New Zealand Trauma Registry
& National Trauma Network

Annual Report
2019/20

Te Hononga Whētuki ā-Motu
National Trauma Network

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National Trauma Network

Foreword

This is the fifth annual report of the National Trauma Network. It presents the incidence, process of care and immediate clinical outcomes of patients admitted to hospital in New Zealand in 2019/20 after suffering major trauma.

Over the last three years a stable pattern has emerged in relation to the epidemiology, treatment and mortality of major trauma. On this basis, specific events with either focal, short-term impacts or general, long-term impacts can be evaluated. In this reporting year, the Whakaari/White Island eruption represents the former and the COVID-19 pandemic the latter. Both events have had significant impacts on the delivery of trauma care in New Zealand as this report will discuss.

The ongoing activities of the Network are reflected in the topics covered by this report; specifically, equity, critical haemorrhage as a cause of death and the relevance of serious traumatic brain injury as a driver of ongoing disability post-injury. Data from the New Zealand Trauma Registry (NZTR) is included.

The report has been compiled thanks to the dedicated efforts of nurses and clerical staff who have identified patients and entered relevant data in the NZTR, and the analytic expertise available through the Network partner, the Health Quality & Safety Commission. It outlines the progress that has been made in delivering optimal outcomes for patients suffering major injury and provides baselines for quality improvement work planned in the future.

We would like to thank all those who work for, or contribute to, the Network and the NZTR, and our sponsors, who provide support directly, or in kind, by resourcing aspects such as data collection in each acute hospital in New Zealand. Those sponsors are the Accident Compensation Corporation (ACC), district health boards, Waka Kotahi NZ Transport Agency and the Ministry of Health.

Ian Civil

National Clinical Director
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Siobhan Isles

National Programme Director
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January 2020

Executive Summary

Two unprecedented events have had a significant impact on trauma services in 2019/20.

The first event is the eruption of Whakaari/White Island in the early afternoon of 9 December 2019, with 47 people on the island. Twenty-one people died and a further 26 were injured, many seriously. The unique and insidious nature of the burn injuries were poorly understood at the time and stressed the capacity of the air ambulance system and burn services across New Zealand. The survivors, the whānau of everyone on the island and the first responders are still coping with the physical and emotional toll of the response. In this report, we reflect on the mass casualty response and some of the lessons learned, such as patient tracking and communication. The National Trauma Network (the Network) notes that this is the second consecutive annual report featuring a mass casualty event in New Zealand, which highlights that such events must form a part of trauma service planning.

The second event is, of course, COVID-19 and the Level 4 and Level 3 lockdowns that began in late March 2020. There was an initial reduction of around 50 percent of major trauma during this period; that reduction was driven almost entirely by there being fewer transport-related injuries. By June caseload returned to 'normal' in the weeks following the return to Level 1.

Notwithstanding the extraordinary effects on the trauma system of these two events, solid progress has been made towards our goal of achieving a contemporary trauma system in New Zealand. We are pleased to present results that show a continuing decrease in mortality rates. A number of processes of care also indicate areas where improvement would result in further preventable deaths and reduced severity of injury.

Highlights from the New Zealand Trauma Registry

Case Fatality Rate

7.2%

down from 8.4% in the previous year

Standardised mortality ratio:

no outliers

Deaths from haemorrhage

9%

down from 12.6% in the previous year

Trauma calls range

45-58%

Low rates of trauma calls in small- and medium-sized hospitals.

Patients with a trauma call receive a CT scan 50% faster.

Patients with serious traumatic brain injury (TBI):

sTBI managed in a neuroscience centre:

74%

(range 65-81%)

Median time for transferred patients:

9-18

hours

Tertiary survey completeness

35%

Alcohol collection up

5%

Incidence

The focus of the Network is improving outcomes for injured people. We have little control over who gets injured, although we have excellent data on the patterns of injury, which is of interest to agencies involved in injury prevention. Points of note include:

- strong association between living rurally and being at greater risk of transport-related injury than those who live in urban areas
- young Māori males who have a disproportionately high burden of injury
- a positive alcohol level associated with injury related to transport (car), falls, cutting/piercing and being struck by another person, ranging 26-30% of cases in each category.

Highlights of progress in achieving a contemporary formal trauma system in New Zealand

When the Network was established seven years ago its goals were reducing mortality, improving the level of disability for those who survive trauma and making the system more efficient. Our early work focused on pre-hospital and immediate hospital care, ensuring the right patient goes to the right hospital at the right time.

This year our work programme has made good progress against our Strategic Plan 2018–23 and with ACC's funding of the five-year business case. With support from the Health Quality & Safety Commission as the key delivery partner, we have entered a phase of initiating large quality improvement work to achieve transformational change across the trauma system. A strong equity focus is embedded across our work programme and in specific areas to help address the burden of trauma in Māori and in line with Te Tiriti o Waitangi. The highlights from this year follow.

Initiatives focused on the pre-hospital and immediate hospital care

Critical haemorrhage

Outcomes for patients with critical haemorrhage in New Zealand are not as good as in similar countries. This project was set up to address this gap with the aim of reducing mortality and associated multi-organ failure from critical haemorrhage caused by trauma. Led by Dr Kerry Gunn, early work is progressing well to develop national guidance and a bundle of care.

Trauma team training

Following successful pilots of this high-fidelity simulation course, a funding proposal for national roll-out to all major trauma hospitals was approved by the 20 district health boards (DHBs) and the Community Road Safety Fund. The course is held in emergency departments and is based on real-life scenarios. The results are practical steps to improve processes of care and communication between clinicians who do not typically work together but are expected to perform as a high-functioning team to treat critically injured patients. The course will be implemented nationally over the next few years.

Initiatives focused on post-acute care

We are pleased to have started early work to understand the journey for patients after discharge from acute hospital. Initiatives include the following.

Rehabilitation

While New Zealand is in the fortunate position of universal cover for all major trauma patients, we have limited understanding about the rehabilitation journey. Kat Quick, a physiotherapist and an expert at leading large and complex projects, is leading the rehabilitation project. The project will develop solutions to reduce unwarranted variation and improve access to the right services.

Māori experience of trauma

Māori have a higher burden of trauma than any other ethnicity, yet we have limited understanding of their experiences from the point of injury through to rehabilitation. Sharon Pihema (Ngāti Porou), who has a background in population health and community engagement, is leading a project to talk with young Māori from small and large centres across New Zealand about their experiences, and to develop a plan to support a strong kaupapa Māori approach to trauma care.

Patient-reported outcomes

Our current understanding of how well patients recover from their injuries is limited to whether they live or not, and survival is a very blunt measure of recovery. A large project has been initiated to interview major trauma patients at 6, 12 and 24 months post-injury to gather unique information about these patients and, importantly, improve the quality of their care. The University of Otago is contracted to undertake the survey which begins with patients injured from 1 July 2020. Professor Belinda Gabbe, the academic lead for the Network, is leading the development of this project based on her world-leading work in Victoria, Australia, which provides a unique and rich source of information about the long-term outcomes of trauma patients.

Enablers

The enablers of our work programme have also undergone extensive transformation this year.

National Trauma Registry

Dendrite Clinical Systems was appointed the software developer and host for the new New Zealand Trauma Registry (NZTR) following a successful open-market procurement process. The NZTR is single-instance, web-based software platform that meets the requirements set out by the sector. Developing a new platform during the COVID-19 pandemic presented a number of challenges, but it was delivered on time and to budget for implementation on 1 July 2020. We would like to acknowledge the Midland Trauma System for its outstanding support during the first five years of the NZTR.

Workforce

While the capacity of the trauma nursing workforce has increased, and more nurses are engaged in case management and quality improvement as well as data collection, there is a persistent nurse shortage in key major trauma hospitals.

Despite the limitations, initiatives to advance the quality improvement skills of the existing workforce began. In the quality improvement facilitator course participants are taught quality improvement methodology and undertake a local improvement project.

Analytics and research

Analytics has focussed on consolidating the reporting capability of the NZTR data through this report and providing the evidence base for our quality improvement work.

Work is underway to provide business intelligence to DHBs and regions on NZTR data and geospatial mapping of location of injury.

The study of road trauma evidence and data (SORTED) received full approval to continue on an ongoing basis. This is an analysis of seven transport, police and health data sets, which provides a comprehensive view of the patterns of road trauma in New Zealand.

There is a good level of interest by academics to use the NZTR data for research purposes, however, the actual uptake has been disappointing. The Network is considering alternative approaches to stimulating academic research on the burden of injury in New Zealand.

Governance

The national programme is supported by ACC and strategic partners including the Ministry of Health, Waka Kotahi NZ Transport Agency and DHBs. A new governance group structure was developed and signalled broad, cross-sector representation including Māori and consumer partnerships. Over the next year this new structure will be implemented and promote a whole-of-system response to trauma.

Introduction

Titiro whakamuri
Kokira whakamua

Look back and reflect, so you can move forward.

This annual report presents the highlights of the analysis of data from the New Zealand Trauma Registry (NZTR) data on all patients admitted to hospital with serious injury that meet the threshold for inclusion into the NZTR. Transforming data into information is crucial for identifying and addressing areas requiring improvement.

The report also presents the work of the National Trauma Network, its regional partners and other stakeholders to drive improvements across the trauma system.

Part 1: Report of the New Zealand Trauma Registry (NZTR)

All data presented in this section is for major trauma, which includes injuries with ISS ≥ 13 unless stated otherwise.

Overview of changes in 2019/20

This year we have moved the New Zealand Trauma Registry (NZTR) to a new software and hosting platform, which has prompted a few changes in collection. Patient details are now automatically retrieved from the Ministry of Health National Health Index Collection. Because this data source records gender, rather than sex, we now report on gender.

In practice this makes little difference to the overall trends and patterns seen when reporting by sex.

We are now using mechanism of injury instead of what we previously referred to as cause of injury. The major difference is that assaults are no longer a category (but are covered under injury intent), and there is a replacement category of struck by/collision with object or person.

There are two new Registry fields, which record the completion of a tertiary survey and the initiation of a trauma call at arrival at first hospital.

Incidence

In 2019/20 there were 2191 major trauma hospital admissions. The national incidence of trauma was 44 cases per 100,000. This is lower than in 2018/19 (48 per 100,000). In 2018/19 a particularly high incidence rate was seen for the South Island, which has now reduced this year. Although 2018/19 was marked by the terrorist attack on Christchurch mosques, this contributed 24 major trauma cases to the registry in 2018/19 and alone does not explain this variation in incidence. Higher numbers of transport injuries and falls were also seen.

Incidence rates per 100,000 (caseload) by region 2019/20

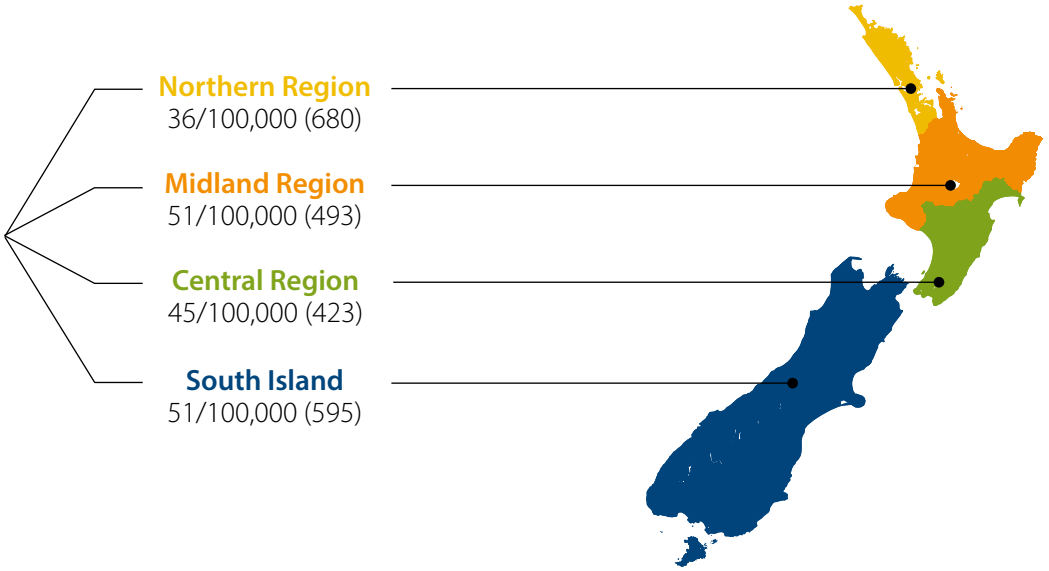
National incidence of major trauma
44/100,000 (2191)

