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This Issue in the Journal

Preventability of pre-hospital trauma deaths in southern New Zealand

James A Falconer

This study was done on the pre-hospital preventability of trauma deaths in New Zealand as no similar study has been done despite trauma being a leading cause of death in this country. Post-mortem reports were examined and scored with a well recognised scoring system to determine preventability of the deaths in the study region (Otago and Southland from 2000 to 2004). Most of the study population was found to have multiple anatomical regions injured, with the head and chest the most frequently fatally injured regions. Most deaths were in males under the age of 35, and the majority of the study population died as a result of motor vehicle accidents. The majority of the study population had non-survivable injuries however nearly half (45%) had either survivable (10%) or potentially survivable injuries (35%). This is similar to other comparable international studies.

Patterns of lower limb fractures sustained during snowsports in Otago, New Zealand

Alistair Patton, James Bourne, Jean-Claude Theis

We describe the nature and circumstances of leg fractures sustained during skiing and snowboarding, that required operative fixation at a single orthopaedic unit in New Zealand from 2002 to 2008.

Ethnicity of severe trauma patients: results of a population based study, Auckland, New Zealand 2004

Gowan Creamer, Ian Civil, Alex Ng, David Adams, Shas Čačala, Timothy Koelmeyer, John Thompson

Ethnicity is a factor in severe injury and mortality (death) rates in Auckland. Our study findings show that Māori and Pacific people had increased risk of severe injury and injury-related mortality in 2004.

Intensive care triage in Australia and New Zealand

Paul J Young, Richard Arnold

We conducted a web-based survey of Australian and New Zealand intensive care doctors measuring demographics, details of recent triage decisions and attitudes towards various triage scenarios. This survey demonstrated that there are significant differences between the views of intensive care practitioners in Australia and those in New Zealand with respect to a range of common intensive care triage scenarios with those in New Zealand tending to be more selective in their admission criteria. Despite

these differences, we did not demonstrate any difference in the proportion of referrals to the intensive care unit that were refused.

Illness severity scoring for Intensive Care at Middlemore Hospital, New Zealand: past and future

Susan L Mann, Mark R Marshall, Alec Holt, Brendon Woodford, Anthony B Williams

Scoring systems are one of the tools used in intensive care to allow study of progress in medical techniques and treatment over time. Middlemore Hospital caters for a unique population, and this is reflected in the diverse nature of admissions to our intensive care unit. Until recently, we have relied upon an international gold-standard scoring system to help us benchmark the outcomes we are achieving in our intensive care unit. In this study we show how this scoring system has become less helpful over time. We suggest some new approaches that might provide a more realistic reflection of practice and outcomes in our population.

Capturing outcomes following injury: a New Zealand pilot study

Sarah Derrett, Gabrielle Davie, Shanthi Ameratunga, John Langley

To identify ways of improving outcomes after injury we need to know what promotes good outcomes and reduces poor outcomes. Few studies have followed the impact of injury on individual New Zealanders over time. We were unsure if injured New Zealanders would be willing to take part in a study of outcome following injury if the initial invitation came from their insurer—the ACC. Two-thirds of eligible people contacted were willing to take part in a pilot study and participants included those with a range of injury types and causes. Following the pilot study, improvements were made to the main ‘Prospective Outcomes of Injury Study’ which is now underway.

Unintentional falls at home among young and middle-aged New Zealanders resulting in hospital admission or death: context and characteristics

Bridget Kool, Shanthi Ameratunga, Wayne Hazell, Alex Ng

This study describes the characteristics and contexts of unintentional falls at home among adults aged 25–59 years that resulted in admission to hospital or death during a 12-month period in Auckland, New Zealand. Of the 335 people who fell during the 12 month period and agreed to be interviewed (in the case of death or major injury a family member was interviewed), 36% fell on stairs/steps, 31% fell on the same level, 13% of falls involved ladders or scaffolding, and 11% fell from buildings or structures. The majority of falls (81%) occurred in the individual’s own home. While this analysis was not designed to identify the specific causes of falls, 24% of participants had consumed ≥ 2 drinks in the 6-hours preceding the fall, and 24% were on ≥ 2 prescription medications. The findings reveal several important contextual factors that can be targeted to prevent fatal and serious non-fatal falls at home among this age group.



The future of acute care in New Zealand

Peter Freeman, Tim Parke

Picture this. An elderly male patient lies on a trolley in the corridor of the emergency department (ED). He is there because his GP is concerned about his sudden confusion and deterioration in mobility. The GP is suspicious the patient has had a stroke. He is waiting to see the medical registrar who has accepted him, but that registrar is busy seeing other patients. There are currently no medical beds available and ED staff have initiated care and commenced investigations.

At the same time, a similarly aged patient sits comfortably in an inpatient bed. She has recovered from a bout of severe pneumonia requiring intravenous antibiotics and is waiting for her discharge medications, clinical summary to be written and her family to pick her up. All this takes time. The ward is full and nursing staff are happy that one patient, at least, is not requiring heavy nursing care.

The first patient requires the facilities that the second patient occupies—but these are not available because of systems issues. These systems issues are ubiquitous in our public hospitals and the paper *How to achieve New Zealand's shorter stays in emergency departments health target* (<http://www.nzma.org.nz/journal/123-1316/4152>) in this issue of the *Journal* by Prof Mike Ardagh examines some of these problems.

EDs are the 'barometer' of acute health care demand and availability. Like all barometers, they measure pressure, and pressure in the acute sector has been building through increasing ED attendances, increasing hospital bed occupancy, demographic changes, and advances in acute medical care.

The community relies on the ED to be there 24/7 to assess and treat acute patients some of which (~30%) will be deemed to require hospital-based care. Emergency physicians and nurses need to be available to resuscitate and manage the immediate care of the most sick. Once an ED is compromised by becoming a reservoir for acute inpatients (overcrowded), these functions become critically impaired, and Prof Ardagh's paper highlights the resultant inefficiencies and risk that may result.

The recent epidemic of 'ED overcrowding' has highlighted the need to be smarter about admission and streaming into hospital-based care. Analysis of patient flows has identified distinct patient streams and queue theory has shown that by separating out the various needs of patients their care and journey can be improved.^{1,2}

Patients attending ED requiring acute care fall into three main categories. In the first group, the sick, traumatised, compromised and often undifferentiated patients require urgent care which is undoubtedly best provided by specifically trained emergency physicians and nurses based in ED. Senior doctor input in patient care in the ED adds accuracy to disposition decisions, impacting on patient safety and improving department flow.³ This care can be provided soon after arrival of the patient as emergency medicine teams are rostered to work shifts in ED, generally have no

commitments outside of ED and have a broad skill set to deal with a wide range of serious illness, from critical care, orthopaedic trauma, medical, paediatric and psychiatric emergencies.

Emergency physicians and nurses are also well placed to treat another group of ED attendees which are the vast range of less serious acute conditions seen in ED many of whom will be able to return to the community after treatment (~70%). These patients may require a procedure, such as a lumbar puncture, wound closure, dislocation reduction or slit lamp examination, and some patients (especially poisoning and head injury) may require short-term (<24 hr) observation. The facilities and staff competencies found in ED make for a potentially efficient and cost-effective acute service for this group. It has been repeatedly shown that primary care appropriate patients are difficult to identify within an emergency department workload.^{5,6}

Then there is the group of relatively stable patients who have received assessment either by a GP or emergency physician in ED and are deemed to require admission to hospital for specific care or ongoing assessment. This is the group that can receive inpatient attention in an 'admission unit' and these patients do not benefit from much or any time in ED. These units (APU, MAPU etc) have been introduced in the UK, NZ and Australia with measurable improvement in the patient journey by the reduction in 'double handling'.⁷

Decongesting ED for new arrivals has the potential to reduce ED length of stay by reducing corridor waits, improving efficiency and reducing the burden on the ED nurses. The additional benefit of these units is that they 'keep the ED for emergencies'. The most prevalent comment from ED staff at Auckland City hospital when the new Adult ED and Admission and Planning Unit opened in 2003 was "at last we have the right patients in ED and no patients in corridors". Interestingly the Auckland City Hospital model of care (AED & APU) has resulted in no patients managed in the ED corridors for the last 5 years. This is despite increasing volumes.⁸

So what of the future?

Emergency physicians working in ED are hospital-based 'general' specialists. They are uniquely placed between the community and inpatient services to effect a change in the way hospital beds are used. However this can only happen with close liaison with our community-based colleagues and inpatient specialists.

A culture of realism needs to develop in understanding that health cannot continue as it has in the past. It cannot be driven by historical medical practices. Difficult ethical issues need to be addressed, such as how we can maintain the dignity of patients at the end of their life without subjecting them to futile hospital-based practices.

The burden of patients with chronic illnesses is going to be an increasing challenge to health care provision. More care for these groups will have to be delivered in the community and ways of achieving this must be addressed.

If the scarce and expensive inpatient hospital resource is to be made available to the acute patient waiting in the ED corridor, then the convalescing patient occupying a hospital bed will need to move back into the community as soon as acute care is complete. It will be argued that hospital length of stays are already short and by

shortening further will just cause more readmissions. However many readmissions are due to poor discharge planning and lack of chronic illness facilities in the community.

The health dollar must support an expansion of community-based care where end-of-life care, chronic illness and convalescing recovery can be delivered. The current model of a community care/hospital split needs to be changed. There needs to be a new concept of 'intermediate' care which occurs in the community in support of primary care and hospital-based acute care.

The status quo is not an option unless we are to witness a steady decline in standards of health care to our patients. Not only will we fail to look after our increasingly elderly population, but our emergency departments may not be able to provide the episodic urgent hospital-based care that the public rightly expects to be immediately and reliably available.

The new Ministry target and Professor Ardagh's paper provide a stimulus and the tools to begin addressing the acute care crisis in our hospitals.

Competing interests: None.

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A national trauma network: now or never for New Zealand

Ian Civil

It was as long ago as the late 1970s that Trunkey and West in their classic Orange County study showed that without a trauma network, or system, there was a high percentage of preventable and potentially preventable trauma deaths.¹ Similar data were reported in the UK in the late 1980s^{2,3} and, with the failure to develop an effective trauma network, very similar data was reported from the UK recently.⁴

In Australia, in particular in Victoria, McDermott and others reported a similar incidence of preventable and potentially preventable trauma deaths as in the UK.⁵ Unlike the UK, however, Victoria instituted a trauma system in 1999 and is now able to show a statistically significant reduction in the incidence of both these categories of death,⁶ demonstrating without doubt what Trunkey first espoused in the late 1970s “Trauma Systems Save Lives”.

In New Zealand (NZ) we have never had a study that confirms the US, UK and Australian data, that there are likely to be a significant number of preventable and potentially preventable deaths in our systemless “non-network”. In many ways we have taken a leaf out of Samuel Shem’s classic novel, *The House of God*, and demonstrated that if you don’t want to find a fever, don’t take the temperature⁷. Undertaking studies like Trunkey’s in the US and UK and McDermott’s in Victoria takes resolve and resources and these have never been in evidence in NZ. Seemingly there has been no jurisdictional resolve to establish what is almost certainly the case, that at least 30% of trauma deaths in NZ are preventable or potentially preventable.

The paper by Falconer published in this issue of the NZMJ using basic methodology suggests about 10% of pre-hospital deaths were preventable and about 30% potentially preventable.⁸ While anatomic analysis of injury severity in this study suggested the survivability of large numbers of pre-hospital deaths, the magnitude of this is questionable. For example, patients with an ISS between 25 and 49 were regarded as potentially survivable but this group includes those with extremely severe (AIS=5) head injuries that may in themselves be unsurvivable. In fact, amongst a group of 996 trauma patients with an ISS between 25 and 49 admitted to Auckland City Hospital a total of 328 (33%) died.

More rigorous TRISS methodology,⁹ which incorporates physiology as well as anatomic and mechanism of injury criteria, revealed only 148 patients who had probabilities of survival over 50% but who died, a much smaller potentially preventable group (Auckland City Hospital Trauma Registry, unpublished data).

However, despite the fact that pre-hospital deaths, where resources are likely to be an issue, are much less likely to be truly preventable than hospital deaths (in the ED, OR or ICU) where resources may be adequate but decision-making questionable, this study highlights what has been not been demonstrated before in NZ on a population-based denominator, that there are a significant number of preventable and potentially preventable trauma deaths in NZ.

Over the past 15 years there have been a number of attempts to establish an effective national network for the management of major trauma patients. In Victoria, injury-related agencies—in particular the Department of Health and Aging (DoHA) and the Transport Accident Commission (TAC)—have been able to work together to define a network, incentivise it, and get improvements in trauma care. In contrast, interagency “parcel-passing” in NZ has seen no one group or collective assume responsibility for this process. As a result, a national major trauma network and the data system to monitor the performance of trauma care delivery does not exist.

The current political environment which supports multidisciplinary clinician-led governance in healthcare has yet again opened the window for development of a national trauma network. The overseas data and the local paper published in this issue support the assumption that we have an incidence of preventable and potentially-preventable trauma deaths and that this could be reduced by an effective trauma network. To miss this opportunity would see NZ remain amongst a minority of first world countries and consign our population to hit-and-miss trauma care.

The evidence, the enthusiasm and the essential elements for the development of a national trauma network exist in NZ right now and if this cannot be accomplished there must be doubt that NZ can ever take this step towards first world trauma care.

Competing interests: None known.

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Preventability of pre-hospital trauma deaths in southern New Zealand

James A Falconer

Abstract

Aim To assess the preventability of pre-hospital trauma deaths in the Otago and Southland regions of New Zealand.

Methods A retrospective audit was carried out of all post-mortems from trauma deaths that occurred in these regions between January 2000 and December 2004. The injuries documented in the post-mortem reports were scored using the Abbreviated Injury Scale (AIS) 2005 and from this an Injury Severity Score (ISS) derived. Based on the ISS groupings of Sampalis et al, a probability of the preventability of death was then determined.

Results A total of 362 deaths were identified. Post-mortems were available for 245; 54 were excluded and 191 had their post-mortems scored according to the AIS 2005 with derivation of an ISS. Of these, 19 (10%) were classified as having survivable injuries, 66 (35%) potentially survivable injuries and 106 (55%) non-survivable injuries. The majority were aged 35 years or younger (51%), male (71%) and suffered significant injuries to multiple regions (76% to two regions, 51% three or more regions) and were the result of a motor vehicle accident (70%).

Conclusions In trauma-related deaths in southern New Zealand, the majority of patients who die before reaching hospital do so from non-survivable injuries; however, a significant proportion has either potentially survivable or survivable injuries. These results are very similar to comparable international studies and suggest that there should be further attempts at improving pre-hospital care while also aiming to improve primary prevention. Further research is required.

Trauma is the leading cause of death in New Zealand from age 1 through to 34 years, the third most common cause of death from age 35 to 54, and overall the fourth most common cause of death in all age groups.¹

In 2004 there were 1723 trauma-related deaths in New Zealand, of which 628 were in the 0 to 34 age range. With the exclusion of pregnancy, trauma is the leading cause of hospitalisation from age 5 to 45 years.¹ Despite the significant impact on the health system and wider society, there have been no studies of the preventability of trauma deaths in New Zealand.

A preventable death has been previously defined as “a fatal outcome occurring in patients with survivable injuries”.² However the preventability of trauma deaths is more difficult to quantify, and the published percentage of those deemed preventable varies widely, anything from 2-39%.^{3,4} Therefore to define the degree of preventability for this study the ISS groupings derived by Sampalis et al² have been used, these groupings have previously been used by several other studies.

Studies on the preventability of trauma deaths have been undertaken elsewhere; however New Zealand is unique in many regards, certainly culturally and geographically. However, perhaps the biggest difference is New Zealand's relatively low population density of 15 people per square km, similar to Norway and Finland but significantly less than the OECD average of 33 people per square km.⁵ This low population density is even more pronounced in the southern regions, where expert medical personnel and care can often be several hours' road travel away.

This study was done in an attempt to determine if there was excess pre-hospital trauma mortality in the study region. A determination could then be made regarding further research into the component aspects of any excess trauma, and possible preventive strategies.

Methods

After approval from the Lower South Regional Ethics Committee, the names and identifiers of all people who died of an external cause in the Otago and Southland regions (as defined by the New Zealand Local Government Act 2002 No84⁶) from the year 2000 to 2004 were obtained from the New Zealand Health Information Service (NZHIS). A similar dataset was obtained from the Accident Compensation Corporation (ACC), New Zealand's national no-fault personal insurer, after approval from ACC's own ethics committee.

The two datasets were required as the NZHIS data is based on where the patient was domiciled at time of death: therefore those that died in the study regions but were not domiciled there were missed. ACC data is based on location of death; however their database is not as inclusive as that of the NZHIS.

The two datasets were then cross-matched, and all non-trauma deaths (e.g. medical causes, suicide, drowning) and deaths outside the study area excluded. The resultant dataset was then sent to the Department of Justice, Coronial Service to ascertain if a post-mortem had been performed. Those patients who had not had a post-mortem were then excluded, as were those from early 2000 whose post-mortems had been archived and could not be obtained within the study budget. The post-mortems for the remaining patients were obtained from the Department of Justice, Coronial Service. Each post-mortem was reviewed and scored according to the AIS 2005.⁷

The AIS is an anatomically-based scoring system, which classifies the most severe injury for each of six body regions (head/neck, face, chest, abdomen, extremities and external) by increasing severity from 1 to 6. An AIS score of 1 represents an injury such as an abrasion whereas an AIS score of 6 is a non-survivable injury. The ISS is calculated from the sum of the square of the three most severely injured body regions per patient and provides a summary score with a range from 3 to 75. An AIS score of 6 in any single body region is automatically scored as a maximal ISS of 75.

All data collection and scoring was carried out by the author to prevent any inter-observer variation, and the scores were then checked by a dedicated trauma co-ordinator. Any discrepancy between scores was then discussed with a final score being arrived at by consensus agreement.

The ISS was used to determine the preventability of the trauma deaths as there was no available physiological data, and it has been previously demonstrated that ISS has "validity comparable to that of a chart review by a committee of experts".² Cases were classified as survivable (9-24), potentially survivable (25-49) and non-survivable (>49) based on the ISS groupings of Sampalis et al.²

Results

A total list of 362 patients was initially sent to the Department of Justice. No post-mortems had been done on 72 (20%) patients, a decision left to the discretion of the Coroner involved on a case-by-case basis. A further 45 (12%) had post-mortems that had been done in early 2000 that had subsequently been archived.

Post-mortems were obtained on 245 patients and subsequently 54 (15%) patients were excluded as they either: died in hospital, out of the study area, from suicide or non-

trauma related causes. The remaining 191 post-mortems became the study dataset. These were scored according to the AIS 2005 with derivation of an ISS. This revealed 19 (10%) had scores that suggested that they had survivable injuries, 66 (35%) had scores suggestive of potentially survivable injuries and 106 (55%) had non-survivable scores. Of the 106 with non-survivable scores, 90 actually had a maximal ISS of 75.

The pattern of injuries in the different regions scored by the AIS 2005 is illustrated in Table 1. The head/neck and chest regions were most frequently the areas with the highest single AIS scores, and combined accounted for 74% of all the study patients. The head/neck region had the single largest number of AIS 6 scores, which denotes a non-survivable injury. The 16 patients (8%) who had an external AIS score of 6 were motor vehicle accidents with secondary drowning or incineration. In some patients two or even three regions had equally high AIS scores.

Table 1. Highest AIS[†] score by anatomical region

Region	Highest AIS Score				Total (%)
	3	4	5	6	
Head/Neck	4	10	19	42	75 (39)
Face	0	0	0	0	0 (0)
Chest	1	16	22	26	65 (35)
Abdomen	0	1	3	1	5 (2)
Extremities	0	0	0	0	0 (0)
External	0	0	2	16	18 (10)
Two equal regions	2	13	3	5	23 (12)
Three equal regions	3	2	0	0	5 (2)
Totals	10	42	49	90	191

[†]Abbreviated Injury Scale.

The multiplicity of injuries in the study population is illustrated in Table 2. Only those regions with AIS scores of two or greater are included.

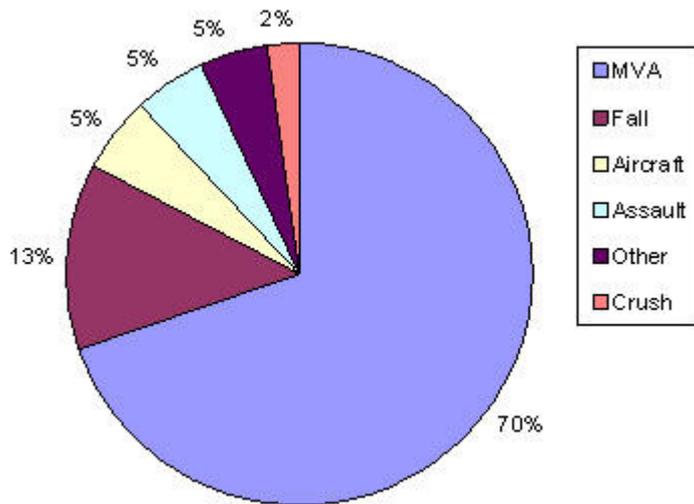
Table 2. Number of regions with AIS[†] Score ≥ 2 per post-mortem

Variables	1	2	3	4	5	6	Total
Patients	46	47	51	28	18	1	191
Percentage	24	25	27	15	9	1	100

[†]Abbreviated Injury Scale.

The causes of death are shown in Figure 1. The predominant cause of death in this study was from motor vehicle accidents (MVAs), with falls from a height the next most common. The falls were commonly leisure-related and reflects the study area's rugged geography, with many of them mountaineering in nature. The mountainous nature of the region was also reflected in the deaths attributable to light aircraft accidents with 11 deaths from just 6 accidents. Five of these deaths arose from a single scenic flight aircraft accident.

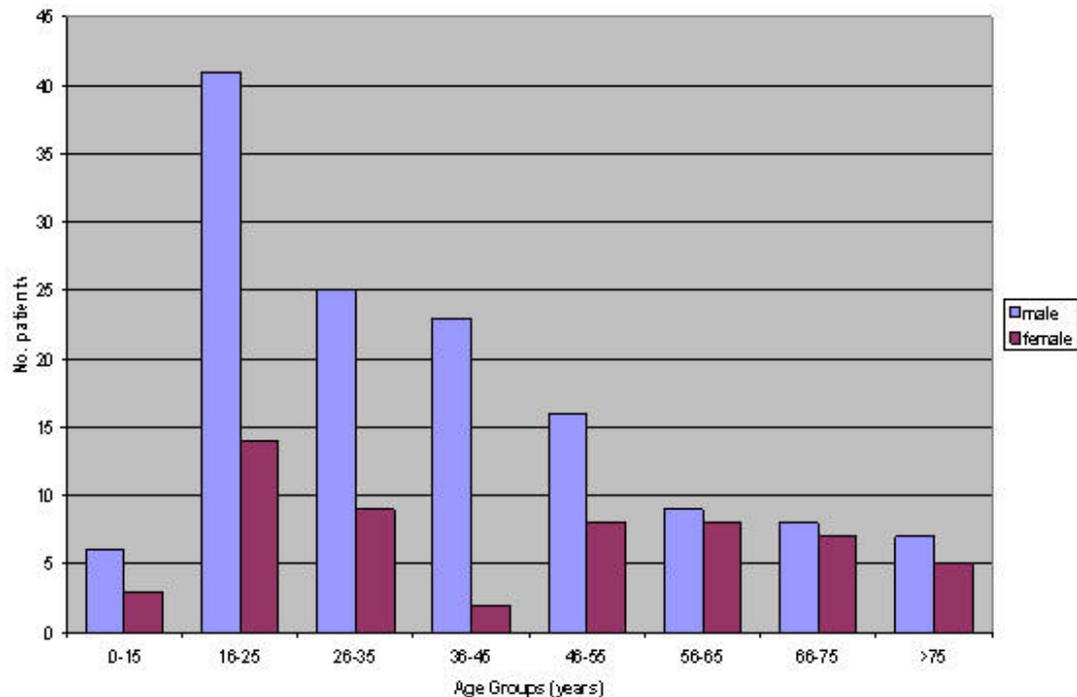
Figure 1. Cause of death



MVA=motor vehicle accident.

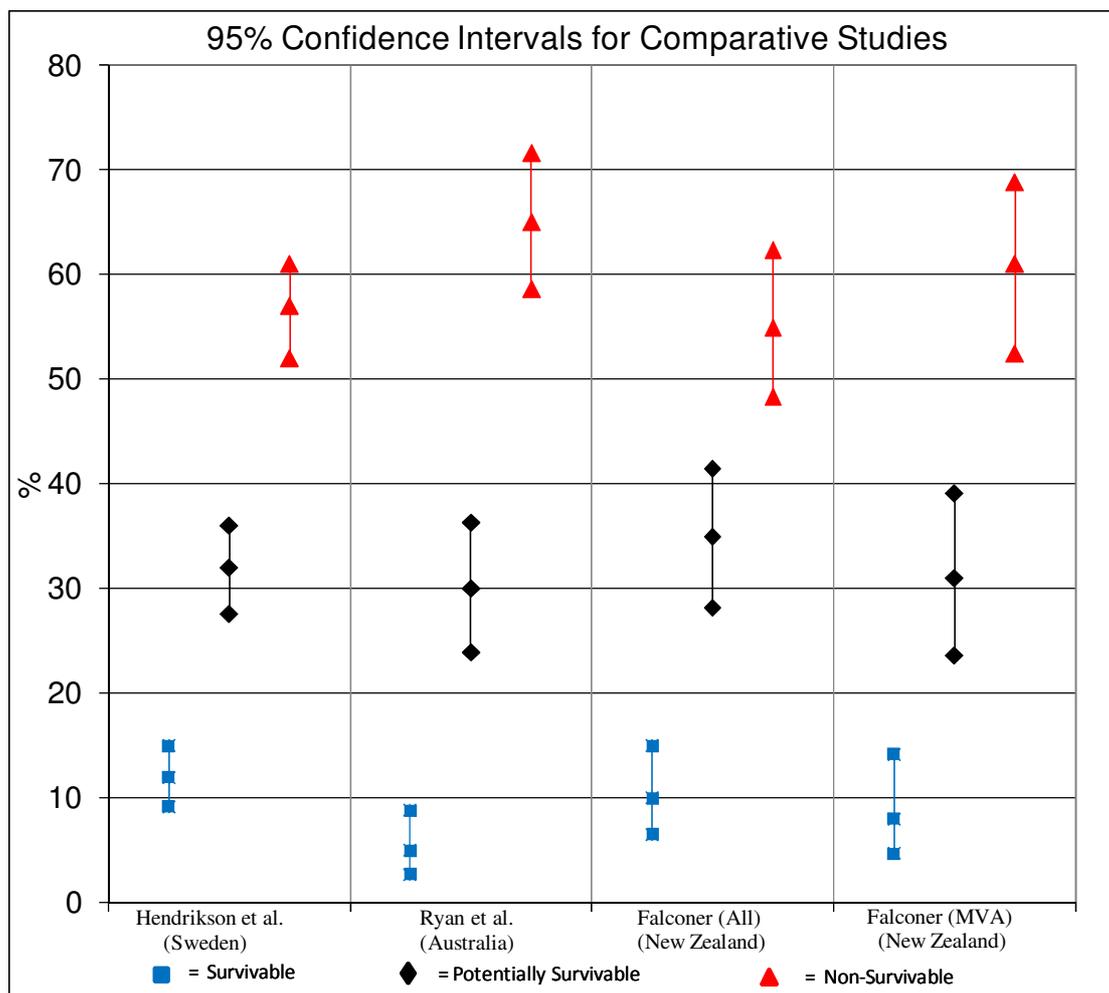
Demographic breakdown of the study population is shown in Figure 2. Fifty-one percent of the study population were aged 35 years or younger. Males outnumbered females at a ratio of 2.4:1, and accounted for 135 (71%) of the total study population. There was also a preponderance of young males, with 74% of those aged between 16–45 years being male.

Figure 2. Trauma deaths by age



These results are similar to those obtained in studies undertaken in Australia⁸ and Sweden,⁹ all of which were attempting to determine the preventability of trauma death using AIS and ISS. However the Australian and Swedish studies only looked at motor vehicle accidents, therefore to aid comparison between similar study populations the motor vehicle accident subset from this study has been graphed separately from that of 'all trauma' which includes this subset as part of the total study population. The 95% confidence intervals for all of these studies have been graphed (Figure 3) and illustrate the very similar results.

Figure 3. 95% confidence intervals for comparative studies



Discussion

Trauma is a significant cause of death in New Zealand. This is illustrated by data from the Injury Prevention Research Unit at Otago University in Dunedin,¹ and supported by the findings of this study where the majority (51%) of the study population were

aged less than 35 years, and 71% were male. These results illustrate the significant cost of this disease to the New Zealand Health system, and underscore the impact it has on the wider New Zealand society.

The preventability of trauma deaths is difficult to quantify, and there are widely divergent figures quoted in the literature (2–39%).^{3,4} This variability is likely multifactorial with possible variables including: geography, demographics, methodologies, trauma systems and injury patterns. This is all complicated by the fact that what may be medically preventable in an ideal situation, may actually be non-preventable in a ‘real world’ scenario, where constraints such as physical isolation, availability of limited resources and prevailing weather all impact on outcomes.

Yet the results of this study are very similar to other studies of a similar nature done in Australia⁸ and Sweden;⁹ despite the obvious geographical and population differences. The ranges for each category from all three studies being: survivable (ISS 9–24) 5–12%, potentially survivable (ISS 25–49) 30–35% and non-survivable (ISS >50) 55–65%.

However, of note is that the Australian⁸ and Swedish⁹ studies only related to motor vehicle accidents, whereas this study was trauma deaths of all causes. However 70% of trauma deaths in this study were also as the result of a motor vehicle accident and if this subset is extracted, then an even tighter correlation to the Australian⁸ and Swedish⁹ studies is obtained, with ranges for each category in this subset being: survivable (ISS 9–24) 5–12%, potentially survivable (ISS 25–49) 30–32% and non-survivable (ISS >50) 57–65%. This tight correlation of ranges for each category is reflected in the consistency of the ranges for the 95% confidence intervals between the studies.

With regard to motor vehicle accidents, New Zealand as with other OECD countries has had a declining mortality for many years, this is a reflection of many things including: improved vehicle safety, public education (e.g. seatbelts/alcohol) and hazard mitigation works on dangerous stretches of road. However when analysis was attempted to see if this declining overall mortality was reflected in this studies population, the results did not reach statistical significance in the relatively short period of this study.

The majority of the study population suffered significant (AIS \geq 2) injuries to multiple regions, as defined by the AIS 2005 scoring system, with 76% injured in two regions and 51% in three or more.

Not surprisingly the head/neck and chest were the most common sites of fatal injury accounting for 74% of the total fatalities, and the head/neck was the single most lethally (AIS score 6) injured area (21%). This multiplicity and pattern of injuries further supports the suggestion, based on the injury severity scores, that the majority of pre-hospital trauma deaths in this study are not survivable.

Given that the majority of patients in this study had non-survivable injuries, then there is significant justification for continuing preventative measures such as improved road configuration, driver/pilot education and also general public education with regard to simple first aid and injury prevention. However given the marked number of young people killed in motor vehicle accidents combined with New Zealand’s relatively low driver licensing age (15 years as compared to other OECD countries which are on

average 17-18 years), then consideration should be given to modification and improved young driver licensing and education.

However in this study there are still a significant proportion of patients who had survivable or potentially survivable injuries, who died. The cause for this is likely to be multifactorial and may reflect retrieval times, time delay until victim found, experience of initial attending medical staff, causation of injury, or other as yet undefined causes. This area is one which requires further detailed study with the prospect that potentially remedial causes of preventable deaths may be identified and subsequently ameliorated.

New Zealand still lacks a national trauma database, something which has been recommended and promoted both by clinicians and health officials for at least the last decade. If implemented a national trauma database would allow “quality assessment, standardisation and coordination of care”¹¹, and therefore potentially lead to significant improvements in the provision of trauma care in New Zealand.

The benefits of a trauma system are perhaps best illustrated by the continued decline in mortality in the state of Victoria, (Australia) after the implementation of the Victorian State Trauma Registry¹² in 2001.

There are several factors that limited this study. The retrospective nature of this study and the fact that it is limited to post-mortem reports without any access to data that would allow assessment of the patient’s physiological state. There was also no access to the patients past medical history, Police or ambulance reports.

