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## **This Issue in the Journal**

### **Lack of effect of seasonal trivalent influenza vaccine against influenza A(H3N2) infections in hospitalised patients in winter 2012**

Jeremy Buchanan, Catherine Buckley, Lance C Jennings, Lutz Beckert

This study sought to assess the effectiveness of the 2012 trivalent inactivated influenza vaccine in preventing admission with confirmed influenza A(H3N2) infection and whether vaccination status influenced the duration or outcome. We contacted 100 patients via telephone and asked whether they had received the seasonal influenza vaccine prior to their hospital admission. We collected information such as age, gender, documented comorbidities (other/associated illnesses), smoking status, ICU admission, length of stay, and final outcome of admission and compared these between the vaccinated and non-vaccinated groups. 67 of 92 contactable participants reported having been vaccinated with the 2012 seasonal influenza vaccine prior to their admission. This audit shows that the 2012 seasonal influenza vaccine did not provide significant protection against the H3N2 influenza strain in Canterbury. Vaccination did not alter the clinical course or final outcome in patients infected with H3N2 influenza.

### **Evaluation of the Canterbury under-18 seasonal influenza vaccination programme**

Kristi Calder, Susan Bidwell, Cheryl Brunton, Ramon Pink

We aimed to evaluate the performance of the 2013 Canterbury under-18 Seasonal Influenza Vaccination Programme (Christchurch, New Zealand). Overall uptake of influenza vaccination in 2013 was 32.9%, (compared to 18.5% in 2012), close to the target of 40%. Overall uptake in primary care was higher than in the school-based programme (29.2% versus 19.7%). Māori students had higher uptake than NZ European students in the school-based programme. In primary care, uptake for both Māori and Pacific children was lower than overall uptake, with 30.2% uptake in the least deprived quintile (richer areas) compared to 21.9% uptake in the most deprived quintile (poorer areas). The interviews with schools highlight the need to improve partnership and communication between the health and education sectors.

### **New Zealanders' self-reported uptake and attitudes towards the influenza vaccine in 2012**

Hayley Guiney, Darren Walton

This study assessed uptake of the influenza vaccine in 2012 and identified the main reasons why some did not get the vaccine. Two-thirds of New Zealanders aged 15 years and over said they did not receive the influenza vaccine in 2012. Younger adults and those who thought they were not eligible to get the vaccine for free were least likely to have received it. The most common reason for not receiving the vaccine was

a low perceived susceptibility to influenza. Other relatively common reasons were related to dislike or distrust of the vaccine. Data were from a national health and lifestyles survey, which is conducted biennially by the Health Promotion Agency.

### **Coroners' recommendations about healthcare-related deaths as a potential tool for improving patient safety and quality of care**

Jennifer Moore

A Law Foundation-funded study of 607 coronial inquiries during five years from July 2007 to June 2012 was published in the New Zealand Medical Journal today. The main finding of the research, which also included 123 interviews with coroners, and public and private organisations sent coroners' recommendations, was that the preventive and patient safety potential of coroners' recommendations is not being maximised due to serious systemic issues and under-resourcing. The study identified poor information sharing systems, an under-resourced coronial system, a lack of training for Coroners to make health and safety assessments, a shortage of available expertise, insufficient targeting of important coronial recommendations – some went to no-one in particular – and that some coroners felt their recommendations were not considered. This was noticeable in the high number of repeated and identical recommendations, particularly in drowning and sudden infant deaths.

### **The impact of major earthquakes on the psychological functioning of medical students: a Christchurch, New Zealand study**

Frances A Carter, Caroline J Bell, Anthony N Ali, Janice McKenzie, Timothy J Wilkinson

No previous studies have systematically assessed the psychological functioning of medical students following a major disaster. We aimed to describe the psychological functioning of medical students following the earthquakes in Canterbury, New Zealand, and identify predictors of adverse psychological functioning. 7 months following the most severe earthquake, medical students completed the Depression, Anxiety and Stress Scale (DASS), the Post-Traumatic Stress Disorder Checklist, the Eysenck Personality Questionnaire, the Connor Davidson Resilience Scale, the Work and Adjustment Scale, and Likert scales assessing psychological functioning at worst and currently. The results showed that around 10% of medical students experienced moderate–extreme psychological difficulties 7 months following the most severe earthquake on 22 February 2011.

### **Can a paediatric department provide health care for vulnerable adolescents?**

Genevieve Rayner, Kendall Crossen

Adolescents face significant health problems especially in relation to mental health and participating in risky behaviours such as substance use and unprotected sexual intercourse. Adolescents usually seek health care from their general practitioners and/or school-based clinics. There are multiple barriers to accessing health care and many primary providers report difficulties in providing care tailored to adolescents. A

clinic designed for young people who are perceived as vulnerable was established at Tauranga Hospital. A review of this service was undertaken, which has shown that the goal of providing a youth focused service for vulnerable teenagers has been achieved. This review has demonstrated good uptake of this service by both Maori adolescents and young people from lower socioeconomic backgrounds, but that there was low utilisation by males. This review has identified that recording potentially sensitive information was difficult, highlighting challenging issues relating to electronic documentation and confidentiality.

### ***In vitro* comparison of four rapid antigen tests for group A streptococcus detection**

Arlo Upton, Cathy Lowe, Joanna Stewart, Susan Taylor, Diana Lennon

The performance of rapid tests for detection of group A streptococcus (bacteria that can cause sore throat) in throat swabs is dependent on the bacterial load in the swab. Performance amongst kits tested varied. Rapid tests are not easy to read when they are only just positive.

### **The current state of ototoxicity monitoring in New Zealand**

Lotte Steffens, Kinau Venter, Greg A O'Beirne, Rebecca Kelly-Campbell, David Gibbs, Philip Bird

Ototoxicity is damage to hearing resulting from therapeutic pharmaceutical agents, including some chemotherapy drugs. By conducting telephone interviews, we explored clinicians' knowledge and attitudes regarding monitoring of hearing during such medical treatments and how monitoring is currently being conducted in NZ, including how this could be improved upon. Oncologists and audiologists showed comprehensive understanding of the issues, however the way in which monitoring of hearing is conducted is varied across DHBs, and there is currently no national guideline in place. The majority of participants were in favour of implementation of a national protocol to guide monitoring, and this may improve patients' hearing outcomes.

### **Are hearing losses among young Māori different to those found in the young NZ European population?**

Janet E Digby, Suzanne C Purdy, Andrea S Kelly, David Welch, Peter R Thorne

There are differences in the types of permanent hearing losses found among young Māori when compared with their NZ European counterparts. Young Maori are more likely to have a permanent hearing loss (which is categorised as being mild or greater in terms of its severity) compared with young NZ Europeans. They are less likely to have a severe or profound hearing loss and more likely to have a hearing loss which affects both ears than their NZ European counterparts.

## **Influenza: optimising control strategies for New Zealand**

Lance C Jennings

Influenza has been recognised for many years as significant disease affecting New Zealanders. Although it has been given a high profile and extensive control strategies are in place, little has been published, especially on our annual seasonal influenza vaccination programme.

In this issue of the *New Zealand Medical Journal*, the results of three influenza vaccine-focused studies are reported. In the first study, Buchanan and colleagues report the results of a retrospective audit of vaccine-effectiveness among hospitalised patients during the 2012 influenza season.<sup>1</sup> This observational study highlights the difficulty in measuring influenza vaccine performance, especially in the older-aged populations.

Influenza vaccines are unique amongst licenced vaccines as they require biannual review, frequent updating with reformulation and annual administration. This is because both influenza type A and B viruses are continually undergoing genetic evolution leading to changes or “drift” in their antigenic nature.

The performance of influenza vaccines depends on the closeness of fit between the circulating seasonal influenza strains and the vaccine formulation. However because of the time lag between vaccine strain selection by the World Health Organization (WHO), vaccine manufacture and administration, antigenic “drift” often occurs, leading to a decreased vaccine performance.

The measurement of vaccine performance is also problematic because each updated trivalent vaccine is essentially a new vaccine. Randomised, placebo-controlled trials (RCTs) are accepted as providing the best estimates of vaccine performance or efficacy (VE) as vaccinated and unvaccinated groups are assigned randomly and any bias is minimised. Because of the difficulty in conducting such trials, the bulk of the vaccine performance data we have available is from observational studies where vaccine effectiveness (VE) estimates can be variable and subject to inherent bias.

Recently, the monitoring of vaccine effectiveness using a test-negative case-control design has gained recognition as a method for the monitoring of vaccine performance on an annual basis, allowing vaccine effectiveness estimates to be made relevant to an influenza season and eliminating some of the bias of observational studies. Such studies however are limited to healthcare visit outcomes.

A number of other factors in addition to closeness of fit can influence the estimation of influenza vaccine effectiveness thus VE is usually expressed as a range: 70–90% in healthy adults.<sup>2</sup> In a meta-analysis of vaccine trials using laboratory-confirmed influenza in healthy adults 18–65 years an efficacy of 59% (95%CI 51–67) was estimated, while in older adults the efficacy was lower highlighting the influence of age or risk group on vaccine efficacy.<sup>3</sup>

In the study by Beckert et al, it is relevant that the average age of those vaccinated was 80 years, an age group subject to both humoral and cellular immunity decline termed immunosenescence.

Poor performance of trivalent inactivated influenza vaccines against the A(H3N2) virus was described during the Northern Hemisphere 2011/12 influenza season. In pooled European studies, data for VE against A(H3N2) gave a point estimate of 39% (95%CI wide).<sup>4</sup>

In New Zealand, a case test-negative design study during the 2012 influenza season, where A(H3N2) was the dominant of the 3 influenza viruses circulating, Turner et al have estimated a VE at 59% (95%CI 26–77) in hospitalised patients aged 45–64 years of age and 8% in those aged 65 years and older.<sup>5</sup> The observation of no apparent difference in terms of duration of hospital stay or clinical outcome between vaccinated and non-vaccinated patients in the Christchurch audit in 2012 is consistent with other published studies.

Even though a considerable variation in vaccine effectiveness has been found in the elderly, the high burden of disease means that vaccines of lower effectiveness are likely to be beneficial in reducing morbidity and mortality.<sup>3,6</sup> Optimising the use of influenza vaccines that we currently have available, ensuring health care workers and others in contact with the elderly are vaccinated and considering the risks and benefits of new vaccines with improved immunogenicity and providing cross-protection such as the high-dose vaccines for the elderly, are ways forward.

In the second study, an expanded seasonal influenza vaccination programme for Canterbury children under 18 years old is evaluated by Calder and colleagues.<sup>7</sup> This was a public health strategy initiated to reduce admissions to Christchurch hospitals which were extensively damaged during the February 2011 earthquakes. Children have a high burden of disease and are recognised as being important disseminators of influenza in the household and community, thus should be a priority group for vaccination. In a situation of social disruption, as occurred following the Christchurch earthquakes, offering influenza vaccination is a novel public health strategy, which has not previously been widely documented.

New Zealand's national immunisation programme targets children from 6 months of age with underlying risk factors for influenza, although from 2013 this has been extended to include children under 5 years with a history of hospitalisation for respiratory illness. It is recognised that younger children of 6 months to 2 years of age are the highest risk group for severe influenza and hospitalisation, while older children over 2 years of age have significantly increased out-patient attendances, antibiotic usage and absenteeism from school. For these reasons, some countries have moved to the universal vaccination of children.

The Japanese experience with the vaccination of schoolchildren is a useful reminder of both the direct and indirect benefits from such policies. From 1962 to 1987, up to 85% of all schoolchildren received an influenza vaccine which provided protection, reducing the influenza rate 3–4 times, class cancellations and absenteeism and mortality from influenza among older persons: an estimated 30,000 deaths per year were averted.<sup>8</sup>

There are a number of accepted strategies for influenza vaccine implementation and increasing vaccine coverage. Most research supports the recommendation from a general practitioner or health care professional as being the best predictor of influenza vaccine acceptance by a patient. Evidence-based practices including recall notification in primary care are pivotal. Expanded access through other settings such as pharmacies, the workplace and schools are increasingly used for influenza vaccine delivery.

Although schools may offer vaccination to teachers and sometimes school children, regional school-based influenza vaccination programmes have not been previously documented in New Zealand. In this study by Calder et al, school vaccination achieved a better equity of uptake than primary care vaccination which raises an important issue about the health seeking practises of individuals within the more deprived sectors of our community and how best to deliver influenza vaccine. The cumulative effect of this mixed model of delivery through primary care vaccination and a school-based programme along with a regional media campaign has clearly led to an improved awareness of influenza and to an increase in primary care vaccine uptake.

One-third of children under 18 years of age were vaccinated in Canterbury in 2013. This was achieved in the face of an overall national campaign where 1.25 million doses of vaccine were distributed covering ~30% of the New Zealand population,<sup>9</sup> and a 74.6% coverage of those 65 years and over achieved in Canterbury. The resources required to extend such a school-based programme nationally would be significant and to ensure sustainability an approach such as that being implemented into the United Kingdom currently with the use of a Quadrivalent Live Attenuated Influenza Vaccine (Q-LAIV) would be a consideration.<sup>11</sup>

In the third study, Guiney and Walton investigate the attitudes towards the influenza vaccine uptake in 2012.<sup>10</sup> Individual interview responses were obtained as part of a wider national Health and Lifestyles Survey which excluded children under 15 years of age.

An interesting finding was that younger adults who thought they were not eligible to get their influenza vaccine for free, were least likely to have received the vaccine. The reason for this was most likely their low perceived susceptibility to influenza.

This key finding is consistent with other studies and Independent Market Research conducted for the National Influenza Specialist Group (NISG) in New Zealand, where low perceived susceptibility to influenza among adults is also found, and responses “being fit and healthy so I don’t need the vaccine,” are common. A dislike or distrust of vaccines was also a common reason for not getting vaccinated by all age groups, which possibly relates to the comment “I had the vaccine and it gave me the flu” which is another common response in market research. Consistent national messaging is required to improve the knowledge base in New Zealand on the reasons for and the benefits of annual influenza vaccination.

The clarification of groups in our population least likely to receive a seasonal influenza vaccine identified in this study could be very useful at the primary care level, guiding general practitioners with the design of more comprehensive patient recall systems.

The three *NZMJ* papers mentioned here all address issues relating to our National influenza control strategy and immunisation programme. They contribute to the overall knowledge base increasing awareness on the seriousness of influenza.

As we enter the 2014 influenza season, experience gained from the unseasonal activity of the A(H1N1)pdm09 virus circulating in some regions of New Zealand from January, causing local outbreaks with some individuals requiring hospital admission and intensive care support, and experience from the Americas during their past Northern Hemisphere winter, should provide a warning of what is yet to come.

Our task is to optimise the tools currently available to protect the New Zealand population against influenza, while perusing new vaccines and approaches for influenza control.

**Competing interests:** Dr Jennings reports personal fees and other from F. Hoffman – La Roche, Glaxo Smith Kline, Baxter, Sanofi Pasteur, and grants from F. Hoffman – La Roche; and Chairperson of the Asia Pacific Alliance for the Control of Influenza Ltd. (APACI) a Charitable Trust registered in Hong Kong.

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## Lack of effect of seasonal trivalent influenza vaccine against influenza A(H3N2) infections in hospitalised patients in winter 2012

Jeremy Buchanan, Catherine Buckley, Lance C Jennings, Lutz Beckert

### Abstract

**Aims** This study sought to assess the effectiveness of the 2012 trivalent inactivated influenza vaccine in preventing admission with confirmed influenza A(H3N2) infection and whether vaccination status influenced the duration or outcome.

**Methods** We used the CDHB Delphic Laboratory Information System to identify 100 consecutive patients with confirmed influenza A(H3N2) infection. The patients were contacted via telephone and asked whether they had received the seasonal influenza vaccine prior to their hospital admission. We collected information such as age, gender, documented co-morbidities, smoking status, ICU admission, length of stay, and final outcome of admission and compared these between the vaccinated and non-vaccinated groups.

**Results** A total of 92 participants could be contacted and participated; 67 these reported having been vaccinated with the 2012 seasonal influenza vaccine prior to their admission. There were no significant differences in length of stay or final outcome in vaccinated and non-vaccinated patients.

**Conclusions** This audit shows that the 2012 seasonal influenza vaccine did not provide significant protection against the H3N2 influenza strain in Canterbury. Vaccination did not alter the clinical course or final outcome in patients infected with H3N2 influenza.

Influenza is an infectious respiratory disease caused by the influenza virus. Each year, approximately 10–20% of the world's population is infected with an influenza virus, resulting in economic and personal costs to both the healthcare system and wider society.<sup>1</sup>

In temperate climates such as New Zealand, seasonal epidemics are largely confined to the winter period.<sup>2</sup> Seasonal influenza epidemics have been shown to be associated with both increased morbidity and mortality.<sup>3</sup> Vaccination is considered to be the best strategy for preventing influenza infection and has been shown to be effective in preventing influenza among healthy adults and children.<sup>4,5</sup>

The influenza virus is a segmented, enveloped RNA virus. There are two distinct genera of influenza virus: A, B which are relevant to human infection. The general structure of the virus consists of a viral envelope wrapped around a central RNA containing core.

Two large glycoproteins; haemagglutinin (HA) and neuraminidase (NA), are displayed on the outer viral envelope of influenza A and B viruses.<sup>6</sup> These proteins facilitate the invasion of host cell and are used as antigens for influenza vaccines.

Influenza A and B viruses undergo antigenic change, ‘antigen drift’, the result of random RNA mutations which occur during viral replication and can lead to alteration of HA and NA protein structures. These changes give rise to new antigenic variants of virus able to evade host antibodies generated against previously circulating influenza strains. This constant change requires the regular review of influenza vaccine composition and vaccine updating.<sup>7</sup>

Each year the World Health Organization (WHO) provides recommendations on which influenza strains should comprise the annual Northern and Southern hemisphere seasonal influenza vaccines. The aim is to select vaccine strains that will match the predicted circulating influenza strains and provide good immunogenic protection against them.

The recommendation from the WHO is made approximately 9–12 months before the targeted influenza season.<sup>4</sup> Unfortunately, between vaccine strain selection and vaccine deployment significant viral antigenic drift may occur.<sup>8</sup> This allows a potential for mismatch between the circulating viral strains and the strains for which the vaccine confers optimal protection against, the result of which can mean reductions in vaccine efficacy.<sup>7</sup>

The 2012 influenza vaccine used within New Zealand contained three influenza strains: A/California/7/2009 (H1N1) pdm09-like strain A/Perth/16/2009 (H3N2)-like strain, and B/Brisbane/60/2008-like strain.<sup>9,10</sup>

The aim of this audit was to assess whether the 2012 influenza seasonal trivalent influenza vaccine was effective at preventing admission of patients with confirmed influenza A(H3N2) infection, and to determine whether their vaccination status influenced the duration or outcome of hospital admission.

## Methods

Starting from July 2012, 100 consecutive hospital inpatients with a laboratory confirmed influenza A(H3N2) infection were selected from the CDHB laboratory database. The participants were contacted via telephone and asked whether they had been vaccinated with the 2012 Southern hemisphere seasonal trivalent influenza vaccine prior to their hospital admission.