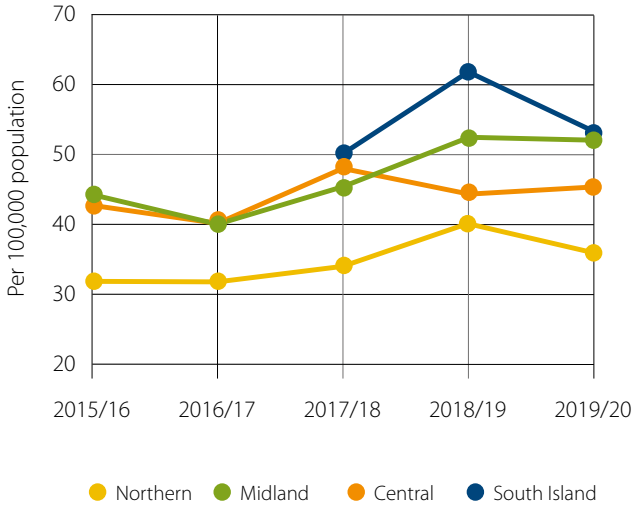
Northern Region
36/100,000 (680)

Midland Region
51/100,000 (493)

Central Region
45/100,000 (423)

South Island
51/100,000 (595)



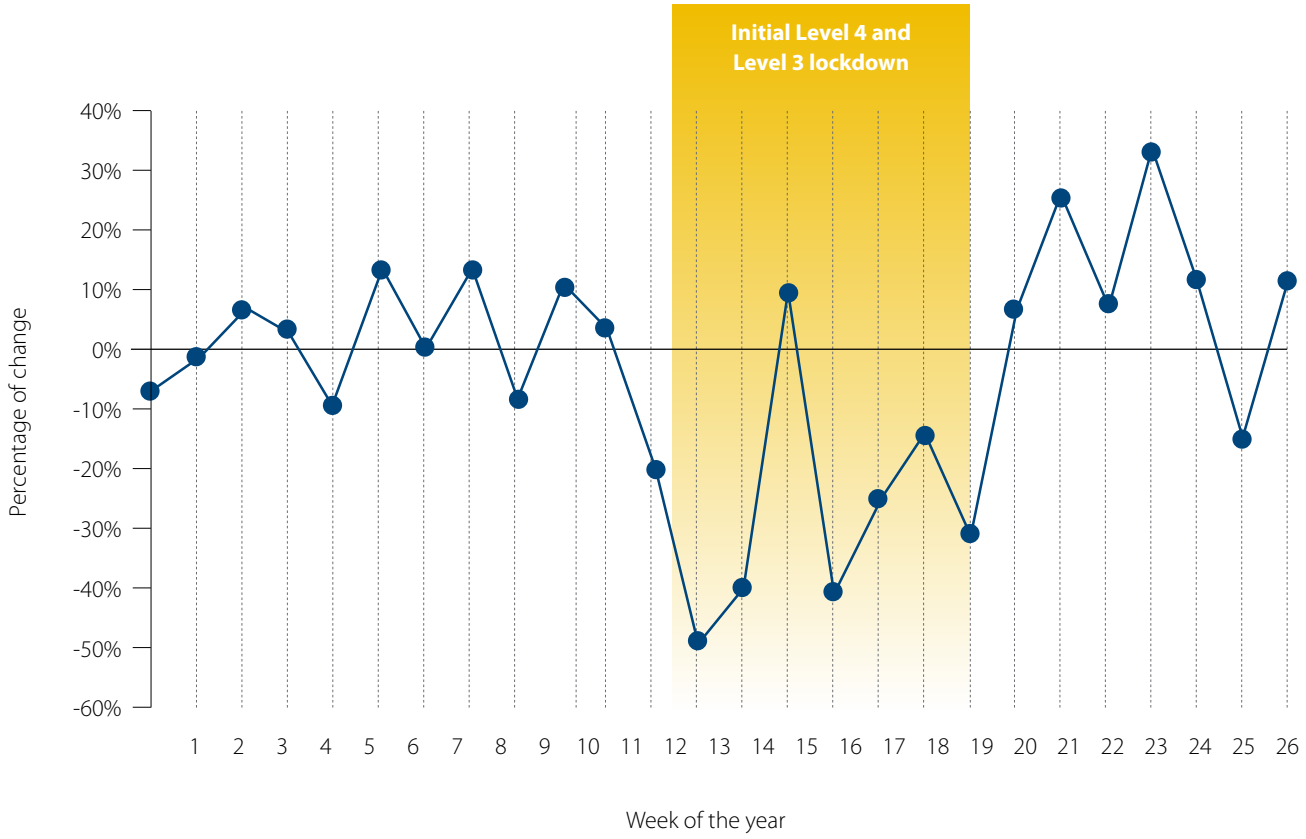


Impact of COVID-19

While there is some evidence of the impact of COVID-19 (via the restrictions placed at the different levels of the New Zealand COVID-19 Alert System), the impact lasts no longer than the period of the week leading up to the initiation of Level 4, which began on 26 March 2020, through to the week of the national introduction of Level 2 beginning on 14 May.

The reduction in major trauma events (compared with the average of the previous two years) peaked in the first week of Level 4 at an approximate 50% reduction in major trauma nationally. This reduction was largely driven by changes in transport injuries. There is the suggestion of an elevated period of major trauma following the return to the less-restricted conditions of Level 2 in week 20.

Percentage change in 2020 major trauma cases from 2018 and 2019 average (first 26 weeks of the year)



Patterns of injury

More than half of major trauma was the result of transport injuries (52%, similar to 54% in 2018/19). Major trauma to car occupants was lower than in the previous year (-9%, 555 cases, versus 612 cases in 2018/19), with reductions in other transport injuries. Last year saw a marked increase in pedestrian and pedal cyclist injuries, and these categories had the largest decrease this year (-29% and -15% respectively from 2018/19). Falls did not decrease in the same fashion (642 cases *versus* 639 cases in 2018/19). These trends might have been contributed to by the changes in mobility and locations required by Level 4 and Level 3 lockdowns in March to May 2020. Publications from NZ and overseas have shown substantial decreases in road related injuries during this time with falls not decreasing and more injuries occurring in the home environment.

Due to the change in methods this year, not all categories are directly comparable with the previous year (with injury type being replaced by injury mechanism). The notable difference is that assaults are presented separately (see below).

Mechanism of injury by region 2019/20

				Transport					
	Falls	Struck by/ collision with object or person	Other	All Transport	Car	Motorcycle	Pedestrian	Pedal cycle	Quad bike/other
Northern	34% (230)	10% (66)	11% (76)	45% (308)	22% (152)	11% (73)	5% (34)	5% (35)	2% (14)
Midland	21% (102)	6% (28)	15% (72)	59% (291)	32% (156)	14% (67)	4% (18)	7% (35)	3% (15)
Central	29% (123)	9% (39)	13% (54)	49% (207)	22% (91)	12% (50)	6% (24)	7% (31)	3% (11)
South Island	31% (187)	4% (26)	10% (59)	54% (323)	26% (156)	11% (64)	3% (15)	11% (67)	4% (21)
National	**29% (642)**	**7% (159)**	**12% (261)**	**52% (1129)**	**25% (555)**	**12% (254)**	**4% (91)**	**8% (168)**	**3% (61)**

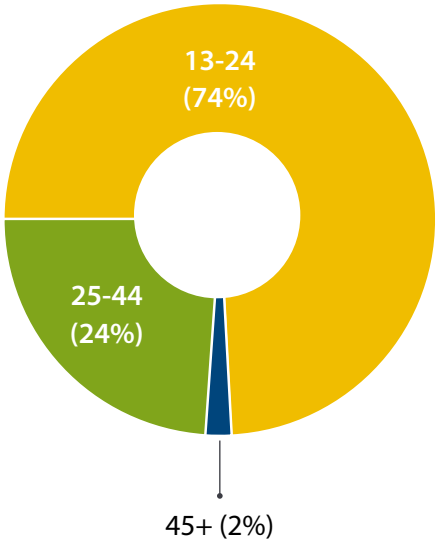
Injury patterns show similar splits in injury severity, injury type and injury intent from previous years. There was an increase in the proportion of injuries from burns (recorded under 'Other') which relates to the eruption of Whakaari/White Island.

Due to rounding to whole numbers, some totals may not add to 100%

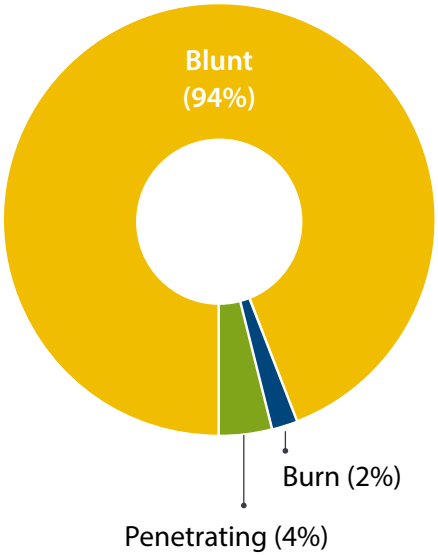
Patterns of injury severity, type, and intent, 2019/20

Patterns for age-standardised incidence rates remain stable with those seen over the prior two years.

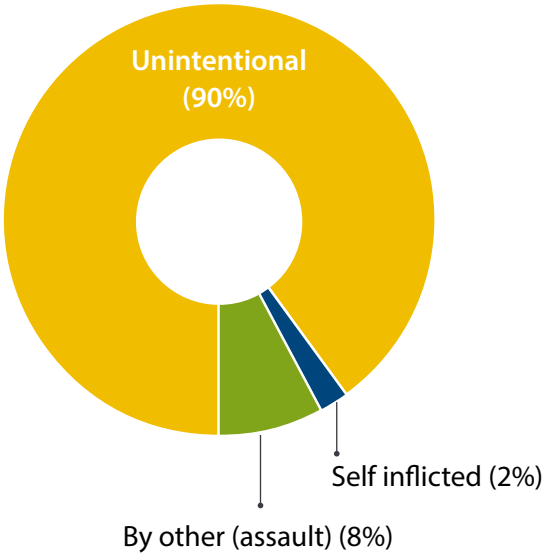
Injury severity



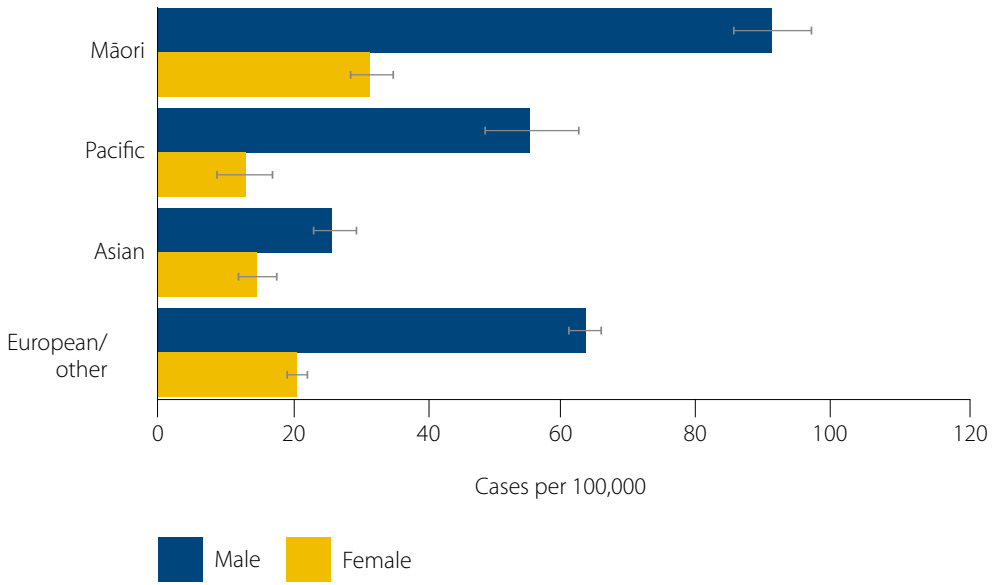
Injury type



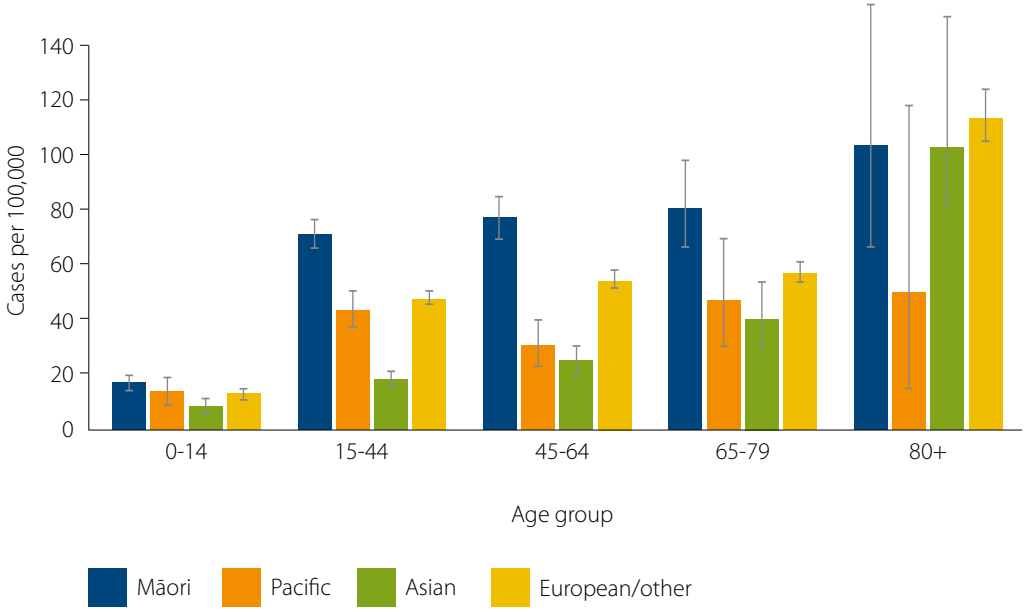
Injury intent



Age standardised incidence per 100,000 by gender and ethnicity 2019/20



Annual major trauma incidence per 100,000 by age and ethnicity 2017/18–2019/20



Data: 2017/18, 2018/19, 2019/20 financial years.

