ANNUAL REPORT
1 JULY 2018 TO 30 JUNE 2019

AUSTRALIA
NEW ZEALAND
TRAUMA REGISTRY
Management of the
Severely Injured

ATR AUSTRALIA NEW ZEALAND TRAUMA REGISTRY

ANNUAL REPORT
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FOREWORD

Welcome to the 2018-19 Australia New Zealand Trauma Registry (ATR) Annual Report on behalf of the Australian Trauma Quality Improvement Program Steering Committee, the Collaboration of Australian major trauma centres, and the National Trauma Network in New Zealand. This is the second bi-national annual report after the ATR became the Australia New Zealand Trauma Registry in 2018, with the formal inclusion of data from seven major trauma centres across New Zealand. This year, the ATR has become a leading Clinical Quality Registry, providing much needed risk-adjusted outcomes. The registry has now obtained quality data that can be utilised for comparison and benchmarking, based on four years for Australia and two years from New Zealand.

We acknowledge the sponsorship from a number of federal agencies for the ATR that has made this work possible. Earlier this year, the Australian Government Department of Health and Department of Infrastructure, Transport, Regional Development and Communications provided federal funding until 2022 to maintain and develop ATR activities. Through the Memorandum of Understanding, the (NZ) Accident Compensation Corporation provides additional funding for New Zealand contribution to the ATR. The combined supports are matched by progressing hospital participation to 34 sites, demonstrating the commitment by trauma services to improved trauma care. Variations to the initial collaboration agreement will allow more sites to join with the goal of moving towards a population-based registry.

An important, recent publication highlights the under-utilisation of registry data and its capacity to instigate improvements in clinical processes as well as systems[1]. Our mission is to encourage the use of the trauma data that includes geospatial, pre-hospital and associated cost information, so that quality improvement strategies are evidence-based and specifically targeted to services and regions[2]. We anticipate several publications later this year - with ATR data utilised to improve injury prevention strategies, clinical care and trauma service planning. For example, new risk-adjustment models have been developed for the severely injured patients and the models, and service comparisons are described in this current report.

We re-emphasise that all major trauma data published by the ATR is accessible to all ATR contributors, government and health policy decision-makers, the research community and the public. Use of this data has important implications for education, acute care, resources allocation and epidemiology. For more information about data access please refer to the ATR website – www.atr.org.au.

We would like to thank all of the contributors, collaborators, supporters and funders for their contributions and assistance.

1. Curtis K, Gabbe B, Shaban RZ, Nahidi S, Pollard C, Vallmuur K, Martin K, Christey G. Priorities for trauma quality improvement and registry use in Australia and New Zealand. Injury 2020;51:84-90.
2. Fitzgerald MC, Curtis K, Cameron PA, Ford JE, Howard TS, Crozier JA, Fitzgerald A, Gruen RL, Pollard C. on behalf of the AusTQIP Consortium. The Australian Trauma Registry, ANZ J Surg. December 2018. doi:10.1111/ans.14940

Professor Kate Curtis
Co-chair ATR Steering Committee

Professor Mark Fitzgerald
Co-chair ATR Steering Committee

Professor Ian Civil
Clinical Lead
NZ National Trauma Network

2018-19 YEAR IN REVIEW
AUSTRALIA

DEMOGRAPHICS

8,528 severely injured

median **AGE 49**

73% **MALE**

36% occured on the **WEEKEND**

CAUSE OF INJURY

4.3% penetrating **trauma**

1.1% BURNS

94% **BLUNT** trauma

36% **FALLS**

5% BY assault

45% **transport related**

PLACE OF INJURY

47% **streets & highways**

30% home

PRE-HOSPITAL

68% direct from scene to definitive **HOSPITAL**

Median time from scene to definitive care 1hr 26mins

HOSPITAL

Median time **spent in ED 4hrs 21mins**

median **length** of stay **7days**

39% **admitted to ICU**

median ICU length of stay **4 DAYS**

OUTCOMES

9.8% in-hospital **deaths**

41% of deaths **aged 75+**

15% **of deaths** OCCURED IN ED

- **65%** discharged **home**
- **21%** to rehabilitation
- **14%** to other

2018-19 YEAR IN REVIEW
NEW ZEALAND

DEMOGRAPHICS

1,761 severely injured

median **AGE 45**

73% MALE

37% occured on the **WEEKEND**

CAUSE OF INJURY

5% penetrating **trauma**

1.1% BURNS

94% **BLUNT** trauma

28% **FALLS**

7.7% by assault

54% **transport related**

PLACE OF INJURY

51% streets & highways

23% home

PRE-HOSPITAL

77% direct from scene to definitive **HOSPITAL**

Median time from scene **to definitive care** **1hr 35mins**

HOSPITAL

Median time **spent in ED** **3hrs 55mins**

median **length** of stay **7.7days**

34% admitted **to ICU**

median **ICU** length of stay **3.7 DAYS**

OUTCOMES

9.8% in-hospital **deaths**

36% of deaths **aged 75+**

10.4% **of deaths** OCCURED IN ED

- **55%** discharged **home**
- **23%** to rehabilitation
- **22%** to other

EXECUTIVE SUMMARY

The Australia New Zealand trauma registry is now entering an exciting phase, having established itself as a leading Clinical Quality Registry. The registry now has reliable data, collected in a consistent manner and collected over a long time period. There is also secure funding for three years. This allows analyses of regional and national injury prevention programs, clinical care and improvements in trauma systems at a binational level. The engagement of trauma services across both nations, ensures findings translate into practice. The importance of credible, reliable data from trauma registries has been shown to drive improvements to trauma systems.

This annual report covers dates of injury between 1 July 2018 to 30 June 2019 for severely injured patients Injury Severity Score greater than 12 or in-hospital death following injury) from 24 Australian and seven New Zealand designated trauma services. In 2018-19 the ATR received data for 10,289 patients (8,528 in Australia, 1,761 in New Zealand). Overall, men continued to be over-represented, accounting for 73 percent of severe injuries.

Bi-nationally, ninety-five percent of severe injury was caused by blunt mechanisms, with 4.1 percent due to penetrating trauma, and less than one percent due to burns. In New Zealand, there was a major spike in penetrating injury related to the Christchurch mosque attacks in March 2019.

Forty-six percent of severe injuries were transport-related and 35 percent falls-related, accounting for 81 percent of all severe injuries. A major change is occurring in the epidemiology of severe injuries with older patients injured from low falls increasingly the predominant group experiencing severe injury and death (1,2). Low falls accounted for 20.4% of all severe injuries. The median (IQR) age for low falls was 73 (55-84) years with 15 per cent mortality and 87 per cent of deaths aged 65 years and above.

Seventy percent of severely injured patients were transferred from the scene directly to definitive care. Of these, 73.5 percent were transported directly from the scene to definitive care by road ambulance, 18.4 percent by helicopter and 5.8 percent arrived via private vehicle/walk-in.

The median (IQR) time from scene to arrival at definitive care was 1.47 (1.03-2.23) hours and the median (IQR) time spent in the emergency department was 4.27 (2.35-7.25) hours. The traditional “Golden Hour” mostly occurs prehospital. Transport times from regional locations, prehospital stabilisation and bypass of non trauma centres contribute to these extended prehospital times. The median time to first head computed tomography (CT-Head) for patients with a total GCS less than 13 was 0.73 (0.43-1.23) hours from time of arrival.

The median (IQR) length of stay in hospital was 7.1 (3.6-14.4) days and the median (IQR) intensive care unit length of stay was 3.8 (2.0-8.0) days. Overall in-hospital mortality was 9.8 percent with 13.8% of deaths occurring in the emergency department.

Length of stay and mortality were risk adjusted for age, mechanism, arrival Glasgow Coma Scale, shock index and injury severity. No significant difference were noted across sites or age groups for length of stay, however three sites fell outside the 95% confidence intervals for mortality (two high mortality and one low). These sites were lower volume sites and thus influenced more by annual fluctuations in case mix. Trends over time will give a better indication of comparative outcomes.

At the conclusion of the acute care episode most severely injured people were discharged home (63 percent), or to a rehabilitation facility (21 percent).

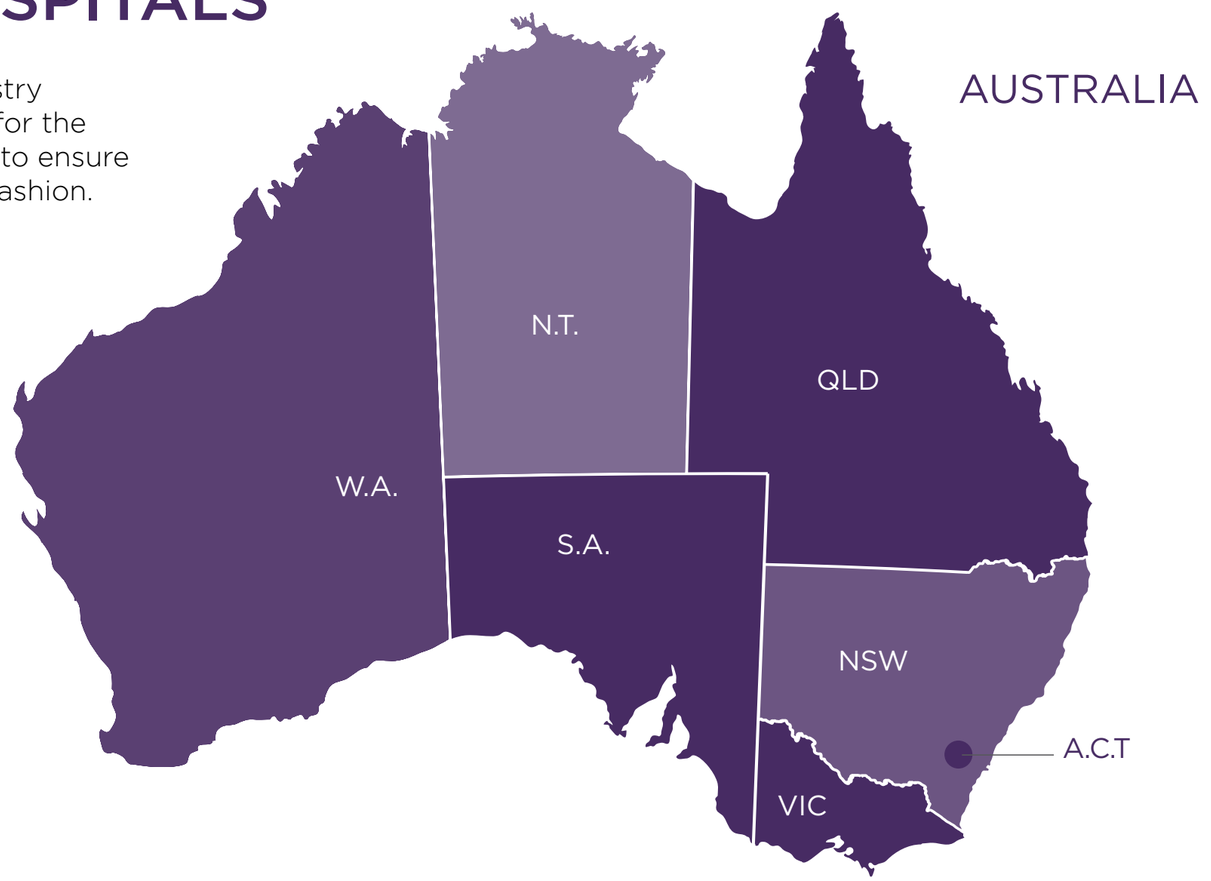
This report provides a bi-national view of severe injury resulting in hospitalisation. It is hoped that as data quality and completeness continue to improve, together with improved benchmarking of processes and outcomes, preventable death and morbidity following severe injury will continue to decline.

Professor Peter Cameron
University Representative
Monash University

Emily McKie
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.



JURISDICTIONS

AUSTRALIAN CAPITAL TERRITORY (A.C.T.)

Canberra Hospital

(from 1 July 2014 to present)

QUEENSLAND (QLD)

Gold Coast University Hospital
(from 1 January 2015 to present)

Queensland Children's Hospital *(formerly Lady Cilento Children's Hospital)*
(from 1 December 2014 to present)

Princess Alexandra Hospital
(from 1 July 2014 to 31 March 2018)

Royal Brisbane and Women's Hospital

Townsville Hospital No data submitted

Sunshine Coast University Hospital
(from 1 October 2018)

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

Flinders' Medical Centre
Royal Adelaide Hospital
Women's and Children's Hospital, SA

TASMANIA (TAS)

Royal Hobart Hospital
No data submitted since the inaugural report (2010-2012)

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.)

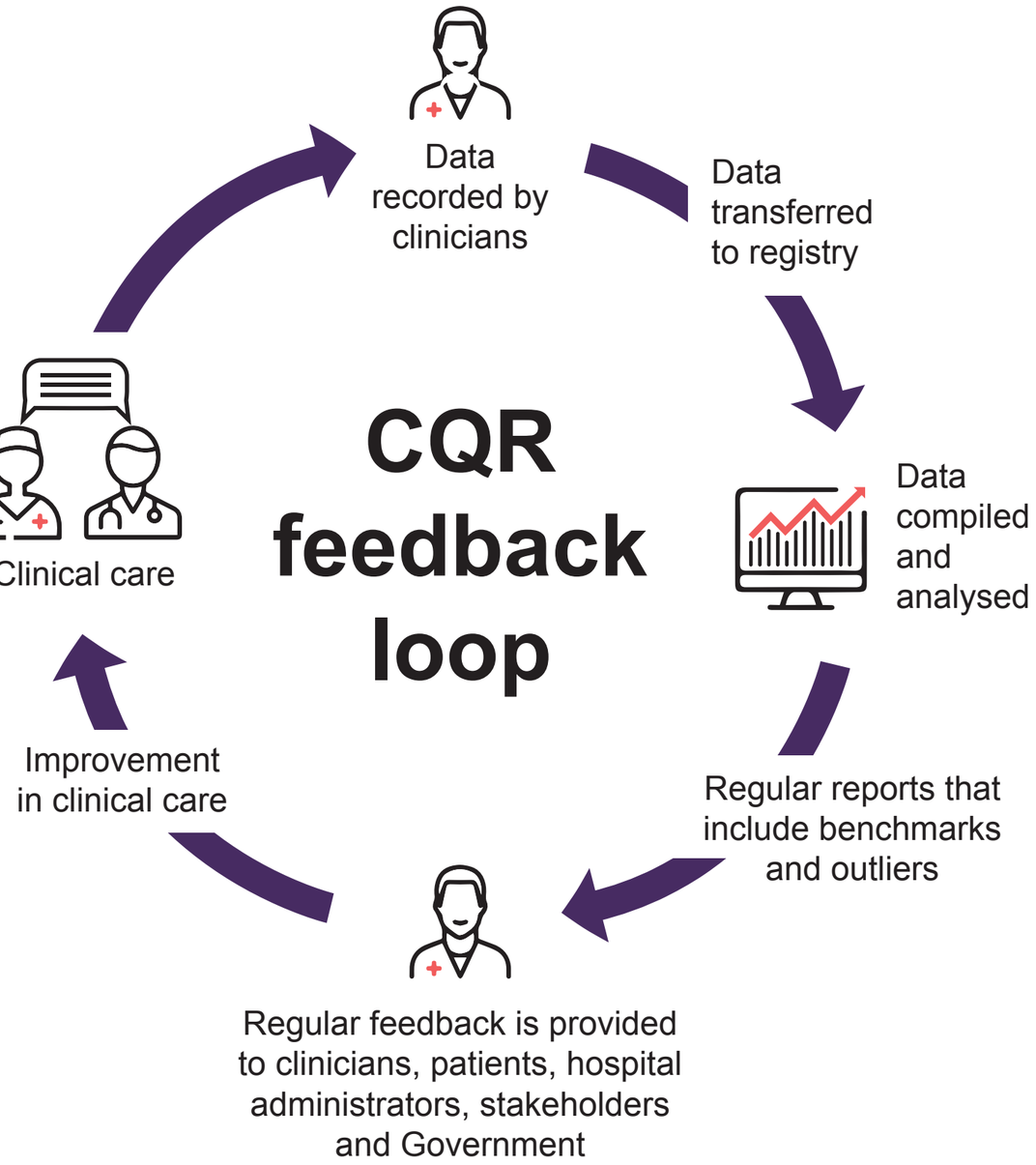
Perth Children's Hospital *(formerly Princess Margaret Hospital)*
Royal Perth Hospital

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 Economies 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.