Participants were classified as vaccinated if they reported having received the influenza vaccine in the current season and had received the vaccine at least 2 weeks before the onset of their illness. Utilising the clinical data repository database, demographic information such as age, gender, documented co-morbidities, smoking status, ICU admission, and length of stay of admission were collected and compared between vaccinated and non-vaccinated participants.

Smoking status was based on whether a patient was a current smoker at the time of their admission. Pre-existing lung disease was defined as doctor diagnosed chronic lung disease; diseases included conditions such as COPD, asthma and interstitial lung disease. This audit was assessed by the Ministry of Health not to require formal ethics approval.

This audit was designed to assess the percentage of those presenting with influenza A(H3N2) that had had the annual seasonal vaccination. We had no a-priori data upon which to calculate a sample size; we choose n=100 on the basis that the 95% confidence interval on the estimated percentage would be no larger than  $\pm 10\%$ . The estimate from this study could potentially inform the sample size estimation for a larger study

## Results

A total 92 out of the 100 selected participants were eligible for inclusion and responded to our enquiry; 67 of the 92 (73%) patients found infected with H3N2

influenza reported having been vaccinated with the year's seasonal influenza vaccine prior to admission while 25 of the 92 (27%) had not received the seasonal influenza vaccine.

The average age and sex of the two groups were similar: 80 years (95%CI 78.4–82.3) in the vaccinated group, and 78 years (95%CI 74.9–81.1) in the non-vaccinated group. The male:female ratio was also similar between groups: 0.92 in the non-vaccinated group, and 1.16 in the vaccinated group.

No significant difference was found in length of stay between the vaccinated and non-vaccinated group: 5.09 days (95%CI 3.63–6.55) vaccinated, 4.72 days (95%CI 2.99–6.45) non-vaccinated. Of the 92 patients infected with influenza 40 were found to have a pre-existing respiratory condition (Table 1).

**Table 1. Demographic data of the participants who were admitted with laboratory confirmed influenza A(H3N2) in winter 2012 in the Canterbury District Health Board area of New Zealand**

Variables	Non-vaccinated	Vaccinated	Total
Number	25	67	92
Average age	78 years	80 years	80 years
Gender (M:F)	0.92	1.16	1.09
Vaccinated	0	100%	73%
Current smokers	4	8	12
Lung Disease	9	31	40
Length of Stay	4.72 days	5.09 days	4.99 days
ICU Admissions	2	3	5
Deaths	0	0	0

The presence of pre-existing lung disease (irrespective of vaccination status) did not significantly alter the length of stay: 5.10 days (95%CI 3.06–7.14) pre-existing lung disease vs. 4.90 days (95%CI 3.56–6.25) no pre-existing lung disease. Amongst patients with pre-existing lung disease, vaccination status had no significant effect on length of stay: 4.33 days (95%CI 3.35–5.32) non-vaccinated, 5.32 days (95%CI 2.70–7.95) vaccinated.

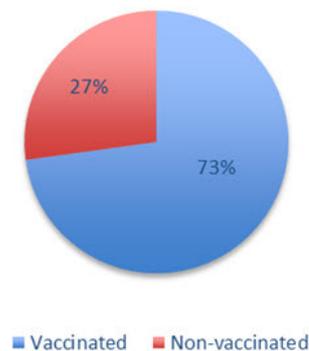
There was no significant difference in the number of ICU admissions between the vaccinated and non-vaccinated patients with only five patients in total requiring ICU admission during their hospital stay (2 from non-vaccinated group, 3 from vaccinated group). Smoking status had no significant effect on the duration of stay: 3.33 days (95%CI 1.71–4.96) smokers, 5.72 days (95%CI 4.19–7.24) non-smokers.

See Table 2 and Figures 1–3.

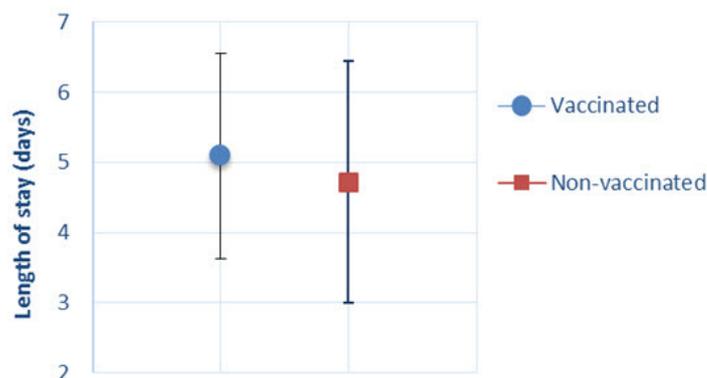
**Table 2. Comorbidities of patients admitted with confirmed influenza A(H3N2) in winter 2012**

Respiratory condition	Number
<b>COPD</b>	27
- Severe	12
- Moderate	2
- Mild	4
- No spirometry	9
<b>Asthma</b>	3
<b>Nodules</b>	2
<b>Lung cancer</b>	1
<b>Pneumonitis</b>	1
<b>Interstitial lung disease</b>	1
<b>Chronic bronchitis</b>	1
<b>OSA</b>	1
<b>Asbestosis</b>	1
<b>Childhood TB</b>	1
<b>Nitrofurantoin lung</b>	1
<b>TOTAL</b>	40

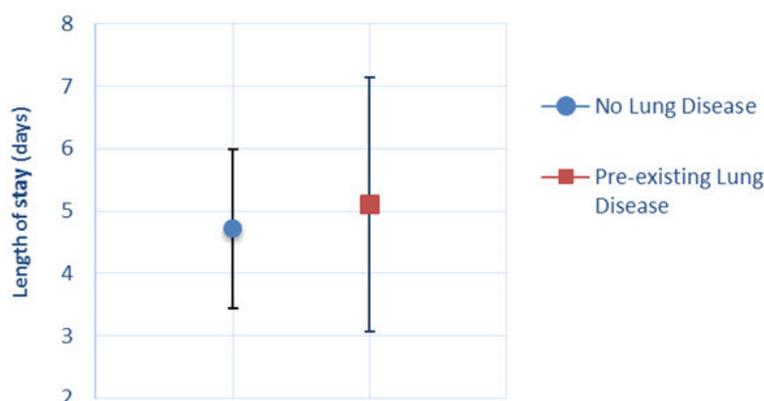
**Figure 1. Proportion of vaccinated versus non-vaccinated patients admitted with confirmed influenza A(H3N2); n=92**



**Figure 2. Average length of stay vaccinated versus non-vaccinated (all patients)**



**Figure 3. Length of stay in patients with pre-existing lung disease vs. no lung disease (all patients included irrespective of vaccination status)**



## Discussion

This audit suggests that the 2012 seasonal influenza vaccine did not reduce the length of stay of people receiving trivalent influenza vaccination and admitted with laboratory confirmed influenza A(H3N2) infection. It raises the possibility that this vaccine didn't provide significant protection against the strain of H3N2 influenza encountered in Canterbury during the 2012 influenza season particular for the older age group.

Seasonal influenza vaccination uptake rate in our sample group (73%) was consistent with PHO data which showed an uptake rate of 70% in people aged >65 years in the Canterbury region in 2012.<sup>11</sup> Patients infected with H3N2 influenza who had received the seasonal influenza vaccine prior to infection did not appear to differ from non-vaccinated patients in terms of duration of hospital stay or clinical outcome. Patients with pre-existing lung disease did not have an increased length of stay or worse clinical outcomes when compared to patients without lung disease.

It is well known that influenza vaccine efficacy can vary season-to-season, with studies suggesting an approximate mean efficacy of 70% essentially in health adults when the circulating strains match the vaccine strains.<sup>5</sup> In Canterbury in 2012, the dominant circulating H3N2 influenza strain was closely related to the A/Victoria/361/2011 (H3N2) strain and had undergone a significant degree of both genetic and antigenic change from the vaccine (H3N2) strain resulting in the probable reduced protection from the seasonal influenza vaccine.<sup>12</sup>

Interestingly, North American data looking at efficacy of the 2011-2012 vaccine also showed only modest overall efficacy, with particularly low efficacy noted against the predominant H3N2 influenza strain.<sup>13</sup> This seems consistent with our findings from Canterbury during this period.

This retrospective audit has the limitations of a small sample size and retrospective data collection; our findings cannot necessarily be applied to the whole population. We can only report on the effect on this vaccine during the May–August 2012

influenza season and not the possible cumulative protective effect on subsequent epidemics. The results are also limited by not including a control group of aged matched inpatients with respiratory non-influenza illness. There is the potential for recall bias due to patients being able to self-report vaccination status and timing of seasonal influenza vaccination. Also, the mean age of participants in this study was approximately 80 years old. In this age group there is less evidence supporting influenza vaccine effectiveness in reducing morbidity and mortality.<sup>5,6</sup>

There is the possibility that a younger group of participants may have had exhibited different outcomes than the one observed. Finally this audit may have introduced bias by focussing only on respiratory comorbidities, for which we didn't detect any difference between the two groups, however we didn't control for other variables like cardiac comorbidities. Randomised study design or large population based studies would give more confidence in the conclusion of non-efficacy of this 2012 influenza vaccine.

This study on the effect of the seasonal influenza vaccine did not find it reduce the length of stay of people with influenza vaccination admitted with confirmed influenza. It raises the possibility that this vaccine didn't provide significant protection against the H3N2 influenza strain encountered in Canterbury during the 2012 influenza season particular for the older age group. This was likely due to the antigenic mismatch between the vaccine and circulating strain of H3N2 influenza.

Although vaccine effectiveness appeared lower than optimal in this audit, vaccination still remains the most effective means of reducing influenza-associated morbidity and mortality.<sup>1</sup>

Health practitioners should continue to offer the seasonal influenza vaccine to ensure the best outcome for their patients. However they also need to be alert to influenza infection occurring despite vaccination. When seeing a patient with influenza symptoms, practitioners need to keep in mind the possibility of influenza disease, even if the patient has been vaccinated.

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## Evaluation of the Canterbury under-18 seasonal influenza vaccination programme

Kristi Calder, Susan Bidwell, Cheryl Brunton, Ramon Pink

### Abstract

**Aim** To evaluate the performance of the 2013 Canterbury under-18 seasonal influenza vaccination programme (Christchurch, New Zealand).

**Methods** Routinely collected under 18 influenza vaccination uptake data were analysed to determine levels of vaccination uptake and equity of uptake across ethnic groups (NZ European, Māori and Pacific) and by level of deprivation. Qualitative data were collected to identify strategies that helped to achieve high uptake in primary care practices and schools.

**Results** Overall uptake of influenza vaccination in 2013 was 32.9%, (compared to 18.5% in 2012), close to the target of 40%. Overall uptake in primary care was higher than in the school-based programme (29.2% versus 19.7%).

Māori students had higher uptake than NZ European students in the school-based programme. In primary care, uptake for both Māori and Pacific children was lower than overall uptake and there was a marked gradient in uptake by socioeconomic quintile, with 30.2% uptake in the least deprived quintile compared to 21.9% uptake in the most deprived quintile.

**Conclusions** The cumulative effect of 3 years' consistency in offering the under-18 influenza vaccination in primary care practices, assisted by a timely media campaign and additional awareness generated by the school-based programme, has resulted in a marked increase in uptake of the vaccine in primary care in 2013. However, this was not equitably distributed. The school-based programme achieved better equity of uptake by deprivation and ethnicity. The challenge is to achieve both high and equitable uptake.

Vaccination is the most effective method of preventing influenza in any age group. There is a large literature on effectiveness and safety of the various types of influenza vaccines including those used in New Zealand.<sup>1-3</sup> Influenza is a major cause of illness among infants and children.

School children, including adolescents, have high attack rates for influenza, ranging between 25–43%.<sup>4</sup> Compared to adults, children shed more of the influenza virus and for a longer time, so they are important primary transmitters of infection to at-risk populations, including the elderly.<sup>5,6</sup>

Universal influenza vaccination of children, rather than targeting vaccination only at children with chronic illness, is now recommended in a number of countries. For example, in the United States, influenza vaccination is recommended for all children except those aged under 6 months, and all adults.<sup>7</sup>

In New Zealand, influenza vaccination is funded for people aged 65 years and over, younger people with certain chronic health conditions, and for pregnant women. In 2013, eligibility for the funded vaccine was extended to include children aged under 5 years who had been hospitalised for respiratory illness or who, in the opinion of their general practitioner, had a history of significant respiratory illness.

Following the February 2011 Christchurch earthquakes the Canterbury District Health Board (CDHB) explored strategies to reduce admissions to its hospitals in Christchurch which had been extensively damaged by the earthquakes and had significantly reduced capacity as a result.

The evidence suggested that a targeted seasonal influenza vaccination programme for under-18 year olds could potentially reduce the number of people with seasonal influenza and this in turn would reduce the number of hospital admissions over winter in Christchurch.<sup>4,6</sup>

Since 2011, the Canterbury District Health Board has provided free influenza vaccine for all children up to the age of 18 living within the area served by the Board. Based on the evidence of the effects of childhood influenza vaccination on population incidence of influenza,<sup>4</sup> a target uptake of 40% was set for influenza vaccination of the under-18 population and a vaccination programme was planned and has been carried out in each of the last 3 years (2011–2013). As far as the authors are aware, offering a population-based influenza vaccination programme in response to post-disaster social disruption is a novel public health strategy, at least in the New Zealand context.

Due to the wide age range covered by the programme, capacity of existing services and the tight timeframe to deliver this programme, a combined targeted approach was chosen to achieve the 40% target. A mixed model of delivery was selected for seasonal influenza vaccination for under-18 year olds. This included vaccination in general practice, as primary care staff are trained and have systems in place to deliver vaccination to their enrolled population.

In 2012, school-based vaccination was also included as a targeted approach within two school clusters, selected by location, size and ability to support delivery. These schools were all located in the eastern part of the city, which was among the worst affected in the 2011 earthquakes. In 2013 it was decided to continue the mixed model of delivery. However, the school-based programme was offered through high schools across all of Christchurch, rather than primary schools as in the previous year. The rationale for offering the vaccination in high schools was based on several factors: the primary care sector in Christchurch was beginning to recover capacity following the disruption caused by the earthquakes; primary care practices have more frequent and regular contact with younger school children and already deliver National Immunisation Schedule vaccinations to this age group; secondary school aged children have less frequent contact with primary care and it was thought that offering the vaccine in high schools would boost overall coverage, particularly among older children.

## Methods

A mixed methods approach to data collection was used. Routinely collected under-18 influenza vaccination uptake data were provided by Pegasus Health, Rural Canterbury Primary Health

Organisation and the Christchurch Primary Health Organisation. These data were obtained by the PHOs from the patient management systems of their constituent practices and supplied to the evaluators without practice identifiers. The proportion of uptake in primary care was determined by the total number of children vaccinated, divided by the enrolled population in the target age group for each PHO which provided data. Uptake by ethnic group was calculated similarly. The CDHB Public Health Nursing and Vision Hearing Services provided uptake data from the school-based programme. The proportion of uptake in schools was determined by dividing the total number of children vaccinated in participating schools by the combined rolls for these schools. School roll data were obtained from the Ministry of Education. Overall vaccine uptake was calculated using age specific census data as a denominator.

Vaccination uptake data were provided in Microsoft Excel format and were analysed using SPSS (version 17.0) software to determine levels of uptake and equity of uptake across ethnic groups (NZ European, Māori and Pacific) and by level of deprivation. These data were also used to identify individual primary care practices and schools with the highest uptake of vaccination to enable selection of potential interviewees.

Qualitative data were collected through interviews and a focus group to identify strategies that helped to achieve high uptake in primary care practices and schools.

Representatives of five primary care practices and five schools were interviewed for the evaluation in 2013. The practices and schools with the highest vaccination uptake were purposely selected with consideration being given to covering a range of geographic and socioeconomic areas across Christchurch, uptake rate, and equity aspects. The selected practices and schools were asked to nominate for interview the person who had the most involvement with the vaccination programme. The primary care interviewees were all practice nurses. The school interviewees included two deputy principals, two health teachers and one administrator. A focus group was conducted involving ten PHNs.

Potential interviewees were contacted from July onwards and interviews were completed by the end of August 2013. Interviews were conducted face-to-face at the school or primary care practice. The interviews were semi-structured using open-ended questions based on areas of interest derived from the literature and the programme evaluation carried out in 2012. Interviews also explored any other issues brought up by the interviewees. The focus group was also conducted using a similar semi-structured interview schedule.

All interviews and the focus group were recorded and transcribed. The transcripts were read, re-read and coded by two members of the evaluation team who then conducted a thematic analysis.

## Results

The overall under-18 influenza vaccine uptake in 2013 was 32.9% of the eligible Canterbury population, compared with the target of 40%. This was higher than the uptake achieved in previous years (18.5% in 2012 and 21% in 2011). In 2013 there was a significant difference in uptake between models of care with higher overall uptake achieved in primary care. In 2012 there was also a significant difference in uptake between models of care with higher overall uptake achieved in the school-based programme.

A comparison of uptake by model of care is shown in Table 1. However, the schools in which the programme was delivered differed in each year. In 2012 there were 13 participating schools: nine primary schools, one intermediate and three secondary schools. In 2013 there were 31 schools participating: 25 high schools and six schools with both primary and secondary age students. In these six schools, the primary school aged students were also offered the vaccine. No primary schools were part of the school-based programme in 2013.

**Table 1. Comparison of uptake for each model of delivery 2012 and 2013**

Mode of delivery	Overall uptake 2012	P value	Overall uptake 2013	P value
Schools	29.4%		19.7%	
Primary care	16.8%	<0.001	29.2%	<0.001

In 2013, there was no statistically significant difference in uptake for Māori students and Pacific students (18.6% and 16.7% respectively) in the school-based programme compared to non-Māori and non-Pacific students (17.8% and 17.9%). However, in primary care, Māori and Pacific children (17.1% and 15.6% respectively) had a significantly lower uptake than non-Māori and non-Pacific (29.5% versus 28.6%) (Table 2).

**Table 2. Comparison of uptake by ethnicity for each model of delivery in 2012 and 2013**

Mode of delivery	Ethnic group	Overall uptake 2012	P value	Overall uptake 2013	P value
Schools*	Māori	32.9%	<0.05	18.6%	0.46
	Non-Māori	28.3%		17.8%	
	Pacific	34.2%	<0.05	16.7%	0.47
	Non-Pacific	28.8%		17.9%	
Primary care	Māori	10.9%	<0.05	17.1%	<0.001
	Non-Māori	17.5%		29.5%	
	Pacific	17.1%	0.62	15.6%	<0.001
	Non-Pacific	16.7%		28.6%	

\*Includes schools where the whole school was offered the programme (including pupils younger than secondary school age).

