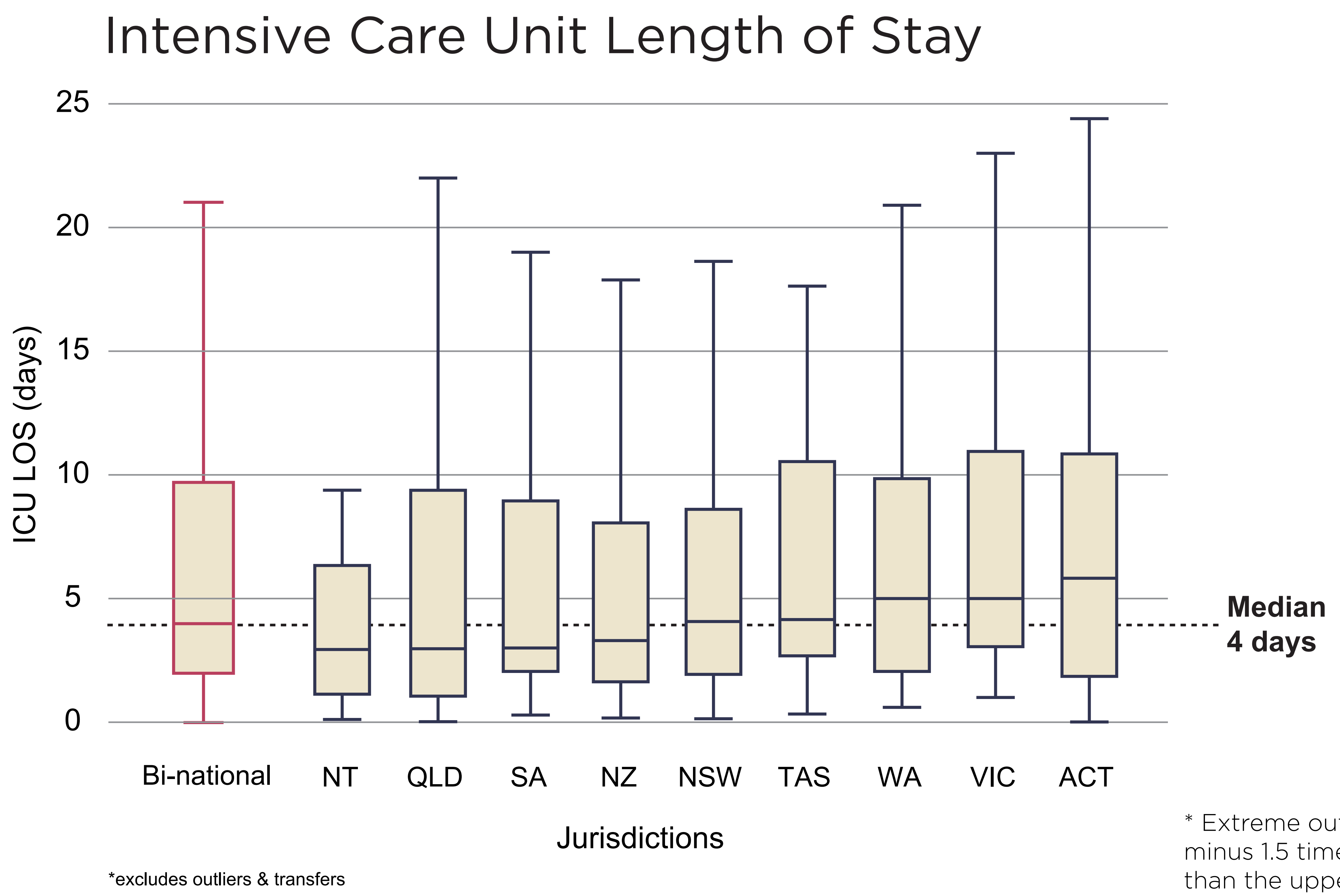
Mean Length of Stay Paediatrics (Aged ≤15years)



Among age group<=15 yrs. Excludes transfers & includes only blunt injuries and among survivors

INTENSIVE CARE UNIT (ICU) LENGTH OF STAY (LOS)

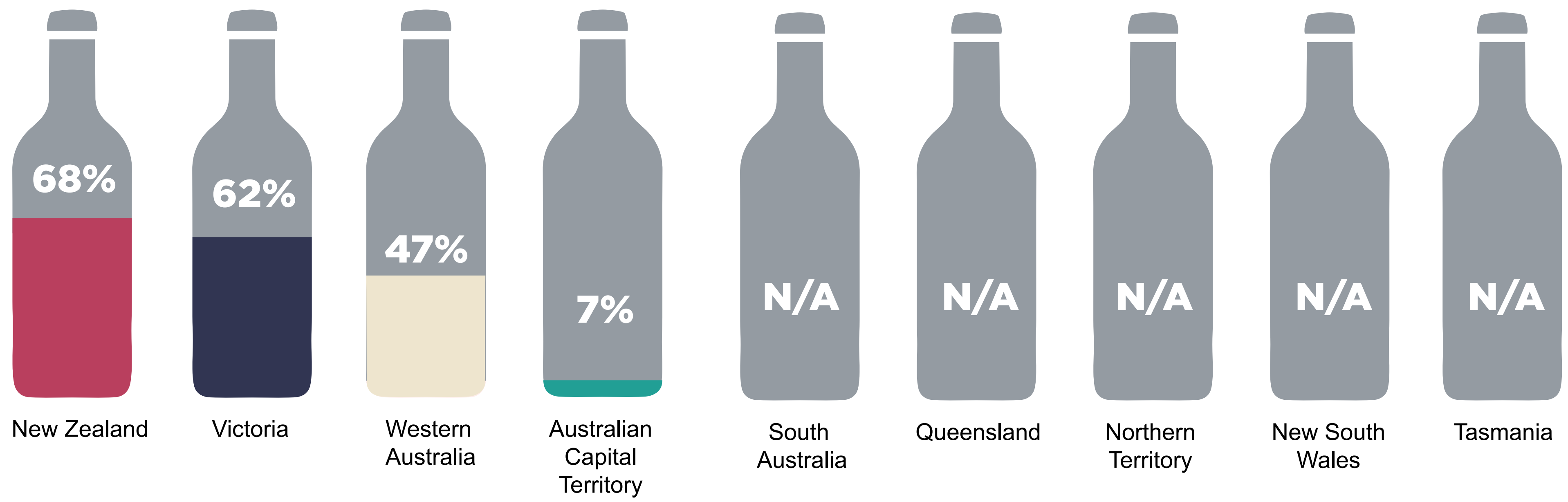
The bi-national median (IQR) hospital ICU LOS was **4.0 (2.0-9.4) days.**



* Extreme outliers are values smaller than the lower quartile minus 1.5 times the interquartile range (IQR) or values larger than the upper quartile plus 1.5 times the IQR (Tukey, 1977)

BLOOD ALCOHOL CONCENTRATION COLLECTION RATE

Blood alcohol collection is one of the eight RACS process indicators and is recommended in patients with an ISS>12. The ATR does not currently receive blood alcohol concentration from all jurisdictions, due in part to differences between states in the roles of medical staff and their responsibilities for reporting this data. The ATR continues to work with registries and sites to improve data capture for this process indicator. The below figure demonstrates the proportion of severely injured cases there a blood alcohol test was performed and recorded for transport-related injuries in patients aged 15 years and older.



OUTCOMES FROM INJURY

The primary outcome collected by the ATR is discharge destination (including deaths). Discharge destination was provided for 99.5% of patients.

MORTALITY

One thousand and forty severely injured people died in-hospital with a bi-national mortality rate of 9.7%. Categorising by age-group identified further mortality trends in the severely injured.

Mortality Over Past Five Years

Year	Severe Injuries (n)	Deaths (n)	Deaths (%)
17/18	9,840	927	9.4
18/19	10,135	1,007	9.1
19/20	10,050	1,053	9.6
20/21	11,254	1,050	9.3

9.7% MORTALITY

INCREASE FROM 9.3% IN 2020-21

9.7% OF DEATHS OCCURRED IN ED
from 11.5% in 2020/21

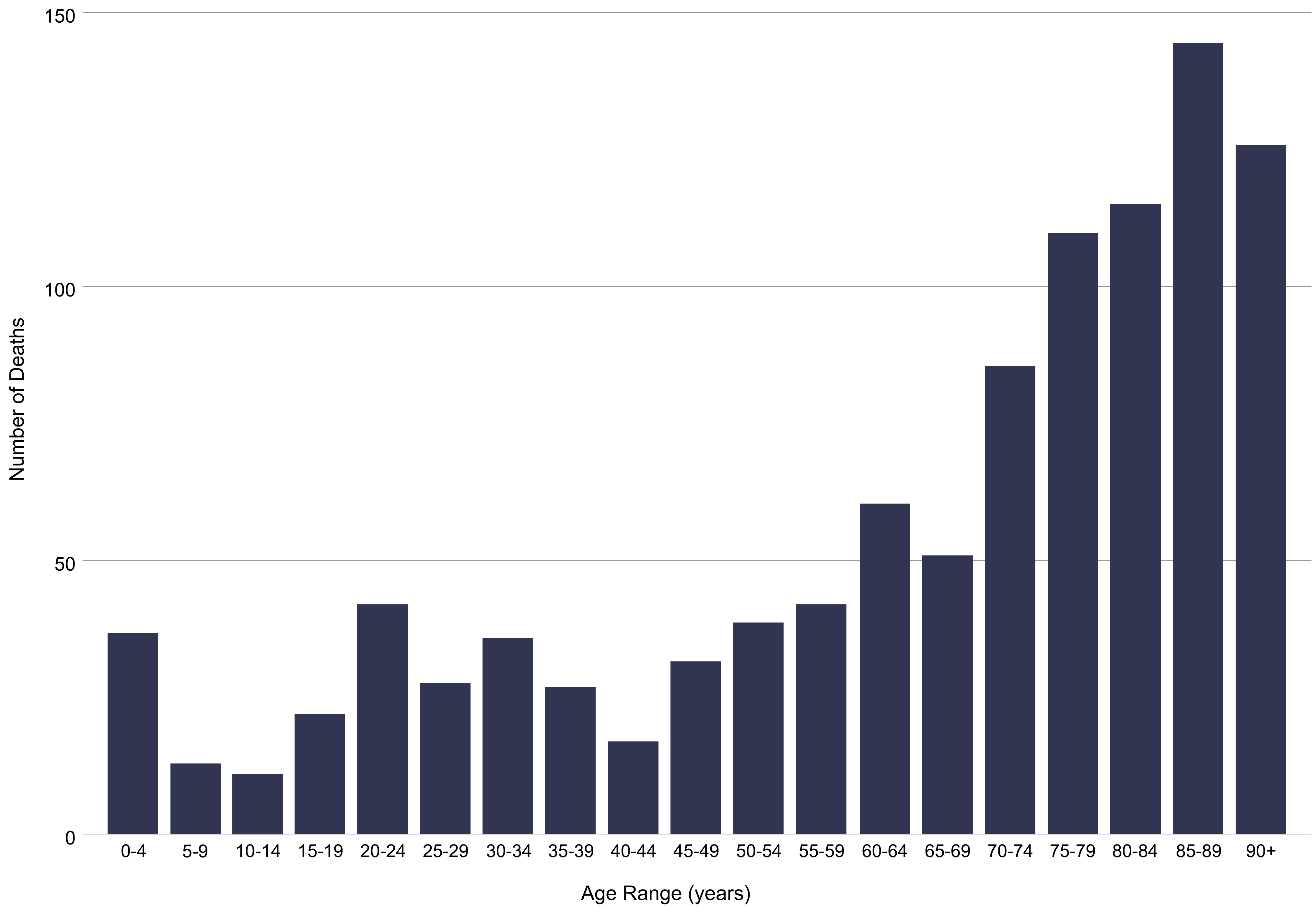
55.9% OF DEATHS AGED 70+

69.3% MALE

56.7% ISS>24

6.2% OF DEATHS AGED ≤15 YEARS

Mortality by Age Range (years)



