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The incidence and risk factors of dog bite injuries requiring hospitalisation in New Zealand
Jonathan Mair, Natasha Duncan-Sutherland, Zachary Moaveni
The incidence of serious dog bites requiring hospitalisation in New Zealand has risen over the study period 2004–2014 and in comparison to earlier New Zealand studies over the previous two decades. Unfortunately the most vulnerable members of society (children under 10 and those from low socioeconomic areas) are also the most at-risk for these injuries. It appears that current New Zealand legislation has been ineffective in addressing the rise in this preventable public health issue.

Improving patient experience and outcomes following serious injury
Angela Beaton, Katrina O'Leary, Julie Thorburn, Alaina Campbell, Grant Christey
This study highlights perceived issues in the patient care pathway in the transition from inpatient to community-based care, especially communication and discharge information delivered by surgical clinical teams. Comprehensive inpatient care and clinical handover to primary care (rather than discharge planning processes) by dedicated clinical trauma services may provide more holistic models for surgical services to improve their influence on the transition of trauma patients into the community, assisted by organisation changes and support to enable effective service delivery. This is the first qualitative study to investigate the experience of Waikato Hospital (non-major) trauma patients and their families/whanau as they transition from inpatient surgical services to community-based care. The findings will inform system changes to support improved health, vocational and social outcomes for injured patients.

Incidence and outcomes of major trauma in New Zealand: findings from a feasibility study of New Zealand's first national trauma registry
Karol J Czuba, Paula Kersten, David Anstiss, Nicola M Kayes, Belinda J Gabbe, Ian Civil, Bridget Kool, Gareth Terry, Greta A Smith, Mahesweran Rohan, Alain C Vandal, Richard J Siegert
This paper aims to characterise the New Zealand major trauma (significant injury) population in terms of long-term disability and functional outcomes after major trauma. Our findings suggest that at 12 months post-injury the majority of participants in this study had made a good recovery in terms of disability, living situation and health. A sizeable group of survivors were still experiencing pain and problems with their usual activities 12 months post-injury, which suggests that not all major trauma survivors will follow the same trajectory of recovery. We found that approximately two-thirds of all injuries were traffic-related, while falls accounted for approximately a quarter of the injuries. The findings suggest that trauma registries are ideally placed to monitor long-term outcomes of trauma survivors, and can play an important role in reducing the impact of burden associated with major trauma.
Cycling-related injuries and cycling promotion: a trauma service perspective

Neerja Singh, Natalie Joe, Janet Amey, Alastair Smith, Grant Christey

Hospital admission volumes and rates are rising with underlying variation in patient demography, place and severity of injury. Current policy direction to grow cycling participation based on the health, environmental and economic benefits is ahead of the implementation of safer cycling infrastructure, creating a timing lag. From a regional hospital-based trauma service perspective, this timing lag needs due consideration if the full benefits of increasing participation are to be realised.

What is medicinal cannabis?

Michelle Glass, John C Ashton

If we are going to ask doctors to prescribe medicinal cannabis, shouldn't it meet the same safety and efficacy standards as other medicines? This article asks why we are inventing a whole new definition of a medicine just for cannabis.

An updated critique of the use of the Twin Spine Study (2009) to determine causation of low back disorder

Christopher B Walls, Andrew Snell, David J McLean, Neil Pearce

Many working people struggle after an episode of low back disorder because Accident Compensation coverage is withdrawn as their condition is blamed on genetic influences. The authors argue that the reliance on one genetic study (The Twin Study) for this stance is based on faulty epidemiology and is not valid.
This edition of the *New Zealand Medical Journal* has a focus on trauma. Previously this journal has published articles forecasting that we are now on the brink of having a high-quality trauma care.\(^1\) One benefit of a robust trauma reporting system is the research and audit it produces. An important part of the audit cycle is the review of data with a plan for improvement, then further audit/research in the future with, hopefully, an improved result.

An article by Mair et al\(^2\) reviews dog bite injuries in New Zealand. They have found that the incidence of dog bites are continuing to rise, especially in the vulnerable populations of children under 10, Māori and those with a higher deprivation score. To use the audit cycle it would be wonderful to see a future study reviewing some public health strategy that was put in place following the results of the Mair article, which would hopefully lead to a decrease in rates of dog bites. Mair et al suggest that a comprehensive review of dog control is needed along with a public health prevention strategy.

A similar article with a public health strategy is from the Midland Trauma System. Singh et al\(^3\) reviewed cycle-related injury in the Midland region. They found that cycle-related injuries are rising with increased admission volumes. They feel that the current policy of trying to grow cycle participation is ahead of implementation of safety programmes for cyclists.

Two other articles then focus on the outcomes of trauma for the patients. The first by Czuba et al\(^4\) reviewed 112 patients admitted in the Auckland region with major trauma over an 18-month period. They found most had made a good recovery but there is still a large proportion of patients suffering disability, pain and who are unable to return to paid employment at 12 months. They conclude that we must use our trauma registries to follow patients and monitor long-term outcomes. As suggested by the authors, further studies need to look at a return of normal or modified ADLs and a return to work.

The second article looking at outcomes by Beaton et al\(^5\) comes from the Midland region and is a qualitative study which used a semi-structured interview process to review perceived outcomes following trauma. We now are achieving world-class mortality rates for our major trauma patients, but for all admitted trauma patients what are our outcomes? This paper shows that there are perceived issues occurring for patients, with limited access to psychological services being a prime example. Beaton et al propose that a dedicated trauma service may be able to address some of these issues better than sub specialities which focus on the one injured body system. This may work in the hospitals with an established trauma system such as Waikato, but most other hospitals do not have such an established and resourced system. Good-quality research which shows a benefit for an established trauma service may be useful to push other hospitals to get the funding they require to better staff and resource trauma services in their regions.

The other article of interest is a review of the epidemiology of mass fatality in New Zealand. Wilson and Thomson\(^6\) point out that the 15 March terror attack is the single worst mass shooting event in New Zealand’s history. They however report this quite prematurely, being less than a month down the line with severely injured patients still in hospital, many looking towards a long recovery and no account of the indirectly injured. The Christchurch community and hospital system are still in the process of reviewing the events of that day and the subsequent and ongoing care needs of the patients, their families and the wider community. The editorial from Baddock last month\(^7\) nicely outlined...
the feeling of the whole community. There is still a lot more work ahead as inpatients and outpatients are needed. In particular the mental health stress will be very high for some time for patients, health professionals and the whole community.

The New Zealand trauma system as a whole has made vast improvements in the last few years. We need to continue to report trauma outcomes as these papers have outlined, and then make changes to improve outcomes.

Competing interests:
Nil.

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The incidence and risk factors of dog bite injuries requiring hospitalisation in New Zealand

Jonathan Mair, Natasha Duncan-Sutherland, Zachary Moaveni

ABSTRACT

AIM: This retrospective cohort study aims to describe the incidence of dog bite injuries requiring hospitalisation across New Zealand in the 10-year period between 2004 and 2014.

METHOD: The National Minimum Dataset (NMDS) was used to collate information from public and private hospital discharges for publicly funded events in New Zealand with the external cause of injury code W54.0 (Bitten by Dog) during the period of 1 July 2004 to 30 June 2014. Information regarding potential risk factors and indicators of severity was also collected.

RESULTS: From 2004 to 2014 there were 4,958 dog bites requiring hospitalisation in New Zealand, giving an overall incidence of 11.3 (11.0–11.6) per 100,000 people per annum, representing 496 events per year on average. The average length of stay in hospital was 2.5 days (SD = 3.5 days). The overall incidence has been rising during this period from 9.7 (8.8–10.7) per 100,000 population per annum in 2004 to a peak of 12.3 (11.3–13.4) per 100,000 in 2013/14. The highest risk factors were identified as children under the age of 10 years, Māori and those with a higher deprivation score. In cases where the scene of injury was recorded, 69% occurred at a private residence or property. Head and neck bites were increasingly common in younger age groups, with 78% of the 0–4 year age group and 63% of the 5–9 year age group injured in the head/neck region. Upper and lower limb bites were increasingly common in older age groups.

CONCLUSIONS: The incidence of dog bite injuries requiring hospitalisation has continued to rise in comparison with previously published rates in New Zealand. Additionally, more vulnerable population subgroups have been identified who are most likely to require hospitalisation.

In 2014 there were 531,158 registered dogs in New Zealand.¹ There are many potential benefits of dog ownership,²,³ however, dog bite injuries can cause significant morbidity, and be difficult to treat.⁴ International studies show a significant burden of disease from dog bites in the US,⁵,⁶ UK⁷ and Australia.⁸ Additionally, the physical and emotional impact can be long-lasting,⁹,¹⁰ particularly in children who are over-represented as victims of dog bite injuries.¹¹,¹²

Figures from the Accident Compensation Corporation (ACC) show that there were 99,003 claims for dog-related injuries in New Zealand during the period 1 July 2005 to 30 June 2014.¹³ However, rates of dog bite injuries requiring hospitalisation in New Zealand have not been monitored since a study by Marsh et al in 2004.¹⁴ This study aims to describe the incidence of dog bite injuries requiring hospitalisation in New Zealand between July 2004 and June 2014.

Methods

Search strategy
Data was obtained from the New Zealand Ministry of Health (NMDS).¹⁵ This is a collection of public and private hospital discharge information for publicly funded events in New Zealand. It includes discharges from hospital admissions, stays in an emergency department for three hours or more, or when a patient dies in an emergency department. We identified all hospital
discharges with the primary external cause of injury code W54.0 (Bitten by Dog), as per the Australian Modification of the 10th revision of the International Classification of Diseases, during the period of 1 July 2004 to 30 June 2014. All discharge records with a W54.0 external cause of injury code were included. The code W54.8 (Other Contact with Dog) was introduced on 1 July 2002. Therefore, we have assumed that patients with the code W54.0 were bitten by a dog as opposed to sustaining other types of dog-related injuries. In cases in which there was more than one event submitted against an individual patient identification number, all events apart from the earliest submission were removed.

Differences in reporting of short stay emergency department (SSED) events from district health boards around the country prior to 2012/13 meant that the incidence rates could not be reliably reported with these included. Therefore, all SSED events were removed from the entire study period as per Ministry of Health recommendations.16 Short stay events are defined as any hospital discharge where both the length of stay is zero or one midnight spent in hospital, and the hospital specialty code is M05, M06, M07 or M08, which refer to emergency medicine or adult intensive care.

Data extraction
Information regarding potential risk factors was collected for each unique event, including patient demographic information (ethnicity, age, gender, domicile) as well as the scene of injury and the season in which it occurred. Information regarding dog breed was not included, as it was rarely recorded, and can be inaccurate. Information about the incidence per DHB was not included, as it was difficult to get population data for the DHBs to calculate incidence.

Patient ethnicity was recognised as an important risk factor, and was defined as Māori, Pacific Peoples, Asian or Other.

Patient domicile codes were used to assign a Deprivation score, based on the New Zealand Deprivation Score 2006 (NZ Dep 2006). The NZ Dep 2006 score considers dimensions of deprivation for areas in New Zealand including income, home ownership, employment, qualifications, living space and access to a telephone and car.17 Population estimates for incidence calculations were taken from Statistics New Zealand.18-20

Information regarding the severity of the events was also collected, including the length of hospital stay, location of injury on the body and the number of general anaesthetics used. We were unable to obtain data regarding local anaesthetic procedures. The location of injury on the body was determined using the diagnosis codes relating to head/neck, upper limb, thorax/abdomen, lower limb or multiple (two or more body regions).

Statistical analysis
Given the difference in age distribution between different ethnicities in New Zealand, annual incidence rates for the total population and individual ethnicities were age-standardised to allow comparison. World Health Organization recommendations were used for this standardisation.21 Relative risk was calculated to compare the age-adjusted annual incidence rates for each ethnicity group to the Other (reference) category. The incidence rates per year in the study as well as per age group were also calculated. The Mid-P exact test was used to calculate 95% confidence intervals. The subsequent relative risk calculations were then performed using the year of 04/05 and the 25–59 year-old age group as the respective reference groups. The Byar method was used to calculate the 95% confidence intervals.

The programmes OpenEpi (Dean AG, Sullivan KM, Soe MM. OpenEpi: Open Source Epidemiologic Statistics for Public Health, Version. www.openepi.com, updated 2014/09/22), SPSS version 19 (SPSS, Chicago, IL), and Microsoft Excel version 14.0 (2010 Microsoft Corporation) were used for statistical analysis. The level of significance was set at p<0.05.

Results
From 2004 to 2014 there were 4,958 dog bites requiring hospitalisation in New Zealand, with an overall incidence rate of 11.31 (10.98–11.64) per 100,000 people per annum. The incidence rates per financial year is given in Figure 1.
The incidence in 2004/2005 was 9.72 (8.79–10.71) per 100,000 people. This was relatively stable until 2010/2011 when the incidence was significantly higher at 11.83 (10.85–12.88) per 100,000 people, RR = 1.22 (1.07–1.39). The incidence remained elevated after 2010/2011 and peaked in 2013–2014 [12.29 (11.29–13.35) per 100,000 people; RR = 1.27 (1.11–1.44)].

We found a seasonal variation in dog bite admissions with 1,425 (30.9%) injuries occurring in the summer and 956 (20.7%) occurring in the winter months. Similar numbers of injuries occurred during the spring (1,110, 24.1%) and autumn (1,122, 24.3%) months.

### Risk factors

Māori had the highest incidence [21.28 (20.71–22.40) per 100,000 people per annum], with significantly greater relative risk [RR = 2.21 (2.04–2.40)] than for the Other ethnicity [9.62 (9.23–10.01) per 100,000 people per annum]. The age-adjusted incidence rate was lowest for Asians [1.81 (1.38–2.24) per 100,000 people per annum; RR = 0.19 (0.17–0.21)].

The incidence rates for each gender are demonstrated in Table 2. Male patients were more commonly admitted to hospital with a dog bite injury [RR = 1.43 (1.35–1.52)].

### Table 1: Age adjusted incidence rates per 100,000 people per annum (95% Confidence Interval) by ethnicity.

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Count (%)</th>
<th>Age-adjusted incidence rate per 100,000 people per annum (CI)</th>
<th>Relative risk (CI)</th>
</tr>
</thead>
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<tr>
<td>Total</td>
<td>4,613</td>
<td>11.31 (10.98–11.64)</td>
<td>---</td>
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<tr>
<td>Māori</td>
<td>1,466 (31.78)</td>
<td>21.28 (20.16–22.40)</td>
<td>2.21 (2.04–2.40)</td>
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<tr>
<td>Asian</td>
<td>76 (1.65)</td>
<td>1.81 (1.38–2.24)</td>
<td>0.19 (0.17–0.21)</td>
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<tr>
<td>Pacific Peoples</td>
<td>364 (7.89)</td>
<td>12.72 (11.39–14.05)</td>
<td>1.32 (1.17–1.50)</td>
</tr>
<tr>
<td>Other</td>
<td>2,631 (57.03)</td>
<td>9.62 (9.23–10.01)</td>
<td>1.00 (Ref)</td>
</tr>
</tbody>
</table>

### Table 2: Incidence rates per 100,000 people per annum (95% Confidence Interval) by gender.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Count (%)</th>
<th>Incidence rate per 100,000 people per annum (CI)</th>
<th>Relative risk (CI)</th>
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<tr>
<td>Male</td>
<td>2,672 (57.9)</td>
<td>12.68 (12.20–13.17)</td>
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<tr>
<td>Female</td>
<td>1,941 (42.1)</td>
<td>8.86 (8.48–9.26)</td>
<td>1.00 (Ref)</td>
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Figure 2 demonstrates incidence rates for each age group. We found that the 0–4 year [22.69 (21.03–24.44) per 100,000 people per annum] and 5–9 year [18.45 (16.94–20.06) per 100,000 people per annum] age groups were at the highest risk for dog bites requiring hospital admission. The incidence rate plateaued after 10 years of age.

The incidence rates expressed across the NZ Dep 2006 deprivation scale are displayed in Figure 3. The areas with the highest deprivation score (most deprived areas) had a significantly higher incidence [22.63 (21.23–24.10) per 100,000 people per annum, RR = 4.56 (3.94–5.28)] in comparison to the areas with the lowest deprivation score [4.97 (4.34–5.66) per 100,000 people per annum].

The scene of injury was recorded in 54% of instances, and of these 69% occurred while the patient was at a private residence or property.

Figure 3: Incidence rates per 100,000 people per annum expressed across New Zealand deprivation 2006 (NZ Dep 2006) scores.

1 = Least Deprived, 10 = Most Deprived.
Severity of events

The average length of hospital stay was 2.47 days (SD = 3.50 days), with 66% of patients requiring a general anaesthetic, and 15% of these requiring more than one.

The location of injury on the patient’s body shows clear patterns based on age group (Figure 4). Seventy-eight percent of the 0–4 year age group and 63% of the 5–9 year age group were injured in the head/neck region. This figure declines to 40% in the 10–14 year age group and 13% in the 15–19 year age group. Only 9% and 5% of the 20–59 year and 60+ year age groups were bitten on the head/neck, respectively. As the injuries to the head/neck region decline with increasing patient age, the injuries to the limbs increase. The upper limb is the most common site of injury in the 25–59 year (55%) and 60+ year age groups (55%). The upper limb was the second most common site of injury in the 0–4 year (12%) and 5–9 year (15%) age groups. The thorax/abdomen was rarely bitten with only 45 (1%) patients in total injured here. There were 23 (0.5%) patients in which a location was not recorded.

Discussion

We found an overall incidence of 11.31 (10.98–11.64) per 100,000 people per annum admitted to hospital with a dog bite injury in New Zealand. This represents on average, 496 events per year, and is a rate higher than previously published New Zealand data.\textsuperscript{14,22} and in comparison to the inpatient rates for dog bite injuries in the UK,\textsuperscript{23} US\textsuperscript{6} and Australia.\textsuperscript{24} While this may be partly due to differences in data collection and reporting, there is clearly a high burden of care created by dog bite injuries in New Zealand.

We have focused on dog bite injuries severe enough to require hospital-level admission and treatment. Other studies have shown dog bite injuries requiring hospitalisation represent a small proportion of all dog-related injuries.\textsuperscript{25–26} Therefore while the current study population represents the most serious bites, the true incidence of dog bites in New Zealand is likely to be much higher than is shown here. Data from ACC shows the number of people registered for medical attention after injury by a dog (“bitten/kicked/buttoed”) was 99,003 over the last nine years.\textsuperscript{13} A further limitation of our study is that only one discharge per patient was chosen, again likely under-representing the true incidence of dog bite hospitalisations. The incidence increase may also be due to an increase in the number of dogs owned, however it was not possible to ascertain this, as dog control statistics have only been recorded from 2013.

The incidence of dog bite injuries admitted to hospital is highest in younger patients. This is in line with international studies.\textsuperscript{11,12,23} Children were more likely to be bitten on the head/neck, whereas adults were more likely to be bitten on their limbs. This is very concerning, given that injuries to the head and neck are likely to be more serious and
life-threatening than limb injuries. It also suggests that dog bite prevention strategies should focus on children.

Dog bite injuries were more likely to occur at a private residence or property. It is therefore likely that dog bite injuries are inflicted by dogs known to the victims. This is also a factor to be considered when dog bite prevention strategies are being explored.

The NZ Dep 2006 score was referenced against each patient's domicile area, showing a strong association between higher depravity score and incidence of dog bite injuries (Figure 3). This is similar to international findings with areas of lower socioeconomic status experiencing a higher incidence of dog bite injuries.24,27 Strong trends are also present in ethnicity group analysis, with Māori having the highest incidence and Asian patients the lowest. The reasons for this are unclear and may represent different dog ownership rates or attitudes towards education and behaviour around dogs. We did not explore the relationship between ethnicity and socioeconomic status. Further study in this area would be helpful and intervention to lower dog bite rates might be best targeted to those most at risk of dog bite injuries.

To address this concerning issue, a comprehensive review of our national legislation of dog control is required, along with a review of what other dog bite prevention strategies might be effective.

Conclusions

We have found that the rate of people being admitted to hospital in New Zealand with a dog bite injury is high. Children under the age of 10 years are most at risk as are Māori, males and those from areas with a higher deprivation score. We are highlighting an ongoing and growing public health issue to prompt meaningful conversation and action to reduce this preventable and devastating injury.
REFERENCES:


Improving patient experience and outcomes following serious injury
Angela Beaton, Katrina O’Leary, Julie Thorburn, Alaina Campbell, Grant Christey

ABSTRACT

AIM: To explore injured patients’ experiences of care to identify areas for improvement in routine service delivery from surgical teams in the transition from inpatient to community-based care.

METHODS: Qualitative study drawing on 17 in-depth, semi-structured interviews, conducted from 1 October 2017 to 31 November 2017, with trauma patients (and patient-nominated key support people and health or social care professionals) registered by the Midland Trauma System Registry (New Zealand).

RESULTS: All patient respondents had been under the primary care of surgical sub-specialty teams at Waikato Hospital rather than the specialised trauma service that primarily cares for patients with major multi-system trauma. Patients perceived their pre-hospital and emergency care as high quality and highly valued the compassion of staff during their inpatient phase of care. Exceptions were the perception of communication gaps across the spectrum of care from admission to discharge and beyond, limited access to psychosocial services to manage ongoing psychological trauma and a lack of preparedness for discharge. Following discharge, respondents reported the high level of reliance on key support people, inadequate information provision about what to expect in relation to the journey through the health system after discharge, and a lack of coordination of post-discharge care.

CONCLUSION: This study highlights perceived issues in the patient care pathway in the transition from inpatient to community-based care, especially communication and discharge information provided by surgical clinical teams and Accident Compensation Corporation (ACC). Comprehensive inpatient care and clinical handover to primary care (rather than discharge planning processes) by dedicated clinical trauma services may provide more holistic models for surgical services to improve their influence on the transition of trauma patients into the community, assisted by organisation changes and support to enable effective service delivery. Specifically, trauma patients and their carers perceived the need for better screening and treatment for psychological trauma in the inpatient and outpatient setting; better information exchange prior to the transition from inpatient to primary care; more convenient and accessible follow-up services including a single point of contact for coordination of post-discharge care; and acknowledgement and practical support to relieve the significant and pervasive carer burden identified in this study. These findings provide the opportunity to implement focused system changes to provide more equitable and effective support in the transition to community care and beyond. The end result will be better experiences for patients and whānau, and improved health and vocational outcomes following serious injury.

ARTICLE

A trauma system is an organised, coordinated effort in a defined geographic area, which delivers the full range of care to all injured patients, and is integrated with the local public health system with a focus on prevention.1 Injured patients have the best chance of making a good recovery if the trauma system performs well and is effectively integrated into wider health and social care systems, leading to lower mortality rates, reduced lifelong disability and improved quality of life, with demonstrated cost savings to the health system.
Serious injury means that the patient met the eligibility criteria for the study and was admitted to Waikato Hospital with the possibility of long-term functional deficit. Eligible patients had complex injuries; that is, they experienced injuries to two or more body regions or one significant injury to one body region with the possibility of long-term deficit. Qualitative studies of patient and whānau experience following serious injury are few, with most focusing on traumatic brain and spinal cord injuries. This is the first qualitative study to investigate the experience of Waikato Hospital trauma patients and their whānau as they transition from inpatient surgical services to community-based care. The findings will inform system changes to support improved health, vocational and social outcomes for injured patients.