In 2012, Māori and Pacific students had significantly higher vaccination uptake (32.9% and 34.2% respectively) than non-Māori and non-Pacific students (28.3% and 28.8%) in the school-based programme. However, in primary care, Māori children had significantly lower uptake than non-Māori (10.9% vs 17.5%). There was no significant difference in uptake between Pacific and non-Pacific children.

**School-based delivery**—Vaccination uptake in the school-based programme was lower in 2013 than in 2012 (19.7% compared to 29.4%).

The school-based vaccination programme was predominantly delivered in high schools in 2013 compared with the school-based programme in 2012 which was delivered predominantly in primary schools.

In 2013, there was no significant difference in uptake between Māori and non-Māori students in the school-based programme whereas in 2012 there was a significantly higher uptake for Māori students, compared to non-Māori (note that the non-Māori ethnicity category includes all ethnic groups other than Māori, not just NZ European).

There was a statistically significant difference in uptake between Māori and NZ European students, with NZ European students having a lower uptake than Māori students in the school-based programme.

In the school-based programme in 2013, there was no significant difference in uptake between Pacific and non-Pacific students, while in 2012 there was a significantly higher uptake for Pacific students, compared to non-Pacific.

**Primary care-based delivery**—Overall vaccination uptake in primary care was higher in 2013 than in 2012 (29.2% of those eligible compared to 16.8%). Vaccination uptake in primary care was higher than in the school-based programme in 2013, although the reverse was true in 2012. In 2013, uptake in Māori and Pacific children was lower than overall coverage in primary care, in contrast to 2012 where Pacific uptake was higher than overall coverage (Table 3).

**Table 3. Primary care under-18 influenza vaccine uptake by ethnicity**

Influenza vaccine uptake	2012 (%)	2013 (%)
Overall uptake	16.8	29.2
Māori uptake	10.9	17.1
Pacific uptake	17.1	15.6

Vaccination uptake also varied by NZDep 2006 quintile with a higher uptake in the least deprived quintiles, with uptake decreasing significantly with decreasing deprivation (Table 4).

**Table 4. Primary care under-18 influenza vaccine uptake by NZDep 2006 quintile**

Influenza vaccine uptake	2012 (%)	2013 (%)
Overall uptake*	16.8	29.2
Dep 1 uptake	16.4	30.2
Dep 2 uptake	16.2	29.2
Dep 3 uptake	16.4	26.6
Dep 4 uptake	16.2	24.3
Dep 5 uptake	17.1	21.9

\*Excludes patients with no deprivation data

**Primary care practices' response to the under-18 influenza vaccination programme**—As influenza vaccination of under-18 year olds appears to have become more “business as usual” for primary care in Canterbury, the key factors leading to high uptake in practices also seem to have changed. Practice staff believed that less effort is now needed to promote the vaccine to families, and the emphasis has been on team work within the practice to ensure all those who are eligible are offered the vaccine when they attend the practice.

There has also been a cumulative effect over 3 years that the vaccine has been offered, as practice staff perceived that parents are now much more aware that the vaccine is

available free of charge for children under 18 and appear to be more likely to look for the opportunity to have their children vaccinated. In contrast to 2012, practice staff mentioned the media campaign promoting the vaccination programme as having more of an impact, and they also believed that the school-based programme was responsible for increasing awareness of the influenza vaccine and its availability to all children under 18.

While the practices were very supportive of the under-18 influenza vaccination programme, it clearly still created a significant extra workload and stretched their resources. A number of practices reported deferring less urgent work or extending hours to cope with the demand.

**The school-based programme**—All secondary schools in Christchurch were notified via email in mid-January 2013 that their school was eligible to have free influenza vaccination for their students provided at school. Follow-up contacts were made by the public health nurse (PHN) who normally had responsibility for the particular school.

Only three (out of 34) schools declined to participate in the school-based vaccination programme. Two of these schools were decile 6 with ethnically mixed rolls and one decile 10 with a predominantly NZ European roll (decile ranking are based on the socioeconomic status of the school's catchment, and higher decile corresponds to lower deprivation). The primary reason given by two of them was that they saw it as the responsibility of parents, rather than the school, to have their children vaccinated.

The timing of the vaccination carried out by the PHNs was also key issue for schools. Although well aware that the vaccine is best offered early in the season, the PHN staff resources available meant that the programme was spread across several months, with the final vaccination dates not being until late June and early July. The 2012 school-based programme ran from the third week in May until the end of June. Another key practical issue was finding a suitable venue within the school for the vaccination to take place; some had to make do with a venue that was less than ideal.

Participating schools differed in the degree to which they promoted the vaccination programme; some saw their role as simply providing an opportunity if parents and students wished to take it up, whereas others took a much more active role in promoting the programme.

Overall, relationships with the PHNs were seen by schools as very positive, particularly in schools where the liaison PHN had had a previous contact there and was known to the staff.

The most significant issue for the PHNs in the 2013 programme was the lateness of the approval for the school programme to go ahead. The PHNs also highlighted timing, venue, and information as issues that were relevant to the receptiveness of schools to the programme.

## **Discussion**

Canterbury primary care practices have now had 3 years of offering the influenza vaccine free-of-charge to under-18 year olds. It seems to have become something that is now expected and factored into their planning.

The major change noted by practices in 2013 was the increased number of families that sought out the vaccination proactively. This appeared to be due to a combination of factors: awareness of the availability of the free vaccination has built up year by year; the media campaign appeared to have been better timed and more effective than in 2012; and the school-based programme appeared to have further raised awareness among parents and motivated them to bring their younger children to practices to be vaccinated as well. In conjunction with this externally generated demand, all of the practices interviewed reported taking every opportunity to vaccinate children and young people who were visiting the practice for other reasons.

While primary care practices seem now to have settled into “business as usual” for influenza vaccination of under-18 year olds, the school-based programme posed new challenges for the public health nurses.

In 2012, a school-based programme was offered to a targeted group of low decile mainly primary schools and a small number of high schools in the east of Christchurch. In 2013, the PHNs were asked instead to offer the programme in all high schools in Christchurch. As such, they were faced with implementing the programme in schools with very different cultures, organisation and demands on their timetables.

It was a major undertaking to offer the school-based influenza vaccination programme to every high school in Christchurch, and to every student in every school that decided to participate, and to do this within a short time frame with limited resources.

The factors that made for higher uptake of vaccination within schools were the timing of the vaccination day, the presence of a motivated and persistent school coordinator, the relationship between the coordinator and the PHN assigned to the school, and the “fit” between the school culture and the approach of the programme as a whole. The PHNs were unable to cover all schools in a short period of time and therefore the programme stretched into June and early July. This was seen by many parents as too late, and therefore these schools were unlikely to achieve a high uptake no matter how favourable the other relevant factors. It is unsurprising that the two high schools with the highest uptake both had their vaccination days at the beginning of Term 2.

As in the previous year, the time, effort and persistence that the school coordinator devoted to the programme was a key factor in achieving high uptake of vaccination within the school. The coordinators actively promoted the vaccination to the staff and students, had developed a good relationship with the PHN assigned to the school, and were persistent in getting the students to return their consent forms.

The selection of high uptake practices and schools was a deliberate strategy to determine factors involved in achieving high uptake, however, this may affect the generalisability of the findings of this evaluation to practices and schools with lower uptake.

In addition, because the school-based programme expanded to include more schools in 2013 and targeted a different age group than in 2012, it is not possible to draw firm conclusions about the reasons for differences in coverage by ethnic group between these years.

## Conclusions

The under-18 influenza vaccination programme in 2013 appears to have had a high level of acceptability amongst staff in both settings in which it was delivered and has achieved close to the target levels of overall uptake.

The cumulative effect of 3 years' consistency in offering the vaccination in primary care practices, assisted by a timely media campaign and additional awareness generated by the school-based programme, resulted in a marked increase in uptake of the vaccine in primary care. However, this was not equitably distributed; with higher uptake amongst the least deprived quintiles (30.2% uptake in the least disadvantaged to 21.9% uptake in the most disadvantaged of NZ Dep 2006).

Uptake by Māori and Pacific under-18 year olds in primary care was also lower than overall uptake. By contrast, and as in 2012, the school-based programme achieved better equity of uptake by deprivation and ethnicity. The challenge is to achieve both high overall uptake and equitable uptake by ethnicity and deprivation. The mixed model of delivery used in the Canterbury programme goes some way towards addressing this.

The interviews with schools highlighted the need to improve partnership and communication between the health and education sectors.

The findings of this evaluation have resulted in the CDHB making an earlier decision about the 2014 school-based programme and communicating this decision to schools during Term 4 of 2013 to enable them to incorporate the vaccination programme into their planning for the following year.

There will also be some additional PHN resources made available in 2014 so that the vaccine can be delivered in a shorter, more concentrated programme before the onset of the influenza season.

**Competing interests:** Nil.

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## New Zealanders' self-reported uptake and attitudes towards the influenza vaccine in 2012

Hayley Guiney, Darren Walton

### Abstract

**Aims** This study sought to assess New Zealanders' uptake of the influenza vaccine in 2012, identify the demographic characteristics of people least likely to take up the vaccine, and identify the main reasons why some did not get the vaccine.

**Method** We analysed responses to questions in the 2012 Health and Lifestyles Survey (HLS) about the influenza vaccine. The 2012 HLS was an in-home survey with a nationally representative sample of 2672 New Zealanders aged 15 years and over.

**Results** Two-thirds of New Zealanders said they did not receive the influenza vaccine in 2012. Younger adults and those who thought they were not eligible to get the vaccine for free were least likely to have received it. The most common reason for not receiving the vaccine was a low perceived susceptibility to influenza. Other common reasons were related to dislike or distrust of the vaccine.

**Conclusions** This study provides information that could be used by health professionals, health promoters, and government agencies to improve the targeting and effectiveness of communication messages related to the influenza vaccine. Such communications are important because they can help encourage those New Zealanders who would benefit most from receiving the vaccine to take it up.

Influenza places a considerable burden on employers and health systems, with many days of lost work<sup>1</sup> and increased demand on health services during the influenza season. For example, at the peak of the influenza season in 2012, influenza-like illnesses accounted for 154.1 consultations per 100,000 patient population;<sup>2</sup> across the year they accounted for 34.4 per 100,000 hospitalisations and 27.3 per 1000 deaths.<sup>3</sup>

In an effort to reduce this burden, the New Zealand Ministry of Health invests a significant amount of money in purchasing and promoting the influenza vaccine each year (\$18.6 million in 2011/12; Ministry of Health Immunisation Team, personal communication, 2013).

Given this significant investment, it is important to understand New Zealanders' attitudes and behaviour towards the seasonal influenza vaccine. It is further important to understand those attitudes and behaviours since, as shown by a recent study in the US, they correlate highly with attitudes towards vaccination against more serious population health threats (such as the H1N1 virus).<sup>4</sup> Therefore, understanding New Zealanders' attitudes towards the seasonal influenza vaccine could provide insight into how people are likely to respond to a call to be vaccinated during an influenza pandemic.

To examine the characteristics of New Zealanders who were least likely to take up the influenza vaccine, and to understand the reasons why some people did not get the

vaccine, the current study used data from a nationally-representative survey conducted between May and August 2012.

Previous international research has shown that perceived susceptibility to influenza,<sup>5-7</sup> perceived effectiveness of the vaccine,<sup>6,8</sup> concern about side-effects,<sup>5,9,10</sup> and prior experience (either positive or negative) with influenza vaccination<sup>6</sup> are relatively consistent correlates of influenza vaccine uptake. While such studies are typically from the US and limited to specific “high risk” populations such as elderly adults and healthcare workers, there are a number of studies indicating that similar attitudes are associated with vaccine uptake in the general adult population.<sup>11-14</sup>

This is the first New Zealand study to examine attitudes and behaviour towards the influenza vaccine at the population level.

## Method

Data are from the 2012 Health and Lifestyles Survey (HLS), the methodology of which (including the design, sample composition, data collection procedures, coding procedures, and weighting procedures) has been described elsewhere.<sup>15</sup>

In brief, a nationally representative sample of 2672 New Zealanders aged 15 years and over took part in the in-home survey, which assessed respondents’ attitudes and behaviours relating to tobacco, sun safety, healthy eating, gambling, alcohol, exercise, child immunisation, influenza vaccination, mental health, breast feeding, and cancer screening. The survey interviews were conducted between autumn and winter (May to August) 2012.

This report focuses on responses to the questions relating to the influenza vaccine. Specifically: “Will you receive the ‘flu vaccine this year?” “Are you eligible to get the flu vaccine for free?” and (for those who said they would not get the vaccine) “Why don’t you think you’ll get the flu vaccine this year?” For the final question, people could give multiple open-ended responses, which the interviewer either (i) coded at the time of the interview if the reason given had the same meaning as one of the pre-coded answers (based on likely reasons for not taking up the vaccine); or (ii) recorded verbatim for later analysis if the reason given did not have the same meaning as one of the pre-coded answers. The interviewer recorded the relevant code(s) and verbatim response(s) by typing them into a laptop computer.

## Results

**Analysis**—Following data collection, two researchers from the Health Promotion Agency analysed the open-ended responses that were recorded verbatim but not coded at the time of the interview. The researchers determined recurrent themes arising from the verbatim comments and then assigned a unique code to each of the new themes. All verbatim comments were then back-coded into the appropriate categories (determined by consensus), with those comments that were unique to a single person coded as ‘other’ (3.3% of respondents gave a reason identified as ‘other’).

The aim of this coding procedure was to represent what people said as closely as possible rather than collapsing the themes into broad categories. As a result, some of the codes (e.g., “I never get the flu” and “I’m healthy so I don’t need it”) contain similar ideas (e.g., low perceived susceptibility to influenza), but still represent somewhat different reasoning (e.g., one is that they have a lack of experience with getting the flu and the other is that they believe being a ‘healthy’ person who lives a healthy lifestyle means they will not contract the virus).

Once the coding was completed, statistical analyses were conducted using STATA IC (version 12.0) software. Responses were weighted according to the 2006 Census data

to ensure that the sample accurately represented the New Zealand population aged 15 years and over. All proportions were calculated using the delete-a-group jackknife method.<sup>16</sup> Differences between demographic groups were assessed with logistic regression.

The independent variables considered in the logistic regression analyses were age (continuous), gender (males compared with females), ethnicity (Māori compared with non-Māori; prioritised<sup>17</sup>), neighbourhood deprivation status (New Zealand Deprivation Index 8 to 10 and 4 to 7, compared with New Zealand Deprivation Index 1 to 3), perceived eligibility to get the vaccine for free (thought they were eligible compared with thought they were not eligible), and employer subsidy of the vaccine (employed respondents only: employer not paying for the vaccine or not knowing if employer paid for the vaccine, compared with employer paying for the vaccine).

The dependent variables were self-reported uptake of the vaccine and the reasons respondents gave for not receiving the vaccine.

**Self-reported vaccine uptake**—When asked if they would receive the influenza vaccine in 2012, 26.8% (95%CI 24.5–29.1) of respondents said they had already received it. A further 7.8% (95%CI 6.2–9.3) said they had not received the vaccine but intended to. Approximately two-thirds (63.7%; 95%CI 61.1–66.3) of respondents said they would not get the vaccine and a further 1.8% (95%CI 1.0–2.5) either refused the question or said “don’t know”. For the following analyses, self-reported vaccine uptake was defined as having already received the vaccine at the time of the survey; all other responses were counted as not having taken up the vaccine.

Initial bivariate logistic regression analyses indicated that people more likely to have already received the vaccine were: older (likelihood increased with age;  $t=12.44$ ,  $p<0.001$ ), non-Māori (compared to Māori; 28.0% versus 17.9%, OR=1.77, 95%CI 1.34–2.34,  $p<0.001$ ), and people who thought they were eligible to get the vaccine for free (compared to people who thought they were not eligible; 44.7% versus 12.9%, OR=5.53, 95%CI 2.78–11.00,  $p<0.001$ ). There were no differences by gender ( $p=0.318$ ), neighbourhood deprivation ( $p=0.894$ ), or employer subsidy of the vaccine (employed respondents only;  $p=0.723$ ).

Subsequent multiple logistic regression with age, ethnicity, and perceived eligibility as independent variables indicated that only age (OR=1.03, 95%CI 1.02–1.05,  $p<0.001$ ) and perceived eligibility (OR=3.57, 95%CI 2.38–5.35,  $p<0.001$ ) were significant correlates of vaccine uptake; ethnicity was no longer significant after adjusting for the other variables (OR=1.33, 95%CI 0.83, 2.13,  $p=0.228$ ).

**Reasons for not getting the vaccine**—Table 1 shows the reasons respondents gave for not getting the influenza vaccine and the percentage of respondents reporting each reason. Almost all (99.7%) respondents provided at least one reason for not getting the vaccine (including “I don’t know” responses), with the majority (83.9%) providing one reason only. The mean number of reasons given by each respondent was 1.2.

**Table 1. Percentage of respondents reporting particular reasons for not getting the influenza vaccine**

Reason	%	95% CI
I never get the flu	21.6	18.8–24.6
I'm healthy so I don't need it	18.9	16.0–21.8
I don't like the ingredients in the vaccine	11.1	8.7–13.6
I'm concerned about possible side effects	11.0	9.1–13.0
I'm skeptical about vaccines in general	9.8	7.7–11.9
I don't know	7.5	5.4–9.7
It costs too much	5.3	3.8–6.8
It's only flu, it won't kill me	5.3	3.7–7.0
I have doubts about its effectiveness	4.1	2.6–5.6
I'm afraid of needles	3.8	2.5–5.2
Other	3.3	2.1–4.6
I use natural prevention methods	3.0	1.8–4.1
It will reduce my immunity	2.5	1.4–3.6
I've never had the vaccine before	2.0	1.1–3.0
I can't be bothered	1.7	0.6–2.8
It's too hard for me to get to the doctors to get it	1.4	0.7–2.2
I missed it when it was on offer	1.2	0.4–1.9

**Note:** Responses given by fewer than 1% of respondents are not shown.

The most common reasons for not getting the vaccine were related to a low perceived susceptibility to influenza: “I never get the flu” or “I’m healthy so I don’t need it”.

Other relatively common reasons for not getting the vaccine were related to a dislike or distrust of vaccines: “I don’t like the ingredients in the vaccine”, “I’m concerned about possible side effects”, or “I’m skeptical about vaccines”. The least common reasons (given by fewer than 1% of people) for not getting the vaccine were: “I’m too young to get it”; “I forgot”; “I didn’t get around to it”; “it hurt”; “I have a health condition that means I can’t have it”; “I’m too busy”; “I’m not interested”; “I’m pregnant and concerned about its effect on my baby” (women only); “I haven’t been offered it”.

The observed pattern of responses was similar across age, gender, ethnicity, perceived eligibility, and neighbourhood deprivation status, with people from these demographic groups giving similar reasons at similar rates for not getting the influenza vaccine.

## Discussion

The purposes of this study were to assess New Zealanders’ self-reported uptake of the influenza vaccine in 2012, identify the demographic characteristics of people who were least likely to take up the vaccine, and identify the main reasons why some people did not get the vaccine.