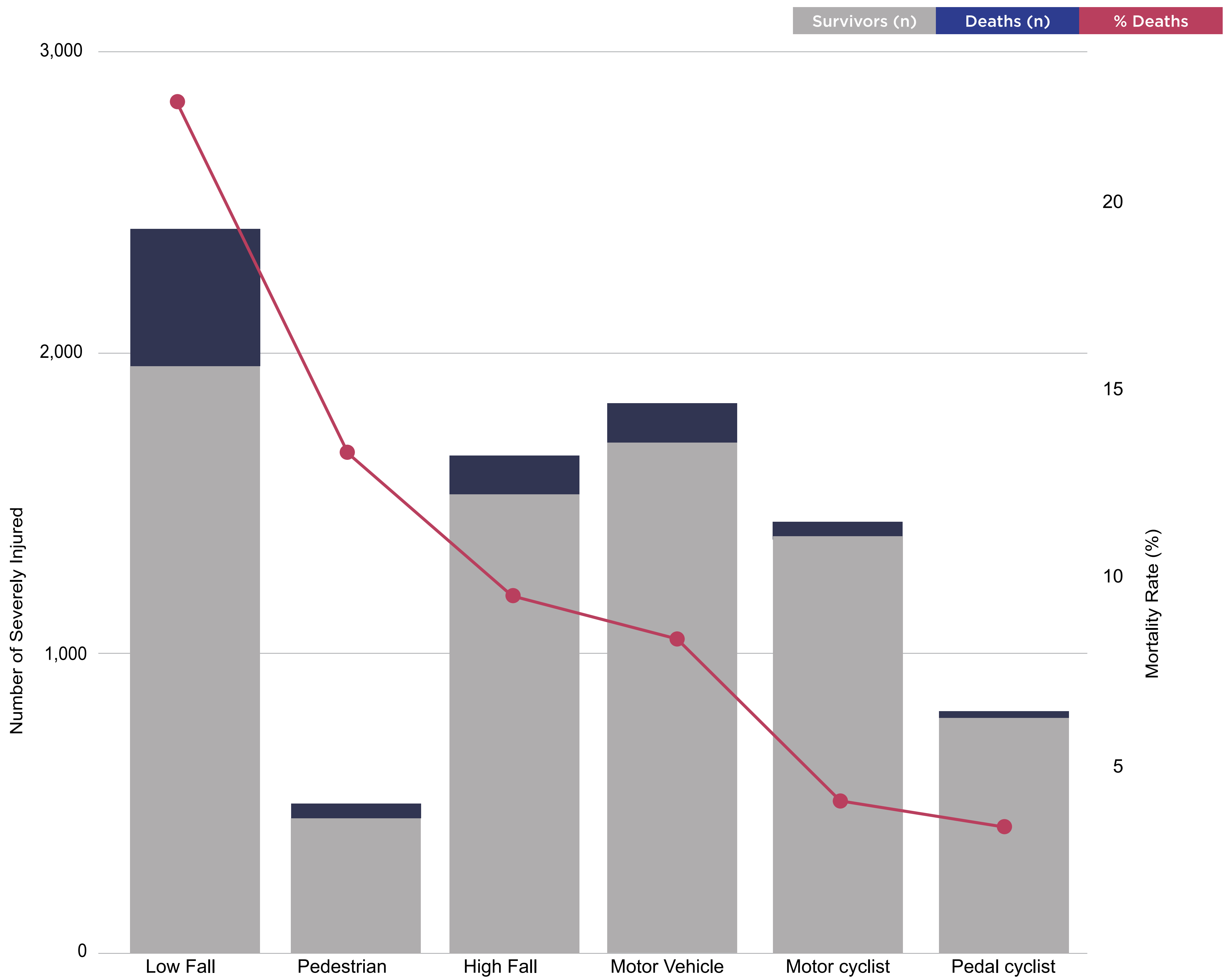
MORTALITY BY MECHANISM OF INJURY

As a proportion of total deaths, low falls accounted for the highest number of deaths (43.5%) and transport-related accounted for 26.3% percent. The graph below shows the total incidence, including survivors and deaths as well as the proportion of deaths for each injury cause from highest mortality rate to lowest. Low falls had the highest proportion of deaths (18.9%) followed by pedestrians (11.1%). Pedal cyclist had the lowest mortality rate (2.8%).

43.5% DEATHS LOW FALLS

26.3% DEATHS **TRANSPORT** RELATED

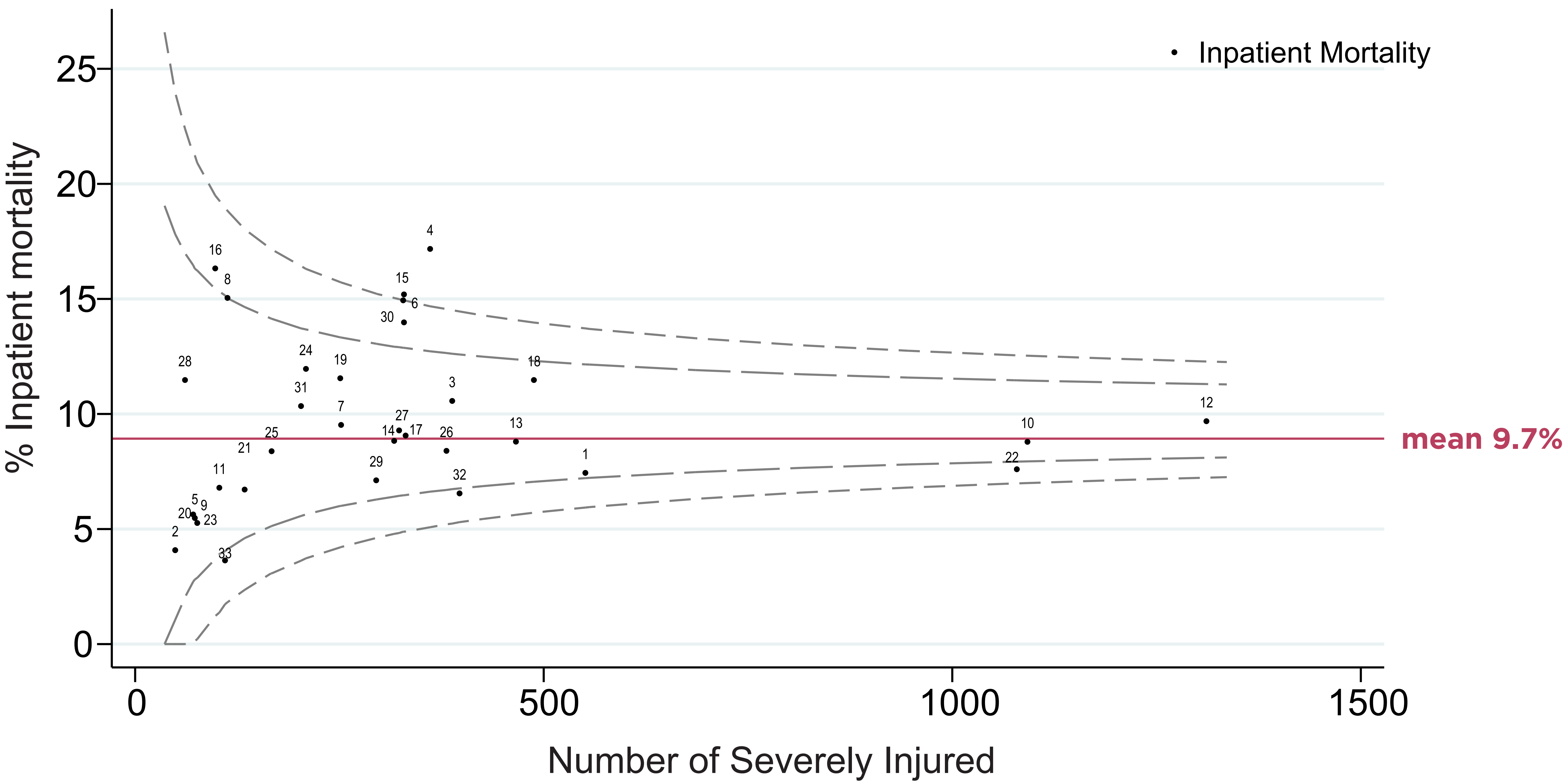
Survivors, Deaths and Mortality Rate by Injury Mechanism



UNADJUSTED MORTALITY BY HOSPITAL (INCLUDING TRANSFERS)

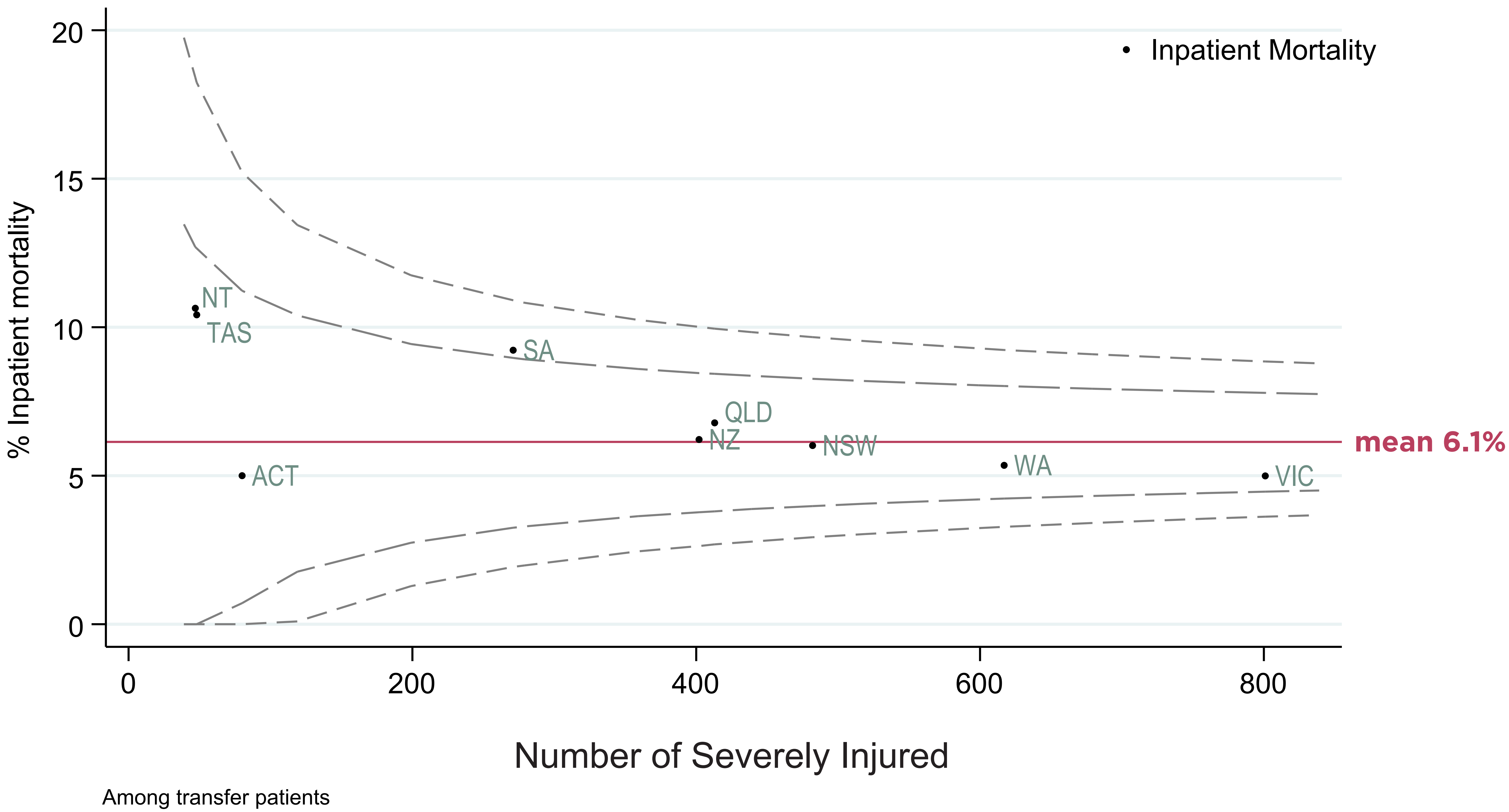
Unadjusted plots do not take into account the variations in casemix which occur between hospitals, such as patient proximity to hospital, number of transfers and prior treatment, and severity of injuries. The below plot represents unadjusted mortality by hospital, including all transfers. It allows the reader to identify the total number of severely injured patients admitted for severe injuries. Unadjusted mortality for patients who were transferred to one or more hospitals are represented on page 19, by jurisdiction.

Unadjusted Mortality By Hospital (including transfers)

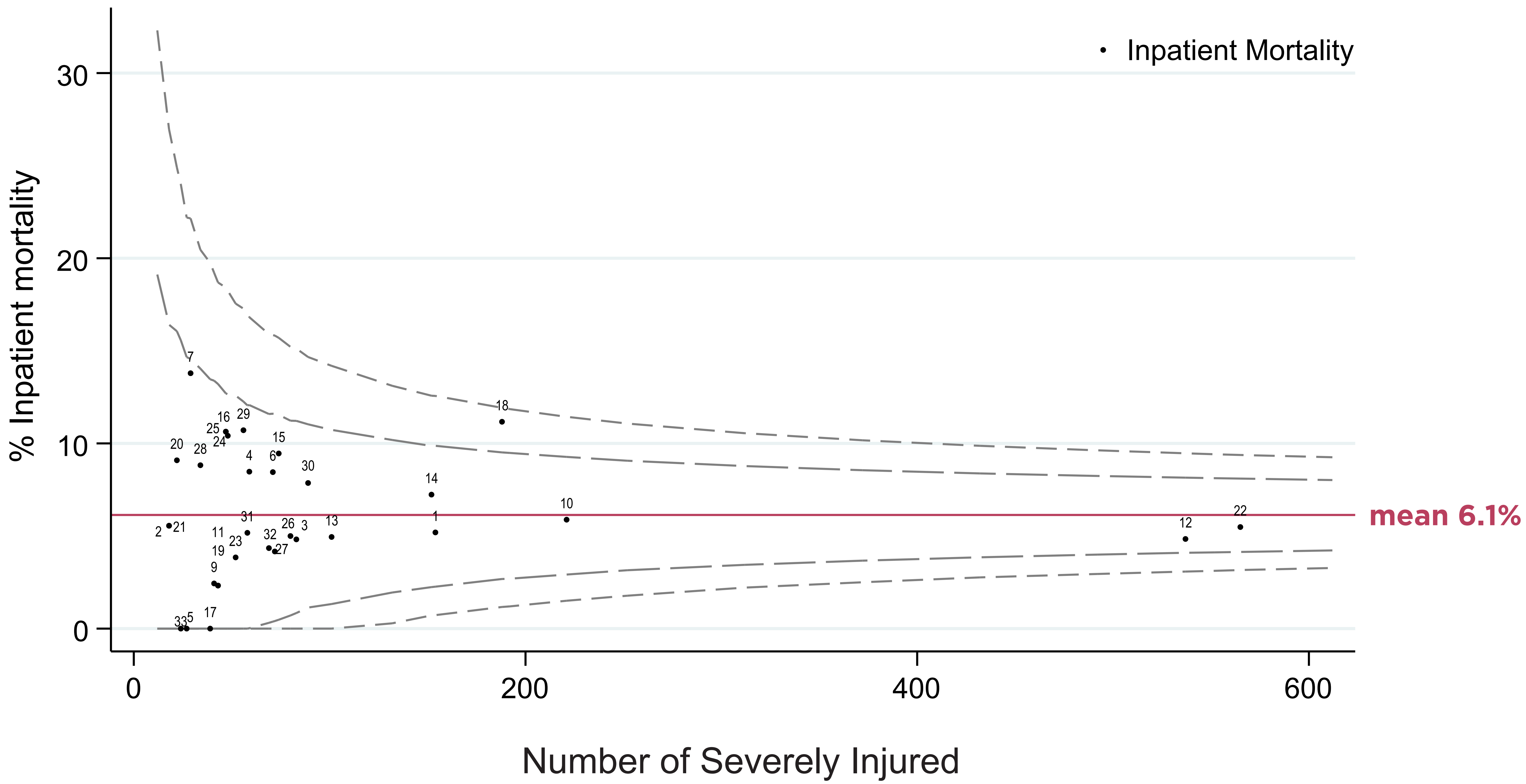


The use of these funnelplots to identify outliers needs to be interpreted with caution due to small numbers