As the study data was derived solely from post-mortem reports it was unable to be ascertained whether the patient was dead at the scene, or died in transit to hospital. This would have been extremely useful information to extract, as it would then allow a much more accurate assessment of the practical preventability of pre-hospital trauma deaths. This is important as with New Zealand’s rugged and sparsely populated geography then many of these patients were possibly not found for sometime after their accidents.

There are several well recognised limitations when classifying injuries according to the AIS and ISS scoring systems. These are that:

- Spinal injuries are often not described in detail in post-mortem reports, therefore skeletal injuries are recorded but not the potential spinal cord injury underlying this. (This is of particular relevance in the cervical spine.)
- There is only one injury scored per injury region which can therefore underestimate the severity of injuries in a patient who has multiple severe injuries in the same region.
- These scoring systems give no weight to physiological variables.
- Equal weighting is given to each of the regions in the scoring system.
- Only the injuries from the three most severely injured regions contribute to the ISS.

Conclusion

The Otago and Southland regions of New Zealand have a significant trauma burden, primarily from motor vehicle accidents and involving young people. Falls, aircraft accidents and interpersonal violence also cause significant mortality.

The majority of all trauma patients in this study suffered non-survivable injuries, similar to comparable international studies. However, there are still a significant number who suffered potentially survivable and survivable injuries, who died. Therefore while there needs to be attention to primarily preventing these accidents, there still needs to be further analysis of those who die of potentially survivable or survivable injuries.

This analysis needs to be undertaken in an attempt to identify remedial causes of death and consequently potentially avert future unnecessary loss of life.

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Patterns of lower limb fractures sustained during snowsports in Otago, New Zealand

Alistair Patton, Jim Bourne, Jean-Claude Theis

Abstract

Aims The aim of this study was to determine the nature and circumstances of lower limb fractures caused by skiing and snowboarding at the Otago skifields that required operative treatment at Dunedin Hospital from 2002 to 2008.

Methods Patients were retrospectively identified from clinical records.

Results 108 cases were included in the study; 28 snowboarders and 80 skiers. Snowboarders had more fractures involving the ankle whereas skiers had more fractures of the proximal third of the tibia and fibula. Snowboarders were more likely to fracture the fibula compared to skiers. Nearly two-thirds of fractures in snowboarders were to the left limb whereas in skiers a laterality was not demonstrated. Most fractures were the result of falls but a greater proportion of snowboarders had jump-related injuries.

Conclusions Snowboarding related lower limb fractures are more likely to involve the ankle and be left sided. Skiing related lower limb fractures are more proximal with no laterality.

Snowsports in New Zealand have increased in popularity since 1979 with 1.4 million visitors to New Zealand skifields in 2006.¹ The most popular sport is still traditional alpine skiing which has been developing for over a century. Over this time alternative downhill sports have been invented, most of which have been short lived. However snowboarding has grown disproportionately and now accounts for a third of snow sport participants in New Zealand.¹ With increasing popularity there is a need to understand the pattern of injuries associated with these sports.

Injury rates in skiers have fallen from 5–8 injuries per 1000 skier days in the 1970s to 2–3 injuries per 1000 skier days currently². This has been attributed to the evolution of equipment design, such as break-away bindings, and improved planning and grooming of slopes. It has been noted that the pattern of injury has also changed with lower leg injuries becoming less common while the incidence of proximal leg and knee injuries are increasing.³

Snowboarders experience a higher injury rate of 4–16 injuries per 1000 snowboarder days^{4,5} and this appears to be increasing. The most common injuries in descending order are head and facial, left upper limb, spine, chest and abdomen, left lower extremity, right upper extremity, and right lower extremity.⁶ This pattern demonstrates laterality of injury as one-side leads, a technical variance to skiing⁷; it also shows that upper body injuries are more common.^{8,9}

Differences in equipment and body position between the two sports may lead to different mechanisms and hence patterns of injury. The injury rate is also influenced

by the demographics of participants. In regard to the lower limb the most obvious difference is the plane of stance to the direction of travel i.e. skiers travel forward, whereas snowboarders go sideways with one side leading.

The boots and bindings are also very different. Snowboarders fix both feet to one board with 'soft' boots and non-releasing bindings. Skiers use 'hard' plastic shelled boots with releasing bindings and a ski on each foot. We aimed to define the differences in the pattern of lower limb fractures requiring operative management in these contrasting sports at the Central Otago skifields.

Methods

All patients who required surgical, orthopaedic treatment for ski or snowboard-related leg injuries treated by the orthopaedic department at Dunedin Hospital during the period 2002 to 2008 were included. An electronic search via the clinical coding of injuries was undertaken to find all cases of leg fractures that had been admitted. This was then focused to those that had occurred whilst skiing or snowboarding.

Patient records were manually reviewed to determine the nature and mechanism of injury. Age, gender and nationality were noted. Circumstance of injury was grouped as occurring during a jump, fall or collision. If the specific skifield that the injury occurred at was available this was also recorded. Laterality of the injury was documented.

Anonymous data retrieval was used to fulfil local ethical requirements.

Results

A total of 108 cases (80 skiers and 28 snowboarders) suffered fractures of the patella and distally, whilst participating in their chosen sport during the seven year study period. A mean of four cases per year occurred due to snowboarding and 11.4 cases per year due to skiing.

The demographic characteristics of the 108 cases are presented in Table 1. The snowboarders had an mean age of 27 years (range 9 to 45 years) and 86% were male. The mean age of the skiers was 32 years (range 4 to 65 years) and 60% were male. In both groups the majority of patients were resident in New Zealand (15 snowboarders and 51 skiers).

Table 1. Patient demographics

Variable	Snowboarders (n=28)	Skiers (n=80)
Age		
Mean	27 years	32 years
Range	9 to 45	4 to 65 years
Gender		
Male %	86%	60%
Female %	14%	40%
Nationality		
New Zealand	15	51
Australian	4	22
Other	9	7

Each group was analysed to establish the fracture pattern and circumstances of the injury, as displayed in Tables 2 and 3.

Table 2. Fracture pattern and circumstance among snowboarders

Fracture position	Snowboarders (n=28)		
	Jump	Fall	Collision
Knee		1	
Proximal		3	
Midshaft	3	5	
Distal	1	3	1
Ankle	5	6	
Total	9	18	1

Table 3. Fracture pattern and circumstance among skiers

Fracture position	Skiers (n=80)		
	Jump	Fall	Collision
Knee		1	1
Proximal	2	23	1
Midshaft	3	25	8
Distal	1	6	1
Ankle		8	
Total	6	63	11

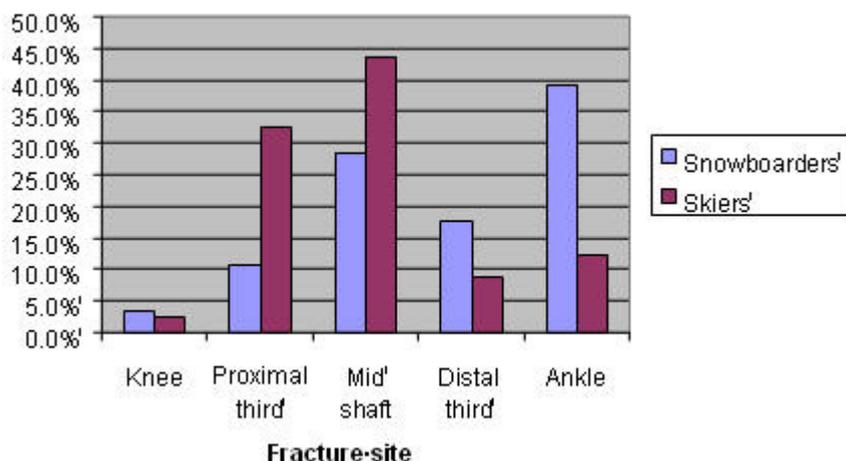
In both sports falls were the most common cause of injury. However the next most common cause for injury in snowboarders was jump related, making up 32% of the group. For skiers this only accounted for 7.5% of injuries. Collision was the cause of injury in 13.8% of cases for skiers but only 3.6% of snowboarder injuries.

Snowboarders were more likely to injure the ankle (39% of cases). The next most common point was mid shaft tibial fractures (28%), followed by distal third (18%), proximal third (11%), and knee (4%). Skiers were most likely to have a midshaft tibial fracture (44%). Followed by proximal third (32.5%), ankle (12.5%), distal third (9%), and knee fractures (2.5%). This is illustrated in Figure 1.

19 of 28 fractures occurred to the left leg in snowboarders and 9 to the right. In skiers the laterality was evenly distributed, 41 right and 39 left.

Of 16 tibia and fibula fractures in snowboarders, 5 involved the tibia alone, and 9 involved both the tibia and fibula, only 2 were isolated fibula fractures. Of the 70 tibia or fibula fractures in skiers, 36 were of the tibia alone and 34 involved both the tibia and fibula with no isolated fibula fractures.

Figure 1. Comparison of fracture site between skiers and snowboarders



Discussion

The demographic data suggests that a male in their late 20's is the most likely snowboarder to sustain a leg fracture. This is consistent with previous studies ^{8, 10}. Today's Otago skiers have a higher average age and a more even gender split than snowboarders, also consistent with previous studies.¹¹ The majority of patients in our study were from New Zealand but a higher proportion of non New Zealand residents are snowboarders. This fits with the analysis of the New Zealand ski industry which shows a static domestic market but an overall increase in overseas users, particularly snowboarders, in the last 10 years ¹.

A large proportion of the injuries to the proximal tibia are tibial plateau fractures. Of these the higher grade (Schatzker classification 5&6) injuries occur in high speed skiing accidents. Skiers are also more likely to sustain avulsion fractures of the anterior tibial spine or posterior intercondylar area, where the anterior and posterior cruciate ligaments, respectively, insert.^{13,14} Our finding of a higher number of proximal third tibia and fibula fractures, including tibial plateau fractures, in skiers corresponds with the published data.

Fractures of the tibial diaphysis are common long bone fractures. Often the consequence of road traffic accidents they are also common in snowsports. Traditionally they have been difficult to manage but advances in intramedullary nails, pre-contoured plates and locking plates has led to a decrease in fracture complications and an improved outcome.¹⁵ Both skiers and snowboarders have a high incidence of these fractures but snowboarders are more likely to fracture more distally than skiers.

Compared to skiers the snowboarder group had a slightly higher proportion of fractures that involved the tibia and fibula, 57% versus 47%, which have been associated with high energy or rotational forces.¹⁵ In the case of skiers these large rotational forces may be due to the ski failing to release from the breakaway binding and thus acting as a long lever arm, in snowboarders these injuries may be caused by a higher initial force transmitted through bindings that are not designed to breakaway.

The higher initial force being related to the preponderance for snowboarders to undertake activities such as jumping.

Isolated fibula fractures were seen exclusively in the snowboarders and we postulate that the hard shell boots worn by skiers protect them from these injuries. A study of novice snowboarders using hard ski boots showed similar findings,¹⁶ and we know that prior to the introduction of modern ski boots and bindings the pattern of injury was similar to that seen in modern snowboarders.¹⁷

The finding of more left sided injuries in snowboarders (68%) may be explained by the stance. Most snowboarders lead with their left foot and when moving at speed this is at 90 degrees to the direction of travel, with weight distribution biased towards this lead leg. Skiers will transfer their weight from one leg to the other as they turn, and when moving at speed the foot and ankle face in the direction of travel with no laterality of weight distribution. This accounts for the equal distribution of fractures between sides we observed in skiers.

Conclusion—The pattern of injury in these two sports is very different. This study has highlighted how vulnerable the ankle is to injury in snowboarding and we offer reasoning for this based upon an understanding of the differences in equipment used in skiing and snowboarding. The challenge to reducing the incidence of ankle injury in snowboarders is in the balance of allowing movement in order to accomplish the tricks and jumps deemed integral to the sport whilst protecting the ankle, although more rigid boots such as those used in skiing may create more proximal injuries by transmitting force proximally.

We propose a more protective boot for the lead foot of snowboarders that includes a lace up ankle support. In our opinion and with personal experience of both sports, no advances in equipment design can negate the importance of common sense and abiding by local skifield policies when undertaking these sports.

Limitations—Many injuries that do not require orthopaedic operative intervention are seen and treated by skifield doctors and general practitioners within Otago, thus we were unable to obtain details of these injuries within our unit. Injuries sustained in the Queenstown skifields that require operative management are usually treated in Invercargill, and as such the incidence of injuries is higher, but the anatomical distribution or circumstances of injury should not differ. We elected to exclude injuries of the femur and above in order to make data retrieval less complicated. Inaccurate coding may have led to some cases being missed.

Competing interests: None known.

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Ethnicity of severe trauma patients: results of a population-based study, Auckland, New Zealand 2004

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Abstract

Aim To investigate the role of Māori and Pacific ethnicity within the severe trauma and population demographics of Auckland, New Zealand.

Methods A population-based study utilising prospectively gathered trauma databases and coronial autopsy information. Population data was derived from Statistics New Zealand resident population projections for the year 2004. The geographic boundaries of the Auckland district health boards (Waitemata DHB, Auckland DHB and Counties-Manukau DHB). Severe injury was defined as death or injury severity score more than 15. Combining data from coronial autopsy and four hospital trauma databases provided age, gender, ethnicity, mechanism, mortality and hospitalisation information for severely injured Aucklanders.

Results Māori and Pacific had increased risk of severe injury and injury-related mortality. A major gender difference is apparent: Māori female at increased risk and Pacific female at decreased risk compared to the remaining female population; both Māori and Pacific male have high severe injury rate than the remaining population. The relative risk for severe injury (and mortality) for Māori RR=2.38 (RR=2.80) and Pacific RR=1.49 (RR=1.59) is higher than the remaining population, the highest risk (and more statistically significant) is seen in the 15–29 age group (Māori RR=2.87, Pacific RR=2.57). Road traffic crashes account for the greatest proportion of injuries in all groups. Māori have relatively higher rates of hanging and assault-related injury and death; Pacific have relatively higher rates of falls and assault.

Conclusion Ethnicity is a factor in severe injury and mortality rates in Auckland. Age is an important influence on these rates. Although mechanism of injury varies between ethnic groups, no particular mechanism of injury accounts for the overall differences between groups.

Trauma is a significant healthcare burden. Mortality risk increases with increasing injury severity. An Injury Severity Score of 16 (ISS > 15) or more is considered life threatening, a severe injury.¹ Age and gender are two well-recognised risk factors for traumatic injury and death. Some ethnic groups have higher injury and mortality rates.²⁻⁵

Ethnicity has been seen as a risk factor in several population studies. Mortality rates are higher in some ethnic groups as a reflection of interpersonal violence. In Los Angeles County the homicide mortality rates for African Americans, (40.4/100,000), was higher than the total population mortality rate (30.9/100,000).²

The mechanism of injury can be similar to that of the reference population with some causes having higher relative risk. In the Calgary Health Region, Aboriginal Canadians had higher severe injury rates than the reference population (relative risk 3.7). Motor vehicle crashes, assault and suicide had highest relative risks.⁷

Native Americans and Australian Aboriginals had differing injury mortality profiles when compared by Stevenson et al.⁸ In different populations the mechanism of injury for different ethnic groups varies. Specific interventions, for specific ethnicity and mechanism, can be effective.⁹

Auckland severe injury and mortality rates, for the year 2004, are 14.4/100,000 and 33.6/100,000.¹⁰ As both the reference and study populations had ethnicity as part of the data set an ad hoc analysis was performed.

Methods

The boundaries of the Auckland, Waitemata and Counties Manukau District Health Boards were used to define the study population. This population is served by four major metropolitan hospitals: North Shore Hospital, Starship Children's Hospital, Auckland City Hospital and Middlemore Hospital. Statistics New Zealand population projections (age, gender and ethnicity) for the resident population, 2004, were utilised to identify the baseline population characteristics.¹¹

Trauma registries at the four major hospitals were utilised to identify ISS >15 patients and inpatient deaths from injury. Pre-hospital traumatic mortality was identified from coroner's autopsy records (New Zealand law requires coronial autopsy for all pre-hospital traumatic deaths). Self-harm from physical cause was included. No individual had more than one severe injury in the time frame. A residential address was available for all individuals. Prioritised ethnicity was used for both the trauma and resident populations. Age, gender, ethnicity, injury severity score, mortality and mechanism were identified. Injury mechanism group was prioritised: road traffic crash (including pedestrian), falls, hanging, assault, burns other.

The inclusion criteria were: Auckland resident, death from injury, life threatening injury (ISS >15), injury occurring during the 2004 calendar year and treatment at one of the four major hospitals. Exclusion criteria were: injury occurring outside of geographic catchment and the exclusion criteria of the hospital trauma registries (examples of registry exclusions include: poisoning, drowning, and overdose as mechanisms, and fractured neck of femur or chronic subdural as injuries).¹²

The Auckland Ethics committee approved the study.

Results

In Auckland 2004, Māori comprised 11% of the population, had 27% of the injuries and 23% of the injury mortality. Pacific comprised 14% of the population, had 15% of the injuries and 15% of the injury mortality. With univariate analysis, Māori showed the highest risk of both severe injury and mortality.

In multivariate analysis these risks increased after controlling for age and gender, compared to the non-Māori, non-Pacific group, Māori had a relative risk of 2.38 (95%CI 1.88–3.02) of severe injury and 2.80 (95%CI 1.96–3.99) for mortality. A similar effect was seen in respect of the Pacific group, however the relative risks were not as high, 1.49 (95% CI 1.11–1.95) for severe injury and 1.59 (95% CI 1.05–2.41) (Table 1).

Table 1. Injury and mortality rates and relative risk by ethnicity

Variables	Rate (/100,000)	Univariate risk RR (95% CI)	Multivariable risk RR (95% CI)
Severe injury			
Māori	61.4	2.14 (1.70–2.70)	2.38 (1.88–3.02)
Pacific	38.6	1.35 (1.04–1.77)	1.49 (1.13–1.95)
Other	28.5	1.00	1.00
Mortality			
Māori	28.4	2.37 (1.68–3.35)	2.80 (1.96–3.99)
Pacific	16.4	1.37 (0.91–2.07)	1.59 (1.05–2.41)
Other	11.9	1.00	1.00

CI=confidence interval.

When relative risks for ethnicity by age group were analysed, the relative risks varied notably by age group. In the older age groups the numbers of Pacific and Māori were small and statistical analysis was unable to be carried out. For Māori there were statistically significantly increased risks associated with severe injury for all age groups below 45 and mortality for the 15–29 and 30–44 age groups. The point estimates of the other groups were increased however did not reach statistical significance.

For severe injury an increased risk was seen in the 15–29 year age group, those for the 0–14 and 30–44 year groups were increased but did not quite reach significance at the 5% level. The only age group showing an increased risk of mortality amongst the Pacific group was those 15–29 years of age (Table 2).

Table 2. Relative risk, injury and mortality for Māori and Pacific in 15-year age groups

Age group	Māori injury	Pacific injury	Māori mortality	Pacific mortality
0–14	2.66 (1.89–3.74)	1.48 (0.98–2.23)	2.58 (0.69–9.62)	1.23 (0.24–6.35)
15–29	2.87 (1.46–5.63)	2.57 (1.29–5.09)	3.03 (1.88–4.91)	1.86 (1.07–3.25)
30–44	2.83 (1.71–4.69)	1.73 (0.96–3.11)	3.84 (1.78–8.25)	1.40 (0.48–4.12)
45–59	1.71 (0.85–3.45)	0.82 (0.33–2.05)	2.00 (0.69–5.81)	1.30 (0.39–4.35)
60–74	Numbers too small		Numbers too small	
75+	Numbers too small		Numbers too small	

The risk of mortality was increased in both Māori and Pacific Island males compared to those of other ethnicities, whilst the risk of injury was only significantly increased amongst Māori male. For females, Māori were at increased risk of both mortality and injury, whilst there was no significant difference in risk compared to those of non-Māori/non-Pacific ethnicity for Pacific women, in fact the point estimated for mortality was in a protective direction (Table 3).

Table 3. Relative risk, injury and mortality for Māori and Pacific by gender

Gender	Māori injury	Pacific injury	Māori mortality	Pacific mortality
Male	1.97 (1.37–2.83)	1.36 (0.91–2.03)	2.18 (1.43–3.32)	1.76 (1.14–2.73)
Female	2.03 (1.09–3.78)	1.29 (0.63–2.66)	2.90 (1.58–5.35)	0.36 (0.09–1.49)

Mortality rates are highest for Māori male, and lowest for Pacific female (Figure 1). Severe injury rates are highest for 15–29 year old Māori male (Figure 2). The lowest rates are seen in elderly Māori and Pacific. The denominator in these groups is small. The Pacific female graph (Figure 3) is different from all other groups, the peak injury incidence is in childhood, when it is higher than Pacific male for the same age range.

Figure 1. Mortality rates for gender and ethnicity

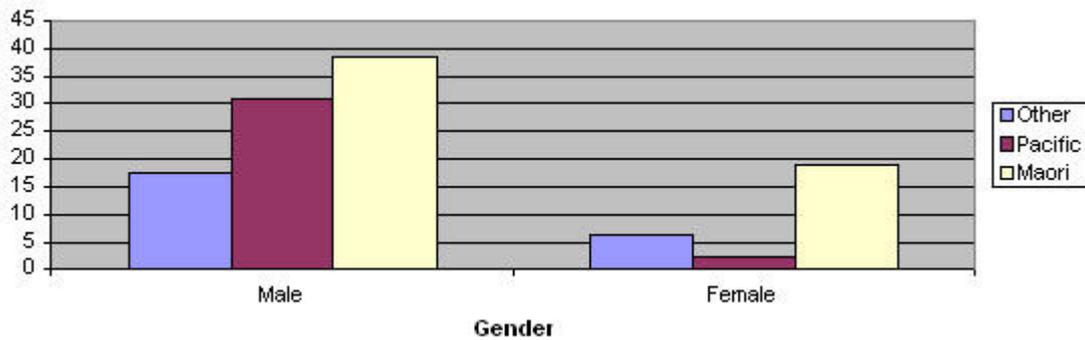


Figure 2. Male injury rates, age groups and ethnicity

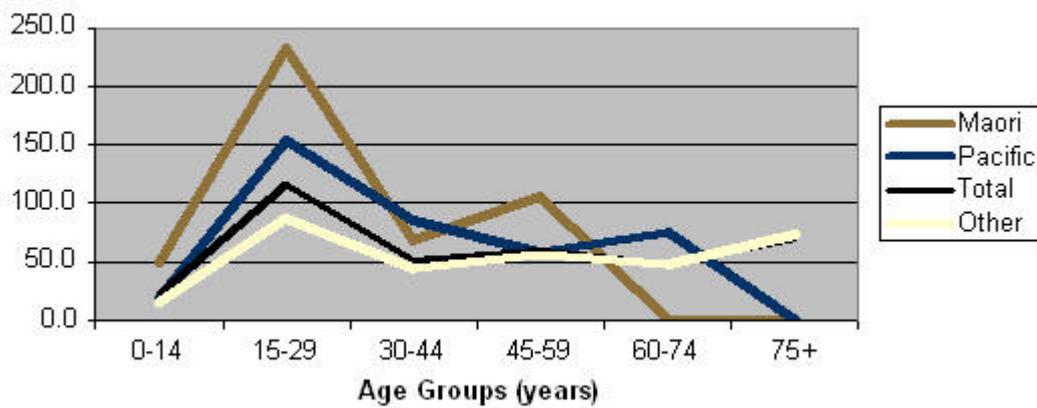
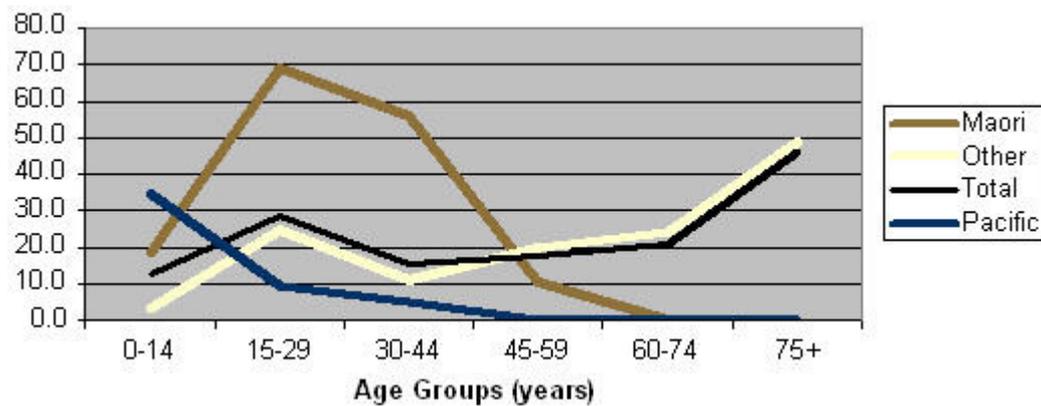


Figure 3. Female injury rates: age groups and ethnicity



The most common cause for injury, accounting for 50% of the injuries across all ethnic groups, was road traffic crashes including pedestrian injuries (Table 4). This was followed by falls (18%), hanging (15%) and assault (11%). There was, however, a significant difference of injury between ethnicities ($p=0.0013$).

Hanging (25%) and assault (18%) were the second and third most common causes for Māori; falls (23%) and assault (14%) were second and third for Pacific. (The non-Māori, non-Pacific group followed the overall pattern.)

Table 4. Number (percent) of injury type by ethnicity

Injury type	Māori	Pacific	Other
Road traffic crashes	43 (45.3)	29 (43.9)	150 (52.3)
Falls	6 (6.3)	15 (22.7)	62 (21.6)
Hanging	24 (25.3)	8 (12.1)	35 (12.2)
Assault	17 (17.9)	9 (13.6)	22 (7.7)
Burns	2 (2.1)	3. (4.6)	6 (2.1)
Other	3 (17.7)	2 (3.0)	12 (4.2)

Discussion

This paper shows statistically significant differences for Māori and Pacific injury and mortality rates from the remaining population. Although the mechanisms of injury are the same, Māori and Pacific have relatively more assaults and hangings. Pacific women have lower injury rates than all other ethnic and gender groups. The basis for this is not known and is beyond the scope of this paper.

Using severe injury, ISS >15, utilises an accepted mechanism for grading injury, and defines the injuries as clearly life threatening.¹ Prioritised ethnicity was used in each group.

In a similar Canadian Study, being of aboriginal Indian descent was associated with increased risk of injury.⁷ The higher injury rates noted in Canada may be, in part, due to a lower injury severity score (greater than 12) as a definition of major injury, and

partly due to databases characteristics. In Los Angeles county the variation in mortality rates between ethnicities was related almost entirely to interpersonal violence.² In our study, motor vehicle-related injury was the most common cause of injury and death in all ethnic groups.

Bias may be introduced into this study in many ways. This is an ad hoc analysis. Prioritised ethnicity, although consistent between the data groups, may be a methodological issue.¹⁴ Finally, the data used for the population are projections.

A single year of data allows for limited interpretation. In many groups, especially elderly Māori and Pacific, the sub-populations are small. A single injury in the 75+ Māori male group would give an incidence of more than 280/100,000. However, the data collated in this study is the first time that such information has been drawn together in New Zealand, and is the first time that paediatric data is included in such a study. Further research in this area might include more years of data, and be the objective of the research, rather than an ad hoc analysis.

In summary, this paper demonstrates the characteristics for severe injury and mortality in the Auckland region for Māori and Pacific people for the 2004 calendar year. Pacific female had the lowest injury rate, although this only reaches significance when children are excluded. Further study is needed to verify or refute this. Māori and Pacific generally have higher rates of major injury (including injury causing death) than the rest of the population. For Māori and Pacific men, ethnicity appears to be a significant risk factor for severe injury and mortality.

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Intensive care triage in Australia and New Zealand

Paul J Young, Richard Arnold

Abstract

Aim To compare the attitudes towards common intensive care triage scenarios in New Zealand and Australia and to evaluate Australasian intensive care triage practice.

Method A web-based survey of Australian and New Zealand intensive care doctors measuring demographics, details of recent triage decisions and attitudes towards various triage scenarios.

Results A total of 238 responses were obtained (32.6% response rate). The mean number of triage decisions was 6.3 per clinician per week in New Zealand (95% CI 4.6–8.0) and 8.5 per week in Australia (95% CI 6.6–10.4) (test for difference in means, $p=0.08$). The mean rate of refusal for the week prior to the survey was 30.8% (95% CI 19.5–42.1) among New Zealand respondents and 25.1% (95% CI 19.7–30.4) among Australian respondents (test for difference in proportions, $p=0.35$). Australian respondents were more likely than New Zealand respondents to agree that it was appropriate to admit a patient:

- with a non-survivable brain injury who may progress to brain death ($p=0.0001$);
- with acute respiratory distress syndrome in the setting of relapsed acute myeloid leukaemia ($p=0.0005$);
- in a persistent vegetative state with pneumonia due to malposition of a feeding tube ($p=0.03$);

However, there were no differences found between Australian and New Zealand respondents on the appropriateness of admitting a patient:

- in a persistent vegetative state with pneumonia with a non-iatrogenic cause ($p=0.58$);
- with an infective exacerbation of chronic obstructive pulmonary disease with a background of functional impairment ($p=0.060$);
- of an advanced age who is unable to extubate due to drowsiness and hypoventilation following a laproscopic hernia repair ($p=1.00$);
- suffering from a massive stroke, intubated in a crowded emergency department, but now needing extubation and palliation ($p=1.00$).

Conclusions New Zealand doctors have more selective views of what constitutes an appropriate admission to intensive care.

The demand for health care increasingly exceeds available resources and the pressure to contain the cost of medical care in the face of an ageing population is leading to growing pressure to use available resources as efficiently as possible.¹

In the intensive care setting, resource conservation requires careful determination of who receives treatment based on expected benefit. Intensive care triage requires a determination of which patients are 'too well' to require intensive care² as well as which patients are 'too sick' to benefit.³ Considerations of individual patient's wishes and quality of life are also important.^{4,5}

Triage decisions are difficult because even the best available prediction scores are unable to predict survival with sufficient accuracy to guide decisions about individual patients and factors such as lead time bias and casemix may further confound their interpretation.⁶

Although studies investigating the process of intensive care triage have previously been performed in the United Kingdom,⁷ Europe,^{8,9} and the United States,¹⁰ no such study has previously been conducted in Australia or New Zealand. Previous studies have demonstrated that there are significant differences in both the manner and frequency with which intensive care treatment is withheld in different parts of the world and in different cultures.¹¹

Although New Zealand and Australia are often considered culturally similar, there are significant differences in our respective cultural heritages. For example, New Zealand has larger proportions than Australia of indigenous people (15% vs 2.5%) and Polynesians (7% vs 0.5%).¹²⁻¹⁴ In addition, there are a number of factors in Australia such as greater availability of private intensive care, a higher level of funding for medical care and, a larger number of intensive care beds that are likely to lead to differences in intensive care triage practice.

We hypothesised that there would be differences between Australia and New Zealand in the attitudes towards and practice of intensive care triage and sought to demonstrate these differences by way of a survey.

Methods

This study involved an online survey of intensive care specialists and trainees in Australia and New Zealand. The sample of 731 intensive care specialists and trainees were identified by a combination of an internet search of State (and New Zealand) Medical Registers, and a search of intensive care unit websites, supplemented by direct phone contact with individual intensive care units.

The survey was designed to examine views about a range of triage scenarios and also to review recent triage practice. Prior to distribution, the survey was piloted on a small number of intensive care specialists and some minor modifications to the survey were made as a result of this.

The intensive care specialists and trainees in the sample were invited to participate in the survey by an email sent on 19/05/09 that contained a link to an online survey on the website www.surveymonkey.com. A subsequent reminder was sent on 27/05/09 in order to maximise the response rate. The survey was closed to responses on 04/06/09. The survey was approved by the Multi-Region Ethics Committee of the Health Research Council of New Zealand (MEC/09/25/EXP).

Respondents were required to answer a number of demographic questions including location of practice, qualifications and experience. Those respondents who made final decisions about whether or not to admit a patient were asked about recent triage decisions including the number of such decisions they had made in the previous week and how the decisions were made and communicated. All respondents were asked to consider specific triage scenarios.

For each scenario they were asked to consider (a) how appropriate (on a 5-point Likert scale) they felt that intensive care was and (b) whether they would admit the patient on the basis of the information provided.