The results indicate that around two-thirds of New Zealanders aged 15 years and over did not receive the influenza vaccine in 2012, with younger adults and people who thought they were not eligible to get the vaccine for free least likely to have received it (note that the age effect still held after adjusting for perceived eligibility). There

were no effects of ethnicity, gender, socioeconomic deprivation, or employer subsidy of the vaccine on self-reported uptake after adjusting for the relevant variables.

The most common reason people gave for not taking up the vaccine in 2012 was that they did not think it was necessary because they perceived themselves to be at low risk of contracting the virus (either because they do not typically get influenza or because they believed that being a generally “healthy” person would protect them from infection). It was also relatively common for people to say they would not get the influenza vaccine because they disliked or distrusted the vaccine (either because they disapproved of the ingredients or because they were concerned about side effects).

The reasons people gave were similar across age and other demographic groups, indicating that perceived invulnerability to influenza and dislike or distrust of the vaccine were common reasons for not taking up the vaccine among both low risk (e.g., adults aged under 65 years) and high risk populations (e.g., adults aged over 65 years).

The main reasons New Zealanders in this study gave for not taking up the influenza vaccine were relatively consistent with findings from a review of previous international research,<sup>12</sup> indicating that perceptions about the influenza vaccine are similar across different locations and populations. Further, it appears that some concerns about the vaccine (e.g., about side effects) have persisted over time, with research published in the US as early as 1979 highlighting many of the same concerns reported by non-adopters in this study.<sup>13</sup> This suggests that health professionals, promoters, and educators could more effectively communicate the risks and benefits of the vaccine to the general population.

A key strength of this study is in its provision of the types of information that have been identified as contributing to effective social marketing campaigns.<sup>18</sup> In particular, this study identifies the segments of the New Zealand population that could be targeted in an influenza vaccination campaign, the attitudes that those campaigns could seek to change, and the competition to the desired behaviour (taking up the vaccine). Based on the results presented here, messages that could be included in such campaigns are those that depict the possibility of getting influenza as a healthy person who lives a healthy lifestyle, and those that seek to increase trust in vaccines generally.

While this study provides good insight into New Zealanders’ attitudes and behaviour in relation to the influenza vaccine, it has several limitations. For example, its cross-sectional retrospective design introduced the possibility of recall bias and may have led to inaccurate reporting of vaccine uptake rates and reasons for not taking up the vaccine. It is also possible that the reasons for not taking up the influenza vaccine are more complex than can be represented in the categorical responses used in this study. However, given the similarities between these results and previous research using a range of different methodologies, it appears unlikely that the design of this study had a major impact on the key findings.

## Conclusion

This is the first New Zealand study to examine attitudes and behaviour towards the influenza vaccine in a nationally-representative sample of adults aged 15 years and over. By identifying the characteristics of people least likely to get the vaccine and the reasons why some people did not take it up, this study provides information that could be used by (i) health promoters to improve the targeting and effectiveness of influenza vaccination messages, (ii) health professionals to address their patients' likely concerns about the vaccine, and (iii) government agencies when planning responses to the threat of an influenza pandemic.

**Competing interests:** Nil.

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## Coroners' recommendations about healthcare-related deaths as a potential tool for improving patient safety and quality of care

Jennifer Moore

### Abstract

**Aims** To describe and investigate the nature, recipients and preventive potential of New Zealand coroners' recommendations from 1 July 2007–30 June 2012.

**Method** (1) A retrospective study of coroners' recommendations during the study period was undertaken. (2) Interviews with coroners, recipients of recommendations and interested parties were conducted.

**Results** There were 607 coronial inquiries that resulted in 1644 recommendations. There were 309 recipients of coroners' recommendations. Government organisations received the highest proportion of recommendations (121/309). Not for profit organisations received 67 recommendations, for profit organisations received 44 recommendations and individuals received 5 recommendations. There were 72 untargeted recommendations that did not specify an identifiable organisation. The Ministry of Health received the second-highest proportion of coroners' recommendations. Transport accidents, drowning, intentional self-harm and complications of medical or surgical care were the main underlying causes of death categories investigated by coroners. Fifty-eight of the 607 inquiries involved complications of medical or surgical care. The 123 interview participants reported that there have been improvements in coronial recommendations since the introduction of the Coroners Act 2006, but that the prophylactic and patient safety potential of recommendations is not being maximised.

**Conclusion** Coronial investigations provide external insight into the way that our health system works and recommendations can be used as a tool to learn from preventable deaths. Given that this was the first New Zealand study of coroners' recommendations since the introduction of the Act, more research is needed to corroborate these findings.

Coroners have been described as “public health officials” because of their statutory preventive functions.<sup>1</sup> One of the main goals of the New Zealand (NZ) Courts Minister's current review of the coronial system is to “help improve public safety and reduce unnecessary deaths.”<sup>2</sup> The NZ Coroners Act 2006 provides the legislative framework for the operation of the coronial jurisdiction.

The purpose of the Act is to prevent deaths and promote justice through:

- Investigations, and the identification of the causes and circumstances of sudden and unexplained deaths, or deaths in special circumstances and;
- The making of specified recommendations or comments that, if drawn to public attention, may reduce the chance of occurrence of other deaths in circumstances similar to those in which those deaths occurred.<sup>3</sup>

NZ coroners are lawyers appointed as judicial officers.<sup>4</sup> NZ's 16 coroners and the Chief Coroner investigate sudden, unnatural and violent deaths.<sup>5</sup> There are approximately 29,000 deaths in NZ per year.<sup>6</sup> About 20% of those must be reported to the coroner.<sup>7</sup>

Deaths that "must" be reported under the Coroners Act 2006 include deaths:

- Without known cause, suicide, or unnatural or violent.
- For which no doctor's certificate is given.
- During medical, surgical, or dental operation, treatment, etc.
- In official custody or care.<sup>5</sup>

Sections 13(1)(c) and 13(1)(d) include numerous subsections. For example, reportable deaths under s 13(1)(c)(iv) that occur "during medical, surgical, or dental operation, treatment etc" include "every death...that occurred while that person was affected by an anaesthetic."<sup>5</sup>

Section 63 of the Coroners Act 2006 states that coroners can decide whether to open and conduct an inquiry and, in doing so, they must have regard to several matters such as whether the death "appears to have been unnatural or violent" and "the existence and extent of any allegations, rumours, suspicions, or public concern, about the death..."

Pursuant to section 80 of the Coroners Act 2006, a coroner who decides to open an inquiry may decide to hold an inquest or undertake a chambers ("on the papers") investigation. However, if the death appears to have occurred in official custody or care (as defined in section 9) the coroner "must" hold an inquest.

Pursuant to section 14 of the Coroners Act 2006, a person who learns of a death to which section 13 applies must report that death to a member of the police as soon as practicable. "A person" in section 14 includes medical practitioners and other health professionals who are aware of section 13 reportable deaths.

Families who lose loved ones to preventable death hope that coroners' findings and recommendations will "save a life."<sup>8</sup> Complaints are voiced by coroners and families when organisations that receive coroners' recommendations do not implement them.<sup>9</sup> However, can all coroners' recommendations about healthcare contribute to patient safety initiatives? What is the nature of NZ coroners' recommendations and who are the recipients?

Coronial recommendations are "an increasingly important aspect of inquests".<sup>10</sup> Given the high public profile of coroners, it is surprising that little is known about coroners' decision making or their recommendations.<sup>11-16</sup>

Although scientific researchers often use coronial data, research about coroners, their procedures and recommendations is recent. Research in Australia and the UK has quantified the frequency of coroners' recommendations,<sup>12,14,16</sup> provided legal and forensic descriptions of death investigations,<sup>17</sup> analysis of families' experiences of inquests<sup>18</sup> and examined the implementation of recommendations about the deaths of Aboriginal people.<sup>13</sup> The difficulty of accessing full coroners' findings in NZ is a barrier to conducting research and informing patient safety initiatives.<sup>19</sup>

Patient safety and quality of care could be improved by drawing from a variety of data sources, including hospitals' internal reports, patients' complaints and coronial data. According to a South Australian study about coroners' recommendations into healthcare-related deaths, "coronial findings provide a wealth of insight into circumstances behind medical misadventure, but to date they have remained a largely untapped source of knowledge."<sup>22</sup>

Coronial data has been used to try to improve quality of care and patient safety in jurisdictions such as Australia and England.<sup>20-23</sup> There is arguably a place for inquiries by coroners where external scrutiny of health service quality is necessary.<sup>24</sup>

## Methods

**Ethics**—Ethics approval for this study was granted by the University of Otago Human Participants Research Ethics Committee in May 2012.

**Coroners' recommendations**—The study population comprised deaths reported to, and investigated by, the Coronial Services of NZ (CSNZ) for the study period, where one or more recommendations were made by coroners in their findings. The 1 July 2007 was chosen as the study period start date because that is the date that the Coroners Act 2006 came into force.

The full coronial findings were read. The text of each coronial recommendation was extracted and entered into Microsoft Excel. An example of a coroner's recommendation is:

That the Ministry of Health communications and guidelines regarding influenza-like illness, whether routine or in response to an influenza outbreak, include the caution that other illness, notably bacterial sepsis, may present with similar symptomology as influenza. In the absence of a cough, sore throat, a differential diagnosis of influenza-like illness should also include possible bacterial sepsis until proven otherwise.<sup>25</sup>

**Data analysis of coroners' recommendations**—The data in Excel was checked for errors using a custom-designed computer script. The data analysis procedure included, broadly, assessment of the:

- Number of coroners' recommendations;
- Recipients of recommendations;
- Organisations' responses to recommendations;
- Number of coroners' references to previous, similar cases.

**Interviews**—The interview schedules for coroners, organisations and interested parties were piloted on two key informants before the guiding questions and themes were finalised. With the participants' permission, interviews were audio-taped. The grounded theory strategy of theoretical sampling was used.<sup>26, 27</sup>

**Interviews with coroners**—All practising coroners (17) were emailed an introductory letter inviting them to participate in the study. Three retired coroners were also emailed a letter inviting them to participate in the research. The interviews were semi-structured, one-on-one, in-person and lasted between 50 minutes and 2½ hours. Coroners were asked questions about their formulation of recommendations, identification of recipients, consultation with stakeholders, law reform options, and the preventive potential of recommendations.

**Interviews with organisations and interested parties**—232 organisations that were sent coroners' recommendations were identified in the study period. Recruitment letters were sent to senior individuals from all these organisations.

The interviews with organisations and interested parties were semi-structured and lasted between 40 minutes to 2½ hours. Fifteen interviews were conducted on the telephone, while the remaining 75 were in-person interviews.

After learning about the research in the media or from research participants, seven interested parties contacted the researcher. One interested party was approached using snowball sampling after referrals from three other participants. The participant who was contacted by the researcher was recruited via an introductory letter and email follow up. In order to avoid reliance on the self-selection process of the interested parties, criteria for selecting participants was used.

Recipients were asked questions about the recommendations they had received, reasons for non-implementation or implementation of recommendations, preventive potential of recommendations and law reform options.

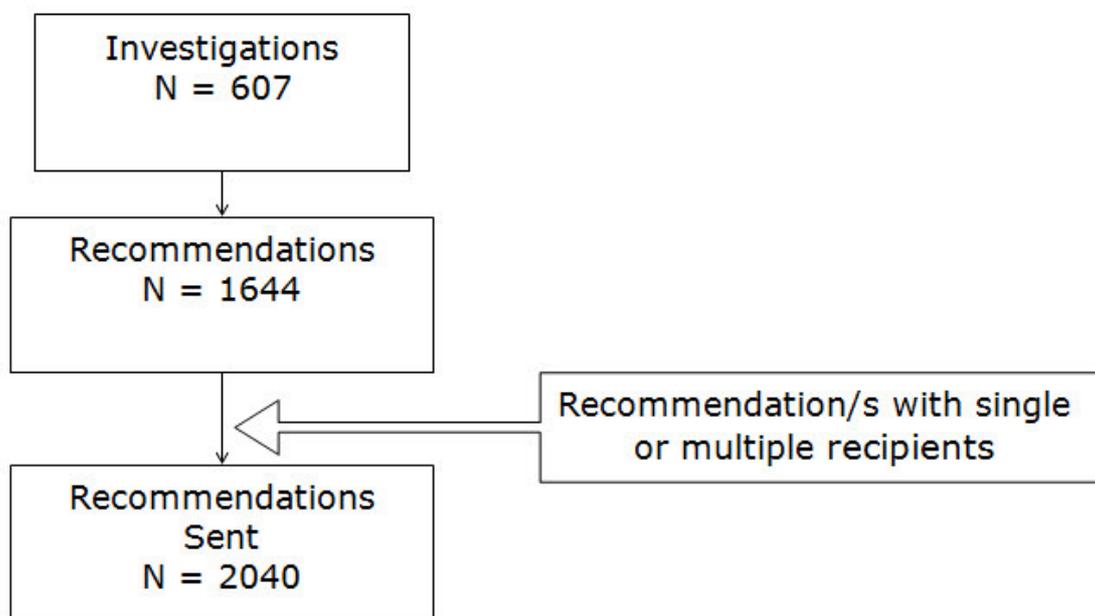
**Data analysis of interviews**—Grounded theory, thematic and narrative approaches was used to analyse this study’s interview data.<sup>27</sup> The structured data analysis process began with a line-by-line analysis of the transcribed interviews. Patterns of commonality and cases that “didn’t fit”<sup>28</sup> were noted. Axial coding was used to make connections between the categories.

## Results

Not all the findings are discussed because the focus of this article is coroners’ recommendations about healthcare-related deaths.

**Coroners’ recommendations**—During the study period, there were 607 coronial inquiries which resulted in 1644 recommendations (Figure 1). Fifty-nine percent of these inquiries were inquests (public hearings in Court) and 41% were chambers findings (“on the papers”).

**Figure 1. Summary of coronial investigations and recommendations during the study period**

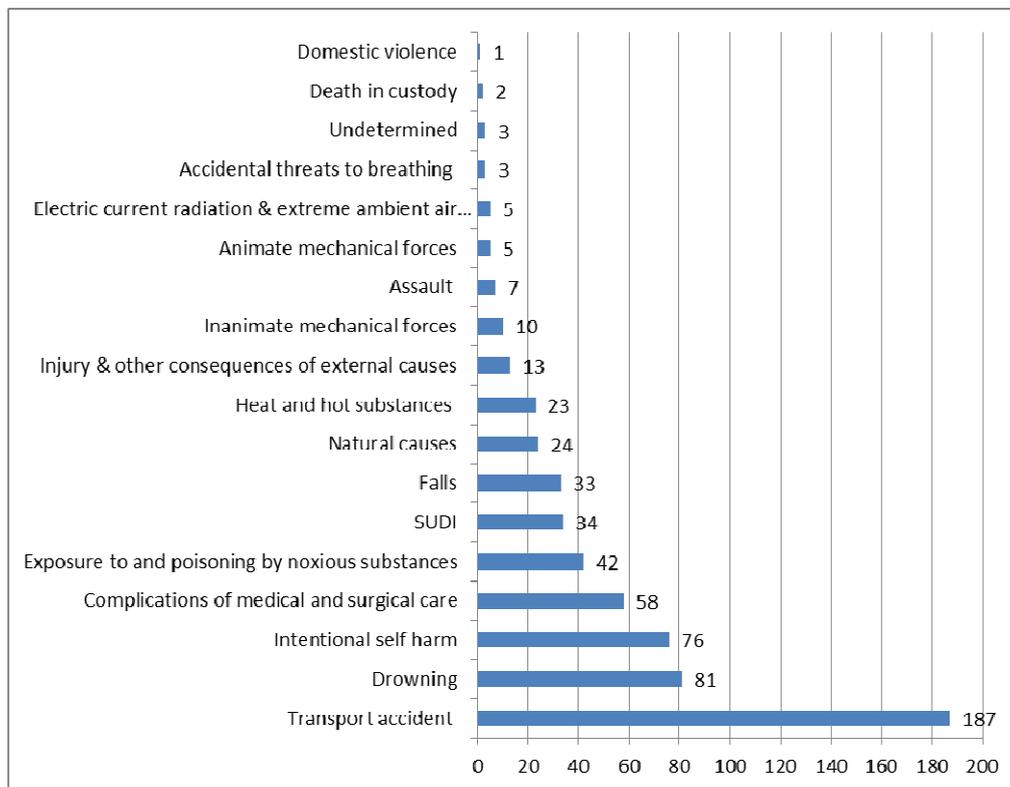


The total number of recommendations sent to recipients was 2,040 because coroners made single or multiple recommendations to one or more recipients (Figure 1).

There were four main scenarios for the analysis of recommendations directed to recipients. First, a coroner may direct a single recommendation to a single recipient such as the Royal NZ College of GPs. Second, a coroner may direct a single recommendation to multiple recipients such as the Ministry of Health, the NZ Nurses' Organisation and Plunket. Third, a coroner may issue multiple recommendations (e.g. 10) to a single recipient such as ACC. Finally, a coroner may issue multiple recommendations to multiple recipients. For example, the coroner may formulate five recommendations, two of which are directed to the Canterbury District Health Board, two are directed to the National Addiction Centre and the other one is directed to the Health Quality Safety Commission.

The underlying cause of death categories that the coroners investigated during the study period are described in Figure 2.

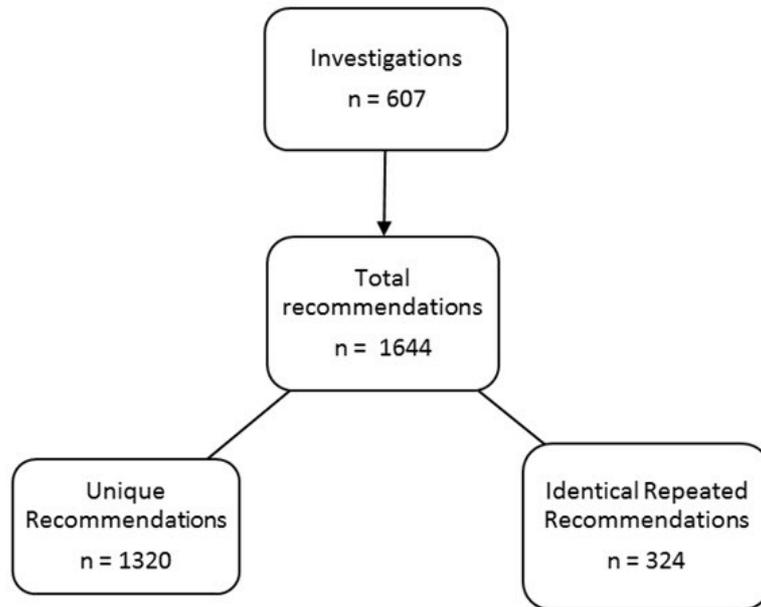
**Figure 2. Underlying causes of death categories investigated by NZ coroners, 1 July 2007–30 June 2012**



Fifty-eight of the 607 coronial inquiries concerned deaths attributed to complications of medical and/or surgical care (Figure 2).