Unadjusted Mortality By Jurisdiction (among transfers)



Unadjusted Mortality By Hospital (among transfers)



Among transfer patients

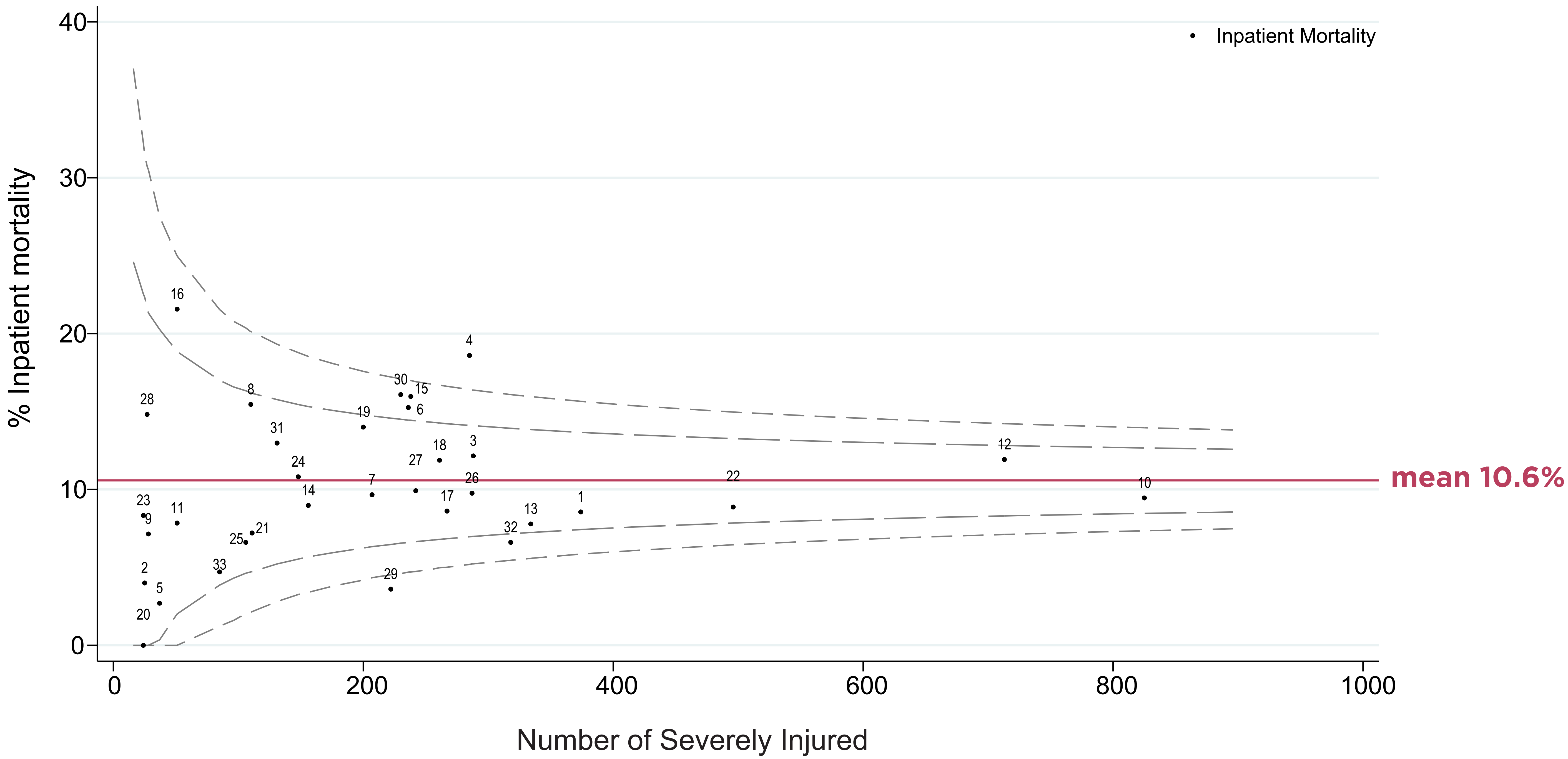
MORTALITY BY HOSPITAL (EXCLUDING TRANSFERS)

Mortality was compared between hospitals, before and after risk adjustment. The following risk factors were included in the model as they were found to be significant predictors: age, cause of injury, arrival Glasgow Coma Scale (GCS), highest and second highest AIS scores. No significant differences were noted after risk adjustment. Please refer to Appendix A for detailed data analysis.

Each numbered dot represents one hospital in the funnel plots below. The funnel plots, where the aim is to identify outliers, show contours which represent two standard deviations (95% control limits) and three standard deviations (99.8% control limits) from the mean. Those outside these lines are considered outliers, with a 5% and 0.2% chance of a false positive respectively.

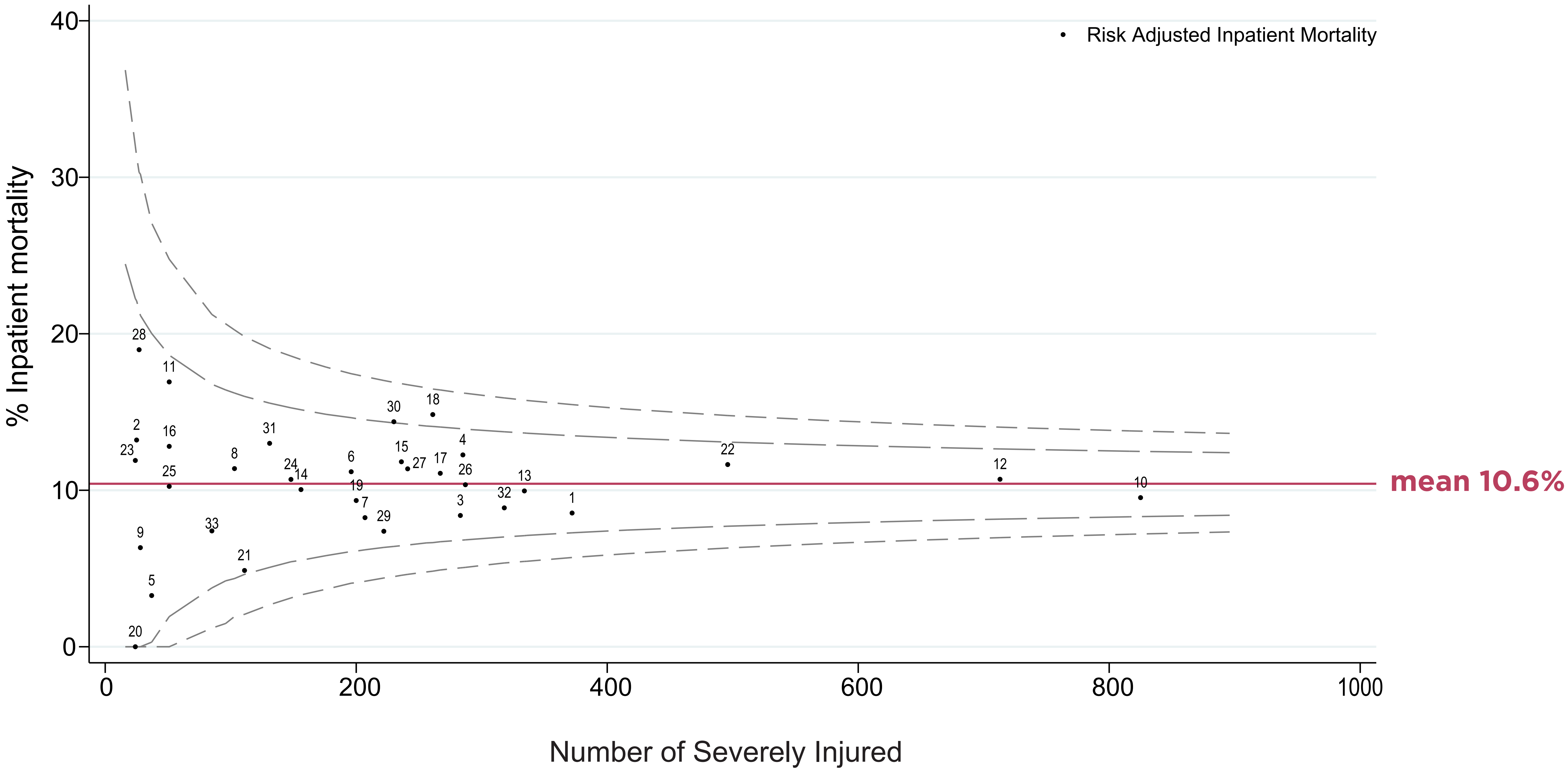
Total numbers for risk adjustment have been reduced because the transferred group of patients has been excluded. This resulted in a 30% reduction in numbers. A further reduction in numbers was the exclusion of non-blunt cases such as burns and penetrating as they are a heterogenous group (5%).

Unadjusted Mortality By Hospital (excluding transfers)