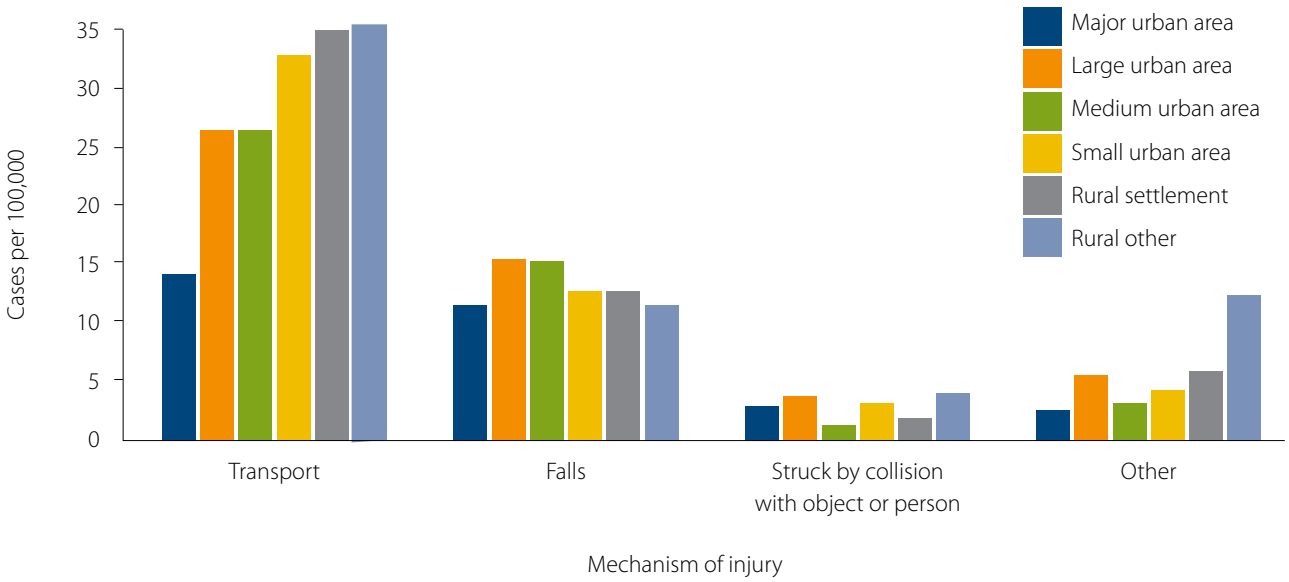
Patterns in major trauma incidence across age and ethnicity are comparable to those from previous years. Māori have elevated major trauma rates up to 80 years of age relative to all other ethnicities, while European/other ethnicities have higher rates in the 80 and over age group. Asian peoples have low rates of major trauma up to 80 years, while Pacific peoples aged 80 and over have low rates of major trauma.

Urban and rural trauma

Urban and rural trauma is defined by the communities in which people live, rather than where injuries takes place. The burden of trauma on rural communities is highest for transport injuries. For other mechanisms of injury, there are less clear patterns, although incidence of 'other' mechanisms such as animal-related injuries are elevated in the smallest rural areas.

The influence of transport-related trauma is large enough that between the largest urban areas and the smallest rural areas, there is a doubling of major trauma incidence. When transport is excluded there is minimal difference between rural and urban trauma. These findings show a strong association between transport injuries and people who live in rural communities and is an area to be addressed for injury prevention.

Urban/rural incidence per 100,000 by mechanism of injury 2019/20



Inflow and outflow of trauma

As seen in 2018/19, the Northern and South Island regions saw a net inflow of major trauma – they provide definitive care to more patients from other regions than is true in reverse. These patterns reflect the paediatric and spinal specialist services delivered in these regions, and patterns of domestic and international tourism activities.

Regional inflow and outflow of trauma cases 2019/20

	Northern	Midland	Central	South Island	Unknown/outside NZ
Inflow	96	79	53	92	–
Outflow	49	77	75	32	87
Net	47	2	-22	60	-87

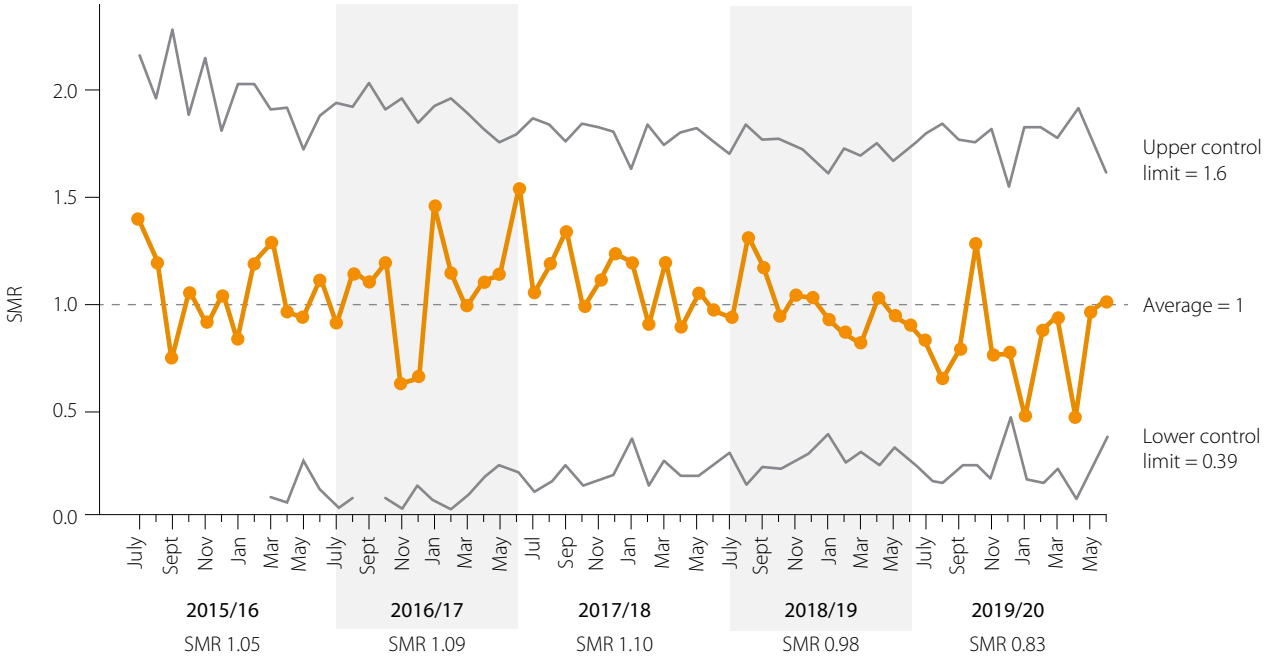
Patient outcomes

Mortality

The case fatality rate for 2019/20 was 7.2%, down from 8.4% in the previous year.

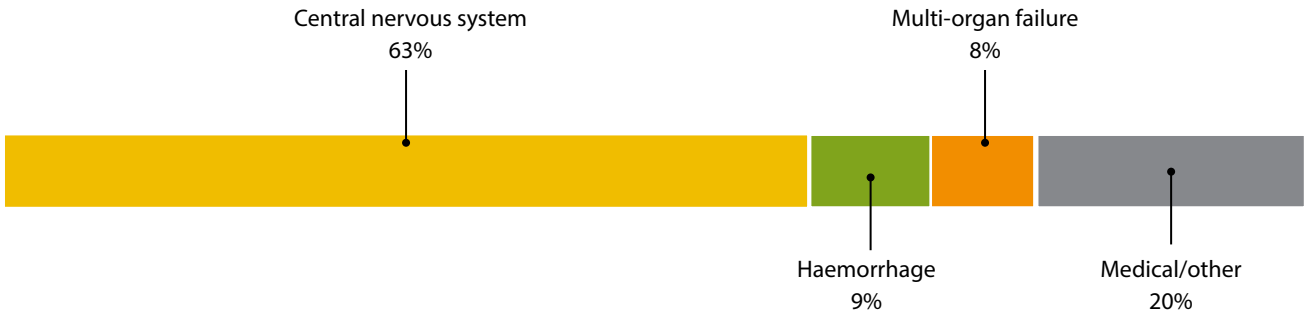
In addition, once adjusting for the risk of death (see Appendix 2 for methods), the standardised mortality ratio (SMR) shows evidence of a declining pattern. Since the beginning of 2019, 15 of the 18 months have had SMRs below 1 (total SMR for this period: 0.86).

Standardised mortality ratio



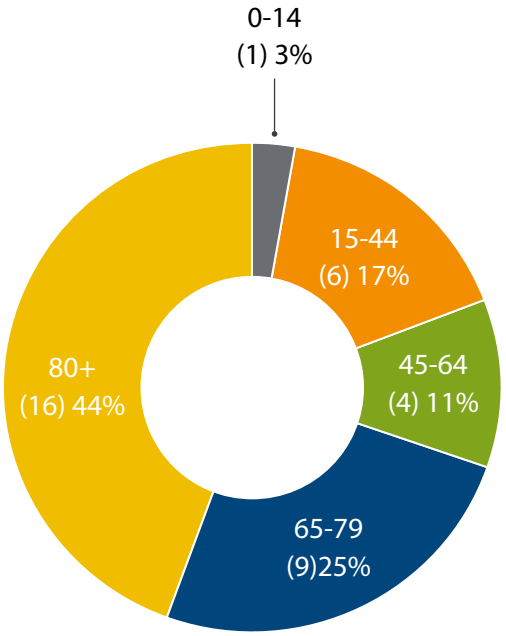
Proportionately fewer deaths were caused by haemorrhage than in the previous year (9% in 2019/20 FY, 13% in 2018/19 FY). A larger proportion of deaths were attributed to medical and other causes (20% in 2019/20, 16% 2018/19). A well-functioning trauma system will result in decreasing mortality from haemorrhage and multiple organ failure whereas the increasingly ageing demographic of trauma presentations will result in higher numbers of patients dying from reasons primarily related to their underlying comorbidity. Central nervous system deaths result from a mixture of preventable and non-preventable causes.

Cause of death 2019/20



Thirty-six patients died in-hospital who had injuries not reaching the anatomic threshold for major trauma (ISS < 13). Almost half (44%) of these deaths occurred in patients aged 80 years or older.

In-hospital deaths for patients with Injury Severity Score (ISS) <13 by age group 2019/20