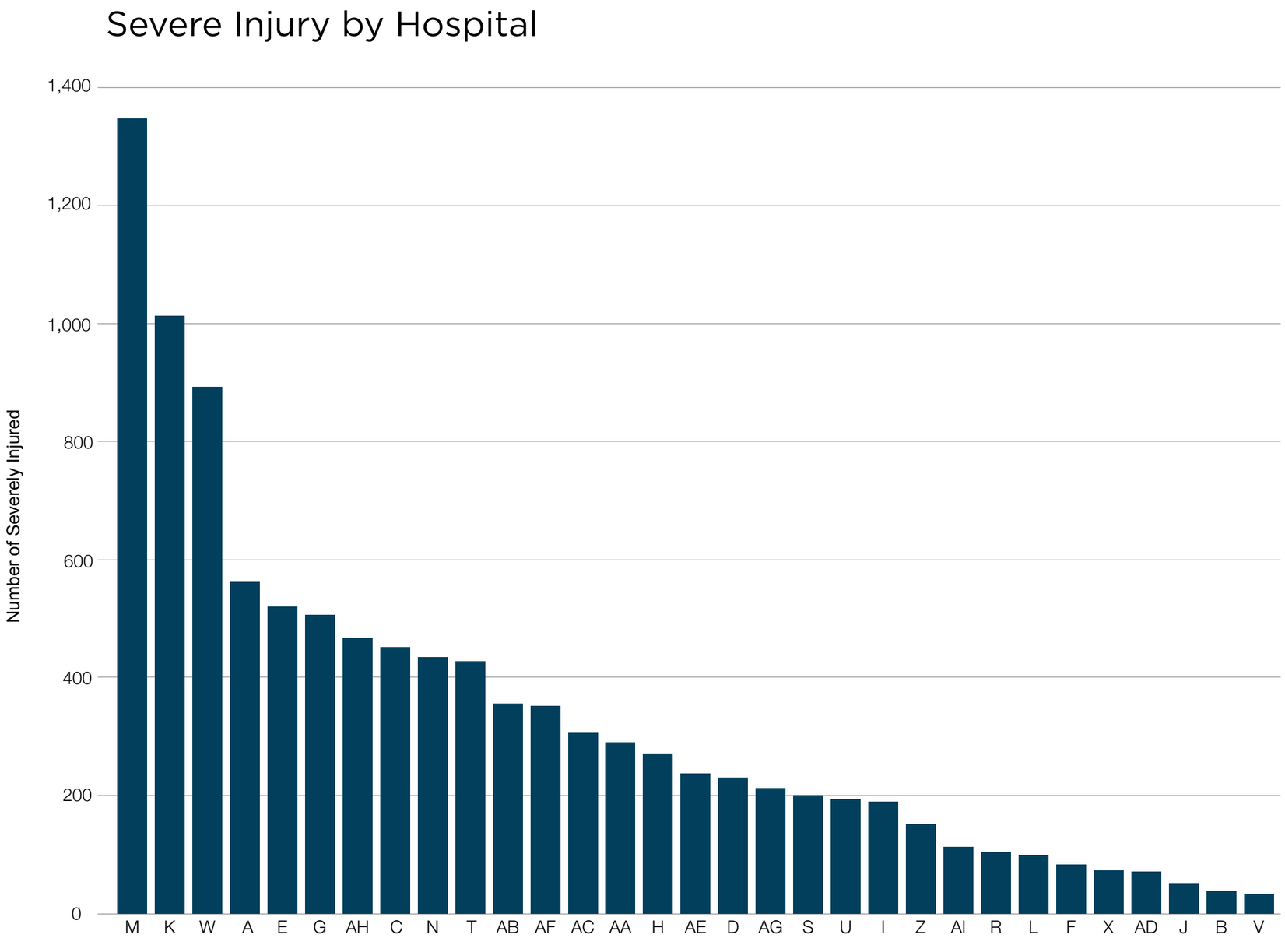
The ATR is now a leading CQR, collecting pre-hospital and in-hospital data on the most severely injured patients, defined as an Injury Severity Score (ISS) greater than 12 or death following injury, from 27 Australian and seven New Zealand level 1 trauma centres. The ATR now has four years of quality data from 1 July 2015 to 30 June 2019, and continues to recruit sites with the purpose of capturing population-based data for the severely injured.

DEMOGRAPHICS

Across the 2018-19 financial year (FY) 10,289 episodes of severely injured were collected by the ATR. Australia collected 8,528 episodes from 24 major trauma centres, and New Zealand provided 1,761 episodes of severely injured, from seven trauma centres. Incidence of severe injury varied greatly between hospitals. Due to current sharing data agreements, hospitals have not been identified.

Australia
DECREASE in SEVERE injury 1.2%
SINCE 2017 - 18

New Zealand
INCREASE in SEVERE injury 18%
SINCE 2017 - 18



The ATR is not currently a population-based registry, collecting in-hospital data on the most severely injured from 27 Australian and seven New Zealand major trauma services.

The NZ National Trauma Network has been modifying its destination policy so while there was an absolute increase in the numbers of major trauma patients in the 2018-2019 period, some of the apparent increase shown here relates to more patients being admitted to the 7 tertiary hospitals rather than remaining in smaller hospitals.

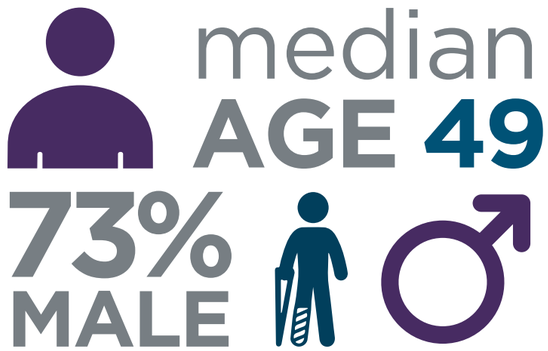
In New Zealand, a 30% yearly increase in major penetrating trauma was related to the Christchurch mosque shootings in March 2019.

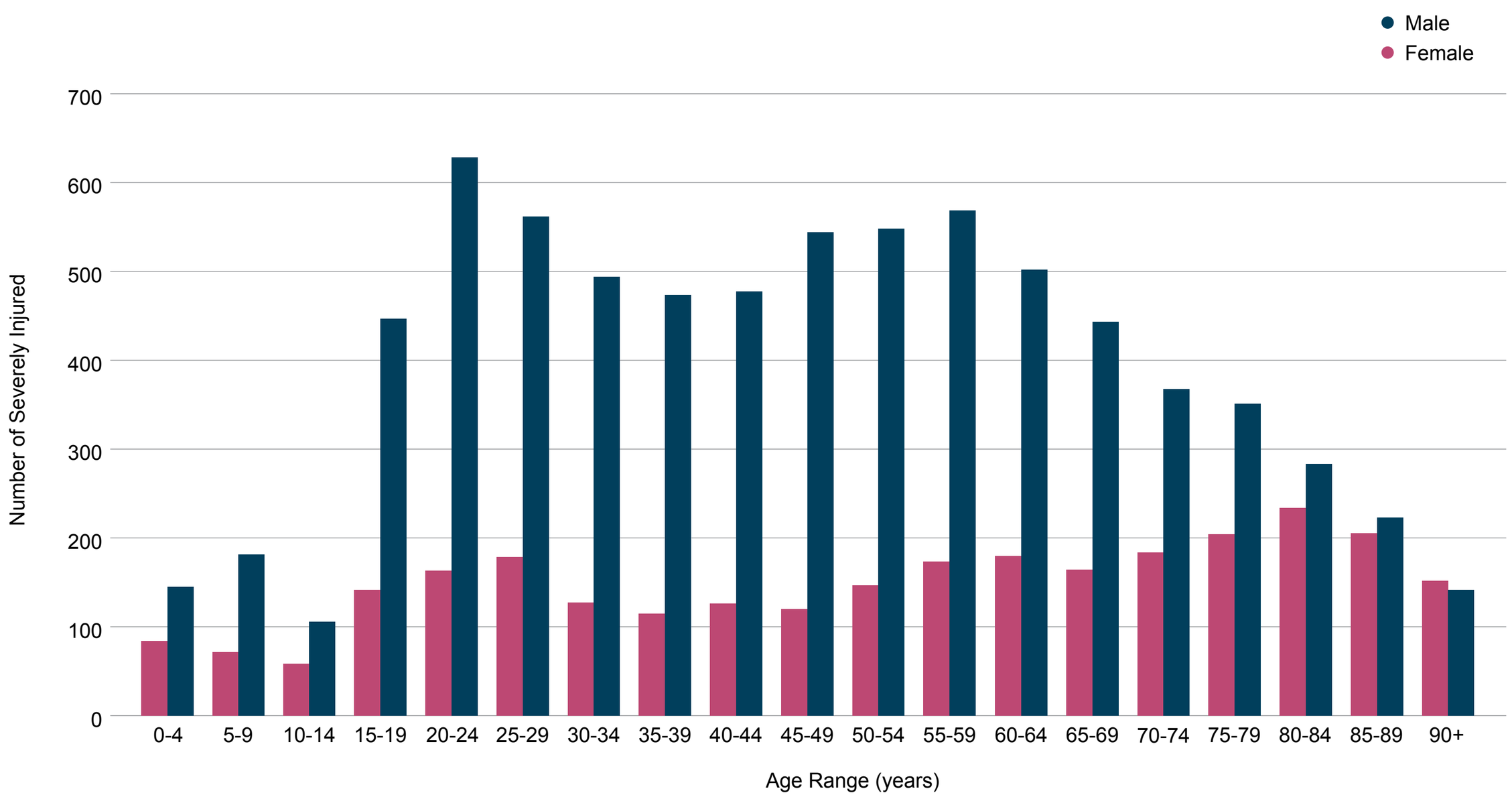
DEMOGRAPHICS

AGE AND GENDER

Incidence by age and gender showed that most severe injuries continue to involve the male population (73%). The distribution of severely injured patients according to sex and age group are shown in the figure below.

There were two main age-group peaks for males: the 20-29 year olds and the 45-59 year olds. For females, there were also two main peaks. The first was the same as males (20-29 years) but the second was in the older females (aged 75-89 years).





INJURY EVENT

DAY OF INJURY

The incidence of severe injuries according to day of the week remained consistent with previous years. Saturday and Sunday remains the predominant days for injury, with 36 per cent of injuries occuring over the weekend.

The incidence of severe injuries according to day of the week remained consistent with previous years. Whilst most falls and transport-related injuries had peak incidence over the weekend some groups such as pedal cyclists and motorcyclists had much higher numbers occurring on the weekends. A larger proportion of pedestrians were injured on Thursdays and Fridays with fewer occurring over the weekend.

PLACE OF INJURY

Eighty-nine per cent of severely injured patients had a known place of injury, with 48 per cent occurring on the street or highway and 27 per cent occurring at home. In the home was the most common place of injury for children aged 0-4 years old (68 per cent) and older adults aged 70 years and older (57 per cent). The street and highway was the most prevalent injury place for all other age groups, particularly for the 15 to 29 year age group (66 per cent). The category 'home' for patients aged 75 years and above includes residential aged care.

	Assault	High Fall	Low Fall	Transport: Motor Vehicle	Transport: Motorcyclists	Transport: Pedal Cycle	Transport: Pedestrian
Monday	8.6% (n=48)	12.5% (n=188)	12.9% (n=272)	12.7% (n=271)	10.2% (n=133)	11.0% (n=74)	12.6% (n=77)
Tuesday	10.7% (n=60)	11.4% (n=172)	12.1% (n=254)	13.2% (n=282)	7.3% (n=95)	13.5% (n=91)	15.5% (n=95)
Wednesday	12.1% (n=68)	13.6% (n=204)	13.6% (n=285)	14.4% (n=308)	9.7% (n=126)	10.4% (n=70)	12.6% (n=77)
Thursday	9.6% (n=54)	12.9% (n=194)	14.5% (n=305)	13.2% (n=281)	10.7% (n=140)	12.7% (n=86)	16.3% (n=100)
Friday	20.0% (n=112)	13.9% (n=209)	15.5% (n=325)	15.4% (n=328)	13.8% (n=180)	10.2% (n=69)	16.0% (n=98)
Saturday	19.1% (n=107)	18.7% (n=281)	17.0% (n=357)	15.5% (n=330)	24.2% (n=316)	12.2% (n=150)	13.9% (n=85)
Sunday	20.0% (n=112)	17.1% (n=257)	14.4% (n=303)	15.7% (n=335)	24.1% (n=315)	20.0% (n=135)	13.2% (n=81)
Total	100.0% (n=561)	100.0% (n=1,505)	100.0% (n=2,101)	100.0% (n=2,135)	100.0% (n=1,305)	100.0% (n=675)	100.0% (n=613)

INJURY EVENT

INTENT OF INJURY

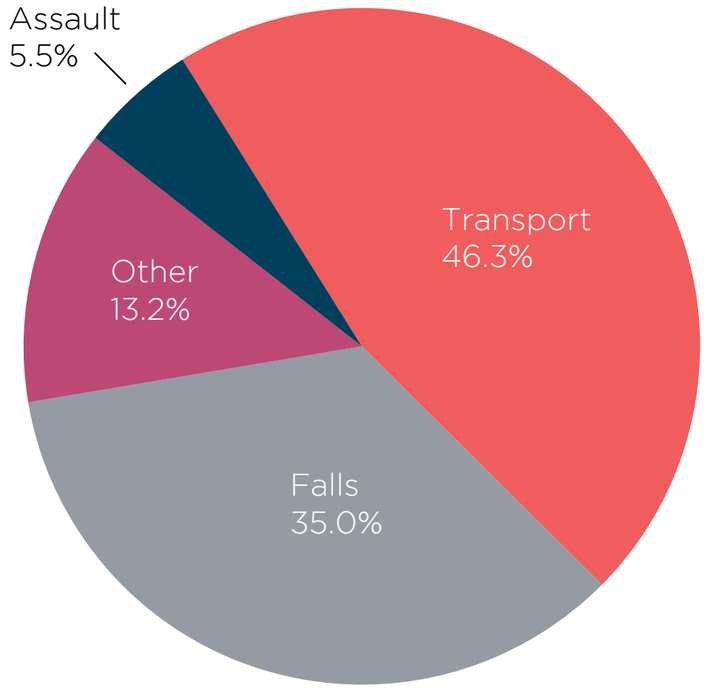
Injury intent was specified for 70 per cent of all severe injuries of which 88 per cent were related to unintentional injuries. Injury intent data is not provided by New South Wales or the Northern Territory.