Excludes transfers & includes only blunt injuries

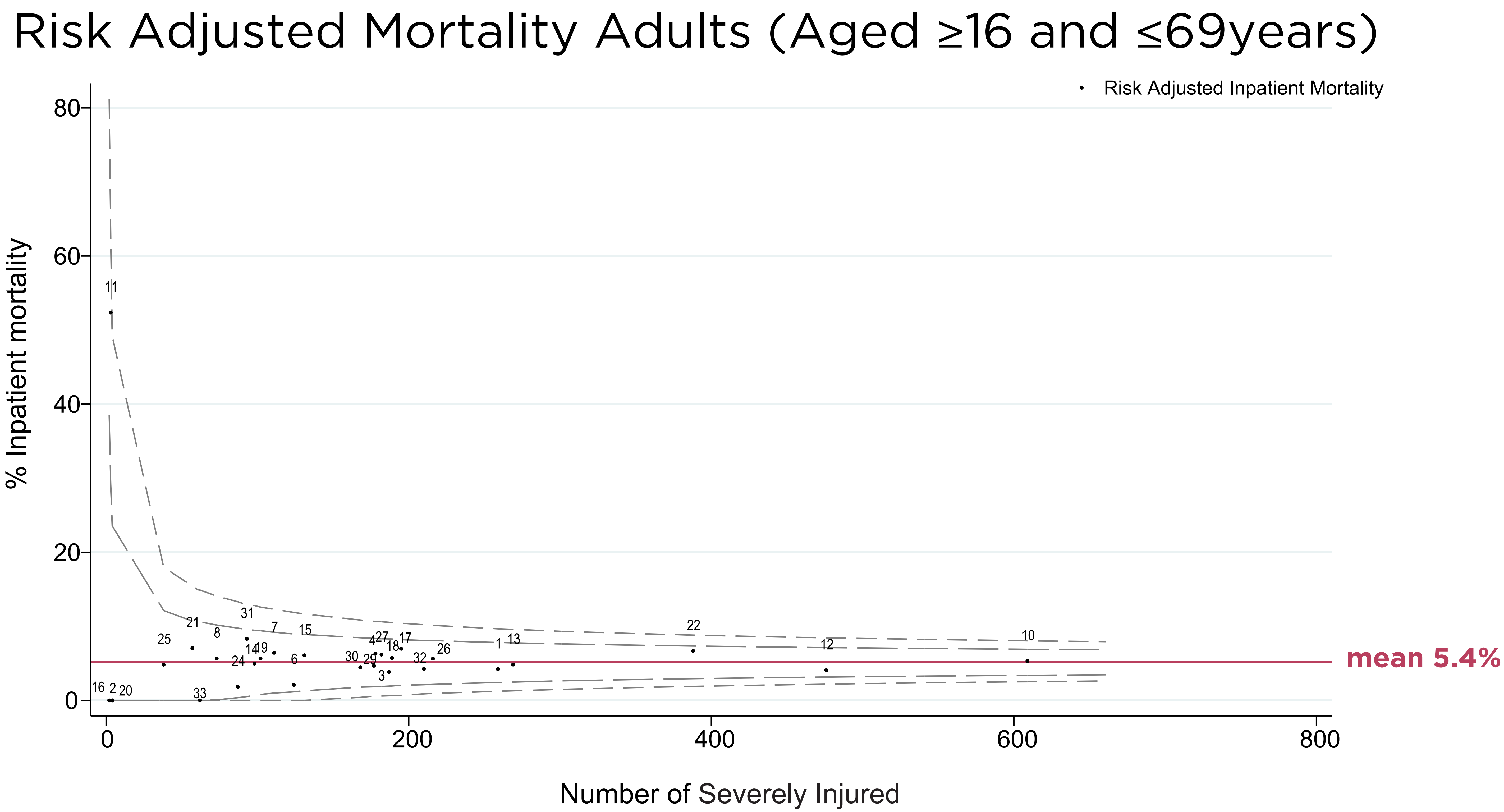
Risk-adjusted Mortality by Hospital



Excludes transfers & includes only blunt injuries

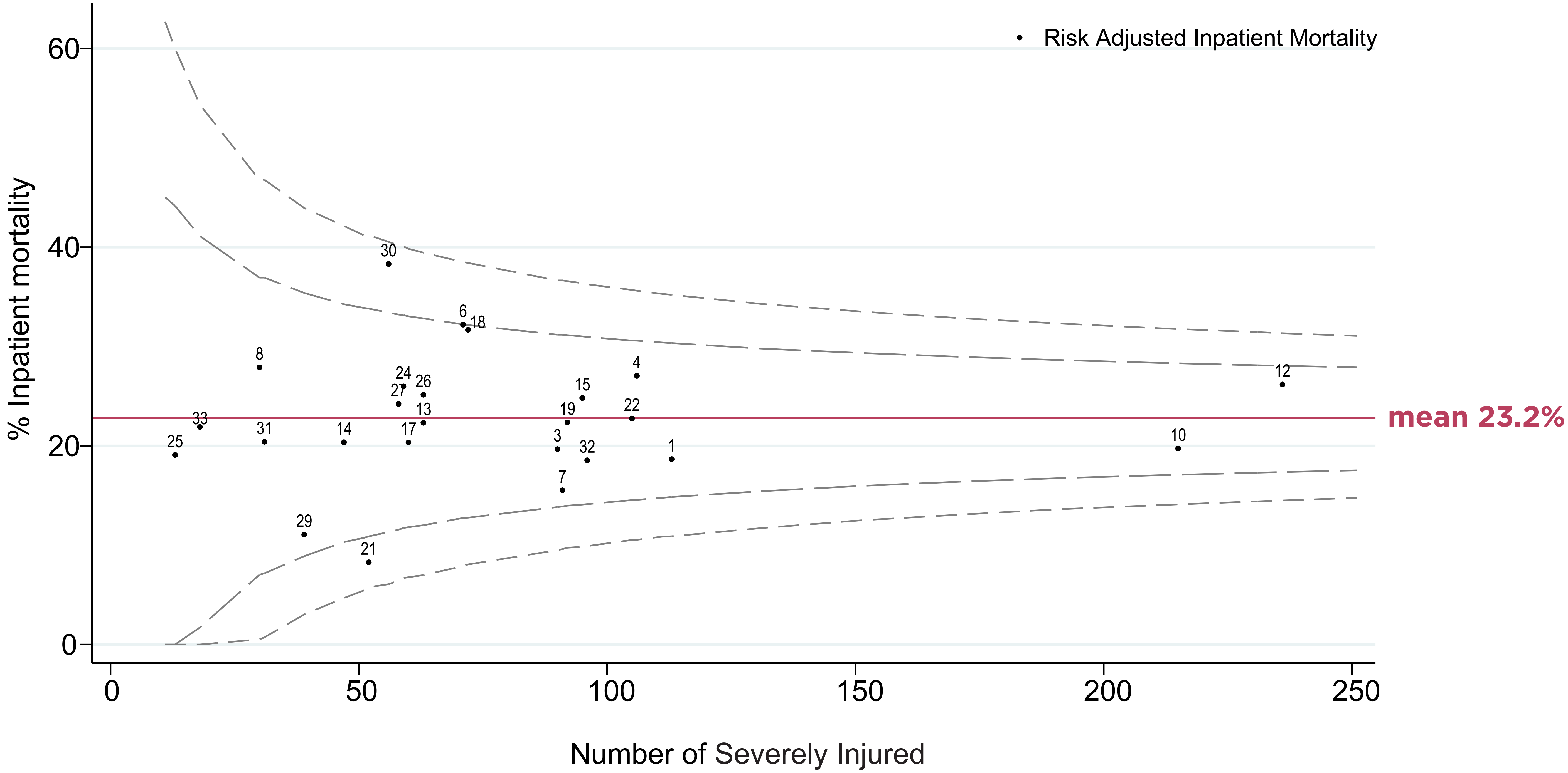
RISK ADJUSTED MORTALITY BY HOSPITAL AND AGE GROUP (EXCLUDING TRANSFERS)

Mortality was compared between hospitals using funnel plots and risk adjusted. Patients were categorised into three age groups: children (aged ≤15 years), adults (≥16 and ≤69years) and older adults (≥70 years). There were no outliers for risk adjusted mortality.



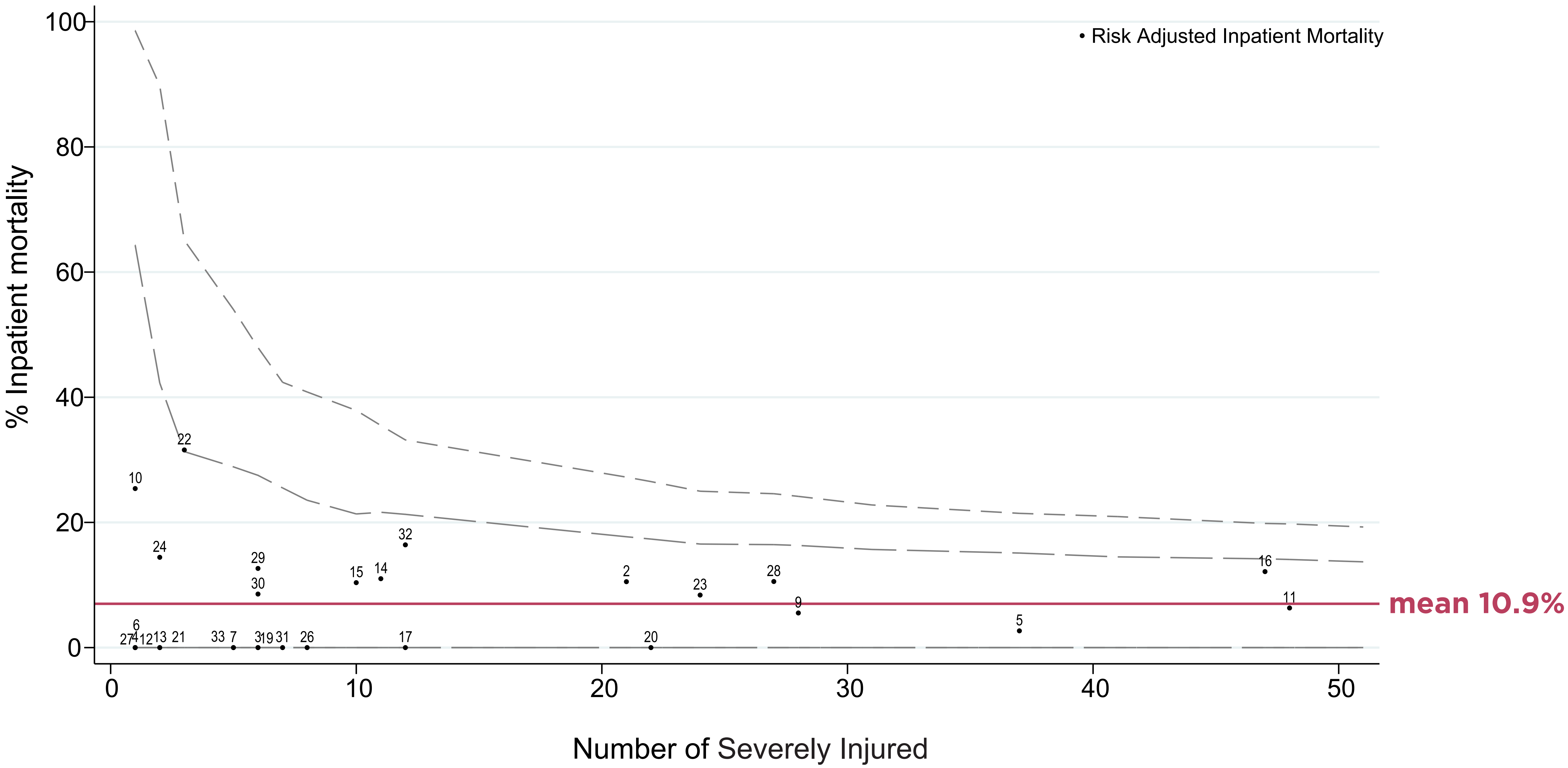
Among those aged 16-69 yrs. Excludes transfers & includes only blunt injuries

Risk Adjusted Mortality Older Adults (Aged ≥70years)



Among those aged 70+ yrs. Excludes transfers & includes only blunt injuries

Risk Adjusted Mortality Paediatrics (Aged ≤15years)



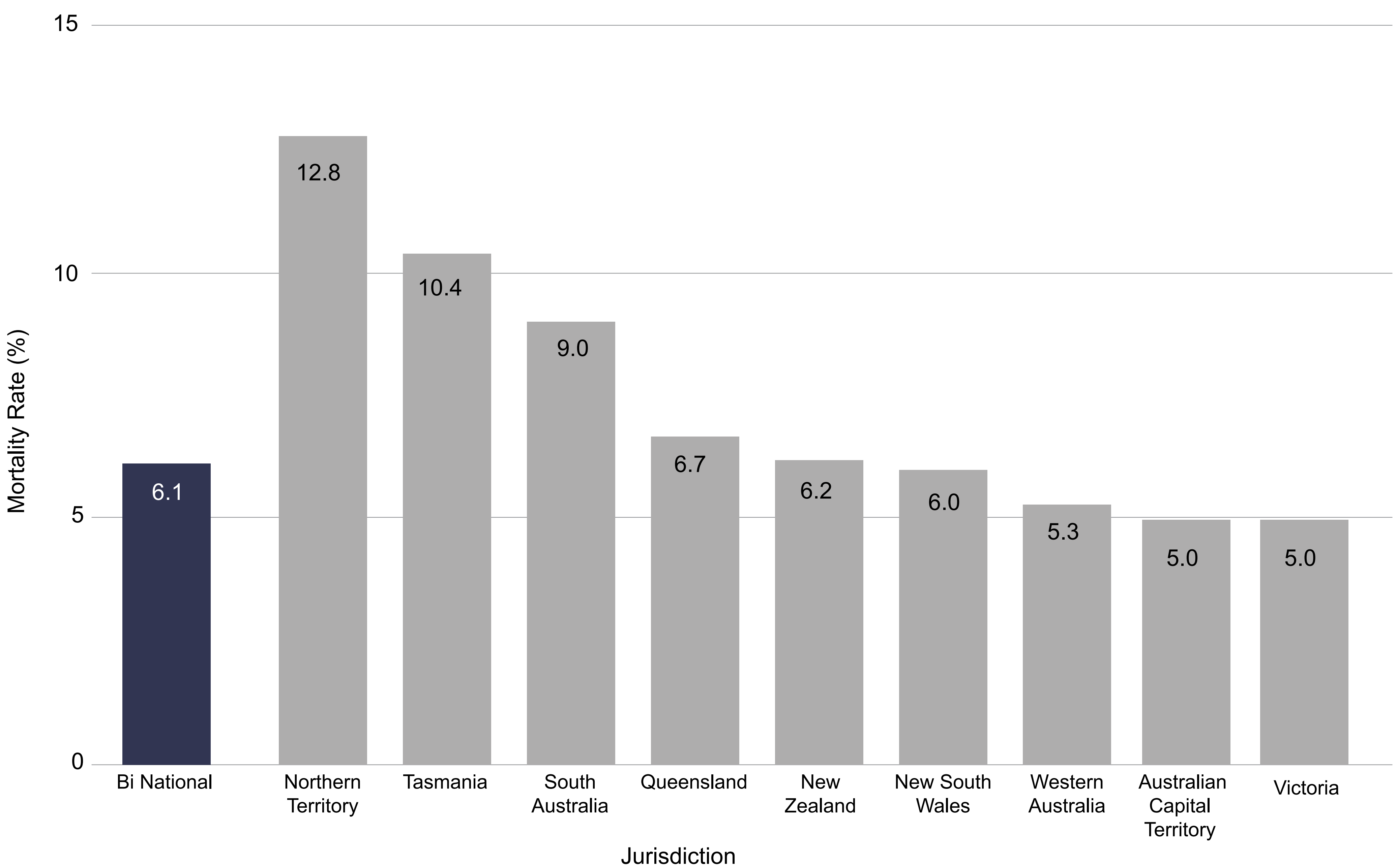
Among those aged <=15 yrs. Excludes transfers & includes only blunt injuries

TRANSFER OUTCOMES

Transfers make up 29.3 percent of all major trauma patients and they are an important group of patients to consider when assessing trauma outcomes across the trauma system. Approximately 6.1 per cent die after transfer to a major trauma service, which is similar to 6.2 percent in the previous year. Twenty-nine per cent of transferred patients were treated in the ICU.

Unfortunately, this is an extremely heterogenous group which makes interfacility comparison of outcomes difficult. To reliably compare outcomes for this group, we will need to link with geospatial information on location of injury and with identification of pre-hospital and regional hospital deaths, prior to transfer. The ATR is developing processes to allow for risk adjusted comparisons over coming years.