The results were analysed using the R statistical package.¹⁵ Independent samples t-tests, with two-sided p-values, were used to compare means between New Zealand and Australia. Chi-squared tests were

used to compare the proportions over categories, including the distribution over the 5-point Likert scale responses. Where 20% or more of the expected counts in a contingency table were less than 5 so that the standard Chi-squared test is invalid, a Monte Carlo simulation method was used to compute p-values.^{16, 17} In addition to Chi-square tests of association, logistic regressions were carried out to test for the importance of the explanatory variables: 'is a trainee' (yes/no) and 'has an additional qualification' (yes/no).

Results

Respondents—A total of 238 responses to the survey were obtained, representing a response rate of 33%. The proportion of respondents from various geographical locations was similar to that of all trainees and specialists registered with the Joint Faculty of Intensive Care Medicine except that the proportion of total respondents from New Zealand was higher and the proportion from New South Wales lower, than the proportion of trainees and specialists from New Zealand. The demographics of respondents are shown in Table 1.

Table 1. Demographics of respondents

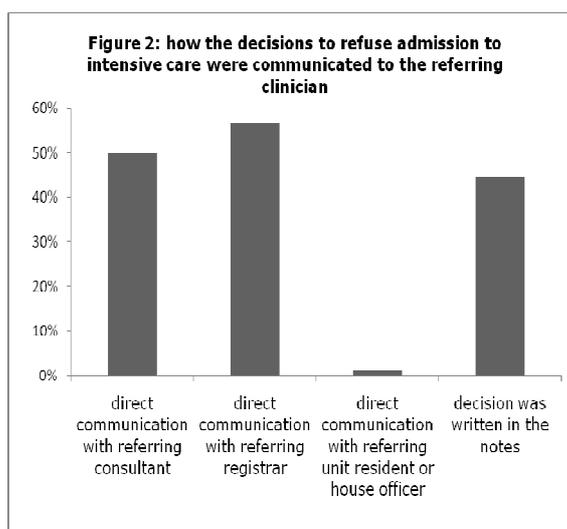
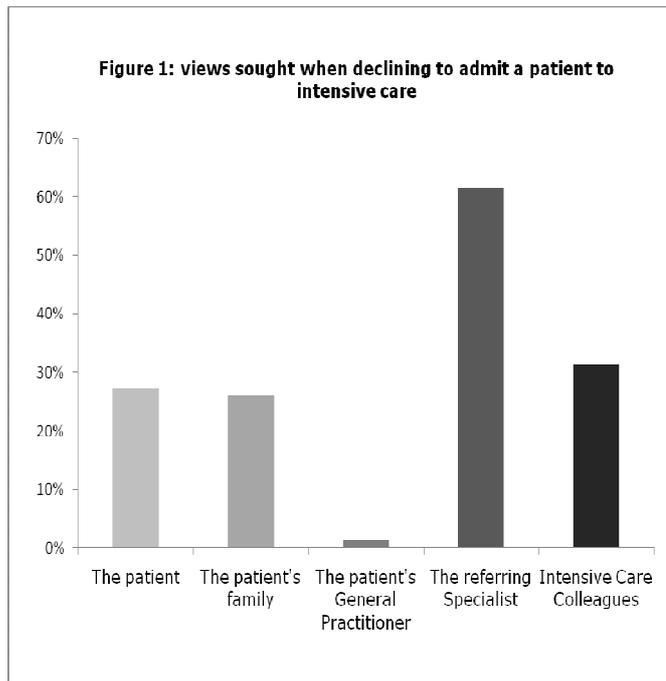
Variables	Number of respondents (%)
Location of respondents	
New Zealand	47 (19.7%)
Australian Capital Territory	2 (0.8%)
Victoria	46 (19.3%)
New South Wales	49 (20.6%)
Queensland	37 (15.5%)
South Australia	23 (9.7%)
Northern Territory	6 (2.5%)
Tasmania	3 (1.3%)
Western Australia	20 (8.4%)
Other	5 (2.1%)
Respondent experience*	
Trainee	129 (54.7%)
Specialist with <5 years experience	35 (14.8%)
Specialist with 5-10 years experience	24 (10.2%)
Specialist with >10 years experience	48 (20.3%)
Nature of practice	
Tertiary or quaternary adult or mixed ICU (public)	167 (70.5%)
Other urban adult or mixed ICU (public)	23 (9.7%)
Rural ICU (public)	7 (3.0%)
Specialised paediatric ICU	12 (5.1%)
Private ICU	28 (11.8%)
I do not currently work in an ICU	37 (15.6%)
Additional qualifications	
FANZCA	47 (19.7%)
FACEM	19 (8.0%)
FRACP	38 (16.0%)

* Two respondents did not answer this question.

Recent triage decisions—Of those surveyed, 134 personally made decisions about whether to admit patients to the intensive care unit of which 77% were consultants and the remainder were trainees. These 134 were asked about triage decisions they

had made in the previous week. The mean number of decisions about whether to admit a patient to the intensive care unit in New Zealand was 6.3 (95% CI 4.6–8.0) and 8.5 in Australia (95% CI 6.6–10.4) (test for difference in means, $p=0.08$). The mean refusal rate for the week prior to the survey was 31% (95% CI 20–42) among New Zealand respondents and 25% (95% CI 20–30) among Australian respondents (test for difference in proportions, $p=0.35$).

79 respondents had refused an admission in the previous week. The sources of views sought in coming to this decision are shown in Figure 1 and the means of communicating decisions to refuse admission are shown in Figure 2.



No differences between Australia and New Zealand were found in the distribution of levels of experience or proportions having non-intensive care unit specialist qualifications. 41% of patients who were declined admission to intensive care were physically reviewed by an intensive care specialist.

Intensive care triage scenarios—For all 7 triage scenarios described, (see Table 2) two comparisons were made between New Zealand and Australia. The first comparison was with respect to whether the respondents agreed that admission was appropriate, and the second was whether the respondents would actually admit the patient (the results are in Table 3).

We also test for associations with being a trainee, and with having an additional qualification. No associations were found with respect to having additional qualifications, but in two scenarios trainees responded differently to specialists. In most of the scenarios there was a wide variety of opinions, in several cases spanning the full range of the 5-point Likert scale used to measure the strength of agreement that the patient should be admitted.

Table 2. Triage scenarios

1.	A previously well 50-year-old woman with an intracerebral haemorrhage that the neurologist describes as 'non-survivable' and who you feel may progress to brain death over the next 48 hours.
2.	A 30-year-old female with relapsed acute myeloid leukaemia following a bone marrow transplant who has ARDS and who you believe will imminently require intubation.
3.	A 30-year-old male with pneumonia requiring ventilation who has been in a nursing home in a persistent vegetative state for the past five years following a severe traumatic brain injury.
4.	A 30-year-old male with pneumonia requiring ventilation who has been in a nursing home in a persistent vegetative state for the past five years following a severe traumatic brain injury, and has developed aspiration pneumonia due to malposition of a feeding tube in the right main bronchus.
5.	A 70-year-old male with an infective exacerbation of COPD who has a documented FEV1 of 0.9L and has failed to improve despite non-invasive ventilation for 6 hours in the emergency department. He lives at home but requires help with showering, shopping and meals.
6.	A 95-year-old man with no previous medical history who the anaesthetist, despite appropriate attempts, has been unable to extubate due to drowsiness and hypoventilation following an elective laparoscopic hernia repair.
7.	An elderly patient with a massive stroke who has been intubated in a crowded Emergency Department but is now to be extubated and palliated.

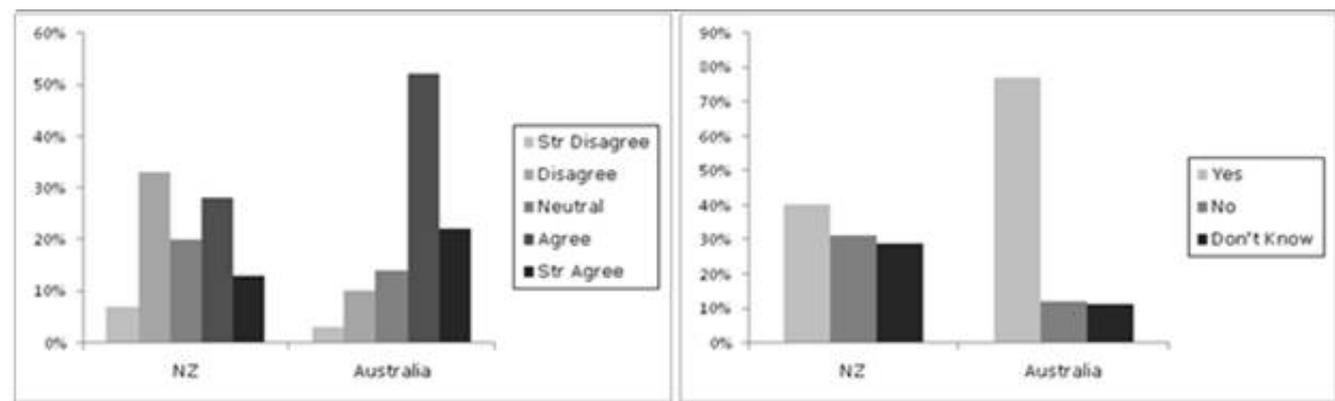
The responses for all triage scenarios were similar for all States in Australia; however, the responses from New Zealand were often significantly different from those from Australia. The most striking difference was in Scenario 1, involving a previously well 50-year-old woman with an intracerebral haemorrhage that the neurologist described as 'non-survivable' and who it was felt may progress to brain death over the next 48 hours (see Figure 3).

Table 3. Results of Chi-squared tests for differences between New Zealand and Australia

Scenario	Agree or Strongly Agree with admission		Would admit the patient	
	Statistic	p-value	Statistic	p-value
1	16.35	0.0001*	14.32	0.0002*
2	12.26	0.0005*	5.68	0.0280*
3	1.28	0.5767	2.66	0.2034
4	4.5	0.0339*	10.6	0.0011*
5	3.55	0.0595	12.58	0.0004*
6	1.39	0.3128	0.11	1.0000
7	0.24	0.6216	0.01	1.0000

[All tests are Chi-squared tests of association. *=significant at the 5% level]

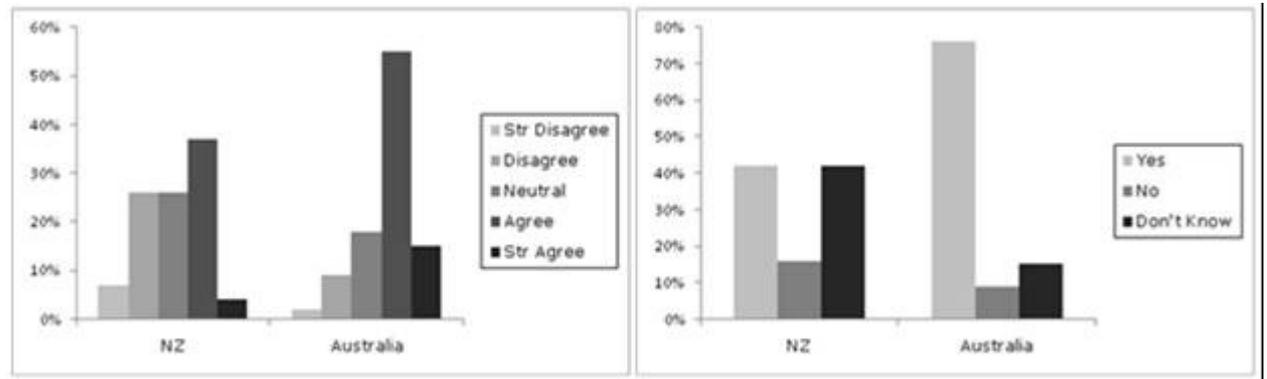
Figure 3. Scenario 1: Comparison of responses to the question: ‘Do you agree that Intensive Care Admission would be appropriate for a previously well 50-year-old woman with an intracerebral haemorrhage that the neurologist describes as non-survivable and who you feel may progress to brain death over the next 48 hours?’ and whether respondents would admit this patient



Australian respondents were more positive about the appropriateness of admission in this scenario than their New Zealand counterparts ($p=0.0001$) and a greater proportion of Australian respondents would have admitted in this scenario ($p=0.0002$).

Scenario 2, which described a 30-year-old female with relapsed acute myeloid leukaemia following a bone marrow transplant who had acute respiratory distress syndrome and imminently required intubation, again demonstrated significant differences between Australia and New Zealand with respect to views on appropriateness ($p=0.0005$) and whether or not the patient should be admitted ($p=0.03$) (see Figure 4). For this Scenario, trainees were more likely than specialists to agree that admission was appropriate ($p=0.0002$) and more likely to say that they would admit ($p=0.0023$).

Figure 4. Scenario 2: Comparison of responses to the question: ‘do you agree that Intensive Care Admission is appropriate for a 30-year-old female with relapsed acute myeloid leukaemia following a bone marrow transplant who has ARDS and who you believe will imminently require intubation?’ and whether respondents would admit this patient

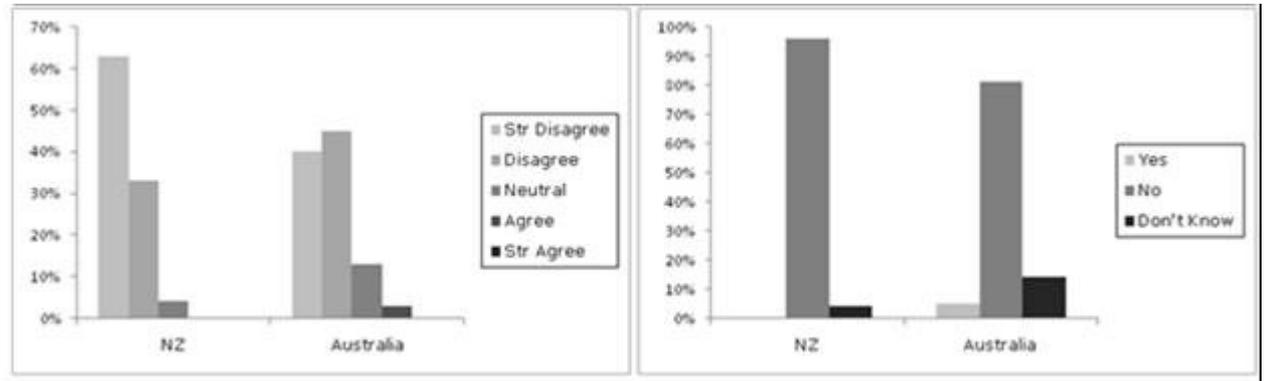


Scenarios 3 and 4 described a young patient who had been in a persistent vegetative state for five years and had pneumonia (see Figures 5 and 6). The two scenarios were the same except that in the second scenario the pneumonia was the event of an iatrogenic complication. In Scenario 3, there were no differences between the New Zealand and Australian respondents ($p=0.58$): both groups in general opposing admission. However, when iatrogenesis was the cause of the pneumonia a pronounced difference appeared.

While New Zealand respondents generally remained strongly opposed to intensive care admission, Australian respondents were significantly less so ($p=0.034$); more than 20% of Australian respondents would have admitted the patient compared to 2% (just one respondent) from New Zealand ($p=0.0011$). In the latter Scenario, trainees were both more likely to feel that admission was appropriate ($p=0.0035$), and more likely to say that they would admit the patient ($p=0.0071$).

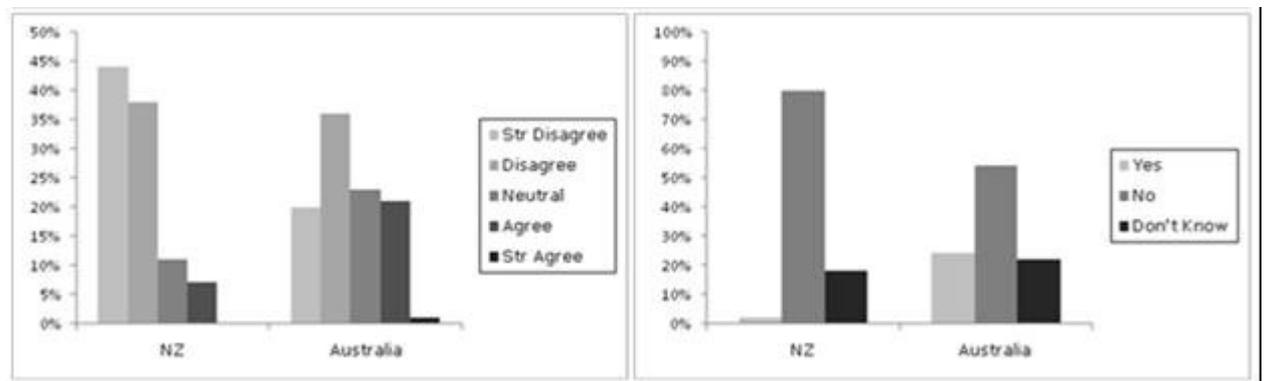
Scenario 5 described a patient with an infective exacerbation of COPD on a background of functional impairment. There was no significant difference between New Zealand and Australian respondents in the proportions agreeing that the patients should be admitted ($p=0.060$). However, a significantly higher proportion of Australian respondents stated that they would in fact admit the patient ($p=0.0004$). In both groups the proportion that felt there was insufficient information to make a decision was high (see Figure 7).

Figure 5. Scenario 3: Responses to the question: ‘Do you agree that Intensive Care admission would be appropriate for a 30 year old male with pneumonia requiring ventilation who has been in a nursing home in a persistent vegetative state for the past 5 years following a severe traumatic brain injury?’ and whether respondents would admit this patient



There was broad consensus about Scenarios 6 and 7. Scenario 6 described a 95 year old man with no previous medical history who the anaesthetist, despite appropriate attempts, had been unable to extubate due to drowsiness and hypoventilation following an elective laparoscopic hernia repair (see Figure 8). The overwhelming majority of respondents felt that intensive care admission was appropriate in the scenario described.

Figure 6. Scenario 4: Responses to the question: ‘Do you agree that Intensive Care admission would be appropriate if the patient in a persistent vegetative state described in the previous question had developed aspiration pneumonia due to malposition of a feeding tube in the right main bronchus?’ and whether respondents would admit this patient



No difference was noted between Australia and New Zealand ($p=0.31$). The proportion who would have admitted the patient was also the same ($p=1.00$). Scenario 7 involved an elderly patient with a massive stroke who was intubated in a crowded emergency department but for whom extubation and palliation was planned (see Figure 9). Although some in both countries felt that admission might be appropriate, the majority were opposed to admission and there was no significant difference between the two countries in the proportions who thought that the patient should be admitted ($p=0.62$) or said they would admit ($p=1.00$).

Figure 7. Scenario 5: Responses to the question: ‘Do you agree that Intensive Care admission is appropriate for a 70 year old male with an infective exacerbation of COPD who has a documented FEV1 of 0.9L and has failed to improve despite non-invasive ventilation for six hours in the emergency department? He lives at home but requires help with showering, shopping and meals.’ and whether respondents would admit this patient

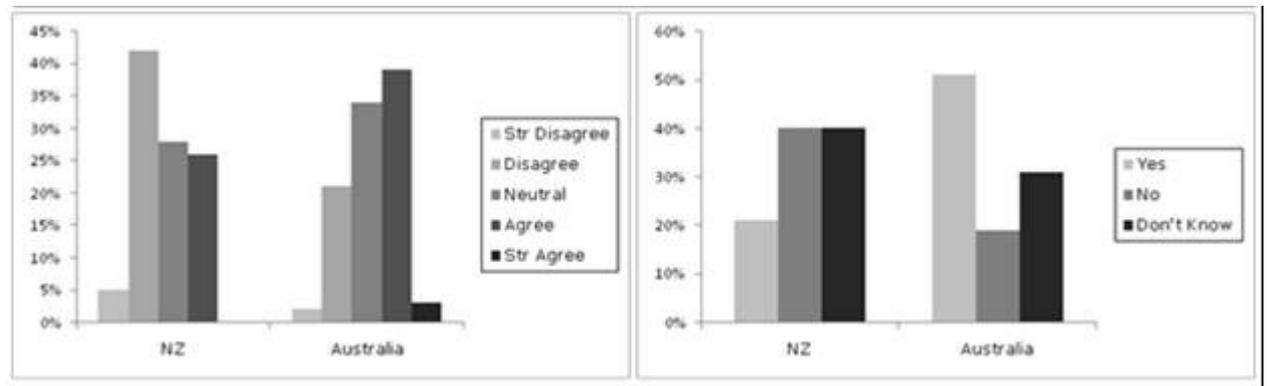


Figure 8. Scenario 6: Responses to the question: ‘Do you agree that ICU admission would be appropriate for a 95 year old man with no previous medical history who the anaesthetist, despite appropriate attempts, has been unable to extubate due to drowsiness and hypoventilation following an elective laparoscopic hernia repair.’ and whether respondents would admit this patient

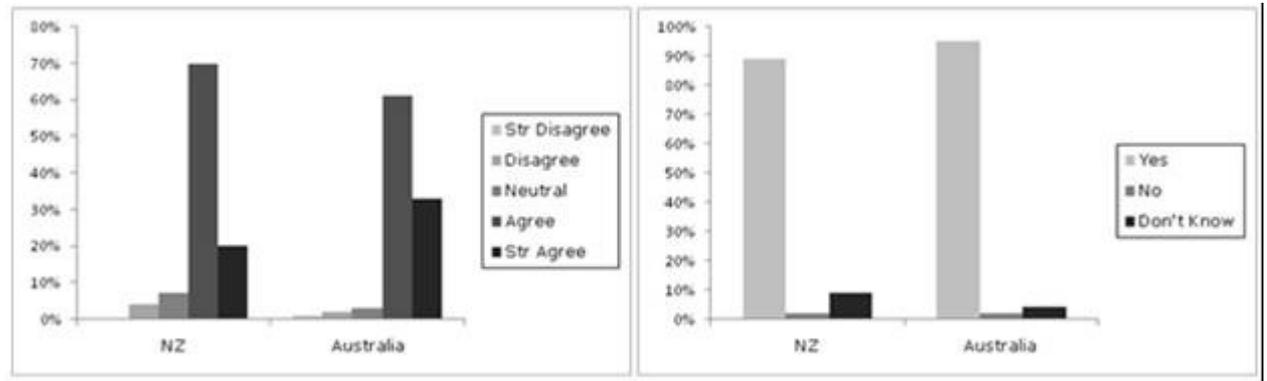
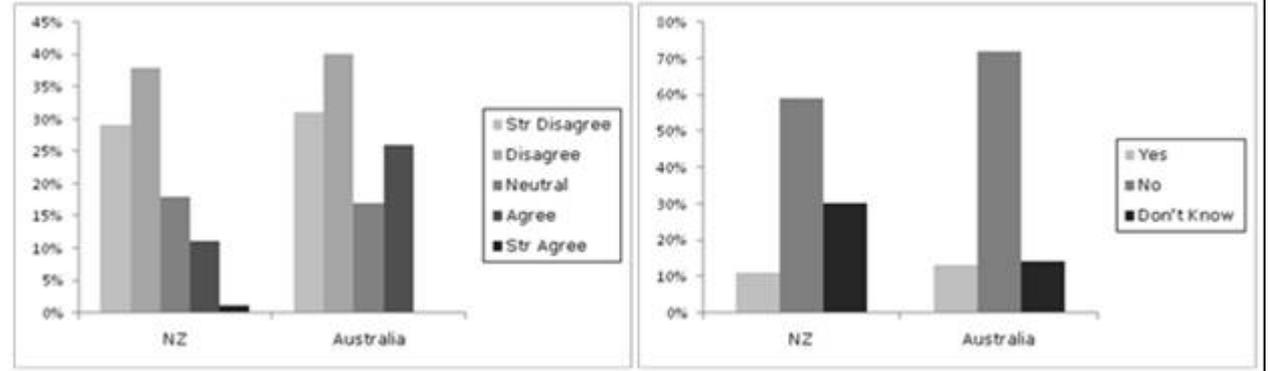


Figure 9. Scenario 7: Responses to the question: ‘Do you agree that Intensive Care admission is appropriate for an elderly patient with a massive stroke who has been intubated in a crowded Emergency Department but is now to be extubated and palliated?’ and whether respondents would admit this patient



Discussion

This study was designed to compare Australian and New Zealand intensive care practitioners with respect to the practice of and attitudes towards intensive care triage. We have demonstrated that the views of New Zealand practitioners, with respect to the appropriateness of intensive care in a range of triage situations, are more restrictive than those of their Australian colleagues.

Despite these different viewpoints, we did not demonstrate differences in the rates of refusal of patients referred to intensive care or in the manner the triage decisions were undertaken or communicated. One explanation for this apparent discrepancy in these

findings is that, despite stating different views, Australian and New Zealand practitioners actually act in much the same way. However, a more likely explanation is that patterns of referral change depending on the previous experience of those making the referral. For example, if an intensive care unit does not offer admission to a patient with an infective exacerbation of chronic obstructive pulmonary disease who has mild functional impairment, the person referring the patient may be less inclined to make subsequent referrals in similar situations.

There are a number of potential reasons why New Zealand intensive care units may have more selective admission criteria. Resource constraint was specifically mentioned by a number of New Zealand respondents as a reason why they would not admit a patient in a particular scenario, but was not mentioned by Australian respondents.

New Zealand has fewer intensive care beds (70 per million) than Australia (88 per million) and both the government and total health care expenditure in New Zealand is substantially lower than it is in Australia. The 2006 per capita total expenditure on health care in Australia was \$3316 (US) while the New Zealand expenditure was \$2420 (US) (September 2009 exchange rate).¹⁸

Cultural differences are well established as reasons that influence triage decisions¹¹ and cultural differences between Australia and New Zealand may have an effect. The ICU 'culture' or 'usual practice' that follows an intensive care admission may influence triage decisions. If ICU admission is likely to be followed by continued or escalating levels of therapy in the face of ongoing deterioration because of the views of family members or other involved specialists, then intensive care specialists may seek to avoid these situations by declining admission in the first place. Whereas, if all those concerned are comfortable with admitting the patient on the proviso that treatment will be withdrawn if the patient does not respond to early treatment, then admission may be more likely to occur.

Intensive care doctors and hospitals in New Zealand are protected from litigation by the Injury Prevention, Rehabilitation, and Compensation Act¹⁹ (that provides an alternative no-fault compensation scheme) and this may have had some influence on responses. In the scenario that involved an iatrogenic complication, the potential for future litigation was mentioned by a number of Australian practitioners as being influential in their decision to admit the patient.

Given the recent emphasis on increasing organ donation rates, Scenario 1 (Figure 3) which described a patient with severe brain injury who may progress to brain death is worthy of further consideration. Those who disagreed with admitting the patient in this situation often stated that the intensive care management was not in the patient's best interest.

An alternative viewpoint, which was also expressed by some, is that helping to fulfil a patient's wish to be an organ donor in the event of non-survivable illness does, in fact, serve that patient's interest. The relatively low proportion of practitioners in New Zealand who would admit a patient with a non-survivable brain injury who may progress to brain death indicates that there are either significant barriers to admitting patients in this scenario in New Zealand, or a difference in prevailing opinion about the appropriateness of this practice. Despite this, organ donation rates between

Australia and New Zealand are similar²⁰ and, as the scenario described is likely to be a relatively rare one, it probably makes little difference to the overall rates of donation.

Of course, there may be other reasons why practitioners choose to admit the patient other than those related to organ donation and these may vary between Australia and New Zealand. These include allowing the family more time to come to terms with the situation, allowing a further period of medical assessment and providing end of life care in a more appropriate environment than a busy emergency department.

We demonstrated a difference between trainees and specialists for two scenarios. In both cases, trainees were more likely to admit. Both scenarios described situations in which a poor outcome was likely. For the situation of acute respiratory distress syndrome requiring ventilation in the setting of relapsed acute myeloid leukaemia, the tendency of trainees to admit may be a reflection of a lack of prior experience dealing with this specific scenario. For the scenario that described an iatrogenic complication, the tendency to admit may reflect generally more defensive practice amongst trainees than specialists.

There are a number of weaknesses of the current study design. Firstly, the 33% response rate, typical of this mode of surveying, means that it is possible that those who replied to this survey were more interested in the issue of intensive care triage than those who did not and that the responses are therefore not representative of Australasian intensive care practitioners as a whole. It is not possible to estimate the effect of such self-selection. However, if it operated similarly in both Australia and New Zealand, this study still compares like with like. Secondly, the questions regarding recent triage decisions asked respondents to recall recent referrals and are therefore subject to recall bias. As only 79 respondents had refused a patient in the previous week, the questions about the process of refusal were limited to this relatively small sample. Thirdly, the triage scenarios generally provided only a small amount of detail and it may be that more consistent responses between respondents would have been obtained if there were more details available on which to base the decisions.

Nevertheless, the primary purpose of the study was to test the hypothesis that attitudes towards triage decisions differed significantly between Australia and New Zealand and the differences for many scenarios turned out to be pronounced. We felt that a balance needed to be struck between providing sufficient detail to provide the flavour of the scenario described without decreasing the likelihood of having a respondent complete the survey by making scenarios unduly complex. We decided that a larger number of less complex scenarios was more desirable than a smaller number of more complicated ones in order that a broader range of situations could be covered.

Conclusions

This study has demonstrated that there are significant differences between the views of intensive care practitioners in Australia and those in New Zealand with respect to a range of common intensive care triage scenarios with those in New Zealand tending to be more selective in their admission criteria.

Despite these differences, we did not demonstrate any difference in the proportion of referrals to the intensive care unit that were refused. This may be because the more selective criteria used by intensive care practitioners in New Zealand influence the extent to which referrals are made to them at all.

Competing interests: None known.

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Illness severity scoring for Intensive Care at Middlemore Hospital, New Zealand: past and future

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Anthony B Williams

Abstract

Aim The Acute Physiological and Chronic Health Evaluation (APACHE) II score is a popular illness severity scoring system for intensive care units. Scoring systems such as the APACHE II allow researchers and clinicians to quantify patient illness severity with a greater degree of accuracy and precision, which is critical when evaluating practice patterns and outcomes, both within or between intensive care units. The study aims to: assess changes in APACHE II scores and hospital-standardised mortality ratio at our ICU over a nine year period from 1 January 1997 to 31 December 2005; assess for changes in the performance of the APACHE II scoring system in predicting patient hospital mortality over the same period; and assess for any clinical subgroups in which APACHE II scoring was particularly inaccurate or imprecise.

Methods Retrospective audit of a single centre relational database, with evaluation of the APACHE II scoring system by year through discrimination (ability to discriminate between the patients who will die or survive at hospital discharge) using receiver operating characteristic (ROC) curves, and calibration (ability to predict mortality rate over classes of risk) using goodness-of-fit as assessed by the Hosmer-Lemeshow statistic.

Results Data from 7703 patients were available for analysis. There was a decrease in overall hospital mortality, from approximately 19% at the beginning of the period of observation to approximately 12% at the end. There was also a decrease in the hospital standardised mortality ratio from 0.94 (95%CI 0.82–1.06) to 0.66 (95%CI 0.55–0.76). In general, both the APACHE II score and risk of death model performed adequately in each year with ROC curve AUCs of >0.8, albeit with progressively poorer performance over time and ‘model fade’ that approached statistical significance. There was progressively poorer calibration with the APACHE II risk of death model as indicated by the Hosmer-Lemeshow statistic, with a statistically significant difference between the predicted and observed mortality from 2003 onwards. Overall, there was moderately poor model performance in the diagnostic groups with the largest number of patients (sepsis and post-surgical complications).

Conclusion This study shows the progressively worse performance of the APACHE II illness severity scoring system over time due to ‘model fade’. This is especially so in common diagnostic categories, making this a clinically relevant finding. Future approaches to illness severity scoring should be tested and compared, such as re-estimating coefficients of the APACHE II diagnostic categories or using locally developed ones, moving to later evolutions of the system such as the APACHE III or APACHE IV, or developing novel artificial intelligence approaches.

Illness severity scoring systems such as the Acute Physiological and Chronic Health Evaluation (APACHE) have become important tools for the evaluation and planning of intensive care practice patterns. These systems objectively estimate patient risk for mortality from acute physiological and chronic health status. They are not, however, a tool used for deciding treatment for individual patients; they are a group measurement used for patients who have similar disease processes. Their origin in the late 1970s and early 1980s was driven by the need to relate such practice patterns to patient outcomes.