324 of the 1644 coronial recommendations were identical repeated recommendations (Figure 3).

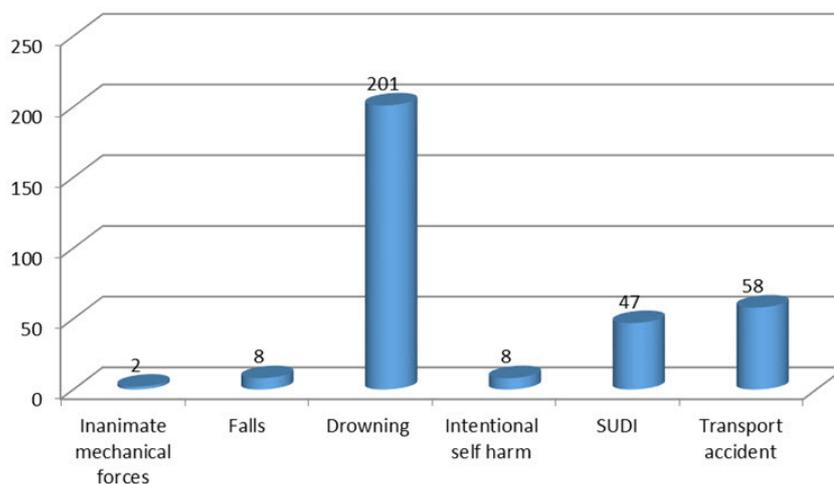
**Figure 3. Summary of coronial investigations, unique and repeated recommendations, 1 July 2007–30 June 2012**



The underlying cause of death categories that attracted the greatest number of identical repeated recommendations are described in Figure 4.

This research adapted Bugeja’s definition of ‘original or repeated recommendation’.<sup>12</sup> An ‘original recommendation’ was one that was made only once in the study period. A ‘repeated recommendation’ was one with identical wording to another recommendation in a different coronial finding.

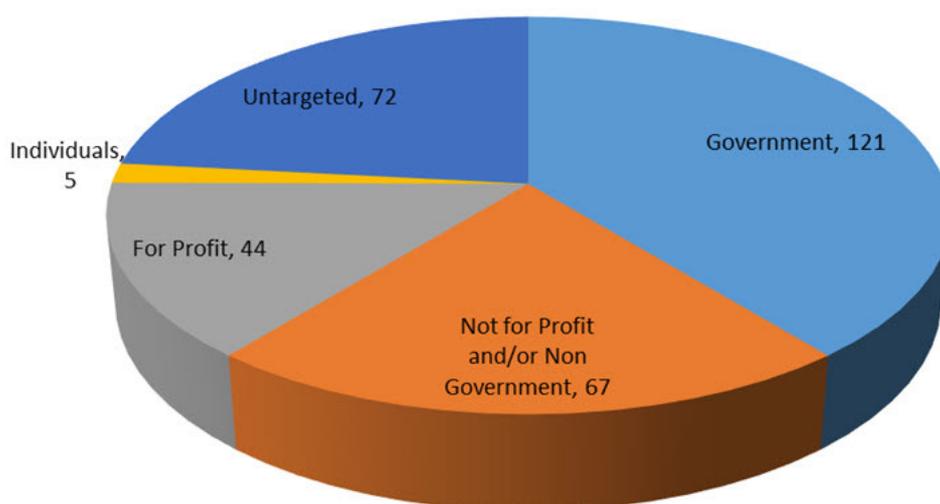
**Figure 4: Summary and number of identical repeated recommendations, 1 July 2007–30 June 2012**



Some organisations (61/79) that were interviewed for this study reported that the cumulative effect of repeated recommendations may aid the uptake of coronial recommendations. However, coroners that were interviewed reported that their repeated recommendations are “falling on deaf ears” and not being implemented.

**Recipients**—There were 309 recipients of coroners’ recommendations. The type of recipients is described in Figure 5.

**Figure 5. Summary and number of recipients of coroners’ recommendations by type, 1 July 2007–30 June 2012**



There were 232 organisations: 121 government, 67 non-government not for profit and 44 for profit. The finding that government organisations received the highest number of recommendations is consistent with other research from Victoria, Australia.<sup>12</sup>

Apart from the Attorney General, the other four individuals were health practitioners.

An ‘untargeted’ recommendation was defined as a recommendation which was not directed to an identifiable organisation. For example, a recommendation that was directed to “all whitebaiters”<sup>29</sup> or “any person reading...this decision”.<sup>30</sup>

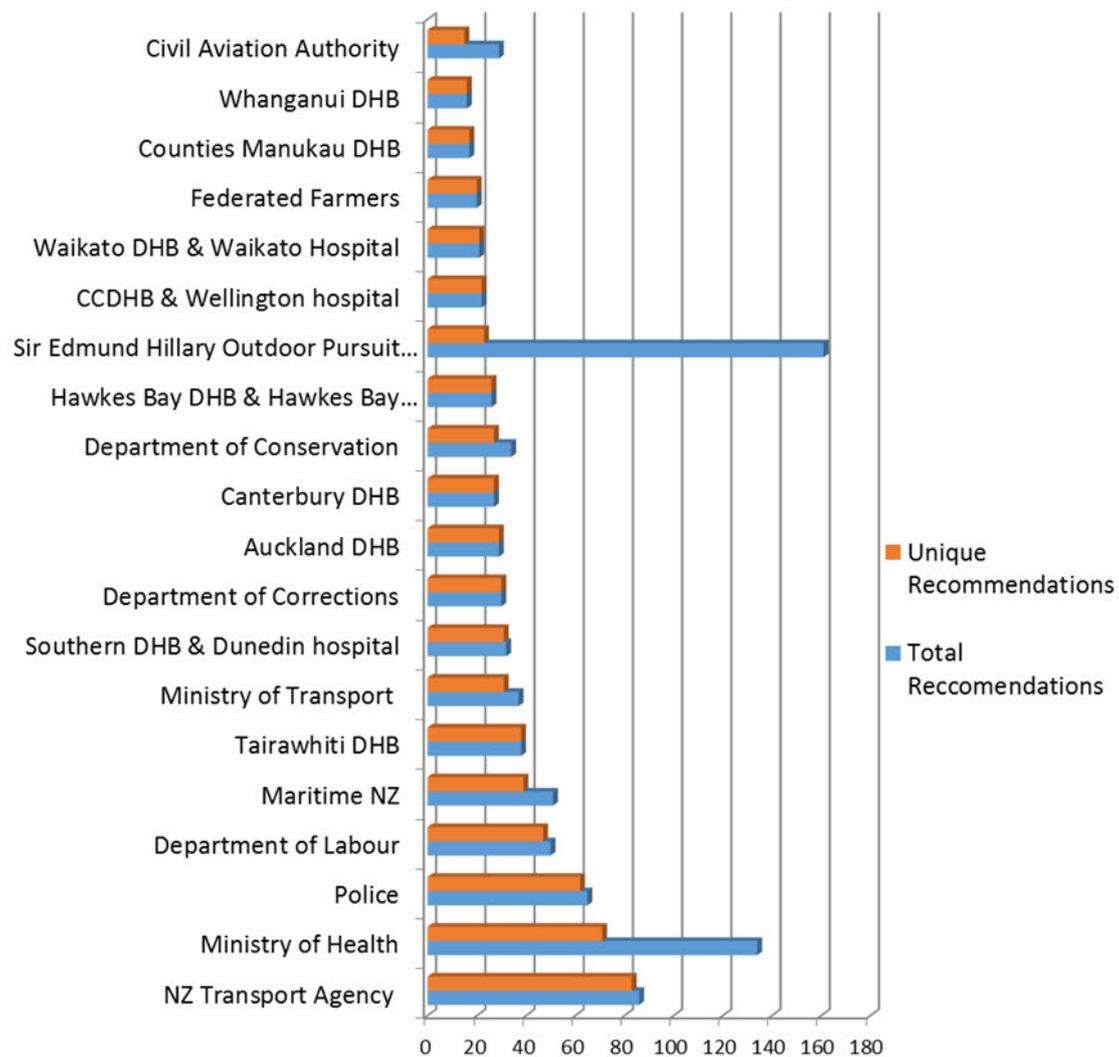
The number of untargeted recommendations was investigated because coroners endeavour to maximise the preventive potential of their recommendations by targeting them at a specific organisation. Australian research has demonstrated that vaguely directed recommendations receive poor or no responses and have little or no preventive impact.<sup>38</sup>

Organisations can argue that the recommendation was not directed at them and therefore does not require any action which, in turn, limits the effectiveness and preventive potential of recommendations. Eighty nine per cent of the 232 organisations received between one and ten recommendations. Occasionally organisations received 10 or more recommendations, but this was comparatively rare.

Thirty-seven percent of organisations received one coronial recommendation during the study period. Seventeen percent of organisations received two recommendations during the study period. Thirty four per cent of organisations received between three and ten recommendations during the study period.

The NZ Transport Agency and the Ministry of Health received the highest proportion of unique coroners' recommendations (Figure 6).

**Figure 6. Number of recommendations (15 or more unique and total) sent to organisations, NZ 1 July 2007–30 June 2012**



The Sir Edmund Hillary Outdoor Pursuit Centre received the highest number of total recommendations (161), but relatively few unique recommendations (23) because of the number of people who died in a single incident. On 30 March 2010, a teacher and six students died while undertaking an adventure challenge exercise conducted by the Sir Edmund Hillary Outdoor Pursuit Centre (Figure 6).<sup>31</sup>

The health sector organisations that were sent coroners' recommendations during the study period are summarised in Table 1.

**Table 1. NZ health sector organisations sent coroners' recommendations, 1 July 2007–30 June 2012**

Organisation's name	Total N of recommendations during study period
Plunket	7
NZ College of Midwives	10
All DHBs	297
Ministry of Health*	134
Midwifery Council	2
NZ Nurses' Organisation	6
St John	14
Royal NZ College of GPs	10
Medical Council	9
Centre for Adverse Reactions Monitoring and Intensive Medicines Monitoring Programme, Pharmacovigilance Centre, University of Otago	6
National Addiction Centre	6
Central Emergency Communications Ltd	6
ACC	5
Ashburn Clinic	5
Nursing Council	5
Tunstall Healthcare NZ Ltd	4
Alcohol Advisory Council (ALAC)	4
Health and Disability Commissioner	4
Health Quality Safety Commission	10
Nova Trust	4
Health Director, Southern Institute of Technology, Invercargill	2
Pharmac	2
River Ridge East Birth Centre	2
Springhill Residential Treatment Centre	2
Waiuku Health Centre	2
Medical Officer of Health (Dunedin)	2
Calvary Hospital	2
Otaki Medical Centre	2
Auckland Health Clinic	1
McKesson NZ Ltd (Healthline)	1
Medirest	1
Catlins Medical Centre	1
Cromwell Medical Centre	1
Junction Health	1
Medicines Adverse Reactions Committee	1
WellTrust	1
Safekids (child injury prevention service of Starship Children's Hospital)	1
Australasian College of Emergency Medicine	1
Diabetes Society of NZ	1
Gore Hospital	1
NZ Charter of Health Practitioners	1
NZ Natural Medicine Association	1
NZ Society of Naturopaths	1
Pharmacy Council	1

Organisation's name	Total N of recommendations during study period
NZ Medical Journal	6
Royal Australasian College of Surgeons	1
Royal Australian and NZ College of Psychiatrists	1
The NZ Anaesthesia Education Committee	1
Royal Australian and NZ College of Radiologists	1
Royal Australian and NZ College of Obstetricians and Gynaecologists	1
National Poisons Centre, Dunedin School of Medicine	1

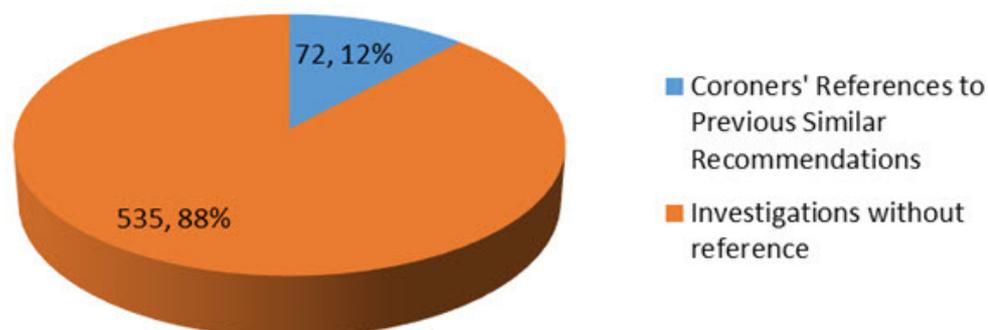
\* Includes recommendations directed to the Ministry of Health, Medsafe, Minister of Health, Director-General of Mental Health, Director-General of Health, Te Utuhi Manaakitanga Trust.

**Qualitative nature of coroners' recommendations about healthcare related deaths**—Recommendations about healthcare-related deaths addressed matters such as:

- The introduction of, or changes to, guidelines, pathways, protocols, checklists and/or standard operating procedures;
- The importance of maintaining adequate medical records;
- Further training and education;
- Increased supervision of junior doctors in specific areas of practice;
- Review of telephone triage systems;
- Improved communication between healthcare workers, especially during changeovers;
- Reviews of hospital policies;
- Raising awareness in the medical community of unusual or rare presentations.

**Coronial references to previous similar findings**—Coroners referred to previous similar findings in 72 of the 607 inquiries (Figure 7). This calculation was undertaken for two reasons. First, the preventive impact of coroners' recommendations may be improved if coroners (or their researchers) analyse larger datasets for patterns, rather than focusing on an isolated case. Second, an aim was to assess the extent to which legal precedent was applied in coroners' findings and recommendations.

**Figure 7. Number of NZ coronial references to previous similar findings, 1 July 2007–30 June 2012**



**Interviews**—123 interviews were undertaken with 15 coroners, 100 senior individuals from 79 organisations and eight interested parties.

**Coroner participants**—All NZ coroners were approached, and 13 were able to participate. Three retired coroners were invited to participate to garner perspectives on the old and new coronial systems. Two agreed to participate.

Fewer female (4/15) than male (11/15) coroners participated in the study. Thirty-five percent (6) coroners in NZ are female. Therefore, the percentage (26.7%) of female coroners interviewed is similar to the proportion of female coroners in NZ. The percentage of male coroners interviewed was 73.3%.

In keeping with the aim to capture a range of experiences, similar numbers of participants were interviewed from each category of years of experience. Five (33.3%) interviewed coroners had 5-9 years of experience, four (26.7%) coroners had 10-14 years of experience and six (40%) had fifteen or more years' experience.

**Organisation participants**—The 79 organisations included 55 government, 14 non-government not for profit and 10 for profit agencies that received coroners' recommendations during the study period. Twenty-six were healthcare sector organisations. Senior individuals from each organisation were interviewed. For example, for DHBs, the individuals interviewed were often the Chief Medical Officer, in-house lawyer and coronial liaison officer.

**Interested party participants**—The eight interested parties included two medical professionals, three lawyers, three families and one organisation. Interested parties were included if they had three or more years of experience with the coronial jurisdiction, particularly coroners' recommendations. The sample of interested parties is not representative, nor can it be generalised to all NZ lawyers, medical professionals, families that are involved in the coronial jurisdiction. The interested parties were included because they provide a different perspective on coroners' recommendations than the views garnered from organisations and coroners.

**Access to full coronial findings**—There are no Coroner's Court Law Reports. 'Law reports' are published volumes of judicial decisions by a particular Court or group of Courts. In NZ the official law report series is the *New Zealand Law Reports* which

report cases from the NZ Supreme Court, Court of Appeal and High Court. It is unusual for a Court not to have law reports.

All coroners and interested parties and 50/79 organisations complained about under-reporting in the coronial jurisdiction and the difficulties in accessing full coroners' findings. There are only 38 full coroners' findings of "public interest" on the CSNZ website.<sup>32</sup> Summaries of some coronial recommendations issued since 2007 are available online at the NZ Legal Information Institute.<sup>33</sup> For a fee of between \$1000–\$2750, researchers can request access to the Australian National Coronial Information System.<sup>34</sup>

Participants stated that the inaccessibility of full coronial findings means that:

- There are fewer opportunities to learn from deaths, improve patient safety and quality of care;
- Coroners' decision making is inconsistent;
- An international body of law and practice has not developed;
- Coronial cases are often decided in isolation with little reference to patterns or comparative risks (Figure 7);
- Coroners' ability to fulfil their statutory preventive function is undermined.

**Prophylactic function**—All participants reported that coroners' recommendations have the potential to contribute to injury and death prevention. All participants understood that coroners have a statutory preventive function. However, coroners (11/15), interested parties (7/8) and healthcare organisations (24/26) questioned whether this function was being maximised.

A commonly cited weakness of coroners' recommendations was that they focus on an isolated case. Interested parties (7/8), healthcare organisations (25/26) and coroners (13/15) suggested that recommendations could be improved by encouraging coroners to consider similar cases, undertaking analysis of patterns and comparative risks. Some coroners (8/15) preferred to work collaboratively with organisations to produce recommendations:

In terms of our prevention role, I like the work we have done on SUDI where there is an alliance and collaboration with researchers and practitioners who know what they are doing and we are assisting that process. It is informing our understanding of the issue and it increases our chances of commenting usefully...I don't think that our value is in making recommendations on a case-by-case basis.

Similarly, some healthcare organisations (14/26) reported that it is useful to work with coroners to produce preventive recommendations and outcomes:

It's a question of joining forces. If you're talking about deaths that occur as the result of a kid not being immunised, then the coroner's office should join hands with the paediatricians and get it out on a broad front. And if you're talking about wearing helmets, again contact those of us who deal with the emergency situations that result from not wearing helmets and say, "Look let's get this out there and take preventive action." And so as opposed to just the coroner saying it, the coroner should potentially approach involved stakeholders and say, "I'm going to make this recommendation, do you agree with it and would you be happy to endorse it?" Share the learning to prevent deaths and publicise the potential risks.

Although most coroners (11/15) stated that recognising a preventable death is “obvious”, their recommendations were not systematically consistent with public health principles. Coroners’ recommendations rarely identify the population at risk or whether the proposed countermeasure addresses an identified risk factor.<sup>14</sup> For example, the following recommendation does not apply injury prevention principles: “Lastly, in stating the obvious, chewing ones food properly before swallowing goes without saying.”<sup>35</sup>

Participants identified a range of strategies to increase the preventive potential of coroners’ recommendations including:

- Consultation with appropriate organisations so that their evidence and experience informs the formulation of recommendations;
- Training and resources for coroners;
- Providing coroners with easy access to clinical and epidemiological expertise;
- Practice notes and guidelines issued by the Chief Coroner;
- Targeting recommendations to the appropriate organisation that can take action;
- Accessing previous similar cases to enable coroners and/or their staff to assess patterns;
- Law reform such as a mandatory requirement for recipients of recommendations to respond so that feedback is provided to coroners.