Mortality Rate Of Transferred Patients by Jurisdiction



Jurisdiction	Total Transfers (n)	Deaths (n)	Mortality (%)
Northern Territory	47	6	12.8
Tasmania	48	5	10.4
South Australia	278	25	9.0
Queensland	417	28	6.7
New South Wales & Australian Capital Territory	562	35	6.2
New Zealand	405	25	6.2
Western Australia	619	33	5.3
Victoria	801	40	5.0
Bi-national	**3117**	**195**	**6.1%**

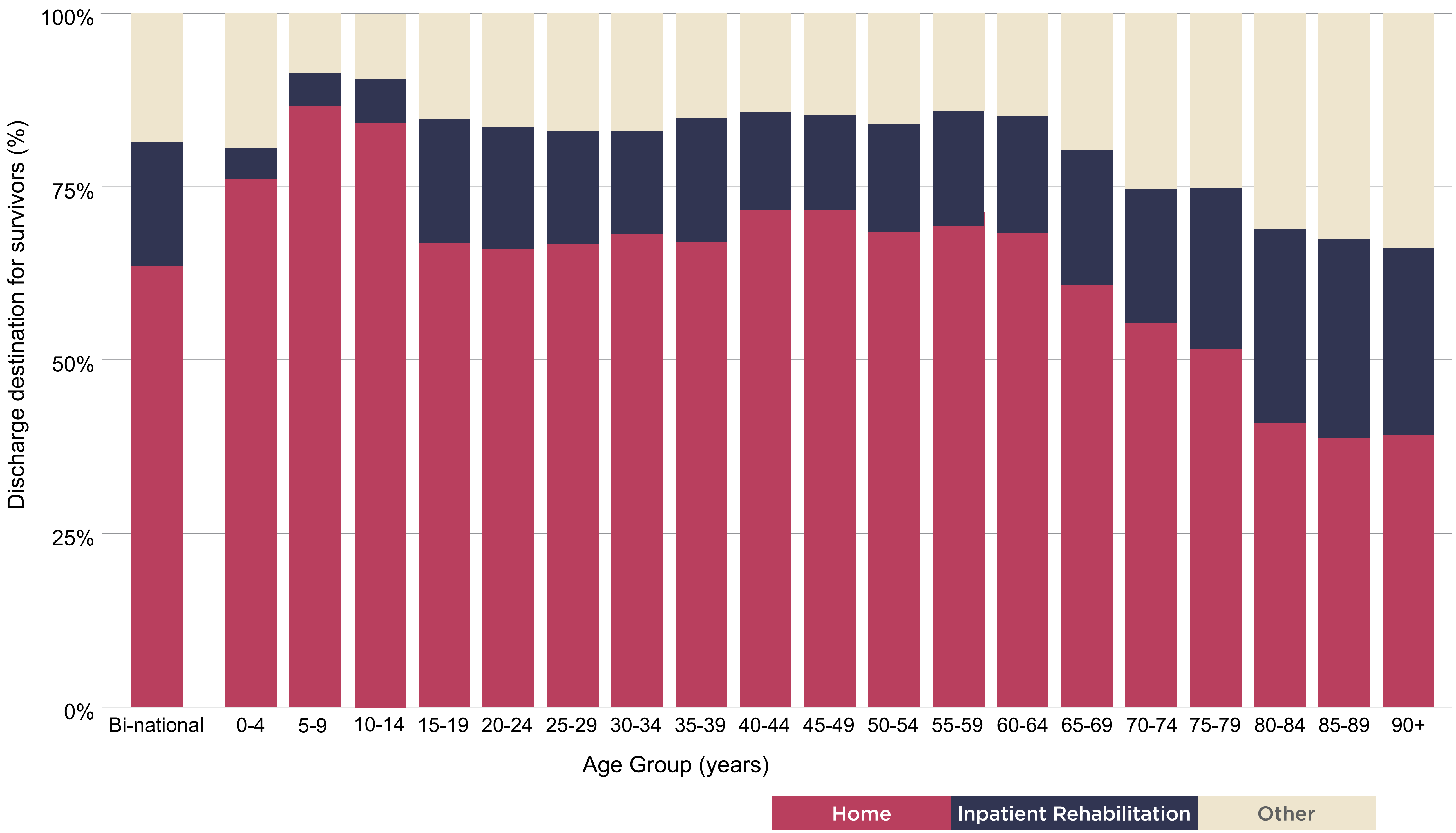
DISCHARGE DESTINATION

A known discharge destination was provided for 99.5% of patients. For patients discharged alive, the proportion of patients discharged home decreased as injury severity increased. A similar trend occurred with age. As age increased, the likelihood of being discharged home decreased and being discharged to inpatient rehabilitation increased.

64% discharged **HOME**

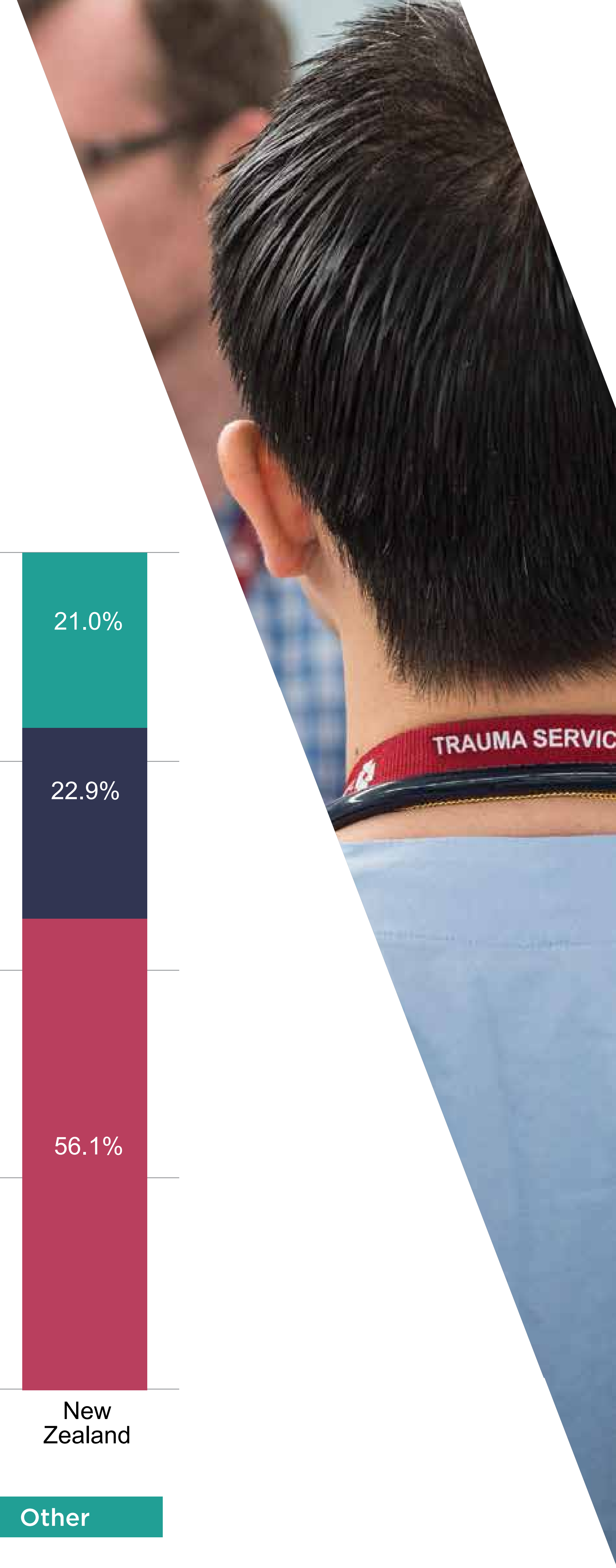
18% discharged to **INPATIENT REHABILITATION**

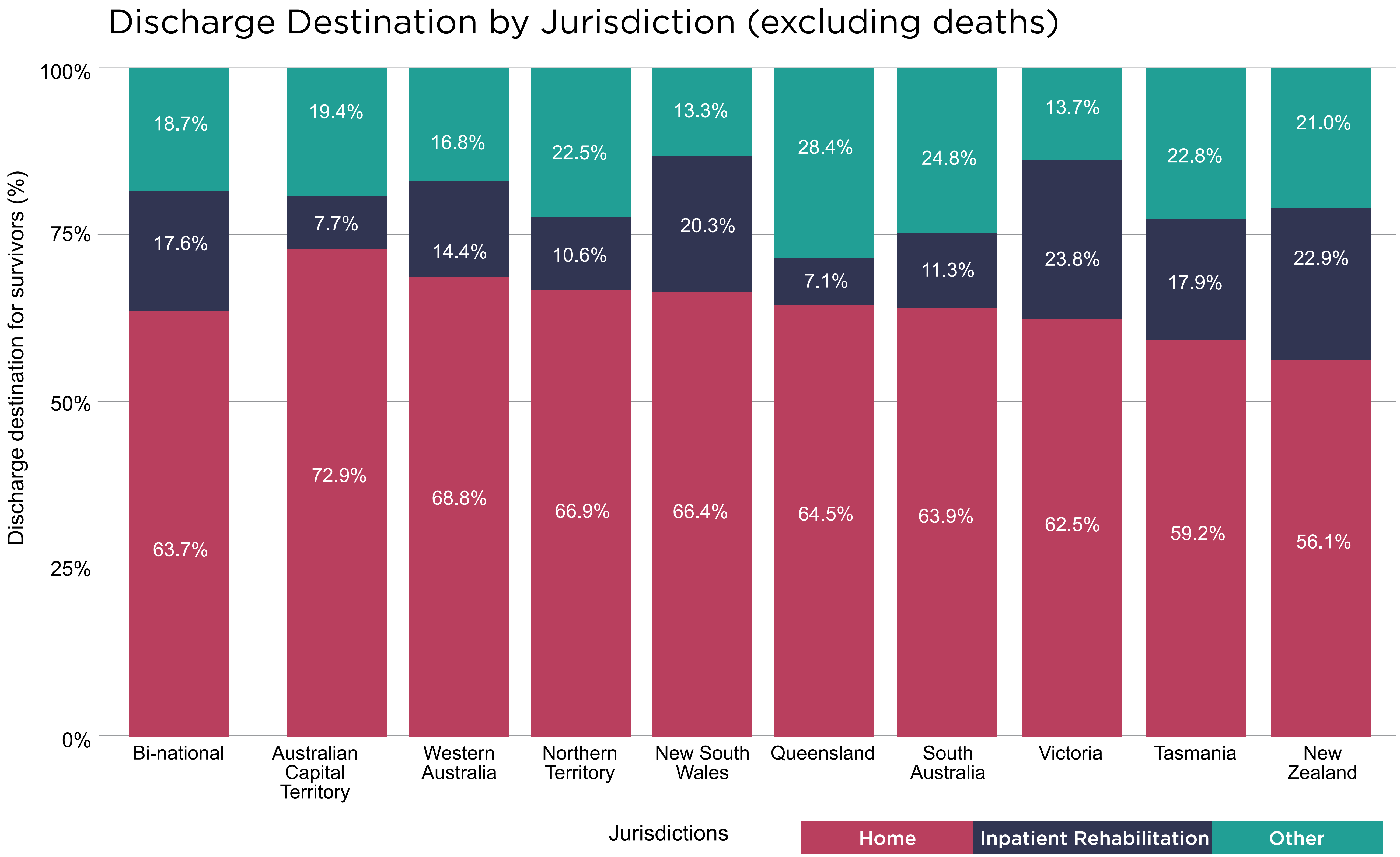
Discharge Destination by Age Group



DISCHARGE DESTINATION BY JURISDICTION

When looking at discharge destination by jurisdiction, the proportion of patients discharged to home and to inpatient rehabilitation vary greatly. The reasons for this are not clear and will be investigated further. Importantly discharge to rehabilitation has decreased over time as new models of home rehabilitation and recovery have been developed [9].





PAEDIATRICS (0-15 YEARS OLD)

More than 62,000 children aged 0-14 were hospitalised following injury in Australia in 2019-20, according to the Australian Institute of Health and Welfare [10]. The Australia New Zealand Trauma Registry collects trauma data on only the most severe injuries - those who are hospitalised with an Injury Severity Score (ISS) of greater than 12 or death after injury.

Seven hundred and forty-four children aged zero to 15 years were reported across Australia and New Zealand for the period 1 July 2021 to 30 June 2022, accounting for 6.9% of all severe injuries.

744 SEVERELY INJURED

8.7% mortality

57.0% 0-15 yo deaths were AGED 0-4

CHILDREN AGED 0-4 YEARS

Children aged zero to four years accounted for one third of all paediatric severe injuries (n=260, 34%) and over half (57.8%) of all paediatric deaths. The most common known mechanism was low fall (n=80). One hundred and nine were classified with a mechanism of other or unknown, the largest group (see graph below). Of these, 53 had an intent of unintentional, nine maltreatment by parent, and 33 unknown or undetermined.

Drownings and hanging are not included in this report.

The majority of cases in this age group had an ISS in the range of 25-40 (36%), followed by an ISS in the 16-24 range (34%).

The in-hospital mortality rate in children aged 0-4 years was 14.2%, above the bi-national mortality rate of 9.7%.