In the modern setting, tools such as the APACHE scoring system allow researchers and clinicians to quantify patient illness severity with a greater degree of accuracy and precision, which is essential for benchmarking and program evaluation. The interest in illness severity scoring systems is evidenced by the extensive body of literature that continues to advance both technical aspects of the systems themselves, and the applications for which they are used.

Middlemore Hospital was one of the earlier facilities in New Zealand to implement APACHE II scoring in clinical settings. The routine scoring of patients began in the Intensive Care Unit (ICU) in 1986. This advance was facilitated in no small part by the availability of one of the developers of the APACHE system, Dr Jack Zimmerman, who spent an extended sabbatical in New Zealand, some of which was at Middlemore Hospital.

Despite enthusiastic support for APACHE II scoring by international opinion leaders at the time, the relevance and utility in New Zealand has been questioned from an early stage. The external validity of the system in such a different population from that in which it was developed was acknowledged by Zimmerman et al:¹

The NZ hospitals designated 1.7% of their total beds for intensive care compared to 5.6% in the US hospitals. The average age for NZ admissions was 42 compared to 55 in the US ($p < 0.0001$). The NZ ICUs admitted fewer patients with severe chronic failing health (NZ 8.7%, US 18%) and following elective surgery (NZ 8%, US 40%). Approximately half the NZ admissions were for trauma, drug overdose, and asthma while these diagnoses accounted for 11% of US admissions. When controlled for differences in casemix and severity of illness, hospital mortality rates in NZ were comparable to the US. This study demonstrates substantial differences in patient selection among these US and NZ.

Furthermore, after more than two decades of use, it is unclear whether the performance of the APACHE II has been maintained. Patient casemix in New Zealand has changed from earlier times, and the improvements in supportive care that are now available may have decreased mortality for any given illness severity.

International opinion leaders are in general moving towards the more recently developed scoring systems such as APACHE versions III and IV, which have been shown to outperform older versions in studies of North American and European ICU populations.²

This paradigm is slowly translating to clinical practice in this part of the world: the Australian and New Zealand Intensive Care Society adult patient database now collect data sufficient to model both APACHE II and III scores.³

There are three aims of this study. We aim to:

- Assess change in APACHE II scores and hospital standardised mortality ratio at our ICU over a 9-year period from 1 January 1997 to 31 December 2005;
- Assess for changes in the performance of the APACHE II scoring system in predicting patient hospital mortality over the same period; and
- Assess for any clinical subgroups in which APACHE II scoring was particularly inaccurate or imprecise.

Methods

Study population and setting—Middlemore Hospital is the main hospital within the Counties Manukau District Health Board (CMDHB). The hospital serves a large urban population. The district catchment includes Manukau City which is rapidly expanding: the population has grown from 356,006 in 1996 to 454,655 at last census in 2006. The population can be summarily characterised as being young, multi-ethnic, and of low socioeconomic status compared with the rest of New Zealand.⁴

Middlemore Hospital is a tertiary referral centre for plastic surgery, burns, orthopaedics, and a range of medical sub-specialities. Any patient requiring neurosurgical or cardiothoracic surgical intervention is referred on to Auckland City Hospital as Middlemore Hospital does not have these facilities; all other patient categories remain at Middlemore Hospital.

Although there is a specialist regional paediatric hospital in the area, Middlemore Hospital is also a paediatric hospital; the Middlemore Hospital ICU therefore cares for those children down to 2 kg weight requiring intensive care accounting for approximately 120 paediatric admissions per year.

The hospital is academically affiliated and thus a teaching institution. Middlemore Hospital has had between 700 and 900 acute beds over the time in which this research was done, and now also includes a satellite surgical centre which caters for the majority of elective cases apart from those that are particularly high risk.

Currently, the Middlemore ICU is nominally a seven funded-bed Level 3 facility. Since the inception of the Middlemore Hospital ICU in the late 1960s, the unit has been structurally modified on several occasions. As a result of the both national and local changes in healthcare strategy, the unit had at times had nominated HDU beds, and at other times not. Since 2004, there has been a four-funded bed Level I intensive care unit at a satellite surgical centre, which currently shares clinical governance, staff, policies and procedures with the main ICU at Middlemore Hospital. These patients were not included in this study.

Data source—All data were sourced from a single-centre relational database that has been in continuous use at the Middlemore Hospital ICU since January 1986. The database contains information on all patients admitted to ICU during this period, using data that is prospectively collected, collated, and agreed upon by senior specialists and the charge nurse at the time.

Data collection was progressively expanded during this period to ultimately include demographic information, APACHE II score, diagnostic information, ventilatory and inotropic support, procedures performed, and patient outcome. Patients who were less than 15 years of age, or who had been admitted solely for the purpose of a procedure such as difficult central venous line or endoscopy were not scored, as the system was not devised for these groups. The database specifically includes both patient death at both ICU and hospital discharge.

The database includes locally developed diagnostic codes (“adclasses” and “subclasses”) in addition to the APACHE II ones, which were developed to better reflect and discriminate disease categories related to the local population (see Appendix). Generic APACHE II diagnostic codes do necessarily provide a realistic reflection of the local disease categories and population outcomes. They can be ‘localised’ by adjustments to either disease categorisation and / or the category weights subsequently used with the APACHE II scores for calculating risk of death supported in the case of Middlemore Hospital by Zimmerman et al who emphasised differences between North American and New Zealand ICU patient populations.¹

Data were prospectively stored in Microsoft Access (Microsoft Corporation, Seattle, WA, USA), and retrospectively abstracted for analyses from a 9-year period from 1 January 1997 to 31 December 2005.

Calculation of APACHE II scores and risk of death—All APACHE II scores and risk of death were calculated at patient hospital discharge using the prospectively stored data and the logistic regression equation developed by Knaus et al.⁵ The data for calculation of the APACHE II score included physiological measurements in the first 24 hours of ICU admission, age and chronic health status.

The APACHE II risk of death is calculated not only from scores but also diagnostic categories, which were rigorously and continuously evaluated by the senior ICU medical staff during the process of prospective data collection. Such minimisation of misclassification was necessary to avoid error arising from the heavy reliance of the APACHE II risk of death formula on reason for ICU admission.

Statistics—Standard statistics were used to describe data, making particular use of median and interquartile range to avoid assumptions around data distribution. Hypothesis testing was undertaken using Kruskal-Wallis equality-of-populations rank test for continuous variables, and the Pearson's Chi-squared test for categorical ones.

Risk-adjusted mortality by year was assessed by hospital standardised mortality ratios and 95% confidence intervals (regarding observed mortality as a binomial variable), which were obtained by dividing the number of observed hospital deaths in each year by the number of predicted ones using the APACHE II system.⁶

Overall predictive performance of the APACHE II scoring system by year was gauged through discrimination (ability to discriminate between the patients who will die or survive at hospital discharge) and calibration (ability to predict mortality rate over classes of risk). Discrimination was assessed using receiver operating characteristic (ROC) curves, which plot the true positive rate (sensitivity, or predicted hospital deaths / observed hospital deaths) against the false positive rate (1-specificity, or 1-predicted hospital deaths / observed hospital deaths).

The predictive performance is indicated in this method by the ROC area under the curve (AUC), with a value of 0.5 equating to random prediction and a value of 1.0 equating to perfect discrimination. The slope the curve indicates ratio of true positives and false positives, which also is known as the likelihood ratio.⁷ For the analyses in this article, equality of ROC AUC for each year of study was compared.⁸

Calibration was assessed using the correspondence between the number of observed hospital deaths and the number of predicted hospital deaths within each 10% stratum (decile) of the cohort's expected risk of death. The predictive performance is indicated in this method by goodness-of-fit as assessed by the Hosmer-Lemeshow statistic.⁹

The predictive performance of the APACHE II scoring system in major clinical subgroups was assessed by discrimination using hospital standardised mortality ratios within each of the major "adclasses".

All analyses were performed using Microsoft Excel (Microsoft Corporation, Seattle, WA, USA) and Intercooled Stata 9.2 (Statacorp, College Station, TX, USA) software.

Ethics—The need for formal approval for the research process was waived by the National (New Zealand) Health and Disability Ethics Committee under the provisions made for clinical audit.

Results

Data from 7703 patients were available for analysis. Baseline patient characteristics are presented in Table 1. Numbers of patients admitted to the ICU increased steadily from 686 in 1997 to 730 in 2005. The demographic characteristics of patients changed over the period of observation, with a trend to older and more Māori patients.

There has also been a change in casemix of patients, with a reduction in the number of patients with diagnoses of poisoning and trauma, and an increase in the number of patients admitted after elective or emergency surgery. Patient length of stay has progressively reduced, as has the proportion of patients requiring mechanical ventilation. Overall hospital mortality decreased from approximately 19% at the beginning of the period of observation to approximately 12% at the end.

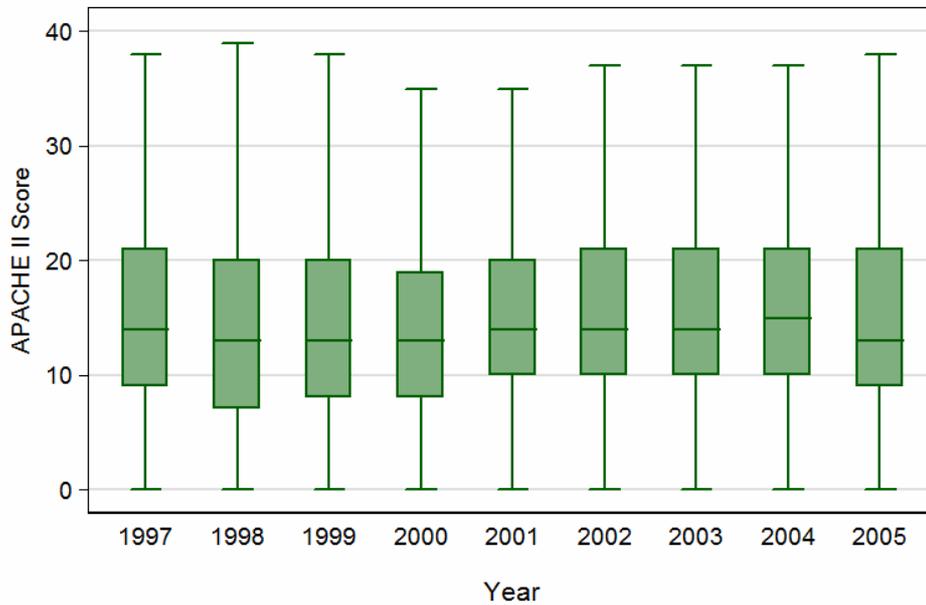
Table 1. Baseline patient characteristics by year

Year	Age (mean)	Gender M/F	Ethnicity	Diagnostic groups		Median length of stay (hrs)	% mortality	% mechanical ventilation	% inotropic support
1997	45.5	413/338	Local data not available	Surgical	15.3%	24.5	19%	65.24%	33.4%
				Trauma	14.4%				
				Sepsis	14.1%				
				Poisoning	10.1%				
				Other	45.8%				
1998	47.3	529/352	Eur 56% M 18% PI 19% Other 7%	Surgical	24.5%	22.0	17.8%	56%	23.7%
				Trauma	17.0%				
				Sepsis	12.3%				
				Poisoning	5.5%				
				Other	40.7%				
1999	46.2	454/336	Eur 56% M 19% PI 15% Other 10%	Surgical	26.2%	23.0	13.0%	60%	22.5%
				Trauma	15.7%				
				Sepsis	12.3%				
				Poisoning	7.1%				
				Other	40.7%				
2000	49.3	469/390	Eur 53% M 21% PI 19% Other 7%	Surgical	31.6%	23.0	14.2%	57.3%	21.5%
				Trauma	12.9%				
				Sepsis	9.9%				
				Poisoning	5.1%				
				Other	40.5%				
2001	45.1	487/328	Eur 48% M 20% PI 16% Other 16%	Surgical	29.7%	25.0	15%	54.8%	25.0%
				Trauma	13.5%				
				Sepsis	16.0%				
				Poisoning	6.1%				
				Other	4.6%				

2002	48.2	487/328	Eur 48% M 21% PI 20% Other 11%	Surgical Trauma Sepsis Poisoning Other	29.6% 13.7% 13.5% 6.0% 7.0%	24.0	13.89%	54.7%	24.6%
2003	43.8	507/427	Eur 50% M 22% PI 21% Other 7%	Surgical Trauma Sepsis Poisoning Other	27% 12.3% 12.5% 5.0% 3.1%	26.0	12.21%	52.5%	20.8%
2004	52.7	424/351	Eur 51% M 21% PI 19% Other 9%	Surgical Trauma Sepsis Poisoning Other	34.3% 12.2% 10.9% 5.1% 7.5%	24.0	15.6%	52.9%	48.1%
2005	55.9	507/355	Eur 48% M 25% PI 19% Other 8%	Surgical Trauma Sepsis Poisoning Other	32.8% 12.9% 14.2% 5.6% 34.6%	27.0	11.83%	49.3%	32.6%

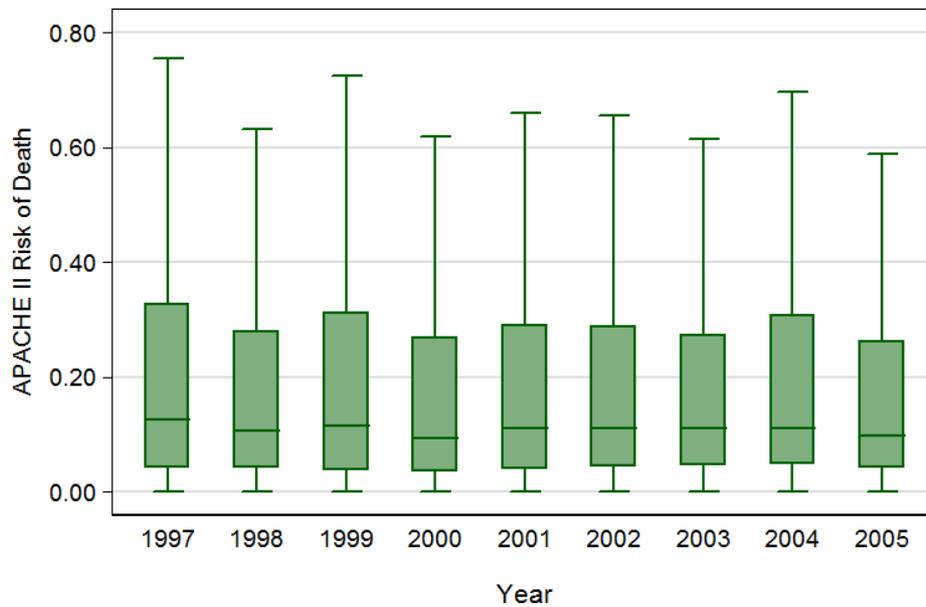
Eur=European, M=Māori, PI=Pacific Islander.

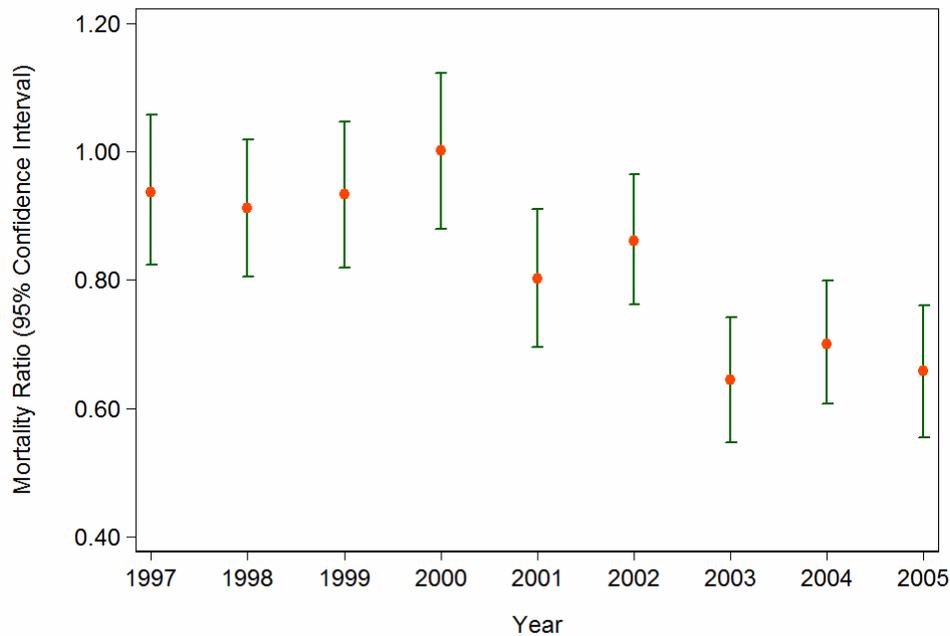
Figure 1. APACHE II scores and risk scores by year, presented as boxplots



Note: In these plots, the middle horizontal line represents the median; the box the second and third quartiles; and the whiskers the upper and lower extreme values which are no more than $1.5 \times$ the interquartile range beyond the middle quartiles.

Figure 2. Hospital-standardised mortality ratio and 95% confidence intervals, by year



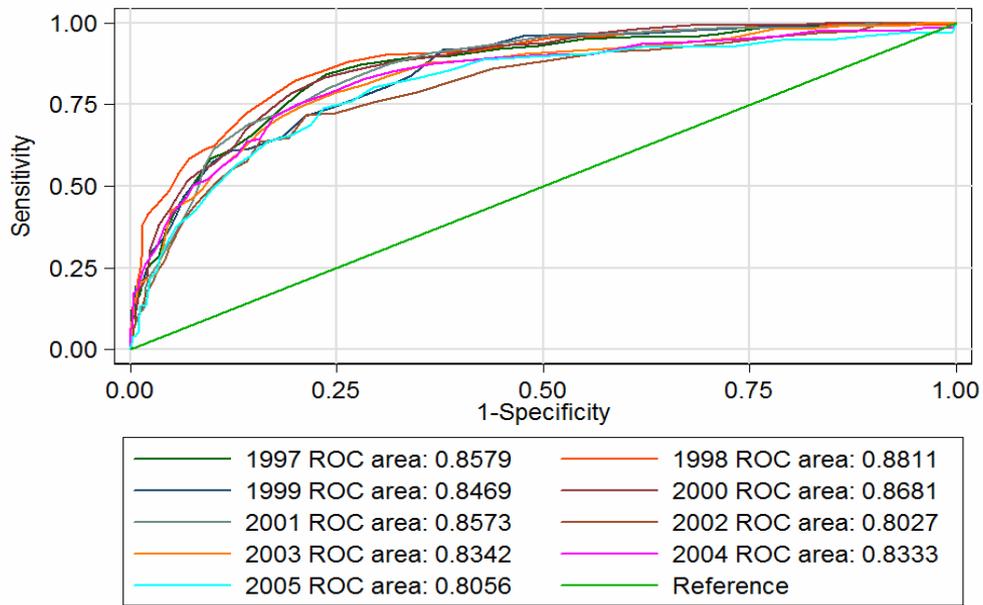


The APACHE II score decreased marginally over the period of observation as illustrated in Figure 1, with a median value of 14 in 1997 (IQR 9–21) and a corresponding value of 13 in 2005 (IQR 9–21). Although this reduction did achieve statistical significance ($p=0.0001$), it cannot be regarded as being clinically important. APACHE II predicted risk of death has remained stable over the period of observation, with a minor trend to reduction that did not achieve statistical significance ($p=0.11$).

The hospital-standardised mortality ratio decreased over the period observation as illustrated in Figure 2, with a value of 0.94 (95% confidence intervals 0.82–1.06) in 1997 and a corresponding value of 0.66 (95% confidence intervals 0.55–0.76) in 2005. Model adequacy for discrimination by APACHE II score is illustrated by year in Figures 3 and 4. In general, the APACHE II score performs adequately in each year with ROC curve AUCs of >0.8 . However, there is deteriorating accuracy of mortality predictions over time (otherwise known as ‘model fade’¹⁰ that approaches statistical significance).

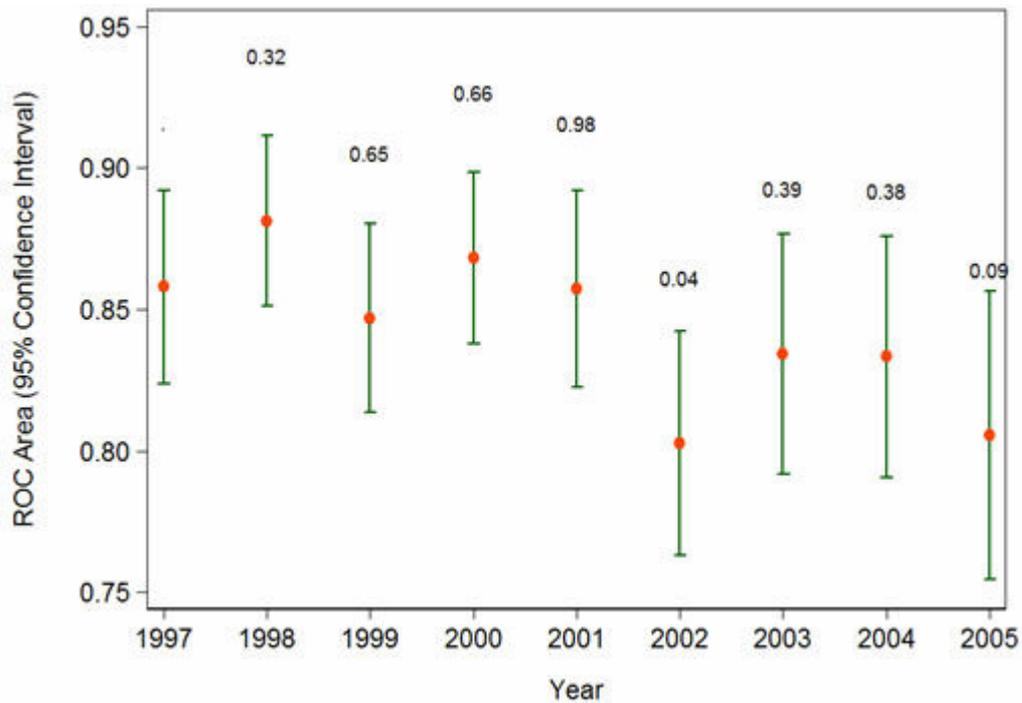
Corresponding model adequacy for discrimination by APACHE II predicted risk of death is illustrated in Figures 5 and 6. The risk model performs similarly to the APACHE II score showing a like degree of ‘model fade’.

Figure 3. ROC curves for APACHE II Score, by year



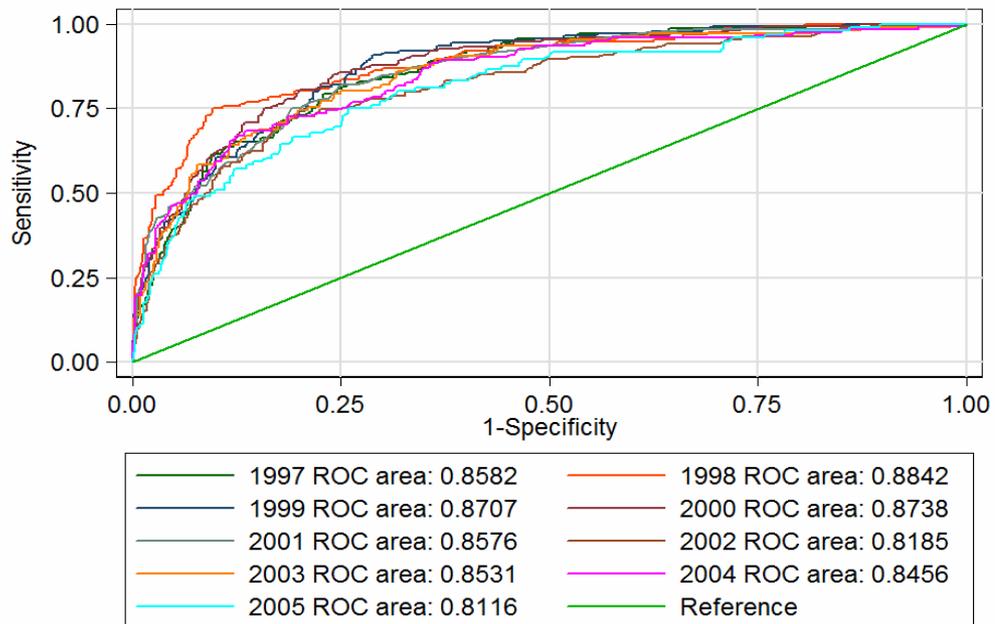
Note: The predictive performance is indicated by the ROC area, with a value of 0.5 equating to random prediction and a value of 1.0 equating to perfect discrimination.

Figure 4. ROC curve AUC (95% CI) for APACHE II Score, by year, as shown in figure 3



Note: Marker labels indicate the P value for the test of equality of ROC areas relative to the reference year of 1997.

Figure 5. ROC curves for the APACHE II Risk score by year



Note: The predictive performance is indicated by the ROC area, with a value of 0.5 equating to random prediction, and a value of 1.0 equating to perfect discrimination.

Figure 6. ROC curve AUC (95% CI) for APACHE II Risk Score by year as shown in figure 5.. Marker labels indicate the P value for the test of equality of ROC areas relative to the reference year of 1997

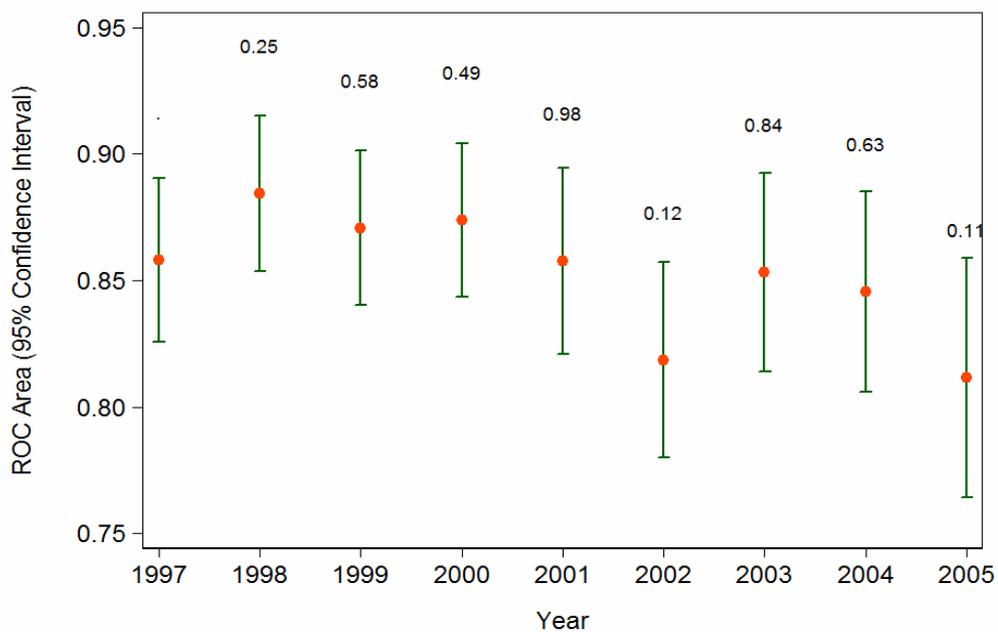


Figure 7. Calibration curves for APACHE II predicted risk of death, by year showing the number of observed and predicted deaths within each 10% stratum (decile) of the cohort's expected risk of death. Predictive performance is assessed by the Hosmer-Lemeshow statistic (see table 2)

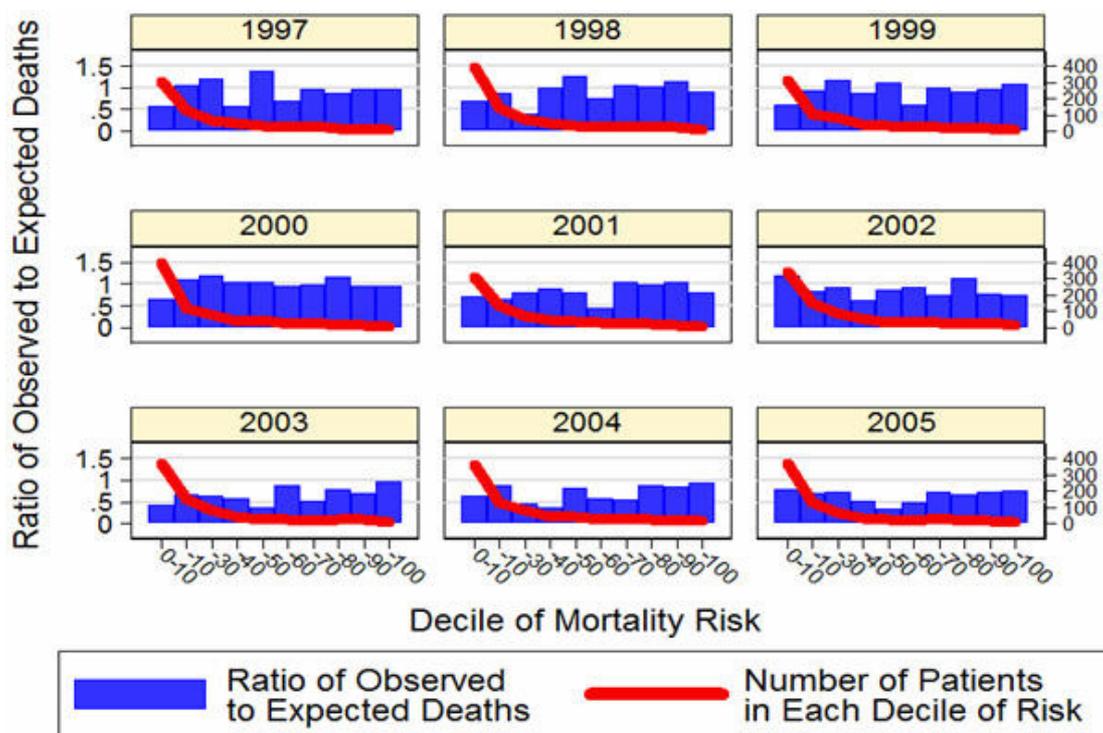
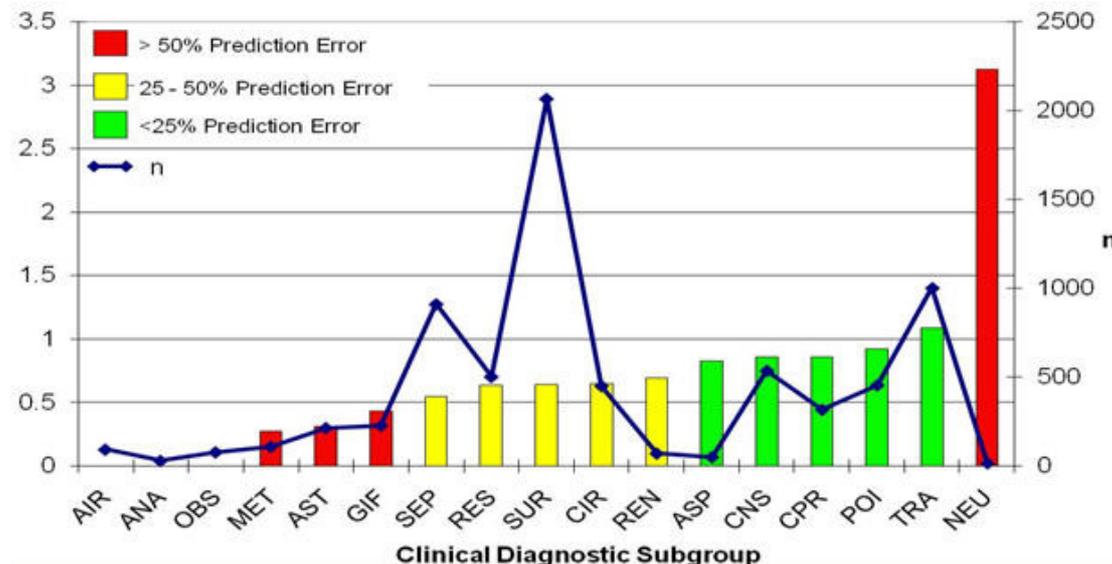


Table 2. Model adequacy for calibration by APACHE II predicted risk of death, by year as indicated by the Hosmer-Lemeshow goodness-of-fit statistic for each of the calibration curves in figure 7. A high Hosmer-Lemeshow statistic and a P value <0.05 indicates poor correspondence between the number of observed and predicted deaths within each 10% stratum (decile) of the cohort's expected risk of death

Year	Hosmer-Lemeshow Goodness-of-fit Statistics (P values)
1997	9.82 (0.132)
1998	11.14 (0.084)
1999	5.49 (0.482)
2000	3.31 (0.769)
2001	10.24 (0.111)
2002	8.04 (0.235)
2003	25.31 (0.0003)
2004	21.49 (0.001)
2005	19.41 (0.004)

Figure 8. Hospital-standardised mortality ratio (observed/predicted hospital deaths) for clinical diagnostic subgroups (“adclasses” as described in Appendix)



Model adequacy for calibration by APACHE II predicted risk of death is illustrated by year in Figure 7. There is progressively poorer goodness-of-fit as indicated by the Hosmer-Lemeshow statistic, with a statistically significant difference between the predicted and observed mortality from 2003 onwards as shown in Table 2.