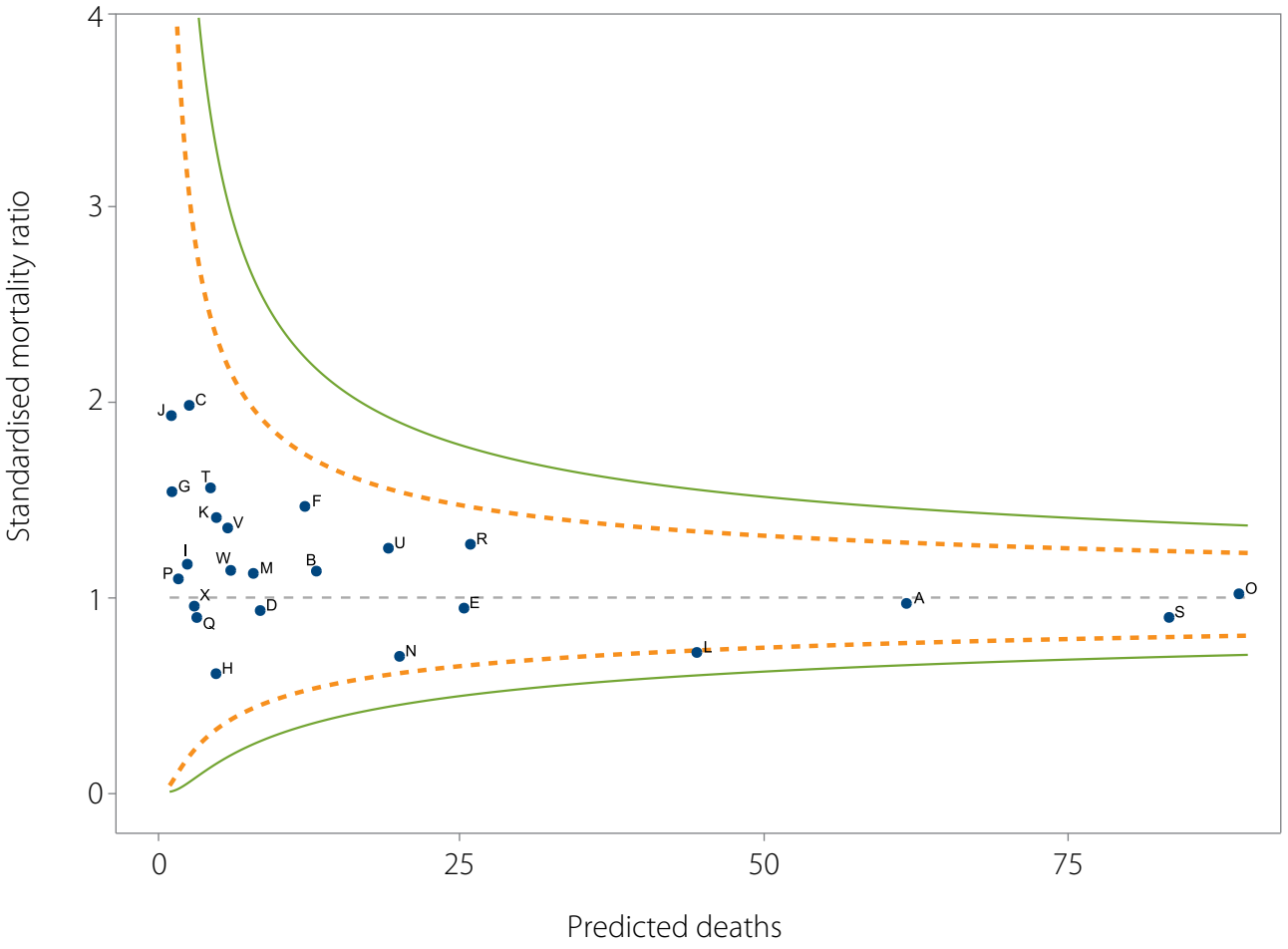
While the case fatality rate is lower in small hospitals than medium or large hospitals, once caseload is adjusted for risk of death to produce a SMR (see Appendix 2 for details), risk of death decreases with hospital size. This suggests that outcomes for patients are better in larger hospitals which treat more trauma.

Three-year case fatality rate and standardised mortality ratio by size of hospital 2017/18–2019/20

Size of hospital	Small	Medium	Large
Case fatality rate	7.9%	8.9%	8.6%
Standardised mortality ratio	1.2	1.1	0.9

No individual sites have a SMR above or below the expected range, accounting for variation. However, there is a pattern of small and medium sites typically having ratios above 1.

Funnel plot of standardised mortality ratios by site (anonymised), 2015/16–2019/20



This funnel plot shows the standardised mortality ration for each major trauma hospital in NZ. Each hospital is represented by a letter with those having the highest number of death closely approximating the expected numbers whereas hospitals with fewer expected death have wider variation in the actual number of deaths. This finding is to be expected and consistent with the broadening 95% and 99% confidence parameters associated with a funnel plot

Orange dashed line, 95% Poisson limit; green line, 99.8% Poisson limit)

In 2019/20 there were fewer post-discharge deaths than in previous years, notably at the 90-day timepoint. The highest rate occurred in those aged over 80 years, with 6.4% mortality at 90 days, half the rate that occurred in the previous year. No reason for this change is known.

Post discharge deaths

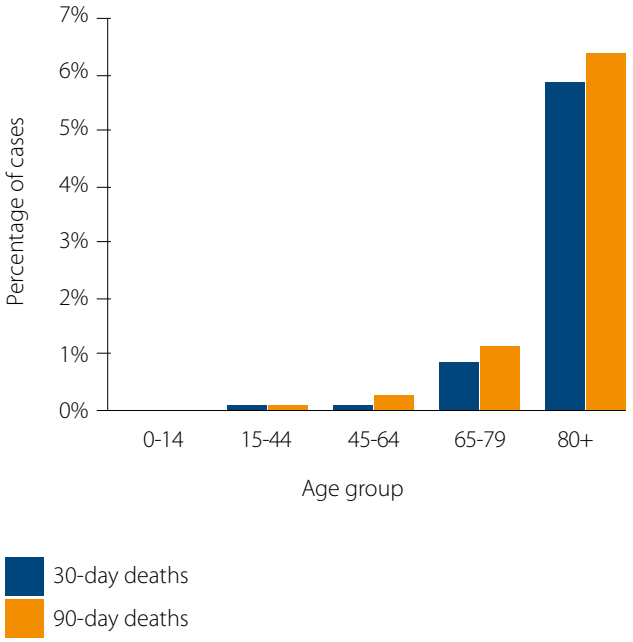
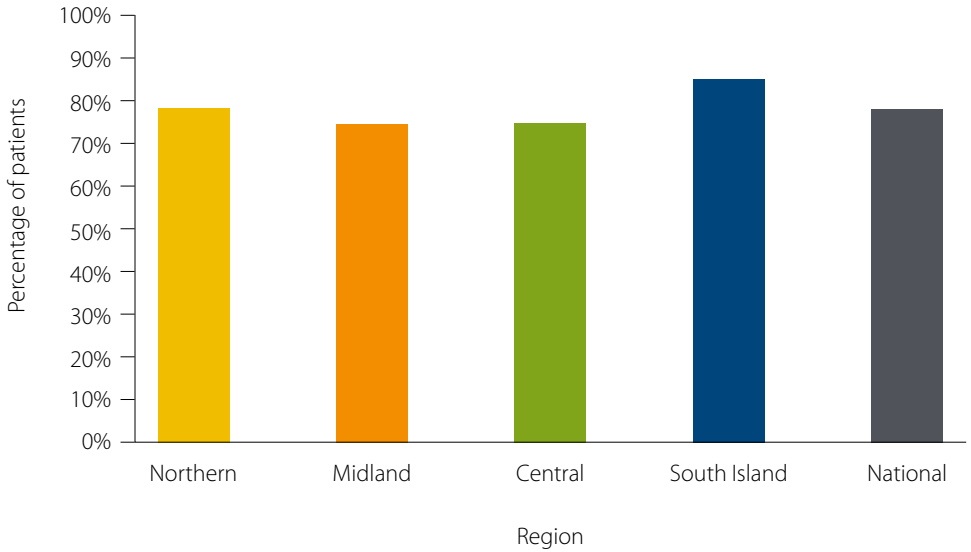


Photo: Stuff Ltd

Process of care

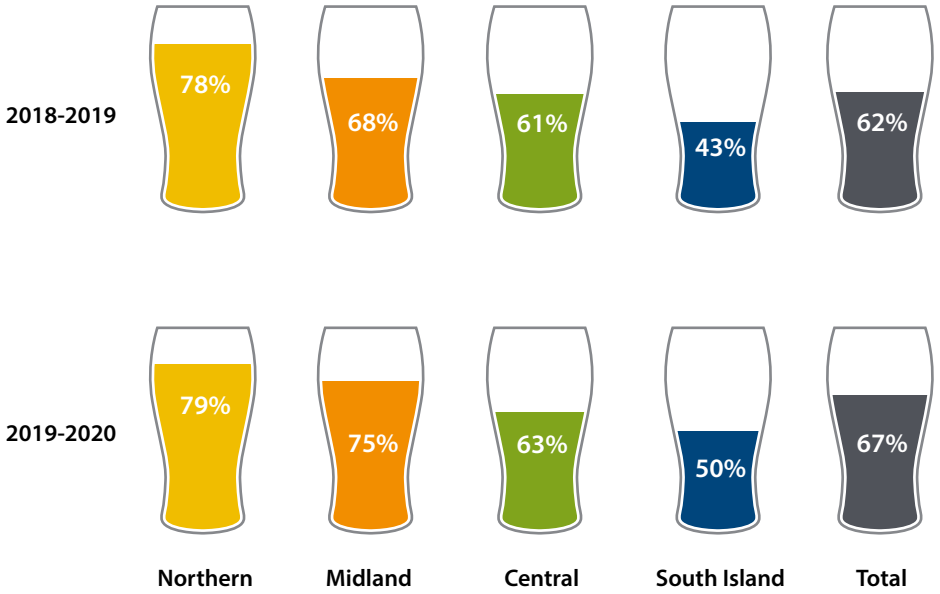
Ideally, all patients would be transferred directly to the hospital able to provide definitive care. However, geography and the time-critical nature of certain injuries means that some patients are initially transported to a nearby hospital with subsequent transfer for definitive care. The overall rate of transfer for definitive care (20%) has not changed despite the introduction of prehospital destination policies. There may well be more patients who would benefit from transfer from the initial hospital to which they are transported. These trends would have counteracting effects on the proportion directly transported to definitive care and the relatively stable 80% rate reported here is not expected to change.

Patients directly transported to definitive care 2019/20



Blood alcohol concentration recording improved nationally. However, there is still a large disparity by region in recording rates, with the Central and South Island regions recording blood alcohol concentrations less often than the Northern and Midland regions.

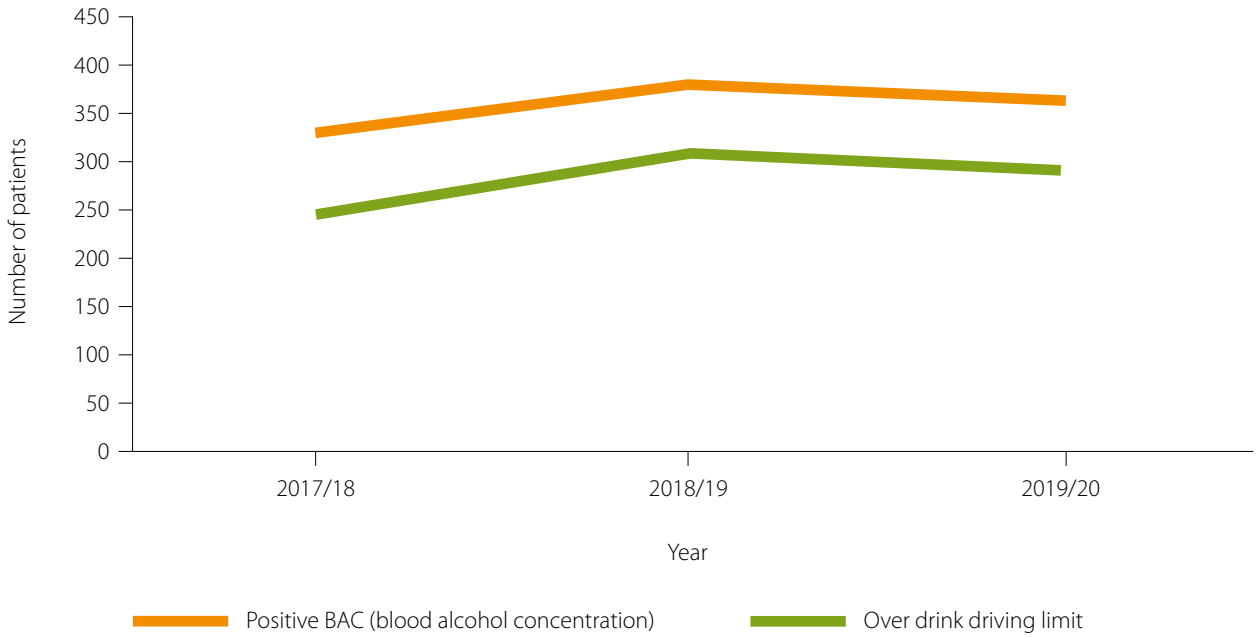
Blood alcohol concentration recorded at first hospital 2019/20 and 2018/19



As the proportion of major trauma patients having blood alcohol concentrations recorded increased, the proportion of those with a positive test has declined. More than three-quarters of those with a positive blood alcohol concentration are also above the legal limit for driving (reported regardless of mechanism of injury).

Positive tests for blood alcohol occur at different rates for different mechanisms of injury. Car transport injuries, cutting/piercing/penetrating injuries, falls, and struck by/collision with object or person all more commonly involved alcohol than non-car transport injuries and other traumas. Note this breakdown of mechanism varies from that presented earlier, as cutting/piercing/penetrating is separated from other trauma, and transport trauma is divided into car and non-car transport injuries. This data is for all cases recorded in the NZTR.

Number of major trauma patients with positive blood alcohol readings, 2017/18–2019/20



Blood alcohol concentration results for patients by mechanism of injury 2015/16–2019/20

Mechanism	Tested patients with positive blood alcohol test	Tested patients with blood alcohol above driving limit (of the total)
Transport (car)	34%	25%
Transport (non-car)	27%	16%
Struck by/collision with object or person	36%	27%
Cutting/piercing/penetrating	37%	30%
Falls	38%	26%
Other trauma	23%	16%

Trauma call on arrival to hospital

Trauma calls are systematic responses to incoming or recently arrived patients recognised as having acute or complex trauma, in which a pre-specified clinical team coordinates care for the patient. The composition of the team varies by site.