CAUSE OF INJURY

Transport-related and falls-related injuries accounted for 81.3 per cent of all severe injuries and remain the leading cause of in-hospital admissions for severe injury.

Forty-six per cent of severe injuries were transport related. Of these, 45.2 per cent were motor vehicle, 27.6 per cent were motorcyclists, 14.3 per cent were pedal cyclists and 13.0 percent were pedestrians.

Thirty-five per cent of all severe injuries were caused by falls, low falls accounted for 20.4 per cent and high falls 14.6 per cent.

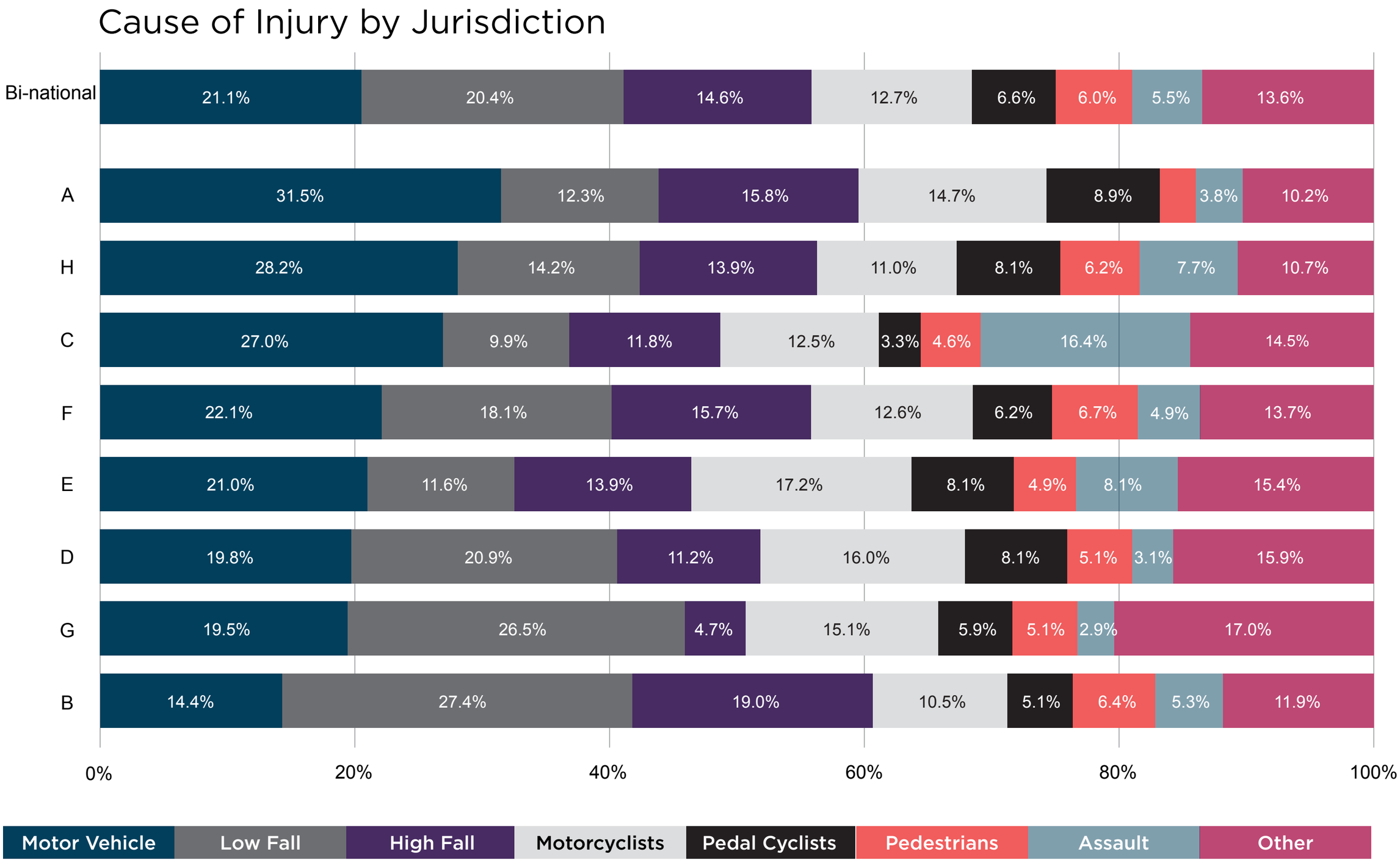


Cause of Injury

INJURY EVENT

CAUSE OF INJURY BY JURISDICTIONS

Transport and falls-related injuries continue to be the most common severe injuries across all jurisdictions. In 2018-19, motor vehicle crashes were the most prevalent for five of the eight jurisdictions, whilst low falls were the most prevalent for three jurisdictions. Jurisdictions and sites remain deidentified in the current report. The AusTQIP Steering Committee is currently seeking a variation to identify sites and jurisdictions in future reporting.



INJURY

SEVERITY OF INJURY

Injury Severity Score (ISS) is an internationally-standardised approach to describing the overall severity of injury for each patient. 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.

In the 2018-19 financial year, the proportion of severely injured categorised by ISS range was comparable with the previous three years. Most injuries admitted to hospital had an ISS between 16 and 24 (42.3%). When the cohort was broken down into gender, similar proportions by ISS range occured.

An ISS greater than 25 was most prevalent in the pedestrians and low falls populations whilst less severe injuries occurred in pedal cyclists. Low falls are defined as falls of one metre or less.

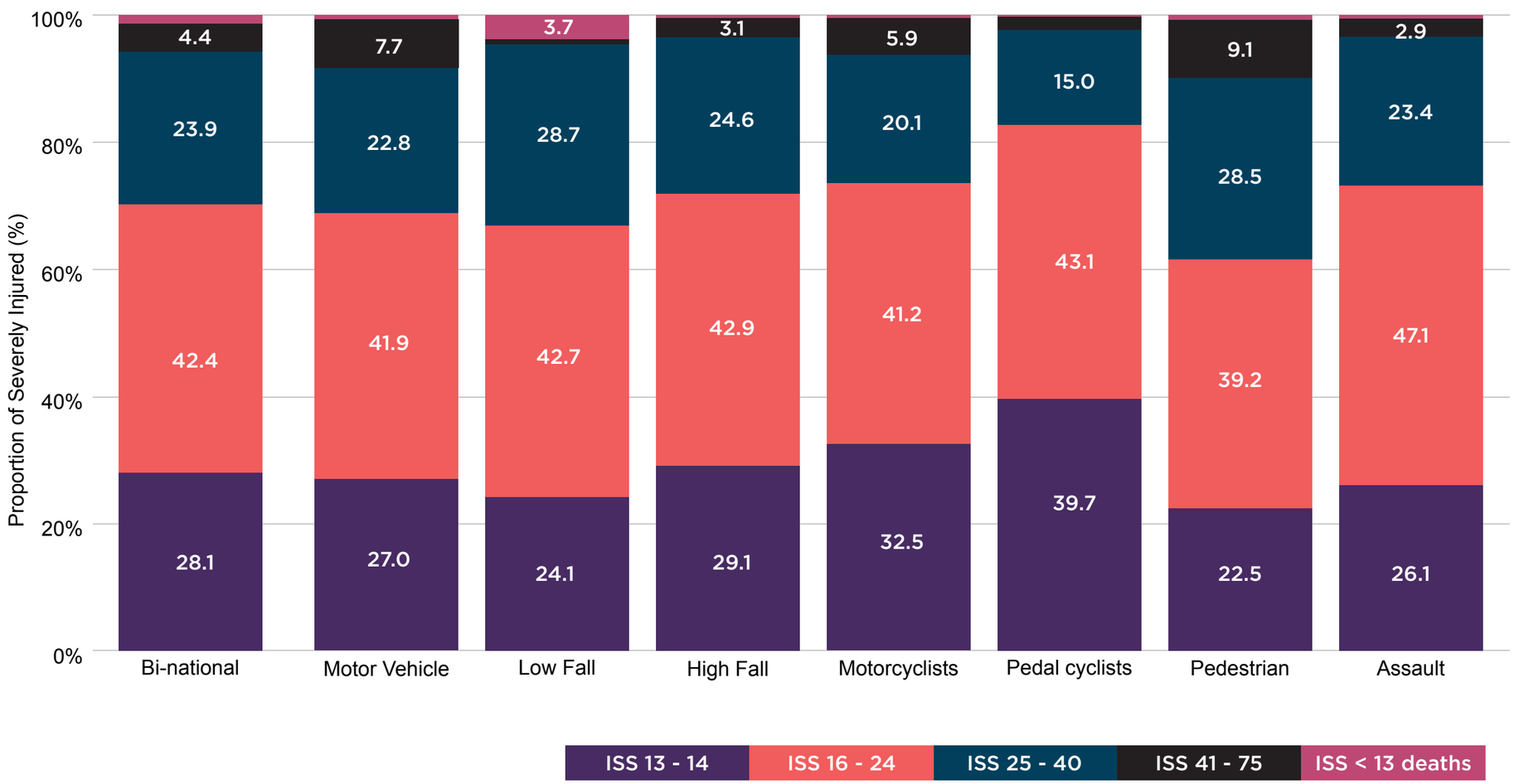
Children aged 0-4 years had the highest proportion of most severe injuries, with 41% having an ISS>24. Followed by 15-19 year olds (36%) and 20-24 year olds (35%).

DEATHS WITH ISS<13

The ATR also collects data on in-hospital deaths with an ISS less than 13. For the 2018-19 financial year there were 118 patients.

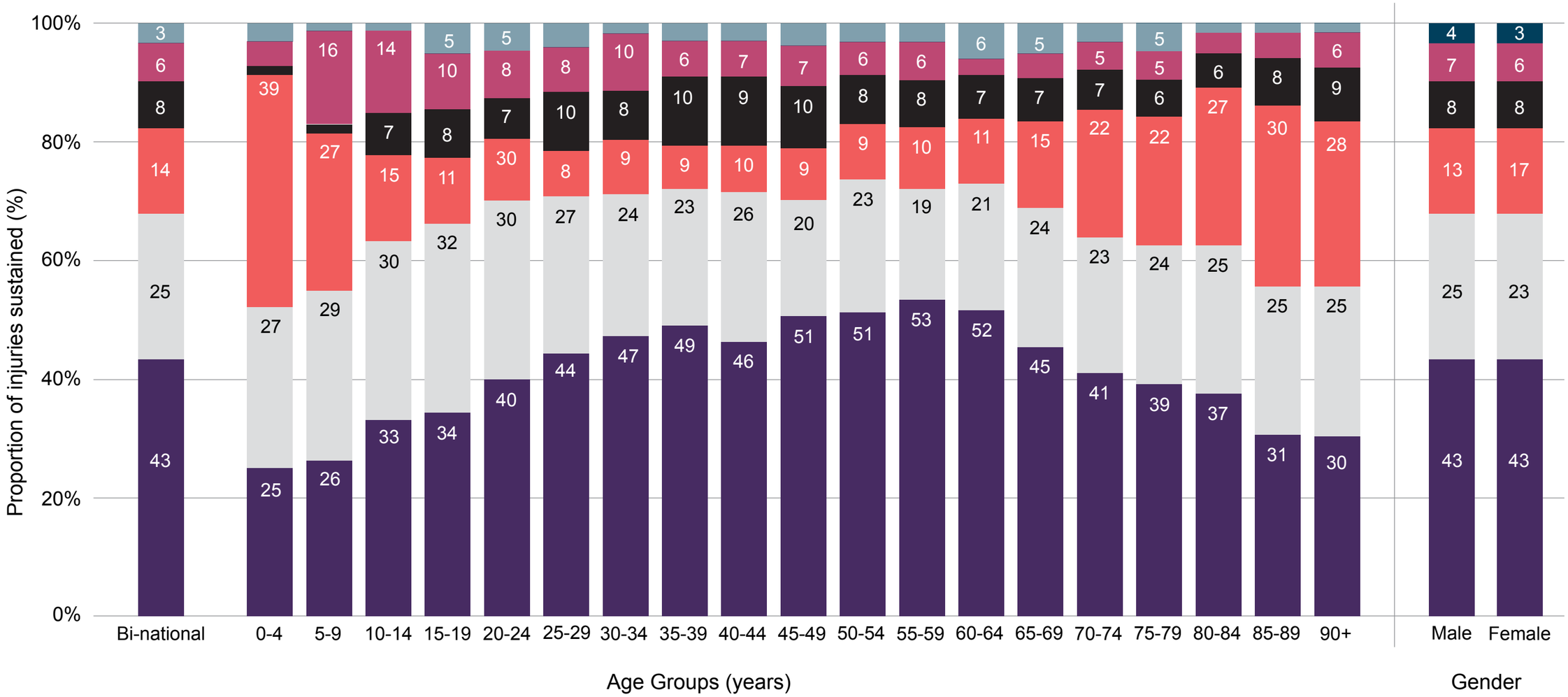
- 78 per cent were aged 70+ years
- 66 per cent were caused by a low fall
- 9.3 per cent died in the Emergency Department

Injury Severity by Cause



INJURIES SUSTAINED

Multiple injuries were the most prevalent across all jurisdictions for the severely injured, followed by ‘head and other associated injuries’ and ‘isolated head injuries’. Head injuries, both complex and isolated, make up nearly 40 per cent of all injuries.