Methods

Setting

Patients were identified through the Midland Trauma System’s population-based trauma registry, which captures data on major and non-major trauma patients admitted to six hospitals within the Midland region of New Zealand. The MTS registry has the following eligibility criteria (Midland Trauma System, n.d.) and can register over 200 data points related to each major trauma event:

- MTS registry inclusion
  - Admission to a Midland hospital as a result of and within seven days of injury
  - Death in hospital as a result of injury
- MTS registry exclusion
  - Trauma patients discharged from the emergency department
  - Injuries from documented pathological processes
  - Isolated peri-prosthetic fractures
  - Exertional injuries
  - Hanging/drowning/foreign bodies without anatomical injury
  - Poisoning
  - Patients admitted primarily for pre-existing medical conditions not directly as a result of injury

Sampling strategy

The following patients were eligible to participate:

- 16 years of age or above
- Injury Severity Score (ISS) equal to or above 8
- Blunt trauma mechanism
- Waikato Hospital as the definitive acute care provider
- Waikato district domicile patient

Exclusion of injury within the Abbreviated Injury Scale (AIS) body region 1 (head/neck). The AIS is an anatomical scoring system that grades injuries on a scale of 1 to 6 to assess the potential for risk to life; an AIS score of 1 is minor and 6 is reflective of a non-survivable injury.

A heterogeneous purposive sample of all eligible patients was used to target sample diversity across gender, age and ethnicity. A total of 17 participants were recruited to the study, including eight patient participants (up to 12-months post-discharge), eight patient-nominated key support people, and one patient-nominated health professional (an occupational therapist). Only one patient participant felt able to nominate a health or social care professional involved in their care. Participants provided consent prior to interviews and were informed that the interview questions may raise issues that could cause distress. If this occurred, the distressed patient protocol was applied, and participants were provided options for follow up.

Ethics approval was gained from the Health and Disability Ethics Committee NZ (HDEC), and project approval provided by Te Puna Oranga Maori Consultation Research Review Committee, Waikato District Health Board.

Data collection

A total of 17 participants participated in semi-structured, in-depth interviews rather than focus group, to enable participants to speak freely about their experiences and perceptions. Kanohi ki te kanohi (face to face) interviews were offered to encourage trust, which is critical to engagement and relationship development with Māori. The interviewer was not known to the participants. The purposive sampling was done...
by an MTS hub data analyst and details of potential patients were kept confidential from the researchers and interviewer. Participants were recruited to the study and interviewed until saturation occurred (which was earlier than anticipated). Saturation occurred when the same themes were recurring, and no new insights into these themes were given by additional sources of data. Patients were invited to participate in one interview (by telephone or kanohi ki te kanohi) up to 12 months post-discharge. All interviews were conducted between 1 October 2017 and 30 November 2017. Interviews were recorded with participant consent using a digital voice recorder. A topic guide (Appendix) was used to provide interviewer prompts of key issues for exploration, including the injury; treatment of the injury; experience with compensation agencies; impact on work life, home life, transport and health; communication and cultural needs; and perception of recovery.

Data analysis
Each interview was transcribed from the audio recording for analysis using the NVIVO Version 8.0. Braun and Clarke’s six-phase process of thematic analysis was used to identify important thematic groupings and the relationships between them. Transcripts were read a number of times to ensure consistency of meaning of individual responses, initial codes were given within each interview, then compared and integrated across the entirety of the transcripts enabling theme development (AB and KO). Two researchers coded the data and confirmed the themes to ensure the thematic analysis was authentic and of good quality. AB is an experienced health services researcher (PhD) with extensive health services research experience in areas other than trauma and critical care; KO is an emerging researcher and registered nurse (RN, MN, Crit Care) with 30 years’ experience working intensive care, emergency department and remote area nurse in Australia and New Zealand. Larger, broader themes developed and were able to be described and labelled. Participant quotes were included to illustrate patient experience themes post serious injury.

Results

Participant profiles
The ages of patient participants ranged from 16 to 79 years (Table 1). All patient participants nominated a key support person; however, of the eight patients interviewed up to 12 months post-discharge, all but one could not identify who was responsible for their care coordination following discharge and were therefore not able to nominate a health or social care professional to participate in an interview. The one patient-nominated health professional was an occupational therapist.

Patients perceived their pre-hospital and emergency care as high quality and highly valued the compassion of staff, although expressed concerns regarding access to psychosocial services, reliance on key support people, poor communication and information provision and a lack of preparedness for discharge, and coordination of post-discharge care.

The need for routine screening and access to psychosocial services
All patients perceived ongoing physical and emotional stressors associated with the initial traumatic impact, regardless of the time since discharge. Several patients reported hiding their physical and emotional concerns from their key support person to avoid upsetting them, which added to the sense of isolation they were already feeling. Ongoing effects such as pain, fatigue, reduced memory, emotional instability, physical decline and financial pressure caused concern for the future and the unknown likelihood of returning to pre-accident health. Some patients returned to work earlier than they should have, misrepresenting their recovery to their doctors in order to get clearance for work.

“As soon as I got the clearance I just went back, even though… I still can’t close my fingers properly. I’m forcing myself to squeeze it and just do my jobs. I needed that money because I had bills to be paid… I just felt hopeless. Because I couldn’t support my family or do anything for them.”

– Steven
Patients, their key support people, and the nominated service provider all stated that earlier access to psychological care or counselling could have avoided escalating issues and concerns regarding restoration of function.

“... I would have much preferred earlier access to counselling. It still would have been difficult after hospital, but it probably would have shortened the amount of time [for recovery]. I wouldn’t have lost a lot of my life... lost a lot of dignity, all that sort of stuff. ...I was in a really, really dark place and I was quite suicidal for a long time.”

– Elizabeth

Improved access to counselling services following routine psychological screening initiated in hospital, was one of the practical recommendations suggested by patients and key support people to improve the patient experience following serious injury.

**Pivotal role of the key support person**

All patients were highly appreciative of the support provided by key support people and the crucial role they played in recovery, stating their key support person was the primary factor that facilitated recovery. Recognition was afforded to the key support person for preserving order during a perceived tumultuous time and maintaining communication with everyone; family, friends, (in some cases) the media and service providers.

### Table 1: Patient participant demographics.

<table>
<thead>
<tr>
<th>Patient participant pseudonym</th>
<th>Gender</th>
<th>Ethnicity</th>
<th>Age range</th>
<th>Timeframe since discharge from hospital</th>
<th>Mechanism of injury</th>
<th>Patient reported injuries</th>
<th>Key support person relationship to participant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hailey</td>
<td>Female</td>
<td>NZ European</td>
<td>46–60</td>
<td>6 weeks</td>
<td>Fall</td>
<td>Liver laceration, fractured ribs, punctured lung</td>
<td>Friend</td>
</tr>
<tr>
<td>Tina</td>
<td>Female</td>
<td>NZ European</td>
<td>31–45</td>
<td>6 months</td>
<td>Workplace incident</td>
<td>Fractured ribs, punctured lung</td>
<td>Sister</td>
</tr>
<tr>
<td>Elizabeth</td>
<td>Female</td>
<td>NZ European</td>
<td>16–30</td>
<td>6 months</td>
<td>Road traffic crash</td>
<td>Multiple fractures (arms, legs, pelvis), kidney injury, concussion</td>
<td>Partner</td>
</tr>
<tr>
<td>Mike</td>
<td>Male</td>
<td>NZ European</td>
<td>46–60</td>
<td>6 months</td>
<td>Fall</td>
<td>Fractured ribs, punctured lung</td>
<td>Wife</td>
</tr>
<tr>
<td>Steven</td>
<td>Male</td>
<td>Māori</td>
<td>46–60</td>
<td>12 months</td>
<td>Road traffic crash</td>
<td>Multiple fractures (ribs, pelvis, fingers), concussion</td>
<td>Wife</td>
</tr>
<tr>
<td>Belinda</td>
<td>Female</td>
<td>NZ European</td>
<td>&gt;61</td>
<td>6 weeks</td>
<td>Workplace incident</td>
<td>Limb amputation</td>
<td>Husband</td>
</tr>
<tr>
<td>Karen</td>
<td>Female</td>
<td>NZ European</td>
<td>&gt;61</td>
<td>6 weeks</td>
<td>Fall</td>
<td>Multiple fractures (nose, compound fracture of leg and wrist)</td>
<td>Friend</td>
</tr>
<tr>
<td>Joe</td>
<td>Male</td>
<td>NZ European</td>
<td>&gt;61</td>
<td>12 months</td>
<td>Fall</td>
<td>Fractured ribs</td>
<td>Wife</td>
</tr>
</tbody>
</table>

...
“I just felt hopeless. Because I couldn’t support my family or do anything for them. Everything (was left) up to our eldest daughter. She did a wonderful job. Without her and my sister-in-law... they’ve done wonders. Kept the family all intact, let them know what’s happening. It was quite amazing.”

– Steven

All patients were concerned with the concept of carer burden, as often the key support person would have to assume the extra financial obligations, home responsibilities, carer duties, become the patient’s champion when dealing with service providers, and preserve the memory of events patients were often unable to recall due to analgesia and/or turmoil during the acute hospital phase.

Inadequate communication and information provision

The quality of patient care is improved when members of the healthcare team work in collaboration to share their patient care perspectives, yet many barriers exist that can obstruct a team-based system. While all participants were satisfied with the overall care they received during their admission and were highly appreciative of the pre-hospital and emergency care they received, all participants shared concern regarding communication during rehabilitation (in-hospital and at follow up clinics).

“The biggest problem was communication from day one. The ambulance were brilliant, the trauma team [emergency department staff] were brilliant and then it turned to custard, to put it politely. There just hasn’t been any follow up...”

– Karen

A lack of staff continuity also contributed to feelings of insecurity from being lost in the system, and unfamiliarity with staff contributed towards a perception of confusion as to who was caring for them and in what capacity.

“In the hustle and bustle of the weeks at hospital things got overlooked... you’d go through three or four shifts of nurses and think have any of them reminded (her) to do that.”

– Sibling, key support person

Reported lack of communication both in hospital and at follow up clinics, resulted in missed (minor) injuries, and some delays in treatment, which patients and key support people felt affected their confidence in the care received and recovery time.

Lack of preparedness for discharge

Communication surrounding discharge processes was described as a significant concern and the discharge process itself was felt to be ad hoc rather than meeting patients’ expectations of a meticulously considered practice. Almost all patients reported distress when medical staff sought discharge as they reported no prior discussions with them about going home. Discharge was generally required on the day and did not always acknowledge and address home conditions and the provision of discharge supports. Patients and key support people reported that discharge from hospital was perceived as stressful, and many felt ill prepared for discharge. All reported apprehension at the perceived lack of discharge planning. Key support people were alarmed at the thought of the responsibility of caring for their family member without adequate resources as they had expectations of being supplied with equipment, which may have been eased through referral to allied health to assist with discharge planning.

“There was a bit of... we’ll just push you out the door and you can go home ...because (my husband) wouldn’t have been able to look after me and there was the conversation of is there anyone at home that can look after you and I was like well not really ...if I’m in trouble he’s not really going to be there to help me out. I explained to them my house... is... old... and I’ve got pets, toilet outside, awkward little steps and stuff, and at that stage I was still sleeping sitting up in the hospital bed because I couldn’t lie flat, but they wouldn’t listen and discharged me anyway.”

– Tina

A further practical recommendation suggested by patients and their key support people was to ensure more specific discharge information and preparation is provided for patients and key support people during the hospital stay and before patient discharge from hospital.
Lack of coordination of post-discharge care

A consistent emerging theme was the sense of a lack of coordination of post-discharge care, and the absence of a consistent point of contact for ongoing management. Frustration at the lack of communication surrounding follow-up appointments was frequently expressed. Participants reported multiple appointments on multiple days of the week with physical, social and financial consequences. Patients commonly reported staff in outpatient clinics requesting regular follow up for them, but not receiving appointment invitations. This produced a lack of confidence in the current booking system.

“I think it was two appointments one day and the third appointment was about three days later. Because they were all in Hamilton, I did try and get them all on one day and it just wouldn’t work. It’s... extra travel and time. …everything is based in Hamilton and that’s an hour’s drive, and yes ACC do pay for that but when you go an hour there, an hour back plus the appointment it’s actually a big chunk out of the day.”

– Belinda

A further practical recommendation suggested by patients and their key support people was that travel to follow up appointments could be avoided through the use of a virtual trauma clinic, where possible. Patients and key support people believed this would reduce much of the disruption and the tangible and intangible costs associated with attending clinics.

Discussion

This study is the first to provide a detailed description of patient experiences following serious injury and admission to Waikato Hospital. It highlights perceived issues and limitations in the patient care pathway following serious injury, especially relating to access to psychosocial services, the high level of reliance on key support people, inadequate communication and information provision and a lack of preparedness for discharge and coordination of post-discharge care. Despite significant issues with parts of the transition process, most patients emphasised the high quality of care and empathy provided by in-hospital services during their admission phase of care.

Several limitations of the study are noted. Complete exclusion of AIS body region one (head/neck) limited the number of eligible participants. Service provider perspectives were not fully explored as only a single participant from this group was nominated, which reinforced patient perceptions regarding lack of coordination of post-discharge care. The sample size limited the ability to explore emerging concepts seen in smaller patient subgroups, including perceptions regarding cultural responsiveness. A larger study would provide the opportunity to explore additional emerging themes more thoroughly. The study was limited by sample size through its focus on adult patients managed at Waikato Hospital (where most major trauma patients are managed), which may not reflect the wider, less severely injured patients in the MTS population. Nevertheless, saturation occurred for the key themes described in this study, and patients felt very strongly that these should be disseminated widely with a view to promoting system improvements. Due to the inclusion criteria, the difference in experience between patients managed by anatomically-oriented surgical services in comparison with the dedicated Trauma Service at Waikato Hospital was not assessed. Along with improvement of specific services such as psychological counselling, it is likely that more widespread adoption of the continuation of care model used by the Waikato Trauma Service could improve consistency across all discharging services in the delivery of information and clinical care in the transition to the community. The continuation of care model has been reported to improve patient outcomes by coordinating timely access to appropriate care through improved coordination and communication between multidisciplinary staff which can be overseen by trauma coordinators. Length of hospital stay may also be reduced through timely discharge and communication with onward support services. Furthermore, length of time spent in more costly higher dependency settings may be reduced through timely transfer of care.17

Most patients expected a single point for communication and advocacy; a person or a service who would take responsibility for meeting needs, although there were
mixed reports as to which service provider should hold responsibility of this. General practitioners were generally not thought of as first points of contact and while some patients stated the cost of GP consultations was more than they could afford, most patients expected ongoing assessment by treating staff from the hospital. Patients often reported ongoing health concerns but had no knowledge of who to report it to and whether they should; they expressed apprehension when needing to report symptoms previously raised with medical staff, leaving patients with perceived uncertain medical diagnoses. While not uncommon, the impact of suboptimal handovers at hospital discharge on the patient experience and potentially avoidable hospital readmissions warrants further investigation to ensure system level improvement occurs such as the use of ISBAR—introduction, situation, background, assessment, recommendation—to guide a clinical handover to primary care rather than the provision of a discharge summary, which may be perceived as an administrative process only.

Confidence was lost with outpatient clinics as patients were promised regular engagement and, in some cases, failed to receive appointment bookings. The lack of staff continuity in follow-up clinics also contributed to this, as patients wanted review by staff familiar with their injuries. Bookings were felt to be made irrespective of the inconvenience this may cause with multiple appointments on multiple days; satellite clinics or virtual clinics appear not to be offered or explored but were suggested by patients to support follow-up care. Most patients perceived a sense of isolation and lack of psychosocial support, turning to their key support person for assistance. This caused anxiety for all patients, who felt that ongoing physical and emotional assessments should be an essential part of treatment for a patient with serious injury, including engagement with psychological or counselling services from the earliest reasonable point following admission. These issues were exacerbated when patients themselves were key support person for other more seriously injured family members.

The key support person was crucial to the patient and their recovery, which is a common finding. With deficiencies perceived in counselling assistance from in-hospital and post-discharge service providers, the key support person would often be the only avenue for patients to receive emotional care. Additionally, the key support person became the only link to a social network system, travel means and financial support. Most patients were concerned about the burden transferred to their key support person and chose to be interviewed with their key support person in attendance; it became evident that the patients relied upon the key support person for recall of events. Without recording events, recollection of much of the recovery was vague for some patients due to an intensive care stay, analgesia, and the turmoil surrounding an admission with an acute injury. Immense gratitude was expressed regarding support from key support people during the hospital stay and post discharge care. The altruism of all participants was evident through the concern expressed for other patients who may not have the care of a key support person, with patients describing the central role of the key support person in orchestrating discharge supports and coordinating appointments.

Surviving a traumatic event resulting in serious injury is a time of chaos and confusion for patients and their key support people. Inadequate communication from staff during the in-hospital phase about what to expect following discharge, especially links to community health and social services, adds to this predicament significantly. Once patients and their key support people adjust to the initial impact of the traumatic event, further adjustments are required to manage the ongoing effects of the event such as the physical and emotional concerns and financial pressures. Key support people are the single largest factor in facilitating patients’ recovery from serious injury yet are left significantly unsupported.
In summary, this study identified several possible areas for improvement to service delivery following serious injury, specifically:

1. the review of service provider communication and service delivery processes and practices in co-design with former patients and key support people, particularly in relation to information sharing and discharge planning;

2. the establishment of trauma navigators (specific trauma discharge planners), for patients not admitted under a trauma service, to assist with the provision of more holistic, integrated care;21–23 and the use of ISBAR (introduction, situation, background, assessment, recommendation) to guide a clinical handover to primary care rather than the provision of a discharge summary, which may be perceived as an administrative process only;

3. focused service improvements to support early screening for psychological trauma and facilitation of early engagement with psychological, counselling and social services that extend from hospital to community-based services to improve outcomes for patients and whānau;24

4. review of post-discharge assessment and follow-up services, including the use of virtual multi-disciplinary clinics linked to expert helpline services to assist with capacity for ad hoc support from an informed, single-point-of-contact, post-discharge service;25

5. engagement of ACC and GPs in redesign of the information exchange and follow-up processes;

6. increasing the visibility of carer burden to community service providers to aid the development of effective carer-support services; and

7. the application of comprehensive trauma care and discharge planning methods currently employed by specialised trauma services to surgical service discharges of all trauma patients.

Although undertaken in the Waikato region of New Zealand, opportunities for improvement may apply to other healthcare contexts.

Appendix
Interviewer prompts used in semi-structured interviews with patients treated at Waikato Hospital following serious injury

About the injury
- Briefly describe the event and the resulting injuries.

Treatment of injury
- Was St John/Helicopter service involved at the scene?
- How do you feel about the care you received?
- How could the treatment you received be improved?
- How do you feel about the care you received in hospital?
- How could the treatment you received be improved?

Hospital-based care
- How do you feel about the communication you received?
- Describe the discharge planning/process?
- What follow up clinic appointments were arranged for you?
- Have these changed over time?
- Are the services and treatments meeting your needs?
- How do you feel your cultural needs have been met following your injury?
- How could this have been improved?
Post discharge care

**ACC participants**
- How do you feel about the care you’ve received from ACC?
- Is there anything you feel could have been done differently by ACC regarding your recovery?
- Can you tell me about any rehabilitation assistance?
- Did these services meet your needs?
- Are there any improvements that could be made?

**Private health insured participants/another insurer**
- Did you make a claim with your private health insurer for your injury?
- Can you tell me about your experiences with your health insurer since your injury?
- Is there anything you feel could have been done differently by your health insurer to help your recovery?

Work life/finances
- What impact did the accident have on work life?
- If you have returned to work, did you need clearance from a health professional?
- Were you ready to return to work?
- Did this involve a return to work program?
- Can you tell me what impact the accident had on you financially?
- If you weren’t provided with financial compensation from ACC, did you seek assistance from other means? Eg, family, bank, Work and Income NZ
- What financial costs have you had as a result of the injury?
- What costs weren’t covered by ACC?

Home life and relationships
- What impact has the injury had on your home life?
- Can you describe any disruptions that occurred?
- Has the injury affected your relationships with friends or relatives in any way?

Transport
- Have you had any transport issues since the accident?

Health
- What impact has the injury had on your general health?
- Probe: Memory, fatigue, decreased mobility.
- Are these ongoing since the accident?
- What has helped you recover the most?
- What has made it harder to recover?
- How do you think you’re coping emotionally?
- Probe: Have they sought counselling/psychological assistance?

Perception of recovery
- How well/quickly do you feel that you have recovered?
- How do you think the injury will impact on your future?
Competing interests:
Nil.

Acknowledgements:
The authors would like to thank Waikato Institute of Technology for funding aspects of this project.

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URL:

REFERENCES:


**Incidence and outcomes of major trauma in New Zealand: findings from a feasibility study of New Zealand’s first national trauma registry**

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**ABSTRACT**

**AIMS:** The aim of the study was to pilot the feasibility of long-term outcomes data collection from adult major trauma survivors in New Zealand. This initial paper aims to characterise the New Zealand major trauma population in terms of long-term disability and functional outcomes after major trauma.

**METHODS:** A prospective cohort study of adults who had survived major trauma was conducted between June 2015 and December 2016 at two major trauma centres in Auckland.

**RESULTS:** Of 256 trauma referrals, 112 (44%) were confirmed eligible and consented. One hundred completed the survey at six months and 83 at 12 months. A majority of the study sample were male (72%), under 65 years (84%), with a disproportionally higher number of Māori in the sample (23%). At six months post-injury, the majority of participants were categorised as experiencing either moderate disability (37%) or good recovery (42%). Half of the participants experienced moderate pain at both 6 and 12 months post-injury (50% and 52% respectively), and problems with their usual activities at six months post-injury (51%).

**CONCLUSIONS:** Most study participants made a good recovery, but there was still a large group of people experiencing disability, pain and not in paid employment at 12 months post-injury.

Improvements in acute care have increased survival rates after major trauma, with more people now living with long-term and often complex consequences of their injuries. Data on outcomes for these populations are needed for health and disability service planning, and to identify opportunities for sustainable provision of rehabilitation, health and social care to people living with the long-term impacts of injury. The lack of such data in New Zealand greatly limits the evaluation of the cost-effectiveness of trauma care as well as limiting evaluation of rehabilitation services. Data describing injury survivors’ long-term recovery could inform service providers and funders about ways to improve care and support for trauma survivors, their family and whānau.

Existing surveillance systems in New Zealand, including hospital admission datasets and hospital registries, do not include data on long-term outcomes of trauma survivors. Although barriers to the collection of such data (eg, cost, mode of administration, privacy legislation) exist, these can be overcome. The Victorian State Trauma Registry (VSTR) in Australia has
implemented routine collection of these outcomes through establishment of opt-out consent, access to both patient and their next-of-kin contact details, use of a brief interview covering a number of areas important in trauma recovery, centralised data collection system and use of interviewers with clinical experience.6

The overall aim of the study reported here was to pilot the feasibility of long-term outcomes data collection from adult major trauma survivors in New Zealand. As the first of a series of papers from a broader project exploring feasibility of long-term follow-up of major trauma survivors, this paper aims to characterise the New Zealand major trauma population, focusing on ratings of long-term disability and functional outcomes after major trauma.

Methods

Study design

The Outcomes after Trauma Study (OATS) Study was conducted in Auckland, New Zealand's largest urban area (>1.5 million) which accounts for approximately one third of the country's population. Auckland is serviced by two major trauma centres (out of a total of six centres across New Zealand), which were selected as the study's data collection sites.