**Evidence-based recommendations**—The majority of coroners (14/15) appreciated the need for their recommendations to be informed by evidence. All coroners defined ‘evidence’ as information tested in court. Such evidence may include research and scientific evidence. However, the scientific and legal definitions of ‘evidence’ are not always compatible.

Coroners reported that they were often unable to draw on this information because of financial constraints, staff shortages and difficulties in finding experts. The following extract from an interview with one DHB is illustrative:

It is a devil’s job to get an expert, actually. No conflict, has the expertise, who is willing to do it. We struggle with it. I know the coroners do too. I know that we had these particular cases where we had the same expert used in both cases. There was a feeling that that particular expert was trying to set a gold standard and was not representative of every day practice in the DHB at all.

Healthcare organisations reported that it is crucial that coroners choose the most appropriate expert/s. The following view from a healthcare organisation is reflective of participants’ concerns:

To a significant degree, partly it’s about having the right expert to suit the case. For example, you wouldn’t have a psychiatrist talking about general surgery. One key thing is the processes around the expert advice. So the HDC has a process of preparing a preliminary report and giving all the interested parties an opportunity to comment before making a final decision. Their framework is clear: the Code of Consumers’ Rights. So they have a safe approach, I think, because they rely on a variety of opinions. The other key issue is what the outcomes are. So the HDC will come up with whether there was a breach of the Code and what action like an apology. The coroner can make a whole range of safety recommendations. If the

coroner makes those on the basis of a single expert's advice, that is when the outcomes become more of a problem because it's hard to get systems-wide recommendations.

A lawyer suggested that Chief Medical Officers or the Colleges would be an appropriate resource for coronial decision-making:

We've also had coroners' inquests where the coroners have used an expert where we think probably they're not the best person they could have used. For example, they might not have practised in the public sector for a long time, or it might not really be their area of practice...I think the Chief Medical Officers group...could be a source of information because they are a very knowledgeable group of clinicians. And I think the input from the colleges is important as well...I think those groups are...probably underutilised by both DHBs and external agencies.....But I think if the coroners have to line up an expert from every group, it will become quite cumbersome.

**Quality of care and patient safety**—Many healthcare organisations (20/26) reported that they were not adequately consulted during the coronial process, which was particularly problematic if the coroner made recommendations about clinical practice. Improved communication between coroners and clinicians could enhance the preventive potential of coroners' recommendations and also improve quality of care and patient safety. For example, one DHB observed that:

There was one in particular that agitated nearly all of us. It was about clinical practice about CT scanning after head injury. It was a recommendation that basically said that everybody who falls over, well, I'm exaggerating but, everyone who falls over gets a CT scan. We thought "hang on guys, we've got pretty good protocols in place from the College of Emergency Medicine". That recommendation stands out as being one where the coroner was really firm about our threshold for CT scans in elderly head injuries. We thought "Well, actually, on the basis of *one case*, does not necessarily make a good protocol." So coroners' recommendations can have a positive impact on quality of care, but there has to be communication between DHBs and coroners, otherwise the recommendations can be misguided.

Healthcare organisations emphasised that their calls for consultation did not mean that they were not supportive of external independent investigations which could provide insight into the operation of healthcare systems. Many of these organisations (21/26) stated that coroners' recommendations have the potential to raise awareness about unfamiliar issues or alert healthcare organisations to patterns:

Where the coronial jurisdiction can come into its own is by drawing data from related deaths. That can be in the form of a post inquest process, pulling together collecting over time, information from a number of different cases and consolidating. Suicide in healthcare settings is an example. There are lessons to be learnt by looking at a collection of coronial investigations into suicides that occur in healthcare settings. This is partly why we are interested in reading and receiving all coroners' findings that relate to mental health because we are looking for patterns. Are there common issues that are emerging, so that for the benefit of future patients and patient safety, we can make changes? Are there issues that we had missed that are emerging before the coronial inquiries? Or, in fact, hearing inquests into related deaths together, as coroners sometimes do, is a good idea. That's where there can be the benefit of the coronial process.

Some healthcare organisations (11/26) gave examples of coronial recommendations that had a positive impact on clinical practice. For instance, one healthcare organisation explained that:

We had a lady who stopped taking her anticoagulation meds after she went on IVF. When she went back on the meds she got blood clots in her heart and passed away. The coroner looked at the case and found that there was poor communication between the GP and the IVF specialist. Recommendations were made about communication, monitoring and responsibility.

We took those recommendations on-board and we believe that patients in that lady's situation are safer as a result.

However, participants reported that some coroners' recommendations and coronial processes need to be improved before their potential to assist initiatives to improve patient safety can be fully harnessed. For example, recommendations must be directed to the most appropriate organisation. As one participant explained, coroners should "not use the Ministry of Health as a convenient PO Box for all health-related recommendations."

**Training and resources**—All participants reported that the CSNZ would benefit from further resources. Almost all healthcare organisations interviewed (25/26) reported that the CSNZ would benefit from epidemiological and clinical input. The Coronial Prevention Unit (CPU) and the Clinical Liaison Service (CLS) at the Coroner's Court in Victoria, Australia were frequently cited by coroners (12/15) and healthcare organisations (12/26) as the "gold standard" models.

The CPU comprises a multidisciplinary team trained in medicine, law, public health and the social sciences that assists coroners with their prevention role.<sup>36</sup> The CLS provides coroners with assistance from practising clinicians for the investigation of healthcare-related deaths.<sup>37</sup> One clinician warned that the disadvantage of the CLS model is that there "are limited experts in New Zealand to fill such roles." Some healthcare organisations (18/26), interested parties (3/8) and coroners (3/15) questioned the appropriateness of requiring legal training alone.

## Discussion

The findings highlight strategies for improving coronial recommendations and are important for death investigation systems that wish to strengthen their preventive function and role in patient safety.

In the 5-year study period there were 607 coronial inquiries that resulted in 1644 recommendations and 309 recipients of coroners' recommendations. The 123 interview participants reported that there have been improvements in coronial recommendations since the introduction of the Coroners Act 2006, but that the prophylactic and patient safety potential of recommendations is not being maximised.

There is limited international research.<sup>12–14,16,22</sup> This study's results reinforce South Australian research which suggests that coroners' recommendations have the potential to make contributions to patient safety initiatives.<sup>22</sup> However, this study confirms the barriers (such as the quality of recommendations) to implementation which have been identified by previous research.<sup>13,22</sup> These barriers mean that some NZ coroners' recommendations (like South Australian coroners' recommendations) have failed to have a significant impact on preventing adverse events.<sup>22</sup>

Australian research which identified these barriers, nonetheless emphasised that the "role of the coronial system as a reporting agency with wide ranging powers to explore such incidents provides an important public health service by investigating why adverse events happen and what might need to be introduced or changed to prevent such incidents recurring."<sup>22</sup> As the first study of its kind in NZ, the study makes an important contribution to the NZ literature and the CSNZ.

Major strengths of this project are that it was the first empirical study of NZ coroners' recommendations and it has the potential to inform coronial practice and organisations' policies. In addition, the findings have the potential to contribute to law reform, including the NZ Government's current review of the coronial jurisdiction. Given the Ministry of Justice's expenditure on the coronial jurisdiction, it is surprising that the main preventive tool (recommendations) have been under-researched. An additional strength of the study was its mixed methods: legal, qualitative and quantitative. The response rates for coroner and organisation participants are a strength of the project.

A limitation of the study is that the interested party participants are not representative. Future research should be undertaken to further explore their views. Although selection criteria were applied, there may be selection bias in the interested party sample because of the high proportion of participants who contacted the researcher. There may be case selection bias in the analysis of recommendations because the sample of repeated recommendations was limited to those that were identical in wording. Repeated themes were not eliminated which may have led to an overestimate of the total number of recommendations. Another limitation of the study is the possible impact of the Ministry of Justice's review of the Coroners Act 2006 which began in 2012 during the study period. The review may have impacted the coroners' formulation of recommendations. As this was the first analysis of NZ coroners' recommendations, it is exploratory only and further research should be undertaken.

It is not surprising that the research revealed that coroners typically sent recommendations to government organisations and that the MOH received the second-highest proportion of recommendations because these entities are responsible for the development of legislation, policies and programmes designed to manage public health.

An important finding is that there are a significant proportion (n=72, 23%) of untargeted recommendations. This study reinforces prior research findings that vaguely directed recommendations (e.g. 'to the government') receive poor or no responses and have little or no preventive impact.<sup>38</sup>

Coroners "are trying to ensure that a recommendation is targeted and that it says *who* it is to go to".<sup>39</sup> If a recommendation is inappropriately directed its preventive potential is undermined because it does not reach the organisation that can consider and/or implement it.

This research revealed that only 72 of the 607 coronial inquiries included references to previous similar findings. Opportunities for preventing morbidity and mortality and improving patient safety may be maximised if coroners consider previous similar findings. When coroners focus on one particular death in a specific case, it is unlikely that they will assess patterns or comparative risk. How many similar deaths have occurred in the last 30 years? What are the risks attributed to that type of death compared to the health risks associated with other categories of death?

Most NZ coroners are not trained in the disciplines that would be required to undertake comparative health and safety assessments. Ready access to clinical and epidemiological advice would enable the facts to be interpreted in light of the wider

context and specific populations, enabling the formulation of robust recommendations. By not systematically addressing areas where the greatest morbidity or mortality burdens exist, coroners limit their ability to reduce illness, disease and injury at the population level.<sup>19</sup>

This study's findings suggest that the introduction of services similar to the Victorian CPU and CLS could assist coroners to accurately identify preventable deaths and to improve the quality of coronial recommendations and processes.<sup>19</sup> Australian research has found that the coronial process was delayed because of a lack of readily available clinical and public health expertise.<sup>25</sup> Delays can hinder the preventive impact of recommendations because once the proposals are released, they may be outdated and inconsistent with recent changes within organisations. The CPU and CLS were established to remedy these issues. Access to multidisciplinary teams within the NZ coronial services could assist coroners to formulate recommendations that are consistent with public health principles.<sup>19</sup>

Some coronial data is shared with other injury and death prevention agencies in NZ and overseas,<sup>40</sup> but the inaccessibility of full coronial findings prevents the prophylactic potential of coronial recommendations from being achieved. The introduction of *Coroners' Court Law Reports* would ensure that full coronial findings and recommendations are accessible and could improve the quality of coronial decision making.<sup>19</sup> A public database of responses to coronial recommendations would encourage accountability and the identification of common themes.

Families who have lost loved ones to preventable death sometimes complain to coroners about the quality of healthcare that they received. A common complaint is that a diagnosis was missed. The recent Gravatt case, where a 22-year-old medical student died of *Neisseria meningitides* infection, is an example.<sup>25</sup>

Coroners have sometimes identified problems with healthcare that standard mortality data collection within the healthcare organisation had missed.<sup>21</sup> For example, preventable neonatal deaths following the insertion of long lines was documented by coroners, but missed by the healthcare organisation.<sup>21</sup>

Coroners have an educative role and their recommendations to healthcare organisations may "give valuable insights into the strengths and weaknesses of nursing, medical and institutional practice and many inquests serve as catalysts for reform."<sup>41</sup> In Western Australia, healthcare-related recommendations issued in 2007 had a high rate of implementation and a high level of progress updates provided by the Office of Safety and Quality.<sup>38</sup>

Coronial recommendations could be a key patient safety resource and reduce the incidence of adverse events, subject to the quality improvements identified by research participants. The potential value of the quality of care learning that can be derived from coronial recommendations is currently under-researched, but is worth exploring further in future projects.

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## The impact of major earthquakes on the psychological functioning of medical students: a Christchurch, New Zealand study

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### Abstract

**Background** No previous studies have systematically assessed the psychological functioning of medical students following a major disaster.

**Aim** To describe the psychological functioning of medical students following the earthquakes in Canterbury, New Zealand, and identify predictors of adverse psychological functioning.

**Method** 7 months following the most severe earthquake, medical students completed the Depression, Anxiety and Stress Scale (DASS), the Post-Traumatic Stress Disorder Checklist, the Eysenck Personality Questionnaire, the Connor Davidson Resilience Scale, the Work and Adjustment Scale, and Likert scales assessing psychological functioning at worst and currently.

**Results** A substantial minority of medical students reported moderate–extreme difficulties on the DASS subscales 7 months following the most severe earthquake (Depression =12%; Anxiety =9%; Stress =10%). Multiple linear modelling produced a model that predicted 27% of the variance in total scores on the DASS. Variables contributing significantly to the model were: year of medical course, presence of mental health problems prior to the earthquakes, not being New Zealand European, and being higher on retrospectively rated neuroticism prior to the earthquakes.

**Conclusion** Around 10% of medical students experienced moderate–extreme psychological difficulties 7 months following the most severe earthquake on 22 February 2011. Specific groups at high risk for ongoing psychological symptomatology were able to be identified.

Disasters have the potential to disrupt and overwhelm individuals, families and entire communities.<sup>1</sup> Natural disasters such as major earthquakes have been shown to have substantial adverse psychological effects across a range of different cultures.<sup>2-7</sup>

Youth have been identified as being vulnerable to psychological symptoms following disasters.<sup>8</sup> Following Hurricane Katrina at New Orleans, USA, displaced university students were found to have greater levels of distress and psychological symptoms than non-displaced students.<sup>9</sup> It is unclear how medical students who continued studying and working in Christchurch, New Zealand, following the major earthquakes may have been affected in terms of their psychological functioning.

In 2010 and 2011, the region of Canterbury, New Zealand was struck by a series of powerful earthquakes and aftershocks. The first earthquake (September 2010) measured 7.1<sup>10</sup> on the Richter scale,<sup>11</sup> and resulted in minimal physical damage to

buildings and infrastructure. The second major earthquake (February 2011) measured 6.3<sup>10</sup> on the Richter scale,<sup>11</sup> but was situated close to Christchurch city. Despite its relatively moderate magnitude, this earthquake generated amongst the highest peak ground accelerations ever recorded<sup>10</sup> and had devastating effects. It resulted in significant loss of life and multiple injuries,<sup>12</sup> and widespread damage to property and infrastructure. This was followed by a further 6.3 magnitude earthquake in June 2011,<sup>10</sup> which resulted in more damage but no loss of life. In addition, there were more than 10,000 aftershocks over the years 2010–2011.<sup>10</sup>

These earthquakes directly affected the medical students in Christchurch as the main medical school building which housed lecture theatres, the library, tutorial rooms, computing facilities and the common room was closed following the February 2011 earthquake. Further disruption may also have resulted from increased demands on teaching staff due to disruption to their work places, changed clinical demands and damage to their own homes.

The present study aimed to describe the impact of these earthquakes on the psychological functioning of medical students in Christchurch, and to identify predictors of adverse psychological functioning.

## Method

### Participants and survey administration

All 253 medical students (registered from November 2010) from the Christchurch campus (University of Otago) were emailed inviting them to participate in an electronic survey asking them about their experiences relating to the earthquakes. One student had transferred from Christchurch to another campus over the period of interest.

Students were in their 4<sup>th</sup>, 5<sup>th</sup> or 6<sup>th</sup> years of study. Surveys were sent in September 2011, which was 1 year following the initial earthquake, 7 months following the most severe earthquake, and 3 months following the third key earthquake. If students did not respond, three email reminders were sent over the course of the next month. Students were given relevant information about the survey at the outset, and were asked if they consented to participate in the survey. When the surveys were returned to the survey coordinator, they were anonymized prior to being shared with the rest of the research team and analysed. The study was approved by the University of Otago Ethics Committee.

**Measures**—The survey was designed to assess a broad range of variables to enable us to evaluate the impact of the earthquakes on students' functioning. The present paper reports findings for the measures described below.

**Demographics and earthquake exposure**—Age, gender, ethnicity (New Zealand European, Maori, Samoan, Chinese, Indian, Malay, Middle East, other), relationship status (single, in a relationship, or married/de facto/civil union), year of medical course (4<sup>th</sup>, 5<sup>th</sup> or 6<sup>th</sup> year), years spent living in New Zealand, and if they were in Christchurch for each of the three major earthquakes (yes/no) were reported by students.

**Perception of safety**—Students rated the impact of the earthquakes on how safe they currently felt *living* and *working* in Christchurch (1=very safe; 5=not at all safe). To ease interpretation, these categories were dichotomized as follows: Very safe-somewhat safe, and less than somewhat safe-not at all safe. Students were also asked to indicate (yes/no) if they were currently thinking about leaving Christchurch as a result of the earthquakes.

**Before versus after the earthquakes: health problems and resilience**—Students rated the presence (yes/no) of health problems (mental and physical) and resilience (1-5; 1=very resilient; 5=not at all resilient), prior to the earthquakes and currently.

**At worst versus current ratings: symptoms, relationships and substance use**—Students rated the severity of impact of the earthquakes on the following variables: sleep, concentration, anxiety, mood, relationships, alcohol use and cigarette use. Severity of impact was originally rated as being either:

none, mild, moderate or severe. To ease interpretation, these ratings were dichotomized as follows: none–mild and moderate–severe.

## Psychological scales

**Depression, Anxiety and Stress Scale (DASS)**—The DASS measures self-rated current (past week) symptoms of depression, anxiety and stress.<sup>13</sup> The present study used the 21 item version of the scale, which produces comparable results to the longer version.<sup>14,15</sup> The DASS yields a total score indicating overall severity of symptomatology (all domains combined), plus subscale totals for depression, anxiety and stress. Subscale totals are categorized as follows: normal, mild, moderate, severe and extreme. To ease interpretation, these categories were dichotomized as follows: normal–mild and moderate–extreme.

**Post-Traumatic Stress Disorder Checklist—Specific Event (PCL-S)**—The PCL-S assesses self-rated current (past month) symptoms of post-traumatic stress disorder in relation to an identified stressful experience.<sup>16</sup> The scale consists of 17 items.

**Eysenck Personality Questionnaire (Brief Version)**—The Eysenck Personality Questionnaire (Brief Version) assesses self-rated personality characteristics amongst adults.<sup>17</sup> The scale consists of 24 items. In the present study, students were asked to retrospectively rate their characteristics *prior to* the earthquakes. Scores for the subscales Extroversion and Neuroticism are reported here.

**Connor Davidson Resilience Scale**—The Connor Davidson Resilience Scale assesses self-rated current (past month) resilience.<sup>18</sup> The scale consists of 25 items.

**Work and Adjustment Scale**—The Work and Adjustment Scale assesses current (time frame not provided) self-rated impairment attributable to an identified problem (earthquakes and aftershocks in this case).<sup>19</sup> Five items assess work, home management, social leisure activities, private leisure activities and family and relationships.

## Statistical analyses

Data were entered into the statistical analysis package SPSS.<sup>20</sup> Descriptive statistics were performed initially. Comparisons between year groups were performed using Chi-squared and analysis of variance for categorical and continuous variables respectively. Comparisons of ratings for before and after the earthquakes were made using Chi-squared and paired t-tests for categorical and continuous variables respectively. Statistical modelling was performed using multiple linear regression.