Multiple Injuries, burns or other (excluing serious neurotrauma)	Head and other associated injuries	Isolated head injury	Extremity and/or spinal injuries only	Chest and/or abdominal injuries only	Serious Spinal Cord injury

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	219	157	248	584	788	740	617	582	599	661	691	736	680	605	548	553	515	425	291

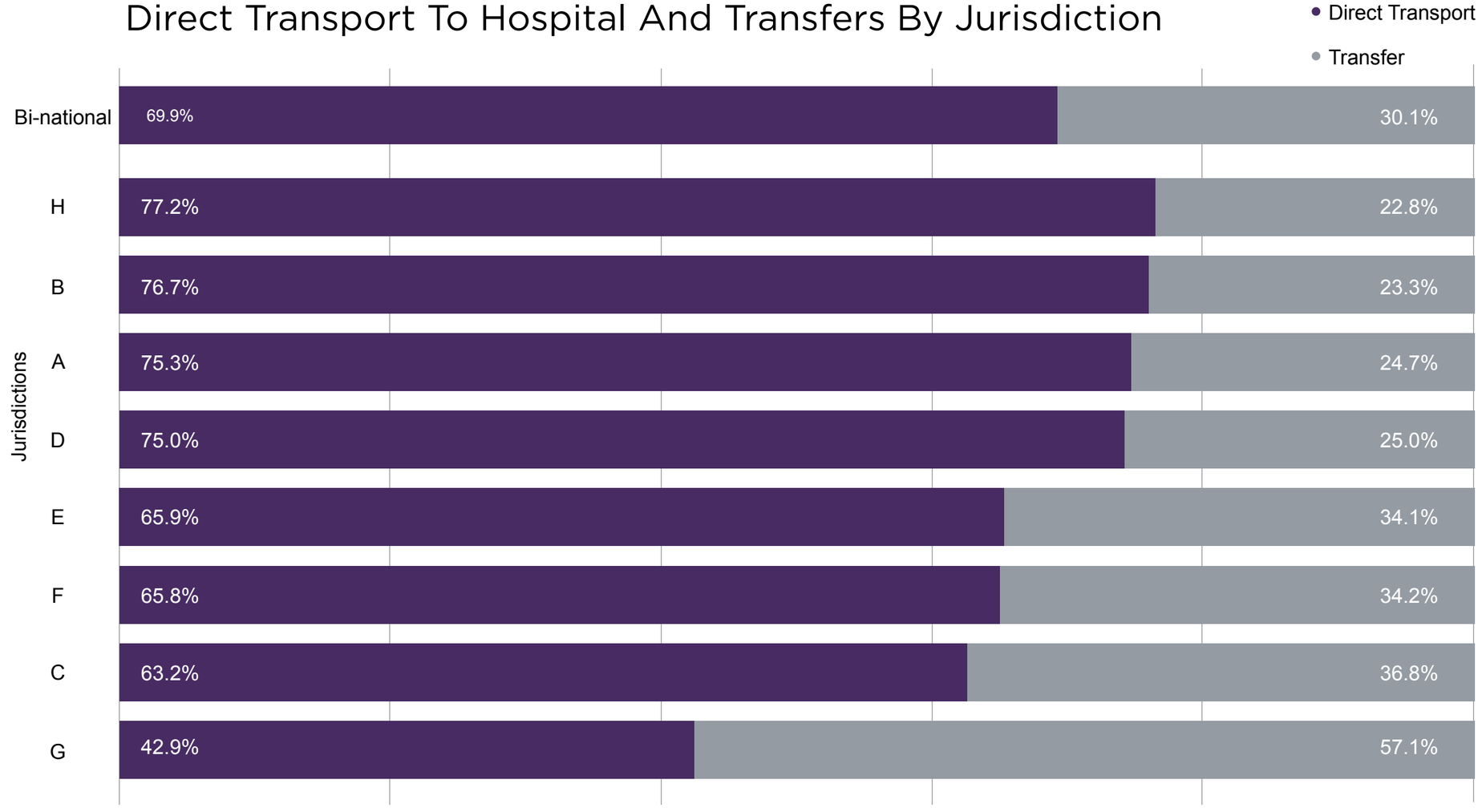
Multiple injuries, burns or other = includes multiple body region injuries (excluding serious neurotrauma), burns and other injuries that do not fit into any of the other groups.
Head and other associated injuries = head injury with AIS > 2 in addition to another injury.
Isolated head injury = head injury 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
Serious spinal cord injury = spinal cord injury with AIS > 3 with or without other injuries

Gender	Male	Female
n	7481	2808

TRANSPORT TO HOSPITAL

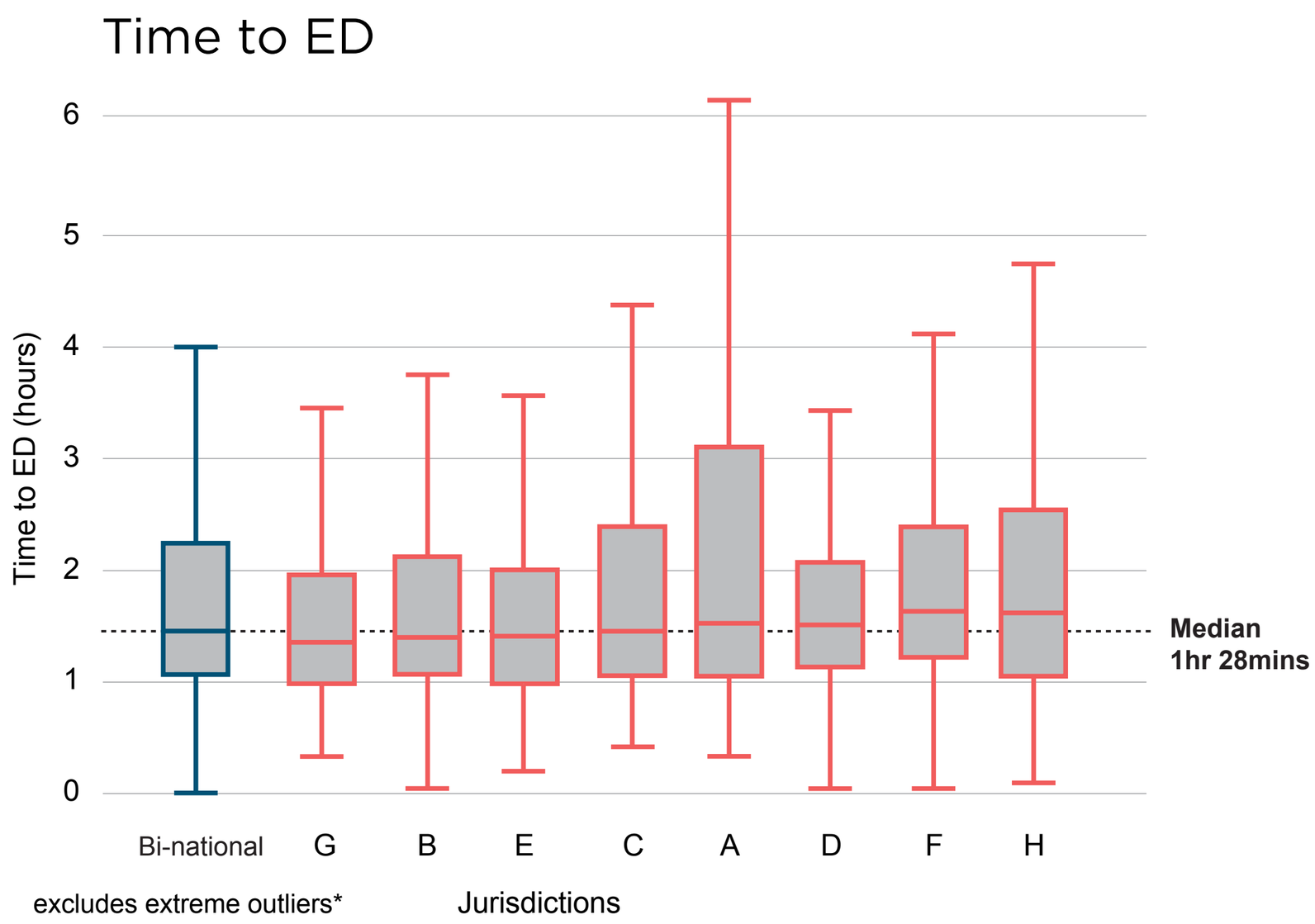
Over two-thirds (70%) of severely injured patients were transported direct from the scene to definitive care. Of those transported direct, 73.5 per cent arrived via road ambulance, 18.4 per cent via helicopter and 5.8 per cent via private vehicle/walk-in.

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 42.9% to 77.2% .



TIME FROM SCENE TO EMERGENCY DEPARTMENT

Time to the Emergency Department (ED) was analysed for patients conveyed directly from scene to definitive care. The median time from scene to definitive care was **one hour 28 minutes**, similar to the previous financial year.

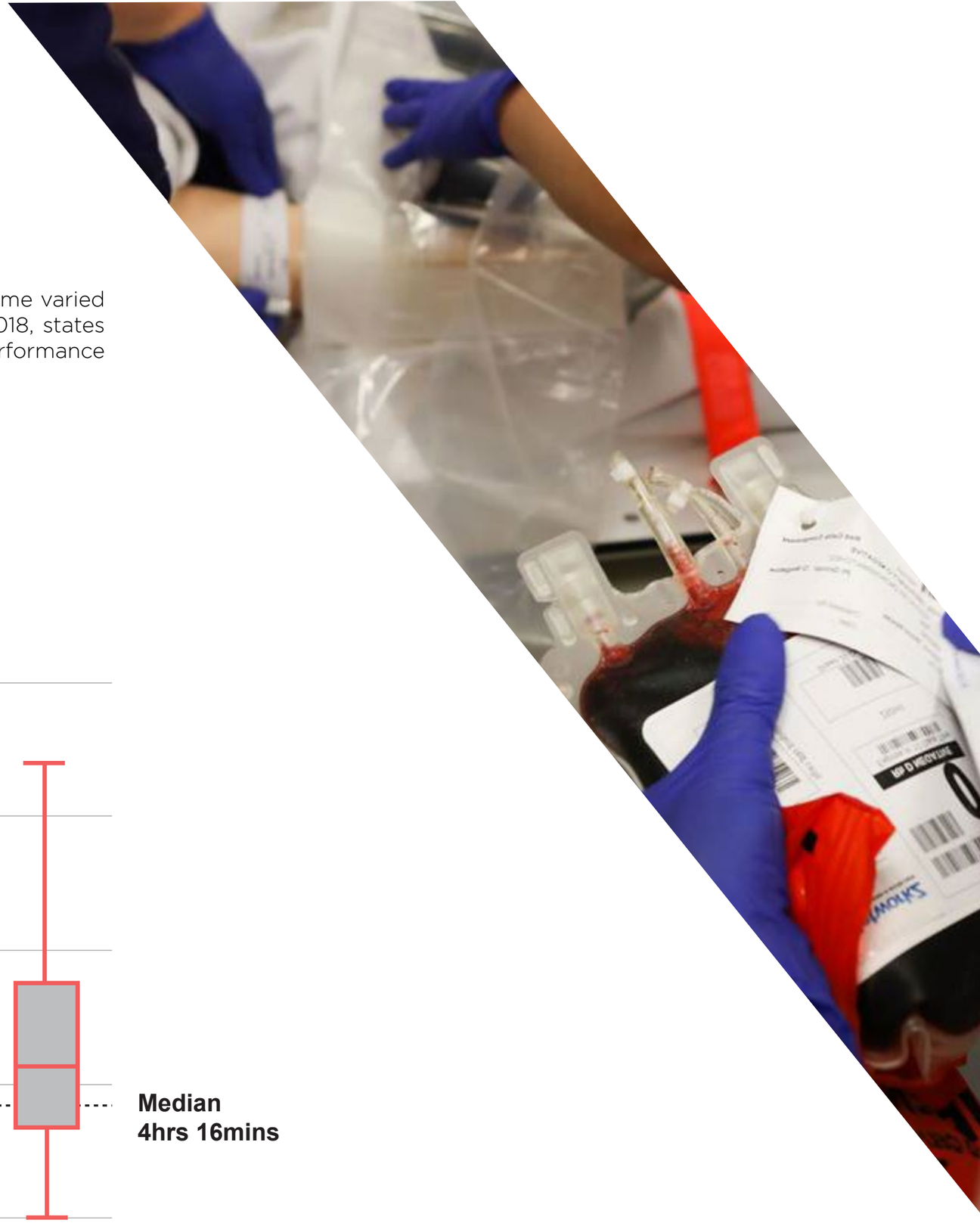


* Extreme outliers are values smaller than the lower quartile minus 1.5 times the interquartile range (IQR) or values larger than the upper quartile plus 1.5 times the IQR (Tukey, 1977)

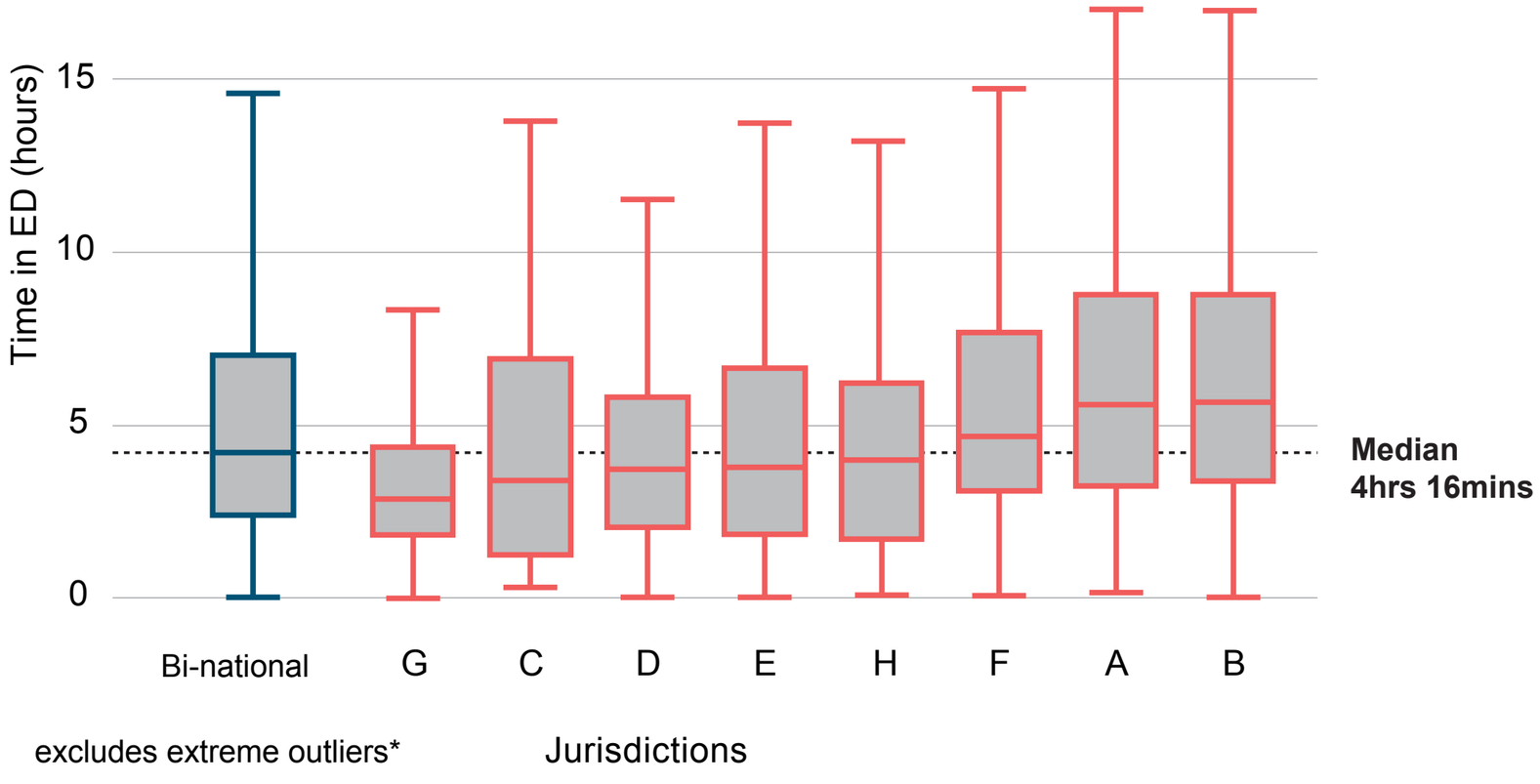
TRAUMA CENTRE CARE

TIME IN EMERGENCY DEPARTMENT (ED)

The bi-national median time spent in the ED was **four hours and 16 minutes**. This time varied when categorised by jurisdiction. The Australian National Healthcare Agreement, 2018, states the importance of Emergency Department care remaining within 4-hours is a key performance indicator for improved outcomes.