A prospective cohort study of adults who had survived major trauma was conducted between June 2015 and December 2016. The study used consecutive sampling and a mixed-methods approach, incorporating a quantitative component (using self-report measures and interviewer-administered questionnaires) and a qualitative component (using semi-structured face-to-face interviews). The current paper focuses on the quantitative component of the study, aimed at characterising the New Zealand major trauma population.

Participants

Included participants were those who were admitted to one of the two recruitment sites, and who had sustained significant physical trauma—defined as an Injury Severity Score (ISS) of 12 or more (Table 1). The ISS score is a widely used anatomical score to assess the severity of trauma.7 Patients who died as a result of their injuries, were in a vegetative state or who were unable to give informed consent due to significant cognitive impairment were excluded.

Eligible patients were invited to take part in the study in person (during their hospital stay) or by mail (following discharge), as soon as was deemed appropriate by the study team and no longer than six months post-injury. Written informed consent was obtained from those who agreed to take part. No proxy consents were obtained.

Data collection

Data were collected from eligible participants at baseline (on discharge following their injury), and at 6 and 12 months post-injury ('follow-up data'). At baseline, demographic and injury data were collected from the participants and their hospital records, including: age, preferred ethnicity, pre-existing long-term conditions, pre-injury employment status, residential status, ISS score, diagnosis, cause of injury and length of hospital stay.

Participants were given the option of completing follow-up surveys via telephone interview, online, face-to-face, postal or e-mail. Up to five attempts were made to collect the data from participants, with the

<table>
<thead>
<tr>
<th>Inclusion criteria</th>
<th>Exclusion criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. ISS 12</td>
<td>f. acquired major trauma due to drowning, poisoning, hanging (where only asphyxia occurs without other physical injury), or burns (ie, where burns were a major component requiring admission to a burns unit); as per NZMTN definition.8</td>
</tr>
<tr>
<td>b. admitted to one of the two trauma centres following their injury</td>
<td>g. unable to complete the assessment tasks in English</td>
</tr>
<tr>
<td>c. sustained their injury between 15 June 2015 and 14 December 2015</td>
<td>h. people with significant cognitive deficits (pre-existing or as a result of the injury)</td>
</tr>
<tr>
<td>d. living permanently in New Zealand</td>
<td></td>
</tr>
<tr>
<td>e. aged 18</td>
<td></td>
</tr>
</tbody>
</table>
counter being reset every time we spoke to a participant. After five failed attempts in a row, participants were deemed uncontactable. The follow-up surveys were identical at both data collection points and included the Glasgow Outcomes Scale-Extended (GOS-E) as the primary outcome measure, and five secondary outcomes: the Short Form 12 (SF-12), the Euroqol 5d-3L (EQ-5D-3L), Numeric Rating Scale (NRS), World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0) and a set of questions regarding productivity status (asking whether participants were in paid employment, homemaking, retired, studying or volunteering, and whether in full- or part-time capacity). These measures were chosen based on their use in previous injury outcome studies, brevity and psychometric properties.

Statistical analysis
Data were analysed using R 3.0.3., a statistical software developed by R Core Team in Vienna, Austria. Descriptive data were summarised using frequencies and percentages for categorical variables, and means and standard deviations for continuous variables; skewed data were reported as median and interquartile range (IQR). Two response rates were calculated: (1) response rate for eligible trauma cases ((total number of referrals—non-respondents—people deceased at screening)/(total number of referrals—people deceased at screening) *100%) and (2) consenting rate (consenting participants/total number of referrals—confirmed ineligible referrals—non-respondents—people deceased at screening) *100%). Reasons for non-participation, when provided, were recorded and summarised. For each participant, total scores for questionnaires were only computed when there were no missing data.

Changes in continuous outcomes were estimated using the mean change from complete case data and tested for a location shift using the Wilcoxon (aka, Mann-Whitney) paired sample test. In case of failure of the Wilcoxon test to produce reliable p-values (due to the presence of too many ties and of zeros), the p-value was approximated from the estimated difference between periods and the bootstrapped variance under the alternative, using a normal approximation. Confidence intervals (CI) for the mean difference at the 95% level were constructed using the bootstrap.

Changes in categorical outcomes were expressed as absolute numbers in transition tables, and as proportions in conditional probabilities tables (Appendix). These latter proportions are probability estimates, and the 95% confidence intervals for these probabilities were constructed using the Clopper-Pearson method. The overall significance of the transitions were tested using the McNemar-Bowker test.

The EQ-5D-3L was converted to a utility score using the New Zealand Tariff 2 coefficients, as recommended by the tool's developers.

Ethics
Ethical approval for the study was received from the Health and Disability Ethics Committee of New Zealand (15/STH/98/AM02).

Results
Recruitment process
In total, we were notified of 256 trauma referrals, of whom 112 (44%) were confirmed eligible and consented to take part in the study (Figure 1). A further 112 individuals were either confirmed to be ineligible or declined participation in the follow-up study. Individuals (n=32) with confirmed or with unknown eligibility, who did not respond to the study invitation are referred to as 'non-respondents'.

The follow-up study's response rate was 86.5% and the overall consenting rate was 75.2%. The main reason given for refusal was lack of interest in taking part in the study (n=28), followed by being “too busy” (n=8). The main reason for ineligibility was death during the hospital stay (n=18) followed by an inability to speak English to a sufficient degree to complete the questionnaires (n=16).
Study sample characteristics

A large majority of the study sample were male (72%) and under 65 years of age (84%) (Table 2). Median age was 45.5 years (IQR 27–58). There were disproportionally higher numbers of Māori in the sample (23%) than their representation in Auckland’s population (10.7%; Statistics New Zealand, 2013). The majority of participants were in paid employment prior to their injury (69%). The majority of participants had completed a secondary-level qualification (73%), with 62% also completing a post-secondary qualification.

The most common cause of injury was motor vehicle crash (30.4%), followed by injuries received as a result of a fall (27.6%) and vulnerable road-users (25.9%; includes motorcyclists, pedal cyclists and pedestrians; Table 3). The cause of injury was not known for two participants. The majority of the study sample sustained neurotrauma (n=66; 59%), with 88% of these classified as having a traumatic brain injury (TBI; defined as an alteration in brain function, or other evidence of brain pathology, caused by an external force). The most common specific pre-existing medical conditions reported were asthma (n=14), arthritis (n=13) and heart disease (n=7). Sixty-five participants (58%) reported no pre-existing medical condition.

Table 2: Demographic characteristics of study population at baseline.

<table>
<thead>
<tr>
<th>Category</th>
<th>Participants N=112</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>31 27.7</td>
</tr>
<tr>
<td>Male</td>
<td>81 72.3</td>
</tr>
<tr>
<td><strong>Age (in years)</strong></td>
<td></td>
</tr>
<tr>
<td>&lt;40</td>
<td>47 42.0</td>
</tr>
<tr>
<td>40–64</td>
<td>47 42.0</td>
</tr>
<tr>
<td>65+</td>
<td>18 16.0</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
</tr>
<tr>
<td>NZ European</td>
<td>67 59.8</td>
</tr>
<tr>
<td>Māori</td>
<td>26 23.2</td>
</tr>
<tr>
<td>Pacifica</td>
<td>12 10.7</td>
</tr>
<tr>
<td>Asian</td>
<td>5 4.4</td>
</tr>
<tr>
<td>Other</td>
<td>28 25.0</td>
</tr>
<tr>
<td><strong>Productivity status</strong></td>
<td></td>
</tr>
<tr>
<td>Paid employment</td>
<td>77 68.7</td>
</tr>
<tr>
<td>Retired</td>
<td>16 14.2</td>
</tr>
<tr>
<td>Home making</td>
<td>14 12.5</td>
</tr>
<tr>
<td>Study</td>
<td>11 9.8</td>
</tr>
<tr>
<td>Volunteering</td>
<td>7 6.2</td>
</tr>
<tr>
<td><strong>Educational attainment</strong></td>
<td></td>
</tr>
<tr>
<td>Secondary qualification</td>
<td>73 65.1</td>
</tr>
<tr>
<td>Post-secondary qualification</td>
<td>62 55.3</td>
</tr>
<tr>
<td>Information not provided</td>
<td>14 12.5</td>
</tr>
</tbody>
</table>

*Multiple selection was allowed.
Injuries classified with an ISS of 16–20 were most common (n=40; 36%), followed by those with an ISS of 12–15 (n=27; 24%). Average length of hospital stay was greater in those with higher ISS scores (Table 4). The median hospital stay was nine days (IQR 6–19.5).

Prior to injury, the majority of participants (77%) were in paid employment, this declined to 55% at 12 months follow-up. The number of people reporting home-making as one of their occupational activities increased over time—from 12.5% prior to injury to 58% at 12 months post-injury.

At 6 and 12-month follow-up, most participants reported living at home independently (61% and 76% respectively). Almost a third of all participants (29%) were residing in their own home but still required support six months post-injury. This number decreased over time, to 16% 12 months post-injury. A small number (n=8) of participants were not residing in their own home at six months post-injury. At 12 months post-injury, all but nine participants were residing in their own home.

Major trauma outcomes at 6 and 12 months post-injury

Primary outcome—GOS-E

At six months post-injury, the majority of participants were categorised as experiencing either moderate disability (37%) or good recovery (42%) (Table 5). At 12 months post-injury, the number of people in the severe (15%) and moderate disability groups (32%) declined. There were no deaths among respondents during the follow-up period. McNemar-Bowker’s test did not detect any statistically significant difference in transitions between GOS-E outcome categories at 6 and at 12 months (p =0.15; see Appendix Tables 1 and 2).

Secondary outcomes

NRS

The mean difference between ‘current pain’ at 12 and 6 months was -0.062 (95% CI [-0.55, 0.44]) and was not statistically significant (p=0.81). The mean difference between ‘worst pain in the last 24 hours’ at 12 and 6 months was -0.85 (95% CI [-1.49, -0.20]) and was statistically significant (p=0.0079). The mean difference between ‘best pain in the last 24 hours’ at 12 and 6 months was -0.2 (95% CI [-0.6, 0.2]) and was not statistically significant (p=0.34). McNemar-Bowker’s test detected statistically significant difference in transitions between pain level categories for ‘worst pain in the last 24 hours’ at 6 and at 12 months (p=0.04), and no statistically significant differences in transitions

---

**Table 3:** Cause of injury.

<table>
<thead>
<tr>
<th>Cause of injury</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
</tr>
<tr>
<td>Motor vehicle crash</td>
<td>34</td>
</tr>
<tr>
<td>Vulnerable road users*</td>
<td>29</td>
</tr>
<tr>
<td>High falls (1 meter or higher)</td>
<td>15</td>
</tr>
<tr>
<td>Low falls (standing or &lt;1m)</td>
<td>16</td>
</tr>
<tr>
<td>Struck or collision**</td>
<td>13</td>
</tr>
<tr>
<td>Other***</td>
<td>3</td>
</tr>
<tr>
<td>Unknown</td>
<td>2</td>
</tr>
</tbody>
</table>

*Includes: motorcyclists, pedal cyclists, pedestrians.
**Includes: rugby injuries, physical assaults, stabblings.
***Includes injuries with a combination of causes, eg, car crash with electrocution, or hit by a wave and fall in the surf.

**Table 4:** Median hospital length of stay (in days) by ISS scores.

<table>
<thead>
<tr>
<th>ISS ranges</th>
<th>Length of stay (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12–15</td>
<td>7</td>
</tr>
<tr>
<td>16–20</td>
<td>7</td>
</tr>
<tr>
<td>21–25</td>
<td>10</td>
</tr>
<tr>
<td>26–30</td>
<td>22</td>
</tr>
<tr>
<td>&gt;30</td>
<td>25</td>
</tr>
</tbody>
</table>

**Table 5:** GOS-E scores at 6 and 12 months (n=83).

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Severe disability*</th>
<th>Moderate disability*</th>
<th>Good recovery*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follow-up period</td>
<td>6</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>Overall n (%)</td>
<td>23 (23%)</td>
<td>12 (15%)</td>
<td>37 (37%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Moderate disability*</th>
<th>Good recovery*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follow-up period</td>
<td>12</td>
<td>27 (32%)</td>
</tr>
<tr>
<td>Overall n (%)</td>
<td>12</td>
<td>40 (40%)</td>
</tr>
</tbody>
</table>

*Due to small numbers for some of the outcomes, the outcome levels (eg, upper severe disability and lower severe disability) were bundled into broader levels of function (eg, severe disability).
The majority of participants reported experiencing no problems with mobility (six months—59%; 12 months—66%), self-care (six months—77%; 12 months—86%) or anxiety (six months—63%; 12 months—64%) post-injury (Table 6). Half of the participants experienced moderate pain at both 6 and 12 months post-injury (50% and 52% respectively), and problems with their usual activities at six months post-injury (51%). With the exception of ‘usual activities’ at six months post-injury (12%), few participants experienced extreme problems in any of the categories (between 1% and 5%).

The mean difference in EQ-5D tariff scores between 12 and 6 months was 0.01 (95% CI [-0.04, 0.05]). The p-value of the test for the difference in location to be different from 0 was 0.63, meaning no statistically significant change in the participants’ health status score derived from their ratings of EQ5D subscales. The mean difference in EQ-5D VAS scores between 12 and 6 months was 4.09 (95% CI [-0.15, 8.52]), and it was statistically significant (p=0.03), meaning there was a statistically significant improvement in the participants’ health score on VAS.

### Table 6: EQ5D scores.

<table>
<thead>
<tr>
<th>EQ5D subscale</th>
<th>6 months N=100</th>
<th>12 months N=83</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Mobility*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No problem</td>
<td>59</td>
<td>59</td>
</tr>
<tr>
<td>Moderate problem</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>Extreme problem</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Self-care</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No problem</td>
<td>77</td>
<td>77</td>
</tr>
<tr>
<td>Moderate problem</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Extreme problem</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Usual activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No problem</td>
<td>44</td>
<td>44</td>
</tr>
<tr>
<td>Moderate problem</td>
<td>44</td>
<td>44</td>
</tr>
<tr>
<td>Extreme problem</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Anxiety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No problem</td>
<td>63</td>
<td>63</td>
</tr>
<tr>
<td>Moderate problem</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>Extreme problem</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

*n=2 participants did not provide any response at six-month follow-up.

The Physical Component Score (PCS-12) increased between 6 and 12 months with the mean difference of 3.45 (CI [1.57, 5.31], p=0.001), indicating a slight improvement in participants’ physical health.
The mean difference between 12 and 6 months WHODAS scores was -3.23 (CI [-5.03, -1.58], p=0.001).

Over one-third (38%) of participants reported high scores (and thus ongoing problems) at six months post-injury, compared to 22% at 12 months post-injury. Just over half of the participants (51%) reported low WHODAS scores at 12 months post-injury, suggesting fewer ongoing problems.

McNemar-Bowker’s test did not detect any statistically significant differences in transitions between WHODAS score categories at 6 and 12 months (p=0.06; see Appendix Tables 9 and 10).

**Productivity status following injury**

Prior to injury, most participants (69%) were in paid employment (Table 2). At six months 51% of people were in paid employment; this increased to 55% by 12 months (Table 7). The proportion of people reporting home-making as one of their occupational activities increased over time—from 12% prior to injury (Table 2) to 58% 12 months post-injury (Table 7).

McNemar-Bowker’s test did not detect any statistically significant differences in transitions between productivity status categories at 6 and 12 months (see Appendix Tables 11–20).

**Discussion**

Trauma registries provide a valuable opportunity to monitor long-term outcomes for major trauma survivors. Such knowledge could be used to improve service planning, prognostication and quantification of the burden of major trauma. However, collecting long-term outcomes data for this group is not routine in New Zealand, nor in most countries. This is the first study, to our knowledge, that has explored the feasibility of capturing and describing long-term outcomes of a New Zealand major trauma population.

Our findings suggest that at 12 months post-injury the majority of participants in this study had made a good recovery in terms of disability, living situation and health. It is important to note, however, that patients in vegetative state and those who did not have the cognitive capacity to give informed consent were not included in the study sample. Nevertheless, as compared with the six-month findings, fewer participants were experiencing a severe or moderate disability. In addition, a greater number of survivors were living in their own home independently, and indicated experiencing no problems with mobility, self-care or usual activities. Fewer survivors required home-based support. Participants also indicated higher self-rated health, self-rated quality of life, and better functional outcomes at 12 months compared to six months post-injury. However, a sizeable group of survivors were still experiencing pain and problems with their usual activities 12 months post-injury, which suggests

---

**Table 7**: Productivity status.

<table>
<thead>
<tr>
<th></th>
<th>Baseline 6 months N=100</th>
<th>12 months N=83</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Paid employment*</td>
<td>77</td>
<td>69</td>
</tr>
<tr>
<td>Home making*</td>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td>Retired*</td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td>Volunteering*</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Study*</td>
<td>7</td>
<td>6</td>
</tr>
</tbody>
</table>

*Multiple selection was allowed, so percentage values do not add up to 100.*
that not all major trauma survivors will follow the same trajectory of recovery. Furthermore, almost half of the participants were not in paid employment at 12 months post-injury.

Differences in the inclusion criteria, rates of follow-up and the case-mix of patients make comparisons with other outcome studies of major trauma patients challenging. Nevertheless, the prevalence of reporting problems on each of the EQ-5D items was lower in our study than observed in previous studies of Australian\(^2\) and Dutch\(^3,4\) major trauma populations, potentially reflecting differences in inclusion criteria and follow-up rates. In our study, we did not use proxy interviews of patients, and excluded patients who were unable to consent at baseline, which likely resulted in a lower prevalence of patients with significant TBI, when compared to the previous studies. Notably, our return to work rates were 51% at six months, and 55% at 12 months post-injury. The observed rates were lower than reported in an Australian population-based study of major trauma survivors where the return to work rates were 58% at six months, and 66% at 12 months post-injury.\(^5\) Holtslag et al\(^3\) reported a return to work rate of 73% at 12–18 months post-injury in their study of more than 300 major trauma patients in the Netherlands.

In the current study, 70% of the participants were male, 50% having sustained a brain injury, with Māori participants (New Zealand’s indigenous population) over-represented in the study population, particularly in terms of poorer outcomes. This is consistent with findings from other research.\(^2,6,16\) We found that approximately two-thirds of all injuries were traffic-related, while falls accounted for approximately a quarter of the injuries. Our findings suggest future research could focus on exploring these characteristics as potential risk factors for major trauma in New Zealand.

The focus of many trauma care systems is still on mortality, with the ISS being the most commonly used method to assess trauma care performance.\(^2,6,16\) With recent care improvements, many trauma survivors go on to live past their hospital admission.\(^1\) However, our knowledge on what happens to this group and what their long-term outcomes are is limited. Our study has shown that a large proportion of trauma survivors experience ongoing disability at 12 months post-injury and are not in paid employment, potentially causing heavy burden on public health resources. This experience highlights the need to monitor outcomes other than just mortality in trauma, and was further explored in a nested qualitative study conducted as part of this project (in preparation for publication).

This study has provided new and important information on the New Zealand major trauma population. However, we would like to acknowledge some limitations. First, we were only able to gain informed consent from 54% of eligible trauma survivors. This is consistent with many other research studies, but lower than reported by Gabbe et al.\(^16\) One reason for this is that we used an opt-in, rather than an opt-out consent process (as in Gabbe et al study). Using an opt-out consent (where trauma patients are automatically included in the registry) increases the follow-up rates and has obvious benefits for trauma outcomes monitoring. However, as the current study was conducted by an organisation external to the hospital registries, it was not in a position to use an opt-out consent protocol.

Another reason for the lower consenting rate might be the exclusion of people who were unable to complete the study questionnaires in English (n=16). In the future, we recommend using validated translations of long-term outcome measures, and using interpreters where appropriate. Also, in the current study 19 people who were referred to us, were later found to not be diagnosed as major trauma (ie, their ISS was lower than 12). As our aim was to contact the potential participants as soon as possible, some referrals might have been made before the full extent of injuries was known to the medical teams. We recommend delaying patient screening until their inclusion on hospital trauma registries, at which time their diagnoses are final.

In this study, only those major trauma survivors who were personally able to consent to taking part were included. This meant exclusion of people who had ongoing or incurred substantial cognitive deficits. Hence, caution needs to be taken when applying these findings to a wider context, as
they do not necessarily represent the experience of all major trauma survivors. Future studies should attempt to use proxy consent for major trauma survivors who are in vegetative states, or who are unable to consent from a cognitive perspective. It is important to include as much data as possible from the patients’ next-of-kins to gain a better understanding of major trauma outcomes.

Another limitation is our lack of knowledge regarding the 66 people who either refused to take part, withdrew their consent, or were lost to follow-up. While we know most people who refused to take part were “not interested”, we have no indication of whether the long-term outcomes of these people reflect the experience of our study’s participants. Again, an opt-out consenting approach may facilitate improvements in response rates, which could help understand biases in the population available for follow-up.\(^\text{16}\) Notably, a recently published paper\(^\text{18}\) reports on a number of developments made by the New Zealand Major Trauma Network (NZMTN), which will allow for automatic opt-out consent, and a routine and centralised data collection system. This initiative has great potential for improving trauma care and addressing challenges identified in the current study.

Future studies might also want to gather more detailed information on survivors’ return to work status. In the present study we focused on capturing details on all productive activity that participants engaged in before and after the trauma. Involvement in paid work decreased in frequency and the role of homemaker increased. It could be useful in future to collect more detailed information on the length of time taken to return to normal or modified work or normal ADLs for participants who achieved this.

In conclusion, this paper reports the long-term outcomes of a subset of major trauma survivors in New Zealand. The findings show that most study participants made a good recovery, but there was still a large group of people experiencing disability and not in paid employment at 12 months post-injury. The findings suggest that trauma registries are ideally placed to monitor long-term outcomes of trauma survivors, and can play an important role in reducing the impact of burden associated with major trauma.

## Appendix

### Definitions of acronyms:

- GOS-E—Glasgow Outcome Scale – Extended
- NRS—Numeric Rating Scale
- WHODAS—World Health Organization’s Disability Assessment Schedule
- NaN—not a number; indicates an incomputable number
- NA—not applicable/not available

### Appendix Table 1: Transition table for GOS-E.

<table>
<thead>
<tr>
<th>GOS-E at 6 months</th>
<th>Severe disability</th>
<th>Moderate disability</th>
<th>Good recovery</th>
<th>Not available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe disability</td>
<td>9</td>
<td>5</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Moderate disability</td>
<td>1</td>
<td>17</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Good recovery</td>
<td>2</td>
<td>4</td>
<td>30</td>
<td>4</td>
</tr>
<tr>
<td>Not available</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>10</td>
</tr>
</tbody>
</table>
Appendix Table 2: Conditional probabilities for GOS-E at 12 months with 95% confidence intervals (n=83; McNemar-Bowker's X²=5.26, p=0.154).

<table>
<thead>
<tr>
<th>GOS-E at 12 months</th>
<th>GOS-E at 6 months</th>
<th>Severe disability</th>
<th>Moderate disability</th>
<th>Good recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe disability</td>
<td>0.500 (0.260–0.740)</td>
<td>0.278 (0.097–0.535)</td>
<td>0.222 (0.064–0.476)</td>
<td></td>
</tr>
<tr>
<td>Moderate disability</td>
<td>0.037 (0.001–0.190)</td>
<td>0.630 (0.424–0.806)</td>
<td>0.333 (0.165–0.540)</td>
<td></td>
</tr>
<tr>
<td>Good recovery</td>
<td>0.056 (0.007–0.187)</td>
<td>0.111 (0.031–0.261)</td>
<td>0.833 (0.672–0.936)</td>
<td></td>
</tr>
</tbody>
</table>

Appendix Table 3: Transition table for NRS ‘Current pain’.