Trauma calls on arrival to first care facility were initiated half of the time (52%). This is the first year that this field has been collected in the NZTR. There is some variation by region, with the Midland and Northern regions initiating trauma calls more often than the Central and South Island regions. Hospital size and injury severity also affect the rate of trauma call initiation, with higher trauma call rates at larger hospitals and for more severe injuries.

When a trauma team activation is made, time to CT scan is on average twice as fast as when no activation is made (median time 54 minutes and 109 minutes respectively).

Trauma call initiation by region, hospital size, and injury severity 2019/20

Region	Percent with trauma call
Northern	57%
Midland	58%
Central	46%
South Island	45%
Total	52%

Size	Percent with trauma call
Small	33%
Medium	38%
Large	62%

ISS category	Percent with trauma call
13–24	48%
25–44	57%
45+	80%

ISS = Injury Severity Score.

Time to index CT (minutes) with and without trauma call 2019/20

Region	With trauma call (minutes)	Without trauma call (minutes)	Difference
Northern	40	98	-59%
Midland	57	110	-48%
Central	67	115	-41%
South Island	66	108	-39%
Total	54	109	-50%

Tertiary survey

Tertiary surveys are additional patient evaluations conducted to identify injuries that may not have been identified in the initial and subsequent evaluations. These surveys will typically follow a predetermined checklist developed locally.

Recording the completion of tertiary surveys is also new to the NZTR this year. Nationally, tertiary surveys were completed in about one-third of cases (35%) indicating substantial room for improvement. Large hospitals completed tertiary surveys more than twice as often as smaller sites.

Tertiary survey completion by region and hospital size

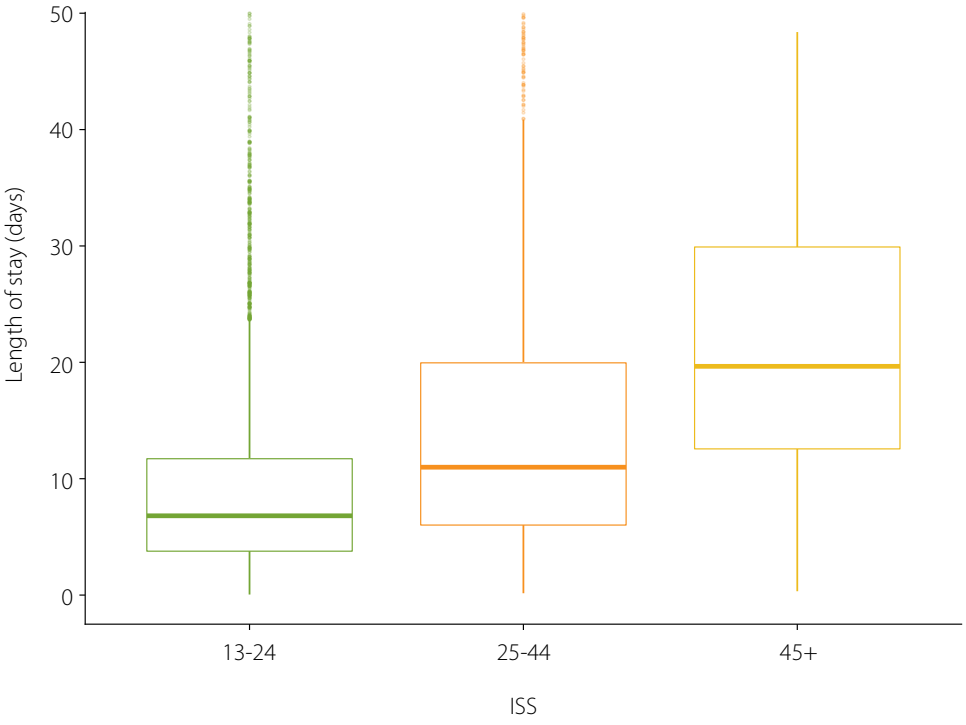
Region	Tertiary survey completed
Northern	29%
Midland	46%
Central	27%
South Island	39%
Total	35%

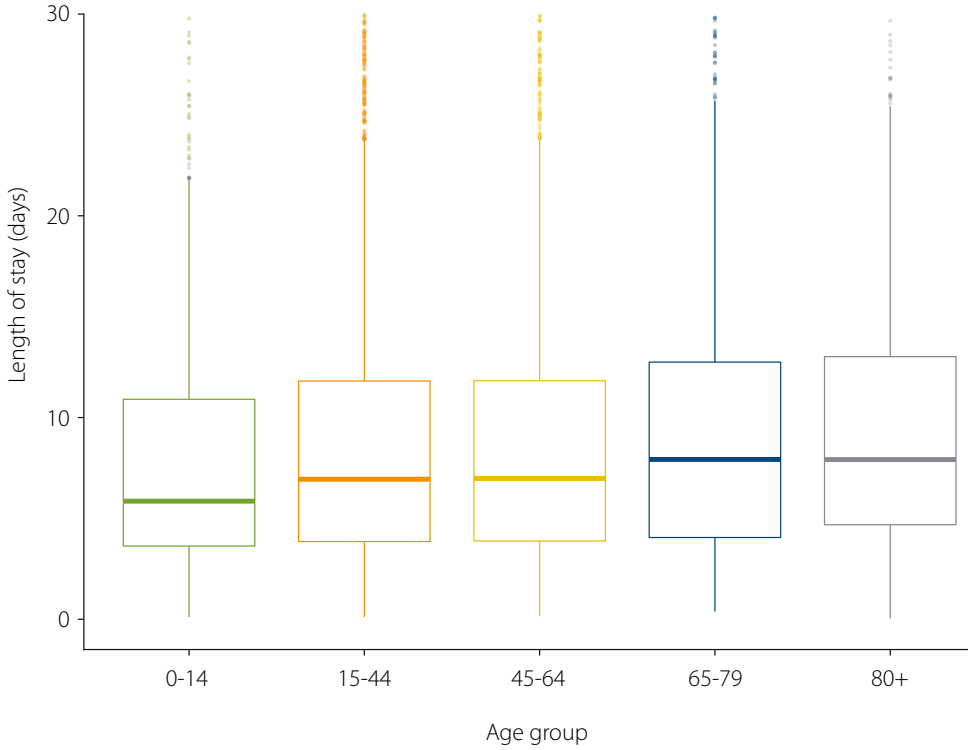
Size	Tertiary survey completed
Small	11%
Medium	18%
Large	43%

Acute hospital length of stay

A longer length of stay is associated with severity of injury. While median length of stay increases with age, the difference is larger within age groups than between them, and therefore age does not appear to be a major factor in length of stay.

Length of stay for surviving patients by injury severity and age group 2019/20





Reducing length of stay may be possible if there is unwarranted variation. However, any aims for general reductions in length of stay should be considered in the light of unplanned readmission rates and other potential negative side effects.

Focus areas

Serious traumatic brain injury

Serious traumatic brain injuries (sTBIs) are defined here as injuries graded 3 or higher on the Abbreviated Injury Scale (AIS) to the head. AIS grades survivable injuries on a scale of 1-5, with injuries being categorised by body region. Examples of graded head injuries follow.

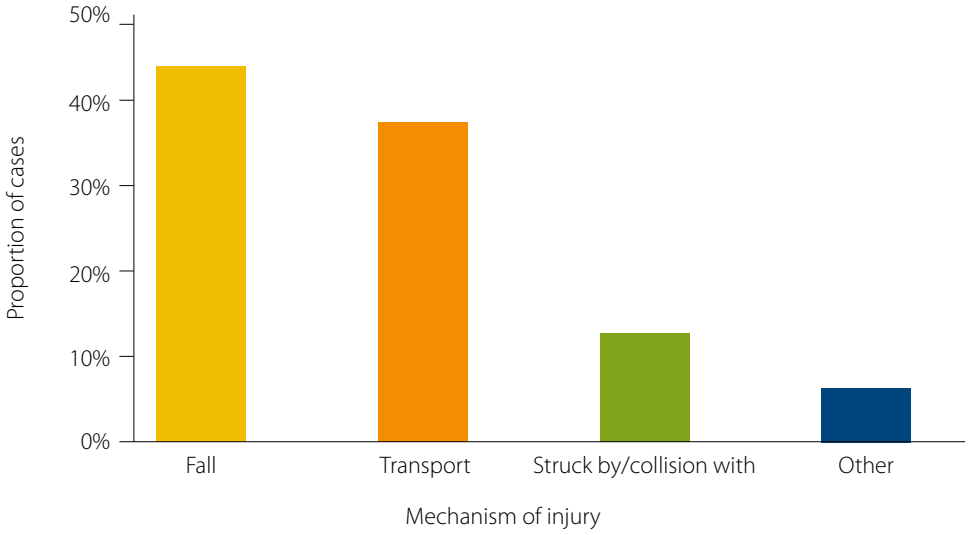
Head injury examples from AIS 2005 (2008 revision)

Injury	AIS severity score
Cerebral concussion, mild; no loss of consciousness	1
Cerebral concussion, loss of consciousness ≤ 30 mins	2
Cerebrum, subarachnoid haemorrhage not further specified	2
Cerebrum, contusion; single, small	3
Vault of skull fracture, comminuted; compound but dura intact; depressed ≤ 2 cm; displaced	3
Vault fracture, complex; open with torn, exposed or loss of brain tissue	4
Cerebrum, hematoma (haemorrhage), subdural, small; moderate	4
Cerebellum, penetrating injury, > 2 cm deep	5
Brain stem injury involving haemorrhage	5

AIS = Abbreviated Injury Scale.

The most common causes of sTBIs are falls (44%) and transport injuries (37%). Notably, falls are disproportionately represented, given that they comprised only 29% of injuries.

Mechanisms causing serious brain injuries 2019/20



Key metrics for serious traumatic brain injury 2019/20

	Isolated	Complex
sTBI caseload = 728	**% (n)**	**% (n)**
As a proportion of all sTBIs	67% (488)	33% (240)
As a proportion of all major trauma	22%	11%
Proportion of sTBI patients with GCS < 9 at scene	18% (86)	28% (68)
Of GCS < 9, intubated pre-hospital	45% (39)	57% (39)
Time to CT under 2 hours*	National: 67% (309)	National: 86% (196)
All major trauma = 71%	Northern: 76% (128)	Northern: 81% (55)
All sTBI patients = 73%	Midland: 63% (56)	Midland: 90% (57)
	Central: 69% (64)	Central: 80% (44)
	South Island: 56% (61)	South Island: 93% (40)
Case fatality rate	15% (71)	15% (35)
All major trauma = 7%		
All sTBI patients = 15%		

**These times are calculated at hospital of first care. In the previous annual report, they were calculated at definitive care hospital; variation between these reports does not reflect differences in care.*

GCS = Glasgow Coma Scale.

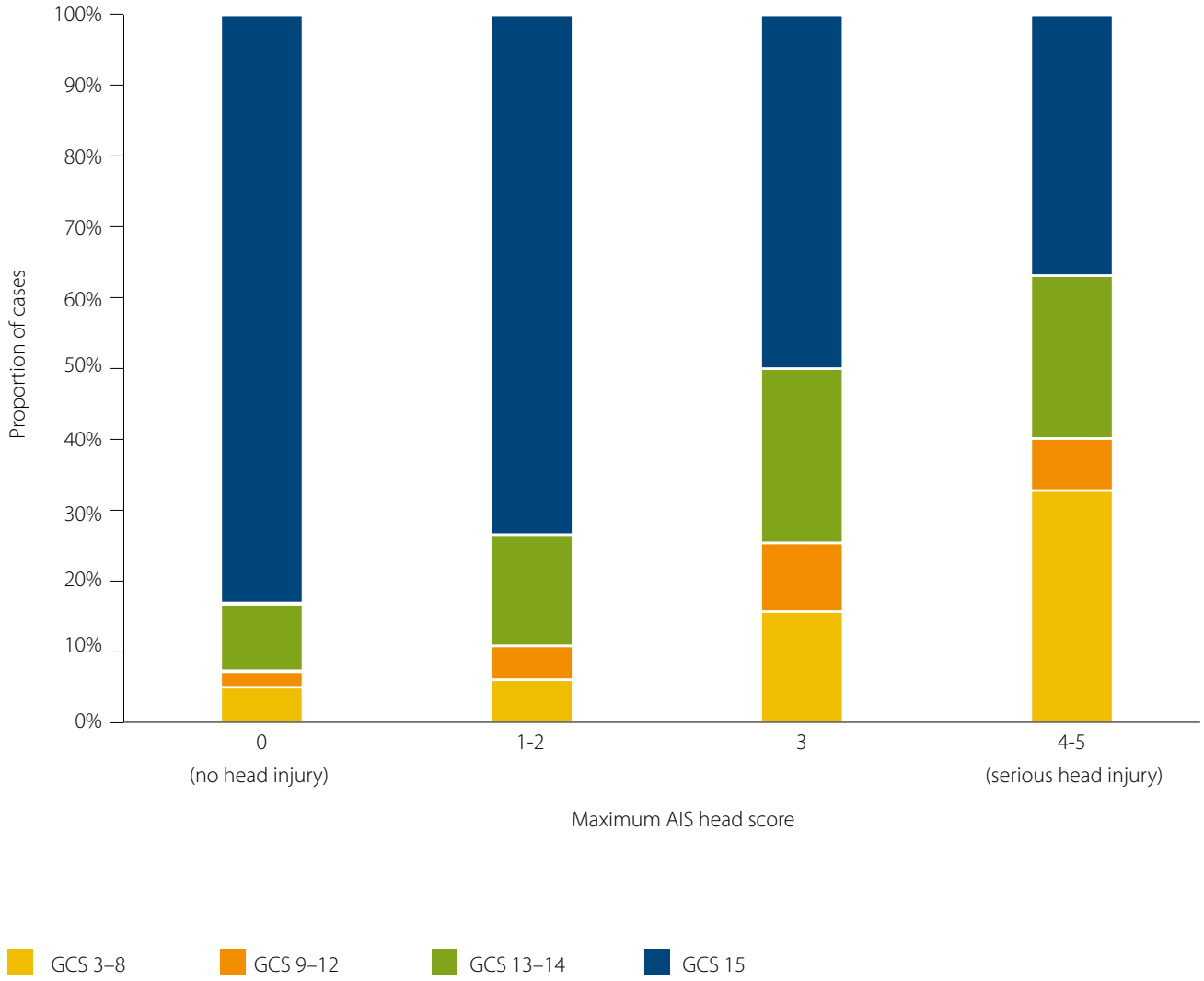
The Glasgow Coma Scale (GCS) indicates the degree of patient consciousness across motor, verbal and eye responses. The scale ranges from entirely unresponsive (3) to normal responses (15). Typically, the GCS will be lower when a patient has experienced a head injury or is in severe shock. The GCS calculation is based on the first available GCS. The majority of first GCS are recorded by ambulance at scene, but if this is not available the first hospital GCS is used.