Time in ED Department

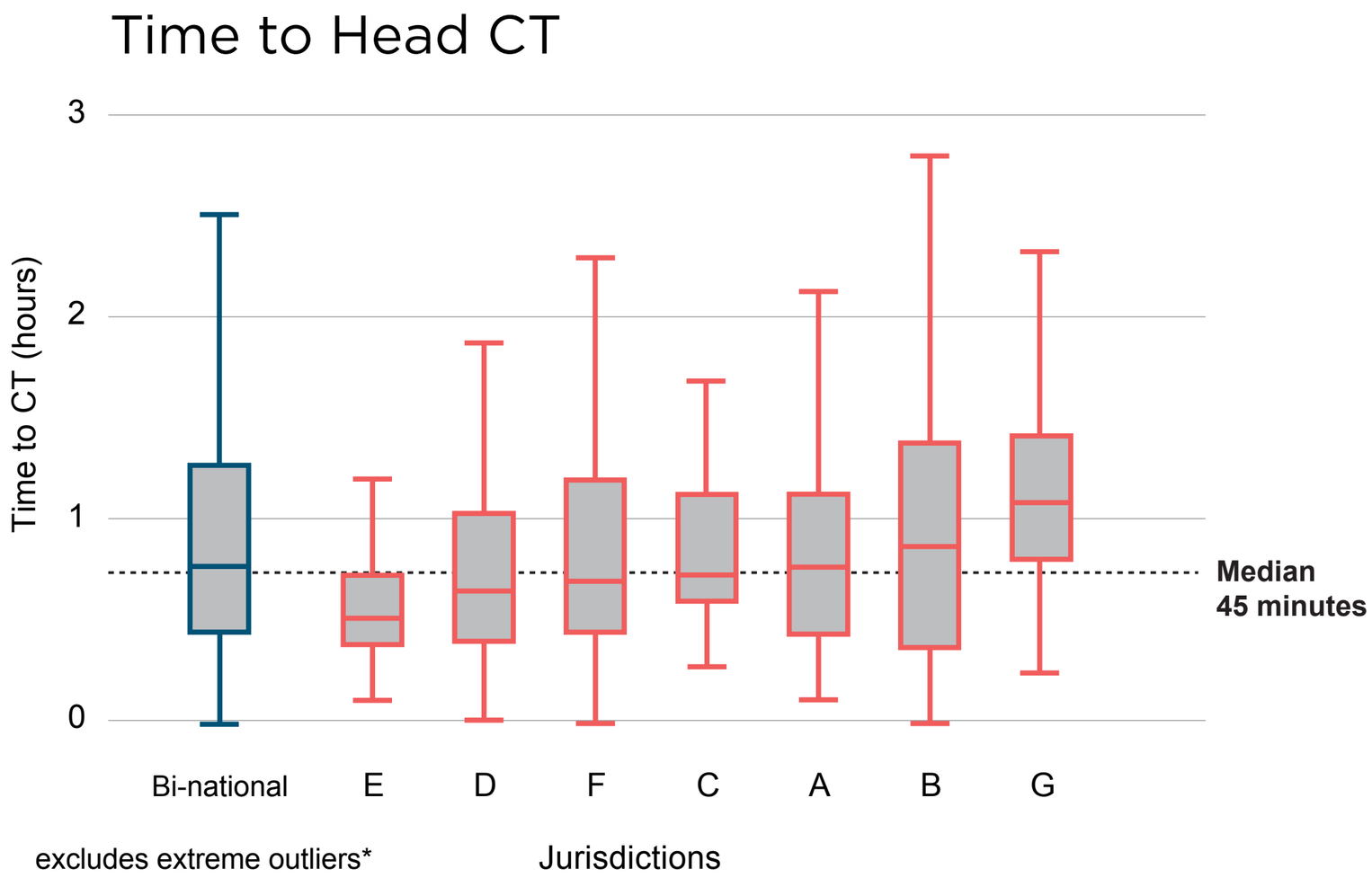


* Extreme outliers are values smaller than the lower quartile minus 1.5 times the interquartile range (IQR) or values larger than the upper quartile plus 1.5 times the IQR (Tukey, 1977)

TRAUMA CENTRE CARE

TIME 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. Fifty one per cent of all severely injured patients received a head CT. Of those, 1,133 (26%) arrived at the Emergency Department with a known total GCS less than 13. The bi-national median time from arrival at the definitive hospital to time of head CT for patients with a total GCS less than 13 was **45 minutes**. Jurisdiction H does not provide CT data so is missing from the boxplot.



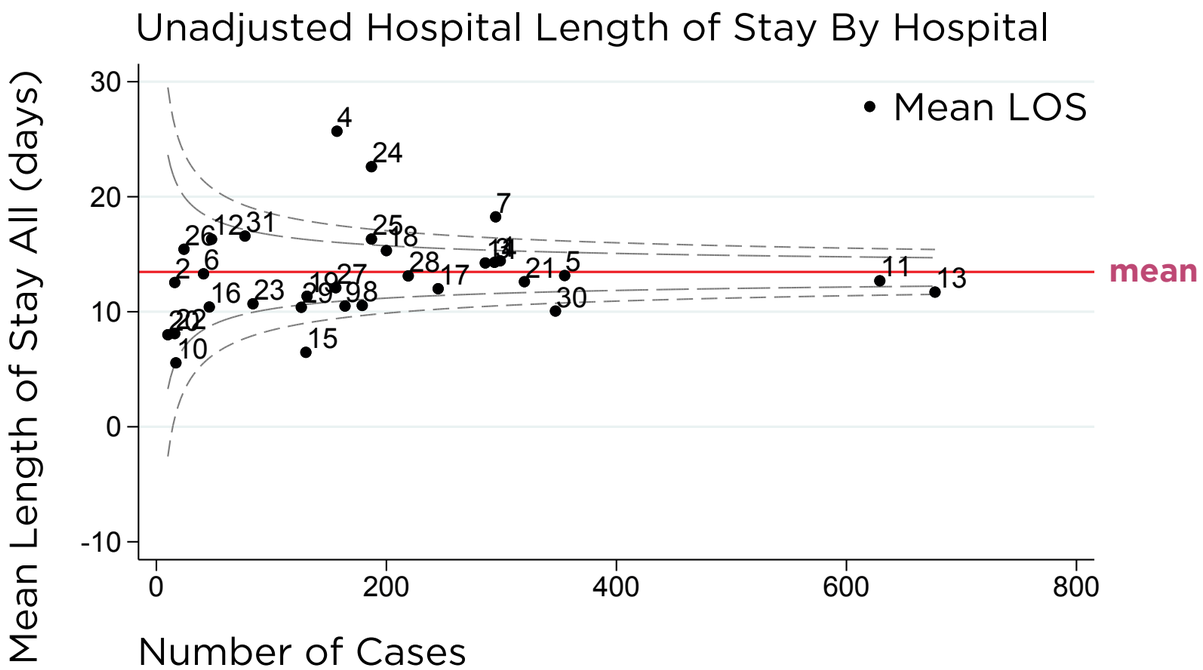
* Extreme outliers are values smaller than the lower quartile minus 1.5 times the interquartile range (IQR) or values larger than the upper quartile plus 1.5 times the IQR (Tukey, 1977)

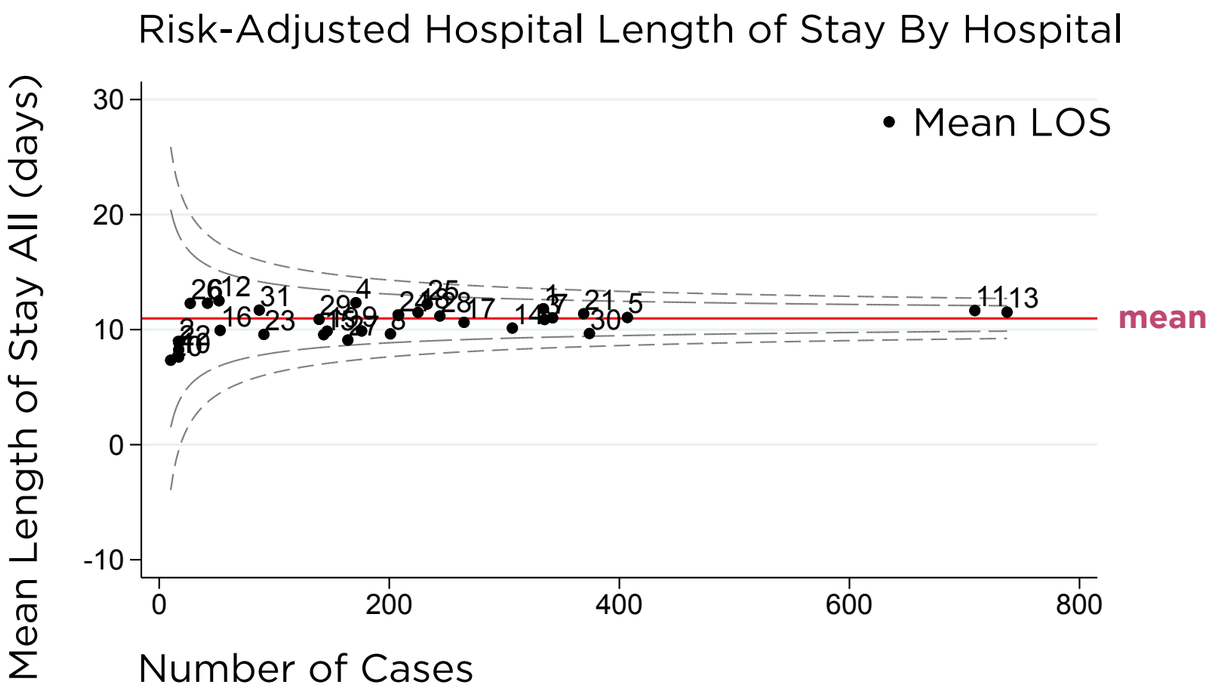
HOSPITAL LENGTH OF STAY BY HOSPITAL (LOS)

Hospital Length of Stay was compared between hospitals, before and after risk adjustment. Data was risk adjusted for injury severity, age, mechanism, arrival Glasgow Coma Scale (GCS), and shock index. The mean LOS was calculated from the robust linear regression model, which accounted for the skewness in the data. 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 above and below these lines are considered outliers, with a 5% and 0.2% chance of a false positive respectively. Due to current sharing data agreements, hospitals have not been identified.

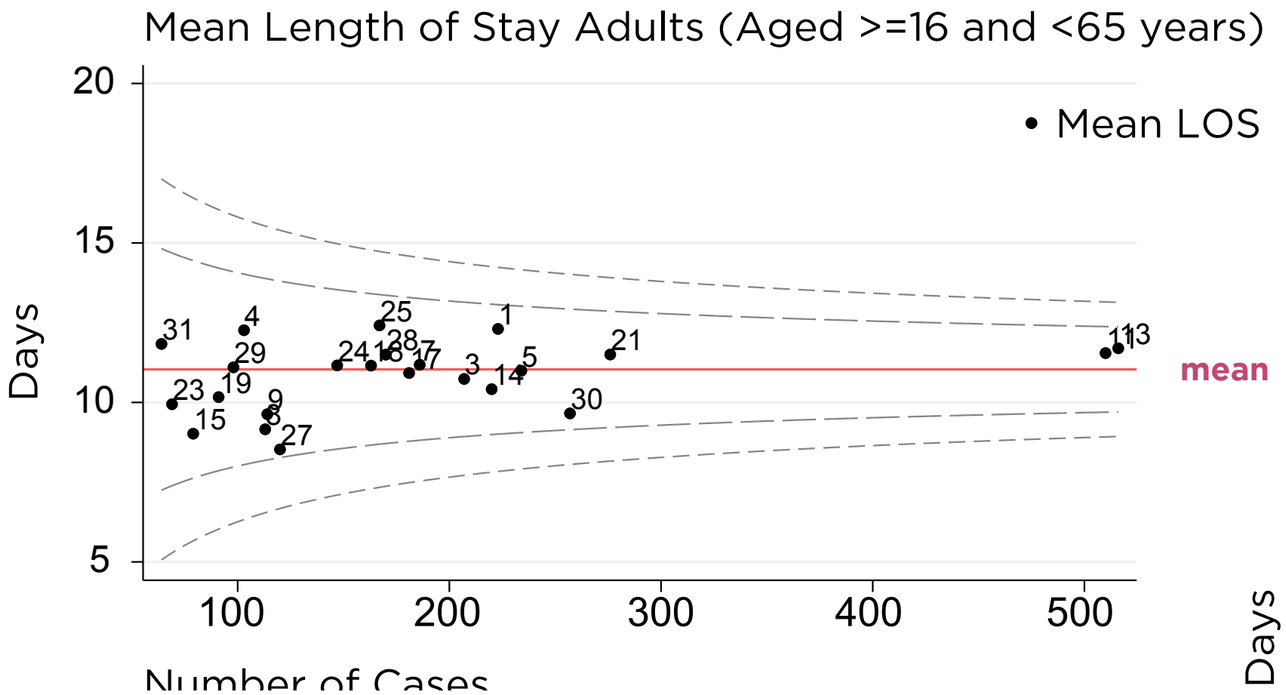
Total numbers for risk adjustment have been reduced because the transferred group of patients has been excluded. This resulted in a 30% reduction in numbers. A further reduction in numbers was the exclusion of non-blunt cases such as burns and penetrating as they are a heterogenous group (5%).