Figure 8 illustrates model adequacy for discrimination by APACHE II predicted risk of death, according to clinical diagnostic subgroup. Although model adequacy was poorest in patients with neurological failure, there were only a small number of patients in this group. In contrast, the large number of patients with sepsis, respiratory failure, postoperative status, and circulatory failure makes the moderately poor model adequacy in these clinical subgroups more clinically relevant.

Discussion

Our data show that there has generally been a change in the overall casemix of patients admitted to the Middlemore Hospital ICU, with a decrease in the number of patients with poisonings and trauma over the period of observation, and an increase in those with complications as a result of surgery.

APACHE II scores have remained fairly constant over the period of observation, with only a subtle trend to decreasing patient illness severity that did not achieve statistical significance. The data also show that there has been with a reduction in crude and risk-adjusted mortality, as assessed mortality rates and by hospital standardised mortality ratios. Despite this, there has been a steady drop in the proportion of patients receiving mechanical ventilation over the period of observation, and the average length of patient stay.

Correlation between mechanical ventilation and increments in length of patient ICU stay has been noted in other studies³. This change in outcomes and practice pattern

may reflect the benefits of clinical pathways within our hospital, and the earlier detection and correction of physiological derangements that occurs in the modern, more pro-active approach to provision intensive care.

An alternative, more pessimistic view is that this scenario may reflect earlier discharges from our ICU to accommodate increasing demand in a setting of increasingly limited resources. Reassuringly, if this latter scenario is the true one, then outcomes appear to have been maintained despite this.

The data are in general terms consistent with a recent paper by Moran et al reporting on intensive care outcomes using an international Australian and New Zealand ICU database (ANZICS database), which to date has not included data from Middlemore Hospital and can therefore be regarded as independent. These investigators reported an improvement in overall risk-adjusted mortality over the last 11 years, which they did not attribute to any one specific factor³.

Most medical administrators and practitioners would consider these improved outcomes to be in some part causally related to corresponding improvements in clinical care and therapeutic interventions. It would, however, take a more complex minimum dataset than both the ANZICS database and our local one to study this question appropriately.

There are two major findings of this study relating to the predictive performance of the APACHE II system. The first is that there has been progressive deterioration model adequacy in terms of both discrimination and calibration. Predictive performance is generally acceptable when ROC curve AUCs are >0.8, and using these and similar criteria it seems that continuing use this system in our current practice may be unreasonable. The second is that the APACHE II system has been better sustained in some clinical diagnostic subgroups but not others.

As is common to most ICUs, the largest clinical diagnostic subgroup in our dataset is sepsis and post-surgical complications, and the APACHE II system has moderately poor model adequacy in this subgroup, with prediction error of between 25-50%. Of note, the subgroups with the largest prediction error in our dataset constitute only ~10% of the entire Middlemore ICU population.

The finding of 'model fade' over time is also consistent with those of Moran et al, who demonstrated deteriorating model adequacy for the APACHE II system over time, both in terms of both discrimination and calibration. This was the case even after the authors recalibrated the APACHE II model by re-estimating coefficients for the Australasian population, thereby optimising discrimination and calibration.

This is an important subtlety, since the performance of all illness severity scoring models is well known to be poorer in populations that are different from those in which they have been developed. This simple recalibration adjusts for geographical differences in measured patient characteristics (physiology and diagnosis), although it does not consider ICU characteristics and different organizational characteristics of healthcare systems as a predictive variable. The Intensive Care National Audit and Research Centre (ICNARC) model is in essence an adaptation of the APACHE model that was developed by Rowan et al. in the 1990s in the United Kingdom,¹⁰ but over the years has resulted in a completely independent model that is widely used in the UK.¹¹

Opinion leaders now recommend regular recalibration of illness scoring systems to local and more contemporary cohorts,¹² although to our knowledge there is no consensus or even propositions concerning thresholds for model performance that would trigger the recalibration process, or standardised methodology around the recalibration itself.

'Model fade' and poor model performance in diagnostic subgroups have led to the evolution of existing scores into a third and fourth generations of illness severity scoring systems, such as SAPS III and APACHE III and IV.^{2,12} The evolution of these scores did not involve simple recalibration of models by re-estimating coefficients, and instead involved the application of new statistical methods, the addition of new variables, an increase in the number of diagnostic groups, and a change to the measurement of certain physiological and diagnostic variables.

These scores can be expected to perform better as a result of their development in a cohort that is more contemporary and externally valid in terms of casemix, and also by using clinical information that was not initially taken into consideration during the development of the earlier systems.

There is a widespread move amongst ICUs to this newer generation of illness scoring systems, although their performance is only marginally better than earlier versions of the scores that have been more simply recalibrated by re-estimating coefficients.¹³ Notwithstanding, the APACHE III system is currently used more widely in the USA, with demonstrably greater discrimination and calibration than the original APACHE II system.² It is too early to say at this time whether more recent evolutions of these systems such as the APACHE IV and SAPS III systems will demonstrate continued improvement.

The findings of our study do not address one of the conundrums of illness severity scoring: the interpretation of changes in scores and outcomes over time. As with other studies, it is impossible to tell from our data whether our results are due to improved patient care and access to care, or alternatively from the deteriorating performance of scoring systems because of changing patient casemix.

Our cumulative clinical experience is in keeping with others: ICU patients are in general sicker than previously, with improving outcomes despite this. Confirmation of this perception will only be forthcoming with studies that extend data collection to include other indicators of patient illness severity and practice patterns, and the use of statistical approaches that use causal or structural times series modelling.

The strength of this study is its size and completeness. This study, running from 1997 to 2005 inclusive contains a large dataset over a nine year period without gaps. The major weaknesses of this study are those that are inherent to any scoring system that is dependent on clinical classification of patients into diagnostic categories (whether local diagnostic codes ("adclasses" and "subclasses") or APACHE II ones). There are no explicit criteria to improve consistency within or between ICUs in making these classification, and all due care was taken in our database to limit subjectivity and optimize accuracy and precision as much as possible.

In terms of the future of illness severity scoring, good reasons abound for us to persist with the APACHE scoring system at Middlemore Hospital, as opposed to moving to

others such as organ failure scoring systems (Multiple Organ Dysfunction Score, Sepsis-related Organ Failure Assessment).

The choice of method within any particular ICU is critically dependent on the degree of confidence in its use; the APACHE scoring systems are more validated than the other choices at Middlemore Hospital ICU. Moreover, it is our opinion that the APACHE scoring systems are also subject to rigorous remodelling and adaptation: this is essential to ensure that the system reflects changes in underlying characteristics of patients and healthcare delivery systems, and therefore correctly model the relationships with patients' outcomes.^{2,14}

Notwithstanding, there have been encouraging results with loosely-termed 'artificial intelligence' approaches. Frize and Walker reported early success of their pilot of neural networks in both adult and neonatal intensive care.¹⁵ Investigation into these modelling methods may prove fruitful for the future, and may result in better performance although this is yet to be definitely demonstrated.¹⁶⁻¹⁸

Our data indicate that we should be preparing to move forward from the APACHE II system. Three workstreams are suggested by the results of this study, which should probably be run concurrently with the results determining the final solution for illness severity scoring.

The first workstream should involve recalibration of the APACHE II model by re-estimating coefficients for our local population using local diagnostic codes ("adclasses" and "subclasses") and/or APACHE II ones. The second should involve a trial of the APACHE III system. The third should involve a pilot of artificial intelligence approaches.

The performance of these three approaches in our population should determine which illness severity scoring system should be used in short and medium term. However, it would appear that regular re-calibration should be undertaken irrespective of what model is chosen, in order to minimise 'model fade' and provide clinicians and managers interested in benchmarking a well validated model to predict mortality.

Competing interests: None known.

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Appendix on next page

Appendix ("Adclass and subclass" classification)

ADCLASS – Use the first category that fits the patient

1. TRAuma (*admitted to ICU for trauma or direct complication of trauma*)
2. POIsoning (*admitted to ICU because of poisoning*)
3. AIRway disease
4. ANAphylaxis
5. ASPhyxiation
6. ASThma
7. SEPsis (*clinical sepsis plus defined focus or positive blood culture*)
8. OBStetric complication
9. CPR (post)
10. SURgery
11. CIRculatory failure
12. CNS failure
13. GIFailure
14. METabolic failure
15. NEUromuscular failure
16. RENal failure
17. RESpiratory failure
18. PROcedures admission
19. MIScellaneous

Subclass on next page

SUBCLASS

1. TRA type of trauma

BLUnt
PENetrating
BURn

2. POI type of poisoning

CYCLic medication (\pm sedative)
SEDative medication
MEDication (other)

NON-medicinal

4. ANA type of anaphylaxis

MEDicinal
NON-medicinal

5. ASP type of asphyxiation

DROwning
HANging
STRangulation

7. SEP locus of sepsis

BLOod only
ENDocardium
GENital tract
GIT tract
JOInt
MENinges
RESp tract

SOFT tissues

URInary tract
VAScular catheter
WOUNd
MIScellaneous

10. SUR type of surgery

ABDominal
ENT

11. CIR type of circulatory failure

DYSrhythmia
CCU overflow
PULmonary
embolism
AMI (acute)
UNDiagnosed shock
CGS (cardiogenic shock)
CHF (congestive
heart failure
MIScellaneous

12. CNS type of CNS Failure

VIRal encephalitis
SEIZures
CVA
SAH (subarachnoid
haem)
MIScellaneous

13. GIF type of GI failure

HAEmorrhage
HEPatic failure
PANcreatitis

14. MET type of metabolic failure

HEAt stroke
HYPothermia
MIScellaneous
DIAbetic

15. NEUromuscular failure

MYAsthenia
MIScellaneous
GBS (Guillain-Barré)
TETanus

16. REN type of renal failure

ARF (acute)
CRF (chronic)

FACio-maxillary and dental
GYNaecological

17.RES type of respiratory failure 18 PROcedure type admitted for

NECK	CVP insertion
ORTHopaedic	Dialysis
PLAstic	OTHer
OSA	
CORD	
MISCELLANEOUS	



Capturing outcomes following injury: a New Zealand pilot study

Sarah Derrett, Gabrielle Davie, Shanthi Ameratunga, John Langley

Abstract

Aim Before an intended Prospective Outcomes of Injury Study (POIS), a pilot was undertaken to determine whether: 1) injured entitlement claimants would participate in an injury study when first approached by their insurer, the Accident Compensation Corporation (ACC); 2) people with different types of injury would participate; 3) injured people would answer detailed questions about their injury, alcohol use, disability, health and financial status; and 4) participants would be satisfied with the process of recruitment and interviewing.

Method ACC randomly selected eligible entitlement claimants who were: aged 18 to 65 years, New Zealand residents at the time of injury, from one of four regions, and registered for an acute injury in November 2006. ACC sent a covering letter introducing the study and advised people of the opportunity to 'opt out', together with a Participant Information Sheet. Contact details those not opting out were provided to the researchers who then arranged a telephone interview. After interview, participants were sent a thank you letter and \$10 voucher. Interviews included a range of measures selected to reflect the World Health Organization model of functioning, disability and health including the short-form WHODAS II, the EQ-5D and questions about their health, satisfaction with ACC and health services, financial status, paid and unpaid activities and demographics.

Results 66% (111/168) of contactable people participated. Compared to non-participants, participants were more likely to be older and female. Participants reported a range of anatomical regions injured and injury types, including multiple trauma following vehicle crashes, burns, blood poisoning, sprains and strains. Missing responses were highest for total income. However, few responses were missing to questions about difficulty living on household income, likelihood of financial hardship, standard of living and other personal questions. Interviews took an average of 57 minutes. Two-thirds of participants expressed a positive impression of the interview and questions. Four percent reported feeling negative about the initial contact coming from ACC.

Conclusion An injury outcome study collecting a range of pre-injury and post-injury data, able to identify predictors of disability, was both feasible and acceptable to the intended study population. Methods that required refinement were identified for the main POIS study which is currently underway.

The Accident Compensation Corporation (ACC) is a Crown organisation providing no-fault personal cover for injuries to residents and visitors to New Zealand according to the Injury Prevention, Rehabilitation, and Compensation Act 2001.¹ In the 2007/08 year, ACC spent \$1.9 billion on support for 215,676 entitlement claimants.²

Entitlement claims are for injuries that may result in a week or more off paid employment, and include payments such as weekly compensation (salary), rehabilitation, equipment and modifications required to housing.

Fifty-eight percent of 2007/08 expenditure supported one-third of claimants with problems resulting from 'old' injuries sustained at least one year earlier.² ACC's expenditure represents only one aspect of the costs of disabling injury; yet provides sufficient evidence that longer-term disability following injury is a significant issue in New Zealand with a population of only 4.3 million people. Furthermore, the 2006 New Zealand Disability Survey identified injury was the reported cause of disability for 166,300 (29%) disabled adults.³

To identify strategies to improve post-injury outcomes for New Zealanders we need to know the barriers to, and facilitators of, good outcomes. The Prospective Outcomes of Injury Study (POIS) was designed to quantitatively determine factors leading to disability following injury in New Zealand, and, to qualitatively explore with injured Māori and non-Māori New Zealanders their 'lived experiences' and perceptions of injury outcome.⁴

Few prospective cohort studies of outcomes following injury have been completed in New Zealand; consequently we did not know if the preferred study design (obtaining the cohort from sampling ACC claimants) was feasible.⁵ We thus applied and obtained funding for a feasibility study.

Key research questions were:

- Will injured claimants participate in an injury outcomes study when a letter of invitation is sent by the ACC insurer;
- Will we be able to recruit a range of people with different types and causes of injury;
- Will injured people be willing to respond to detailed questions about anatomical region, type and cause of injury, alcohol and drug use, disability, health and household composition, home ownership and finances; and
- Will they be satisfied with the interview and the process?

This paper describes the development and piloting of POIS, insights obtained in relation to the research questions and other issues important to the conduct of the proposed prospective cohort study.

Methods

Before the pilot study, developmental work included reviewing literature related to injury and disability outcomes; and consultation with Māori, lay and scientific advisors and stakeholders within ACC, Ministries of Health and Social Development, and Statistics New Zealand. In addition, a focus group was held with people with injury-related disabilities, and a preliminary study questionnaire was pre-tested with recently-injured people.

Developmental work supported the need for investigation into the experiences and outcomes of people after injury. To facilitate a high Māori participation rate in the proposed POIS project, recommendations included having a qualitative component and ensuring regions with a high proportion of Māori residents were selected.⁶

Telephone interviews of less than one hour were preferred to postal questionnaires—but Māori and focus group participants also recommended making available face-to-face interviews and postal

questionnaires as optional alternatives. It was recommended that ethnicity be collected according to the Census questions and that interviews be available in *Te Reo Māori*.⁷

The focus group advised collecting information about: pre-injury disability; psychological well-being; sexuality, and positive outcomes following injury. The importance of not sharing participants' individual data with agencies was emphasised, as was the need for the analysis to be undertaken independently of the ACC. A \$10 voucher for participants in appreciation of their taking part was recommended to increase participation.

Following ethical approval the POIS pilot study commenced in 2006. ACC randomly selected eligible claimants from four regions of New Zealand (Manukau City, Gisborne, Otago and Southland). These regions were chosen because they included: people who lived rurally, regions where Māori comprised a significant proportion of the population and a range of socioeconomic groups.

People were eligible for the Pilot Study if they were aged 18 to 65 years, were New Zealand residents, had been placed on the entitlement claimant's register in November 2006 for an acute injury event, lived in one of the four regions and had not already been invited to take part in another survey via the ACC. People were ineligible if the cause of their injury was self-harm, if they were on ACC's Sensitive Claims register (which includes people who have been sexually assaulted), or if they were otherwise unable to participate in a telephone interview administered in English.

All selected entitlement claimants were first written to by the ACC. This postal contact included a covering letter from ACC introducing the study and notifying people about the opportunity to 'opt out' (by phoning a toll-free number at ACC), together with a Participant Information Sheet, provided by the researchers, describing the study.

Contact details of those not opting out were then provided to the researchers by ACC. If people were willing to take part, their oral consent was obtained and contact details given to one of five interviewers. People were then sent a response sheet to help with answering the interview questions, and also a written consent form and a reply-paid envelope to return the consent form to the researchers. Interviewers arranged a telephone interview at a mutually acceptable time. Participants' answers to interview questions were entered onto paper questionnaires. On completion of the interview participants were sent a thank you letter and \$10 voucher.

Interviews included a range of self-reported set-response measures selected to reflect the World Health Organization model of functioning, disability and health.⁸ These included the short-form WHODAS II – a measure developed by WHO specifically to measure disability and health.⁹ The WHODAS was recommended for inclusion in studies of injury outcome by an international working group, along with a brief measure of general health status, the EQ-5D, which was also included.¹⁰

Other questions included health and ACC service satisfaction, the general self-efficacy scale,¹¹ the Positive and Negative Affect Scale (PANAS),¹² chronic health and disability,⁷ exercise,¹³ sleep, height and weight, alcohol and drug use,¹⁴ general health, unpaid activities,⁷ work characteristics before and after injury,¹⁵ general happiness, social and life satisfaction based on General Social Survey questions,¹⁶ expectations of recovery¹⁷ and return to work, independence and demographics.

Open-ended questions allowing free responses asked participants about: the injury event, treatment provided, and factors influencing perceived satisfaction with health and ACC services. Participants were asked to report their pre-injury and current status for certain measures (WHODAS, EQ-5D, global health and happiness). Additionally, interviewers were asked for their perceptions of the questions to help improve the questionnaire for the intended main POIS study.

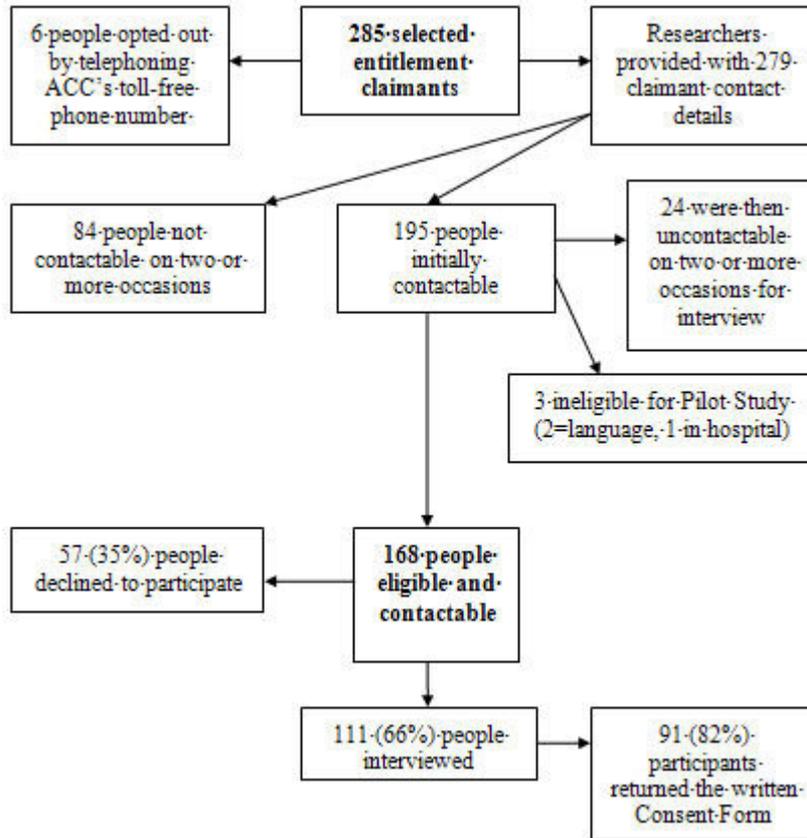
Following written consent, ACC provided injury information from electronic records for participants and anonymous summary information for non-participants. Injury information for participants included: accident description, injury diagnoses, days on earnings-related compensation, days off work and claim costs.

Results

ACC sent 285 letters of invitation to people selected randomly from ACC's entitlement claimant register (Figure 1). Six people did not want to be contacted about the study, three were ineligible and 108 could not be contacted by telephone. Of 168 people who were both eligible and contactable, 111 (66%) participated. In addition to

providing oral consent, all participants were asked to return, in reply-paid envelopes, a written consent form; 91 (82%) did.

Figure 1. Flow diagram of recruitment to the POIS Pilot Study



Participants tended to be older than non-participants and a smaller proportion of men participated (Table 1). Responses from two participants were excluded from the study because they incorrectly assumed the researchers were interested in an older, more serious injury, rather than the injury that led to their selection. Four participants were not asked many interview questions because of difficulties understanding the questions in English language, leaving 105 participants for most interview questions.

Participants reported a range of anatomical regions injured and injury types including multiple trauma following vehicle crashes, burns, blood poisoning, sprains and strains.

Missing responses were highest for self-reported personal and household income—14% and 30% respectively. Questions about difficulty living on household income, likelihood of financial hardship and reduced standard of living resulted in only 2% missing responses. A question about household composition was answered by all; home ownership and highest educational qualification questions had missing responses for 1% and 2% respectively.

Table 1. Characteristics of non-participants and participants

Characteristics	Non-participants (n=168)		Participants* (n=110)		P value
	n	%	n	%	
Age at time of interview					
18-34 years	83	49	37	34	
35-49 years	58	35	43	39	
50-64 years	27	16	30	27	
Mean (SD)	35.9 (12.9)		41.4 (12.6)		.0006
Sex					
Male	132	79	67	61	.001
ACC-reported ethnicity					
New Zealand European/Pākehā	93	55	71	65	
Māori	38	22	12	11	
Pasifika Peoples	16	10	10	9	
Asian	7	4	5	5	
Other	14	8	12	11	.16
Injury at work					
Yes	66	39	40	36	
No	102	61	70	64	.63
Employment					
Employed	146	87	92	84	
Non-earner	5	3	6	5	
Self-employed	17	10	12	11	.56

*The total number of participants equals 110, rather than 111 in Table 1, because descriptive data were inadvertently not provided by ACC for one participant.

The PANAS affect scale and WHODAS disability questions had four percent missing responses. The full range of response options were used for all WHODAS activities apart from ‘Learning a new task’ and ‘Concentrating’ where the greatest level of difficulty reported was Severe (rather than Extreme/Cannot Do). Questions asking about employment situation, exercise and sleep were answered by all participants.

The average time for the interview was 57 minutes, ranging between 20 minutes (with a participant who was not asked the full set of questions because of English-as-second-language) and 183 minutes (Table 2). The overall impression of the interview and questions was positive for two-thirds and negative for 6%. When asked about the initial contact coming from ACC, 4% reported they felt negatively about this. The procedure for taking part was unclear for one person; receipt of the \$10 voucher was perceived negatively by one person who suggested it go to charity instead.

Interviewers provided feedback about: the need to collect quantifiable information about injury treatment received by participants; difficulty answering specific questions about the exact medications received; ease of administration of the self-efficacy questions and list of chronic health conditions; that the WHODAS resulted in a comprehensive range of responses, and difficulty administering the home help and PANAS questions to people for whom English is not their first language. Interviewers also reported the length of interview was most problematic for those with few injury-related problems at the time of interview—but these people also reported understanding the need to include all question areas.

Table 2. Satisfaction with interview and process of recruitment

Characteristics	Participants (n=109)	
	n	%
Length of interview (minutes)		
20-60	72	67
61-90	33	31
>91	3	3
Impression of interview length and questions		
Positive	68	68
Mixed	26	26
Negative	6	6
Satisfaction with initial approach via ACC		
Positive	89	92
Mixed	4	4
Negative	4	4
Procedure for taking part?		
Clear	89	99
Unclear	1	1
Receipt of \$10 voucher		
Positive	95	98
Mixed	1	1
Negative	1	1

Discussion

The POIS Pilot Study provided the first opportunity to test whether or not injured New Zealanders would be willing to participate in such an in-depth study when the initial contact came from their insurer—the ACC.

Our concern was, despite our assurances that no individual information would be fed back to the insurer, some would still have doubts; but only 2% opted out of the study by phoning the toll-free number at ACC and 66% of those contacted were willing to participate. The inability to contact one third of potential participants was disappointing. Obtaining written consent proved difficult; some reported oral consent ought to be sufficient.

Advisors in the developmental phase suggested Māori may not be willing to participate unless face-to-face interviews were possible. Only one person (non-Māori) declined to participate because we could not offer a face-to-face interview. However, the proportion of ACC-identified Māori participating was lower, and inability to offer a face-to-face interview in the Pilot Study may have contributed to this. Importantly, participants were willing to answer a range of detailed questions about their health, disability, family and financial status. Questions elicited wide ranges of responses, and responses seemed sensitive to differences before and after injury, although it was beyond the scope of this Pilot Study to test these differences statistically.

As a result of the Pilot, changes were made to the methods for the proposed main POIS study which is now underway.⁴ Based on our findings and recommendations from other studies, interviewers try a minimum of five times to contact potential participants.^{18 19} Participants are clearly informed that their participation is equally

valuable if their injury is major or minor. Specific questions were added to the interview about the type of health professional and number of times seen, questions about medication use were removed, the PANAS was removed and questions about depression were added. Interviewers were appointed across all study regions making face-to-face interviews possible.

Interviews were translated into *Te Reo Māori* (involving an extended translation process required by the international EuroQol Group for translation of the EQ-5D measure) and Māori-speaking interviewers were appointed to the interview team. A number of people had expressed a willingness to participate in the Pilot Study but reported being too busy with work or family activities. Consequently, we developed paper copies of the interview questions for posting out to busy participants for them to complete at a convenient time.

Obtaining formal consent to collect injury information from participants' electronic ACC and health records was crucial to the design of the main study. The provision of requested electronic fields by ACC in the Pilot Study was straightforward, but only possible for the people who had returned their written consent.

For the main study, ethical approval was sought and obtained to collect formal oral consent instead of written consent. Indeed, this may be preferred in other predominantly telephone interview-based studies, or where the collection of written consent may be problematic for people with visual, intellectual or literacy difficulties. The oral consent process is highly structured and requires interviewer signatures at each consent point on the form and verbal declarations accompanying the signing. Copies of the oral consent form are then sent to all participants so they have a record to keep.

Several people were not asked all questions in the pilot because English was not their first language. Where possible in the main study, versions of measures in other languages have been obtained to be administered by interviewers speaking those languages. In-depth training of all interviewers to the main study included training about the importance of asking all questions wherever possible—even if the interview needed to be completed over two phone-calls with willing participants.

A secure online system which displays the questions for the interviewer to read, who then enters the responses electronically, also means questions cannot be inadvertently missed by interviewers in the main study. Training also emphasised the importance of specifying with participants at the start of the interview, the injury that led to their being selected for the study, so that people were not thinking we were asking about an earlier (and possibly more serious) injury as happened in the Pilot Study.

Interviewer training included tips for encouraging participants to answer using the set-response format—while not discouraging the value of their open-ended responses. The use of response sheets to help with the set-responses proved successful in the Pilot Study and was continued for the main study. Regular meetings occur with the interviewer team and tips are shared among interviewers about strategies for managing awkward situations they may encounter. To date, more than 2850 participants have been recruited to the main POIS study.

In conclusion, the Pilot Study revealed an injury outcome study collecting a comprehensive range of pre-injury and post-injury data, able to identify predictors of

disability, was both feasible and acceptable to the intended study population. This preliminary phase also identified aspects of the methods that required refinement to overcome barriers to participation such as needing face-to-face interviews and the use of postal questionnaires to facilitate involvement.

Based on this experience, the research team is well placed to undertake one of the largest injury outcome studies conducted internationally, and contribute locally relevant context-specific evidence that can inform effective rehabilitation and support services for injured people in New Zealand.

Competing interests: None known.

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Unintentional falls at home among young and middle-aged New Zealanders resulting in hospital admission or death: context and characteristics

Bridget Kool, Shanthi Ameratunga, Wayne Hazell, Alex Ng

Abstract

Aim This study investigates the characteristics and contexts of unintentional falls at home among young and middle-aged adults.

Method We conducted a population-based study of individuals aged 25–59 years resident in Auckland who were admitted to hospital or died following a non-occupational fall at home (July 2005–June 2006). Information was obtained from participant or proxy interviews, and reviews of inpatient records.

Results 344 patients (including 1 death) met the study eligibility criteria representing an overall age-specific incidence rate of 54.0/100,000 (95% CI 48.6–60.1) for the 12-month period. Of the 335 cases (97.4%) interviewed, 36% fell on stairs/steps, 31% fell on the same level, 13% of falls involved ladders/scaffolding, and 11% fell from buildings/structures. Stairs or steps were involved in 43% of falls among females and 28% of falls among males. The majority of falls (81%) occurred in the individual's own home. A quarter (24%) of participants had consumed ≥ 2 drinks in the 6 hours preceding the fall, and 24% were on ≥ 2 prescription medications.

Conclusion While this study was not designed to identify the specific causes of falls, the findings reveal several important contextual factors that can be targeted to prevent fatal and serious non-fatal falls at home among this age group.

Falls are a leading cause of unintentional injury morbidity and mortality.^{1–5} In New Zealand, almost one-third of unintentional falls resulting in hospital admission or death among young and middle-aged adults occur at home.⁶ Deaths from falls at home are uncommon in this age group (in contrast to the high case fatality rate seen in older adults) but for every death there are approximately 150 inpatient admissions.⁶ These falls result in significant health and societal costs.^{6–8}

The cause of falls among older adults is well recognised as multifactorial.⁹ Important intrinsic risk factors for falls among older adults include a past history of falls; impairments in gait, balance, mobility, vision and cognition; a fear of falling; poly-pharmacy (taking two or more prescription medications); and urinary incontinence.⁹

Some intrinsic factors such as physical activity,^{2,10–12} and alcohol consumption,^{2,13,14} have been identified as being associated with both increased and decreased risk of falls in older adults. Extrinsic factors identified as playing a *potential* role in falls among older adults include footwear,¹⁵ inappropriate walking aids,¹⁶ and environmental hazards such as poor lighting and uneven or slippery surfaces.¹⁵ It is estimated that environmental factors contribute to a third to half of all home falls.^{17,18}

Despite the economic and social impact of falls among young and middle-aged adults, the majority of published studies on the epidemiology of injurious falls at home have focused on older adults. In order to develop effective prevention strategies that apply to younger adult populations, information is required on the nature and circumstances of falls in this age group. This paper describes the characteristics of the individuals and the contexts of unintentional falls at home among young and middle-aged adults resulting in death or hospital admission in Auckland, New Zealand.

Methods

As part of a population-based case-control study we prospectively recruited individuals aged 25 to 59 years, resident in the Auckland region of New Zealand, who were admitted to hospital within 48 hours of injury or died following a non-occupational fall at home (theirs or another's) from July 2005 to June 2006.¹⁹ The region includes urban, suburban and rural areas and has a population of approximately 1.3 million.²⁰ We identified eligible people through daily surveillance and case finding in the three trauma hospitals and single coroner's office in the study region.

The study was approved by the Northern Regional Ethics Committee.

Subjects were interviewed face-to-face using a structured questionnaire by trained research nurses. Proxy interviews were obtained for subjects who were too unwell to be interviewed or for those who had sustained fatal injuries. The questionnaire explored a range of known and postulated risk factors for falls identified from the literature including: lifestyle factors such as alcohol use;^{13,21} medication use;^{22,23} demographic information; temporal factors such as day, time, and season of fall;^{24,25} setting;²⁴ and footwear.²⁶ Where possible, question items were drawn or adapted from previous falls research and validated self-report measures.

The NZiDep index was used to measure the individual-level socio-economic deprivation of cases.²⁷ Inpatient medical charts were reviewed to confirm the circumstances of injury and to gather details of blood alcohol concentrations.