## Results

**Response rate**—253 medical students (4<sup>th</sup>, 5<sup>th</sup> and 6<sup>th</sup> year) from the Christchurch campus (University of Otago) were invited to participate in the survey. 210 students completed the survey either partially or fully (210/253=83%). Completing some or all of a survey may *imply* consent. However, only 198 students endorsed the item giving consent for participation in the survey and told us which year of the medical course they were currently in (year 4=66, year 5=77, year 6=55). Analyses reported in this paper involve these 198 students (198/253=78%).

**Demographics**—Table 1 shows the demographic characteristics of the students, earthquake exposure and current perception of safety, by year of medical course and years combined. As expected, students further along in their training were older and had been in New Zealand longer (except 5<sup>th</sup> year students). Females were over represented in all year classes, and the proportion of females increased with each year of training. The most common ethnic groups students endorsed were New Zealand European (56%) and Chinese (22%) for year groups combined. Students were able to endorse more than one ethnic group, so the percentages reported do not add up to 100%. Although students had on average been in New Zealand for 17 years, there was wide variation on this measure (1–33 years).

**Table 1. Demographic characteristics, earthquake exposure and perception of safety of participants by year of medical course and years combined**

Variable	YEAR OF MEDICAL COURSE			All 3 years combined n=198	Comparison between year groups	
	Year 4 n=66	Year 5 n=77	Year 6 n=55		F/Chi-squared (df)	p
	Mean (SD) Range or Percentage					
<b>Age*</b>	22.4 (1.6) 20–28 years	23.5 (1.5) 22–30 years	24.8 (2.4) 22–33 years	23.5 (2.1) 20–33 years	27.0 (2)	<b>.00</b>
<b>Gender**</b> (Female)	51.5%	62.3%	74.1%	61.9%	6.4 (4)	<b>.04</b>
<b>Relationship status**</b>						
Single	63.6%	51.9%	41.8%	53.0%	7.6 (4)	.11
In relationship	33.3%	40.3%	45.5%	39.4%		
Married	3.0%	7.8%	12.7%	7.6%		
<b>Ethnicity** Δ</b>						
NZ European	62.1%	49.4%	58.2%	56.1%	2.5 (2)	0.29
Maori	1.5%	3.9%	3.6%	3.0%	0.8 (2)	0.68
Samoan	1.5%	0%	0%	0.5%	2.0 (2)	0.37
Chinese	19.7%	20.8%	25.5%	21.7%	0.7 (2)	0.72
Indian	3.0%	3.9%	1.8%	3.0%	0.5 (2)	0.79
Malay	6.1%	13.0%	.0%	7.1%	8.4 (2)	<b>0.02</b>
Middle East	3.0%	5.2%	.0%	3.0%	3.0 (2)	0.23
Other	10.6%	16.9%	14.5%	14.1%	1.2 (2)	0.56
<b>Years in New Zealand*</b>	17.0 (7.8) 1–28 years	14.8 (8.3) 2–30 years	18.9 (8.1) 3–33 years	16.6 (8.2) 1–33 years	4.2 (2)	<b>0.02</b>

**Note:** \*P values obtained from analysis of variance; \*\*P values obtained from Chi-squared test; Δ Values indicate the percentage of participants who endorsed each separate ethnicity category. Because participants could choose more than one ethnicity category, percentages add up to more than 100% when a total for each column is computed.

**Earthquake exposure**—The vast majority of students were in Christchurch for at least one of the three key earthquakes. Comparison between the year groups shows significant differences across the year groups in terms of earthquake exposure using Chi-squared. The 5<sup>th</sup> year students were more likely to have experienced all three earthquakes (more than half experienced all three), and they were the most likely to have been in Christchurch for the most severe earthquake in February 2011(96%).

**Perception of safety**—For the group as a whole (years of medical course combined), more than a quarter of students indicated that they did not feel safe either living or working in Christchurch at the time of the survey, and more than a third indicated that they were currently thinking about leaving Christchurch as a result of the earthquakes.

A significant difference was found across year groups for wanting to leave Christchurch because of the earthquakes, but not for how safe students felt living or working in Christchurch using Chi-squared. Year 5 and year 6 medical students were more likely to want to leave Christchurch in comparison with year 4 students.

**Before versus after the earthquakes: health problems & resilience (mental and physical health problems)**—No significant differences were observed across different years of the medical course for health problems (mental and physical problems, yes/no) rated for prior to the earthquakes and currently, using Chi-squared. Therefore, data were combined across year of medical course.

Students were more likely to report psychological problems than physical problems *prior* to the earthquakes, and psychological problems increased significantly following the earthquakes using Chi-squared (Mental Health Problems: Prior to earthquakes=9%; Following the earthquakes=17%; Chi-squared=5.3; p=0.03). Examples of mental health problems following the earthquakes included “stress,” plus other anxiety, mood or sleep related difficulties.

Increases in physical problems following the earthquakes were not statistically significant using Chi-squared (Physical Health Problems: Prior to earthquakes=5%; Following the earthquakes=7%; Chi-squared=1.1; p=0.4). Examples of physical health problems following the earthquakes included a worsening of asthma (which students attributed to increased dust in the city), headaches, eczema and gastrointestinal symptoms.

**Before versus after the earthquakes: health problems & resilience (resilience)**—The following results were found for resilience prior to the earthquakes and currently (1-5; 1=very resilient, 5=not at all resilient).

*Prior to earthquakes* (mean, sd): Year 4=1.8 (.91); Year 5=1.94 (.75); Year 6=1.57 (.70); Years combined=1.79 (.80).

*Currently* (mean, sd): Year 4=1.95 (.98); Year 5=2.24 (.99); Year 6=1.73 (.72); Years combined=2.01 (.96).

(a) Comparison of Before Versus After the Earthquake (Years combined)

Students rated themselves as being significantly less resilient currently using a paired t test (t score=-3.4, df=176, p=<.01).

(b) Comparison by Year of Medical Course

Significant differences were found across different years of the medical course both in terms of resilience prior to the earthquakes ( $F=3.25$ ,  $df=2$ ,  $p=0.04$ ) and currently ( $F=5.2$ ,  $df=2$ ,  $p=.01$ ) using analysis of variance. Post hoc tests show that 5<sup>th</sup> year medical students rated themselves as being less resilient than 6<sup>th</sup> year students both prior to the earthquakes and currently.

**At worst versus current ratings: symptoms, relationships and substance use—**

Table 2 shows the self-rated severity of impact of the earthquakes on a range of variables (sleep, concentration, anxiety, mood, relationships, alcohol use and cigarette use) at worst and currently, and whether treatment was received for these difficulties.

At worst, more than half the students were moderately–severely affected on sleep (70%), concentration (65%) and anxiety (52%). A substantial minority (40%) also indicated a moderate–severe impact on mood at worst.

Currently, 12% or less of students reported moderate–severe impact of the earthquakes on all variables. Students were most likely to report current moderate–severe difficulties with concentration (12%) and least likely to report current difficulties with relationships or cigarette use (1% or less).

**Table 2. Severity of impact of earthquakes on symptoms, relationships and substance use at worst and currently (none–mild or moderate–severe), and whether treatment was received for these difficulties (percentage yes)**

Variable	Severity Percentage Yes		Treatment received (either at worst or currently) Percentage Yes
	At worst	Currently	
<b>Sleep</b>			
None–Mild	29.7%	93.8%	3.5%
Moderate–Severe	70.3%	6.2%	
<b>Concentration</b>			
None–Mild	35.2%	87.7%	2.3%
Moderate–Severe	64.8%	12.3%	
<b>Anxiety</b>			
None–Mild	48.2%	91.3%	5.8%
Moderate–Severe	51.8%	8.7%	
<b>Mood</b>			
None–Mild	59.9%	90.7%	5.3%
Moderate–Mild	40.1%	9.3%	
<b>Relationships</b>			
None–Mild	87.5%	99.0%	0.6%
Moderate–Severe	12.5%	1.0%	
<b>Alcohol use</b>			
None–Mild	88.0%	97.4%	0.0%
Moderate–Severe	12.0%	2.6%	
<b>Cigarette use</b>			
None–Mild	99.0%	100.0%	0.6%
Moderate–Severe	1.0%	0.0%	

**Psychological scales**—Table 3 shows scores on various self-report psychological scales by year of medical course and years combined. Mean (sd) scores are presented for all psychological scales, plus categories for the DASS subscales (percentage in each category). Years of medical course were compared and tested for statistical significance.

**Depression, Anxiety and Stress Scale (mean scores)**—Comparison of mean DASS scores (Subscale totals for Depression, Anxiety and Stress, plus overall total) shows significant differences across year of medical course using analysis of variance. 5<sup>th</sup> year medical students had the highest mean scores on all DASS subscales (Depression, Anxiety and Stress) plus the highest mean DASS total.

**Categories**—Overall (years combined), the vast majority of students were in the normal–mild category on all three sub-scales (88-91%), leaving a substantial minority who reported moderate–extreme difficulties on these subscales (9-12%). Significant differences were found across year of medical course for Anxiety and Stress subscales (but not for Depression subscale) using Chi-squared, with 5<sup>th</sup> year students being more likely to report moderate–extreme difficulties.

**Post-Traumatic Stress Disorder Checklist (specific event)**—Significant differences were found across year of medical course on the PCL-S using analysis of variance, with 5<sup>th</sup> year students being more likely to report higher scores (i.e., more symptomatic).

**Eysenck Personality Questionnaire (brief version)**—No significant differences were found across year of medical course on either the extroversion or the neuroticism subscales of the Eysenck Personality Questionnaire (Brief Version) using analysis of variance.

**Connor Davidson Resilience Scale**—Significant differences were found across year of medical course on the Connor Davidson Resilience Scale using analysis of variance, with 5<sup>th</sup> year students being more likely to report lower scores (i.e., lower resilience).

**Work and Adjustment Scale**—Significant differences were found across year of medical course using analysis of variance, with 5<sup>th</sup> year students being more likely to report higher scores (i.e., more impairment).

**Statistical modelling**—A multiple linear regression analysis was conducted to determine if DASS Total scores could be predicted from the measures we had assessed. The DASS total was selected a priori as the dependent variable as this was seen as the best single measure of broad based psychological distress that we had available. The predictor variables that we entered into the model were measures of pre-morbid status or functioning, as follows: gender, age, year of medical course, years in New Zealand, ethnicity, relationship status, total earthquake exposure, exposure to the most severe earthquake (February 2011), retrospectively rated pre-morbid personality (Eysenck Personality Questionnaire extroversion and neuroticism scales), presence of mental health problems prior to earthquakes and resilience prior to the earthquakes. Ethnicity data were collapsed down to one variable (New Zealand European: yes/no) for inclusion in the model, as the numerous overlapping ethnicity categories (sometimes containing only a small number of participants) were not suitable for inclusion in the statistical model.

**Table 3. Self-report scores on psychological measures by year of medical course and years combined**

Variable	YEAR OF MEDICAL COURSE				F (df) or Chi-squared (df)	p
	Year 4 N=66 Mean (SD) Range or Percentage	Year 5 N=77 or % Mean (SD) Range or Percentage	Year 6 N=55 Mean (SD) Range or Percentage	Years Combined N=198 Mean (SD) Range or Percentage		
<b>DASS Depression*</b>	5.6 (7.0) 0–34	7.9 (8.8) 0–40	3.0 (6.3) 0–40	5.6 (7.8) 0–40	4.7 (2)	0.01
<i>Categories**</i>						
Normal–Mild	84.4%	85.7%	96.2%	88.2%	4.5	0.10
Moderate–Extreme	15.6%	14.3%	3.8%	11.8%	(2)	
<b>DASS Anxiety*</b>	2.4 (3.5) 0–14	4.4 (6.0) 0.30	1.0 (2.0) 0–8	2.7 (4.5) 0–30	6.3 (2)	0.00
<i>Categories**</i>						0.02
Normal–Mild	88.9%	85.5%	100.0%	90.8%	8.0	
Moderate–Extreme	11.1%	14.5%	0.0%	9.2%	(2)	
<b>DASS Stress*</b>	5.6 (5.6) 0–22	10.1 (8.2) 0–34	3.7 (5.9) 0–30	6.7 (7.3) 0–34	10.3 (2)	0.00
<i>Categories**</i>						
Normal–Mild	92.1%	84.5%	96.2%	90.4%	8.0	0.08
Moderate–Extreme	7.9%	15.5%	3.8%	9.6%	(2)	
<b>DASS Total*</b>	14.5 (16.0) 0–64	21.1 (20.3) 0–94	8.4 (13.6) 0–78	15.3 (17.8) 0–94	8.1 (2)	0.00
<b>Post-Traumatic Stress Checklist Total*</b>	27.9 (9.7) 17–59	31.7 (12.8) 17–72	26.0 (11.5) 17–67	28.8 (11.7) 17–72	4.5 (2)	0.01
<b>Eysenck Personality Q: Extroversion*</b>	38.6 (6.5) 24–54	36.3 (9.3) 14–60	37.3 (7.4) 21–50	37.3 (7.9) 14–60	0.2 (2)	0.84

**Table 3. Continued**

Variable	YEAR OF MEDICAL COURSE				F (df) or Chi-squared (df)	p
	Year 4 N=66 Mean (SD) Range or Percentage	Year 5 N=77 or % Mean (SD) Range or Percentage	Year 6 N=55 Mean (SD) Range or Percentage	Years Combined N=198 Mean (SD) Range or Percentage		
Eysenck Personality Q: Neuroticism*	23.6 (7.3) 12–48	25.9 (8.3) 12–51	22.6 (8.2) 12–53	24.2 (8.0) 12–53	1.8 (2)	0.17
Connor Davidson Resilience Scale*	64.9 (16.1) 0–90	61.5 (12.4) 33–92	69.3 (12.6) 28–95	65.0 (14.0) 0–95	4.3 (2)	0.02
Work and Social Adjustment Scale*	11.2 (9.4) 0–29	15.1 (9.7) 0–35	11.7 (9.0) 0–37	12.8 (9.5) 0–37	5.0	0.01

\* P values obtained from analysis of variance

\*\* P values obtained from Chi-squared.

Overall, the statistical model predicted 27% of the variance in DASS total scores. The variables that significantly contributed to predicting the DASS total were: year of medical course (both 4<sup>th</sup> and 5<sup>th</sup> years more symptomatic), presence of mental health problems prior to the earthquakes, not being New Zealand European, and being higher on retrospectively rated neuroticism prior to the earthquakes. Examination of Cohen's *d* estimates shows that the effect sizes ranged from small–moderate (approximately 0.3–0.6). Effects were found independently of earthquake exposure (total exposure and exposure to most severe earthquake).

## Discussion

The present study aimed to describe the impact of the Canterbury earthquakes on the psychological functioning of medical students, and to identify predictors of adverse psychological functioning.

Medical students (4<sup>th</sup>, 5<sup>th</sup> and 6<sup>th</sup> year) were surveyed electronically approximately 7 months following the most severe Canterbury earthquake, and data were analysed for 198 consenting students (response rate=78%). The vast majority of students were in Christchurch for at least one of the three key earthquakes. We are unaware of any previous systematic assessments of the psychological functioning of medical students following a major disaster.

As with the general population in Christchurch,<sup>21</sup> we found that it was common for medical students to be substantially psychologically affected following a major earthquake. Overall, medical students reported similar levels of depression and lower levels of anxiety and stress in comparison with the general population (DASS Depression mean: medical students =5.6 [7.8], general population =5.8 [6.3]; DASS Anxiety mean: medical students =2.7 [4.5], general population =6.4 [8.1]; DASS Stress mean: medical students =6.7 [7.3], general population =11.7 [9.6]). This was despite, the present study being conducted following all three of the severe earthquakes (i.e., September, February and June), whereas the study involving the general population was conducted following only the September earthquake.

For most students in the present study, psychological difficulties improved markedly in a matter of months. For example, at worst, most students rated themselves as being moderately-severely affected on sleep (70%), concentration (65%) and anxiety (52%). However, by the time of the survey a minority of students (12% or less) continued to report moderate–severe difficulties.

Approximately 10% reported current moderate–extreme scores on the three subscales of the DASS. Students' mean scores on a measure of post trauma symptomatology (PCL-S) were below threshold for diagnosis of post-traumatic stress disorder in the context of a specific trauma.<sup>22</sup> It was more likely for students to report an increase in mental health problems rather than physical health problems following the earthquakes, and self-rated resilience was significantly reduced following the earthquakes.

Few suitable studies exist for comparison with the present study. Davis et al<sup>9</sup> found that following Hurricane Katrina, University students (both displaced and non-displaced) were more symptomatic on average than the medical students in

Christchurch on the Depression, Anxiety and Stress subscales of the DASS. Overall totals on the DASS were not reported by Davis and colleagues.

Examination of the present results shows a clear pattern for 5<sup>th</sup> year medical students to be more affected by the earthquakes than other year groups. There are a number of potential explanations for this. First, exposure to the earthquakes was not equal across the year groups. Fifth year students were more likely to have greater total earthquake exposure (total number of key earthquakes experienced), and they were more likely to have been in Christchurch for the most severe earthquake. Second, they arguably were under the most pressure as their final exams (leading to graduation) were coming up at the end of the year (the academic year in New Zealand runs from February to November with the final exams in October/November). We have previously shown some effect on examination performance for this cohort.<sup>23</sup>

As mentioned previously, the Medical School was substantially affected by the earthquakes which may have increased students' anxieties about being adequately prepared for their final exams later in the year. Third, the 5<sup>th</sup> year students had on average been in New Zealand for less time than might have been expected (i.e., less time than 4<sup>th</sup> year students).

Finally, statistical modelling was performed to try and identify which variables may be the most useful at predicting current symptomatology (DASS total). Overall, the model predicted 27% of the variance in DASS total scores. Variables contributing significantly to the model were: year of medical course (both 4<sup>th</sup> and 5<sup>th</sup> years more symptomatic), presence of mental health problems prior to the earthquakes, not being New Zealand European, and being higher on retrospectively rated neuroticism prior to the earthquakes. These effects were found independent of earthquake exposure.

The finding that *both* 4<sup>th</sup> and 5<sup>th</sup> year students were more symptomatic was somewhat out of keeping with the previous results showing that 5<sup>th</sup> year students tended to be the most symptomatic group. However, on this particular measure (DASS total), 4<sup>th</sup> year students were also symptomatic.

A study involving the general public in Christchurch following the September 2010 earthquake also found that neuroticism was associated with greater levels of psychological symptomatology.<sup>21</sup>

Limitations of the present study include the reliance on self-report data (i.e., no ratings from others such as a clinician), and the retrospective nature of the assessment of personality, health problems (mental and physical) and resilience prior to the earthquakes. It is also possible that students under reported difficulties were due to concerns about their responses being scrutinized by the university. While students' data were anonymized once they were received, they may still have had concerns regarding this issue. The response rate of 78% is adequate, although a higher rate would have been desirable.