<table>
<thead>
<tr>
<th>NRS at 12 months</th>
<th>No pain</th>
<th>Mild pain</th>
<th>Moderate pain</th>
<th>Severe pain</th>
<th>Not available</th>
</tr>
</thead>
<tbody>
<tr>
<td>No pain</td>
<td>27</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Mild pain</td>
<td>11</td>
<td>11</td>
<td>8</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Moderate pain</td>
<td>1</td>
<td>9</td>
<td>3</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Severe pain</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Not available</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>10</td>
</tr>
</tbody>
</table>

Appendix Table 4: Conditional probabilities for NRS ‘Current pain’ at 12 months with 95% confidence intervals (n=83; McNemar-Bowker’s X²=NaN, p=NA).

<table>
<thead>
<tr>
<th>NRS at 12 months</th>
<th>No pain</th>
<th>Mild pain</th>
<th>Moderate pain</th>
<th>Severe pain</th>
<th>Not available</th>
</tr>
</thead>
<tbody>
<tr>
<td>No pain</td>
<td>0.771 (0.599–0.896)</td>
<td>0.143 (0.048–0.303)</td>
<td>0.029 (0.001–0.149)</td>
<td>0.057 (0.007–0.192)</td>
<td></td>
</tr>
<tr>
<td>Mild pain</td>
<td>0.367 (0.199–0.561)</td>
<td>0.367 (0.199–0.561)</td>
<td>0.267 (0.123–0.459)</td>
<td>0.000 (0.000–0.116)</td>
<td></td>
</tr>
<tr>
<td>Moderate pain</td>
<td>0.077 (0.002–0.360)</td>
<td>0.692 (0.368–0.909)</td>
<td>0.231 (0.050–0.538)</td>
<td>0.000 (0.000–0.247)</td>
<td></td>
</tr>
<tr>
<td>Severe pain</td>
<td>0.333 (0.008–0.906)</td>
<td>0.000 (0.000–0.708)</td>
<td>0.333 (0.008–0.906)</td>
<td>0.333 (0.008–0.906)</td>
<td></td>
</tr>
</tbody>
</table>

Appendix Table 5: Transition table for NRS ‘Worst pain’.

<table>
<thead>
<tr>
<th>NRS at 12 months</th>
<th>No pain</th>
<th>Mild pain</th>
<th>Moderate pain</th>
<th>Severe pain</th>
<th>Not available</th>
</tr>
</thead>
<tbody>
<tr>
<td>No pain</td>
<td>19</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Mild pain</td>
<td>10</td>
<td>7</td>
<td>6</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Moderate pain</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Severe pain</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Not available</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>10</td>
</tr>
</tbody>
</table>
Appendix Table 6: Conditional probabilities for NRS 'Worst pain' at 12 months with 95% confidence intervals (n=83; McNemar-Bowker's X²=13.33, p=0.038).

<table>
<thead>
<tr>
<th>NRS at 12 months</th>
<th>No pain</th>
<th>Mild pain</th>
<th>Moderate pain</th>
<th>Severe pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>No pain</td>
<td>0.864 (0.651–0.971)</td>
<td>0.091 (0.011–0.292)</td>
<td>0.000 (0.000–0.154)</td>
<td>0.045 (0.001–0.228)</td>
</tr>
<tr>
<td>Mild pain</td>
<td>0.400 (0.211–0.613)</td>
<td>0.280 (0.121–0.494)</td>
<td>0.240 (0.094–0.451)</td>
<td>0.080 (0.010–0.260)</td>
</tr>
<tr>
<td>Moderate pain</td>
<td>0.235 (0.068–0.499)</td>
<td>0.235 (0.068–0.499)</td>
<td>0.471 (0.230–0.722)</td>
<td>0.059 (0.001–0.287)</td>
</tr>
<tr>
<td>Severe pain</td>
<td>0.235 (0.068–0.499)</td>
<td>0.118 (0.015–0.364)</td>
<td>0.235 (0.068–0.499)</td>
<td>0.412 (0.184–0.671)</td>
</tr>
</tbody>
</table>

Appendix Table 7: Transition table for NRS 'Best pain'.

<table>
<thead>
<tr>
<th>NRS at 12 months</th>
<th>No pain</th>
<th>Mild pain</th>
<th>Moderate pain</th>
<th>Severe pain</th>
<th>Not available</th>
</tr>
</thead>
<tbody>
<tr>
<td>No pain</td>
<td>43</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Mild pain</td>
<td>7</td>
<td>12</td>
<td>2</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Moderate pain</td>
<td>1</td>
<td>8</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Severe pain</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Not available</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>10</td>
</tr>
</tbody>
</table>

Appendix Table 8: Conditional probabilities for NRS 'Best pain' at 12 months with 95% confidence intervals (n=83; McNemar-Bowker's X²=4.7515, p=0.191).

<table>
<thead>
<tr>
<th>NRS at 12 months</th>
<th>No pain</th>
<th>Mild pain</th>
<th>Moderate pain</th>
<th>Severe pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>No pain</td>
<td>0.860 (0.733–0.942)</td>
<td>0.080 (0.022–0.192)</td>
<td>0.040 (0.005–0.137)</td>
<td>0.020 (0.000–0.106)</td>
</tr>
<tr>
<td>Mild pain</td>
<td>0.333 (0.146–0.570)</td>
<td>0.571 (0.340–0.782)</td>
<td>0.095 (0.012–0.304)</td>
<td>0.000 (0.000–0.161)</td>
</tr>
<tr>
<td>Moderate pain</td>
<td>0.100 (0.002–0.445)</td>
<td>0.800 (0.444–0.975)</td>
<td>0.100 (0.002–0.445)</td>
<td>0.000 (0.000–0.308)</td>
</tr>
<tr>
<td>Severe pain</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Appendix Table 9: Transition table for WHODAS.

<table>
<thead>
<tr>
<th>WHODAS at 12 months</th>
<th>Low score</th>
<th>Average score</th>
<th>High score</th>
<th>Not available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low score</td>
<td>27</td>
<td>1</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Average score</td>
<td>5</td>
<td>11</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>High score</td>
<td>4</td>
<td>7</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>Not available</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>11</td>
</tr>
</tbody>
</table>
## Appendix Table 10: Conditional probabilities for WHODAS at 12 months with 95% confidence intervals (n=83; Mc Nemar-Bowker’s X²=7.4848, p=0.058).

<table>
<thead>
<tr>
<th>WHODAS at 12 months</th>
<th>Low score</th>
<th>Average score</th>
<th>High score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low score</td>
<td>0.964 (0.817–0.999)</td>
<td>0.036 (0.001–0.183)</td>
<td>0.000 (0.000–0.123)</td>
</tr>
<tr>
<td>Average score</td>
<td>0.250 (0.087–0.491)</td>
<td>0.550 (0.315–0.769)</td>
<td>0.200 (0.057–0.437)</td>
</tr>
<tr>
<td>High score</td>
<td>0.174 (0.050–0.388)</td>
<td>0.304 (0.132–0.529)</td>
<td>0.522 (0.306–0.732)</td>
</tr>
</tbody>
</table>

## Appendix Table 11: Transition table for Productivity status ‘Working’.

<table>
<thead>
<tr>
<th>‘Working’ at 6 months</th>
<th>‘Working’ at 12 months</th>
<th>Not available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>37</td>
<td>5</td>
</tr>
<tr>
<td>No</td>
<td>8</td>
<td>31</td>
</tr>
<tr>
<td>Not available</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

## Appendix Table 12: Conditional probabilities for Productivity status ‘Working’ at 12 months with 95% confidence intervals (n=83; Mc Nemar-Bowker’s X²=0.3077, p=0.58).

<table>
<thead>
<tr>
<th>‘Working’ at 12 months</th>
<th>‘Working’ at 6 months</th>
<th>Not available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>0.881 (0.744–0.960)</td>
<td>0.119 (0.040–0.256)</td>
</tr>
<tr>
<td>No</td>
<td>0.205 (0.093–0.365)</td>
<td>0.795 (0.635–0.907)</td>
</tr>
</tbody>
</table>

## Appendix Table 13: Transition table for Productivity status ‘Homemaking’.

<table>
<thead>
<tr>
<th>‘Homemaking’ at 6 months</th>
<th>‘Homemaking’ at 12 months</th>
<th>Not available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>28</td>
<td>8</td>
</tr>
<tr>
<td>No</td>
<td>19</td>
<td>26</td>
</tr>
<tr>
<td>Not available</td>
<td>1</td>
<td>10</td>
</tr>
</tbody>
</table>

## Appendix Table 14: Conditional probabilities for Productivity status ‘Homemaking’ at 12 months with 95% confidence intervals (n=83; Mc Nemar-Bowker’s X²=3.7037, p=0.054).

<table>
<thead>
<tr>
<th>‘Homemaking’ at 12 months</th>
<th>‘Homemaking’ at 6 months</th>
<th>Not available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>0.778 (0.608–0.899)</td>
<td>0.222 (0.101–0.392)</td>
</tr>
<tr>
<td>No</td>
<td>0.422 (0.277–0.578)</td>
<td>0.578 (0.422–0.723)</td>
</tr>
</tbody>
</table>
### Appendix Table 15: Transition table for Productivity status ‘Volunteering’.

<table>
<thead>
<tr>
<th>‘Volunteering’ at 6 months</th>
<th>Yes</th>
<th>No</th>
<th>Not available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>4</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>No</td>
<td>8</td>
<td>62</td>
<td>17</td>
</tr>
<tr>
<td>Not available</td>
<td>0</td>
<td>2</td>
<td>10</td>
</tr>
</tbody>
</table>

### Appendix Table 16: Conditional probabilities for Productivity status ‘Volunteering’ at 12 months with 95% confidence intervals (n=83; McNemar-Bowker’s $X^2=0$, $p=1$).

<table>
<thead>
<tr>
<th>‘Volunteering’ at 6 months</th>
<th>‘Volunteering’ at 12 months</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>0.364 (0.109–0.692)</td>
</tr>
<tr>
<td>No</td>
<td>No</td>
<td>0.636 (0.308–0.891)</td>
</tr>
</tbody>
</table>

### Appendix Table 17: Transition table for Productivity status ‘Studying’.

<table>
<thead>
<tr>
<th>‘Studying’ at 6 months</th>
<th>Yes</th>
<th>No</th>
<th>Not available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>5</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>No</td>
<td>5</td>
<td>67</td>
<td>17</td>
</tr>
<tr>
<td>Not available</td>
<td>1</td>
<td>1</td>
<td>10</td>
</tr>
</tbody>
</table>

### Appendix Table 18: Conditional probabilities for Productivity status ‘Studying’ at 12 months with 95% confidence intervals (n=83; McNemar-Bowker’s $X^2=0$, $p=1$).

<table>
<thead>
<tr>
<th>‘Studying’ at 6 months</th>
<th>‘Studying’ at 12 months</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>0.556 (0.212–0.863)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>0.444 (0.137–0.788)</td>
</tr>
</tbody>
</table>

### Appendix Table 19: Transition table for Productivity status ‘Retirement’.

<table>
<thead>
<tr>
<th>‘Retirement’ at 6 months</th>
<th>‘Retirement’ at 12 months</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Not available</td>
<td>0</td>
</tr>
<tr>
<td>No</td>
<td>Yes</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>Not available</td>
<td>10</td>
</tr>
<tr>
<td>Not available</td>
<td>Yes</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Not available</td>
<td>13</td>
</tr>
</tbody>
</table>
Appendix Table 20: Conditional probabilities for Productivity status ‘Retirement’ at 12 months with 95% confidence intervals (n=83; McNemar-Bowker’s $X^2=0.5$, p=0.48).

<table>
<thead>
<tr>
<th>‘Retirement’ at 12 months</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>1.000 (0.768–1.000)</td>
<td>0.000 (0.000–0.232)</td>
</tr>
<tr>
<td>No</td>
<td>0.042 (0.005–0.143)</td>
<td>0.958 (0.857–0.995)</td>
</tr>
</tbody>
</table>

Competing interests:
The study was funded by ACC.

Acknowledgements:
We thank the members of this study Advisory Group for their expertise and time. We also acknowledge the vital involvement of Lynn Tucker and Kevin Henshall for their assistance with study recruitment.

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The popularity of recreational cycling is increasing in New Zealand, both on- and off-road, while evidence shows that cycling as a means of active transport has decreased over time.1–3 These diverging trends are occurring in an increasingly supportive policy environment at the national, regional and local government level, with the aim of better integrating recreational and active transport into planning processes.4,5 Government aspirations to increase active transport were clear in the 2008 New Zealand Transport Strategy 4 and making cycling a more attractive choice is now a strategic priority of the New Zealand Transport Agency.6 In 2018 the Labour-led Government announced the development of a replacement road safety strategy, including further investigation of the ‘Vision Zero’ philosophy, which aims to achieve a transport system with no fatalities or serious injuries involving road traffic.5

Owing to the fragility of the unprotected human body,8 cyclists are vulnerable to injury compared to those in motorised vehicles8,10 and are likely to sustain injuries to more than one body area.8 Crashes involving collisions with motor vehicles are associated with more severe injuries11 and males often have higher cycling-related morbidity and mortality than females.12 The most common cause of death is from major trauma events involving blunt multi-system trauma, and brain injuries.13 Although the majority of injuries are non-major in nature, a large portion of patients continue to suffer physical symptoms for more than six months following injury.14

In New Zealand, the Ministry of Health acknowledges that cyclists are at increased risk of death or injury per hour spent travelling.10 In 2016, 958 cyclists were hospitalised in New Zealand for a total of 4,596 bed days.3 In that year five cyclists died, 169 were seriously injured and 560 suffered

Cycling-related injuries and cycling promotion: a trauma service perspective
Neerja Singh, Natalie Joe, Janet Amey, Alastair Smith, Grant Christey

ABSTRACT

AIM: Current policy direction seeks to promote participation in both recreational and active transport cycling. We evaluate cycling-related injuries resulting in hospital admission across the Midland Region of New Zealand to establish injury trends.

METHOD: A retrospective review of anonymised prospectively-collected trauma registry data from 1 June 2012 to 31 July 2016 in the Midland Region. Cases include patients hospitalised with cycling-related injuries.

RESULTS: Nine hundred and ninety-eight cyclists were admitted to hospital (2012–2016). Admission volumes increased approximately 16.8% per year, major trauma by 11.9% and non-major trauma by 17.8%. Overall, 66.7% of admissions were for people aged over 20 years and 73.4% were for males. The participation-adjusted annual injury rate was 78.4 per 100,000. This masked considerable variation by gender, age group and injury severity.

CONCLUSION: Hospital admission volumes and rates are rising with underlying variation in patient demography, place and severity of injury. Current policy direction to grow cycling participation based on the health, environmental and economic benefits is ahead of the implementation of safer cycling infrastructure, creating a timing lag. From a regional hospital-based trauma service perspective, this timing lag needs due consideration if the full benefits of increasing participation are to be realised.
non-major injuries in police-reported road crashes—about 6% of the total number of casualties from police-reported crashes.\textsuperscript{15} However, police-reported crashes involving cyclists are under-reported\textsuperscript{16} and police-assessed injury severity can also be discordant with subsequent medical assessment.\textsuperscript{17}

**Methods**

The study criteria included domiciled patients admitted to hospital as a result of an injury sustained while cycling on a non-motorised two-wheeled bicycle in four of the five district health boards (DHBs) in the MTS, between 1 June 2012 and 31 July 2016 (excluding Tairawhiti DHB). Consistent with international trauma registries,\textsuperscript{18} patients were excluded if they sustained injury as a direct result of pre-existing medical conditions, late effects of injury, if the injury occurred more than seven days prior or if the patient was deceased prior to hospital admission.

Severity and pattern of injury diagnoses were quantified using the Abbreviated Injury Scale (AIS), an anatomical scoring system that ranks injuries from ‘1’ (minor) to ‘6’ (non-survivable). The Injury Severity Score (ISS) is also an anatomical scoring system using a 0–75 scale. The highest AIS scores in each body region are the basis of the ISS, with injuries then categorised as non-major (ISS \(\leq\) 12) and major (ISS \(\geq\) 13).\textsuperscript{19} For patient ethnicity we used that recorded on the patient’s National Health Index number and categorised according to the 2005 Ethnicity New Zealand Standard Classification. Publicly available data from the Ministry of Transport’s ‘Cycling New Zealand Household Travel Survey’ were used to calculate participation-adjusted injury rates. Population data for the Midland region were obtained from Statistics New Zealand’s online portal. Statistical analyses were performed in Microsoft Excel 2010.

**Results**

Between 1 June 2012 and 31 July 2016, a total of 998 events that met the inclusion criteria resulted in hospital admission (Table 1), with an increase in the volume of injuries of approximately 18% per year (Table 2). As in other areas of New Zealand there was a significant seasonal component, with higher numbers of cyclists in the warmer months and a corresponding decrease over winter.\textsuperscript{20}

The majority of injuries occurred on road (37.7%), followed by the countryside/beach (22.9%) (Table 1, Table 4). For females, 47.4% of cycling injuries were on road, 19.9% at the countryside/beach and 10.2% at a sports area. For males, injuries were more spread between environments with 34.2% occurring on road followed by countryside/beach locations and sports areas (23.5% and 20.5% respectively). The highest volume of road injuries occurred in the Waikato DHB area, and this was expected given it is the most populated DHB. The highest volume of injuries occurring at the countryside/beach were in the Lakes DHB, with injuries for this category contributing 45.4% of all injuries, suggesting the importance of recreational mountain biking in this district.

A total of 2,097 AIS diagnoses were observed with the majority of injuries having an AIS score of 1 or 2 (42.2% and 47.6%, respectively) (Table 3). Our study found that males had significantly more injuries (Chi Square goodness of fit, \(\chi^2=115, df=1, P<0.0005\)) than females, consistent with other studies.\textsuperscript{1,21} The most common body region injuries were upper extremity injuries (642), lower extremities (438), face (266) and head (228) (Table 3). This is similar to other studies and mainly involved superficial injuries such as abrasions, contusions and lacerations.\textsuperscript{8} We found that patients with an AIS severity score of 3+ were more likely to have injuries to the head, thorax, spine and abdomen/pelvis regions than to the extremities. With AIS diagnoses translated to ISS, overall 91.9% of injuries were categorised as non-major (Table 4). The volume of non-major injuries increased from 173 in the 2012/13 year to 281 in 2015/16. In contrast, major injury volumes fluctuated over time; averaging 20 per year (range 17–25). Driven by the volume increase seen for non-major injuries, the total admission volume (major and non-major injuries) increased from 190 patients in 2012/13 to 302 in 2015/16.

The higher volume of injuries in males translated into higher participation-adjusted injury rates, with higher rates for males across all age groups and injury severity categories (Table 5). Non-major injury rates increased for all population groups with the
### Table 1: Demography of cycle injuries by place of injury in Midland Region (excluding Tairawhiti District) 2012–2016.

<table>
<thead>
<tr>
<th></th>
<th>Road</th>
<th>Countryside/beach</th>
<th>Sports area</th>
<th>Cycleway/sidewalk</th>
<th>Home/farm</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demography</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>376</td>
<td>225</td>
<td>177</td>
<td>78</td>
<td>70</td>
<td>72</td>
<td>998</td>
</tr>
<tr>
<td></td>
<td>37.7%</td>
<td>22.5%</td>
<td>17.7%</td>
<td>7.8%</td>
<td>7.0%</td>
<td>7.2%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Major/non-major</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major</td>
<td>50</td>
<td>14</td>
<td>10</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>81</td>
</tr>
<tr>
<td></td>
<td>61.7%</td>
<td>17.3%</td>
<td>12.3%</td>
<td>2.5%</td>
<td>1.2%</td>
<td>4.9%</td>
<td>100%</td>
</tr>
<tr>
<td>Non-major</td>
<td>326</td>
<td>211</td>
<td>167</td>
<td>76</td>
<td>69</td>
<td>68</td>
<td>917</td>
</tr>
<tr>
<td></td>
<td>35.6%</td>
<td>23.0%</td>
<td>18.2%</td>
<td>8.3%</td>
<td>7.5%</td>
<td>7.4%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>126</td>
<td>53</td>
<td>27</td>
<td>23</td>
<td>16</td>
<td>21</td>
<td>266</td>
</tr>
<tr>
<td></td>
<td>47.4%</td>
<td>19.9%</td>
<td>10.2%</td>
<td>8.6%</td>
<td>6.0%</td>
<td>7.9%</td>
<td>100%</td>
</tr>
<tr>
<td>Male</td>
<td>250</td>
<td>172</td>
<td>150</td>
<td>55</td>
<td>54</td>
<td>51</td>
<td>732</td>
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<td>23.5%</td>
<td>20.5%</td>
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<td>7.4%</td>
<td>7.0%</td>
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</tr>
<tr>
<td><strong>Age group</strong></td>
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</tr>
<tr>
<td>0–14 years</td>
<td>60</td>
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<td>58</td>
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<td>237</td>
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<td>25.3%</td>
<td>10.1%</td>
<td>24.5%</td>
<td>12.2%</td>
<td>19.4%</td>
<td>8.4%</td>
<td>100%</td>
</tr>
<tr>
<td>15–19 years</td>
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<td>7</td>
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<td>5</td>
<td>95</td>
</tr>
<tr>
<td></td>
<td>22.1%</td>
<td>37.9%</td>
<td>24.2%</td>
<td>7.4%</td>
<td>3.2%</td>
<td>5.3%</td>
<td>100%</td>
</tr>
<tr>
<td>20+ years</td>
<td>295</td>
<td>165</td>
<td>96</td>
<td>42</td>
<td>21</td>
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<td></td>
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<td>6.3%</td>
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</tr>
<tr>
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<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>NZ European</td>
<td>274</td>
<td>213</td>
<td>138</td>
<td>61</td>
<td>59</td>
<td>58</td>
<td>803</td>
</tr>
<tr>
<td></td>
<td>34.1%</td>
<td>26.5%</td>
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<td>11</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>50.0%</td>
<td>7.3%</td>
<td>21.3%</td>
<td>8.0%</td>
<td>6.0%</td>
<td>7.3%</td>
<td>100%</td>
</tr>
<tr>
<td>Pacific</td>
<td>7</td>
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<td>1</td>
<td>1</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>43.8%</td>
<td>6.3%</td>
<td>25.0%</td>
<td>6.3%</td>
<td>6.3%</td>
<td>12.5%</td>
<td>100%</td>
</tr>
<tr>
<td>Other</td>
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<td>3</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>69.0%</td>
<td>-</td>
<td>10.3%</td>
<td>13.8%</td>
<td>3.4%</td>
<td>3.4%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>DHB of domicile</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waikato</td>
<td>173</td>
<td>55</td>
<td>70</td>
<td>33</td>
<td>26</td>
<td>26</td>
<td>383</td>
</tr>
<tr>
<td></td>
<td>45.2%</td>
<td>14.4%</td>
<td>18.3%</td>
<td>8.6%</td>
<td>6.8%</td>
<td>6.8%</td>
<td>100%</td>
</tr>
<tr>
<td>Bay of Plenty</td>
<td>105</td>
<td>50</td>
<td>40</td>
<td>16</td>
<td>27</td>
<td>17</td>
<td>255</td>
</tr>
<tr>
<td></td>
<td>41.2%</td>
<td>19.6%</td>
<td>15.7%</td>
<td>6.3%</td>
<td>10.6%</td>
<td>6.7%</td>
<td>100%</td>
</tr>
<tr>
<td>Lakes</td>
<td>43</td>
<td>103</td>
<td>34</td>
<td>15</td>
<td>12</td>
<td>20</td>
<td>227</td>
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<tr>
<td></td>
<td>18.9%</td>
<td>45.4%</td>
<td>15.0%</td>
<td>6.6%</td>
<td>5.3%</td>
<td>8.8%</td>
<td>100%</td>
</tr>
<tr>
<td>Taranaki</td>
<td>55</td>
<td>17</td>
<td>33</td>
<td>14</td>
<td>5</td>
<td>9</td>
<td>133</td>
</tr>
<tr>
<td></td>
<td>41.4%</td>
<td>12.8%</td>
<td>24.8%</td>
<td>10.5%</td>
<td>3.8%</td>
<td>6.8%</td>
<td>100%</td>
</tr>
</tbody>
</table>
exception of females aged 15–19 years. For females, the highest rates are for those aged over 20 years, being broadly similar to those for males aged 0–14 years. Major injury incidence rates for males across all age groups fluctuated over the period and were highest for males aged over 20 years, with a high of 21.1 per 100,000 in 2013/14. There were no major trauma injuries requiring hospital admission for female cyclists aged 0–14 or 15–19 years.