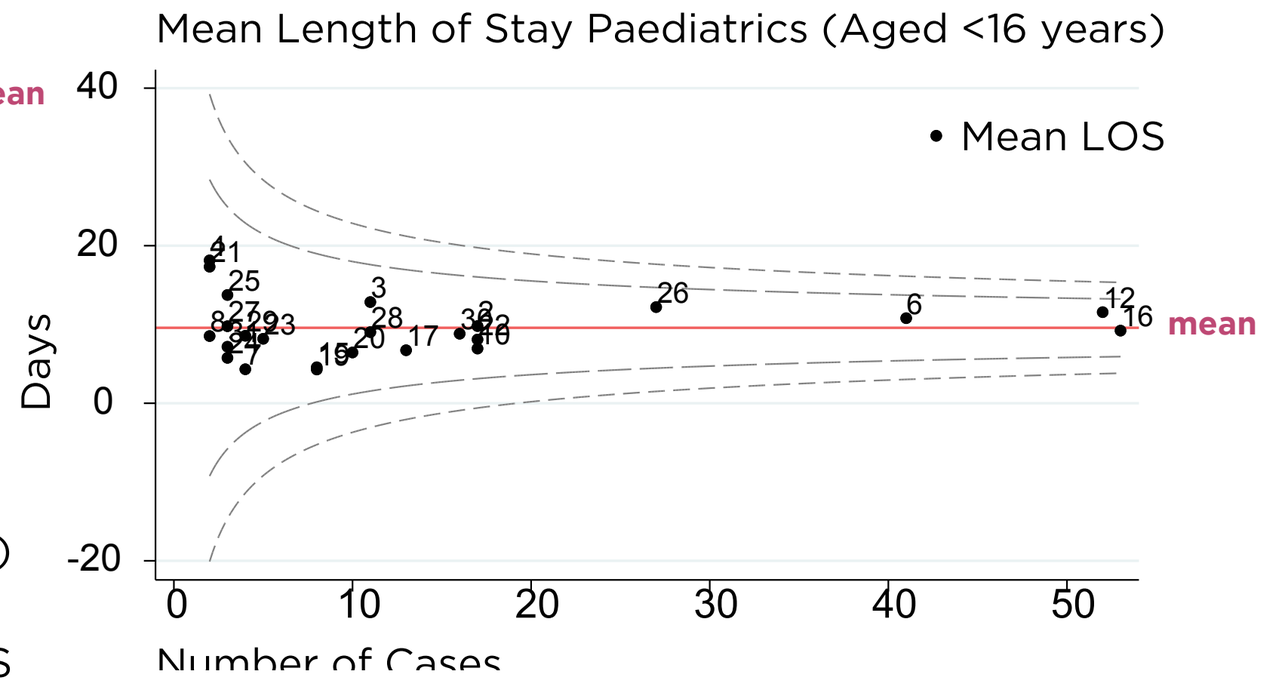


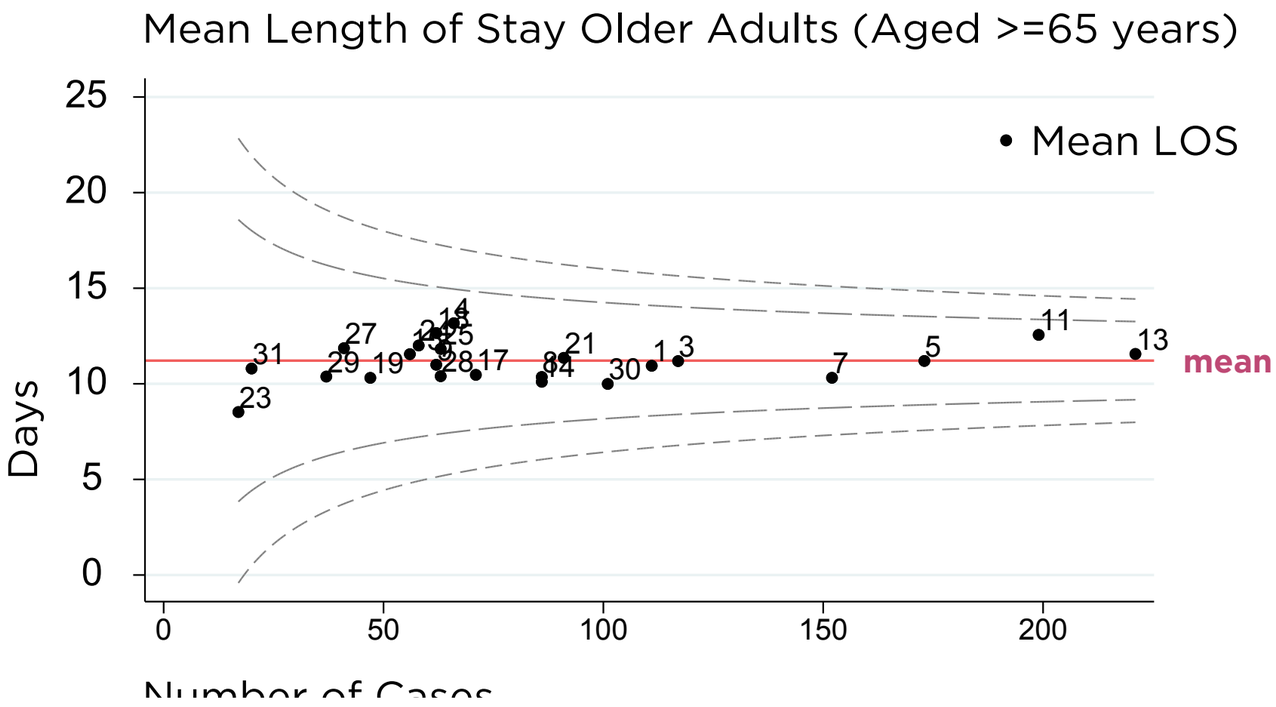


RISK-ADJUSTED HOSPITAL LENGTH OF STAY (LOS) BY AGE GROUPS

The **unadjusted bi-national median (IQR) hospital LOS was 7.1 (3.6-14.4) days**. When hospitals were risk adjusted for injury severity, age, mechanism, arrival Glasgow Coma Scale (GCS), and shock index there was no difference between hospitals for children (aged <16 years), adults (>=16 and <65 years) and older adults (>=65 years). 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 above and below these lines are considered outliers, with a 5% and 0.2% chance of a false positive respectively. Due to current sharing data agreements, hospitals have not been identified.

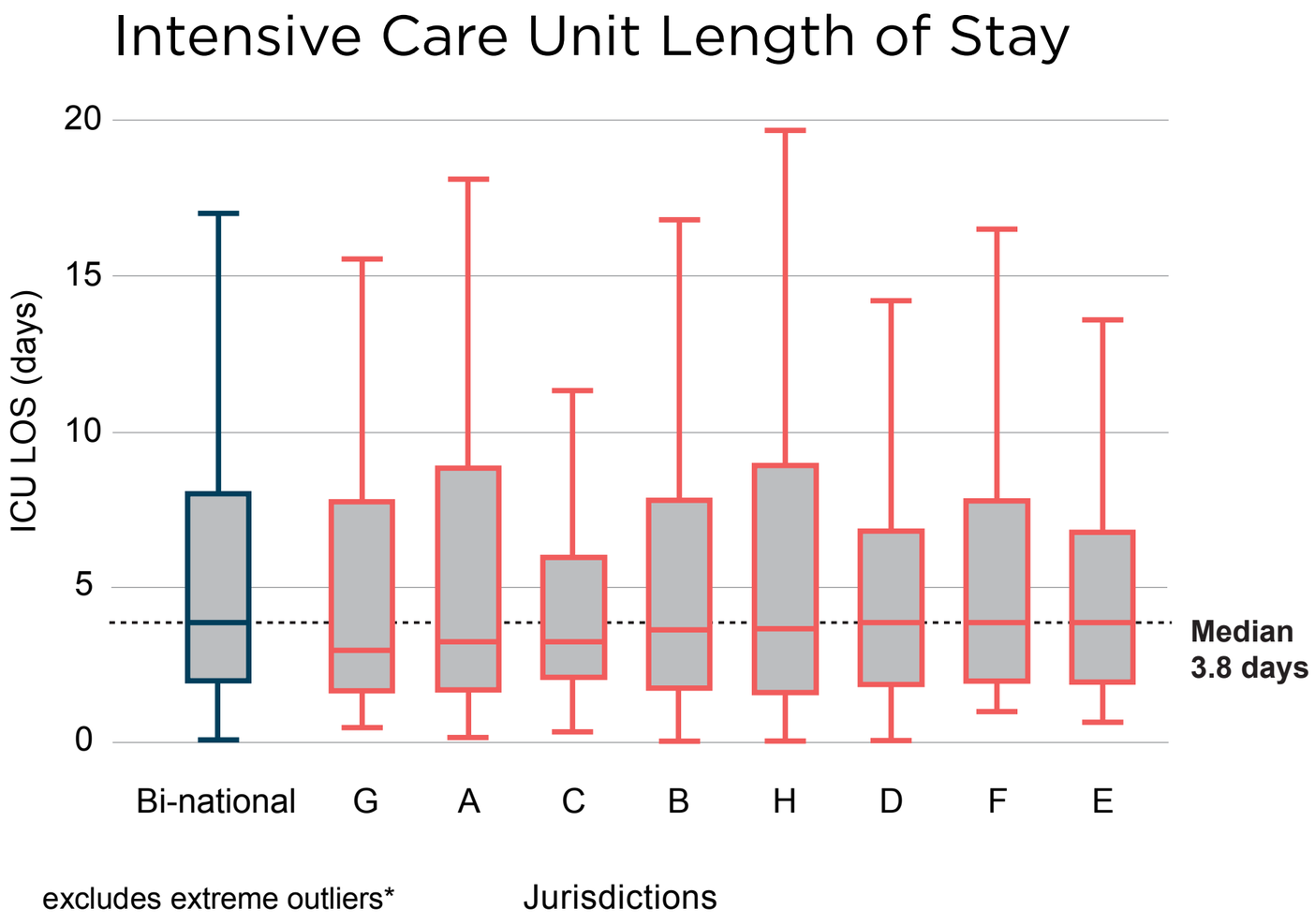






INTENSIVE CARE UNIT (ICU) LENGTH OF STAY (LOS)

The bi-national median (IQR) hospital ICU LOS was **3.8 (2.0-8.0) days.**

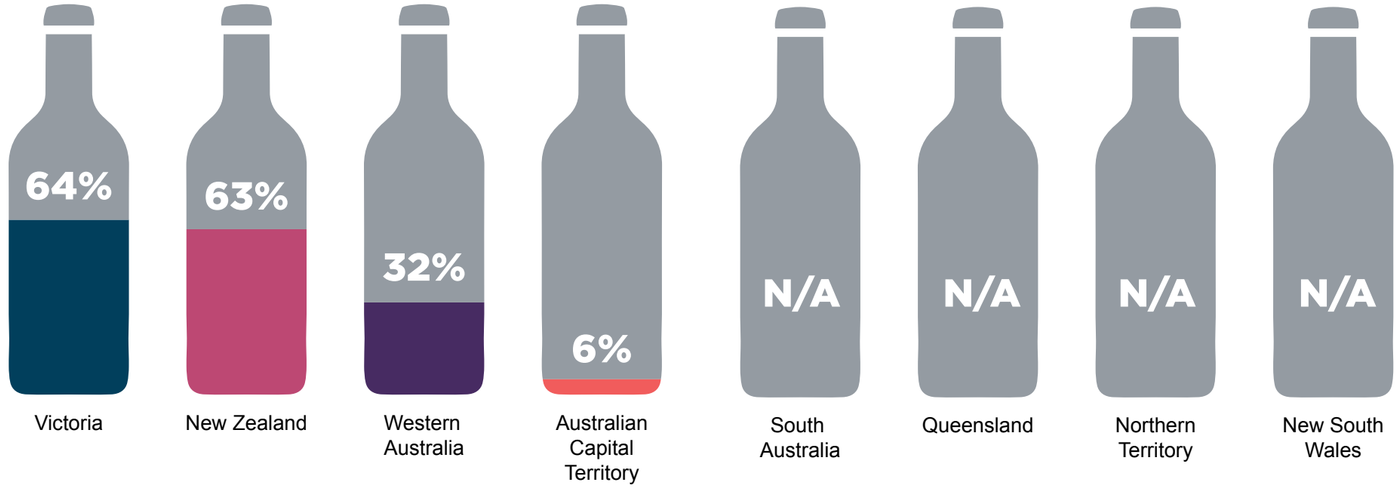


* Extreme outliers are values smaller than the lower quartile minus 1.5 times the interquartile range (IQR) or values larger than the upper quartile plus 1.5 times the IQR (Tukey, 1977)

BLOOD ALCOHOL CONCENTRATION COLLECTION RATE

Blood alcohol collection is one of the eight RACS process indicators and is recommended in patients with severe injuries, defined as an ISS>12.

The ATR does not currently receive blood alcohol concentration from all jurisdictions, and continues to work with registries and sites to improved data capture. The below figure demonstrates the proportion of severely injured cases where a blood alcohol test was performed and recorded.



OUTCOMES FROM INJURY

The primary outcome collected by the ATR is discharge destination (including deaths). Discharge destination was provided for over 99.8 per cent of patients.

MORTALITY

One thousand and three severely injured people died in-hospital with a bi-national mortality rate of 9.8 per cent.

Categorising by age-group identified further mortality trends in the severely injured.