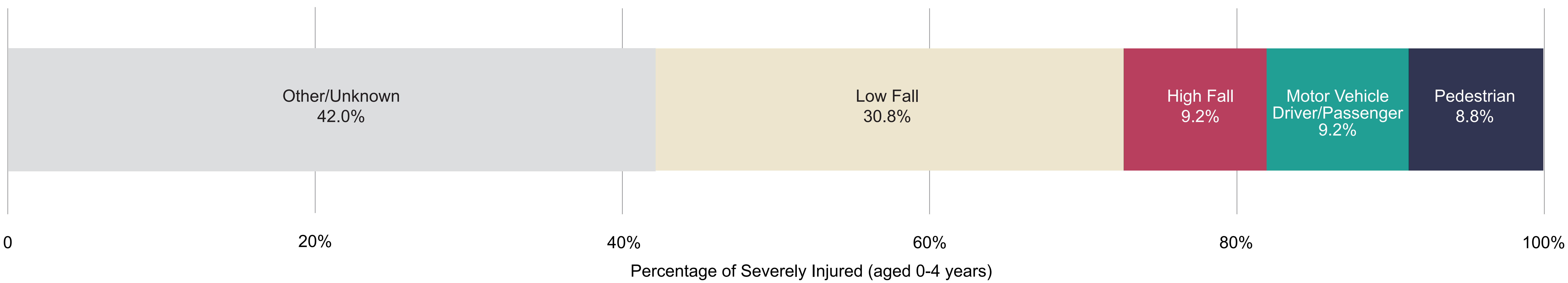
The most common known cause of death was unintentional suffocation/strangulation (n=6). For 21.6% of deaths in this age group, the specified injury intent was assault.

65% of children aged 0-4 years were discharged home and 6.2% to acute hospital for further definitive care. 65.8% of injuries occurred in the home, followed by 15% on the road.

65.8% occurred in **HOME**

15% occurred on **THE ROAD**

Mechanism of Injury (aged 0-4 years)



PAEDIATRICS (0-15 YEARS OLD)

CHILDREN AGED 5-15 YEARS

Children aged five to fifteen years accounted for two thirds of paediatric severe injuries (n=484) which is similar to previous years. The most common cause was transport-related (n= 284, 58.7%) followed by falls (n=113, 23.8%). The majority of cases had an ISS in the range 16-24 (n=213, 44.3%) followed by an ISS in the range 25-40 range (n=138, 28.7%).

CAUSE OF INJURY

59% TRANSPORT RELATED

23.8% FALLS related

PLACE OF INJURY

35.1% ROAD

22.5% HOME

9.3% sports & ATHLETICS AREA

OUTCOME

5.8% DIED in-hospital

54% deaths TRANSPORT RELATED

OUTCOME

5.79% (n=28) of severely injured aged 5 - 15 years died in hospital. This is below bi-national mortality rate (9.7%) but is an increase compared to last year (2021 = n=13, 2.5%). Of these deaths, three (10.7%) died in the emergency department. 53.6% of deaths were transport-related, followed by falls (10.7%). Of those alive at discharge, 81.8% were discharged to the home and 7.4% to inpatient rehabilitation.

ELDERLY (AGED 70 YEARS AND ABOVE)

In the 2021/22 financial year 2,847 (26.2%) of all severely injured were aged ≥70 years. Low falls were the most common cause of injury (53.1%) and had an overall mortality rate of 25.0%. The most common cause of injury in this age group were falls (low and high, 71.3%) followed by transport-related causes (21.0%). A similar pattern has been reported among adult major trauma patients in England, where the cause of injury is dominated by low falls, particularly in older people[11].

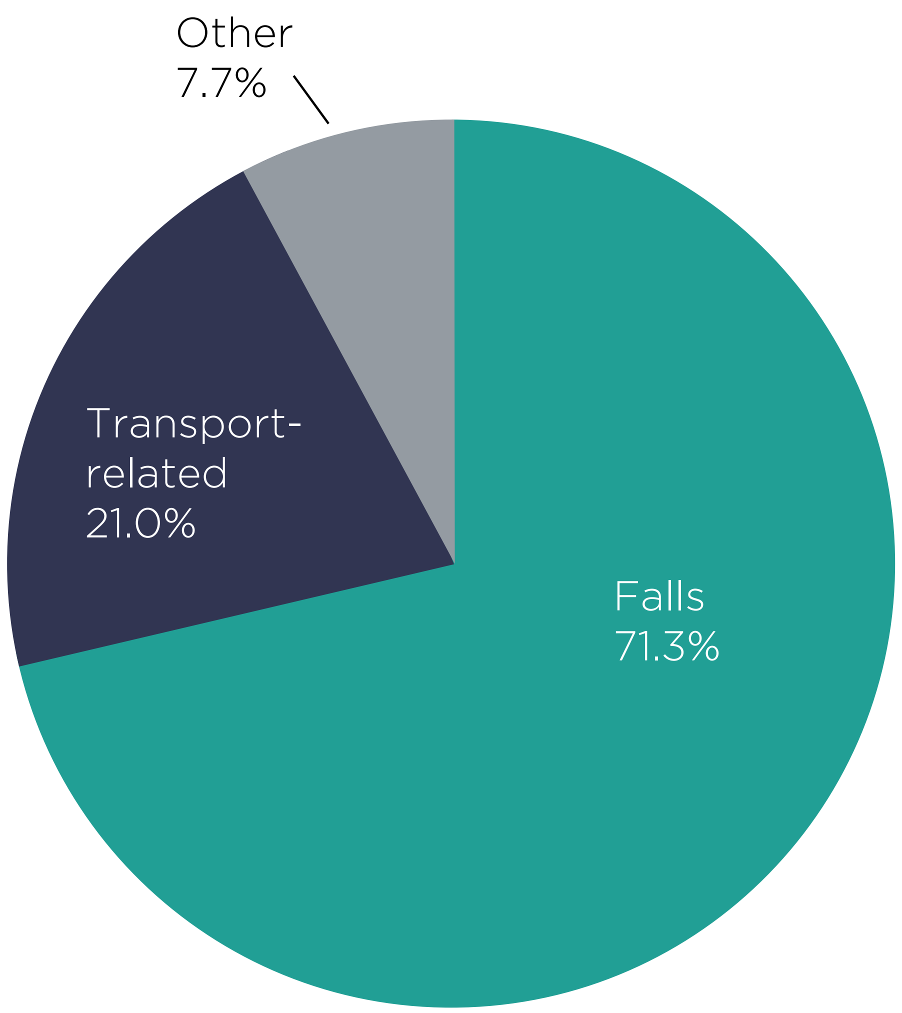
26.2% of all SEVERE INJURIES **AGED 70+**

71.3% FALLS related

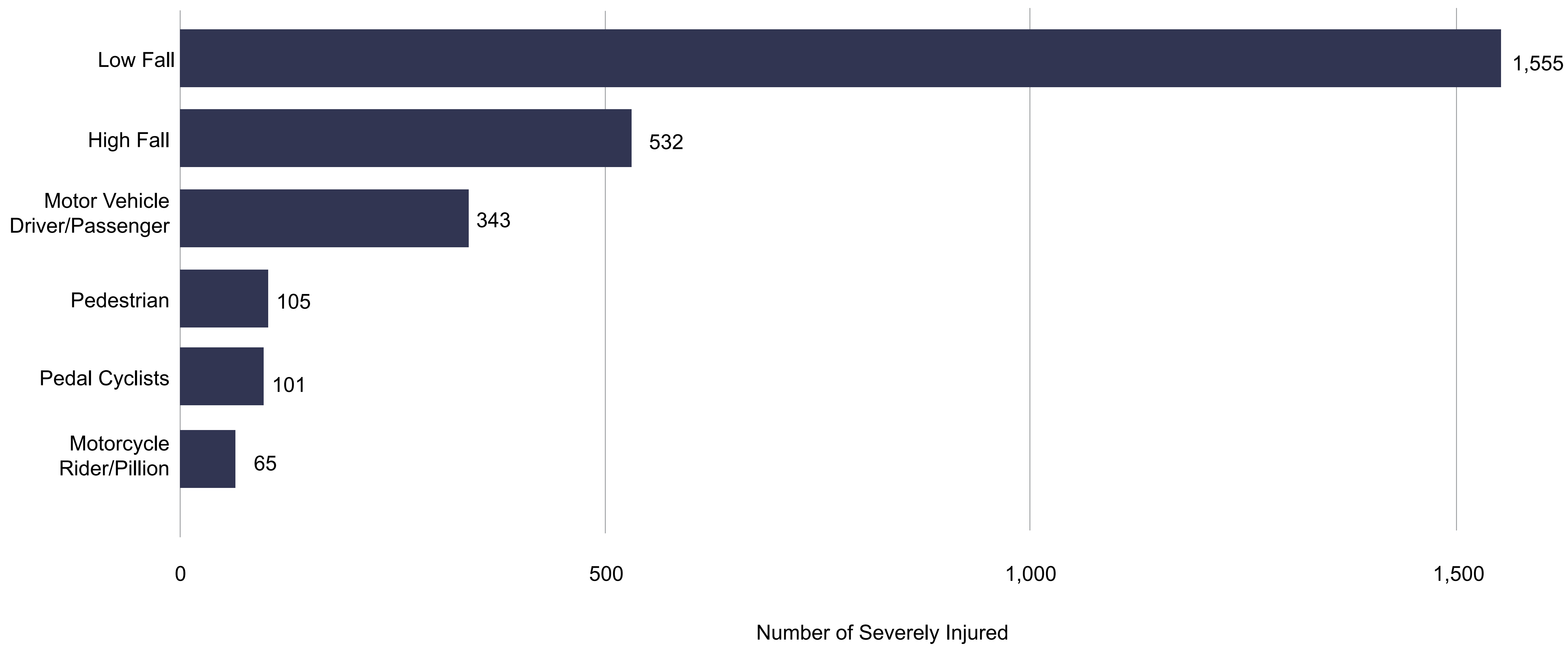
53% LOW FALLS with an overall mortality **rate of 25%**

CAUSE OF INJURY

Falls were the most prominent injury cause within this age group, followed by transport-related causes. When falls and transport-related causes were further broken down, low falls were identified as the most common injury cause for this age cohort, 46 per cent (n=1603), compared with the 19.5 per cent low falls rate for all severely injured.



Further Breakdown of Cause of Injury, aged 70 years and above

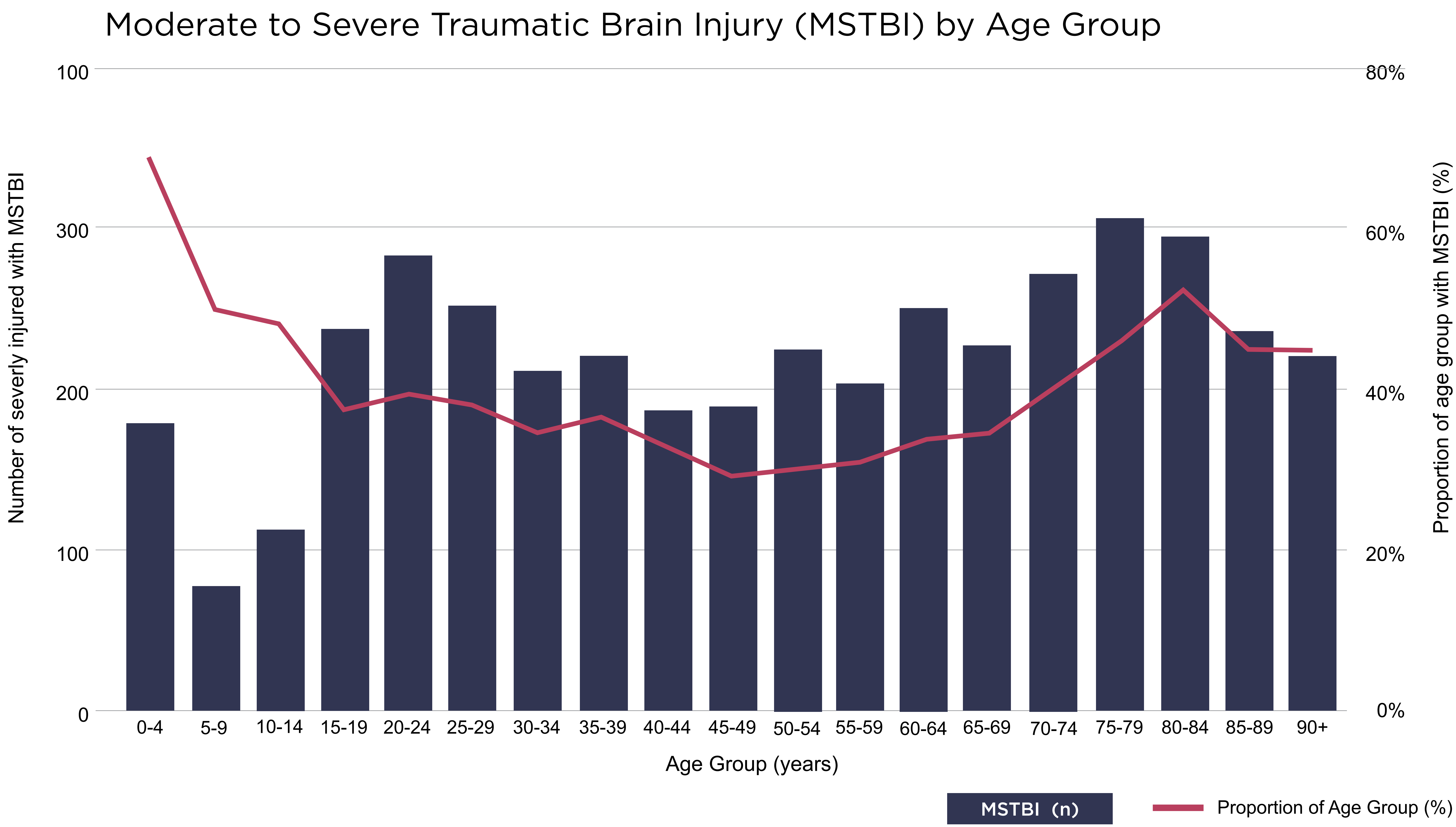


MODERATE TO SEVERE TRAUMATIC BRAIN INJURY

A large percentage of severely injured patients(4186 (38.6%) had moderate to severe traumatic brain injury (TBI), as defined by an AIS code for the head region greater than ≥3.