Table 2: Number of hospital admissions each year by injury severity, in Midland Region (excluding Tairawhiti district) 2012–2016.

<table>
<thead>
<tr>
<th>Year</th>
<th>Non-major (ISS ≤ 12)</th>
<th>Major (ISS ≥ 13)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Events %</td>
<td>Events %</td>
<td>Events %</td>
</tr>
<tr>
<td>2012/13</td>
<td>173 91.1%</td>
<td>17 8.9%</td>
<td>190 100.0%</td>
</tr>
<tr>
<td>2013/14</td>
<td>204 89.1%</td>
<td>25 10.9%</td>
<td>229 100.0%</td>
</tr>
<tr>
<td>2014/15</td>
<td>259 93.5%</td>
<td>18 6.5%</td>
<td>277 100.0%</td>
</tr>
<tr>
<td>2015/16</td>
<td>281 93.0%</td>
<td>21 7.0%</td>
<td>302 100.0%</td>
</tr>
<tr>
<td>Total</td>
<td>917 91.9%</td>
<td>81 8.1%</td>
<td>998 100%</td>
</tr>
</tbody>
</table>

Table 3: Cycling injuries in Midland Region 2012–2016, number of AIS diagnoses by body region and severity score.

<table>
<thead>
<tr>
<th>AIS Severity Score</th>
<th>Upper extremity</th>
<th>Lower extremity</th>
<th>Face</th>
<th>Head</th>
<th>Thorax</th>
<th>Spine</th>
<th>External</th>
<th>Abdomen/pelvis</th>
<th>Neck</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIS Body Region</td>
<td>1</td>
<td>2</td>
<td>3+</td>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper extremity</td>
<td>216 33.6%</td>
<td>420 65.4%</td>
<td>6 0.9%</td>
<td>642 100.0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower extremity</td>
<td>169 38.6%</td>
<td>210 47.9%</td>
<td>59 13.5%</td>
<td>438 100.0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Face</td>
<td>234 88.0%</td>
<td>32 12.0%</td>
<td>-</td>
<td>266 100.0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Head</td>
<td>69 30.3%</td>
<td>105 46.1%</td>
<td>54 23.7%</td>
<td>228 100.0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thorax</td>
<td>40 22.5%</td>
<td>75 42.1%</td>
<td>64 36.0%</td>
<td>178 100.0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spine</td>
<td>23 13.2%</td>
<td>131 75.3%</td>
<td>20 11.5%</td>
<td>174 100.0%</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>External</td>
<td>88 100.0%</td>
<td>-</td>
<td>-</td>
<td>88 100.0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abdomen/pelvis</td>
<td>42 54.5%</td>
<td>24 31.2%</td>
<td>11 14.3%</td>
<td>77 100.0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neck</td>
<td>4 80.0%</td>
<td>2 20.0%</td>
<td>-</td>
<td>6 100.0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>885 42.2%</td>
<td>999 47.6%</td>
<td>213 10.2%</td>
<td>2,097 100.0%</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
Table 4: Cycling trauma events, by place of injury and injury severity, in Midland Region 2012–2016 (excluding Tairawhiti District).

<table>
<thead>
<tr>
<th>Place of injury</th>
<th>Non-major (ISS ≤ 12)</th>
<th>Major (ISS ≥ 13)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Events</td>
<td>Rate</td>
<td>CI 95%</td>
</tr>
<tr>
<td>Road</td>
<td>326</td>
<td>86.7%</td>
<td>376</td>
</tr>
<tr>
<td>Countryside/beach</td>
<td>211</td>
<td>93.8%</td>
<td>225</td>
</tr>
<tr>
<td>Sports area</td>
<td>167</td>
<td>94.4%</td>
<td>177</td>
</tr>
<tr>
<td>Cycleway/sidewalk</td>
<td>76</td>
<td>97.4%</td>
<td>78</td>
</tr>
<tr>
<td>Home/farm</td>
<td>69</td>
<td>98.6%</td>
<td>70</td>
</tr>
<tr>
<td>Other</td>
<td>68</td>
<td>94.4%</td>
<td>72</td>
</tr>
<tr>
<td>Total</td>
<td>917</td>
<td>91.9%</td>
<td>998</td>
</tr>
</tbody>
</table>

Table 5: Cycling injury rate per 100,000 participating population, by age group and sex in Midland Region 2012–2016 (excluding Tairawhiti District).

<table>
<thead>
<tr>
<th>Age group, sex</th>
<th>Non-major injury (ISS ≤ 12)</th>
<th>Major injury (ISS ≥ 13)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rate</td>
<td>CI 95%</td>
<td>Rate</td>
</tr>
<tr>
<td>Males 0–14</td>
<td>49.3</td>
<td>34.1–69.1</td>
<td>1.6</td>
</tr>
<tr>
<td></td>
<td>54.2</td>
<td>38.1–74.8</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>87.6</td>
<td>66.6–113.2</td>
<td>1.6</td>
</tr>
<tr>
<td></td>
<td>83.9</td>
<td>63.4–108.9</td>
<td>-</td>
</tr>
<tr>
<td>Males 15–19</td>
<td>122.8</td>
<td>78.9–182.8</td>
<td>11.2</td>
</tr>
<tr>
<td></td>
<td>126.6</td>
<td>82.2–186.9</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>108.0</td>
<td>67.8–163.8</td>
<td>5.4</td>
</tr>
<tr>
<td>Males 20+</td>
<td>77.9</td>
<td>61.9–96.8</td>
<td>11.1</td>
</tr>
<tr>
<td></td>
<td>96.5</td>
<td>78.6–117.2</td>
<td>21.1</td>
</tr>
<tr>
<td></td>
<td>109.7</td>
<td>90.7–131.6</td>
<td>13.8</td>
</tr>
<tr>
<td></td>
<td>120.9</td>
<td>101.0–143.5</td>
<td>12.6</td>
</tr>
<tr>
<td>Females 0–14</td>
<td>22.3</td>
<td>12.1–37.9</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>33.5</td>
<td>20.5–51.9</td>
<td>-</td>
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<td></td>
<td>26.0</td>
<td>14.8–42.6</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>29.3</td>
<td>17.5–46.9</td>
<td>-</td>
</tr>
</tbody>
</table>
Discussion

The New Zealand policy and funding environment has seen considerable change over the last 20 years. Policy makers have increasingly looked to enable active transport, particularly for short-distance trips, and to increase multi-modal trips for longer commutes. Alongside this has been the growing importance of both on-road and off-road recreational cycling. Regional tourism and local cycle trail organisations have actively targeted recreational cyclists. Within the Midland Region there are now a number of cycle trails and mountain biking destinations, the genesis of some being the 2009 Prime Ministers job summit aimed at boosting regional economic development during the global financial crisis.

This increase in recreational cycling raises the question of whether recreational cycling can influence active transport uptake. A small 2013 Wellington study found that recreational cyclists were more open to moving into active transport (than non-cyclists), but were concerned about sharing the road with motor vehicles. A study of cyclists participating in the Lake Taupo Cycle Challenge suggested the importance of separated cycle paths as an encouraging factor. The new national road safety strategy, for consultation in 2019, will include the possibility of further adopting ‘Vision Zero’ principles. The vision includes the physical separation of cyclists from motor vehicles travelling above 30km/h.

Regional and local government authorities now have dedicated cycle plans aiming to make cycling a safer and more attractive commuting option. These plans are often referred to as ‘sustainable’ initiatives, aimed at increasing the liveability of communities, improving health and wellbeing, ameliorating road traffic congestion to lowering carbon emissions. It is at this local level that implementation issues may arise. There is a timing lag between the more ‘now’ promotion of cycling participation and actual implementation resulting in safer cycling environments. This study has shown increasing volumes and rates of trauma, particularly non-major trauma, which while not categorised by the ISS scale as ‘major’ can be significant in terms of impacts on injured individuals and their families. The MTS, as the regional hospital-based trauma service aims to reduce this burden of trauma, while still supporting the wider health benefits of increased participation.

Obviously not all cycling trauma involves a motorised vehicle. From an awareness raising and prevention perspective a sustained emphasis on cycle skills training (and cycle maintenance) for both young and older cyclists is needed. A higher level of riding skill should result in less ‘loss of control’ incidents. A more contested area perhaps is that of attitudes to cycling and the sharing of physical space on the road (in the absence of safer infrastructure), where a look through the comments section...
of any online article about cycling shows the polarised views of road users. The 2013 Chief Coroners report,25 2014 Cycling Safety Panel report24 and the 2015 interim evaluation of Safer Journeys report27 all consider improving both cyclist and motor vehicle driver behaviour in mixed traffic, including giving more space, cycle placement at intersections and slower speeds.

The Safer Journeys Strategy evaluation report also stated that focus must remain on cycling-related trauma while promoting cycling as a transport mode where “a lot of benefit will be lost if greater activity simply results in additional trauma”.

Progress towards achieving a safer cycling environment was rated as ‘insufficient’ in the context of most safety benefits to date having been accrued to motor vehicle occupants.26

So, while cycling has documented health, environmental and economic benefits1 there remains a tension between these benefits and safety concerns, particularly for cycling that involves sharing physical road space. At all government levels, cycling promotion often appears well ahead of implementation. The resulting timing lag could contribute to an increasing number of injuries, adding to the trauma burden in the community and to costs across the health system.

**Strengths and weaknesses**

One strength of this study is the MTS registry data, which captures both major and non-major trauma. The inclusion of non-major trauma allows the trauma burden to be better quantified. The registry allows analysis of injury events, patient factors and processes in care and outcomes. However, the registry does not include data for injured persons who died prior to hospital admission, where the injury did not result in an admission, those cyclists only treated in primary care facilities, and those who sought no treatment at all.

**Conclusion**

We acknowledge the health, environmental and economic benefits of increased cycling participation but advocate there is a tension requiring greater acknowledgement—in that the promotion of cycling is generally ahead of safety improvement initiatives. From our perspective this timing lag has consequences, for all cyclists injured and for health system costs. Due consideration of these consequences is needed if the full range of cycling benefits are to be realised.

**Competing interests:**
Nil.

**Acknowledgements:**
We want to acknowledge the ongoing commitment of the clinical staff across the Midland Trauma System to collecting the base trauma data, and the hub staff for data entry and quality checks on the Trauma Registry. We also thank Professor Shanthi Ameratunga for reviewing an early draft.

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**URL:**
REFERENCES:


What is medicinal cannabis?
Michelle Glass, John C Ashton

ABSTRACT
As New Zealand considers cannabis legal reform, we ask: what exactly is medicinal cannabis, and why does this matter? Cannabis is not a single entity but comes in diverse forms with various active ingredients. This contrasts with the legal and pharmaceutical definitions of medicines, with wide-ranging implications for quality control, prescriber practice and the assessment of clinical evidence. We argue that what is considered a medicine in the legal and pharmaceutical sense should not be changed in an ad hoc way to accommodate cannabis, but that cannabis products should be held to the same standards as other medicines.

In line with global trends, New Zealand has recently passed a Bill increasing access to “medicinal cannabis”. The Government now has one year (from December 2018) to determine the regulations for a Medicinal Cannabis Scheme. Public survey shows widespread support for increased access to medicinal cannabis, yet GPs and clinicians generally remain more reserved. We believe that part of this difference lies in the lack of clear public understanding of the term “medicinal cannabis”, and a relatively greater awareness by health professions of what generally constitutes a medicine. New Zealand is also about to undergo a binding referendum on recreational cannabis use, the exact wording of which is yet to be determined. Thus, it is timely to consider the question “what is (and isn’t) medicinal cannabis?” Current media use of the term medicinal cannabis encompasses everything from pharmaceutical grade plant derived medicines, such as Sativex, through to home-grown raw plant materials. From the perspective of a potential prescriber these are very different products.

Here we attempt to bring clarity to the issues that the regulations must address. Specifically, we argue that there are already existing cannabis derived medicines approved by Medsafe, and others are expected to follow. Hence, what does the current Act seek to achieve? Is it a new definition of “medicine” designed specifically to accommodate cannabis? Or else does it mean (as we prefer) that medicinal cannabis should be held up to the same standards that all other medicines must meet? That is to say, why should cannabis be treated differently from any other medicines?

What is a medicine?
A billboard currently prominently displayed on the Auckland motorway declares “cannabis is medicine”, but is this true? The first problem encountered in considering cannabis as medicine is that “cannabis” is not a single entity, but a diverse range of related substances and products all referred to as “cannabis” in popular usage. Which of these may be considered a medicine depends on precisely how the product is constituted, although at an individual level, definitions of “medicine” can vary, when products are assessed at the level of manufacturing and marketing as medicines, the definitions become more precise.

Most if not all of products referred to as medicines contain drugs: synthetic chemicals or chemicals from plants (or in some cases from animals or from biotechnology) that can be administered to the body to create a physiological effect. Drugs in their pure form are single molecules, and can be used in biomedical research to elicit particular effects through their actions on specific molecular targets within the body. By contrast, technically a medicine is usually a mixture of chemicals at precisely determined ratios, containing one or more drugs that is administered with the aim of producing a therapeutic effect. Medicines may contain other chemicals than the active drugs such as excipients, stabilisers and solvents.
This pharmaceutical definition of medicines overlaps considerably with legal terminology in New Zealand,8 where under the Medicines Act (1981) the term medicine principally refers to a either a substance that is administered to “one or more human beings for a therapeutic purpose; and achieves, or is likely to achieve, its principal intended action in or on the human body by pharmacological, immunological or metabolic means” or to “...a therapeutically active ingredient” in such a substance. The definition is less clear in the Medicines Standing Order (2002),9 where a medicine “…means a prescription medicine or a specified controlled drug”. Other jurisdictions use similar definitions; notably Australia has a “…two-tiered system for the regulation of medicines, including complementary medicines”10 such that medicines are classified into higher and lower risk categories, and subject to different regulations.

Whether or not a substance meets the criteria for being treated as a medicine has wide-ranging consequences. A substance that has such regulatory approval will be produced in accordance with exacting and costly standards.11 Supply chains will be traceable and monitored to ensure the medicine is not diverted into illicit use. It will contain precisely defined amounts of active ingredients, such that dosages are uniform both between administrations and across production runs. With reproducibility, and the possibility for dose titration, safety and efficacy can be tested with high-quality clinical trials. Adverse events can be monitored by post-marketing surveillance, minimising public risk. With reliable dose and effect information, practitioners are able to both prescribe a medicine with clear expectations of potential effects, and ascertain dose adjustments or other interventions following treatment. Patients can receive reliable information about likely effects of the drug, critical for informed consent. The medicine will be in a form that can be practically and reproducibly administered to the patient, with a known shelf life and important patient information such as onset and duration of action.

What is cannabis?

The precise taxonomic classification of Cannabis is still undecided,12 but prevailing theory recognises one highly diverse species of C. sativa L., with segregates distinguished by morphology and phytochemistry (cannabinoids and terpenoids). The segregates consist of two subspecies: subsp. sativa (European “rope”) and subsp. indica (Asian “dope”). The latter subspecies consists of two domesticated varieties: Central Asian landraces, often hybridised as “Indica”; and South Asian landraces, often hybridised as “Sativa”. Wild-type plants are named C. sativa subsp. sativa var. ruderalis, although a minority of botanists treat the wild-type as a separate species, C. ruderalis. El Sohly has identified 545 distinct compounds in cannabis, among which 120 exhibit the typical C21 terpenopholic skeleton of a cannabinoid.13 The primary focus therapeutically to date has been on Δ9-tetrahydrocannabinol (THC),14 the main psychoactive component of cannabis,15 and cannabidiol (CBD).16 In raw plant material concentrations of these compounds are actually very low, rather they exist as their acid precursors, which are decarboxylated to the active compounds slowly by drying or rapidly by heating, such as when cannabis is smoked or cooked into edibles. Understanding the critical difference between THC and CBD requires an understanding of the system upon which THC acts in the body: the endocannabinoid system.

The endocannabinoid system is comprised of at least two G-protein coupled receptors (CB1 and CB2), at least two endocannabinoids (anandamide and 2-arachidonyl glycerol) and the enzymes responsible for the synthesis and degradation of the endocannabinoids.17 In contrast to classical neurotransmitters that are stored in vesicles, endocannabinoids are N-acyl-lipids, synthesised on demand from lipid precursors in the cell membrane. In the brain, endocannabinoids are thought to be retrograde neurotransmitters—released from the post-synaptic neuron following increases in intracellular calcium concentrations and acting on receptors on the pre-synaptic neuron to inhibit further release of neurotransmitter. The effects of endocannabinoids in the brain are primarily mediated by CB1 receptors, with CB2 being widespread within the immune system. THC acts on CB1 receptors in the brain, creating the characteristic “high” of cannabis,14 THC is a low efficacy (partial) agonist at these receptors with moderate affinity, in contrast
to extremely high efficacy and high potency synthetic cannabinoids that are driving the current synthetic cannabinoid crisis.\textsuperscript{18}

CBD is traditionally obtained from enriched extracts of industrial hemp, a cultivar of cannabis with naturally low THC content. CBD does not significantly activate cannabinoid receptors, which probably accounts for its lack of “high”. Allosteric antagonism at CB\textsubscript{1} and CB\textsubscript{2} has been proposed, but CBD’s mechanism of action is poorly understood, and a multitude of putative mechanisms have been proposed,\textsuperscript{19,20} including acting on the equilibrative nucleoside transporter (ENT), the orphan GPCR GPR55, TRPM8 channels, PPAR-gamma, and other targets such as TRPA1, and 5-HT\textsubscript{1a}, alpha3, and alpha1 glycine receptors. It is a potent antioxidant, and also interacts pharmacokinetically with THC, increasing THC concentrations in serum and brain.\textsuperscript{21,22}

Uniformity is a central feature of medicines, but concentrations of CBD and THC in cannabis plants vary widely. THC concentrations in cannabis sold on the recreational market are high and increasing. In contrast, CBD content is purported to be higher in “medicinal cannabis”.\textsuperscript{23} However, a recent analysis of 32 cannabis cultivars marketed under the Access to Cannabis for Medicinal Purposes Regulations in Canada quantified 10 of the most common cannabinoids and 14 terpenes.\textsuperscript{24} THC concentrations varied from 0.24–7.08\%, while concentrations of CBD varied from undetectable to 5.52\%. The variability in THC and CBD across plants was highlighted in this study which found that plants could be classified into four main types: high THC (6.3\%) with low CBD (0.04\%); moderate THC (3.84\%) with low CBD (0.02\%); approximately equal THC and CBD (around 1.3 vs 1.92\% of respectively); CBD dominant (only one cultivar fell into this category, with >5\% CBD and less than 1\% THC).\textsuperscript{24} In addition, concentrations of other phytochemical constituents varied widely between cultivars—the relevance of these other constituents to therapeutic effect is still being investigated.\textsuperscript{25,26}

Cannabis derived medicines (by the definitions described above) do currently exist. Marinol (dronabinol) is synthetic THC—a single agent medicine containing 2.5, 5 or 10mg THC dissolved in sesame oil. Nabilone is a synthetic THC derivative marketed in 1mg capsules. Sativex is a plant extract, manufactured by GW pharmaceuticals by blending together extracts from two plant varieties (one high THC, one high CBD) to produce a blend and is an oromucosal (mouth) spray administering a metered, actuated dose containing THC (2.7mg/spray), and CBD (2.5mg/spray)—approved by Medsafe in New Zealand for spasticity related to multiple sclerosis and through the medicinal cannabis access scheme for other applications (not funded through PHARMAC). Although not yet approved for distribution in New Zealand, a pharmaceutical grade CBD product, Epidiolex (98\% CBD), has recently become the first FDA-approved plant derived cannabinoid medication.

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**Therapeutic uses of cannabis**

A variety of therapeutic effects have been attributed to cannabis. Perhaps the intended effect that underlies much public discussion is as a pain reliever. There is a small amount of evidence for very mild pain relief by CBD,\textsuperscript{27,28} but most studies have been carried out using THC-enriched preparations. For smoked cannabis the clinical trial evidence for substantial pain relief is mixed.\textsuperscript{28,29} Indeed, at least one study has shown that habitual cannabis use can increase the need for other pain relief after acute injury.\textsuperscript{30}

In a large prospective study carried out over four years in Australia, researchers concluded that there was no evidence that cannabis use improved patient outcomes.\textsuperscript{31} Large scale randomised clinical trials using Sativex have also produced disappointing results,\textsuperscript{32} and meta-analyses have tended to find at best a very mild analgesic effect for any cannabinoids.\textsuperscript{33,34}

Sativex has, however, been found to provide moderate relief for patients with multiple sclerosis, as an add-on treatment for the control of spasticity and painful muscle spasm,\textsuperscript{35} though only as a third- or fourth-line treatment. CBD in the form of Epidiolex has shown promising results as an add-on treatment for the control of epilepsy in the treatment of seizures in associated with Lennox-Gastaut syndrome\textsuperscript{36} or Dravet syndrome,\textsuperscript{37,38} although questions remain as to whether these results might be explained by pharmacokinetic drug interactions.\textsuperscript{39–41} There are various other effects of THC that are well established, such as an appetite...
stimulant for the treatment of cachexia and as an anti-emetic in chemotherapy, but even in these cases THC is at best only indicated as a third line treatment for refractory cases.\textsuperscript{42} CBD has various anti-inflammatory and anxiolytic properties attributed to it, and although this is currently under clinical investigation, there is as yet no convincing evidence for clinically relevant effects.