Typically, GCS scores were lower for patients with more severe head injuries. Nevertheless, a small proportion of patients with no anatomical head injury also experienced severely impaired consciousness (GCS 8 or lower). The most common injury mechanism for such patients was penetrating injury, followed by injuries from electrical current or environmental exposure.

Conversely, more than one-third of patients with a severe head injury (AIS 4 or 5) experienced no impairment of consciousness (GCS 15). Of these, almost two-thirds (64%) had experienced a fall. While older adults often experience less impairment of consciousness with head injuries, more than half of those (54%) with no GCS impairment and a severe head injury were aged under 65 years.

The significance of this finding is that the GCS is commonly used as a marker for urgency for diagnostics such as a head CT scan to determine injuries sustained and guide treatment. However, many patients without impaired consciousness have anatomically severe head injuries that would also benefit from urgent diagnosis and treatment.

Total Glasgow Coma Scale score by maximum head injury severity 2019/20



AIS = Abbreviated Injury Scale; GCS = Glasgow Coma Scale.

A smaller proportion of patients with sTBIs received definitive care at a neuroscience centre (74%) than in 2018/19 (77%). Patients with sTBI benefit not only from neurosurgical intervention but also from the package of care commonly available in neuroscience centres. Ideally therefore, most sTBI patients should receive care in these centres unless there were equivalent intensive care, nursing and allied health resources available in the presenting hospital. The only exceptions would be patients on a palliative care pathway.

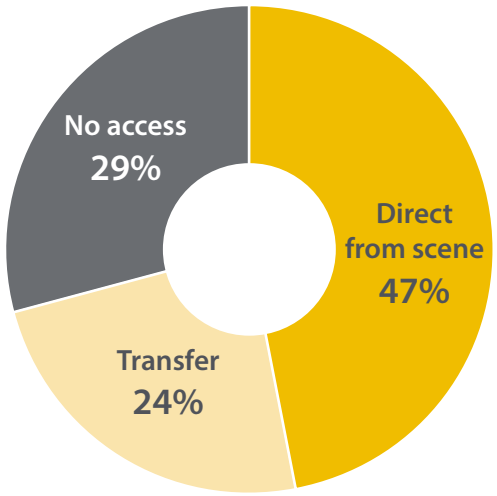
For sTBI patients initially received by a non-neuroscience facility, only 49% received a transfer to a neuroscience definitive care facility. Therefore, 51% of such patients were managed in a centre which has no neuroscience capability. Further work is signalled in this area to better understand why a surprisingly large number of people are not managed in a neuroscience centre, and how this may impact on outcomes.

Proportion of sTBI patients by region receiving definitive care at a neuroscience facility by receiving region 2019/20

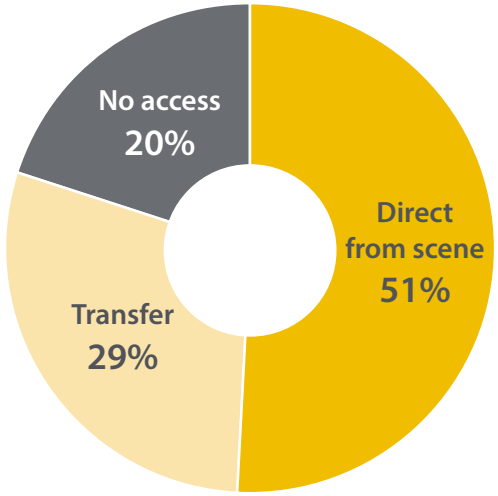
Region	Neuroscience definitive care
Northern	71%
Midland	80%
Central	65%
South Island	81%
National	74%

sBTI = serious traumatic brain injury.

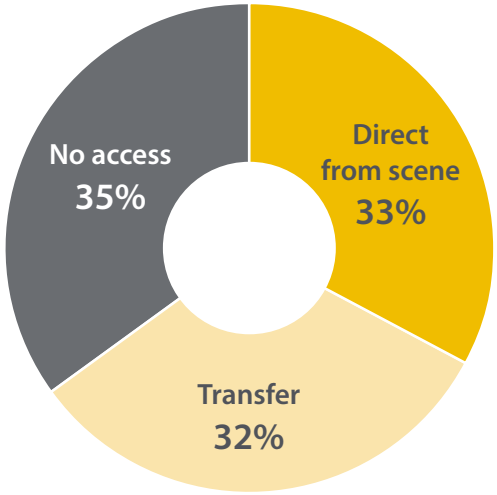
Access to neuroscience care for sTBI patients by region 2019/20



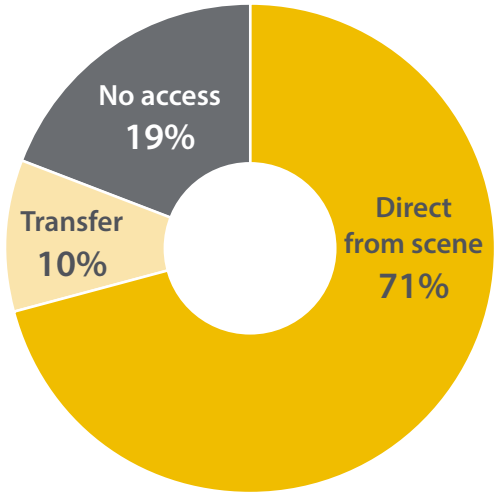
Northern



Midland



Central



South Island

CT scans provide the best tool for diagnostic imaging of head injury, and a fast time to CT is best practice. Time to CT was shorter for patients with impaired consciousness (GCS <or equal to 13) regardless of an anatomical head injury, than for those with a serious anatomical head injury (head AIS over or equal to 3, regardless fo GCS. This suggests the processes of care to enable fast CT scan should be reviewed in all hospitals.

Proportion of patients with impaired consciousness and anatomical sTBIs receiving an index CT within 2 hours 2019/20

	Under 2 hours	Over 2 hours	No CT performed
GCS < 14	81%	9%	9%
GCS 14–15	60%	31%	9%
sTBI	69%	25%	5%
No sTBI	62%	27%	11%

GCS = Glasgow Coma Score; sTBI = serious traumatic brain injury.

Median time (minutes) to index CT scan at first hospital for patients with impaired consciousness by region

Region	GCS 13 or lower	GCS 14 or 15
Northern	42	63
Midland	53	71
Central	72	91
South Island	52	95

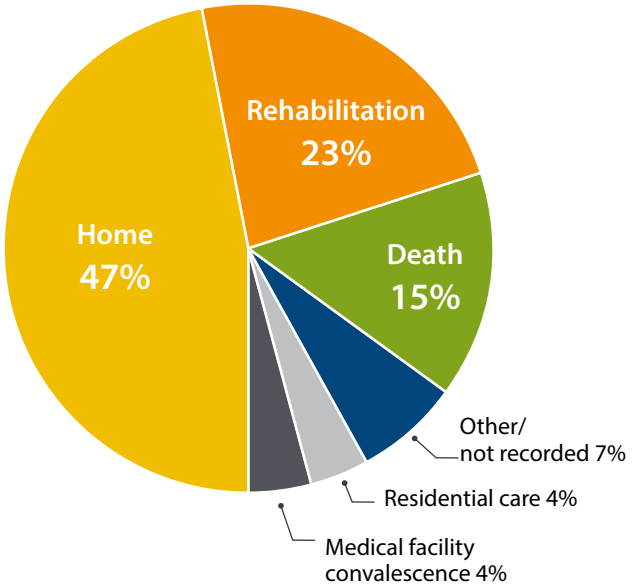
Time to CT is shorter for patients with impaired consciousness (GCS < 14), than for those with normal or close to normal consciousness (GCS 14–15). However, there is also considerable regional variation within these groups. For example, the median time to CT for patients with impaired consciousness in the Central Region is 72 minutes, 71% longer than in Northern region at 42 minutes. This variation shows there is room for improvement in the timeliness of CT scans.

There remains marked regional variation in time from injury to definitive care. This occurs both in terms of pre-hospital transport times, reflecting geographic differences between regions, and in-hospital times to transfer. The variation indicates there can be substantial delays in the transfer process, and therefore room for improvement.

Median time (hours) from injury to definitive care for patients with an anatomical serious head injury by region 2019/20

Region	Direct from scene	With transfer
Northern	1.3	9.5
Midland	2.0	9.0
Central	1.3	12.1
South Island	1.7	17.8
National	1.5	9.9

Discharge place for sTBI patients (excluding those with spinal injuries) 2019/20



sTBI = serious traumatic brain injury.

Photo: Waikato Westpac Rescue Helicopter – Philips Search and Rescue Trust

Dr Tony Smith

Whakaari White Island – 'the dramatic volcano'

New Zealand has had more than its fair share of mass-casualty events. In previous years, we have seen the Christchurch earthquakes, the mosque shootings and many bus crashes with multiple people injured and killed.

This year, in the early afternoon of Monday 9 December 2019, Whakaari White Island erupted with 47 people on the island.

Dr Tony Smith, Clinical Director of St John New Zealand and intensivist at Auckland City Hospital, was among the first ambulance crews called to respond. Arriving by helicopter to Whakatāne airfield and then subsequently to Whakaari White Island, the crews encountered a disaster unfolding. This is Tony's story.

The immediate response

As the helicopter cleared the Hunua Ranges the plume of smoke was visible and as they approached Whakaari White Island a large yellow river of sulphur cut through the sea. Visibility on Whakaari was intermittely obscured by smoke and steam; the landscape was smothered in a thick layer of grey and yellow ash; and they could see a tourist helicopter on the ground with its rotors broken. They circled the island several times to assess safety, and to agree on a landing place and an escape plan.

The helicopter landed on the beach and the clinical crew exited to be met by a wall of ash being swept up by the rotor. Waiting for the craft to depart 'seemed like an eternity' but was only seconds. Visibility soon returned but they were assailed by the toxic ash that attacked any exposed skin and their lungs and eyes, despite the protective equipment.

The only other people on the island were local tourist helicopter personnel and unfortunately all of the remaining people on the island were dead.

Mass casualty response in a small town

Leaving the island, Tony went to the Whakatāne airfield where patients had arrived via tourist helicopter, to the Whakatāne wharf where patients had arrived via tourist boat, and then to Whakatāne Hospital where patients were being staged. The scenes were all very busy, with significantly more badly injured patients than initially reported. Tony assisted the Whakatāne Hospital staff by coordinating the hospitals the patients would go to and the means of their

transport. A simple patient tracking system was set up using a spreadsheet to track the patients, their approximate age, approximate burn size, ventilated status, bed space, hospital destination and method of transport for each patient.

Multiple civilian ambulance helicopters, military helicopters, several fixed wing ambulances and road ambulance crews were assigned to evacuate patients from the small hospital to burn centres and other hospitals around the country.

Patients were assigned an evacuation priority, however, there was additional complexity with this due to the unique nature of the burns. The steam from Whakaari had a high sulphur and hydrofluoric acid content which, coupled with the velocity of the eruption, forced these elements deeply into the skin. This caused burns to continue burning even after irrigation. Further, the hydrofluoric acid binds with calcium and results in the patient becoming hypocalcaemic and hypotensive. Most patients needed vasopressors to maintain blood pressure despite generous intravenous fluid, and approximately half of the patients required intubation and ventilation for airway control or severe hypoxia. Stocks of ketamine, noradrenaline and meteraminol were nearly exhausted by the time the last patient left at approximately 7am, some 17 hours after the eruption.