9.8% MORTALITY

13.8% OF DEATHS OCCURRED IN ED

♂ 70% MALE

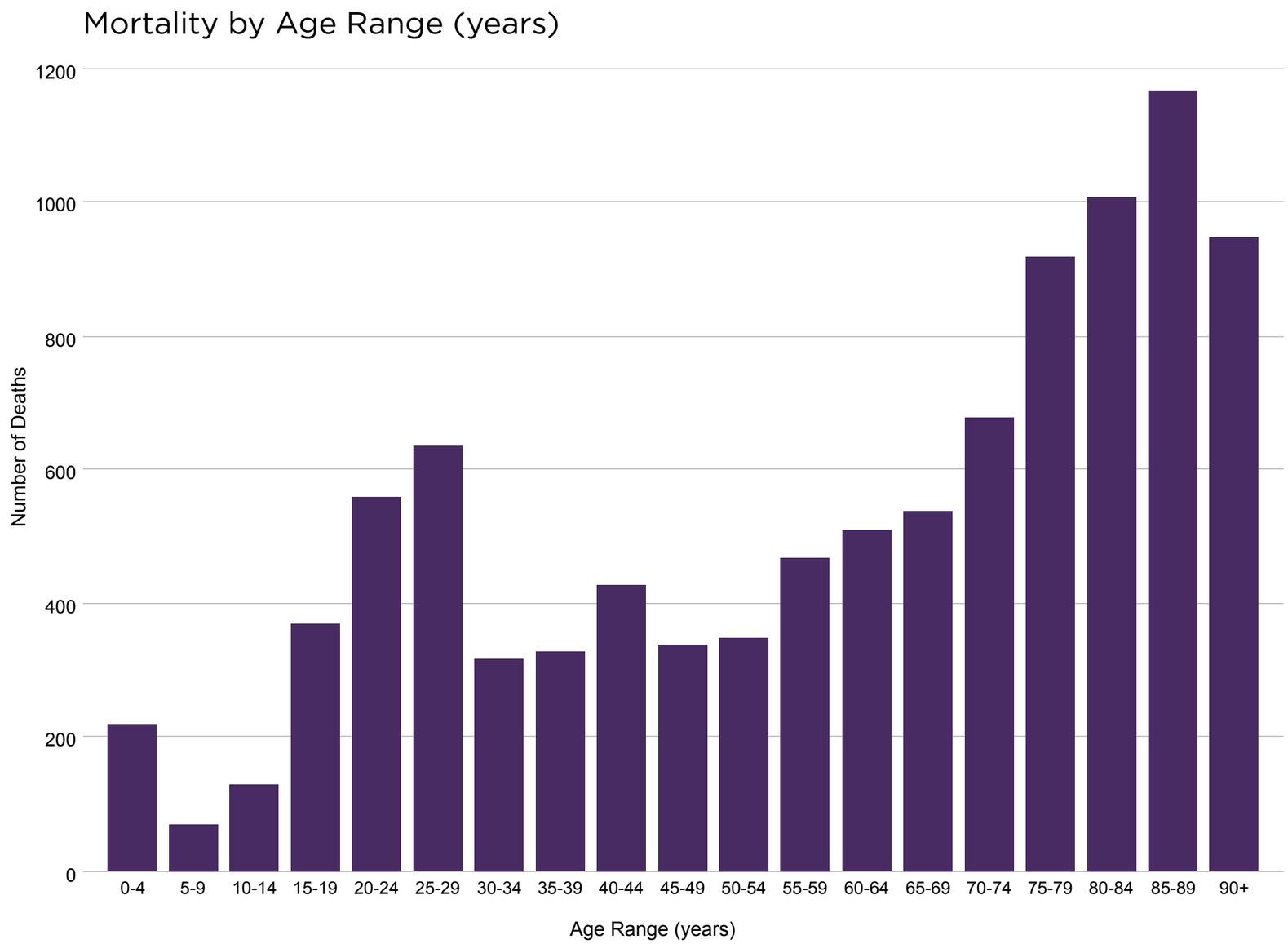
40% of deaths **aged 75+**

31 % DEATHS transport related

32% DEATHS low falls

55% had ISS > 24

23% of 75+ YEAR OLDS died in-hospital

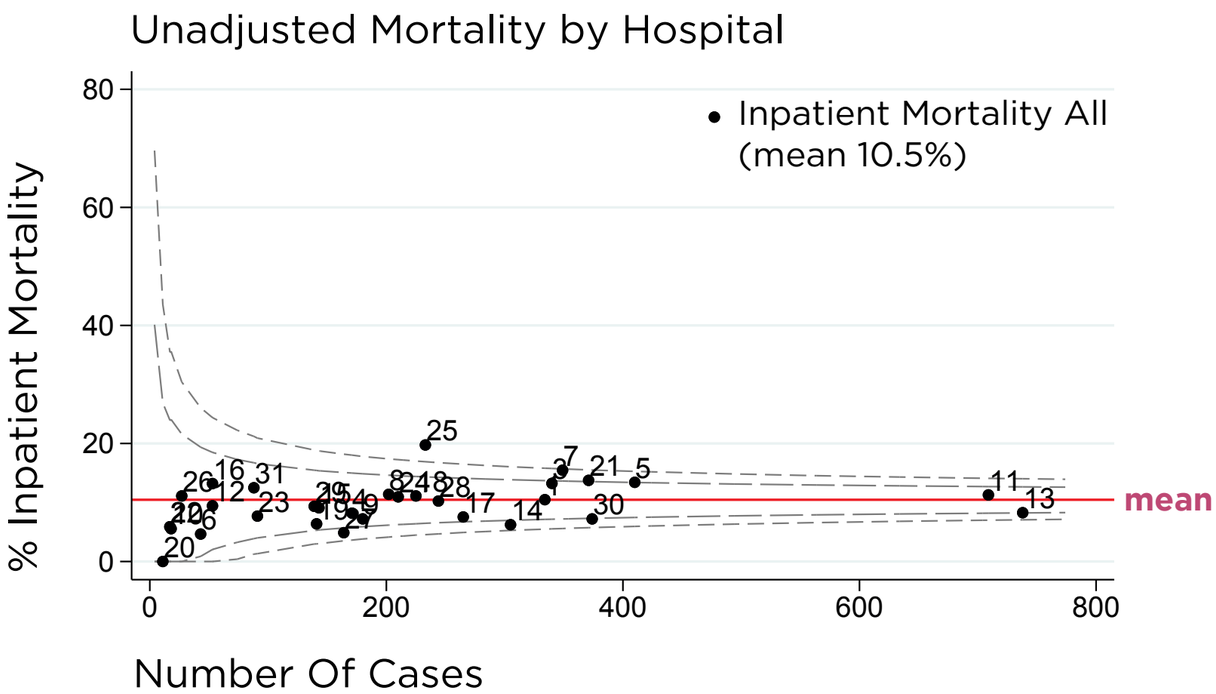


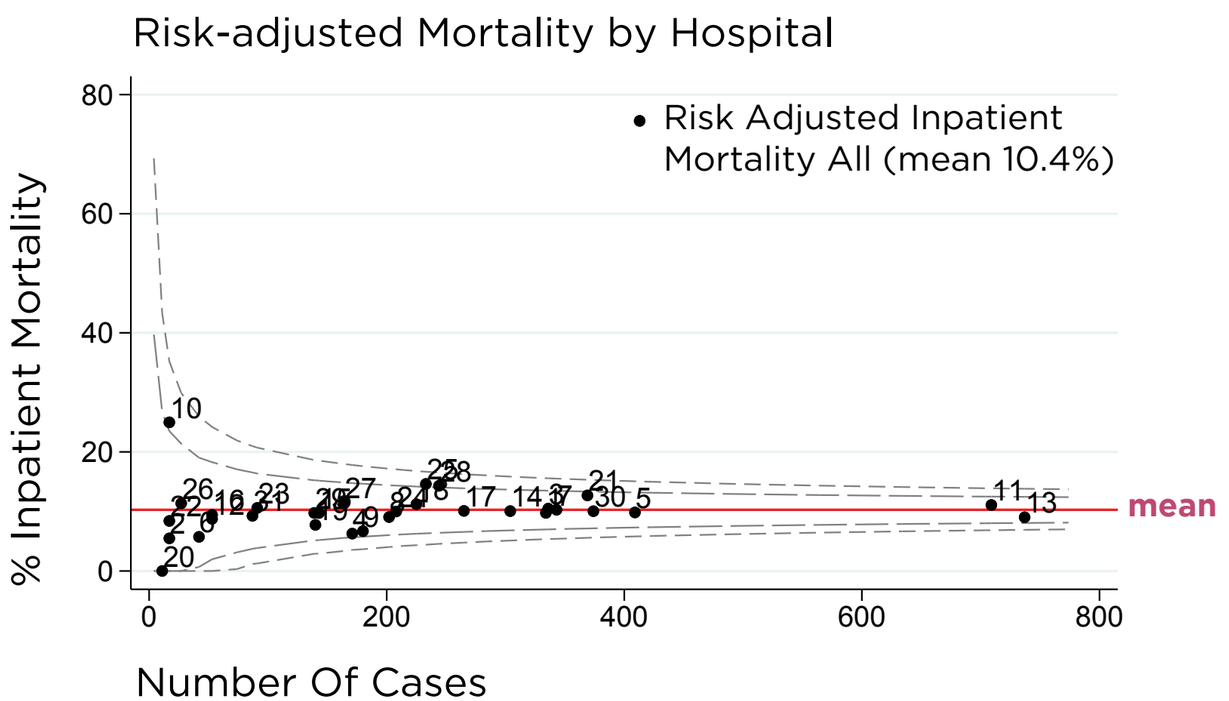
MORTALITY BY HOSPITAL (EXCLUDING TRANSFERS)

Mortality was compared between hospitals, before and after risk adjustment. Data was risk adjusted for injury severity, age, mechanism, arrival Glasgow Coma Scale (GCS), and shock index. The mean mortality was calculated from the robust linear regression model, which accounted for the skewness in the data. 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 above and below these lines are considered outliers, with a 5% and 0.2% chance of a false positive respectively. Due to current sharing data agreements, hospitals have not been identified.

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%).

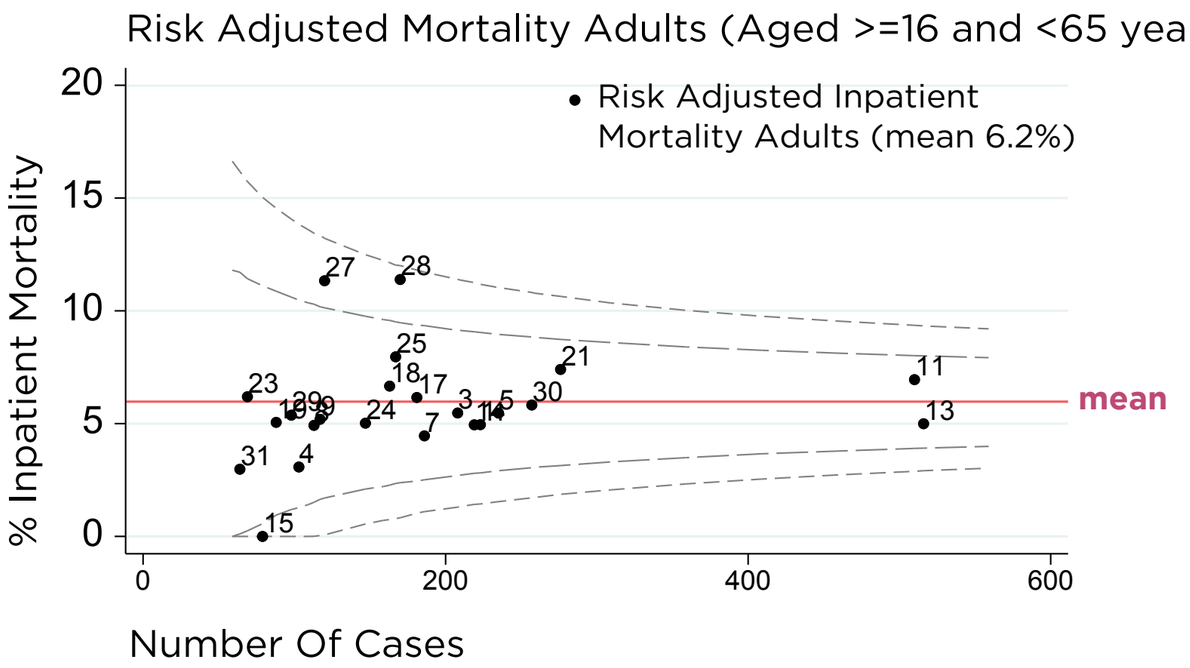


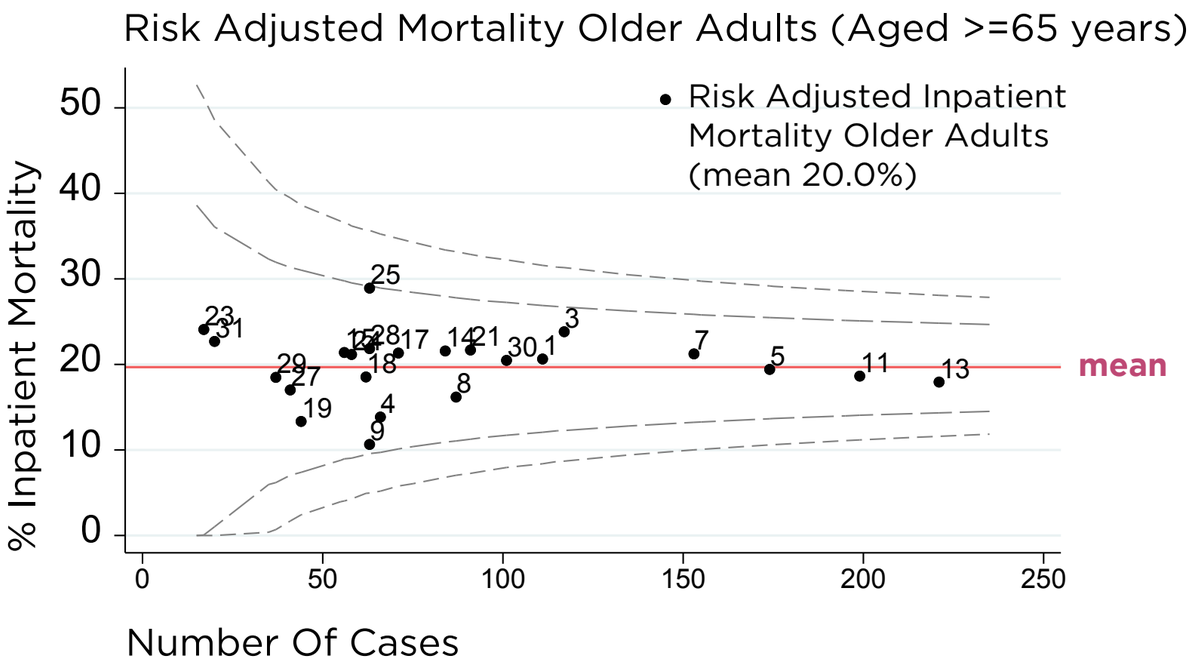


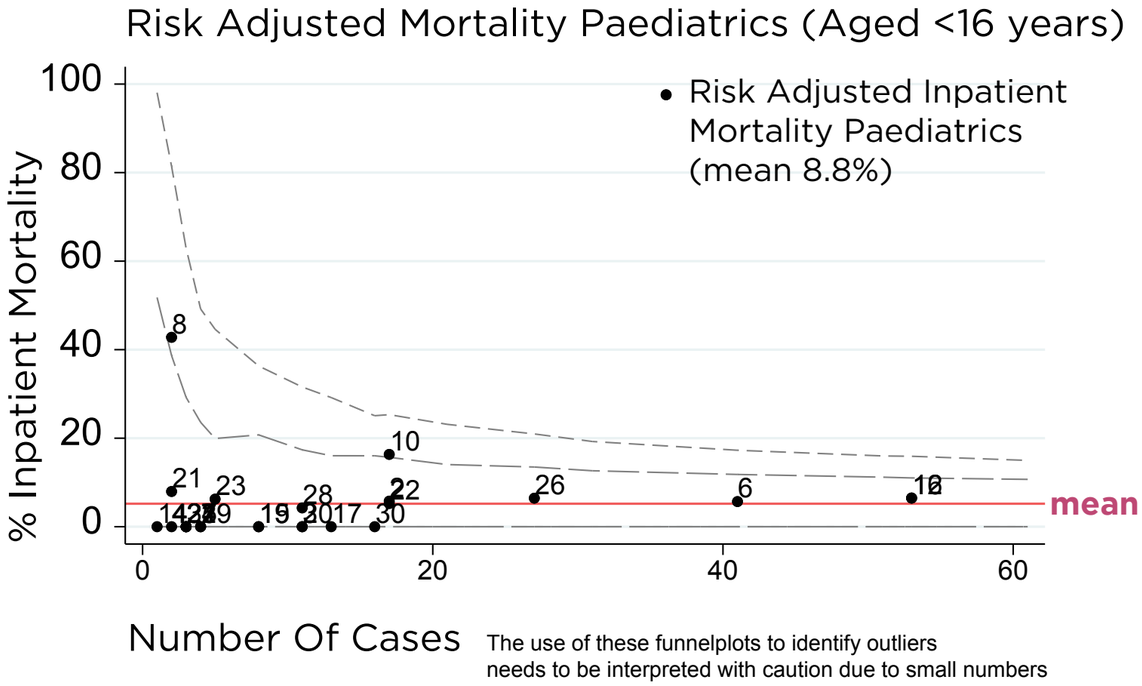
RISK ADJUSTED MORTALITY BY HOSPITAL AND AGE GROUP (EXCLUDING TRANSFERS)

Mortality was compared between hospitals using funnel plots and risk adjusted for injury severity, age, mechanism, arrival Glasgow Coma Scale (GCS), and shock index. Patients were categorised into three age groups: children (aged <16 years), adults (>=16 and <65 years) and older adults (>=65 years). Overall, most sites for each age group were within control limits.

In paediatric and older adult populations there were no significant differences between sites. In the adult population, sites 27 and 28 (two lower volume centres) were outside the 95% confidence interval and site 15 had a reduction in risk adjusted mortality.