Despite the paucity of evidence for strong therapeutic effects from cannabis, it is sometimes claimed that patient anecdotes prove the therapeutic effects of cannabis, and that clinical trial evidence is misleading. One reason that has been suggested to explain this “evidence gap” is the existence of a sub-population of “cannabis responders” that are not accounted for by clinical trials. This claim has been tested recently by trials that use an enriched experimental design, where an initial trial phase is followed up with a second trial phase consisting only of the best responders from the first phase. Using this method, some evidence in favour of this hypothesis has been found for Sativex as a treatment for spasticity caused by multiple sclerosis.\textsuperscript{43} However, the same trial design in a study of cancer pain did not show a clear therapeutic benefit from Sativex even among those previously classified as responders.\textsuperscript{44} Another possible explanation is that apparent therapeutic effects of (THC based) cannabis are due to its mood altering and anxiolytics effects.\textsuperscript{44,45} Also, the absence of adverse effects of opioid treatment such as painful constipation may skew perceptions of the relative efficacy of cannabis. Lastly, Lowe et al.\textsuperscript{46} have argued strongly that experience of self-medication by habitual cannabis users may often be an illusion, where relief from the symptoms of cannabis withdrawal is mistakenly perceived as a therapeutic effect. And in addition to these considerations, it is even possible that cannabis clinical trials may in fact over-estimate therapeutic effects, as the psychoactivity of cannabis may lead to patient unblinding and therefore an expectation of a therapeutic effect.\textsuperscript{47}

The evidence base for any form of medicinal cannabis needs to be as robust as for any other medicines so that risk:benefit profiles can be properly evaluated.\textsuperscript{48} In this respect, the adverse effects of cannabis also require more serious discussion. These are well known,\textsuperscript{46,49} and include; effects on mood and sedation, deficits in cognitive ability, dependence and withdrawal effects, and residual effects on cognition that may last for several weeks after cessation. Heavy use also increases the risk of poor life outcomes and decline in socio-economic status as well as the risk of mental health problems, particularly when heavy cannabis use begins at a young age. Moreover, combined with genetic vulnerability cannabis use at a young age can exacerbate a predisposition to schizophrenia. These risks are often downplayed,\textsuperscript{48} but this is a particularly important consideration as the trend of THC content increasing in cannabis leaf grown for the recreational market\textsuperscript{50–52} has raised a number of health concerns. Frequent use of high potency cannabis is associated with greater severity of dependence\textsuperscript{53} and adverse psychological outcomes.\textsuperscript{54,55} While concentrates (highly purified extracts with 60–80% THC\textsuperscript{56}) are a reasonably new addition to the medicinal market, case reports of psychosis from prescribed products are emerging.\textsuperscript{57,58}

Is “cannabis” a medicine?

Currently the MOH web site lists four categories of “medicinal cannabis”.\textsuperscript{59} 1. Pharmaceutical grade products that have consent for distribution in New Zealand (currently this is just Sativex), 2. Pharmaceutical grade products that don’t have consent for distribution in New Zealand, 3. Non-pharmaceutical grade products and 4. CBD products—which encompasses those products containing CBD with negligible concentrations of THC (there is no requirement that these be pharmaceutical grade).

The Misuse of Drugs (Medicinal Cannabis) Amendment Act\textsuperscript{1} also provides an exemption for those requiring palliation to the charge of possessing or using illicit cannabis, which would encompass any product not prescribed by a doctor, including dried leaf material, oils and balms, and submissions to the select committee urged for these more “home grown” approaches to be allowed within the new regulatory scheme.\textsuperscript{60}
Until recently Canada provided one example of a medicinal cannabis regulatory framework. In Canada, access was initially allowed to dried plant material either through regulated Health Canada supply or by patients producing their own plants. Due largely to legal challenges the Act changed substantially over time. In 2013 a commercial industry was developed, responsible for the production of quality-controlled dried cannabis material produced under “secure and sanitary conditions”. More recently other cannabis products were included, allowing licenced producers to produce and sell cannabis oil and fresh cannabis buds and leaves in addition to dried cannabis. However, the requirement to get cannabis only from licenced producers was legally challenged in 2016 and a new Act was developed which laid out a framework for commercial production of fresh and dried plant material and cannabis oils as previously, but extended also to “starting materials” (seeds and plants) and enabled provisions for individuals to produce limited amounts of cannabis for their own medical purposes or to designate someone to produce it for them. All of this was repealed in October of 2018, when recreational use of cannabis became legal in Canada. The new Cannabis Act still regulates aspects around who can produce, the types of products available, packaging and labelling, standardised potency etc and restrictions on promotional activities.

A market such as this does not fit into any of the traditional definitions of a medicine, regulated by Medsafe in New Zealand, and funded by PHARMAC. Funding is important, one of the major objections from patients about the use of Sativex arises from the high cost per patient. Similar concerns would likely follow if high CBD products such as Epidiolex were not widely funded by PHARMAC. There seems no reason to believe that even local products could be developed that meet pharmaceutical grade, have gone through clinical testing but are significantly cheaper. So, does “medicinal” cannabis fit into any existing frameworks? We would argue no if doctors are asked to prescribe it. This is not to say that non-pharmaceutical grade products couldn’t be treated as something more analogous to recommending a herbal supplement. In such a scenario, quality and safety would still be controlled, but efficacy would not be required to meet medicinal standards.

Regardless of how cannabis is classified, quality standards remain critical. Patients represent a vulnerable and often immune compromised population so in addition to the active ingredients being controlled and clearly labelled, product should be solvent, pesticide—and mould free—reports suggest this is often not the case in the US medicinal cannabis market.

Implications and conclusions
We argue that even if various cannabis products might have benefit for some patients, it is not helpful to classify anything other than a pharmaceutical grade product as a medicine. “Cannabis” is not a single entity, and the entities under discussion usually do not meet the requirements for other medicines.

The quality control rigors for classification as a medicine, the properties that a substance must have for safe and effective prescribing, the assessment and monitoring of effects—both therapeutic and adverse—are safeguards that should not be compromised or redefined without a careful consideration of the consequences, many of which could be unintended.

Quality controls are also one aspect of a quality evidence base, both for therapeutic and adverse effects; anecdotes are not enough. Nonspecific sedative effects, relief from withdrawal and strong placebo effect all confound patient perceptions, and perceptions cannot replace objective standards when formulating medical policy.

Finally, access to medicines in New Zealand is increasingly limited by funding constraints. With so many pharmaceutical grade medicines that have gone through rigorous testing not available to the New Zealand public, we question the wisdom of spending this limited funding on products that do not meet these standards.
Competing interests:
Dr Glass is the chair of the Medicinal Cannabis Research Collaborative, a group that was established to design and carry out research around medicinal use of cannabis, and to provide advice as appropriate to others in this area (government, policy makers or people in the medicinal cannabis industry). She is not paid for this role.

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REFERENCES:


40. Greffey AL, Pollack SF, Bruno PL, Thiele EA. Drug-drug interaction between


60. NZ Drug Foundation Submission on the Misuse of Drugs (Medicinal Cannabis) Amendment Bill Downloaded from http://www.drugfoundation.org.nz/policy-and-advocacy/medicinal-cannabis/


An updated critique of the use of the Twin Spine Study (2009) to determine causation of low back disorder

Christopher B Walls, Andrew Snell, David J McLean, Neil Pearce

Our previous letter to this Journal\(^1\) criticising the “Twin Spine Study”\(^2\) aroused no commentary in your Journal, certainly no contribution supporting the use of the “Twin Spine Study” to deny occupational influences on low back disorder.

Unfortunately this study continues to be quoted by some commentators in the compensation field to “prove” that lumbar spinal disc degeneration arises from genetic factors and such pathology is not influenced even by decades of occupational exposures to recognised risk factors.

As a consequence, coupled with the proposal that radiologically identified deterioration in the structures of the lumbar spine is caused by “degeneration” (ie, a consequence of age alone), Accident Compensation claimants with low back pain are denied cover, subsequent access to treatment modalities and suffer considerable financial hardship as they progress through the long rehabilitation from lumbar disc injury.

We again bring to your readers’ attention the errors in this blanket but incorrect application of imperfect epidemiology.

Battié’s Twin Spine Study deals with lumbar disc degenerative pathologies primarily based on MRI scan findings (now dated by more modern technology) using a standard but individual protocol, the interpretation of which is radiologist dependent.

This and other twin studies are flawed for this and other reasons.

The initial studies of variance were done in the agriculture domain where multiple identical genetic copies of a plant species could be tested in reasonably tightly controlled environmental conditions. In this case of identical genetic organisms raised in different environmental conditions, the observed differences will be entirely environmental.

In contrast, if one considers organisms of a different genetic make-up (such as lab rats) who are raised in identical environmental conditions, any observed differences will not only be caused by the environment but also can relate to how the individual genes that make up each organism interact with the environment. Thus it is often unclear as to what environmental effect and what genetic features are causing the observed outcome.\(^3\)

Studies in humans cannot be interpreted confidently in either of these situations, and it would be most unlikely that the interaction between the genes and any environmental factors will be a direct linear relationship across all traits and interactions.

Complex conditions, such as many spinal pathologies, will involve numerous genes with different levels of influence. Despite much research, no gene or group of genes has been identified as being responsible for lumbar disc degenerative pathologies.

In order to be valid, these studies also have an unproven “equal environments” assumption, ie, that the environments in which the twins are raised (before occupational exposures) are identical. In addition, these studies have insufficient power to warrant the certainty placed in them.\(^4\)

A 2013 meta-analysis\(^5\) of all studies attributed the hereditability estimate for low back pain (not degeneration) to between 21–67%, a threefold difference.
Eskola et al. reviewed 52 genetic association studies in lumbar disc degeneration concluding “...based on this first extensive systematic review on the topic, the credibility of reported genetic associations is mostly weak. Clear definition of lumbar disc degeneration phenotypes and large population-based cohorts are needed...”, in other words that at this time, there is no identified gene/combination that supports the stated outcomes of the Twin Spine Study.

So while genetics almost certainly plays a role in low back pain (as in most disease states), given the extremely complex interactions between our genes and the environment, assigning a percentage value to an individual based on population data while disregarding personal circumstances is impossible.

As our previous critique of the Twin Study points out, to attribute the predominant cause of lumbar disc injury to genetic factors misunderstands the epidemiology used in this study, confusing variation and causation.

It is assumed that the percentage of causation adds to 100% for any disease arising from a combination of factors, described in the examples as both genetic and environmental. However, if one again considers the example of Phenylketonuria (PKU), the genetic contribution is 100%, but the disease doesn’t exist where the person’s diet is phenylalanine free (that is the environmental contribution to causation is also 100%) so that, for example, quoting a >50% contribution (out of 100%) for genetic influences is incorrect.

There are other issues with the structure and assumptions contained within the Twin Spine study and other such studies. Woszak and Cieslik in a complex review of the validity of assumptions underlying such Twin Studies note the experimental basis of their assumptions and conclusions, and concluded that criticisms of the methodology of these types of studies are “fully justified” and commented “Consequently, the heritability indices of somatic traits (for example lumbar disc injury) should be considered only a provisional measure of genetic polymorphism, expressing an estimated relative contribution of genotypic variance to the phenotypic variance of a given trait”.

A further critique of the design of such studies is made by Benchek and Morris who comment that the studies rely on untestable assumptions, and these assumptions, if varied, introduce substantial biases.

Again we would point out that there are a myriad of structures in the lower back capable of generating pain, secondary to sophisticated MRI scanning of the lumbar spine we live in the era of “disc injury” although treatment aimed at these disc injuries is often unsuccessful in relieving patient pain.

The recommendations from the Quebec symposium on low back disorder, although dated, are still relevant. This suggests that doctors should diagnose “low back disorder” and then comment with varying degrees of certainty about the likely pathology causing this disorder (e.g. “L5/S1 disc protrusion; compression fracture L1 vertebral body; of unclear origin” etc).

Thus the confidence of the authors of and commentators using the Twin Spine study to attribute lumbar disc “degeneration” primarily to genetic inheritance is misplaced.

There are fundamental misunderstandings of the epidemiology as discussed in our previous comment in the New Zealand Medical Journal, and Battie’s study is based on assumptions that, although superficially attractive, are unproven and subject to inherent inaccuracies that could substantially alter the stated outcomes.

As we have argued in the past, ‘degenerative changes’ represent a common end pathway to a number of contributing factors, including genetic influences, constitutional (structural) influences, age-related changes and occupational influences, and it would be our proposal that many of the low back ‘degenerative’ changes identified in working people, in the presence of an history of multiple, ‘minor’ episodes of low back disorder represent “post-traumatic osteoarthritis of the lumbar spine”.

Again, the epidemiology of low back pain causation is complex, but in our opinion there is reasonable evidence for an association between specific work factors and low back disorder, best summarised in the dated but still relevant (that is, that has not been superseded) NIOSH epidemiological review.
These factors are supported by a number of more modern studies including the Epilift studies focusing on disc injury that demonstrate a dose response relationship with occupational factors.\textsuperscript{13,14} We would argue that the Bradford Hill criteria for this association (occupational exposure to known risk factors and the development of low back disorder) are reasonably satisfied.

**Competing interests:** Nil.

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**REFERENCES:**

12. Musculoskeletal Disorders and Workplace Factors DHHS (NIOSH) 97–141.
The importance of rurality data in understanding access to healthcare services for childhood obesity

Cervantée EK Wild, Cameron C Grant, Tami L Cave, Lisa E Wynter, José GB Derraik, Esther J Willing, Paul L Hofman, Yvonne C Anderson

Obesity rates in Aotearoa/New Zealand (henceforth referred to as New Zealand) are characterised by marked inequalities across both ethnicity and socioeconomic status. Approximately 17% of Māori children and 30% of Pacific children are affected by obesity, compared with 10% of New Zealand European/Other children. The risk of obesity is also two times higher for children living in the most versus the least deprived areas of New Zealand. Given the high risk of weight-related comorbidities, these inequities are alarming, and it is important that government and obesity-related services work to address this to improve access across the population.

Concerns about the ability of rurality statistics in New Zealand to accurately identify disparities have previously been highlighted by Fearnley, Lawrenson and Nixon (2016). Very little data are collected on urban/rural differences as they relate to obesity in New Zealand. Data that have been collected have not demonstrated the same inequalities present in other similar countries. In developed countries where data exist, the frequency of obesity and related comorbidities is higher in rural populations. Given this pattern in similar developed countries, as well as evidence of rurality disparities across other health and access indicators in New Zealand, it is reasonable to hypothesise that inequities in rurality relating to obesity might also exist in New Zealand. We sought to determine if urban/rural disparities existed in our cohort of children and adolescents with obesity.

Whānau Pakari is a multi-disciplinary, family-centred obesity assessment and intervention programme for children and youth based in Taranaki, a semi-rural region of New Zealand where approximately 26% children aged 5–15 years live in rural areas (compared with 15% in New Zealand overall). The results of the randomised clinical trial, comparing an assessment-and-weekly-sessions model (intervention) with an assessment-and-advice model (control), have been previously reported, and showed improvements across both the intervention and control in body-mass index standard deviation score (BMI SDS), cardiovascular fitness and health-related quality of life at 12 months. Whānau Pakari increased reach and initial engagement with Māori and New Zealand European (NZE) families, each comprising 47% and 43% of trial participants respectively, and with 28% of participants from the most deprived household quintile, demonstrating improved access for these groups.

This secondary analysis assessed inequities by rurality in Whānau Pakari, in order to improve access for all. Analysis was comprised of n=199 participants who were randomised to either the high-intensity intervention (n=100) or low-intensity control arm (n=99) after exclusions. Rurality was classified according to 2006 meshblocks using the Statistics New Zealand Urban/Rural Profile: Geographic Concordance file, and was grouped into two categories: urban (including main urban

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area, satellite urban area, and independent urban area) and rural (including rural area with high urban influence, rural area with moderate urban influence, rural area with low urban influence and highly rural/remote area), due to the small sample size of some of the categories.\textsuperscript{10}

Overall, 80.4\% (n=160) of the cohort lived in households in urban areas with 19.6\% (n=39) in rural areas (Table 1).

There were no differences at baseline assessment between rural and urban participants for primary or secondary outcomes, and for those with 12-month assessments (n=138), there was no difference between urban (n=111) and rural (n=27) participants in BMI SDS at 12 months (p=0.91) or in the change in BMI SDS from baseline (p=0.98). In addition, there were no differences between urban and rural participants across a range of secondary outcomes. There was also no difference between urban (n=74) and rural (n=22) participants in the proportion who attended ≥70\% (n=96) of the intense intervention sessions, which would suggest similar levels of access between urban and rural groups.

Initially, the encouraging lack of difference between participants living in urban versus rural households at both baseline and 12-months might suggest that either inequities in obesity rates by rurality do not exist, or that this community-based intervention programme is equally effective for urban versus rural dwelling children. However, this contrasts with the published literature, which identifies that typically rural children have higher rates of overweight and obesity than urban children.\textsuperscript{12} What is more likely is that the lack of difference is an artefact from a lack of reliable rural health data, as argued by Fearnley and colleagues (2016), who highlight that Statistics NZ’s current rurality definition does not account for health service access.\textsuperscript{3} Moreover, Statistics NZ regards their rurality classification as ‘experimental’, only releases selected data by rurality, and has not released rurality data since 2006, which limits further analysis.\textsuperscript{10}

There was a comparatively low proportion of rural Māori and high proportion of rural NZE children in this cohort. Only 13\% of Māori participants resided in rural areas, whereas 18\% of Māori in Taranaki live in rural areas.\textsuperscript{10} This may suggest that inequities in rural Māori in relation to obesity do not exist; an alternative and more likely explanation is that there are societal and social issues that affect rural Māori that act as a barrier to engagement with the service in the first place—yet this remains difficult to address without accurate, reliable data which captures the complexities of accessing healthcare in rural New Zealand.

We recommend that comprehensive data on rurality is reported alongside more common demographic data such as

### Table 1: Demographics of participants in the Whanau Pakari randomised clinical trial, according to rurality (prioritised ethnicity).

<table>
<thead>
<tr>
<th></th>
<th>Urban</th>
<th>Rural</th>
<th>p-value</th>
</tr>
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<tbody>
<tr>
<td>N</td>
<td>160</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>Ethnicity n (%)</td>
<td></td>
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<td></td>
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<tr>
<td>NZE</td>
<td>59 (37)</td>
<td>26 (67)</td>
<td>0.002</td>
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<tr>
<td>Māori</td>
<td>82 (51)</td>
<td>12 (31)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>19 (12)</td>
<td>1 (2)</td>
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<tr>
<td>Sex n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>75 (47)</td>
<td>18 (46)</td>
<td>0.94</td>
</tr>
<tr>
<td>Female</td>
<td>85 (53)</td>
<td>21 (54)</td>
<td></td>
</tr>
<tr>
<td>Age (years) mean ± SD (range)</td>
<td>10.9±3.1 [7.8–14.0]</td>
<td>9.9±3.5 [6.4–13.4]</td>
<td>0.14</td>
</tr>
<tr>
<td>NZDep2006 decile\textsuperscript{4} median (IQR)</td>
<td>7 (4.0)</td>
<td>5 (3.0)</td>
<td>0.001</td>
</tr>
</tbody>
</table>

SD standard deviation; IQR interquartile range.
ethnicity, age, sex and appropriate deprivation measures. It is important that the current definition and classification of rurality in New Zealand is reviewed and updated, as per Fearnley and colleagues’ suggestion, in order to more reliably and confidently analyse any differences by rurality, and better serve the population. Routinely collecting data on rurality is necessary in order to identify and address inequities, and improve accessibility to healthcare services, especially for Indigenous population groups. Without accurate data, we lack a full understanding of the state of rural health in New Zealand, and we miss the opportunity to further address potential inequities in childhood obesity.

Competing interests:
Nil.

Acknowledgements:
The authors thank the participants of Whānau Pakari. We also thank the Taranaki District Health Board and Sport Taranaki for support of the trial. This work was supported by the Health Research Council of New Zealand, Royal Australasian College of Physicians, Maurice and Phyllis Paykel Trust, Taranaki Medical Foundation, and Lotteries Health Research. The funders of the study had no role in the study design, data collection, data analysis, data interpretation or writing of the report.

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REFERENCES:
4. Jackson J, Doescher M, Jerant A, Hart L. A national study of obesity preva-


Health information research privacy standards should include Māori perspectives on privacy

Rajan Ragupathy, Vithya Yogarajan, Chris Luoni

Secondary research using health records and other personal health data (henceforth referred to as health information research) is a valuable tool for tackling New Zealand’s health and social challenges. It requires however suitable privacy standards to maintain public confidence and social license. The privacy protocols used by New Zealand district health boards have been described in this journal, as have additional safeguards that could be adopted to prevent privacy breaches.1,2

Here we present a more conceptual approach for considering what ‘privacy’ means in health information research, particularly the importance of including Māori perspectives on privacy. The health disparities between Māori and non-Māori are well documented, and privacy standards based on a monocultural view of privacy may hinder efforts to address these. Researchers have identified previously identified instances where cultural background affects what information New Zealanders are comfortable sharing, and with whom.3,4

As an example, individuals from different cultural backgrounds may have different views on:

- what information is considered private
- whether privacy should be maintained by formal laws, informal codes of conduct or both
- where and when intruding on an individual’s privacy is morally justified
- the extent to which information can be shared with family
- whether they are more comfortable sharing information with public agencies or private institutions
- the likelihood of surveillance, stigmatisation and profiling.3-5

Some caveats are in order. Individuals within any culture are heterogeneous, with different perspectives shaped by their unique circumstances, and have a number of facets to their identity.6,7 Just as it is wrong however to assume that any aspect of a person’s identity is deterministic of views or behavior, it is equally wrong to assume that it has no effect.5,7 With those caveats in mind, it is worth examining how past findings on cultural attitudes to privacy might be applied to health information research. Incorporating Māori perspectives into research standards from the outset is crucial if we are to progress towards equity. This helps promote the Māori voice (ensuring the story of Māori health, values and needs are not simply told from the majority perspective), and is part of the larger framework of responsiveness to Māori in health research.8

Individual versus community: Menkes et al found Pakeha [New Zealanders of European descent] were more likely than Māori to see each patient as an autonomous individual whose privacy could only be over-ridden by the needs of society in very limited circumstances such as preventing transmission of a contagious disease.3 Māori were more likely to see autonomy as best being able to be exercised with the involvement of whānau and community, and with due consideration...
of whakapapa (relationships and the structures that maintain relationships, including with those who have come before and future generations). The question of when whānau should be informed about an individual or involved in decision making was nuanced, and often varied between generations. Community consent (in addition to individual consent) was valued by Māori. This is grounded in values of collective ownership of information, especially genetic information. This should be considered in all health information research.

**Formal and informal codes**

Pakeha were more likely to support formal codes governing how and when personal health information should be shared, and to believe these rules should be enough to cover most situations. At the same time, they recognised these general rules may be unworkable in some situations, with exceptions being able to be made based on the severity of the situation and the social connection of the person receiving the information to the patient. Māori were more likely to recognise informal codes (Tikanga), including those specific to an iwi or hapu. Younger Māori were likely to reference these informal codes as sitting alongside formal codes, while older Māori were more likely to consider the informal codes forming a distinct system. Māori were more likely to consider generalised rules to be inappropriate, and that each situation should be evaluated on its merits.

**Trust in government agencies versus private businesses**

New Zealanders of all cultural groups were more likely to trust government agencies with their personal information than private businesses, while also being acutely conscious of the power imbalance between the individual and the state. Māori and Pasifika people were however more concerned about the amount of information government agencies held about them (and how that information could be used), and were more willing to withhold information. Pakeha were more likely to trust government agencies with their information than Māori, Pasifika or Asian New Zealanders. It is important to consider how information held in government or business databases could (for good or ill) be combined with information individuals generate daily through wearable fitness devices, social media and communication metadata. It is also important to remember that ostensibly impartial algorithms can deliver biased results if the data input or analytical frameworks reflect existing societal biases, and/or do not include enough data from minority groups. Organisations such as Te Mana Raraunga (Māori Data Sovereignty Network) have articulated principles that reduce the possibilities of such harmful outcomes. These include upholding the rights of Māori, the ability to disaggregate Māori data, due consideration of all future use of the data, and avoiding deficit or blame framing in data analysis.