The proportion of severely injured with moderate to severe TBI varied across jurisdictions, ranging from 27.7% to 45.3%.

The proportion of moderate to severe TBI peaked in the youngest age group (0-4 years), with a further peak in older adults. The proportion of females with moderate to severe TBI was higher than males (40.0% vs. 38.1%).



MSTBI

Low falls were the most frequent cause of moderate to severe TBI (33.5%), followed by high falls (15.8%) and motor vehicle related injuries (12.7%). Of those with a specified intent, 83.6% were unintentional.

The most common place of injury for children with a moderate to severe TBI aged 0-4 years was the home (73.1%) and most were older adults aged ≥70 years (58.8%). The street and highway was the most common place of injury for all other age groups with a moderate to severe TBI, particularly the 15 to 29 year age group (55.6%).

Five hundred and sixty-five (13.5%) severely injured patients with moderate to severe TBI died in-hospital - higher than the overall bi-national mortality rate of 9.7%. Of these deaths, 35 died in the emergency department. The proportion of in-hospital deaths varied by broad age group: 9.7% of children (aged ≤15 years), 8.7% of adults (aged ≥16 and ≤69 years) and 23.4% of older adults (aged ≥ 70 years) died in hospital.

As a proportion of total deaths in the severely injured with moderate to severe TBI, falls were the most frequently occurring cause of injury (56.7%), and transport-related injuries accounted for 28.3% of moderate to severe TBI deaths.

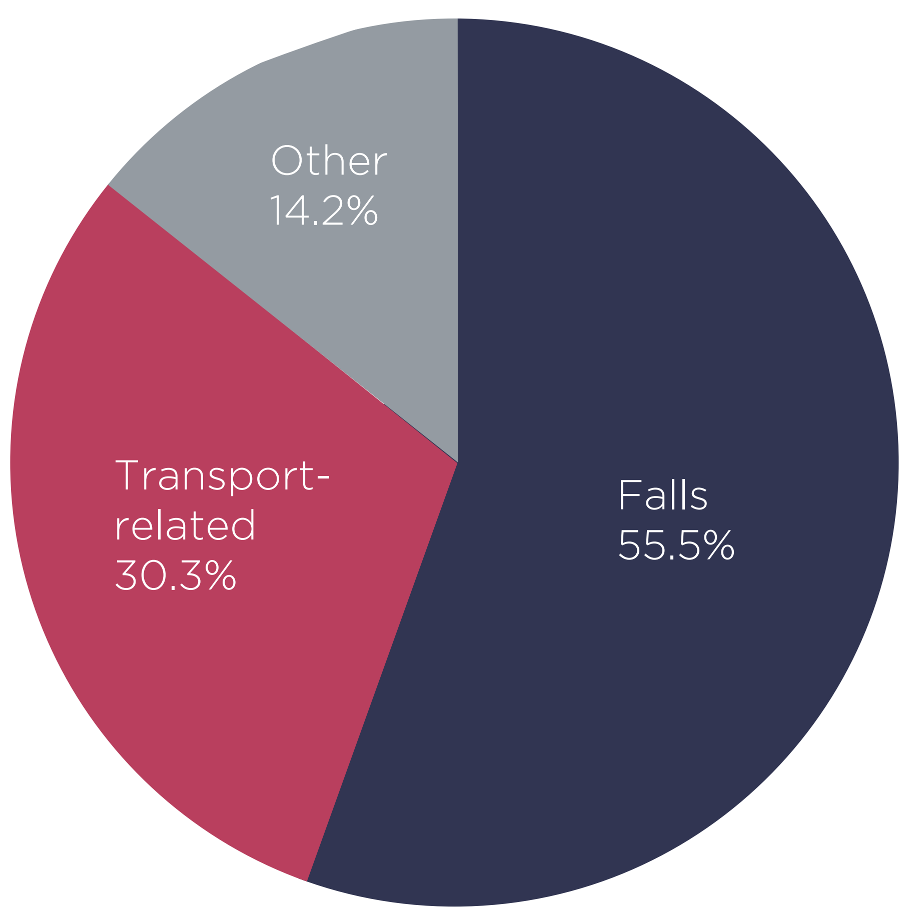
The mechanism of injury for deaths in severely injured with moderate to severe TBI varied by age group. For children (aged ≤15 years) and adults (≥16 and ≤69 years), transport-related injuries accounted for the highest proportion of deaths (46.1% and 60.9% respectively). For older adults (≥70 years) with moderate to severe TBI, falls accounted for 82.3% of deaths (78.9% due to low falls; 20.1% high falls).

Severely injured patients with moderate to severe TBI had a higher rate of transfer compared with the overall cohort (31.4% vs 29.3% binationally). Of those with moderate to severe TBI that were transferred, 97 died (7.4%), and of those with moderate to severe TBI who were not transferred, 364 died (19.4%).

DISCHARGE DESTINATION

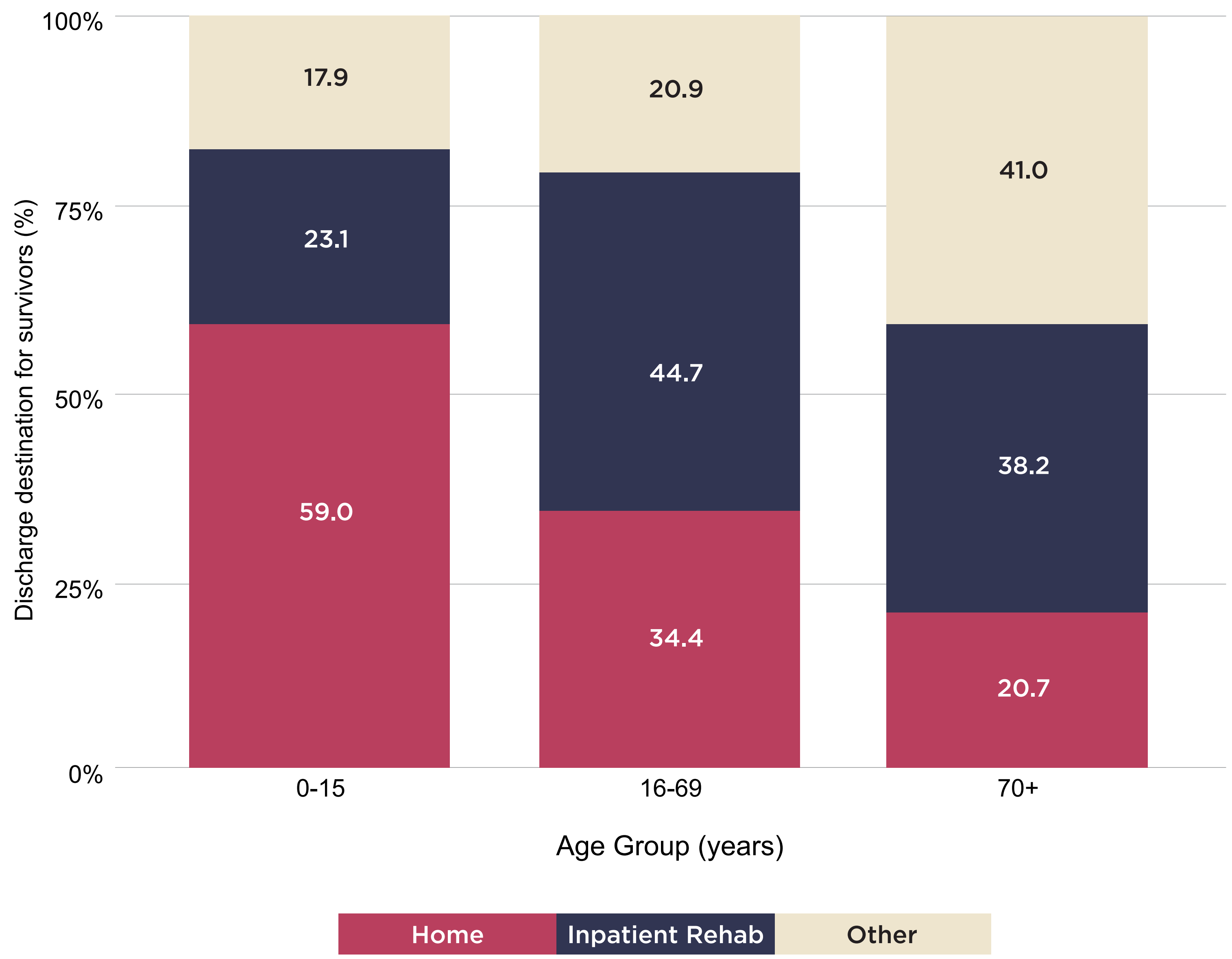
For those severely injured with moderate to severe traumatic brain injury discharged alive, 54.5% were discharged to home and 24.4% were discharged to inpatient rehabilitation. These discharge destinations were the most frequently occurring for all age groups, although children (aged ≤15 years) had a higher proportion discharged to the home than other age groups (75.6%).

Isolated moderate to severe TBI (an AIS code for the head region ≥3, and an AIS code for any other region ≤2) accounted for 67.7% of all moderate to severe TBI, with complicated moderate to severe TBI (defined as an AIS code for the head region ≥3, and an AIS code for any other region ≥3) accounting for 32.3%.

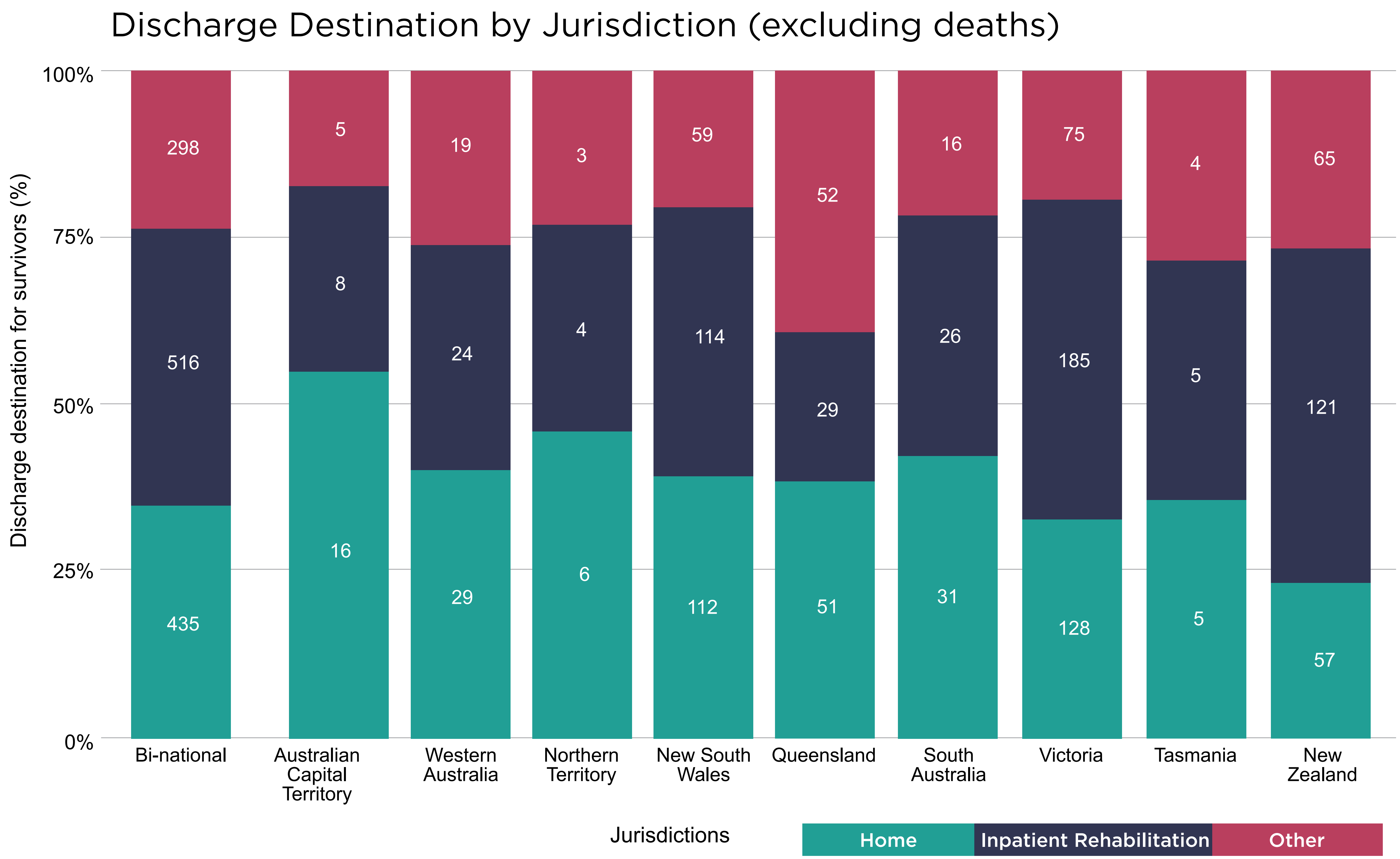


Cause of Injury

Discharge Destination for MSTBI by Age Group



CHARACTERISTICS OF COMPLICATED AND ISOLATED STBI AND OTHER MAJOR TRAUMA



	Case fatality rate	Median (mean) ISS	Median (mean) Age	Mechanism of Injury (%)		
				Falls	Transport	Other
Complicated MSTBI	15.1%	29 (31)	49 (48.7)	32.9	56.4	10.7
Isolated MSTBI	12.7%	17 (20)	54 (51.6)	57.2	22.9	19.8
No MSTBI	7.3%	17 (18)	51 (50.2)	30.3	52.9	16.8

Moderate to severe TBI is a major cause of hospitalisation and death in Australia and New Zealand, and the annual numbers of hospitalisations and deaths have not changed during the 2015-20 period [4]. Moderate to severe TBI is also a major cause of disability, associated with complex long-term problems [12, 13].