The mechanism of falls was coded using the International Classification of Diseases (ICD) ICD-10-AM external cause of injury codes.²⁸ For reporting purposes the fall related codes were further grouped as follows: falls involving stairs or steps (W10), fall on the same level (W01-01.2, W03-09, W18-other fall on same level), fall from building or structure (W13), fall involving ladder or scaffolding (W11-12), and other falls (W14-tree, W17 – other fall 1 level to another, W19 – unspecified fall).

Chi-squared tests were used to test for differences in proportions. All analyses were undertaken using STATA version 8.²⁹

Results

A total of 344 patients admitted to hospital met the study eligibility criteria representing an overall age-specific incidence rate of 54.0 per 100,000 (95% CI 48.6–60.1) for the 12-month period. Interviews were completed for 97.4% (n=335) of the eligible people. Eight cases (2%) declined to participate, and there was one missed case. The median age of patients was 47 years (interquartile range: 38 to 54), and 53% of cases were females (Table 1).

The ethnic distribution of cases was similar to the ethnic distribution of this age group in the Auckland Region.³⁰ Almost 61% of patients had no socioeconomic deprivation characteristics based on the NZiDep index. No regional NZiDep figures are available however Salmond et al estimate 50.7% (95% C; 45.5 – 56.0) of New Zealand adults have no deprivation characteristics.²⁷

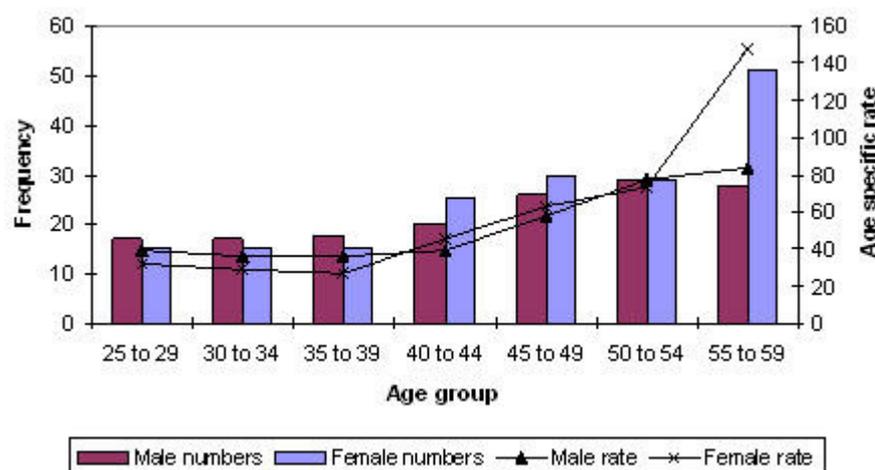
Table 1. Characteristics of study participants admitted to hospital following an unintentional fall at home among 25–59 years olds, New Zealand, 2005–2006 (n=344)

Characteristics	Frequency (%)
Gender	
Male	161(46.8)
Female	183(53.2)
Age group	
25–29	33(9.6)
30–34	33(9.6)
35–39	35(10.7)
40–44	47(13.7)
45–49	58(16.9)
50–54	58(16.9)
55–59	80(23.3)
Ethnicity	
NZ European	219(63.7)
Maori	39(11.3)
Pacific	30(8.7)
Other	56(16.3)
Socioeconomic status (NZiDep*)	
1: No deprivation characteristics	196(60.7)
2: 1 deprivation characteristic	52(16.1)
3: 2 deprivation characteristics	39(12.1)
4: 3–4 deprivation characteristics	14(4.3)
5: 5 or more deprivation characteristics	22(6.8)

*NZiDep: New Zealand Deprivation Index.

The hospitalisation rates were higher among males, until about 40 years of age when the pattern reversed and the rate became higher among females (Figure 1).

Figure 1: Frequency and rate of unintentional falls at home, by age band: among 25–59 years olds, New Zealand, 2005–2006 (n=344) (rate per 100,000)



Females in the 55 to 59 year age group had the highest hospitalisation rate (150.3 per 100,000; 95% CI 114.7–197.1), almost double that of their male counterparts (83.4 per 100,000; 95% CI 57.7–120.5). There was one death during admission to hospital and no deaths prior to admission during the study period.

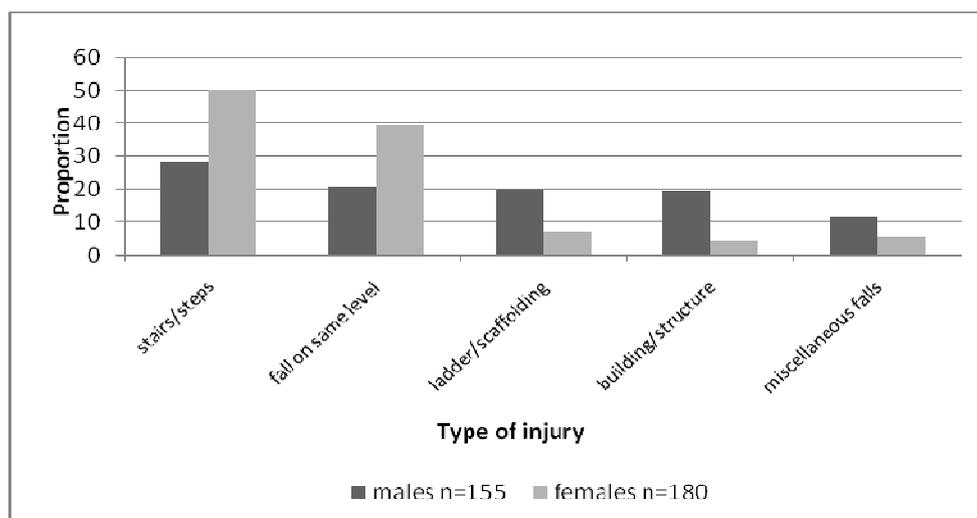
There were no significant differences in the distribution of falls by month or season but 42.0% of the admissions occurred during the weekend. Over two-thirds of falls (69.7%, n=232) occurred during the day (0700–2100). Only 9.9% (n=33) of people fell between 0200 and 0800. Time of fall frequency peaked between 1400 and 1600 (n=41), and was lowest between the hours of 0400 and 0600 (n=5). There was no statistically significant difference between the time of fall for males and females.

Over 80% of the falls occurred in the individual’s own home (n=272/335). The narrative descriptions provided by cases revealed that 36.4% (n=122) of the unintentional falls at home involved stairs or steps, 30.7% (n=103) were falls on the same level, 13.1% (n=44) involved falls from ladders or scaffolding, 11.3% (n=38) were falls out of or through buildings or structures. The remaining 8.4% (n=28) were a miscellaneous group.

There were significant differences ($p < 0.001$) in the types of falls resulting in injury among males and females (Figure 2). Falls on the same level and stair-related falls were more common among females. In contrast, males were more likely to have ladder or scaffolding related falls or fall from buildings or structures.

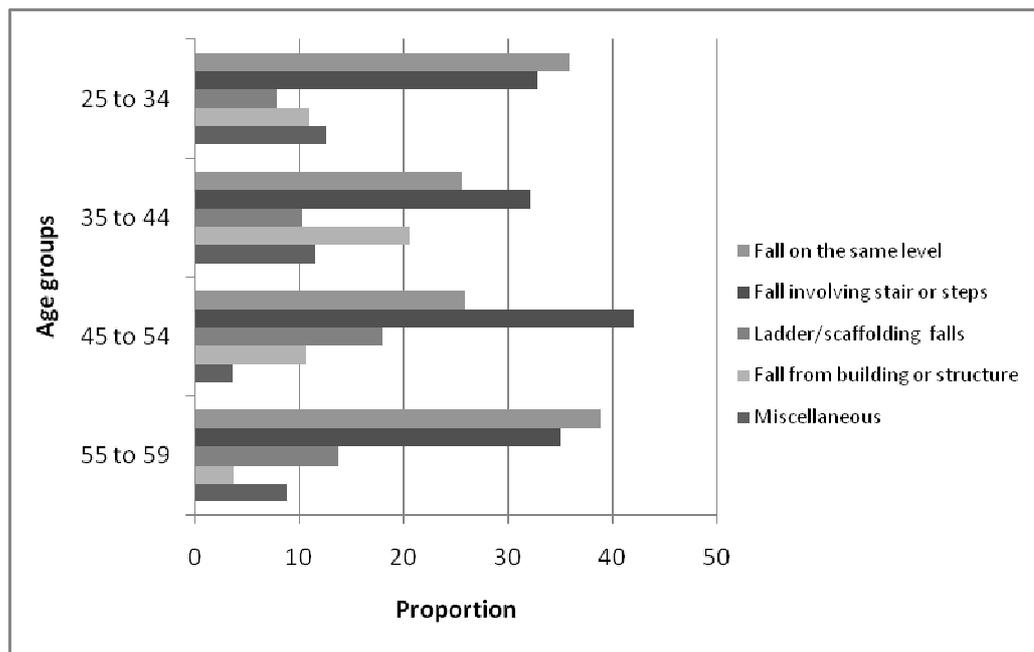
Interestingly almost two-thirds of cases who fell from ladders were stationary (i.e., neither ascending or descending) at the time of the fall (males 65.5%, females 63.6%). Of those injured as a result of falls on stairs, 82.4% (n=148) of females and 75% (n=116) of males were descending at the time of injury. Only 6.7% of males and 5.7% of females reported experiencing sensory symptoms such as light headiness, dizziness, or their legs suddenly giving way prior to their fall.

Figure 2. Distribution of type of unintentional falls at home, by gender among 25–59 years olds, New Zealand, 2005–2006 (n=335)



There were significant differences in the mechanism of injury by age group ($p=0.02$). For both the 25 to 34 and 55 to 59 year age groups *falls on the same level* were the most common type of fall. Among those aged 35 to 54 years falls involving stairs or steps were most common (Figure 3). The majority of falls from ladders or scaffolding were among those in the 45 to 54 year age group (45.5%, $n=20/44$).

Figure 3. Distribution of type of unintentional falls at home, by age among 25–59 years olds, New Zealand, 2005–2006(n=335)



The majority of falls occurred outdoors (60.6%, $n=203$). Of these, 29% ($n=58$) occurred on stairs, 20% ($n=41$) in or around the garden, 20% ($n=42$) took place on driveways or pathways, 14% ($n=28$) involved balconies, and the remaining 16% ($n=33$) occurred on roofs, in garages or other places.

The 123 (31.9%) falls which occurred inside the home were distributed in living areas (30%), stairs or steps (29%), the bedroom (11%), kitchen (11%), and the bathroom or toilet areas (6%) while the remaining 14% took place in hallways, laundries or other places.

A quarter (25.7%, $n=86$) of cases were barefooted at the time of the fall, 19.5% ($n=65$) were wearing running or sports shoes, 14.7% ($n=49$) casual shoes, 13.2% ($n=35$) slippers, 8.1% ($n=27$) gumboots or workboots, and 4.5% ($n=15$) were in stockings or socks. There were statistically significant differences between the footwear worn by males and females at the time of the fall ($p<0.001$). Females were most likely to be barefooted (30.6%) whilst males were more likely to be in running or sport shoes (25.6%).

In one-quarter of cases the recent use of alcohol was suspected by medical admitting staff, however only 16% of cases had blood alcohol levels taken. Twenty-four percent of participants reported having consumed two or more drinks in the 6-hours preceding the fall, and a similar proportion were on two or more prescription medications, factors known to increase the risk of falls at home.

Discussion

This study has described the characteristics and contexts of a population-based sample of unintentional falls at home resulting in hospitalisation or death. The findings highlight common settings (e.g. stairs, ladders, scaffolding), variations in the types of falls by gender, and prevalence of potential contributing factors identified in the published literature. While the falls cannot be attributed to these factors at the individual level, the distribution of these characteristics is useful for planning targeted injury prevention initiatives.

This population-based study with near complete case ascertainment and a very high response rate (97.4%) has provided a representative profile of serious falls at home that resulted in hospital admission or death. The data gathered on the setting and mechanisms of falls provide information that cannot be ascertained using the more limited coding categories in routine databases using the International Classification of Diseases.³¹

The findings must also be interpreted in light of several limitations. Difficulties in recalling information relating to the circumstances of the fall may have resulted in misclassification bias. The methods used to minimise such bias included the administration of a standardised questionnaire by trained research nurses. Although admission to hospital does not capture the full spectrum of injury severity and could be influenced by numerous extraneous factors,^{32,33} the recruitment strategy with study-specific surveillance in all trauma admitting hospitals in Auckland is expected to represent those with moderate to severe injuries following falls at home.

The use of hospital discharge data in New Zealand (cases with a principal diagnosis, primary admission, and a day stay of 1 day or more) for determining injury incidence has been shown to overestimate the occurrence of some injuries by up to 3%.³³ However, the primary hospitalisation rate for unintentional falls at home among 25 to 59 years olds of 54.0 per 100,000 identified in this study is consistent with the findings of a recent review of New Zealand routinely collected data for the region with the same criteria (52.0 per 100,000).⁶ Auckland residents admitted to hospitals outside the region were not eligible to participate in the present study which may have underestimated the numbers of hospitalised injuries of interest.

Blood alcohol concentrations (BAC) results were available for only 16% of cases in this study revealing the potential to under-estimate the importance of alcohol as a risk factor in injuries of this nature. A meta-analysis of 331 medical examiner studies in the US found fatal fall cases were less likely to be tested for BAC than deaths from motor vehicle injury, burns or fires, drowning, or poisoning.³⁴

The study has highlighted some differences between the circumstances surrounding falls at home among young and middle-aged adults compared to falls among older

adults. The majority of falls occurred outdoors—this is in contrast to falls among older adults which are more likely to occur indoors.^{35,36}

There was no seasonal variation in the distribution of falls in this study, Campbell et al in a New Zealand study of falls among community dwelling older adults found rates of falls increased during winter months among women.³⁷ Almost one-third of falls occurred at night (2100–0700) in the present study compared with 20% of falls among older adults for the same time period in the Campbell study.³⁷

The hospitalisation rate in the present study was highest among females in the 55 to 59 year age group, almost double that of their male counterparts. This is consistent with international findings that report significantly more fall-related injuries among older adult women than men.^{38 39}

This study was not designed to identify specific causes of falls but the findings reveal several important contextual factors that can be targeted to prevent fatal and serious non-fatal falls at home among young and middle-aged adults.

Keall et al in a New Zealand study investigating the association between the number of home hazards and home injury in general estimate there is a 22% increase in the odds of injury with each additional injury hazard found in the home.⁴⁰ The authors suggest that addressing hazards in the home may be an effective strategy for reducing home injury.

However a recent Cochrane review found insufficient evidence to show that such changes reduced the number of injuries in the home and recommended larger well-designed randomised controlled trials of such interventions.⁴¹ Given the large number of people injured as a result of falls in the home each year, even interventions that are of moderate success may have a significant impact at a population level.⁵

Raising public awareness of the opportunities to mitigate risks of falls at home is an important step in this process. In a recent New Zealand survey undertaken to measure people's perception of safety culture, only 49% of respondents felt that "everyone is at risk of being injured at the home".⁴²

The New Zealand National Falls Prevention Strategy launched in 2005 identifies falls in the home as a priority area.⁴³ The strategy also acknowledges that while falls among those aged 15 to 64 years are a considerable cost to the government, little is known about how to prevent falls in this age group. The findings from our study, alongside increasing attention to intervention research, signal opportunities to address this gap.

Competing interests: None known.

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Selenium and ocular health in New Zealand

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Abstract

Selenium is an essential mineral and severe selenium deficiency is known to cause significant health problems. It has been well documented that New Zealand soil is low in selenium. Recent studies have addressed the roles of selenoproteins in the eyes, with evidence suggesting that selenium supplementation may have a role in preventing cataract formation and age-related maculopathy. This paper summarises the role of selenium in ocular and general health and discusses selenium supplementation in a New Zealand specific context.

Selenium was first identified by Jons Jakob Berzelius in 1817.¹ In the early 20th Century, selenium became known for its toxic effect on livestock which was called the “blind staggers”.¹ Later in the 20th Century selenium was recognised as an essential trace mineral after the discovery of its roles in glutathione peroxidase, Keshan disease and Kashin-Beck disease.² In the last 10 years, there has been intense interest in selenium supplementation and its role in health.

Selenium biochemistry and metabolism are complex and have been extensively reviewed elsewhere.^{3,4} Selenium is absorbed as selenoamino acids - L-selenomethionine (SeMet), L-selenocysteine (Sec), and Se-methylselenocysteine and then incorporated into proteins by two different pathways. The main pathway involves L-selenocysteine which is inserted into proteins in specific positions, forming specific selenoproteins.³ 25 selenoproteins exist in human, including glutathione peroxidases (GPx-1, GPx-2, GPx-3, GPx-4, GPx-6), iodothyronine deiodinases (DIO 1-3) and thioredoxin reductases (TrxR1, TrxR2, TGR).

Selenium and the eye

Selenium and cataractogenesis—Cataract formation can be induced in mice within 3 to 5 days with a single subcutaneous injection of 30 mol/kg selenium as sodium selenite.⁵ Conversely GPx-1 has been identified in the lens, and cataract formation has been observed in GPx-1 knockout mice.⁴

Given that GPx-1 level declines rapidly with selenium deprivation, this suggests that selenium deficiency may contribute to cataract development. Further evidence comes from selenium-deprived rats where a decrease in GPx-1 activity in the rat lens and early lens morphological changes were noted.⁶ However, there are no convincing human studies (three case-control studies showing contradicting results) linking serum selenium level with cataract formation.⁷⁻⁹

There are three randomised controlled trials addressing antioxidant supplementation, with selenium as one of the ingredients, on cataract formation. In the largest study in 2008, 1020 participants with early or no cataract were observed for 9 years.¹⁰ The study found that a daily intake of Centrum, a multivitamin and mineral tablet

containing 25 microgram of selenium, led to a decreased incidence of total lens opacity (hazard ratio 0.82, P = 0.03) and nuclear opacity (hazard ratio 0.66, p=0.004) compared to placebo, but a higher rate of posterior subcapsular cataract (hazard ratio 2.00, p<0.001) was noted. However, there was no statistically significant reduction on moderate visual acuity loss or cataract surgery in the treatment group.

In the other randomised controlled trials, one showed no benefit on cataract formation when selenium was given with alpha-tocopherol and beta carotene in Chinese subjects likely to be deficient in selenium and other micronutrients.¹¹ In the third randomised controlled trial, when selenium was given as a wider package (β -carotene, vitamin E, vitamin C, citrus bioflavonoid complex, quercetin, bilberry extract, rutin, zinc picolinate, selenium, taurine, n-acetyl cysteine, l-glutathione, vitamin B2, and chromium), there was an increase in cortical cataract in the right eye (p=0.04).¹²

It is important to note that selenium was included with a large number of other micronutrients in these randomised controlled trials, thus it is very difficult to draw conclusions on the real effect of selenium supplementation on cataractogenesis. However, it is biologically plausible that selenium supplementation in selenium deprived individuals can prevent the formation of cataract by optimizing GPx-1 activity in the lens.

Selenium and glaucoma—The association between selenium and glaucoma is complex and not well-understood. In the Nutritional Prevention of Cancer (NPC) trial, a randomised controlled study performed in 1996 involving 1312 patients on selenium supplementation and non-melanoma skin cancer, 200 mcg of selenium supplementation daily was linked to the development of glaucoma (hazard ratio 1.78, 95%CI 1.12–2.82).^{13,14} The risk was even higher in those who chose to continue selenium supplementation after the trial (hazard ratio 10.13, 95%CI 1.32–77.62).^{13,14}

Two studies have been published on the effect of selenium on human trabecular meshwork cells to provide a biological basis for the above observation.^{14,15} These showed that in cell culture, treatment of human trabecular meshwork cells with selenium leads to a number of biochemical changes which may result in an increase in trabecular outflow resistance.

In the latest case-control study involving 47 patients with primary open angle glaucoma and 54 control subjects,¹⁶ the odds ratio for glaucoma was higher in the middle and upper tertile of plasma selenium level (odd ratio 4.6 for middle tertile and 11.3 for upper tertile). However, a protective effect was seen at higher levels of aqueous humour selenium level in this study, with the largest effect seen in the middle tertile (odds ratio 0.06 for middle tertile and 0.41 for upper tertile).

This association between high plasma selenium level and glaucoma confirms the findings from the NPC trial, and suggests that selenium supplementation may carry a risk of developing glaucoma. The suggested mechanism is that excess selenium saturates selenium-related enzyme pools causing cell damage before excretion.

In summary, there are both biological and human studies suggesting selenium supplementation is linked with an increased incidence of glaucoma.

Selenium and age-related maculopathy—When selenium was given as part of a wider anti-oxidant package in a double blinded study, patients with age-related

maculopathy of any type did not experience any decrease in visual acuity over a period of 1.5 years, as measured by LogMAR visual acuity.¹² In another randomised controlled trial, supplementation with lutein and a wider anti-oxidant package including selenium was associated with an improvement in snellen visual acuity and macular pigment optical density compared to placebo.^{17,18} However, there was no added benefit shown with the added anti-oxidant package as compared to supplementation with lutein alone. Furthermore, there are three case-control studies addressing the level of serum selenium and age-related maculopathy.¹⁹⁻²¹

Two studies showed lower serum selenium level in patients with age-related maculopathy, and one showed no statistically significant relationship. There are two Cochrane reviews on the effect of antioxidant supplementation in preventing or slowing the progression of age-related maculopathy. They concluded that an antioxidant package may be of modest benefit in slowing the progression of age-related maculopathy,²² but there is no evidence that the antioxidant package may delay the onset of age-related maculopathy.²³ However, these conclusions cannot be applied directly to selenium as one of the Cochrane reviews did not include any trials that has selenium as part of its intervention,²³ and the other review only included two trials^{12,17,18} where selenium was given as part of a wider anti-oxidant package.²²

Diabetic retinopathy—There has been published data on the beneficial effect of selenium, either given alone or as a wider package of anti-oxidants, on diabetic retinopathy in rat models.²⁴⁻²⁹ There is no human study on selenium supplementation and diabetic retinopathy.

Selenium and general health—Severe selenium deficiency is known to cause Keshan Disease, an endemic cardiomyopathy characterised by multifocal myocardial necrosis and fibrous bone replacement, and Kashin-Beck disease, an endemic osteoarthropathy where degeneration and necrosis of the joints and epiphyseal-plate cartilages are seen.² These diseases are mainly seen in low selenium regions of China, where foods with the lowest selenium content are found.³⁰

Both diseases can be prevented by selenium supplementation.² There is evidence that less overt selenium deficiency is linked to loss of immunocompetence, increase in a number of viral infections, low mood, suboptimal fertility, impairment in thyroid function, cardiovascular disease, and inflammatory conditions such as chronic pancreatitis.³¹

Selenium supplementation of 200mcg daily has been linked to a reduced risk of lung, colorectal, prostate and liver cancers as secondary end-point analysis in two randomised controlled trials performed in 1990's.^{13,32} A comprehensive report on mineral supplements and chronic disease published by the Agency for Healthcare Research and Quality (United States Government, 2006) concluded that there is moderate benefit on total cancer prevention by selenium supplement.³³

A Cochrane Systemic Review published in 2008 concluded that selenium used singly or with other antioxidants significantly reduced all-cause mortality (RR 0.90, 95% CI 0.83-0.98), although this effect disappeared when high-risk bias trials were excluded.³⁴

The latest data suggests that the above effect is due to study bias. Two large-scale trials addressing selenium and general health were published in December 2008. In a

well-designed phase 3 randomised controlled trial involving 35535 men with adequate serum selenium level from the United States, Canada and Puerto Rico, 200 mcg per day of selenium supplementation did not have any statistically significant effect in reducing the risk of prostate cancer, lung cancer, colorectal cancer, overall primary cancer, significant cardiovascular events, and overall mortality, over a time period of 5.46 years.³⁵

In a case-control study involving 959 men with prostate cancer and 1059 controls, there was no relationship between prostate cancer risk and plasma selenium level.³⁶

Selenium toxicity

Acute selenium toxicity with industrial selenious acid is invariably fatal, preceded by stupor, respiratory depression and hypotension.¹ Hair loss, brittle nails, and garlic breath are seen with chronic selenosis in seleniferous areas, including the Northern great plain of USA, parts of Venezuela and Colombia, and Enshi county of China with an average intake of 4900 mcg per day.³⁷

A published report showed no signs of toxicity with selenium intake of up to 819 microgram / day in China and 724 microgram / day in USA from cereal or rice in the form of selenomethionine or selenite.^{38,39} In a study of Inuit of North Greenland where daily intake of selenium at levels up to 5885 mcg per day in the form of selenocystine from meat and organs of marine animals, no sign of toxicity was seen apart from striation of nails.³⁷

In Australia and New Zealand, nutrient reference values set a safe upper limit for selenium intake of 400 microgram/day.⁴⁰ This is considered a safe intake that will not produce toxicity in the majority of the population.

On the other hand, there is evidence that selenium supplementation may not be entirely safe for those with adequate selenium status. A study has linked selenium supplementation with type II diabetes (hazard ratio 1.55, 95%CI 1.03–2.33).⁴¹ Elevated serum selenium was linked to higher level of total cholesterol, LDL cholesterol, HDL cholesterol and triglycerides.⁴²

Furthermore, a U-shape relationship between serum selenium and risk of peripheral vascular disease (increasing serum selenium level to 150 to 160 microgram/L appears to be protective, but followed by gradual increase in risk afterwards), and mortality (decreased risk up to 130 microgram/l but increase in risk in higher level) has been observed.^{43,44}

Selenium intake and adequacy in New Zealand

The selenium content in the food chain depends on the region the food is grown and its soil selenium content.³⁰ Average soil globally contains 0.1 to 2 mg of selenium per kg. It has been documented that soil in parts of New Zealand has a lower than average selenium soil content. For example, the soil in the central volcanic plateau of North Island and most of the South Island contains less than 0.5 mg of selenium per kg, and a higher incidence of selenium responsive diseases is seen in sheep from these areas.⁴⁵

The low soil selenium level is reflected in the selenium content of plants – wholewheat grain produced in the USA on average contains 2 mg of selenium per kg, whereby New Zealand produce on average contains only 0.1mg of selenium per kg.³⁰

The minimum concentration of plasma selenium to support maximum GPx activity in humans is 1.00-1.14 micromol/L.⁴⁶ In New Zealand, the recommended daily intake is 70 mcg per day for men, and 60 mcg per day for women.⁴⁰

The selenium intake estimated from a simulated New Zealand diet was 67 mcg per day for men and 49 mcg per day for women,⁴⁷ confirming that a proportion of the population is not achieving the recommended daily intake of selenium. However, these estimated figures for selenium intake come from a 2003–2004 total diet survey. There have been several reports suggesting the blood selenium concentration of South Island residents has been increasing over past 10 years.⁴⁸ This is possibly due to the use of selenium supplementation in animal feeds and a change in dietary pattern (greater use of multigrain bread and imported legumes and nuts).⁴⁸ So it is likely that New Zealand selenium intakes are now higher.

Even within New Zealand there is a significant difference in selenium intake between the North and South Islands. Imported wheat, especially Australian wheat, is higher in selenium and is used for all bread making in the north of the North Island, so that people in this region have higher selenium intakes. In the south of the North Island about 30-35% of wheat used is Australian. In the South Island usually all wheat is grown locally, accounting for lower selenium intakes in that region.⁴⁸

Furthermore a 2004 New Zealand study showed that infants and toddlers born in the South Island had suboptimal selenium dietary intake and serum selenium levels.⁴⁹ The current plasma selenium levels of residents of the Otago region of the South Island are in the range 0.76–1.65 micromol/L (60–130 microgram/l), which is low compared to other countries.⁴⁸

From this data it can be estimated a proportion of South Islanders have a low selenium status and are not capable of sustaining maximal GPx activity. In this group, the ambulatory, independently living elderly people are more likely to be selenium deficient.⁴⁸

Despite the probable increased dietary intake of selenium and the documented increase over the years of mean plasma selenium levels, the selenium status of New Zealand population remains low compared to other countries, and may be considered as marginal.⁴⁸ Furthermore, an increase in plasma and whole blood GPx activities and levels of functional selenoproteins were noted in New Zealanders after selenium supplementation, which further supports that the current level of selenium intake in New Zealand is not adequate to sustain optimal functioning of selenoproteins.^{48,50}

Discussion

This article highlights that New Zealand soils are low in selenium content and this means serum selenium levels in the New Zealand population, especially in South Islanders, are low. An increasing selenium content of our food supply is probably increasing our selenium status. Although there is a limited evidence base, there is both biological plausibility and data from animal and human studies that selenium deprivation contributes to cataract formation and age-related maculopathy and selenium supplementation is beneficial in prevention of both conditions.

In addition, selenium supplementation has a beneficial effect on general health, improves mood and strengthens the immune system. Although the level of selenium

intake leading to chronic selenium toxicity (around 700 microgram/day) is much higher than the level used in trials (up to 200 microgram/day), selenium supplementation may not be risk free for those with adequate selenium status as it has been linked to an increased risk of diabetes, and increased mortality.

How then should New Zealand eyecare professionals interpret this data and what are the implications for the health of New Zealanders?

Eyecare professionals in New Zealand may choose to interpret the data as inconclusive and await further study on this topic while offering no recommendations to patients. Justification for such an approach lies in the lack of evidence of a higher prevalence of cataract, cataract surgery or age-related maculopathy in New Zealand (especially in the South Island) compared to other Western nations. Proponents of this approach can also argue that further research is needed to clarify selenium biochemistry, the role of selenium and various selenoproteins in ocular health and the best form of supplementation.

But data on selenium's role in ocular health is unlikely to be forthcoming in the near future given that this would require randomised controlled trials which control for many confounding factors and which would require vast amounts of resources and time. Alternative approaches to clarify selenium's role in ocular health would be to conduct an ecological study comparing the rate of cataract in patients in the South Island versus the North Island of New Zealand. Another methodological approach is to assess the selenium levels of the Dunedin Study cohort, comparing those study members who live in Dunedin with those who live elsewhere and correlating this with eye disease when the cohort is a few decades older.

Eye care professionals may rather choose to adopt an alternative approach and advise selenium supplementation to individuals at high risk of selenium deficiency, cataract formation or age-related maculopathy after assessment of their selenium status. Such individuals may include those over 65 years of age, South Island New Zealanders, patients with a family history of cataract or age-related maculopathy and smokers.

When choosing selenium supplementation, it is not known whether different forms of selenium supplementation have different biochemical effects on the body. Based on the current evidence, the authors are not able to recommend what the best form of selenium supplementation is but it would seem sensible to increase selenium intake through foods (fish, poultry, eggs, imported nuts and legumes) rather than supplements. It can be seen from Table 1 that brazil nuts and certain fish stand out as the best dietary sources of selenium.

The consumption of two Brazil nuts daily is as effective in raising plasma selenium concentration as is the consumption of a 100 microgram selenium selenomethionine supplement, and a greater increase in whole blood GPx activity was seen with Brazil nuts as compared with supplements.⁵⁰ However, as Brazil nuts contain high levels of selenium, barium and radium, its consumption should be limited to no more than a few nuts daily to avoid accumulation of these trace minerals.⁵⁰

The optimal dose of selenium and whether additional supplements or co-factors (such as other anti-oxidants, minerals and vitamins) are also needed for selenium to achieve its full beneficial effects are also unclear.

For eye care professionals recommending selenium supplementation it is reassuring to know that toxicity from selenium supplementation is low and that selenium blood levels can be easily measured if toxicity is of concern. But caution is required when implementing selenium supplementation for those with chronic diseases who already have adequate plasma selenium levels.

If eye care professionals choose to offer selenium supplementation, how is such advice best provided? Discussion on selenium supplementation is presently an unrealistic expectation with the time pressures of most clinical consultations. Advice about selenium and optimal ocular health is therefore best given within general advice for optimal ocular health via pamphlets or posters, or by assistants or health promotional groups.

The authors encourage New Zealand eye care professionals to interpret the data presented and decide whether selenium supplementation might benefit the ocular and general health of New Zealanders who have low selenium status.

Table 1. Selenium content in common food groups⁵¹

Food	mcg	cost (\$)	cost (cent/mcg)
2 med eggs	15	0.72 - 2.00	4.8-13
2 cups milk		4-6 1.00	17-25
1/3 cup brazil nuts*	650	2.00	0.31
4 slices wholemeal bread	28	0.80	2.9
4 slices white bread	4	0.30	7.5
100g snapper	120	3.50	2.9
100g all other fish (avg)	50	2.00	4
100g kidney	65	0.70	1.07
100g chicken	15	3.00	20
Supplements			
Solgar 50 caps	80		0.62
Se Methionine			0.78
Comvita 100 caps	50		0.19
Se Methionine			0.38

* Brazil nuts stand out as having high selenium content. However this can vary considerably, between 125 mcg and 2650 mcg according to soil content, and it may contain significant level of radium and barium.