The net effect meant the evacuation priority changed several times as some of the patients deteriorated faster and more severely than expected.

Coupled with managing pilot and crew hours, the range the aircrafts could fly, the clinical capability of the transporting crews, the capacity of the receiving hospitals, and only one helicopter being able to land at Whakatāne hospital after dark, the coordination of transport proved extraordinarily challenging.

Communication and patient tracking

Tony made over 150 calls, received around 150 calls and missed over 100 calls, over the 14-hour response. That was an average of 29 calls per hour, or about one every two minutes.

The majority of those calls were to the ambulance incident control point, hospitals, and air and road ambulance personnel to organise the evacuation of patients. A significant number were to his Deputy, Dr Craig Ellis, who was providing updates to the Ministry of Health and to DHBs.

The usual versus the unusual

The scale of the number of people injured and the severity of their injuries meant that some patients were transferred to hospitals that were not burn centres, and all burn centres had to receive well in excess of their usual capacity. The challenge of shifting trauma services from the 'usual' to the 'unusual' was achieved in some cases by simply saying that patients were on their way and they had to accept them.

Similarly, with pilot hours, many crew were required to exceed normal operating hours. There was simply no choice.

The aftermath

'I am not OK.' After decades of experience and facing emotionally challenging situations in his work as an intensivist and an ambulance service doctor, Tony thought he was immune to post-traumatic stress. However, several weeks after the incident he realised he was not OK and his mental health was suffering severely.

The psychologist he saw afterwards said it doesn't matter if it is a big or small event, there is an impact on everybody involved; expert help will never take away the memories but it does help people to work through the issues and recover.

The impact on the people of Whakātane has also been immense; many people were involved in the immediate response, and many experienced the deaths of friends and whānau. Many livelihoods have been impacted.

Lessons learnt

Patient tracking was very difficult. A simple, electronc, real-time patient tracking log that could be viewed by staff in the ambulance service, hospitals, and by people in other agencies like the Ministry of Health would be a relatively inexpensive, but very useful tool for mass-casualty events like this. Radio-frequency identification (RFID) technology plus cell phones and an app present opportunities to resolve this recurring theme in mass-casualty events.

Training on the known 'unknowns' should be available. The experience in New Zealand during the earthquakes, the mosque shootings and Whakaari White Island, and events elsewhere like the London and Manchester bombings, continually demonstrate there will always be known unknowns, and training for clinicians, first responders and central health agencies should accommodate this.

The 'unusual' must be accepted and this will mean services will have to accept patients beyond their normal capacity, and people will have to do things beyond their normal capability.

Acknowledgement

This annual report could not do justice to all those who responded to the Whakaari White Island disaster: from the tourism operators to the first responders, the air and road ambulance personnnel, the DHB personnel, central government agencies, the Australian and other international services who helped – we acknowledge your support. Thank you.

Pearl's story

Two years ago I had a car crash which left me disabled. It's been a slow recovery. I broke my arm, damaged my hand, and broke my leg. I have a rod in my leg, a rod in my arm, the arm has still not healed at the moment, it still needs a bone graft. And my back, I have scoliosis and arthritis in my lower back. Both knees now have arthritis.

Before the crash I had done Iron Māori, and I did a 2 km swim with my other sisters. It's 40 laps, so I trained for that. We joined Iron Māori to give us an incentive to do something physical.

I'm also the caretaker of my marae. After my crash I couldn't do it anymore, it stopped, I couldn't even go up there and I couldn't help in the kitchen with my hand. I'd just sit and feel pretty hopeless, so I just started staying away really most of the time.

Being in hospital was very hard, very very hard, laying there, day in and day out and having to get out of bed in the mornings with all the pain you're in. Apart from that the nurses were lovely, you get to know all the nurses personally, on a personal level, I was there for seven weeks.

Going home was stressful because if I didn't have my sister here to come home and look after me, I was having to go to a retirement home. And the choices that they gave me were Dargaville and Whangarei (both are about an hour away from where I live).

I was quite stressed about it, I worried about coming home… but my sister kept saying that she'd be there for me, so she took four weeks off work. So it was lucky, if it wasn't for having her, I don't know how I would have coped.

I'm back (at the marae) and I can't work all day, but I can do a little bit. I've got helpers now which is great. And if there's a tangi or something on, I'm always up there.

I've been through quite a bit, but I've come through it and now I can walk 4 kms or longer, now I can walk for an hour or on the beach, I can do everything on my own.

"I would like to acknowledge my whānau for their love and support throughout my recovery. A special thank you goes to my sister Maraea, who took 4 weeks off work to care for me when I left the hospital. Thank you to my support worker Wendy for making my life easier and pleasant. Tena koe Jeanette my Kaimanaaki from Te Hā Oranga for nurturing my wairua and just being there, tena koe."

Tena koutou katoa mo o koutou awhi me te aroha.
(Thank you all for your love and support)

Māori major trauma patterns

Equitable care for Māori is a central goal in health care, and an obligation on all health agencies under Te Tiriti o Waitangi.

Mechanisms of injury differ between Māori and non-Māori major trauma patients. Māori experience a greater proportion of car-related transport injuries, cutting/piercing/penetrating injuries, and struck by/collision with person or object injuries. Māori experience a smaller proportion of other transport injuries and falls. While the Māori population is younger on average than the general New Zealand population, similar patterns exist within older age groups as well.

Mechanism of injury for Māori and non-Māori 2015/16–2019/20

Mechanism	Māori	Non-Māori
Transport (car)	35%	25%
Transport (non-car)	21%	27%
Falls	18%	30%
Struck by/collision with person or object	12%	6%
Cutting/piercing/penetrating	7%	3%
Other (excluding penetrating injuries)	7%	8%

The higher rate of penetrating injuries in Māori translates to a higher proportion of in-hospital deaths from haemorrhage (15% of deaths for Māori, 11% of deaths for non-Māori from 2015/16-2019/20). The quality improvement project to reduce preventable deaths from haemorrhage will therefore have greater benefit for Māori.

In 2018/19, it was highlighted that Māori are more likely to be transferred to their definitive care hospital rather than directly transported from scene. The same pattern is repeated in 2019/20 (69% direct to definitive care for Māori, 81% for non-Māori). Māori are also more likely to have unplanned readmissions to hospital. The 30-day unplanned readmission rate for Māori in 2019/20 was 13%, higher than the rate for New Zealand European/Pākehā (11%) despite having a younger population.

Māori are also more likely to have unplanned readmissions to hospital. The 30-day unplanned readmission rate for Māori in 2019/20 was 13%, higher than the rate for New Zealand European/Pākehā (11%) despite having a younger population.

There are also many aspects of care that are not currently measured by metrics in the NZTR, and other aspects that are not readily measured in general. To address these areas, we are beginning projects to explore Māori experiences of trauma, to understand patient-reported outcomes of care, and improvement initiatives to improve rehabilitation following acute care.

Part 2: National Trauma Network report

National report

The National Trauma Network (the Network) aims to reduce mortality, improve the level of disability for those that survive trauma and create system efficiencies. The focus of our early work has been on pre-hospital and early hospital care, so the right patient goes to the right hospital at the right time.

Headline initiatives this year are the trauma team training and the critical haemorrhage project, which are both designed to reduce mortality and improve the processes of care in the resuscitative stages of care.

While immediate care post-injury will always continue to be a focus, we are also pleased to report that work is emerging to understand the rehabilitation phase of care and outcomes following trauma. Good trauma care does not stop on discharge from acute services, and the work we highlight in this report replicates world-class initiatives applied to New Zealand.

Here are the highlights across the four key areas of work articulated in the Network's Strategic Plan 2017–2022.[1]

[1] *New Zealand Major Trauma Network. 2017. Strategic Plan 2017-2022. Wellington: New Zealand Major Trauma Network. www.majortrauma.nz/assets/Publication-Resources/Strategic-Plans/Strategic-plan-2017-22.pdf*

1: Governance

The Network's contract with the Health Quality & Safety Commission to deliver key aspects of the strategic plan is fully operational and on track for delivery.

The regional trauma networks continue to evolve, although there is significant variance in their plans and resourcing.

The Network's governance group was reformed to provide a stronger clinical focus.

The NZTR's data governance group reviewed 20 submissions to use NZTR data for research, quality improvement, policy-making and data-sharing.

2: Service excellence

Trauma team training

Following successful pilots of a high-fidelity simulation course for trauma team training, a funding proposal for national roll-out to all major trauma hospitals was approved on a 50/50 basis by the 20 district health boards (DHBs) and Waka Kotahi NZ Transport Agency's Community Road Safety Fund.

The course will be held in emergency departments (EDs). It is based on real-life scenarios to identify practical steps to improve processes of care and communication between clinicians who do not typically work together but are expected to perform as a highly functioning team when treating critically injured patients.

The course will be implemented nationally over the next few years.

Critical haemorrhage

Outcomes for patients with critical haemorrhage in New Zealand are not as good as in similar jurisdictions. The critical haemorrhage project was set up to address this gap with the aim of reducing mortality and associated multi-organ failure from critical haemorrhage caused by trauma.

Led by Dr Kerry Gunn and supported by an expert advisory group, early work is progressing well to develop national guidance and a bundle of care for the massive transfusion protocol.

Rehabilitation

While New Zealand is in the fortunate position of universal cover for all major trauma patients (and others), we have limited understanding about the rehabilitation journey and if it is as good as it could be.

A rehabilitation project was set up to understand the key issues involved and develop solutions that focus on reducing unwarranted variation and improving access to the right services. The scoping phase is largely finished and a comprehensive workplan is in development and will guide the collaborative and delivery stages.

The rehabilitation project is being led by Kat Quick, a physiotherapist and expert at leading large and complex projects.

Māori experience of trauma

Māori have a higher burden of trauma than other ethnicities, yet we have limited understanding of their experiences from the point of injury through to rehabilitation.

The Māori experience of trauma project involves talking with young Māori from small and large centres across New Zealand about their experiences and developing a plan to support a strong kaupapa Māori approach to trauma care.

Sharon Pihema, of Ngāti Porou descent and with a background in population health and community engagement, is leading the project.

3: Enablers

New Zealand Trauma Registry

The new NZTR is single, web-based software platform that meets the extensive requirements of the sector. Dendrite Clinical Systems was appointed the software developer and host for the new NZTR following a successful open-market procurement process.

Developing a new platform during the COVID-19 pandemic presented numerous challenges, but it was delivered on time and to budget for implementation on 1 July 2020.

We would like to acknowledge the Midland Trauma System for its outstanding support during the first five years of the NZTR.

Patient-reported outcomes

Our current understanding of how well patients recover from their injuries is limited to whether they live or not, and survival is a very blunt measure of recovery.

A large project has been approved to survey major trauma patients at 6, 12 and 24 months post-injury with the aim of finding out unique information about major trauma patients and, importantly, improving the quality of their care. The University of Otago is contracted to deliver the survey, which begins on 1 July 2020.

Professor Belinda Gabbe, the academic lead for trauma, led the development of the patient-reported outcomes protocol based on her world-leading work in Victoria, Australia, which provides a unique and rich source of information about the long-term outcomes of trauma patients.

Workforce

The capacity of the trauma nursing workforce has increased, and more nurses are engaged in case management and quality improvement as well as data collection. However there is a persistent nurse shortage in key major trauma hospitals.

Several trauma nurses have completed, or are in the process of completing, their Master's degrees.

Three trauma clinicians have recently returned to New Zealand following fellowships in large trauma centres overseas.

The quality improvement facilitator course, delivered by Ko Awatea, has a focus on trauma and trains participants in improvement methodology; an appropriate project is undertaken as a core component of the course.

4: Research and analytics

Analytics has focussed on consolidating the reporting capability of the NZTR data through this report and providing the evidence base for our quality improvement work.

Work is underway to provide business intelligence to DHBs and regions on NZTR data and geospatial mapping of location of injury.

Detailed geospatial analysis is made available to the DHBs (by secure link) about the specific location of road traffic injury. This builds on previous work undertaken by the GeoHealth Laboratory at the University of Canterbury.

The collaborative Study of Road Trauma Evidence and Data (SORTED) is led by the Network and received full approval to continue on an ongoing basis. This is analysis of seven transport, police and health data sets, which provides a comprehensive view of the patterns of road trauma in New Zealand.

There is a good level of interest by academics to use the NZTR data for research purposes, however, the actual uptake has been disappointing. The Network is considering alternative approaches to stimulating academic research on the burden of injury in New Zealand.

Regional trauma network reports

Northern Region Trauma Network (NRTN)

Over the last year the Northern Region Trauma Network (NRTN) has endeavoured to consider the entire journey for the trauma patient and identify the touch points that could be better. For this reason the NRTN has expanded its membership to include rehabilitation specialists and is working to increase community and Māori representation.