At present, the ATR does not collect data on long term outcomes, however it is hoped that as we move to improved data linkage with admissions and pre-hospital data and other important datasets we will be better able to monitor and predict recovery outcomes after TBI.

ROYAL AUSTRALASIAN COLLEGE OF SURGEONS (RACS) TRAUMA QUALITY IMPROVEMENT COMMITTEE AND THE ATR

One of the aims of the Royal Australasian College of Surgeons (RACS) Trauma Quality Improvement (TQI) committee has been to support quality improvement for all trauma patients. This year RACS celebrates 29 years of supporting the development of the Australian Trauma Registry (ATR). By using the ATR data to establish benchmarks, and providing cross-comparison feedback to each trauma centre, processes of care for improvement within the trauma system can be identified.

The RACS TQI committee developed a set of bi-national process indicators which allows for cross-comparison and benchmarking of key process indicators between sites and jurisdictions. There are eight process indicators, all of which are now incorporated in the bi-national data dictionary. The ATR is continuing to work with sites to improve data capture and completeness of these variables so that reporting all of the process indicators will be possible in future.

RACS TQI PROCESS INDICATORS

INDICATORS	1	2	3	4	5	6	7	8
INDICATOR NAME	Mortality	Pre-hospital transport times	Discharge Destination	Time to CT scan if GCS < 13	Trauma team activation for patients with ISS > 12	Blood alcohol collection in patients with ISS > 12.	Time in first facility, if transferred.	Time in the Emergency Department.
DEFINITION	The rate of in-hospital deaths that occur, either in the Emergency Department or after inpatient admission, in patients admitted following injury.	The mean and/ or median times that elapse between the time of injury and the episodes of care that occur prior to arrival at the 1st receiving hospital.	The rate at which patients are discharged to the various destinations other than death, at the conclusion of their hospital admission	The mean and/ or median time that elapses between arrival at the reporting hospital and the first head CT performed at that same hospital.	The percentage of patients with major injuries, defined as an ISS > 12, who had a trauma team activated at the time of presentation to the Emergency Department.	The percentage of patients with major injuries, defined as an ISS > 12, who had a blood alcohol level collected and documented within 6 hours of first hospital admission.	The mean and/ or median length of time that is spent in the first facility, prior to the transfer to definitive care.	The mean and/ or median length of time that is spent in the Emergency Department, prior to discharge to the ward, or other disposition from the ED that is not death.
RATIONALE	To understand the burden of death from injury in patients that are alive on presentation to hospital.	To understand the timeliness of pre-hospital encounters.	To quantify the varying outcomes of in hospital admissions, with a view to determining resource allocation.	To measure the timeliness of CT investigation of a patient with a suspected brain injury.	To determine the accuracy of trauma team activation.	To measure the recognition of major injury by compliance with blood alcohol collection practice.	To measure the timeliness of transfer to definitive care and evaluate compliance with transfer protocols.	To measure the timeliness and efficiency of the care delivered in the Emergency Department.

APPENDIX A - ATR METHODOLOGY

Governance

The National Trauma Research Institute (NTRI), founded in 2003, is a collaboration between Alfred Health, Monash University and Gold Coast University Hospital and Health Service. The NTRI collaborates with organisations nationally and internationally to integrate Research, Education, Medical Technologies and Trauma Systems Development to improve clinical care and outcomes.

In 2012, the NTRI established the Australian Trauma Quality Improvement Program (AusTQIP) including the Australian Trauma Registry (ATR) bringing together Australia's 26 designated trauma centres to form a collaboration to provide important data on the most severely injured. In 2018, New Zealand joined the collaboration, introducing a further seven designated trauma centres to the registry.

In 2022, we welcome Lyell McEwin in SA to the collaboration, bringing the total number of sites to 35. AusTQIP was formed with an overarching Steering Committee comprised of representation from all jurisdictions, and other participating stakeholders (Appendix B). Reporting to the Steering Committee is the AusTQIP Management Committee (Appendix B). The ATR is supported by the Department of Infrastructure, Regional Development and Cities (DIRDC) and the Department of Health (DOH), who have provided further funding for the period 1 July 2019 to 30 June 2022. The ATR is also supported by the New Zealand National Trauma Network and the NTRI, as well as by the large group of contributing sites.

Minimum Dataset

ATR data is defined by the Bi-National Trauma Minimum Dataset (BNTMDS). Data elements from existing hospital and state-based registries were mapped to the dataset according to standard definitions. If data elements were not already collected by existing data sources, they were not otherwise obtained by the ATR. The current version of the minimum dataset (Version 2.0) can be downloaded from the ATR website (www.atr.org.au).

Inclusion/ Exclusion Criteria

The ATR collects data on severely injured patients presenting to one of 35 major trauma centres across Australia and New Zealand.

Inclusion Criteria

Patients admitted to these centres who subsequently die after injury, or who sustain major trauma (defined as an Injury Severity Score greater than 12) are included in ATR data.

Exclusion Criteria

Patients with delayed admissions greater than seven days after injury, poisoning or drug ingestion that do not cause injury, foreign bodies that do not cause injury, injuries secondary to medical procedures, isolated neck of femur fracture, pathology directly resulting in isolated injury, elderly patients who die with superficial injury only (contusions, abrasions, or lacerations) and/or have coexisting disease that precipitates injury or is precipitant to death (e.g. stroke, renal failure, heart failure, malignancy , advanced frailty by Rockwood), drowning, hanging.

Data Definitions

Emergency Department length of stay (ED LOS) is calculated by the ATR based on the date and time of arrival at the definitive care hospital to the emergency department discharge date and time. ED LOS is presented as hours.

Intensive Care Unit length of stay (ICU LOS) is based on values provided by the designated trauma centres or as reported by the state-based trauma registries. ICU LOS is presented as days.

Hospital length of stay (LOS) is from date and time of arrival at definitive care hospital to the date and time of discharge from definitive care hospital as reported. Hospital LOS is based on values provided by the designated trauma centres or as reported by the state-based registries. Hospital length of stay is presented as days.

External cause of injury International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification[6] (ICD-10-AM) codes were used to define causes/mechanisms of injury, injury type and injury intent. Causes of injury were based on the Center for Disease Control's External Cause of Injury and Mortality Matrix (www.cdc.gov/nchs/data/ice/icd10_transcode.pdf).

Type of injury was based on ICD-10-AM codes as previously reported[7]. Codes were mapped to injury types in the BNTMDS.

Data Analysis

Risk adjusted outcomes are provided in this report. The primary outcomes were inpatient mortality and length of stay (LOS). Total numbers for risk adjustment have been reduced because the transferred group of patients has been excluded. This resulted in a 30% reduction in numbers. A further reduction in numbers was the exclusion of non-blunt trauma cases such as burns and penetrating injury as they are a small heterogenous group (5%). For both outcomes, funnel plots were created as a visual representation of how individual sites fare compared to their peers and the overall average; it also identifies those who are performing better or worse than the average. The funnel plot contours represent two standard deviations (95% control limits) and three standard deviations (99.8% control limits) from the mean, those above and below these lines are considered outliers, with a 5% and 0.2% chance of a false positive respectively. Both crude and risk-adjusted funnel plots were calculated. For inpatient mortality, the binary firth logistic regression model was used and the robust linear regression model for LOS, due to right skewness in the data. Only survivors were included in the LOS analysis. The following risk factors were included in the model as they were found to be significant predictors: restricted cubic splines for age with 4 knots, cause of injury, arrival Glasgow Coma Scale (GCS) - motor, shock-index grouped in quartiles, highest and second highest AIS scores. We ran separate analysis for paediatric (age <age64). Data analysis was performed in Stata V16.0 (Stata Corp, College Station, Tx, USA) and level of significance set at 5%. The relationship between age and mortality among trauma patients is nonlinear. There are several options to dealing with non-linearity, including categorising based on arbitrary cut-offs, including a quadratic term or including cubic splines. In a recent publication, we compared the various methods and found cubic splines to be the most appropriate. The model assumes that the relationship is polynomial between the knots, locations set by the model at 18, 52 and 82 years. Although the splines are not easily interpretable, note that this is used in the context of benchmarking and not patient risk-stratification, which would probably require a different approach.

Data Confidentiality

In 2016, Monash University, Department of Epidemiology and Preventive Medicine, became the custodian of the ATR data and responsible for all reporting.

Patient level data is not reported, only hospital and jurisdictional aggregate data is provided in this report.

Data Quality

Data submitted to the ATR underwent various validity checks such as date and time formats and chronology, and correct classification as per the ICD-10-AM and Abbreviated Injury Scale 2005 (Updated 2008)[8] (AIS) codes prior to data processing. If data did not pass these validations, an error file was generated and a notification sent to sites submitting the data to address and correct the error, if possible. Data contribution varies between hospitals as not all hospitals have all the BNTMDS data points available. However this continues to improve, along with data completeness as the hospitals update data systems and improved data quality processes are put in place.

Severity of Injury

Injury Severity Score (ISS) is an internationally standardised approach to describing the overall severity of injury for each patient. The calculated value enables comparison between cohorts of injured patients, and can be used for inclusion into trauma registries. The higher the number the more severe the injury, ranging from one to 75. Trauma patients are allocated an ISS after injury in order to determine their status as 'major trauma'. For this report major trauma is defined as an ISS > 12, which is derived from the Abbreviated Injury Scale (AIS) 2008. ISS is useful for predicting hospital length of stay, and associated morbidity and mortality.

APPENDIX B - GOVERNANCE COMMITTEES

AUSTQIP STEERING COMMITTEE MEMBERSHIP

Member	Committee Role
Professor Ian Civil	NZ National Trauma Network - Clinical Director
Ms Siobhan Isles	NZ National Trauma Network - Programme Director
Professor Mark Fitzgerald	Co-chair/Alfred Health/NTRI representative
Professor Peter Cameron	University representative
Dr Don Campbell	Queensland representative
Associate Professor Grant Christey	RACS TQI Representative
Mr Chris Clarke	South Australia representative
Dr John Crozier	Royal Australasian College of Surgeons (RACS) representative
Associate Professor Michael Dinh	New South Wales representative
Associate Professor Daniel Ellis	Treasurer/South Australian Representative
Dr Yen Kim	AusTQIP Manager
Associate Professor Anthony Joseph	Australasian Trauma Society representative
Ms Bronte Martin	National Critical Care & Trauma Response Centre (NCCTRC) Executive Sponsor
Associate Professor Joseph Mathew	Australasian College of Emergency Medicine representative
Ms Kathleen McDermott	Northern Territory representative
Ms Ancelin McKimmie	Manager, Australia New Zealand Trauma Registry
Dr Rebekah Ogilvie	Australian Capital Territory representative
Dr Sudhakar Rao	Western Australia representative
Professor Michael Reade	Australian Defence Force representative
Mr Nick Rushworth	Consumer representative
Dr Adam Mahoney	Tasmania representative
Associate Professor Warwick Teague	Paediatric Specialist/ Victorian representative

Proxies, Adjuncts and Observers	
Ms Maxine Burrell	Western Australian representative
Mr Huat Lim	NCCTRC / Northern Territory

ATR BOARD COMMITTEE MEMBERSHIP

Member	Committee Role
Professor Mark Fitzgerald	Co-chair
Ms Siobhan Isles	Co-chair
Professor Peter Cameron	Data Host/Management Representative
Ms Ancelin McKimmie	Australia New Zealand Trauma Registry Manager
Professor Ian Civil	NZ Clinical Director, National Trauma Network
Dr Don Campbell	AusTQIP Steering Committee representative
Associate Professor Dan Ellis	Treasurer, AusTQIP Steering Committee representative
Dr Yen Kim	Research Manager, National Trauma Research Institute
Associate Professor Grant Christey	AusTQIP Steering Committee representative, RACS representative
Professor Kirsten Vallmuur	AusTQIP Steering Committee Representative

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Sunshine Coast University Hospital
Townsville Hospital

NEW SOUTH WALES (N.S.W.)
Institute of Trauma and Injury Management (ITIM)
Children's Hospital, Westmead
John Hunter Children's Hospital
John Hunter Hospital
Liverpool Hospital
Royal North Shore Hospital
Royal Prince Alfred Hospital
St George Hospital
St Vincent's Hospital
Sydney Children's Hospital
Westmead Hospital

NORTHERN TERRITORY (N.T.)
Royal Darwin Hospital

SOUTH AUSTRALIA (S.A.)
S.A. Department of Health
Flinders' Medical Centre
Lyell McEwin Hospital
Royal Adelaide Hospital
Women's and Children's Hospital, SA

TASMANIA (TAS)
Royal Hobart Hospital

VICTORIA (VIC)
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Alfred Hospital
Royal Melbourne Hospital
Royal Children's Hospital

WESTERN AUSTRALIA (W.A.)
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This report has been prepared by Ms Ancelin McKimmie, Manager, ATR.

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