**Surveillance, stigmatisation and profiling**

One of the reasons health information research needs dedicated governance structures is that it carries different risks from the interventional research that our ethics system is designed for. These include the surveillance, stigmatisation and profiling of individuals and groups. The burden of such could conceivably fall more heavily on some groups within society, thereby penalising those affected while socially favoring others. Māori key informants have expressed concerns about how poorly handled genomic data could be used to ‘racialise’ illnesses and behaviours. These concerns align with the concerns of Māori and Pasifika about how government information could be used. This is particularly true in the age of ‘big data’, which aims to bring different datasets together to make policy recommendations. Ideally consent for such uses would be purpose-specific and time-limited.

It is worth remembering that none of these studies specifically examined privacy expectations in health information research. Nonetheless, they offer a warning that the emerging governance systems for this rapidly advancing field of research need to be both robust and culturally sensitive. Such an approach is grounded in the ethical principles of beneficence (maximising the benefits of powerful technologies such as machine learning and ‘big data’), non-maleficence (avoiding harms such as stigmatisation and profiling), justice
(addressing disparities) and autonomy (allowing people to participate or not participate in ways that uphold their values). Conversely, ignoring the variety of views on what could be considered ‘private’ risks some groups of people being more likely to exercise their right to opt out of health information research. Alternately, it risks corralling people into research that is inconsistent with their values. Neither of these would serve either patients or researchers well. We argue therefore that research funders and institutions (in their roles as gatekeepers), research teams (in developing their internal culture and ethics), and patient and community groups (by articulating and advocating for their values) all have a role in shaping a research culture that respects New Zealanders’ diverse backgrounds and beliefs.

Competing interests:
Nil.

Acknowledgements:
The authors would like to thank Jade Sewell, Veronique Gibbons and Jan Goddard from Waikato District Health Board for their invaluable reviews and suggestions to improve the manuscript.

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Mass shooting in Christchurch and the epidemiology of sudden mass fatality events in New Zealand

Nick Wilson, George Thomson

In previous work we documented all the sudden mass fatality events in New Zealand since 1900 (for events with 10+ deaths), and identified a downward trend in such events.1 Sadly we now have to include in this record the recent 50 deaths from the mass shooting in Christchurch on 15 March 2019. This is the worst single mass shooting event in New Zealand’s history since 1900 (ie, when compared to the 49 deaths from a mass shooting at a prisoner-of-war camp in Featherston during the Second World War: Table 1). It has also been described as the worst event linked to “white supremacy” internationally2 since 77 people were killed in attacks on Utøya island and in Oslo, Norway in 2011.3 Compared to all other sudden mass fatality events in New Zealand since 1900, it is now the seventh worst such event (Table 1, for the 21 events with 20+ deaths each).

Nevertheless, the New Zealand context of shootings in the century before 1900 includes the “New Zealand wars” where an estimated 2,800 people died (British and colonial troops, kūpapa (Māori Crown allies) and Māori fighting the Crown).4 These were nearly all deaths among Māori. Also in the period 1818 to 1835, more than 18,000 people may have died in the “musket wars”, although estimates vary widely.5 A significant proportion of those in both of these conflicts appear to have died by shooting.

The new total for New Zealand from such sudden mass fatality events can now be estimated at 1,947 for 57 events with 10+ deaths each since 1900. This new total also reflects updated data on some of these disasters based on additional subsequent research: with changes to the death toll from the Hawke’s Bay earthquake,6 Cyclone Giselle and the SS Penguin sinking (Table 1 footnotes). This classification approach does not include slower moving disasters such as pandemics, which often have an even higher death toll (eg, 9,000 in the 1918 influenza pandemic). Of note is that three of the 21 mass fatality events with 20+ deaths each (Table 1: an earthquake, fire and shooting), have all impacted on Christchurch—more so than any other city.

These sudden mass fatality disasters have sometimes triggered legislative and other system changes which have then prevented further injuries and fatal events. For example, various safety improvements have contributed to the massive decline in transport-related disasters in New Zealand: at sea, on rail and in air transport.7 Bradt et al8 have also detailed legislative responses to a number of the disasters listed in Table 1, eg, the Seacliff fire, the Ballantyne’s fire, the Pike River Mine explosion and both the Hawke’s Bay and Canterbury earthquakes. Given this pattern, this most recent mass shooting disaster in Christchurch provides an opportunity for new legislation to upgrade outdated firearm laws in New Zealand. These may include tighter restrictions on semi-automatic weapons, a gun buy-back scheme and a gun registration scheme. Such types of changes appear to have contributed to the reduction of mass shootings in Australia.8
### Table 1: Updated list of the sudden mass fatality disasters with 20 or more fatalities occurring for the period 1900 to March 2019 in New Zealand territory (updated from previous published work)\(^1\).

<table>
<thead>
<tr>
<th>Sudden mass fatality disaster (ordered by number of direct deaths)</th>
<th>Year of disaster</th>
<th>Type of disaster</th>
<th>Deaths (direct)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Crash of Air New Zealand flight TE901 into Mt Erebus, Antarctica (in the Ross Dependency which is claimed by New Zealand)</td>
<td>1979</td>
<td>Transport</td>
<td>257</td>
</tr>
<tr>
<td>2. Hawke’s Bay earthquake (deaths mainly in Napier and Hastings and associated with the collapse of buildings, largely built with unreinforced masonry(^7))</td>
<td>1931</td>
<td>Natural hazard (with defective buildings)</td>
<td>256* (with 5 additional “indirect” deaths)</td>
</tr>
<tr>
<td>3. Canterbury earthquake (February 2011) (and not including likely subsequent cardiovascular deaths associated with this particular earthquake(^9))</td>
<td>2011</td>
<td>Natural hazard (with defective buildings)</td>
<td>185</td>
</tr>
<tr>
<td>4. Tangiwai rail crash related to a lahar from volcanic activity which destroyed a railway bridge (Central North Island)</td>
<td>1953</td>
<td>Natural hazard/infrastructure</td>
<td>151</td>
</tr>
<tr>
<td>5. Sinking of the SS Penguin near Wellington in “heavy seas”</td>
<td>1909</td>
<td>Transport</td>
<td>72*</td>
</tr>
<tr>
<td>6. Cyclone Giselle and sinking of the TEV Wahine near Wellington (51 deaths from the sinking on the day plus two died of injuries subsequently). Giselle caused five other deaths around New Zealand: one in Kaitaia, three in Wellington and one on Stewart Island.(^10)</td>
<td>1968</td>
<td>Transport</td>
<td>59*</td>
</tr>
<tr>
<td>7. Mass shootings at two mosques in Christchurch</td>
<td>2019</td>
<td>Mass shooting</td>
<td>50 (provisional)</td>
</tr>
<tr>
<td>8. Featherston Prisoner-of-War Camp riot (deaths in Japanese prisoners-of-war and one New Zealand guard in a mass shooting)</td>
<td>1943</td>
<td>War-related</td>
<td>49</td>
</tr>
<tr>
<td>9. Sinking of the SS Elingamite off the Three Kings Islands</td>
<td>1902</td>
<td>Transport</td>
<td>45</td>
</tr>
<tr>
<td>10. Ralph’s Mine explosion in Huntly</td>
<td>1914</td>
<td>Industrial</td>
<td>43</td>
</tr>
<tr>
<td>11. Ballantyne’s store fire in Christchurch</td>
<td>1947</td>
<td>Infrastructure</td>
<td>41</td>
</tr>
<tr>
<td>12. Seacliff Mental Hospital fire (north of Dunedin)</td>
<td>1942</td>
<td>Infrastructure</td>
<td>37</td>
</tr>
<tr>
<td>13. Sinking of the MV Kaitawa near Cape Reinga in “heavy seas”</td>
<td>1966</td>
<td>Transport</td>
<td>29</td>
</tr>
<tr>
<td>14. Pike River Mine explosions (West Coast)</td>
<td>2010</td>
<td>Industrial</td>
<td>29</td>
</tr>
<tr>
<td>15. Sinking of the Wimmera after striking German mines during the First World War (north of Cape Maria van Diemen, Northland)</td>
<td>1918</td>
<td>War-related</td>
<td>26</td>
</tr>
<tr>
<td>16. Sinking of the dredge Manchester (Tasman Sea, possibly near Cape Farewell)</td>
<td>1912</td>
<td>Transport</td>
<td>25</td>
</tr>
<tr>
<td>17. Sinking of the Loch Long off the Chatham Islands</td>
<td>1903</td>
<td>Transport</td>
<td>24</td>
</tr>
<tr>
<td>18. Crash of New Zealand National Airways Corporation Flight 441 in the Kaimai Ranges</td>
<td>1963</td>
<td>Transport</td>
<td>23</td>
</tr>
<tr>
<td>19. Sinking of the Ranui off Mount Maunganui in a “violent sea”</td>
<td>1950</td>
<td>Transport</td>
<td>22</td>
</tr>
<tr>
<td>20. Kopuawhara flash flood destroying a railway work camp (during construction of the Napier-Gisborne Railway line)</td>
<td>1938</td>
<td>Natural hazard/infrastructure</td>
<td>21</td>
</tr>
<tr>
<td>21. Railway crash at Hyde (Otago)</td>
<td>1943</td>
<td>Transport</td>
<td>21</td>
</tr>
</tbody>
</table>

*Adjusted relative to previously published figures\(^1\) to account for: (i) two fewer direct deaths for the Hawke’s Bay earthquake based on a new study;\(^2\) (ii) two delayed deaths from the Wahine sinking (bringing the total to 53) and including all six additional deaths from Cyclone Giselle around the country;\(^10\) (iii) correcting the misreporting in some sources of the deaths in the Penguin disaster (the correct figure being 72 deaths rather than 75).
Competing interests:
Nil.

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Keith Edward Debney Eyre

13 May 1926–6 January 2019

Keith Eyre was born on 13 May 1926 in Sydney, Australia. In 1933 the family moved to Auckland where he had his secondary school education at Sacred Heart College before enrolling as a medical student at the University of Otago. He completed the final year of the course in Auckland and graduated with distinction in medicine, being awarded the Marjorie McCallum Memorial Medal and Prize in Medicine, the Colquhoun Memorial Medal in Systematic Medicine and the Batchelor Medal and Prize in Obstetrics in Gynaecology.

Keith married Colleen Lineen in 1951. He was a junior resident medical officer (1950–1951) and medical registrar (1952–1953) to the Auckland Hospital Board. In 1952 he passed the RACP membership examination and in 1953 he passed with distinction the general medicine and therapeutics examinations for the M.D. (Otago).

In 1954 he was awarded a Fulbright Scholarship and joined the neurology fellowship programme at the Mayo Clinic from 1954–1957. Under the supervision of Dr Reginald Bickford, Keith undertook a microelectrode study of the visual cortex and the lateral geniculate body in rabbits. This research was submitted in the form of a thesis for which he was awarded an M.D. in 1957. In 1957 he was also awarded a Nuffield Foundation Travelling Fellowship and spent the next 12 months at the National Hospital for Nervous Diseases, Queen Square, London.

In 1958 he was appointed to the part-time visiting staff at Auckland Hospital as an assistant neurological physician and also started private practice as a consultant neurologist. While waiting for his private consulting practice to grow, Keith supplemented his income by working night shifts for the St John's Ambulance Emergency Medical Service roster. Gavin Glasgow, who had been appointed a year earlier, and Keith Eyre were the founding members of the Neurology Department at Auckland Hospital when it was established in 1959. They also provided a neurological consulting service to the provincial centres in the upper North Island visiting Thames, Tauranga, Rotorua, Whakatane, Gisborne and Hamilton until Bob Craven and John Hill were appointed as MB, ChB (1949), MRACP (1952), MD (1957), FRACP (1965)
neurologists to the Waikato Hospital Board. In 1958 Keith was appointed convenor of a committee to establish a central respiratory unit at Auckland Hospital. This unit was the precursor of the Department of Critical Care Medicine. He was in charge of the neurophysiology service until this responsibility was handed to Barry Cant in 1968. In addition to standard EEG recording he performed sphenoidal lead electrode studies and electroretinography. He was a Clinical Teacher in Neurology in the School of Medicine. Keith was Chairman of the Department of Neurology and Neurosurgery from 1975–1976. He retired from the staff of Auckland Hospital in 1991, in the same year he was appointed Medical Director of Neuroservices, a role that he happily relinquished after 12 months.

He was President of the Neurological Association of New Zealand from 1967–1968. In 1969 he was elected to the executive committee of the Auckland Division of the Medical Association of New Zealand. He was chairman of the Auckland Division from 1971–1973 and President in 1974. He was the chairman of Auckland Division’s Ethics Committee from 1973–1976 and its Benevolent Fund Committee. As a member of the executive committee of the Council of the NZMA from 1973–1978 Keith prepared and presented the Association’s submissions to Royal Commissions of Inquiry into psychiatric services, hospital services and chiropractic practice. He was a member of the Minister of Health’s Special Advisory Committee on Computer Reorganisation in Health and Hospital Services in 1976. In 1976 the Council of the Medical Association asked Keith to prepare a submission to a committee set up by the Minister of Health to study the feasibility of removing anomalies between compensation for victims of accidents and illness.

Keith was an instantly recognisable figure in Auckland Hospital. He attended ward rounds immaculately attired in a suit and bow tie. He was reserved by nature, but had a quiet sense of humour. His clinical method was one of meticulous and methodical interrogation and examination of his patients. He often would spend an hour or more interviewing and examining each patient. Although his ward rounds were slow and he was often reticent in the communication of his opinion, he was a very astute clinician and he was always well-informed. He was insistent on detailed investigation of his patients and strove to reach a diagnosis when confronted with complicated neurological problems. His clinical reports were detailed and lengthy, often many typewritten pages long.

He published relatively few papers, but his meticulous analysis and investigation of patients sometimes paid dividends. His careful investigation of a family with hereditary motor sensory neuropathy with vocal cord palsies (hereditary motor and sensory neuropathy type 2C) eventually led to the discovery of the responsible genetic mutation.

He was frequently called upon as an expert in medicolegal matters, an area in which his careful and logical analysis was much appreciated. He provided expert opinions on neurological matters in many civil and criminal cases, appearing as an expert witness before the Medical Practitioners Disciplinary Committee, the former Magistrates’ and Supreme Courts and in the Coroner’s, District and High Courts.

Outside medicine Keith had a wide range of interests, which were largely not known by his neurological colleagues. These interests included, but were not confined to, sailing, rugby (he and his family had season tickets for Eden Park), economics, geology, jazz and classical music.

After he retired, at first he remained in Auckland, but in the last few years of his life lived in New Plymouth. He was dedicated to his wife, Colleen, and their children. He was pre-deceased by Colleen in 2015. Keith is survived by his four children: Christine (Taranaki), Janet (Rhodes Scholar 1978 and Professor of Paediatric Neuroscience, Newcastle-upon-Tyne, England), David (Tokyo), Julia (Newcastle-upon-Tyne), 10 grandchildren and eight great grandchildren.
Miles Wilson Hursthouse was born in Hastings in 1919 and attended the local primary and high schools. His schooling was disrupted by the Napier Earthquake when a number of local children were evacuated from Hawke’s Bay for several months while repairs and reconstruction were undertaken. Miles’ lifelong ambition was to study medicine but due to financial circumstances, he opted for a law degree at Auckland University during which he could work part-time to fund his studies. During this period he was called up for Army Service in World War 2 and spent the next five years in NZ Artillery 1st Heavy Regiment, 3rd Division, 2nd NZEF, reaching the rank of Captain.

It was during his service in the Army that Miles was able to save enough funds to apply for Otago Medical School, which he commenced in 1945 along with 40 other returned servicemen, graduating in 1950. He became active in student life, eventually holding the post of President of OUSA. He was awarded a New Zealand University Blue as well as two Otago Blues for shooting.

Miles worked as a house surgeon for two years at Wellington Hospital before setting up practice as a GP in Nelson. He embraced life as a general practitioner, which included anaesthetics, lectures at Nelson Hospital for trainee nurses and obstetrics, delivering over 1,200 babies. He was conscientious about keeping his medical knowledge up to date and is remembered for constantly wading through his latest stack of NZMA journals.

Having gained his Private Pilots Licence during his early years in Nelson, Miles combined his love of flying with his medical skills and regularly flew to remote regions such as French Pass or D’Urville Island for emergencies. He also successfully treated his patients who had whooping cough by flying them above 900 metres for 20 minutes. However, not every patient was lucky enough to have a personal flying doctor to administer this treatment.

In 1966 Miles moved to Sydney for two years to study dermatology, graduating as a Fellow of the Australasian College of Dermatologists in 1971. He returned to Nelson where he practised in this speciality until his
retirement in 1988. He published 10 papers, with his most notable covering research into the high incidence of melanomas in Nelson.

Miles met his wife Jillian during his summer vacation work as a rabbiter on her family farm in Hawke’s Bay. They were married in 1950 and enjoyed 64 years of marriage. He led a very full and energetic life with a love of boating, fishing, tramping, amateur radio, gliding and powered flying. He spent innumerable holidays relaxing with family at his beloved bach in the Abel Tasman.

Miles held a lifelong passion for cars and motorbikes. He was active in the Nelson Car Club in the 1950s where the back-beach races were a fixture, and he won an international car rally with his team-mates, George Topliss and Des Hay. He owned an assortment of motorbikes throughout his entire life and in latter years, used his Vincent, complete with sidecar, as his means of transport—carrying his wife or dog as a passenger.

With all his interests he invariably became involved at committee level, holding the post of president for multiple organisations including NZ Faculty Australsian College of Dermatologists, NZ Dermatological Society, NZ Cancer Society [Nelson Branch], NZ Heart Foundation [Nelson Branch] and Nelson Gliding Club to list a few.

Miles was reluctant to retire, fearing it would let down the community of Nelson with the scarcity of dermatologists in the region. His love of medicine and commitment to his patients remained with him throughout his life. He was compassionate, dedicated and benevolent.

He is survived by his children Linda, Tim and Mark, grandchildren Nicola, Fiona, Kate and Sophie, and great-grandchildren Clementine and Meredith.

Author information:
This obituary was provided by Linda Ralph, Accounts Manager, Auckland.

URL:
Vitamin D supplements and prevention of cancer and cardiovascular disease

It is unclear whether supplementation with vitamin D reduces the risk of cancer or cardiovascular disease, and data from randomised trials are limited.

Hence this randomised, placebo-controlled trial. Over 25,000 participants were randomised to receive either vitamin D₃ (cholecalciferol) at a dose of 2,000 IU per day and marine n-3 (also called omega-3) fatty acids at a dose of 1g per day or placebo. End points were invasive cancer of any type and major cardiovascular events.

During a median follow-up of 5.3 years the researchers report that there were no significant differences in the incidence of cancer or major cardiovascular events between the treated and control groups. No excess risk of hypercalcaemia or other adverse events were identified.


Effects of fluoxetine on functional outcomes after acute stroke

Results of small trials indicate that fluoxetine might improve functional outcomes after stroke. This trial aimed to provide a precise estimate of these effects.

Three thousand one hundred and twenty-seven patients from 103 hospitals in the UK were involved. Eligibility included a clinical stroke diagnosis and focal neurological deficits. The patients had to be 18 years of age or older and be assigned to treatment within 15 days after onset. Half were treated with fluoxetine 20mg daily for six months. The others received a matched placebo for six months.

The researchers concluded that fluoxetine 20mg given daily for six months after acute stroke does not seem to improve functional outcomes. Although the treatment reduced the occurrence of depression, it increased the frequency of bone fractures.

Lancet 2019; 393:265–74

Trends in adverse drug reaction-related hospitalisations over 13 years in New South Wales, Australia

Adverse drug reactions (ADR) are severe problems in global public health, and result in high mortality and morbidity. This report is of a study designed to examine trends in ADR-related hospitalisations in New South Wales (NSW) between 2001 and 2014.

A total of 315,274 NSW residents admitted for urgent care of ADR was identified. The age-adjusted rates of ADR-related hospitalisations nearly doubled and increased by 5.8% per annum, with an in-hospital death rate increase of 2.4%. Agranulocytosis, nausea and vomiting, heart failure and acute renal failure were found to be the most common conditions. Anticoagulants and opioid analgesics were the commonest medications involved.

ADR-related hospitalisation remains a population health burden, with significant increase over time. The findings call for continuing efforts to prevent ADR, especially among the high-risk populations, such as older people.

Internal Medicine Journal 2019; 49:84–93

URL:
Adenoma sebaceum is a rare skin disease, and that fact is my only excuse for publishing these few notes on the subject. So rare is the condition that Stellwagon, an American dermatologist of large experience, says he has only seen 11 cases and Norman Walker only 3. The condition occurs almost exclusively in children and young adults who are of low mental development, and is due to a hyperplasia of the sebaceous and sweat glands. Along with this condition of the skin there are frequently developmental anomalies of brain, kidney, and heart.

The patient whom we may call B.C. was admitted to this institution in 1904, aged 25 years. The disease was present on admission and has persisted. The accompanying plate gives a fair idea of the condition. The growths which are scattered over face, brow, and neck are reddish brown in colour, and about the size of a split pea. One at the root of the neck on left side is about the size of a marble. There are numerous patches of telangiectasis, giving the “mottled” appearance described by Walker. The growths give rise to no symptoms beyond disfigurement, and are best removed by the cautery or by application of CO2 snow.

The mental state of the patient is that of a low-grade imbecile.

I am indebted to Dr. Hassall, Medical Superintendent, for kind permission to publish these notes.

Can we select patients for colonoscopy more accurately?

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Introduction
Survival in colorectal cancer (CRC) depends largely on the stage of diagnosis, and patients diagnosed in early stages (stage I and II) are more likely to have successful treatment and long survival. However, early CRC diagnosis can be challenging. CRC is mostly diagnosed via colonoscopy, though the demand for colonoscopies in New Zealand is increasing due to awareness of CRC and implementation of screening programs. The decision about who gets a colonoscopy is made by secondary care specialists mostly based on symptoms and test results included in e-referrals from GPs. Single symptoms are not good predictors of CRC risk in individual patients but when combined and used with other predictors such as demographics, their predictive accuracy for CRC risk increases.

Methods
We analysed WDHB e-referral data from patients suspected of lower gastrointestinal disease in order to fit a logistic regression model which could assist with the colonoscopy decision-making process. We used the model to calculate the number of unnecessary colonoscopies which could be avoided.

Results
The final model included the following predictors: abdominal pain, palpable mass in abdomen or rectum, rectal bleeding, weight loss, anaemia, IBD, patient's age at referral and gender and family history of CRC. Age was the most influential predictor of CRC risk. Males had higher risk of CRC than females but fewer men were referred and had colonoscopy. Using our model, if only 80% of all colonoscopies were performed, 98% of patients would still be diagnosed.

Conclusion
Our model discriminates patients with low risk of CRC, for whom colonoscopy is not necessary, well and therefore has potential to help specialists to select patients for colonoscopy more accurately and to use the resource more efficiently. The predictors are easy to collect during the assessment and are mostly free.

Smoking cessation—all puff no action?