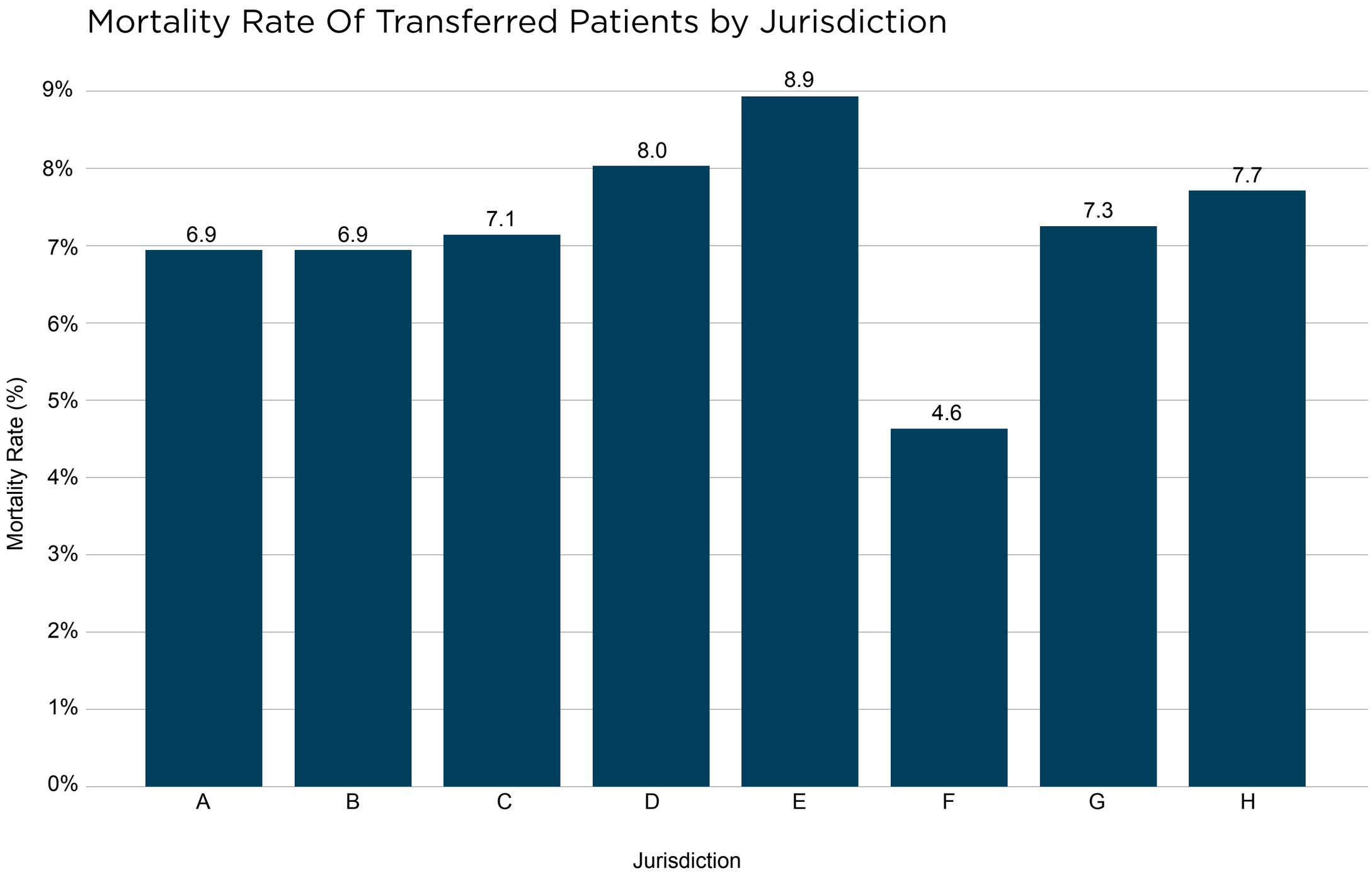


The use of these funnelplots to identify outliers needs to be interpreted with caution due to small numbers

TRANSFER OUTCOMES

Transfers make up 30% of all major trauma patients and they are an important group of patients to consider, when assessing trauma outcomes. Approximately 6.4% die even after transfer to a major trauma service and 36% are treated in ICU. The median LOS was 6.9 days. 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 prehospital and regional hospital deaths, prior to transfer. The ATR is developing processes to allow for this over coming years.

Mortality rates for patients transferred to one or more hospitals prior to arrival at definitive care is shown in the below graph.



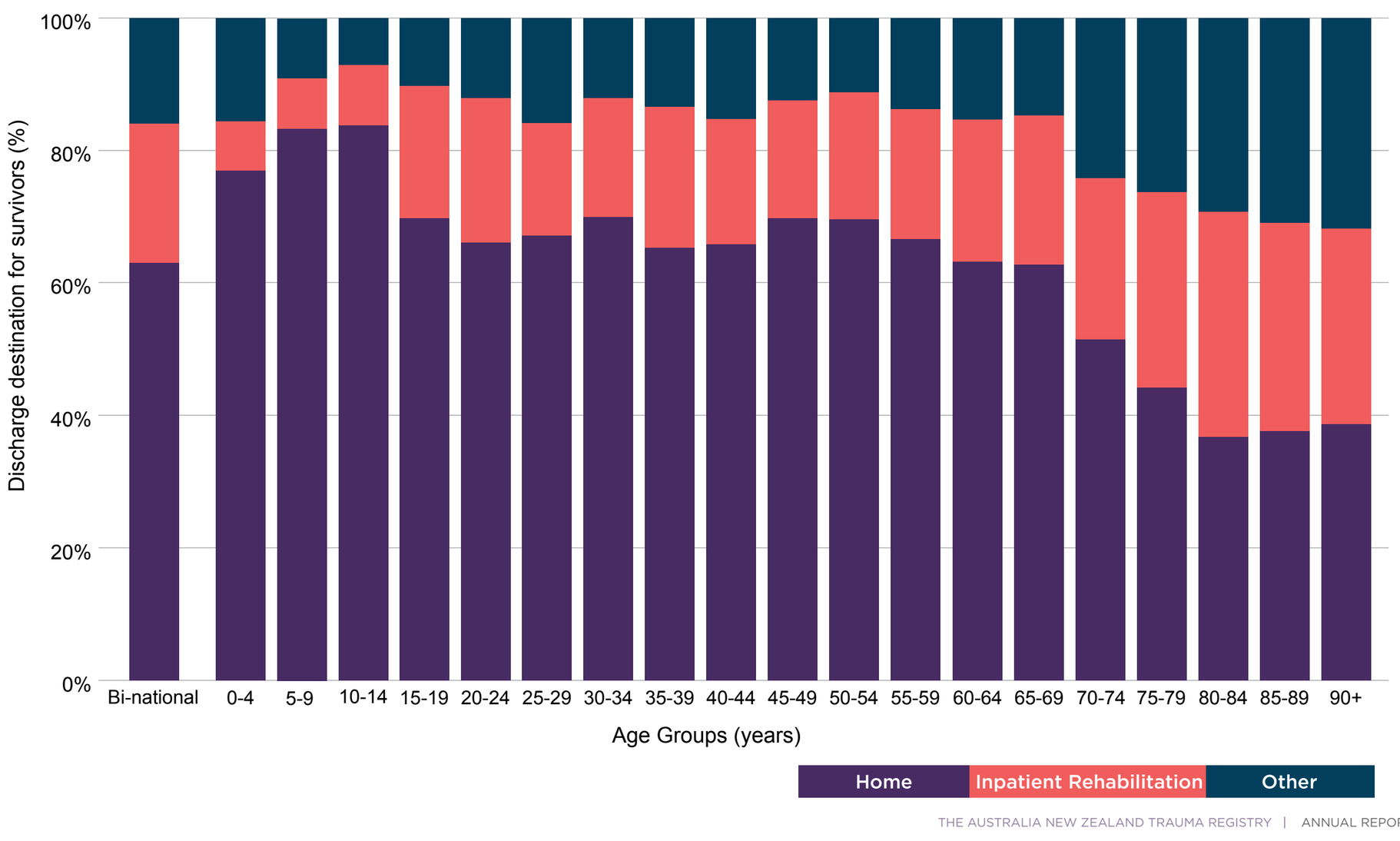
DISCHARGE DESTINATION

A known discharge destination was collected for 99.8 per cent of patients. For patients discharged alive, the proportion of patients discharged home decreased as injury severity increased and patients discharge to inpatient rehabilitation increased with injury severity. A similar trend occurred with age. As age increased, the likelihood of being discharged home decreased and being discharge to inpatient rehabilitation increased.

63% discharged **HOME**

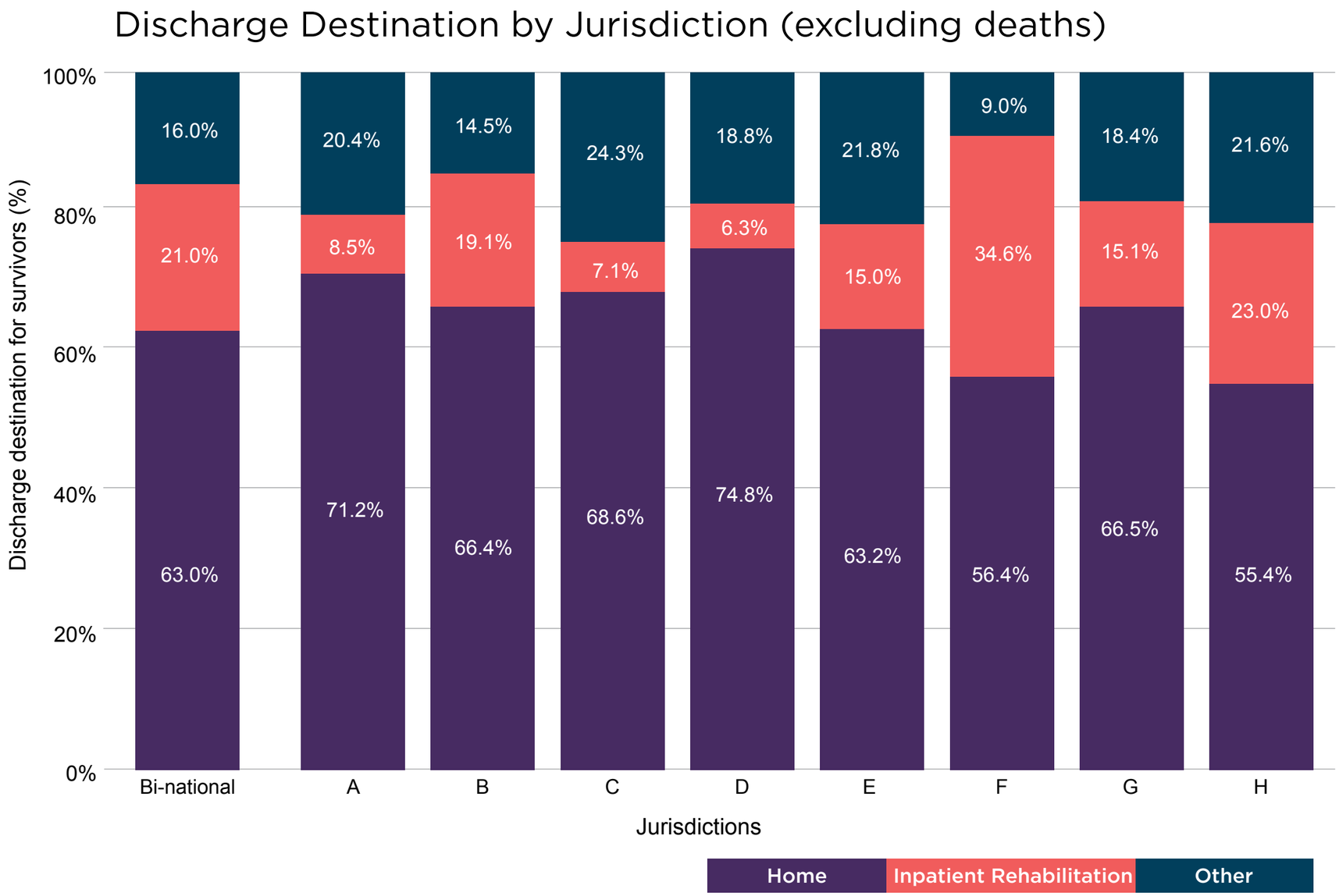
21% discharged to **INPATIENT REHABILITATION**

Discharge Destination by Age Group



DISCHARGE DESTINATION

When looking at discharge destination by jurisdiction, proportions of patients discharged to home and to inpatient rehabilitation vary greatly.



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 26 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 binational process indicators which allows for cross-comparison and benchmarking of key process indicators between sites and jurisdictions. There are eight process indicators, of which the ATR currently collects seven and reports on five. The ATR data working group is in the process of incorporating the remaining indicator into the bi-national data dictionary and is continuing to work with sites to improve data capture and completeness of the existing variables so reporting of all the process indictors is possible.

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 prehospital 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, bringing the total number of sites to 34. This is the first report for the bi-national collaboration, now known as the Australia New Zealand Trauma Registry (ATR).

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 1.51) 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 33 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)[3] 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, older adults (≥65 years of age) who die with superficial injury only (contusions, abrasions, or lacerations) and/or have co-existing disease that precipitates injury or is precipitant to death (e.g. stroke, renal failure, heart failure, malignancy).

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[4] (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[5]. 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). 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 3 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 <16 years), adult (15<age<65) and older adults (age>64). Data analysis was performed in Stata V16.0 (Stata Corp, College Station, Tx, USA) and level of significance set at 5%.

Data Confidentiality

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

All jurisdictional data is de-identified in order to maintain hospital confidentiality as per the collaboration agreement.

Each hospital and jurisdiction has been allocated a unique identifier which is consistent throughout the 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)[6] (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

ATR STEERING COMMITTEE MEMBERSHIP

Member	Committee Role
Professor Ian Civil	NZ National Trauma Network - Clinical Lead
Professor Kate Curtis	Co-chair/University representative
Professor Mark Fitzgerald	Co-chair/Alfred Health/NTRI representative
Professor Peter Cameron	University representative
Dr Don Campbell	Queensland representative
Dr 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	South Australia representative
Dr Teresa Howard	NTRI 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 Emily McKie	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 Marcus Skinner	Tasmania representative
Associate Professor Warwick Teague	Paediatric Specialist/ Victorian representative
Proxies, Adjuncts and Observers	
Ms Maxine Burrell	Western Australian representative
Ms Siobhan Isles	NZ National Trauma Network - Programme Manager
Mr Huat Lim	NCCTRC / Northern Territory
Associate Professor Kirsten Vallmuur	Queensland representative

MANAGEMENT COMMITTEE MEMBERSHIP

Member	Committee Role
Professor Kate Curtis	Co-chair/University representative
Professor Mark Fitzgerald	Co-chair/Alfred Health/NTRI representative
Professor Peter Cameron	Monash University representative
Professor Belinda Gabbe	Monash University representative
Professor James Harrison	Consultant expert, Australian Institute of Health & Welfare
Ms Emily McKie	Australia New Zealand Trauma Registry representative
Ms Sue McLellan	Monash University representative
Ms Mimi Morgan	Monash University representative
Professor Cliff Pollard	State Trauma representative

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The members of the Steering Committee and Management Committee.

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Canberra Hospital
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Gold Coast University Hospital
Queensland Children's Hospital
Princess Alexandra Hospital
Royal Brisbane and Women's Hospital
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
Royal Adelaide Hospital
Women's and Children's Hospital, SA

TASMANIA (TAS)
Royal Hobart Hospital

VICTORIA (VIC)
Victorian State Trauma Registry (VSTR)
Alfred Hospital
Royal Melbourne Hospital
Royal Children's Hospital

WESTERN AUSTRALIA (W.A.)
Perth Children's Hospital
Royal Perth Hospital

NEW ZEALAND (N.Z.)
New Zealand Major Trauma Registry
Auckland City Hospital
Starship Hospital
Middlemore Hospital
Waikato Hospital
Wellington Regional Hospital
Christchurch Hospital
Dunedin Hospital

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Thanks goes to the Royal Australasian College of Surgeons (RACS) and the Australasian Trauma Society (ATS) for over 25 years of continued support.

This report has been prepared by Ms Emily McKie, Manager, ATR.

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IMAGE SOURCES

New Zealand National Trauma Network pg 17
NTRI Alfred pg 18, 19, 21
Ambulance Victoria pg 12
South Australia DoH pg 2, 8, 11, 28

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