A quality improvement initiative taken from a *Royal Australasian College of Surgeons, New Zealand Trauma System Review*[2] *(RACS review)* recommendation has also been launched this year to review preventable deaths regionally, including all haemorrhages and pre-hospital deaths attended by St John. Guided by this RACS Review recommendation we have invited a medical trainee to join the NRTN and we invite a trauma colleague from outside the region to participate in this quarterly review.

Over the last year the NRTN has identified where better communication is needed between the tertiary neurosurgery services and peripheral hospitals without neurosurgery capability, particularly in the management of moderate brain injuries. The NRTN has worked closely with key stakeholders and drafted a communication pathway to standardise how both neurosurgery specialist and acute allied health advice is provided to hospitals without a neurosurgery service. This pathway will be launched formally in the coming year.

2 Royal Australasian College of Surgeons, New Zealand Trauma System Review, 2017 www.nzta.govt.nz/assets/resources/new-zealand-trauma-system-review/nz-trauma-system-review-2017.pdf

Photo: Waikato Westpac Rescue Helicopter – Philips Search and Rescue Trust

Education is always a major focus for the NRTN and the ACC Incentive Fund has enabled us to support education in many different avenues. In the last year nurses attended the Injury Conference, the Australian Trauma Society Conference, the Trauma Nurse Core Course (TNCC), as well as the Abbreviated Injury Scale course, and National Trauma Training Day. The NRTN sponsored the Starship Trauma Education Evening for its third consecutive year, which enjoyed an audience with over 500 live and virtual attendances. After identifying the need last year for more external inpatient trauma nurse training, we drafted a pilot to host the online Trauma Care After Resuscitation (TCAR) course through a virtual classroom with our local subject matter experts guiding the course. We are excited to launch this pilot in the near future and aim to roll it out for more participants next year.

Overall it has been a very constructive year for the Northern Region. We have built strong foundations to support future quality improvements in the provision of rehabilitation, care for moderate brain injuries and increasing access to inpatient trauma nurse education.

Midland Trauma System

It was a busy year for the Midland Trauma System (MTS), with well over 7,700 admissions to our hospitals entered into the Midland Trauma Registry. We acknowledge the hard work put in by all those on the clinical line and behind the scenes working to optimise care for patients and whānau.

In 2019, the Midland Region experienced the Whakaari/White Island eruption, a major mass-casualty event that challenged our system and people. We saw extraordinary actions in a situation that tested our skills and processes. The staff at Whakatāne Hospital did an amazing job treating a large influx of critically injured patients, transferring in rapid time. Those who were transferred to Tauranga, Waikato and other tertiary and burns specialist facilities were met by full teams at the ready. As always there is a lot to learn from such events and we will be continuing to work with local and regional emergency services to turn these learnings into actions.

The experience of our clinical teams and analysis of the Midland Trauma Registry have shown significant inequities in the incidence of trauma affecting Māori. In line with priorities outlined in the Midland Regional Equity Action Plan, the MTS is developing collaborations with local and regional Māori health leaders to identify groups at risk and engage in community-centred education and injury prevention.

A strong focus this year has been reviewing our quality improvement frameworks and processes within each of the Midland Region DHBs to ensure there are clear and consistent structures in place to work through loop-closure of issues and quality improvement initiatives. Utilising the Midland Trauma Registry we are in a good position to apply the learnings from the Trauma Outcomes and Performance Improvement (TOPIC) course which was supported by the National Trauma Network in early 2019.

We have identified that many of our major trauma patients require further help in the transition from hospital to home after injury. The Waikato trauma reach clinic was set up to enable easy access of patients and whānau to trauma service personnel to assess needs and provide help and advice during this time. The clinic has proven to be successful for patients and staff, and the concept is expected to be expanded over the next two years.

Continuing on with our value of 'Patients First' and the research completed by our team in 2018, the MTS has been collecting patient and whānau experience of major trauma patients to identify where improvements in quality of care can be made. Evidence shows that patient experience is positively associated with better health outcomes, better use of health resources, better adherence to medication and treatments, and better use of preventative services. Several themes have been identified through this work and co-design has been undertaken with patients and whānau to identify opportunities to improve patient experience in these areas. Current co-design work underway includes: transition of care; development of patient diary; and improvements to the trauma reach clinic.

The Midland Trauma Research Centre published its strategic plan outlining our priorities for the next three years. It is built from our strong foundations and seeks to collaborate actively with others to achieve our research goals. We will continue to use the trauma data collected daily by our clinicians across the region to guide decision-making, provide quality clinical care and undertake the right research activity so that when injury does occur, patients get the right care, in the right place, at the right time.

ACC funds have been utilised for multiple trauma education and training opportunities including: TNCC, AIS, paediatric education evenings, attendance at national conferences and, more recently, participating in the Northern Region TCAR pilot.

Central Region Trauma Network

Adequate resourcing remains the key challenge within the Central Region. To help drive this, we have established a governance group consisting of the lead chief executive officer (Dale Oliff – Wairarapa DHB), lead chief operating officer (Lyn Horgan, MidCentral DHB), lead chief medical officer (Shawn Sturland, Wairarapa DHB), clinical lead (James Moore, Capital & Coast DHB) and nursing lead (Renate Donovan, Capital & Coast DHB).

This year we said farewell to Susan Hawken, clinical nurse specialist at Hawke's Bay DHB, as she moves on to be the nurse manager at Wairoa Hospital. Susan was the inaugural appointee to this role and was instrumental in improving trauma care and the trauma system for the people of Hawke's Bay – thank you, Susan, for all your work. We welcome Sharlene Olsen as the new clinical nurse specialist in Hawke's Bay and look forward to working with her.

Like much of the country, during the Covid-19 lockdown period trauma volumes have been lower than previously and a number of trauma staff were diverted off to other duties. We have rapidly seen trauma volumes return to baseline post-lockdown, however.

The major projects for the Central Region Trauma Network are improving the standardisation of trauma guidelines across the region and introducing a regional case review and audit process. We have been working with our DHB shared services provider to improve reporting for trauma clinicians across the region.

South Island Trauma Network

Trauma services in the South Island continue to work together through the South Island Alliance Major Trauma Workstream. The region is characterised by two large centres in Christchurch and Dunedin, and the Nelson/Marlborough region, which sits astride two trauma systems (South Island and Central).

COVID-19 saw a temporary decline in caseload of major trauma, however, numbers have rebounded quickly.

One impact of COVID-19 has been the cancellation of educational opportunities such as meetings, conferences and courses. This has made it difficult to spend ACC incentive funding tagged for sending several nursing staff to these activities. As a result we have had to rethink how we meet training and education needs.

Clinicians have provided input into the national critical haemorrhage project, and the option of local provision of blood and plasma during transport is being explored.

A review of the South Island destination policies has started as part of the broader national review of the trauma triage policy.

Trauma morbidity and mortality meetings have become embedded in many hospitals and have proven useful for addressing clinical and system issues and informing local guidelines.

A working group has been established to develop comprehensive data collection on all admitted trauma patients, utilising the South Island information systems. The principle is that data points are collected once and automatically added to the trauma registry.

The workstream has a vision to expand the trauma nurse coordinator role beyond data collection to enable more clinical contact, education and quality improvement. The trauma nurse coordinators continue to maintain their own regional network in support of the regional workstream and together we will work towards improved care for all.

Two training courses at Southern DHB have been held:

- Care of the trauma patient education for inpatient services at Dunedin and Invercargill
- Right Track programme, a community funded injury prevention initiative to improve road safety among young recidivist drivers, in collaboration with community, justice and health organisations.

Southern DHB provision of neurosurgical services remains tenuous, so acute trauma patients needing neurosurgical intervention are flown to Christchurch.

In Christchurch, work has focused on planning for trauma services at the new Christchurch Hospital in time for the move in November 2020. Two trauma surgeons have joined the team following fellowships overseas.

A research group has been established at Christchurch Hospital and many projects are currently underway. A study on post-traumatic stress disorder has begun, using a grant from the University of Otago, and ongoing follow-up with patients impacted by the Christchurch Mosque shooting continues. A drug study has been completed in partnership with ESR and the National Trauma Network. Blood samples were obtained from 300 patients who met the criteria for a trauma call, and the study results are pending.

The South Island Trauma Network has strong membership, plans and intentions, and is poised for another full year of progressing local, regional and national work.

Appendix A: Methodology

Data

As of 1 July 2020, the New Zealand Trauma Registry (NZTR) is hosted by Dendrite Clinical Systems and located at Canterbury DHB. This report coincides with the transition period where NZTR data is dually hosted in this new registry and the previous registry hosted by the Midland Trauma System. Extracts from both registries were combined to include all cases with an injury date between 1 July 2015 and 30 June 2020. Those injured between 1 July 2019 and 30 June 2020 were used in the analyses in this report, unless otherwise specified. It is possible that a small number of cases may not be included. For example, a small number of patients may have not yet been discharged from their definitive care facility at the time of data extraction, or the record may not have been submitted to the registry at the time.

Population estimates for each DHB by ethnicity, age and sex are custom projections produced by Statistics New Zealand specifically for the Ministry of Health from the 2013 Census with projections updated in 2019. The projections are based on prioritised ethnicity and take into account DHB-specific rates of fertility, mortality, migration and inter-ethnic mobility.

Population-based rates

Population-based rates are produced by dividing a number of events by the estimated population size for the area of interest, presented on a per 100,000 usually resident people per annum basis. Unless otherwise specified, the numerator of all such rates is defined by the location of definitive care, not by patient domicile. The interpretation of such rates is the annual number of major trauma patients given definitive care per 100,000 residents and does not imply patients are from the resident population.

Case fatality rate

The Royal Australasian College of Surgeons definition of the case fatality rate is the total number of deaths in the NZTR (ie, including ISS < 13) divided by the total number of major trauma cases in the NZTR (ISS ≥ 13). This is problematic because the inclusion of ISS < 13 deaths in the numerator without the inclusion of ISS < 13 cases in the denominator implies these are treated as 'never events'. However, the majority of such cases are medical deaths in patients aged 65 years and over, and as such other factors complicate their inclusion. We define the case fatality rate as the total number of major trauma deaths in the NZTR (ISS ≥ 13) divided by the total number of major trauma cases in the Registry NZTR (ISS ≥ 13). We discuss ISS < 13 deaths separately.

Standardised mortality ratio

The estimation of a standardised mortality ratio (SMR) requires a model to be built to take account of variation in mortality that is explained by factors external to the trauma system. There is a vast body of literature demonstrating that mortality varies with injury severity and type, patient age and other patient health factors such as presenting co-morbidities.

The SMR was modelled using a generalised additive model (GAM), predicting death at definitive care facility from:

- new Injury Severity Score
- first recorded pulse and systolic blood pressure
- first recorded Glasgow Coma Score total
- Age
- maximum head AIS score
- maximum vessels AIS score
- Charlson Comorbidity Index score
- injury type (blunt, penetrating, burn).

Missing data was handled through multiple imputation, with 20 imputed data sets. Models were compared using Akaike Information Criterion (AIC), and more complex models only retained if preferred by AIC. Other factors were considered, including patient ethnicity, sex and self-presentation to hospital, however they were not significant predictors of mortality and/or did not reduce model AIC.

The final GAM was used to predict probability of death for each case in the data set for ISS ≥ 13. The summed probabilities of death were used as an expected death count for contrast with observed deaths at each site.

Regional comparisons for the SMR exclude inter-regional transfers for definitive care.

Appendix B: RACS key performance indicators 2019/20

Case fatality rate (ISS ≥ 13)

	Northern	Midland	Central	South Island	National
2019/20	7.5%	7.7%	7.3%	6.4%	7.2%

Pre-hospital transport time to hospital in hours (ISS ≥ 13)

	Northern	Midland	Central	South Island	National
2019/20	1.4	1.8	1.4	1.9	1.6

Discharge destination 2019/20 (ISS ≥ 13)

	Northern	Midland	Central	South Island	National
Acute Care Facility	0%	0%	1%	0%	0%
Convalescence	9%	6%	1%	3%	5%
Home	65%	69%	70%	69%	68%
International Medical Facility	1%	1%	1%	2%	1%
Left Against Medical Advice	2%	2%	3%	2%	2%
Other	2%	5%	3%	3%	3%
Rehabilitation	18%	14%	18%	19%	17%
Residential Care	2%	2%	2%	3%	2%
Special Accommodation	0%	0%	1%	0%	0%

Median time in hours to CT for patients with impaired consciousness (GCS ≤ 13; ISS ≥ 13)

	Northern	Midland	Central	South Island	National
2019/20	0.7	0.9	1.2	0.9	0.9

Recording of blood alcohol concentration at first hospital

	Northern	Midland	Central	South Island	National
2019/20	79%	75%	63%	50%	67%

Time in hours in first hospital for patients transferred for definitive care (ISS ≥ 13)

	Northern	Midland	Central	South Island	National
2019/20	5.0	6.4	9.1	9.8	7.1

Time in hours in emergency department in first hospital (ISS ≥ 13)

	Northern	Midland	Central	South Island	National
2019/20	5.8	4.8	5.2	4.5	5.0

Appendix C: Published research on injury in New Zealand

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