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How to achieve New Zealand's shorter stays in emergency departments health target

Mike Ardagh

Abstract

The new shorter stays in the emergency department (ED) health target is an expression of the need for solutions to problems with acute health care in New Zealand. Long stays in the ED, and consequent ED overcrowding, result from the accumulation of contributions from throughout the acute care system, and are associated with bad patient experiences and bad patient outcomes. However, if pursued inappropriately, the shorter stays in the ED health target might be achieved without improving patient experiences or outcomes. In New Zealand, we have the opportunity for this target to drive genuine improvements in quality of care. To do this requires understanding, structure and planning, reflecting a commitment to whole of system reform.

A patient journey

2pm Thursday: A general practitioner (GP) sees a 48-year-old man with cough and fever, worsening despite 2 days of oral antibiotics. He notes high fever, tachycardia and crepitations in his right lung base and decides admission to hospital for intravenous antibiotics is required. He addresses a letter to the emergency department (ED) including his findings and requesting admission.

3pm: The patient is triaged and put in an ED cubicle. A nurse inserts an intravenous cannula and sends off blood tests.

3.50pm: A senior house officer (SHO) sees the man, takes a history, examines him, reviews the blood results and organises an X-ray of his chest.

5pm: The SHO reviews the X-ray and consults with an ED registrar. The registrar briefly takes the patient's history and listens to his chest. He concurs that the patient needs admission for intravenous antibiotics.

5.30pm: The general medical registrar is called.

6.45pm: The acute medical house officer (HO) attends to 'clerk' the patient on the general medical registrar's behalf. She does a thorough history and examination and reviews the results. She concurs that the patient needs admission for intravenous antibiotics, but she worries about a possible pulmonary embolism (PE; clot in the lung). She orders a D-dimer blood test and reports back to her registrar.

8.10pm: The registrar attends. He reviews the notes so far—from the GP, SHO, ED registrar, and the HO. Then he recaps the history with the patient, repeats the examination, records his notes and concludes that the patient needs admission to hospital for intravenous antibiotics.

9pm: A bed is ordered.

1am Friday: The patient is transferred to a bed in a surgical ward (the only suitable bed available).

2pm Friday: He is seen at the end of the 'post acute' round, by the general medical registrar, HO and consultant. His fever has abated, and he is much improved. However, he recounts some pain in his right side and his D-dimer blood test result is markedly raised. A nuclear medicine scan is ordered, to 'rule out PE'.

4.30pm: The scan result is 'indeterminate.'

5.30pm: His registrar organises a CT scan (CTPA) and asks the 'duty' registrar to review the result.

7pm: The duty registrar confirms there is no PE, and that the CT results are consistent with pneumonia. As the patient is being treated for pneumonia no changes to management are made.

The patient continues to be treated for pneumonia Friday night, Saturday and Sunday.

2pm Sunday: A duty house surgeon replaces his intravenous cannula and the patient asks how long he will be in hospital. The house surgeon confirms that the patient's own team of doctors will decide this when they return on Monday.

11.30am Monday: He is seen on the round and discharged from hospital to continue oral antibiotics under his general practitioner's supervision.

5.30pm: He is picked up by his wife.

This man spent 10 hours in the ED and 4 days in hospital, when all he needed was an hour of ED time, and no more than one day in hospital.

Why? We might ask about the processes of GP referral to hospital; why the patient stayed in the ED when the intention was admission to hospital; why the doctor who could confirm admission to hospital was the fifth doctor to see him; why the GP and subsequent doctors' determinations of need to admit were insufficiently worthy to allow admission; why ordering a bed and transfer to the ward could not occur earlier; why he went to a surgical ward, if the pursuit of the diagnosis of PE might be better informed by an evidence-based pathway; why he did not have decision-making capable doctors seeing him over the weekend; and why intravenous antibiotics could not be delivered in the community.

Although this patient journey is a contrived string of delays, these delays are happening now, to a greater or lesser extent, in all of our acute hospitals. Similar delays will be apparent when the pathways of other acute patients are examined.

A realisation of the amount of wasted time and duplicated effort in these pathways makes for an unstable platform from which to make calls for increased resources.

A new health target

In May 2009 the Minister of Health formally announced six national health targets for New Zealand (NZ). The first on the list was *Shorter stays in emergency departments*, defined as '95% of patients will be admitted, discharged or transferred from an ED within 6 hours.'

This target is a very significant development in acute care in this country. Its origins can be traced to the advocacy of clinicians, culminating in the presentation of a document to the Minister in late 2008: *The Report of the Working Group for Achieving Quality in Emergency Departments*.

While the British National Health Service has been working with an ED length of stay (LOS) target for some years, an important contrasting feature of the NZ target is the formative involvement of clinicians in its genesis.

Quality versus compliance

Despite its importance the target is blunt, high level and a bit of a misnomer. It measures patients staying a long time in the ED, but it is mostly about patients not being where they should be.

It is possible to achieve the ED LOS target without resolving important contributors to patients staying longer in EDs, and without getting patients more quickly to the care they should be receiving. It is possible to achieve compliance without improving quality—to hit the target but miss the point.

Without embedding genuine quality there are two possible adverse effects of the target: gaming the target, and shifting the problem.

Gaming the target may include delays to starting the clock (for example by keeping patients in ambulances), and premature stopping of the clock (for example by calling patients in the corridor admitted ‘observation patients’). The Ministry will keep an eye out for such activities, however it is hoped that external scrutiny will be mostly redundant. Unlike the British experience, the call for this target was ‘bottom up’, lifted by the passion of concerned clinicians. The passion persists and is unlikely to tolerate gaming on its patch.

If patients are moved out of the ED to hospital wards, without adequate provision for this work, the problem currently reflected in the ED will surface elsewhere. The solutions are ‘whole of system’—attention to this principle is a prerequisite for success.

Why does it matter?

First, it matters to the patient. Second, it matters because, by staying longer in the ED and in hospital, it obstructs access for others seeking these resources. Third, it causes the accumulation of patients in the ED—the flow coming in is unabated, but the flow out is obstructed. The ED becomes overcrowded and ED overcrowding matters.

The problems caused by ED overcrowding are well described, and interested readers may read further from the reference list. However ED overcrowding is bad; it is associated with delays to care, longer total hospital length of stay, decreased satisfaction, and adverse outcomes.^{1–6} But most significant are the associations between ED overcrowding and death.^{5,6}

Among the patient population who have gone through an overcrowded ED there are about one-third more deaths over the next 10 days. In Australia this equates to a death rate equivalent to the road toll. In NZ this would translate to more than 300 deaths each year.

How applicable these figures are to NZ is open to debate—there may be relatively fewer or more deaths in NZ, but the least plausible argument is that these figures have no relevance to NZ.

ED overcrowding is causing death and other harms in this country.

Achieving the target

Achieving the target will be challenging. However, it is a challenge we must embrace.

Approaching the target may be seen to proceed through four stages.

- *Understanding* the problem and the potential solutions.
- Constructing a *structure* to address the problems.
- Constructing a *plan* to address the problems.
- *Progress* towards the target.

Understanding—Understanding of the problem and therefore its potential solutions, is an essential first step.

Prolonged ED stays are a manifestation of a failing acute care system, with contributors relating to the number and complexity of patients seeking acute care, the ability of the ED to accommodate these patients (including the physical and human resources in the ED and the processes for getting things done), and the ease of getting the patient to the next phase of care (most notably into a hospital bed). One description of these three areas of contribution uses the cardiac failure analogy of preload, contractility and afterload,⁷ and another labels them input, throughput and output.⁸

Every system tends to have contributions in all three of these areas, with a different mix from place to place. Inevitably a complete list of contributors will be large. Focusing on a single solution (for example, efforts to reduce low acuity patient presentations, or opening more hospital beds)—independent of other contributing factors—will frustrate those attempting to fix the problem. So will attempts to fix the problem of ED overcrowding by focusing on the ED only, when two of the three contributing areas are outside the ED's influence.

Examining 'the patient journey' (like the journey of our patient with pneumonia), encourages a 'whole of system' perspective, as well as helping to identify quality as the patient might perceive it. Several different patient journeys can be examined (diagnostics) to identify which parts of the pathway are unnecessary and where in the pathway are the tightest bottlenecks to patients accessing the required next phase of care. Solutions then have two focuses; to eliminate unnecessary steps, or waste, (consistent with 'lean thinking') and to prioritise solutions which fix the narrowest bottlenecks first (consistent with 'theory of constraint').

Fixing obstructions to patient care, when there are bigger obstructions in the same pathway, will not improve patient movement and instead will disillusion and frustrate.

Models of care, for the purpose of this discussion, can be seen as the 'itinerary' of the whole patient journey. In other words; where does the patient go, what happens there, and who does it?

Some innovative models of care have had success in addressing ED overcrowding.^{9,10} The common features of these models are that they take the patient's perspective (what is good for the patient is good for the model), they continue the whole patient journey (therefore whole system) paradigm, and they emphasise lean thinking and working on the narrowest bottlenecks first. The additional contribution they make is the emphasis on value-added tasks, and how best to achieve them.

Patients have some value-added things happen to them on their journey, such as resuscitation, diagnosis, or definitive care. They also have a number of things happen which do not add value, such as waiting, repeated assessments and 'storage' in lieu of an appropriate place to go, and elimination of these steps is in keeping with the concept of 'lean thinking'.

To do the value-added tasks well it is appropriate to have a place resourced to do that task, with staff trained for, and focused on that task. Putting a number of different patients, with different required 'value added tasks', with multiple staff with different objectives, in a single clinical space (for example, an ED) results in inefficiency, confusion and frustration.

Consequences of this paradigm include streaming of patients from triage, to areas of the ED suited to their needs, and the formation of admission and planning units, where patients go specifically for work-up by acute general medical teams.

From this discussion, a number of guiding principles can be drawn:

- Many causes and solutions of long ED stays are outside the ED, so progress towards the target needs a 'whole of system' approach.
- Causes and solutions are multiple across the whole of system and a well structured, prioritised approach is needed so that the best things are done first.
- Wasted time and effort, and bottlenecks in the patient journey, can be identified, and then eliminated, using tools such as those found in 'lean thinking'.
- Innovative models of care, which associate value added tasks with appropriate people working in an appropriate space, have resulted in initiatives such as 'streaming' in the ED, and acute inpatient units such as *admission and planning units*.

Structure—Within the DHB there should be a tangible focus of activity, which is 'above' the ED, and includes prioritised activities across the whole patient journey. The structure includes the people, committees, working groups, and their responsibilities. The structure a DHB adopts will reflect local needs and opportunities, but should include clear leadership and ownership of the 'basket' of activities relevant to achieving the target.

Ideally leadership will include a clinical and corporate partnership, perhaps in the form of both a clinical and a corporate champion. These roles will differ from DHB to DHB, and may be a single person, or more than two. However, having identified champions is important, as is the shared clinical and corporate leadership—bringing different skills and perspectives and emphasising partnership and clinical governance. The title given to the champions should reflect their oversight and leadership of whole of system reforms. To this end it might be preferable to call them something like 'acute care reform champions', rather than 'ED target champions'.

The clinical champion could be an ED clinician, but this risks the perception that the target is an ED one, rather than whole of system. It may be preferable if the clinical champion is an informed, willing and able clinician from an inpatient service, however, local opportunity may determine who undertakes this task.

The corporate champion might be a portfolio manager from Funding and Planning, or another member of the DHB corporate community. Inevitably the projects, and the champions, will need administrative and project management support.

Whoever the individuals, the champions are charged with overseeing the approach to the target, and are the conduit for information between the DHB and the Ministry.

Different structures might already exist, or be chosen, but some structure is required. It is insufficient to report to the Ministry a group of activities which are unlinked except for the purposes of the report.

Plan—The contributors to the problem span the whole of the acute patient journey, and include problems of processes, staff resources and physical space. Consequently, there tend to be an overwhelming number of them. In addition, there is the potential to be repeatedly distracted from the task at hand by other compelling tasks.

While the problems are real and the responses to them are worthy, good things should not impede better things. All of the solutions should be put on paper and prioritised so that the better things are done first.

The plan might take a variety of forms, but the following gives an example of how it could be constructed.

- To begin to list actions, and to determine their relative priorities, several processes can be undertaken, including:
 - Analysis of common patient journeys using tools such as value stream mapping—to identify significant areas of waste and duplication.
 - Examination of ‘breach’ patients (those who stayed more than 6 hours)—to look at the reasons they stayed in the ED more than 6 hours.
 - Ideas and insights from those in the hospital who are ‘street wise’ (with an understanding of current processes, flow and barriers to flow, usually based on experience).
- Construct a 3 by 3 table (Table 1). We have established that there are three general areas of contribution to ED overcrowding: preload, contractility, and afterload. When considering the potential solutions, then we can consider the people (staff, numbers and roles), the plant (space, beds and equipment), and the processes (ways of getting things done).
- Populate the cells in the table with the actions. A few examples are included in Table 1, but do not represent the large number that might populate the plan initially.
- Prioritise the actions so that attention is focused on the right things first. Each of the actions can be graded according to;

- Urgency (based on assessment of degree of risk already present because of the problem the action is intended to address) and;
 - Importance (based on the contribution the project will make to high standards of clinical care, improving patient flow, reducing waiting times or resolving overcrowding, and consequently the degree of risk reduction the project is likely to bring about). Grading under these two headings might be high, moderate or low level of urgency or importance.
 - ‘Quickness’—according to whether the intended solution is a ‘quick fix’ or whether it is slower to achieve.
- Start with the ‘HHQ’ actions (high urgency, high importance, quick) and follow closely with beginning work on the ‘HHS’ actions (high urgency, high importance, but slower to achieve).

Table 1. A possible plan template (with a few examples of relevance to the presented case)

Variables	People	Plant	Processes
Preload (input)	Acute community nurse for IV antibiotics	Observation facility at after hours GP clinic	Pathway for community management of pneumonia
Contractility (throughput)	‘Front-loaded’ decision-making in the ED, with ED SMO briefly seeing referrals first to establish a plan	Reconfigure cubicles in ED to allow ‘streaming’ of patients to the ‘right’ area for their needs	Review ‘admission rights’ so that the last doctor to see the patient is not the first able to authorise admission
Afterload (output)	Review medical registrar roster to improve cover during busy times	Admission and planning unit for workup of stable referred patients	Evidence-based pathway for ‘rule out PE’

Progress—Progress towards the target is based on understanding and is lead by the ‘structure’ (the clinical and corporate champions and the working groups/committees they oversee, possibly defined by a focus on preload, contractility and afterload). It proceeds according to a ‘plan’ which categorises the many possible actions and prioritises them so that attention is applied to the most important things first.

Each DHB will have its own range of problems, and will be starting from different positions. Although there are many potential solutions, and a number of precedents and tools, solutions must be devised and prioritised locally.

Furthermore, efforts to address the target must be continuous, as both progress and changes in acute demand will cause a shift in priorities.

As discussed, the target is high level and blunt and, on its own, tells little about the quality of elements of the patient journey. To continue to progress towards the target, DHBs will need to examine a number of quality measures representing elements of the patient journey.

The Ministry will require reporting of performance against the ED LOS target, and it is expected that attention to triage waiting times will continue.

Other measures will not, individually, have accountability consequences at a Ministry level, but the Ministry team overseeing the target may request perusal of other measures to inform advice to the DHB regarding progress toward the target.

Such measures are likely to include demographic measures describing attendance at the ED, patient journey time measures and clinical measures (including times to critical treatments, and outcome measures). Those DHBs that do not routinely capture some of this data electronically could do periodic spot/manual audits, and work towards electronic capture of appropriate data.

Summary

The new shorter stays in the ED health target is an expression of the need for whole of system solutions to problems with acute health care in NZ, and efforts towards it might proceed through the steps of *understanding, structure, plan and progress*.

Understanding includes appreciation of the whole of system/whole DHB responsibility, the multiple contributions, the need to eliminate waste using tools such as those provided by 'lean thinking', the need to attend to the narrowest bottlenecks first, and the need to 'stream' patients to the area most appropriately set up for their needs.

The most important initial steps for DHBs are to establish a structure for addressing the problem, including clinical and corporate engagement in the form of champions, and a comprehensive, prioritised plan of actions. The structure might include projects in the areas of pre-load, contractility and after-load, with each area categorising actions into 'people', 'processes' and 'plant'. Actions will be multiple, and not all can be addressed at once. Prioritisation of actions is essential, and may include consideration according to urgency, importance and time required to achieve results.

Finally, progress will be identified by a suite of measures representing quality and value added elements of the patient journey.

Competing interests: None known.

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High-pressure injection of silica-based paint into a finger

Jason Locker, Alan Carstens

The severity of injury in high pressure injection injuries is often underestimated due to the small, relatively benign looking entry wound.

These injuries most commonly involve the hand, most usually the pad of the thumb and index finger and often constitute a surgical emergency.

Case report

We report the case of a 28-year-old right-hand dominant painter, who used his left index finger to plug a hole in the tubing of a paint sprayer rated at 2000 psi. It contained a mixture of paint and silica material (used for non-slip surfaces).

The index finger became immediately swollen and painful. He consulted local doctors who washed the 1 mm puncture wound on the pulp and discharged him.

He presented to our emergency department 4 days later with a swollen index finger with a 1 mm entry wound at the pulp. The distal phalanx was pale with no capillary refill and was found to be insensate distal to the distal interphalangeal joint (DIPJ).

He was able to flex both the proximal interphalangeal joint (PIPJ) and DIPJ without pain.

Plain X-ray (Figure 1) showed radio-opaque material throughout the soft tissues corresponding to the middle and distal phalanges.

Figure 1. Plain X-ray of affected digit



He was taken to theatre expediently where the finger was explored using a Brunner type incision.

All of the subcutaneous tissues from the pulp as far proximal as the metacarpophalangeal joint (MCPJ) were found to be covered in granular grey matter (see Figure 2) which was still present despite washing with 8 litres of saline.

Figure 2. Granular grey matter within the digit



It was not possible to debride this tissue without devascularising the skin of the distal digit.

With loupe magnification, identification of anatomical structures proved difficult.

The digital nerves and arteries were found to be intact, but covered in paint.

The foreign material had not penetrated the flexor sheath.

Repeat exploration after 48 hours revealed demarcated skin along the radial border with full thickness ischaemic changes in the flaps.

The subcutaneous tissue was still covered in the grey matter which could not be washed away.

After 2 further debridements it became clear that the finger was not salvageable and underwent ray amputation 14 days after the injury.

Discussion

This is a relatively uncommon injury but recognition of the severity and potential complications is extremely important. Those affected tend to be young males in a new job, injuring their non-dominant hand (75%)

The prognosis is related to the material, temperature, pressure and site injected:

- Grease (25%) is thought to cause fibrosis, while paint (60%) causes immediate tissue necrosis which persists if the tissues are not completely debrided.
- Pressure greater than 7000 psi is thought to be 100% prognostic of amputation.
- Digital injuries are associated with a far worse outcome than those to the palm.

The recommended management is opening of fingers with removal of all paint especially around digital arteries.

In general, wounds should be left open for serial debridement.

In severe paint injection to a digit, early amputation should be considered.

This particular case is unusual as there was no sharp penetration of the skin - it was broken by the pressure—and the nature of the foreign body injected, which was a combination of paint and silica, making removal particularly difficult.

The resulting amputation of an index finger serves as a pertinent reminder of the dangers of high-pressure injection injuries.

Competing interests: None known.

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Foreign bodies do strange things: the case of a shard of glass in the scapulo-thoracic space

Georgette Oni, Nitin Vaingankar

Glass foreign bodies following trauma are a common presentation to emergency departments. When retained, such foreign bodies may be associated with variable clinical presentations.

Case report

A 77-year-old lady presented to clinic with 6-month history of a painful lump in the right scapular region. She recalled having sustained a fall in the greenhouse 25 years previously and had presented to her local accident and emergency department on the day of injury. She had a penetrating glass injury just inferior to the lateral aspect of her right breast from which a shard of glass had been removed. She was discharged on the same day.

Twenty years later she started to experience pain in the right shoulder. She was unable to lie on that side as it was too painful. She was referred for a course of physiotherapy with no improvement in symptoms.

Twenty-three years later she could feel a lump behind her right shoulder, hence her referral to our department. An X-ray revealed a glass shard over 10 cm long on the right side of the chest in the subcutaneous tissue, outside of the ribcage (Figure 1). A CT scan confirmed the presence of foreign body which was seen to pass through the blade of the scapula in the extra-thoracic subcutaneous tissue (Figure 2).

Under a general anaesthetic, the glass shard was found to be adherent to the tissues and had partially worked its way through the blade of the scapula. It was removed in fragments and she made an uneventful postoperative recovery. At 6 weeks' follow up her wound was healed and she was now pain free. An X-ray showed residual glass deep in her back but she reported no symptoms or discomfort.

Discussion

The shard of glass was probably the deep end of a longer piece which had broken off, the superficial portion having been removed in the accident and emergency department 25 years ago. The remaining shard of glass had migrated over the years until it became subcutaneous and symptomatic. Its migration was probably propelled by the movement of the so-called scapulo-thoracic rhythm which is an integral part of shoulder abduction.¹

The likelihood is that the shard of glass migrated through the scapulo-thoracic space where it travelled eventually through the scapula causing shoulder symptoms. In normal subjects the concave scapula glides smoothly over the convex chest wall and disruption to this articulation can cause scapulo-thoracic crepitus or snapping scapula.²

The scapulothoracic space has been described as consisting of two regions, the space between the serratus anterior and the thoracic cage, which usually contains a bursa and a space between subscapularis and serratus anterior,^{2,3} based on cadaveric studies for arthroscopic port insertion. There are few indications for scapulothoracic arthroscopic surgery, but removal of foreign bodies such as bullets have been documented.⁴

Migration of metallic foreign bodies *from* the shoulder region *to* other parts of the body including the heart, lung, spine, abdomen and eye have all been documented in the literature.⁵⁻⁷ However, to the best of our knowledge there is only one other documented case of migration of a large retained glass foreign body, and this did not involve the shoulder region. In that case, the entry wound was from the lower back and the glass shard was removed intra-abdominally after causing a bowel perforation⁸.

Because of the length of time from initial presentation to surgery it is unclear whether our patient had a chest radiograph 25 years ago. Routine x-rays have been shown however to be unnecessary in superficial wounds that can be thoroughly explored⁹. However, there is evidence to suggest that penetrating wounds often have the highest prevalence of retained glass,¹⁰ and therefore imaging such as plain radiographs should be considered at the time of presentation in wounds such as these.

Our case illustrates not only the importance of a good clinical history, but of appropriate radiological imaging in deciding the management of these patients.

Figure 1. Chest X-ray showing glass shard on the right side of chest in the extra-thoracic space

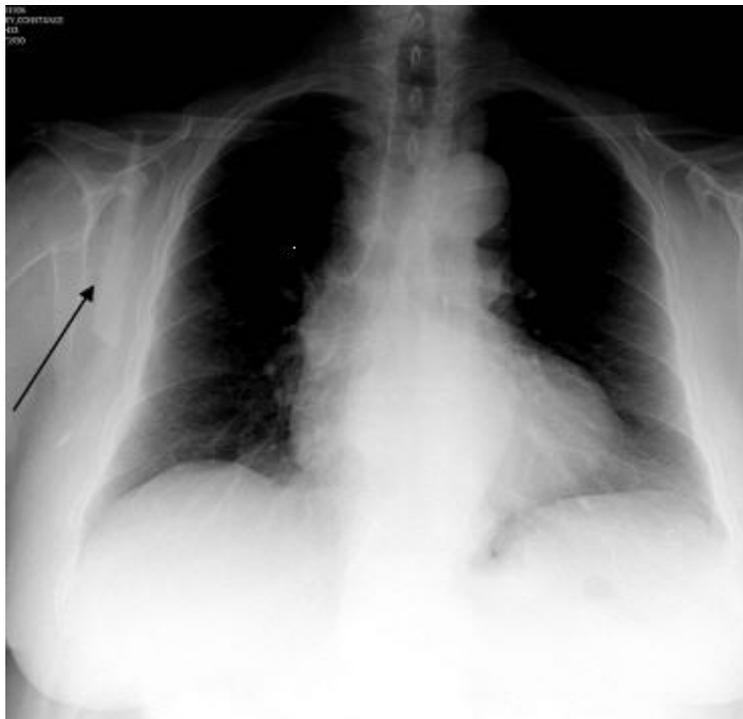


Figure 2. CT scan saggital view showing glass shard through the scapula blade, lying extra-thoracic soft tissues

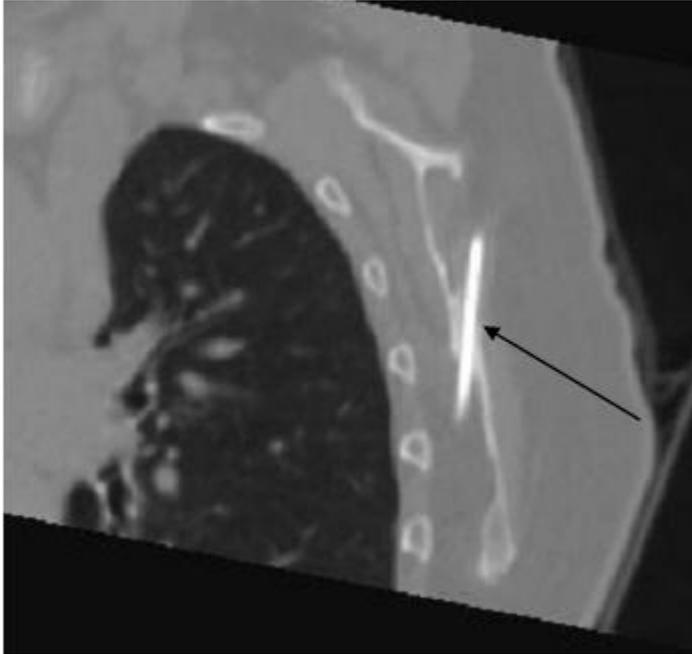


Figure 3. 3D CT reconstruction showing migration of glass shard through scapula



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A thump and an expanding lump

Manar Khashram, Christopher M Holdaway

An 84-year-old woman was referred to the emergency department by her general practitioner following attempted aspiration of a forehead mass. She reported a 5-week history of an expanding mass on the left temporal region following a fall with minor head trauma. The mass was associated with left facial pain and numbness.

Her medical history included atrial fibrillation and she was on warfarin. On examination there was a 4cm by 2cm pulsatile mass (see Figure 1).

Figure 1. Pulsatile mass on the left temporal region with fresh bleeding from the attempted aspiration site



What is the diagnosis?

Answer—*Superficial temporal artery aneurysm*

Comment—Aneurysms of the superficial temporal artery (STA) are rare and they usually involve the anterior branch of the STA.¹ They are often associated with blunt or penetrating trauma giving rise to a pseudoaneurysm.

Patients, typically males, present 2–6 weeks after the initial injury with a slowly enlarging pulsatile mass. Less commonly, true aneurysms involving all three layers of the arterial wall have been reported to occur spontaneously. True spontaneous STA aneurysms have been associated with both congenital and atherosclerotic vascular changes.²

In this case, the STA was ligated and the pseudoaneurysm was excised. The patient made an uneventful recovery with a complete resolution of her symptoms.

This report highlights the dangers of aspirating an undiagnosed mass.

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Medical education to improve Māori health

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Abstract

Medical education in Aotearoa/New Zealand has a critical role to play in producing a health professional workforce that is prepared to meet the challenge of addressing Māori health. While cultural competence is an important aspect of this, we argue that Māori health is an educational domain in its own right with distinct learning objectives and educational approaches. An emerging consensus as to the optimal graduate outcomes and key components of a Māori health curriculum is supported by a growing international evidence base in indigenous health education. Several significant challenges exist, many of which can be overcome by reorienting institutional systems, structures and processes to support effective Māori health teaching and learning. We recommend a combination of immersed, integrated and independent teaching and learning approaches in order to promote high-quality outcomes.

This article looks at the role of medical education in preparing current and future doctors for the challenge of improving Māori health and eliminating health inequities. While acknowledging the need for all health professionals to be able to work safely and effectively in a multicultural, global context; the focus here is explicitly on Māori health in Aotearoa/New Zealand.

We outline the key components of a Māori health curriculum and suggest how these can be most effectively incorporated in health professional education, using examples from New Zealand's undergraduate medical education programmes. Key issues are identified and recommendations for advancing Māori health education are provided.

Why do we need Māori health in health professional curricula?

Equity is a key foundation of New Zealand social policy, including health policy.^{1,2} Despite this high-level goal, ethnic disparities in health remain entrenched with Māori experiencing poorer health and shorter life expectancies than non-Māori.³⁻⁶ The conditions contributing to and maintaining health inequities in New Zealand are in direct contravention of the Treaty of Waitangi,⁷ as well as being a breach of human rights and indigenous rights.⁸⁻¹⁰

Urgent action is required at all levels of society, including the health sector, to reduce and eliminate these inequities.¹¹

Health professional education and training has an important role to play in improving Māori health and promoting equitable outcomes. In line with similar international experience, Māori tend to receive poorer quality care than non-Māori across a range of different health sector contexts.¹²⁻¹⁶

While many factors are responsible, it is clear that health professionals contribute to this differential quality of care.¹⁷⁻¹⁹ To address this, health professional training, including medical education, in New Zealand needs to ensure that all learners have the necessary competencies to improve Māori health and reduce inequities.²⁰ This requires not only generic professional knowledge and skills including cultural competence, but also an understanding of specific issues related to Māori health in Aotearoa including a critical awareness of historical contexts, colonisation and indigenous rights.

What is the relationship between Māori health and cultural competence?

Cultural competence is established as an integral part of medical curricula.²¹⁻²⁵ Within this field it is recognised that culture is a multi-dimensional construct that includes age, gender, ethnicity, spiritual beliefs and sexual orientation.²⁶ However in health professional education the documented emphasis of culture has tended to be more on ethnicity/race than on other dimensions.²⁷⁻²⁹

In medical education in New Zealand, cultural elements of the curriculum have traditionally focused on teaching about Māori. The relative lack of attention to other aspects of culture has often led to an expectation that Māori 'cultural' teaching should be inclusive of other ethnic groups. There is clearly a need to strengthen cultural competence teaching and learning, but responsibility for this should not rest with Māori health academic units.

Indeed, more recent educational developments have seen Hauora Māori (Māori health) established as a discrete thread or domain in undergraduate curricula at both the University of Auckland and the University of Otago, to reinforce the need to explicitly address Māori health.³⁰

In this context it draws on elements of cultural competence, but is an educational subject in its own right, defined from the perspective of Māori as tangata whenua, the indigenous population. Educational developments within this domain to date have been commended by the Australian Medical Council and further developments encouraged.^{31,32}

What are the key elements of a Māori health curriculum?

The Committee of Deans of Australian Medical Schools (CDAMS, now MDANZ, the Medical Deans of Australia and New Zealand) has adopted an Indigenous Health Curriculum Framework.³³ First published in 2004, it has been endorsed by the Australian Medical Council, so that all medical schools in Australia and New Zealand are required to report on the implementation of the Framework as part of regular accreditation requirements. The Framework has also been used by specialist medical colleges to inform the development of indigenous health curricula.

Recent work at both the University of Auckland³⁰ and the University of Otago has used the Framework³³ as the basis for defining the scope and content of Māori health curricula. This has resulted in the following graduate attributes being used to drive Hauora Māori teaching and learning development in the respective programmes.

Te Ara Graduate Learning Outcomes (University of Auckland)

In respect to Hauora Māori, graduates of the Faculty of Medical and Health Sciences will be able to:

- Engage appropriately in interactions with Māori individuals, whānau and communities.
- Explain the historic, demographic, socioeconomic, and policy influences on health status.
- Explain how ethnic inequalities in health are created and maintained and how they may be reduced and eliminated.
- Identify approaches to reducing and eliminating inequalities including actively challenging racism.
- Explain the influence of one's own culture and that of the health system on patient and population health outcomes.
- Engage in a continuous process of reflection on one's practice and actively participate in self-audit in respect of the Treaty of Waitangi.
- Identify and address professional development needs as a basis for life-long learning about Māori health.