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Introduction
17.1% of Waikato District Health Board (DHB)'s patient population are regular smokers (higher than the national average of 15.1%), indicating that a significant proportion of Waikato hospital inpatients could be current smokers.1 If nicotine replacement therapy (NRT) is not appropriately prescribed and regularly assessed, inpatients may experience significant withdrawal symptoms (such as agitation). If patients leave the ward to smoke as a result, this puts them at increased risk of harm due to tobacco use and lack of monitoring, while undermining the DHB's commitment to Smokefree New Zealand 2025.2

Aim
To assess to what extent Waikato hospital wards meet the smoking cessation targets set out in local policy (document no. 2580 Nicotine Replacement Therapy standing order, effective 1 May 2017), which include:

1. NRT offered to all inpatients who smoke or have been smoke-free for <30 days
2. NRT prescribed in accordance with Hospital Medicines List (HML) criteria and Waikato DHB guidelines
3. Withdrawal symptoms assessed, addressed and recorded in patient notes daily
4. Documentation of NRT follow-up on discharge

Method
A standardised audit tool was developed to identify NRT documentation, and an initial pilot study carried out to refine the tool. The audit was conducted on all hospital wards, excluding mental health, rehabilitation and women's health. An initial inpatient snapshot of current smokers was identified by ward pharmacists over a three-day period (11–13 September 2018). Those
patients discharged a week later formed the final study population, data was retrospectively recorded from notes and medication charts using the audit tool. Demographic information (age, gender, ethnicity) was also collected.

Results

The audit included 32 current smokers, with a mean age of 50.63 years (95% CI: 47.67–53.58 years). According to documentation in patient records, an NRT offer was made for 78.13% of patients. 82.35% of male patients were offered NRT, compared to 78.57% of females. 84.21% of Māori patients were offered NRT, compared to 72.73% of non-Māori. There was no statistically significant difference in offers for females and males (p=1, Fisher exact test), or for Māori and non-Māori (p=0.64). An NRT offer was accepted by 28% of all current smokers. Of those offered NRT, 43% of males accepted, compared to 27% of females. Fifty percent of Māori accepted, compared to 11% of non-Māori. There was no statistically significant difference in uptake of males and females (p=0.67), or Māori and non-Māori (p=0.08). All who accepted were prescribed at least one NRT product, and 88.89% of prescriptions met Waikato DHB guidelines. There was no daily monitoring of withdrawal for any patient. Four patients received follow-up on discharge.

Four patients received follow-up on discharge.

Conclusion

This study showed that NRT documentation at Waikato Hospital does not fully meet DHB smoking cessation guidelines. Consistency of recorded interventions needs to be improved, alongside ongoing monitoring and follow-up. Further assessment of Waikato-based NRT, as well as national NRT documentation in hospitals could be performed in future. This could enable better smoking cessation optimisation and more equitable care; improving hospital experiences and safety.

References


Census%20data/Census_14.aspx

z/smokefree-in-action/smokefree-aoteaorua-2025

intranet.sharepoint.waikato.
health.govt.nz/site/pol/
published/Nicotine%20
Replacement%20Therapy.
pdf#search=nicotine%20
replacement%20therapy

Referral pathways for waikato patients with colorectal cancer

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Ralph van Dalen,2; Lynne Chepulis,2
Ross Lawrenson2
1Faculty of Medical and Health
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University of Waikato; 3Waikato
District Health Board.

The prognosis of colorectal cancer (CRC) is highly influ-
enced by the timeliness of a patient’s presentation, with
those presenting to the emer-
gency department (ED) often
having later stage disease and
worse survival. However, we
currently do not know what
proportion of CRC patients
in the Waikato region are
presenting through the different
paths. The aim of this study
was to investigate the char-
acteristics of patients (during
2015–2017) who initially present
to ED as compared to those who
come through the e-referral
pathway. Demographic data
for this study was obtained from
the New Zealand Cancer
Registry, while clinical data
was sourced from the Waikato
Colorectal Cancer Register.

Younger patients (those aged
under 50 years) were nearly
three times as likely as those
aged >70 years to present to ED
(OR 2.76; 95% CI: 1.13–6.75), and
were also more likely than older
patients to present privately
(OR 3.21; 95% CI: 1.11–9.25). In
addition, patients were more
likely to present to ED if they
had stage 4 disease (OR vs stage
1; 2.36; 95% CI: 1.40–3.98), if
they had diabetes (OR: 2.23; 95%
CI: 1.10–4.53) but were less likely
to present with rectal vs colon
 tumours (OR: 0.34; 95% CI: 0.19–
0.60). Individuals with a prior
history of cancer were also less
likely to present to ED overall
(OR: 0.40; 95% CI: 0.18–0.85).

Half of all Māori CRC patients
were referred from their GP
(53%), which was comparable
to that of non-Māori (57%), and
no differences in stage of disease
at presentation were reported.
However, a higher proportion
of Māori than non-Māori
presented directly to ED (33%
vs 21%).

In conclusion, patients
presenting to ED are more likely
to be Māori, younger and with
later stage disease.

Comparative safety, pharmacokinetic and pharmacodynamic profile of three oral selenium compounds in a randomised controlled trial in cancer patients

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Steve Bird,1 Hugh Goodman,2
Michael Jameson2
1University of Waikato, Hamil-
ton; 2Waikato Clinical Campus,
University of Auckland, Hamilton;
3Waikato Hospital, Hamilton.

Background

Selenium (Se) compounds have demonstrated anti-cancer properties in preclinical and clinical studies, with particular promise in combination with anticancer therapies where reduced toxicity and enhanced anti-tumour efficacy is reported. However, the optimal form and dose of selenium in combination with anticancer therapies has yet to be established.

Methods

In a randomised double-blind dose escalation study the safety, tolerability and pharmacokinetic (PK) and pharmacodynamic (PD) profiles of sodium selenite (SS), Se-methylselenocysteine (MSC) and seleno-L-methionine (SLM) were compared in patients with chronic lymphocytic leukaemia.
(CLL), and a cohort of patients with metastatic solid malignancies (MCA). In the first dose level, patients received 400µg of elemental Se orally as either SS, MSC or SLM for eight weeks. Safety evaluations and bloods for PK and PD analyses were taken twice prior to treatment and at Days 2, 28, 56 and 84 from starting treatment. Each dose group for each Se compound (n=8) included four patients with CLL and four with MCA. No assessment of tumour response was made in MCA patients.

Results

Twenty-four patients were treated in the first dose cohort, eight with each Se compound. All Se compounds were well-tolerated, with no grade 3–4 toxicities attributed to the study drugs. The total plasma Se AUC was markedly raised with SLM in comparison to MSC and SS. Assessment of DNA damage in normal and malignant peripheral blood mononuclear cells revealed negligible genotoxicity. In CLL patients, no fall in lymphocyte count was seen in those treated with SS but the majority of those treated with SLM or MSC showed a reduction, one achieving a partial response. Persistent reductions in plasma VEGF were observed in 7/12 patients with CLL and 4/12 patients with MCA. Minimal changes were observed in intracellular glutathione or markers of endoplasmic stress response.

Conclusions

These Se compounds are well-tolerated and non-genotoxic at this dose level. Plasma PK for each Se compound is consistent with previous reports. Of PD mechanisms studied, the reduction in plasma VEGF is most prominent at this dose level; the minimal change in markers of ER stress and intracellular glutathione is consistent with the dose-response seen with Se compounds in tumour xenografts and cell lines. Additional analyses awaited from international collaborators include Se speciation in plasma and white blood cells, gene expression and DNA damage response kinetics. Recruitment to 1,600µg and 6,400µg per day dose cohorts is planned. The study registration number is ACTRN12613000118707.

Interstitial lung disease multidisciplinary meetings change diagnosis and treatment

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1Respiratory Research Unit, Waikato Hospital, Hamilton; 2Respiratory Medicine, Waikato Hospital, Hamilton.

Introduction/Aim

Accurate diagnosis of interstitial lung disease (ILD) is a challenge faced by treating physicians. Multidisciplinary meetings (MDM) increase diagnostic confidence, change diagnosis and treatment of ILD and are recommended by international guidelines. We hypothesised that the introduction of MDM would alter diagnosis for ILD patients in New Zealand. We aim to describe the first cohort of New Zealand patients to undergo a dedicated ILD MDM discussion and to determine its effect on change in diagnosis and treatment.

Methods

This is a single-centre retrospective review of patients discussed at the Waikato Hospital ILD MDM between July 2016 and November 2018. Demographics, clinical features, lung function, radiology and pathology results were assessed. Pre and post MDM diagnoses and treatments were compared.

Results

Two hundred and eleven patients were included. Māori made up 6% of ILD cases compared with 22% of the local population. The most common post MDM diagnoses were idiopathic pulmonary fibrosis (n=43, 20%), connective tissue disease associated ILD (n=37, 18%) and unclassifiable ILD (n=40, 19%). Eighty-three (40%) patients had their diagnosis changed by MDM. MDM significantly altered diagnosis for all major diagnostic categories. Treatment of 69 (32%) patients was modified following MDM discussion.

Figure 1: Treatment modification based on suspected ILD diagnosis.

<table>
<thead>
<tr>
<th>Treatment predicted by suspected diagnosis</th>
<th>no Change</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS</td>
<td>20</td>
<td>74</td>
</tr>
<tr>
<td>Ob</td>
<td>25</td>
<td>18</td>
</tr>
<tr>
<td>IS + cess</td>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td>Smoking cess</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Treat UL</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>AF</td>
<td>23</td>
<td>37</td>
</tr>
</tbody>
</table>

IS = immunosuppression, Ob = observation, Smoking cess = smoking cessation, Treat UL = treat underlying disease, IS+cess = immunosuppression + cessation of aggravating drug, AF = anti-fibrotics.
Conclusion
MDM discussion significantly alters diagnosis and treatment of patients with ILD.

Grant Support: SMF is supported by a University of Auckland Summer Student grant.

Prevalence of depression and anxiety among patients with cardiac implantable electronic devices (CIED)

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Aim
Previous studies have suggested an increased level of anxiety and depression in patients with CIEDs, particularly those with implantable cardioverter defibrillators (ICD). This study aims to ascertain the prevalence of depression and anxiety symptoms among patients with CIEDs.

Method
Patients attending pacemaker clinic at Waikato and Auckland Hospitals between April and July 2017 provided demographic data and completed Pacemaker-Specific and Hospital Anxiety and Depression Score (HADS) questionnaires.

Results
Of 111 patients (mean age 69.5±15.7y, 64 male, 30 ICD), mean HADS scores for depression and anxiety were 3.06 (ICD 3.67, Pacemaker 2.44) and 3.71 (ICD 4.17, Pacemaker 3.25), respectively. Overall rates of potential clinical diagnoses for depression and anxiety were 19.8% (ICD 26.7% Pacemaker 17.3%) and 36% (ICD=40%, Pacemaker=34.6%), respectively. These compare to age and gender-adjusted national rates of diagnosed depression and anxiety (14.0% and 7.5%, respectively). Despite higher rates of self-reported depression and anxiety, 85% of patients believed having a CIED was worthwhile. Subset analysis found no statistically significant difference between the ICD and pacemaker groups (Depression p=0.313, Anxiety p=0.692). Anxiety and depression scores were not affected by gender or ethnicity (p>0.05) but increasing age was associated with lower scores (p=0.03).

Conclusion
There is no significant difference in the prevalence of depression and anxiety between different CIED device types. However, based on the HADS screening tool, the prevalence of potential mental illness, especially anxiety, is higher than expected within these populations compared to the matched general population. Increasing age may also be a protective factor.

What do colorectal cancer survivors die from?

Rachel Nunn,1 Nicola J Lawrence,2 Sanjeev Deva,2 Michael Jameson1,3
1Waikato Clinical Campus, University of Auckland, Hamilton; 2Auckland City Hospital, Auckland; 3Regional Cancer Centre, Waikato Hospital, Hamilton.

Background
Weekly 5-fluorouracil and folinic acid (5FU/FA) chemotherapy was adopted in New Zealand in 2000 as adjuvant treatment for colorectal cancer (CRC) when it was shown to be equally effective as daily x5 dosing every four weeks, with less toxicity. Survival in trials using 5FU 370mg/m² appears inferior to 5FU 425mg/m² on indirect comparison. Adjuvant weekly 5FU was dosed at 425mg/m² at Waikato Hospital (WH) and 370mg/m² at Auckland City Hospital (ACH), which allowed further indirect comparison of the effect of 5FU dose on patient outcomes. This analysis evaluated cancer-specific and other causes of death and their association with patient, tumour and treatment-related factors.

Methods
Patients with non-metastatic CRC who started adjuvant weekly 5FU/FA at WH or ACH
between 2001 (2002 at ACH) and 2004 were identified from institutional databases. Data was gathered on patient and tumour characteristics, duration of treatment, survival (to 12 December 2017), ethnicity, deprivation, causes of death and new cancer registrations. Analysis included actuarial survival, indirect standardisation and multiple linear regression.

**Results**

Median follow-up of survivors was 182 (157–211) months. The table shows patient and tumour characteristics: WH patients were significantly older, with a different ethnic distribution, and lived in more deprived areas, than ACH patients. Chemoradiation was used more often for rectal cancer at WH but chemotherapy started later. Completion rates were similar for both SFU doses. Fifty-three percent and 45% of patients died (35% and 33% due to CRC) in the WH and ACH cohorts respectively, but overall (HR 1.23, logrank p=0.07) and CRC-specific survival (HR 1.10, logrank p=0.51) did not differ significantly. Non-CRC-specific survival was poorer in the WH cohort (HR 1.61, logrank p=0.03), with more deaths from second malignancies and cardiovascular causes. However only age, male sex and deprivation had independent effects, all of which were higher in the WH cohort. No smoking history was available.

**Conclusions**

The two SFU dose regimens achieved similar overall and cancer specific survival outcomes and treatment completion rates. The poorer non-CRC-specific survival in the WH cohort appears to be a summation of a greater proportion of patients with factors associated with poor survival, including age, male sex and deprivation.

**Table 1:** Patient, tumour and treatment characteristics.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Waikato</th>
<th>Auckland</th>
<th>Chi square p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients</td>
<td>295</td>
<td>285</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>Male/female</td>
<td>168/127</td>
<td>151/134</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>NZ European</td>
<td>251</td>
<td>202</td>
</tr>
<tr>
<td></td>
<td>NZ Māori</td>
<td>19</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Pacific</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Other/not stated</td>
<td>21</td>
<td>64</td>
</tr>
<tr>
<td>Age</td>
<td>Median (range)</td>
<td>66 (27–85)</td>
<td>62 (23–87)</td>
</tr>
<tr>
<td>Site</td>
<td>Left colon</td>
<td>113</td>
<td>106**</td>
</tr>
<tr>
<td></td>
<td>Right colon</td>
<td>84</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>Transverse colon</td>
<td>14</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Rectum</td>
<td>84</td>
<td>92**</td>
</tr>
<tr>
<td>TNM stage</td>
<td>1/2/3</td>
<td>1/60/234</td>
<td>2/52/230</td>
</tr>
<tr>
<td>Deprivation</td>
<td>1–2</td>
<td>20</td>
<td>51</td>
</tr>
<tr>
<td></td>
<td>3–4</td>
<td>58</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td>5–6</td>
<td>71</td>
<td>61</td>
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<tr>
<td></td>
<td>7–8</td>
<td>85</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td>9–10</td>
<td>61</td>
<td>35</td>
</tr>
<tr>
<td>Chemoradiation + chemo</td>
<td>73</td>
<td>46</td>
<td>0.0134</td>
</tr>
<tr>
<td>Chemotherapy only</td>
<td>222</td>
<td>239</td>
<td></td>
</tr>
<tr>
<td>Days to treatment start</td>
<td>Median (range)</td>
<td>69 (17–152)</td>
<td>56 (12–173)</td>
</tr>
<tr>
<td>Received all doses</td>
<td>Colon</td>
<td>75%</td>
<td>69%</td>
</tr>
<tr>
<td></td>
<td>Rectum</td>
<td>59%</td>
<td>65%</td>
</tr>
</tbody>
</table>

*10 = Most deprived.
**One patient with synchronous left colon and rectal tumours.
#One Auckland patient with unknown stage.
Does microbial transformation of milk polyunsaturated fatty acids occur in the infant bowel?

Mariza Gomes Reis,1 Gerald Tannock,2 Blair Lawley,2 Yafei Liu,2 Alison Hodgkinson1
1AgResearch Ltd, 2University of Otago.

Several studies have revealed that the gut microbiota plays an important role in several host physiological processes, some of which may be mediated by microbial metabolites. Lipids, along with sugars and proteins, are predominant components of milk and represent an important source of energy for the growth of the newborn and also contribute to the development of immune function.

In vitro studies have shown that bowel bacteria can metabolise polyunsaturated fatty acids, specifically linoleic acid, to generate several metabolites including oxygenated fatty acid (hydroxy and oxo) as well as conjugated linoleic acids (CLAs) that may affect host health by correcting intestinal epithelial barrier impairments,1 decreasing dermatitis score2 and regulating energy metabolism.3,4 Although, studies have shown that bacteria found in the infant intestine can metabolise polyunsaturated fatty acids in vitro, milk composition complexity and environmental restriction may prevent these metabolic transformations by infant microbiota in vivo.

Our study investigated the presence of milk polyunsaturated fatty acid microbial metabolites as well the abundances of specific gut bacteria (Bifidobacterium species) in faecal samples of infants 6–16 weeks old. At sample collection, 38.6% of infants were exclusively breast milk fed, 36.3% of infants were exclusively formula fed and 25% of infants had mixed diet (breast milk fed and formula fed). To provide a measure of temporal variability within an individual, two samples were collected from 29 babies approximately 2–4 days apart, distributed across the three different groups.

Five putative fatty acid microbial metabolites from linoleic acid were identified in the infant faecal samples (10-hydroxy-cis-12-octadecenoic acid (1), 10-hydroxy-octadecanoic acid (2), 10-oxo-octadecanoic acid (3), cis-9, trans-11-octadecenoic acid (4) and trans-9, trans-11-octadecenoic acid (5)). Faecal samples of the same infant collected 1–4 days apart showed temporal variability in the concentration of the metabolites, which may be related to milk composition and bowel transit time. Our results indicated that the infant diet does not affect the concentration of these microbial metabolites.

A strong positive correlation (0.43, p=0.0009) was observed between the concentration of 10-hydroxy-cis-12-octadecenoic acid and Bifidobacterium longum subspecies infantis abundance in the infant faecal samples, indicating the importance of this bacterial species in producing the metabolite.

Acknowledgements

We gratefully acknowledge the staff of the Mothercraft Unit at the Waikato Hospital (Wendy Diamond, Jo Shea Kelly, Lorraine Reid and Eleanor Carmichael), Olivia Wallace (AgResearch) as well as parents of our infants who were critical for the successful completion of this study.

References

Patient characteristics of newly diagnosed lung cancer patients referred for psychosocial support at Waikato Hospital

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1Faculty of Arts and Social Science, University of Waikato, Hamilton; 2Waikato Medical Research Centre, University of Waikato, Hamilton.

Background

Due to high rates of morbidity, mortality and stigma associated with smoking, lung cancer patients are at high risk of psychological distress. To address this, patients are referred to the Midland Cancer Psychological and Social Support Service (CPSSS), a Ministry of Health initiative established in 2016. The aim of this project was to evaluate the demographic and clinical characteristics of Waikato lung cancer patients who were and were not referred to CPSSS.

Methods

Data were obtained from the Midland Lung Cancer Register (MLCR) for patients diagnosed with lung cancer between 2016 and 2018 in the Midland region (n=602), and these were linked via NHI number to the psychological support information available from CPSSS. Chi Square tests compared the characteristics of lung cancer patients who received psychological support from CPSSS (n=39), to those of Waikato lung cancer patients who did not receive CPSSS support (n=563). Thematic analysis looked at reasons for CPSSS referral.

Results

Patients referred to CPSSS were more likely than non-referred patients to be female (74.4% vs 47.6%; p<0.001) and three times as likely to be receiving curative surgery.
Prospective quality improvement audit of sepsis management among patients admitted to Waikato Hospital ICU/HDU with sepsis

Dr Paul Ryan, Dr Eoin O’ Mahony, Ms Odette Paul, Dr Robert Martynoga, Dr Caleb Watene, Dr Jesse Offner, Dr Paul Huggan

Introduction

Each year 15,000 patients in Australia and New Zealand are admitted to intensive care with sepsis. Sepsis is associated with high mortality and its burden of disease is increasing. Study objectives

1. To assess whether patients received key recommended interventions for detection/treatment of sepsis.
2. To assess whether these interventions occurred in the directed timeframe from “Time-Zero”.
3. To evaluate if there is a measurable improvement in sepsis bundle compliance over time with active feedback to healthcare-staff.

Methods

A convenience sample of adult patients admitted to ICU or HDU in Waikato Hospital with a primary diagnosis of sepsis over a three-month period were included. The pre-ICU/HDU care received by patients was audited against recommended guidelines. “Time-Zero” was defined as the time at which patients recorded ≥1 Red-flag or ≥2 Amber-flag criteria where sepsis was the presumed diagnosis.

A number of key variables in sepsis outcomes (eg, time to antibiotic administration) were measured and audited against recommended sepsis guidelines. Each case then had an individualised report formulated, which was fed back to the healthcare-staff involved (Nursing staff/RMOs/SMOs) in each patient’s care.

Results

Over three months, 66 cases of suspected sepsis requiring admission to ICU/HDU in Waikato Hospital were audited. Mean patient age was 60.5 years. Sixty-six percent were under the care of Emergency-Medicine at Time-Zero.

Sepsis targets were achieved in over 70% of cases. Average time to first doctor review was 35 minutes, while average time to first documented SMO review was seven hours. Paired-data analysis of Weeks 1–6 versus Weeks 7–12 of the study period showed an encouraging improvement in sepsis bundle compliance over time with active feedback.

Conclusions

Overall, the identification of sepsis with early appropriate interventions was generally good, but demonstrates scope for improvement. An increase in overall sepsis bundle compliance was observed over time with regular feedback to staff involved.

Is your tocilizumab prescribing creaking at the joints?

Pharmacy Services, Waikato District Health Board, Hamilton.

Introduction

Treatment of autoimmune disease is one of the highest areas of pharmaceutical expenditure in New Zealand. It is estimated that Waikato Hospital spent approximately $500,000 between 2017–2018 on tocilizumab alone for treatment of rheumatoid arthritis. Pharmacist’s special authority pathway closely controls prescribing of such expensive medications. Drug use evaluation (DUE) is the science of using aggregate data to quantitatively and qualitatively analyse prescribing. DUE allows for ongoing assessment to ensure appropriate prescribing of medications. Inappropriate or irrational prescribing of medicines wastes health funding and may reduce the quality of patient care.

Aim

To determine whether the prescribing of tocilizumab at Waikato Hospital adheres to the initiation and continuation criteria outlined in the New Zealand Pharmaceutical Schedule Hospital Medicines List (HML).

Method

A one-year period from 1 May 2017 to 31 April 2018 was selected. Clinical notes for all patients prescribed tocilizumab in that period will be compared with the HML criteria. A pilot study was conducted to test our method. A list of patients receiving tocilizumab from Waikato Hospital was generated using ePharmacy dispensing data. Patients were
randomly selected for the pilot using computer generated numbers. Their clinical notes were then compared against HML criteria. This method will be used for all patients prescribed tocilizumab from 1 May 2017–31 April 2018.

**Results**

The results suggest that rheumatologists are prescribing tocilizumab in accordance with the HML criteria but specific documentation is being missed.

**Conclusion**

The results of the audit demonstrate that tocilizumab prescribing at Waikato Hospital adheres to HML criteria. Improvement in specific documentation of active joint count is an area for improvement in the future.

**References**


**Justification for presentation**

Equitable access to healthcare benefits all New Zealanders. Healthcare professionals have an obligation to uphold fair use of scarce resources. This study describes whether HML criteria are being followed and demonstrates how medicines are being prescribed in New Zealand.

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