University of Otago, Hauora Māori Graduate Learning Outcomes

- Describe the determinants of health disparities between Māori and non-Māori and describe approaches to addressing disparities.
- Demonstrate the principles of cultural safety, competency and literacy within the health environment.
- Demonstrate appropriate engagement in communication skills with Māori patients, whānau and community.
- Describe Māori health status and the health disparities that exist for Māori—both within a national and international context.
- Identify the principles of Māori Beliefs, Values and Experiences (MBVEs) and their application to Hauora Māori.
- Identify and apply a Hauora Māori model to clinical cases.
- Identify evidence based skills when undertaking critical appraisal of epidemiology, clinical research and qualitative research in Māori Health.

The two graduate profiles have a number of common elements, with a focus on critically analysing ethnic inequalities in health, understanding how to reduce health inequalities, engaging appropriately with Māori patients, whānau and communities, and culturally safe practice. In general, the areas of divergence reflect differences in emphasis rather than any fundamental inconsistency in the desired attributes. These differences are largely attributable to the way curricula have developed historically, shaped by a range of institutional and other factors.

Incorporating Māori health teaching and learning in curricula

While Hauora Māori is positioned as a domain or thread in its own right, it may be incorporated into curricula in a variety of ways. This section provides a broad discussion of different approaches. While context will vary, current developments generally seek to integrate Hauora Māori throughout all stages of educational programmes, as well as within the various components at each stage. Different teaching and learning approaches may be characterised as immersed, integrated or independent, as discussed below together with examples from undergraduate medical education in New Zealand.

Immersed—Immersed approaches involve time allocated solely for Hauora Māori content, as opposed to teaching Hauora Māori within other components of the curriculum. Examples include the University of Auckland’s “Māori Health Week”,³⁴ (an interprofessional programme for 2nd year medical, nursing and pharmacy students) and the “Introduction to Hauora Māori” for Year 2 medical students at the University of Otago. Both of these include experience on a marae and the focus is on engaging appropriately with Māori and understanding the context of Māori health and inequalities.

Other examples of immersed teaching and learning activities are evident in Year 4 at both universities. Whilst the approaches differ between the two programmes, the focus is on applying Māori health theory and concepts in clinical settings. At the University of Otago, a Māori Health day (involving student-led clinics at a marae) has been trialled with Year 5 students to increase contact time with Māori patients and to provide an opportunity to gain relevant Hauora Māori competencies as outlined in the previous section.

Immersed teaching components are consistently rated highly by students, who note that the advantages include adequate and appropriate space to learn the core principles of Hauora Māori.

Integrated—Integrated teaching involves incorporating Hauora Māori content into other parts of the curriculum. The ubiquitous nature of Māori health requires that it be addressed within many different educational contexts. Examples include Māori health teaching and learning components in subject areas such as population health, communication skills and quality and safety.

The integration of Hauora Māori into clinical attachments allows for a more detailed examination of issues specific to Māori that may arise in different disciplines. At both the University of Auckland and the University of Otago, Hauora Māori learning objectives and specific teaching are included within clinical attachments. Students report that integrated components allow them to apply learning from immersed teaching in a clinically relevant setting.

Independent—Experience in undergraduate medical education has identified the importance of time allocated within curricula for students to engage in self-directed learning for Hauora Māori. This is being realised at the University of Auckland and the University of Otago by scheduling time to complete allocated readings and assessments and to access required Hauora Māori resources.

At the University of Auckland a teaching and learning resource that uses a short video as a foundation for reflection on a number of issues related to Māori health and cultural competence is also incorporated. Independent learning encourages self-reflection and provides a supported platform for integrating Hauora Māori theory and concepts with clinical experience.

Combining immersed, integrated and independent approaches—It is recommended that a mixture of immersed, integrated and independent teaching and learning approaches are used. Each approach has strengths and weaknesses and may be more or less effective for certain types of learning than others. For example, immersed teaching can result in marginalisation if it becomes separated from ‘real’ clinical experience. Integration into other teaching components may have high clinical relevance but there is a risk that Hauora Māori learning gets overlooked among a range of competing priorities. It is our experience that the different approaches to Māori health teaching and learning complement each other and used in combination can mitigate these risks.

Key issues in Māori health teaching and learning

Assessment

As in other areas of education, assessment of Māori health learning should be defined by the desired learning outcomes.³⁵ The graduate profiles presented above indicate that one of the principal goals of Hauora Māori teaching and learning is to encourage the development of a “critical consciousness”³⁶ and associated behaviours.

Although these learning outcomes are assessable, and must be assessed, conventional assessment tools have not been developed for this purpose. While this poses a challenge, formal assessment of Māori health in medical education is critical, otherwise it can lead to a perception among students and teachers that it is not important or valued.³⁷ Furthermore, if outcomes are not measured it is impossible to determine the effectiveness of the teaching and to identify where changes to the curriculum are required.

Kumas-Tan et al²⁸ conclude that there is a need for assessment of ‘actual’ practice within cultural competence in order to advance this discipline; the same is true of Hauora Māori. At the same time, assessment should extend beyond observable behaviours to include the attitudes, values and reasoning behind them.³⁸

Particular issues arise in clinical settings where students’ supervisors are responsible for assessing Māori health competencies. Hauora Māori as a discipline has evolved considerably in recent times, and clinical supervisors may be unfamiliar with its curricular goals and may feel unprepared to assess students. This raises questions about the value of clinical supervisor reports in this area.

Undergraduate medical programmes are addressing these issues by developing, implementing and evaluating new and innovative assessment tools. Examples of current assessments include case reports on Māori patients and whānau,³⁹ Hauora Māori long cases, simulated Māori patient stations in OSCEs (Objective Structured Clinical Examinations), logbooks, reflective commentaries and multiple choice questions.

Collectively these tools are designed to measure the application of Hauora Māori clinical skills and also to identify students' underlying attitudes (as manifest by behaviours) and values using evidence-based approaches.⁴⁰ It will be important that these developments occur in the context of programmatic assessment,⁴¹ which focuses on the utility of the assessment programme as a whole rather than evaluating individual methods or instruments.⁴²

Teaching capacity

The resources required for delivery of an effective Hauora Māori curriculum are extensive, yet there is a shortage of appropriately qualified staff in both undergraduate and postgraduate medical education.

The Ministry of Health⁴³ has identified Māori health workforce development as a key strategy in addressing current health inequalities and many initiatives are in place to support Māori students and health professionals. Similarly, increasing the number and capability of Māori medical educators is crucial to ensure that New Zealand medical graduates are equipped to meet the challenge of improving Māori health.

Although Hauora Māori is a speciality area in medical education and requires experts to lead curriculum development and oversee teaching and learning, it is important that Māori health academics do not have sole responsibility for this component of the curriculum. A 'whole of faculty' approach including appropriate professional development is needed to ensure that Hauora Māori teaching and learning does not become marginalised.

The hidden curriculum

One of the major challenges with Hauora Māori in medical education is managing learning that occurs outside the taught curriculum (the "hidden curriculum"⁴⁴).

Unless a comprehensive approach is taken to curriculum development with appropriate Māori Health faculty input, students' experiences outside the formal Hauora Māori components can undermine effective learning. For example, senior practitioners' discourse or professional practice may be at odds with the principles underpinning Māori health teaching. This hidden curriculum can have a powerful influence on students' learning and ultimately on their practice.⁴⁵

The issues described here highlight the need for professional development for all teaching staff, to enable them to work with students on teaching and learning in Hauora Māori. This can be achieved through involvement in Māori health teaching activities as well as through designated staff development initiatives. Such interventions can improve the consistency of Hauora Māori teaching and learning, minimise the hidden curriculum effect, reduce dependence on Māori health academics and demonstrate the importance of teaching and learning in this area.

Meeting these challenges

Achieving the goals of Māori health teaching and learning is critically dependent on the institutional context. Areas without large amounts of curriculum time, wide faculty engagement and established assessments may become marginalised with lip service being paid to the achievement of learning outcomes.

Embedding Hauora Māori within the formal, stated curriculum through core learning outcomes and mandatory assessments is an educational approach to addressing some of the challenges identified above. However optimal educational outcomes cannot be achieved unless Māori health curricula are supported by appropriate institutional systems, policies and structures.

We endorse the principle of ‘Indigenous leadership, faculty responsibility’ articulated in the MDANZ Indigenous Health Project Critical Reflection Tool.⁴⁶ This requires faculty-wide commitment to Māori health, including faculty and programme leadership, Māori leadership within the faculty (e.g. Tumuaki and Associate Dean positions), meaningful influence at all levels including on curriculum committees and Boards of Studies, adequate resourcing and recognition, addressing institutional barriers to advancement⁴⁷ and staff development to enable all faculty members to effectively teach and assess Māori health.

Key points—

- Māori health is an integral part of medical and other health professional education, and is a specialty area in its own right.
- Cultural competence is important for appropriate engagement with patients and communities, but is only one of the attributes required for health professionals to effectively address Māori health.
- There is broad agreement on the overall goals and key components of a Māori health curriculum, supported by a developing international evidence base in indigenous health education.
- A combination of immersed, integrated and independent teaching and learning approaches is required to address the range of learning outcomes in Māori health.
- Several challenges exist: however many of these can be effectively overcome by adopting a ‘whole of faculty’ approach, with appropriate responsibility, representation, recognition, resourcing, removal of barriers, and (re-)training of staff.

Disclaimer: The opinions expressed in this article are those of the authors and not necessarily those of the University of Auckland or University of Otago.

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THE NEW ZEALAND MEDICAL JOURNAL

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Notice to Correspondents

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All communications must be written on one side of the paper, and addressed to DR WALTER FELL, Wellington.

OWING to the difficulty in reading some of the manuscript sent in, the Editor would be glad if correspondents would kindly have their M.S. typewritten.

CORRESPONDENTS sending photographs in illustration of their articles are requested not to mark the photographs in any way, as it interferes with their production. Figures or letters will be placed by their printer if a key to their situation be sent.

ALL correspondence in reference to the management of the Journal, advertisements, &c., should be sent to Mr H. M. Gore, addressed, Secretary, General Post Office, Box 156.

THE Chief Health Officer desires to draw attention to the careless way in which some medical practitioners forward sputum for microscopical examination to the Laboratory, Public Health Department, and suggests that such material should be sent in strong glass-stoppered bottles. This would obviate any danger of contamination, and do away with the risk incurred by the Bacteriologist's assistant when opening pill-boxes, ointment-tins, &c. containing tubercular and other dangerous matter.



Firearms and domestic safety

This paper notes that many Americans believe that gun ownership is necessary to protect their family and themselves. The concept is enshrined in the Second Amendment of the US Constitution. Stephen Lippmann and his co-authors who are based in Louisville, Kentucky review the evidence and reach the conclusion that domestic firearm ownership results in more deaths to the owner and/or family members than to intruders.

They produce frightening evidence to support their view. For example, intimate partner homicide is increased fivefold in gun owner households and the female suicide rate is increased threefold. And approximately 15 children or adolescents die from firearm-related causes every day in the United States.

Southern Medical Journal 2010;103:151-3.

Is coronary artery calcium assessment useful in the evaluation of chest pain?

Chest pain is a common cause for presentation at the emergency department. Its evaluation is often difficult as there may be no abnormal physical findings, a normal ECG and the initial cardiac injury markers may not be raised. Cardiac stress testing is not infallible. In this context the authors of this paper point out that coronary artery calcium (CAC) correlates directly with coronary atherosclerosis and is a marker of plaque burden. And quantification of CAC with cardiac computed tomography (CT) is sensitive, accurate and reproducible.

The study involved 263 men and women presenting with chest pain and low to moderate probability of coronary artery disease. 133 (51%) demonstrated no CAC and only one of these was later shown to have a cardiac cause for their chest pain. On the other hand 30/31 (97%) of those shown to have active coronary artery disease had evidence of CAC on CT. At 5-year follow-up none of the 132 subjects with no CAC had developed coronary artery disease problems.

Mayo Clin Proc.2010;85(4):314-22.

More about the concurrent use of clopidogrel and proton-pump inhibitors

Clopidogrel is recommended for patients with significant coronary artery disease. Because of the haemorrhagic risks involved proton-pump inhibitors (PPIs) are commonly prescribed with clopidogrel to reduce the risk for serious gastroduodenal bleeding. The biotransformation of clopidogrel to its active metabolite requires the hepatic cytochrome P450 2C19 isoenzyme and this may be adversely affected by the concomitant use of PPIs.

This study aims to throw light on the issue by evaluating outcomes in 20569 patients (including 7593 concurrent users of clopidogrel and PPIs) hospitalised for myocardial infarction, coronary artery revascularisation, or unstable angina pectoris. Gastroduodenal bleeding requiring admission to hospital was 50% lower in those taking PPIs, and there was no clear cut increased risk for serious cardiovascular events in those taking PPIs.

Ann Intern Med 2010;152:337-45.

Is percutaneous coronary intervention better than medical treatment in relieving angina?

The authors of this meta-analysis state that percutaneous coronary intervention (PCI) has been compared with medical treatment by other reviewers and found to be not superior in terms of death, myocardial infarction and repeated coronary revascularization. Their review focuses on the relief of angina. They pooled data from 14 trials involving 7818 patients and found that PCI was superior and was associated with an overall benefit on angina relief (odds ratio 1.69). However, they note an attenuation of this benefit in the more recent trials. They attribute this to better use of evidence-based medical treatments in the latter trials.

Ann Intern Med 2010;152:370-9.

Can nateglinide or valsartan prevent patients with impaired glucose tolerance developing diabetes mellitus?

Nateglinide is a short-acting insulin secretagogue and there are theoretical reasons to expect that it might prevent or delay diabetes development in such patients. In this English study over 9000 such patients were randomised to this drug or placebo, together with lifestyle modifications over a 5-year period. Sadly there was no reduction in incidence of diabetes or cardiovascular complications.

The second study, from North Carolina tested the same hypothesis with valsartan, which is a renin-angiotensin system blocker, over a 5-year period. There was a reduction of 14% in the incidence of diabetes but no reduction in the rate of cardiovascular events.

An editorial review points out that both reports were components of a single study—the Nateglinide and Valsartan in Impaired Glucose Tolerance Outcomes Research (NAVIGATOR) Study. Also in each study some of the placebo arm patients were taking the alternative medication. The reviewer recommends that neither drug should be used in such patients.

N Eng J Med 2010;362:1463-76, 1477-90 & 1533-5.



Backlash follows chiropractors' attempts to suppress scientific debate

The recent failure of the British Chiropractic Association's attempt to sue the science writer Simon Singh for defamation¹ has resulted in a number of important developments in terms of academic free speech and, almost certainly, the standing of the chiropractic profession.

This failed legal action followed similar actions in New Zealand whereby the *New Zealand Medical Journal* faced legal threats after publishing a paper about chiropractors² and a formal complaint was made to the Broadcasting Standards Association after comments made on television by one of the authors of this letter.³

The Singh case has resulted in widespread support from UK politicians for major reforms of their libel laws, which are widely regarded as being “*out of kilter with the rest of the democratic world, encouraging 'libel tourism' and the erosion of free speech in other countries*”.⁴

Somewhat ironically, the BCA's case against Singh appears to have triggered a backlash against the chiropractic profession's attempt to suppress scientific debate, resulting in their practices and claims being scrutinized by academics, health professionals, journalists and, not least, bloggers. The overwhelming consensus appears to be that there is a dearth of evidence to support many of the claims made by chiropractors, which are mostly based upon a highly dubious anti-science rationale.

We conducted an informal analysis of current material that is critical about chiropractic practices and noted criticism based upon the following themes:

1. Stifling free speech
2. Unsupported claims that they can treat non-musculoskeletal diseases such as asthma, ear infections, colic etc
3. Treating children
4. Dangerous advice and quackery, such as advice not to vaccinate children
5. Use of the title "Doctor"
6. Concerns there is a causal link between neck manipulation and stroke
7. Biological implausibility of treating non-musculoskeletal disease by manipulating the spine
8. Overuse of X-rays

An evidence-based approach to medicine means that chiropractors, doctors and any other practitioners who offer to treat patients should have their claims and practices questioned to make sure that they are safe and effective.

Until recently, many have feared to raise questions about alternative practitioners for fear of litigation. However, the recent Singh case means that concerns such as those outlined above may be debated with far less fear of legal action.

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Response to former HDC's editorial "Lessons from complaints"

In the editorial *Lessons from complaints: implications for medical education*, published in the 14 May 2010 issue of the *NZMJ*, Professor Ron Paterson (<http://www.nzmj.com/journal/123-1314/4110/content.pdf>) looks back over his 10 years as Health and Disability Commissioner and how what he has learned can inform the education of future doctors.

While Professor Paterson has many interesting and invaluable insights to share, we would like to respond to some of the comments he makes about the medical profession and the role of the Medical Protection Society (MPS).

We whole heartedly endorse Professor Paterson's observations that for the doctor-patient relationship to be successful, the doctor should have good communication skills, courtesy, kindness and empathy, as well as the importance of doctors working as members of a clinical team and in partnership with the wider community and the individual patient.

In recent years the medical profession and institutions such as the professional Colleges, have recognised the need to ensure doctors have these qualities and skills, and activities such as peer review, audit and systemic analysis of critical incidents have become the norm. To compliment and support this, MPS delivers workshops for doctors, which focus on further developing communication skills and reflective practice to improve patient care and reduce risk. Several hundred doctors each year participate in these workshops—a reflection of MPS' commitment to supporting members with higher development of these critical skills.

Unfortunately, despite these efforts, Professor Paterson found that some doctors he investigated tended to see fault in others rather than themselves, were poor at self-reflection and resisted constructive criticism from colleagues. He notes that such doctors sometimes took an offensive stance towards his office and believed that such a stance was encouraged by MPS. Naturally, MPS is concerned by this perception and we have raised this with Professor Paterson and will seek further clarification and specific examples to support his statement.

Findings made by the HDC can have a devastating impact on a doctor's professional and personal life. MPS is acutely aware of the stress that an investigation by the HDC puts doctors under and how this can influence the doctor's ability to deliver optimal care to patients.¹ Members rightly expect that they will be supported by MPS through an investigation, ensuring that the process is fair, and that the doctor is assisted to clearly, quickly and effectively respond to a complaint at such a time of increased stress. It is important that the doctor concerned is able to question the Commissioner's interpretation and decision, especially as they cannot appeal it formally. It is in everyone's interest that the process is fair and effective and commands the confidence of the profession and the public—key to this is doctors receiving constructive and

well founded feedback from all involved in the development and regulation of the medical profession.

Dr Denys Court
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Reference:

1. Cunningham W. The immediate and long-term impact on New Zealand doctors who receive patient complaints. N Z Med J 2004;117(1198). <http://www.nzmj.com/journal/117-1198/972/content.pdf>



Response to "In search of professionalism" article

The article by Wearn and colleagues in the 14 May 2010 issue of the *NZMJ* entitled *In search of professionalism; implications for medical education* (<http://www.nzmj.com/journal/123-1314/4116/content.pdf>) is timely and I strongly support the proposal that there be an extension of teaching of professionalism into clinical years and beyond. Obviously, medical teaching has to involve a combination of classroom and clinical settings but I would question the inference in the paper that only university employees are equipped to teach and coach attitudes in clinical practice.

A large proportion of postgraduate students come from a mix of cultures and are not local graduates, nor are many new hospital consultants, so certainly there is a place for ensuring that there is a continuum in the education of professionalism and to include all senior medical officers. For me, the value of professionalism is that it leads to better outcomes for patients. The Royal Australian and New Zealand College of Obstetricians and Gynaecologists has a module about ethics that is done after the Membership and, sadly, the Council has recently decided to make it an option rather than compulsory. I would like it to be an essential component of all training and, amongst other things, we need to recognise that words such as altruism and societal responsibility conflict with the attitude of many young people today.

It was good to see mention of the word "mindfulness" although it would be a shame if it moves into the realms of self-absorption and hedonism. As well as awareness of one's own mental processes, I think mindfulness encompasses listening more attentively, being flexible, recognising bias in our judgements, being curious and humble, to enable us to act with principles and compassion.

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High support for a tobacco endgame by Pacific peoples who smoke: national survey data

The attitudes of smokers to tobacco control interventions is highly topical in New Zealand given the current inquiry by the Māori Affairs Select Committee into tobacco issues.¹ Presenters to this Committee have raised the need for a tobacco endgame strategy (e.g.²), and this idea has currency among Māori leadership,³ non-governmental organisations,⁴ and amongst other researchers.^{5 6}

In the 2006 Census 30.3% of adult Pacific peoples in New Zealand reported being smokers, compared to 19.4% of the European population.⁷ Tobacco use is a substantial burden on the health of Pacific peoples⁸ and is likely to be contributing significantly to the health inequalities between Pacific peoples and other New Zealanders (e.g. see the emerging differences in lung cancer mortality rates⁹). Harm to health and expenditure on tobacco is also likely to be holding back the social and economic development of Pacific communities.

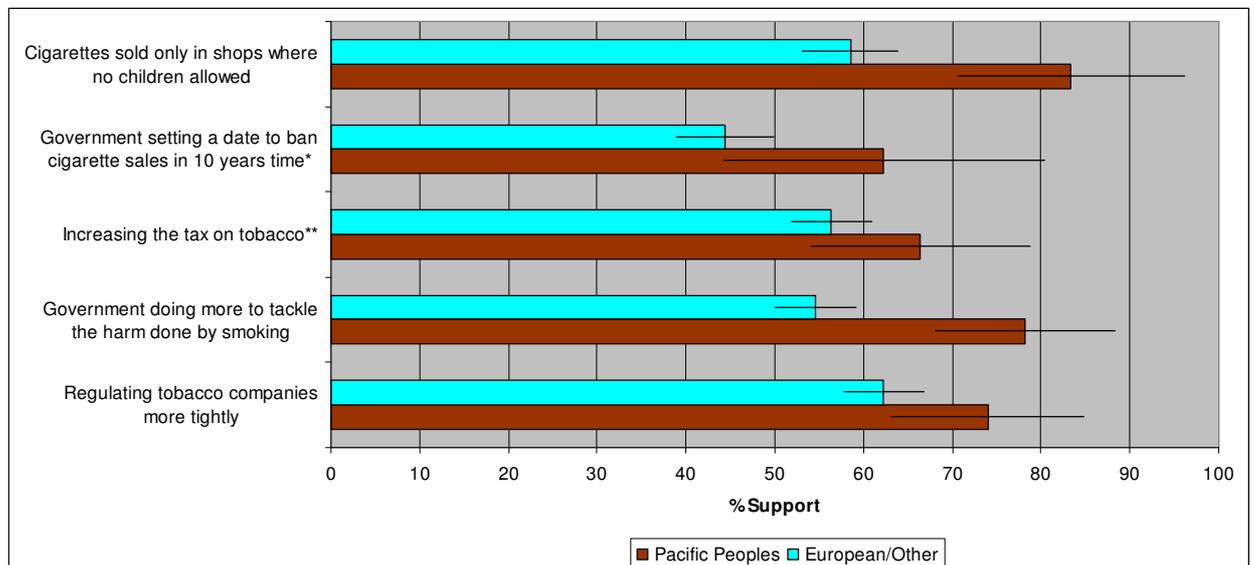
Pacific peoples support improved tobacco control, and in a 2008 national survey (smokers and non-smokers) there was much stronger support than average for tobacco regulation.¹⁰ This high level of support contrasts somewhat to that of Pacific policymakers—at least for extending smokefree regulations.¹¹ Here we describe the results of another national survey that considered attitudes of Pacific smokers to a range of tobacco control policy options.

Methods—The New Zealand arm of the International Tobacco Control Policy Evaluation Project (ITC Project) uses as its sampling frame the New Zealand Health Survey (a representative national sample with boosted sampling of Pacific peoples). From this sample we surveyed adult smokers (n=1376) including 90 Pacific peoples respondents in Wave 1 (Wave 2 included 49 Pacific peoples). Further details of the methods (including response rates, attrition and weighting processes) are available in online reports (available at:

In the analysis presented here we exclude Māori from the comparison group of “European/Other” but this group did include Asian New Zealanders. All results are for Wave one of the survey (unless otherwise stated) and were weighted and adjusted for the complex sample design to represent the national population of all Pacific peoples (and non-Pacific) smokers in New Zealand.

Results—There was strong majority support for five key tobacco control interventions among Pacific smokers (see Figure 1). Support was statistically significantly greater than among the European/Other ethnic group smokers for: greater government action on tobacco (p=0.001), and controls on where tobacco could be sold (i.e., only in shops where children were not allowed [p=0.009]). The majority support for more regulation of tobacco companies, support for a ban on cigarette sales in 10 years and support for higher tobacco tax (if the revenue is used for quitting support), was also stronger than among the European/Other population, but not statistically significantly so.

Figure 1. Support for key tobacco control interventions by Pacific peoples and European/Other smokers in New Zealand



Notes:

* If effective nicotine substitutes that are not smoked became available (Wave 2 data).

** If all the extra money was used to promote healthy lifestyles including helping smokers wanting to quit. But these differences by ethnicity were not statistically significant in a multivariate analysis (i.e., non-significant in two out of three models¹²).

Bars indicate 95% confidence intervals.

Majority support by Pacific smokers was also voiced for the following:

- **New product laws:** That is for laws covering: reducing the toxins in cigarette smoke (81.8%), reducing the addictiveness of cigarettes (84.0%), and for factory-made cigarettes to be fire-safe (97.8%).
- **Marketing controls:** Banning all promotion of cigarettes by tobacco companies (73.3%), complete bans on displays of cigarettes inside shops and stores (77.1%).
- **New smokefree areas:** That is only a minority agreed that smoking *should be allowed* in playgrounds (25.3%), within five metres of the entrance to public buildings (38.4%), and in cars with children inside (4.0%).

For these interventions Pacific smokers usually had higher levels of support than European/other smokers but not at statistically significant levels. In contrast to the above list, only minority support was voiced for tobacco companies being required to sell cigarettes in plain packages (47.0%) and 50.0% thought smoking *should be allowed* on lifeguard patrolled beaches.

Conclusions—This national survey found majority support among Pacific smokers for a wide range of tobacco control interventions—with these generally exceeding

that for the European/Other population of smokers and also Māori smokers (for all results in the Figure¹³). The high level of support for endgame approaches (e.g. banning tobacco sales in 10 years) and rigorous policy measures (e.g., banning sales in shops where children are present) are particularly striking, given the lack of media coverage or public debate about these measures at the time of data collection. The Māori Affairs Select Committee and other New Zealand policymakers should take into account this high level of support when proposing new tobacco control measures, especially those aiming to control the tobacco epidemic with a well defined endgame strategy.

Competing interests: Although we do not consider it a competing interest, for the sake of full transparency we note that some of the authors have undertaken work for health sector agencies working in tobacco control.

Disclaimer: Dr Api Talemaitoga is an employee of the New Zealand Ministry of Health. The opinions expressed in this letter are the authors' own, and do not necessarily reflect Ministry of Health policy.

Acknowledgements: The ITC Project New Zealand team thank: the interviewees who kindly contributed their time; the Health Research Council of New Zealand which has provided the core funding for this Project; and our other project partners (see: <http://www.wnmeds.ac.nz/itcproject.html>).

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Jessie Christine Anderson

October 1945 – November 2009

This tribute to Jessie was written by her twin sister, Margaret, and shares personal as well as professional highlights of Jessie's life.



Jessie was born the middle child in a family of five. She was the elder of twins, being born 10 minutes ahead of me.

Our parents were Jessie Henson, of Hawera, and John Anderson, from the west highlands of Scotland.

On Mum's side we are descended from the Southern Iwi of Kai Tahu, Kati Mamoe and Waitaha, as well as Scots and English settlers. On our first day at school, Jessie, who was left-handed, was smacked across the knuckles by the teacher. I hit the teacher and we ran away and went home

I was angry that the teacher had hit "my Jessie" but she was indignant that we had been to school and had not learnt anything, and so we refused to go back.

As children growing up in Dunedin, Jessie and I were cheeky kids. One neighbour said to us "for two pins I will tell your mother", to which Jessie, perched on the gate, replied, "well, I'm not giving you any pins so you can go away". That neighbour's son was later to be one of Jessie's PhD research colleagues.

By the time we were at High School in Nelson, Jessie's academic ability was obvious, even though we had to do some senior science classes by correspondence. We went back to Dunedin to attend Otago University, where Jessie flew into Medical School with good grades all round, while I was invited to repeat Physics 101 with a seat reserved for me in the front row. This difference came to be known as the Ant (Jessie) and the Grasshopper (me).

Jessie graduated MBChB from Otago University in 1969, then went as a House Surgeon to Taranaki Base Hospital in New Plymouth for 2 years. After returning to Dunedin, she worked as a Medical Registrar in Hypertension (1972), and then as a Registrar in Anaesthetics (1973-74). Following this, Jessie worked as a Registrar/Medical Officer at A&E in Dunedin Hospital from 1975 to 1977. Some of this work was part-time and Jessie went back to studies, completing a BA in Philosophy at Otago University in 1976.

From 1977 onwards Jessie did her training in Psychiatry, specialising in Child and Adolescent Psychiatry, achieving membership of the Royal Australian and New Zealand College of Psychiatrists in 1982 and Fellowship of the College in 1984.

From late 1982 to late 1985 Jessie was awarded a Medical Research Council Fellowship and carried out a research project on the epidemiology of childhood

psychiatric disorders at the Dunedin Multidisciplinary Health and Development Research Unit.

She was awarded a PhD from Otago University in 1989 for this research. One of her supervisors for the PhD, Professor John Werry, says that Jessie broke new ground in this research by personally carrying out a comprehensive psychiatric assessment on all of the more than 800 children in the study, rather than having others conduct interviews or use a questionnaire.

He describes her PhD dissertation as "a classic". The research project was widely recognised internationally and Jessie wrote many academic papers and contributed chapters to major textbooks based on this work. Many of her later students and Registrars were somewhat in awe of Jessie before they even met her, based on this research.

Jessie then moved back to clinical work, first in Dunedin in a joint clinical/academic appointment (1985–1994) where she did general teaching of Behavioural Science to undergraduate medical students as well as teaching and supervision of Post Graduate Trainees in Psychiatry. During this time Jessie also served on the Dunedin Child Protection Team and on the Otago Area Health Board Ethics Committee.

From May to November 1992, Jessie was Visiting Professor in Child Psychiatry at McMaster University in Hamilton, Ontario, Canada. She participated in ongoing research projects and was involved in the design of a new study of Child Abuse amongst Native American children in Ontario.

From 1995 to 2004 Jessie was Consultant Child Psychiatrist at Capital and Coast Health, Wellington, where she was clinically responsible for the Porirua and Kapiti areas and for the Kaupapa Māori Team, based at Te Whare Marie in Porirua. During this time she also travelled on a regular basis to Greymouth to provide clinical services for the West Coast. She was also active on the Māori Expert Panel for the Mental Health Commission, a Board Member for Te Rau Matatini (Māori workforce development) and on the Board of the Werry Centre at Auckland University.

Jessie moved to Blenheim in 2004 and continued her clinical consultancy until she retired with ill health in 2008.

Jessie was seen by her peers as a warm and caring clinician who was passionate in her advocacy for children, but with a bit of a reputation for not suffering fools gladly, and expecting the highest standards of clinical work from her trainees.

Her interests included skiing, tramping, gardening and lately art, especially watercolour painting. Another passion was travel and I finally got Jessie to take longer holidays and sing in the sun for a while in places like China, Mongolia, Greece, Alaska and Iceland.

Jessie passed away peacefully in her sleep on 21 November 2009 after a return of breast cancer. She is survived by a brother, Atholl Anderson, and three sisters: Jane Muru, Mary Butler and Margaret Anderson

Margaret Anderson (Jessie's twin sister) wrote this obituary.

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31st World Medical & Health Games: Poreč, Croatia 3–10 July 2010

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Erratum

Ushtana Antia, Malcolm D Tingle, Bruce R Russell. *'Party pill' drugs—BZP and TFMPP*. 11 Dec 2009 Vol 122 No 1307; <http://www.nzma.org.nz/journal/122-1307/3906> and <http://www.nzma.org.nz/journal/122-1307/3906/content.pdf>

Ushtana Antia (previously the only author listed on this article) advises that there should have been two other authors listed as well (Malcolm D Tingle and Bruce R Russell). Therefore these authors have been added to the manuscript.

Please refer to the links above to view the corrected article.