The findings from this study have potential implications for an educational institution in the event of a disaster. Clearly, the extent to which students have been exposed to a disaster will be an important consideration.<sup>24</sup> However, over and above this, some groups may be more vulnerable to adverse psychological effects. Some high risk groups may be able to be identified by an educational institution, whereas others may be less easily identified. Taken together, the findings from the present study suggest

that in the event of a disaster, an educational institution should be particularly concerned about the following people:

- Specific year groups (e.g., those under particular pressure in terms of upcoming final exams for graduation). *Institution will know this.*
- Students with a history of mental health problems. *Institution may know this for some students, but not for all.*
- Students not from the most common ethnic group in that setting. *Institution may know this.*
- Students with higher rates of neuroticism prior to the disaster. *Institution unlikely to know this for most students.*

## Conclusion

Around 10% of medical students experienced moderate–extreme psychological difficulties 7 months following the most severe earthquake. Specific groups at high risk for ongoing psychological symptomatology were able to be identified.

**Competing interests:** Nil.

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## Can a paediatric department provide health care for vulnerable adolescents?

Genevieve Rayner, Kendall Crossen

### Abstract

**Background** Adolescents can face multiple barriers when attempting to access primary health care and primary health providers often feel poorly placed to provide care. The Adolescent Resilience Clinic (ARC) was established to help overcome some of these difficulties.

**Aim** To evaluate whether goals of the ARC were achieved and identify areas for future improvement.

**Methods** A retrospective review of records for all patients referred to the ARC from May 2011 to May 2012.

**Results** A total 41 patients were seen, aged 12–18 years, the majority of whom (98%) were female. NZ Maori was the most common ethnicity (54%). Contraceptive needs and psychosocial issues were the predominant referral reasons. After consultation, most patients (81%) had multiple diagnoses. The proportion of patients participating in “risky” behaviours showed this group to be at risk of adverse outcomes. However, only 7% of patients had a complete HEEADSS assessment (an acronym guiding systematic psychosocial history taking assessing Home, Education or employment, Eating, Activities and affect, Drug use including cigarettes, Sexual risk behaviours and Suicide)<sup>1</sup> documented.

**Conclusions** The ARC provides accessible healthcare to a vulnerable population. Further work is needed on how to accurately document HEEADSS assessments while ensuring confidentiality.

Adolescents face significant health problems. While they commonly present to their General Practitioners (GPs) with respiratory illnesses, skin conditions or musculoskeletal complaints,<sup>2</sup> their concerns are often in relation to sex, stress, relationships, diet and depression.<sup>3-5</sup> Moreover, the major causes of mortality and morbidity are due to accidents and injuries, mental health problems and participating in “risky” behaviours such as substance use and unprotected sexual intercourse.<sup>6,7</sup>

Whilst the majority of New Zealand Adolescents (>90%)<sup>6,8</sup> report subjectively good to excellent health, many experience chronic health conditions and chronic disability, 17% and 5% respectively.<sup>6</sup> Furthermore, significant at risk behaviours have been identified in this population. 12% of adolescents in the Youth '07 survey<sup>6</sup> took part in either 5 or 6 at-risk behaviours—including illicit drug and cigarette use/sexual intercourse/violence/self-harm—highlighting the need for adolescent-appropriate healthcare services.

Adolescents usually seek health care from GPs and/or school health clinics,<sup>4,6,8</sup> although a small group of adolescents use secondary care specialists as their main

health provider.<sup>9</sup> Unfortunately, many young people experience difficulties accessing health care<sup>6,8,9</sup> and this is particularly true for vulnerable young people.<sup>10</sup> Concerns about confidentiality are a key reason why adolescents often forego seeking health care.<sup>4,8,10</sup> Moreover, they often do not experience private and confidential healthcare.<sup>6,11</sup> In addition, many adolescents do not know where to obtain help especially for mental health, substance abuse or reproductive issues.<sup>4,9,12</sup> Other barriers to accessing health care include lack of transport,<sup>4</sup> poor availability of care,<sup>13</sup> cost,<sup>13</sup> difficulty obtaining an appointment,<sup>2,4</sup> unfriendly environment and/or staff and fear that health workers will scold, ask difficult questions or carry out unpleasant procedures.<sup>4,12,13</sup>

GPs also report difficulties in providing health care to adolescents and that such consultations often require more time.<sup>14</sup> A HEeADSS assessment takes time,<sup>1</sup> which may not be possible within the time constraints of primary care.<sup>4</sup> Moreover, vulnerable adolescents frequently participate in multiple risk behaviours<sup>7</sup> and may be more likely to require lengthy consultations. However, research suggests that the average consultation time for adolescents is shorter than for adults or children.<sup>1</sup> Other difficulties cited by GPs about working with adolescents include feeling inadequately trained in working with young people,<sup>13-16</sup> difficulty managing complex health problems and lack of confidence in their consultation skills.<sup>14</sup> Many desire ongoing education in these areas,<sup>15,16</sup> and linkages with and support from other service providers.<sup>14</sup>

What role therefore might a secondary level paediatric clinic play in helping overcome such barriers? Unfortunately there is a lack of literature on the provision of adolescent focused health care at secondary level hospitals.

Research on youth friendly services has tended to focus on primary care,<sup>2,5</sup> school based clinics<sup>17</sup> and Youth One stop shops, and even then the evidence for these initiatives is small.<sup>13</sup> The available literature on adolescent health care at secondary level has tended to focus on young people with chronic health issues and on the issue of transition.<sup>18</sup>

In 2010, Tauranga Hospital, a secondary level hospital, undertook a review of the services available for adolescents both within the hospital and the community. As part of this, primary care providers were specifically asked what services they felt the hospital should provide. The key issues identified were a desire for a service that would assist in managing young people with multiple and often complex needs especially those considered vulnerable (Personal communication, May 2014: B. Daniel, Youth Adolescent Public Health Nurse, BOPDHB; Dr L Claydon MOSS, Team Leader Clinic 2 Sexual Health, BOPDHB) and to offer advice and support to primary care clinicians.

A secondary desire was for a service that could offer Jadelle (Personal communication May 2014 with Dr L Claydon). Jadelle is an intradermal form of progestin-based contraception lasting up to 5 years,<sup>19</sup> the efficacy of which is independent of individual compliance.<sup>20</sup> Jadelle is of great potential benefit to adolescents in need of contraception,<sup>19</sup> but can be difficult to access as initiation and continuation are provider dependent.<sup>20</sup> In 2011 there were few providers in Tauranga resulting in a significant waiting list. However, the newly appointed paediatrician was trained in

intra-dermal insertion. A business case was submitted and the hospital agreed to fund two Jadelle insertions per week.

In May 2011, the ARC was established. The goal was to provide comprehensive youth focused assessment on adolescents identified as being vulnerable by their primary health care providers. It also aimed to link adolescents into appropriate services and offer support to primary care providers. Each patient was offered a one hour appointment allowing a thorough and holistic assessment. As a hospital service the appointments are free. The clinic was set up to see one new patient and two follow-up patients each week. It was designed as a trial to see whether such a service was actually needed and whether such a service could be provided in the setting of a secondary level hospital.

Since the clinic was a trial it was not officially announced but informally advertised to the Tauranga sexual health centre and the adolescent public health nurses as these were the two services most requesting assistance with care for adolescents they perceived as vulnerable. There were no set criteria as to what constituted vulnerable. Patients attending high school or under 18 years of age if no longer attending high school were eligible for referral. A total of 36 clinics were offered within the first year.

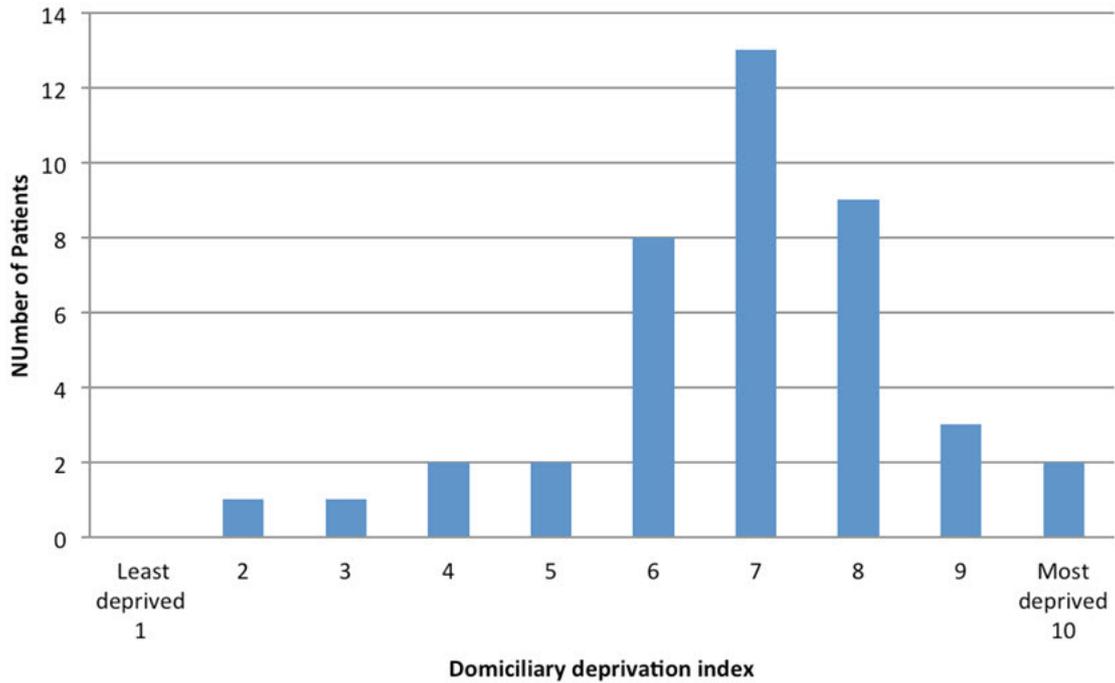
## **Method**

A retrospective review was completed of all electronic records of all patients referred to and attending the ARC from May 2011 to May 2012. Patients referred to the ARC but unable to attend the allocated Thursday were included in the study if they were seen by the same ARC consultant in a different outpatient clinic. Patients not referred to the ARC but seen in that clinic slot because patients could only attend on a Thursday were excluded. All patients referred to the ARC clinic were seen. The Paediatric Department at Tauranga Hospital runs paper lite hence the review of electronic records.

## **Results**

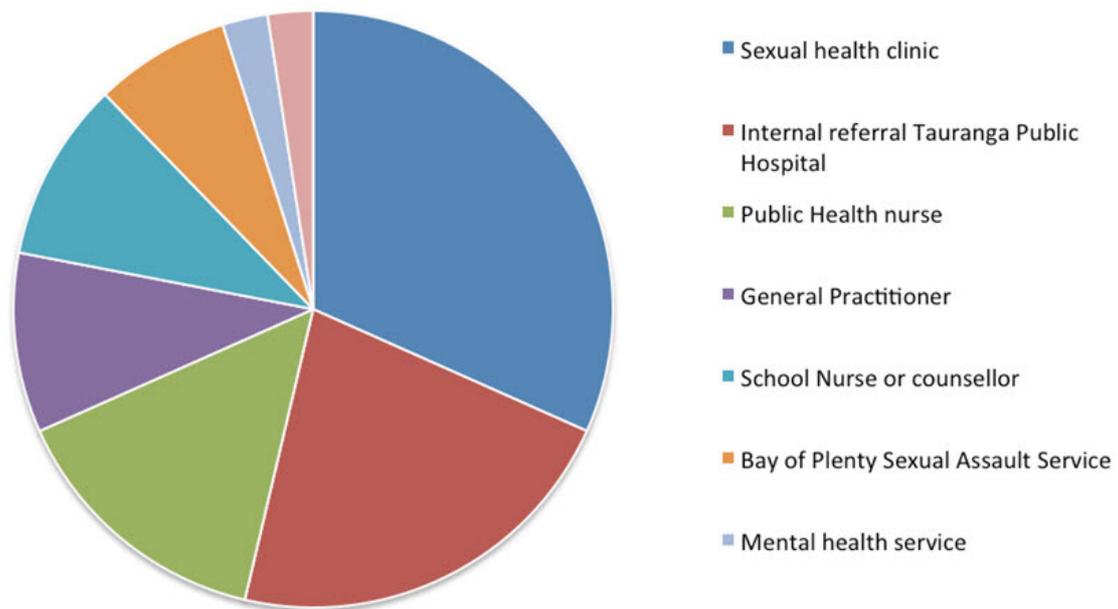
Forty-one patients were seen of whom 40 were female (98%). Just over half the patients were NZ Maori (54%) with 34% NZ European, 4% Indian and 7% other European. Patients ranged in age from 12 to 18 years with the median and mode age of 16 years. NZ Maori were younger than their NZ European counter parts (An unpaired t-test analysis p value 0.0087). As demonstrated in figure one below, patients were predominantly from lower socio-economic neighbourhoods.

**Figure 1. Home address deprivation index of ARC patients**



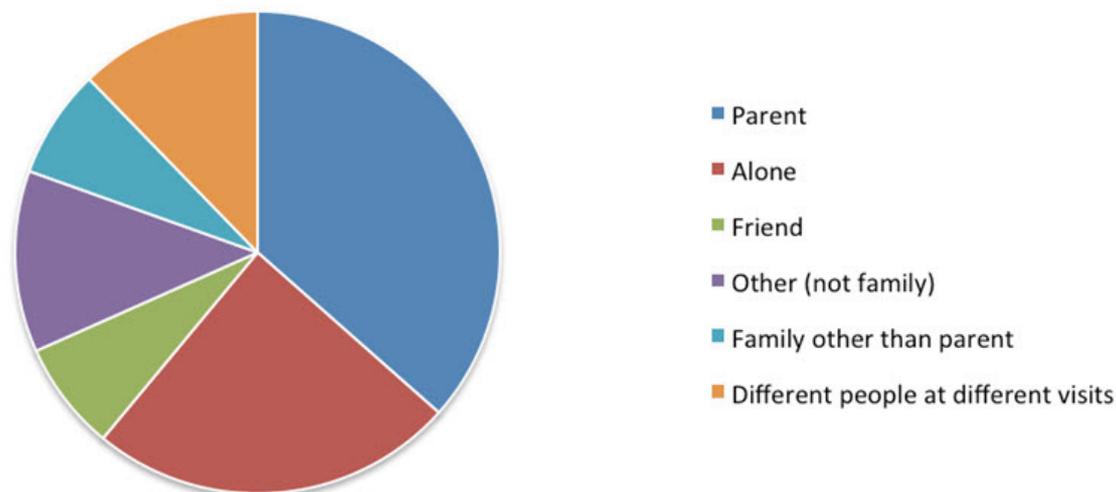
Patients were referred from a variety of sources (Figure 2). The majority of referrals (32%) were from the Tauranga Hospital Sexual Health Clinic, followed by internal referrals from paediatricians (22%).

**Figure 2. Sources of referral to ARC**



The majority of patients (76%) were accompanied by another person (Figure 3) and nearly half of patients were accompanied by a parent or other family member (44%).

**Figure 3. Persons accompanying ARC patients to clinic appointments**

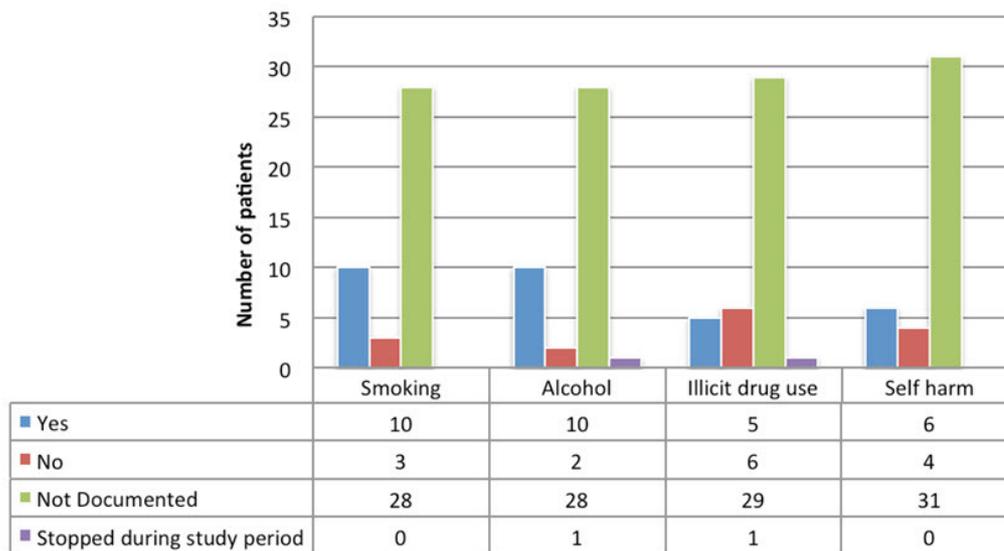


Fifty-nine percent of patients were referred for a single reason either for Jadelle (50%) or for a young person's health assessment (YPHA) (38%). Twenty-nine percent were referred for two reasons and 12% for three or more reasons. Of those referred for several reasons, the two most common combinations were for Jadelle, a YPHA and medical condition(s) (18%), and for Jadelle and a YPHC (18%). Almost a quarter of patients (24%) referred had a general medical condition as part of their referral with the three most common conditions being recurrent abdominal pain (30%), eczema (20%), and obesity (20%). Mental health issues were stated as a reason referral in 20% of all ARC patients.

Eighty-one percent of patients had multiple diagnoses after their consultation(s). The three most common combinations were psychosocial and mental health (12%), psychosocial and medical (12%), and Jadelle and medical (12%). Of those receiving treatment 63% received treatment for a general medical condition, 37% had Jadelle inserted and 22% had contraception other than Jadelle (22%) prescribed. The most common medical treatments provided were eczema management (31%), asthma management (15%) and dietary supplement prescriptions (15%).

Only seven percent of patients had a HEAdSS assessment completely documented. A little less than half (43.9%) had some aspects of the HEAdSS assessment documented. For 20% of patients neither the completion status nor results relevant to the HEAdSS assessment were documented. Documentation of presence or absence of at-risk behaviours, (smoking, alcohol use, illicit drug use and self-harm) was not documented for a substantial proportion of ARC patients (figure 4). Of those for whom at-risk behaviour status was documented, a greater proportion were taking part compared with not, with the sole exception of illicit drug-use. In cases of documented illicit drug use, all identified cannabis as their only drug used.

**Figure 4. At-risk behaviour prevalence of adolescents attending the ARC**



Cessation of an at-risk behaviours occurred during the study period for 2% of those documented as smoking and for 2% of those documented as using illicit drugs. Fifty-six percent of patients received specific medical treatment.

Thirty percent of patients were referred to another service. Of those referred, the majority (57%) had referrals made to multiple services. The five most common referrals were to Child and Adolescent Mental Health Service and their Maori equivalent, Adolescent Public Health Nurses, Clinical Psychology Tauranga Hospital, School Health Nurses and Northern Health Schooling (hospital and/or community-based transitional education for children with prolonged illness-related school absence).

Nearly half of ARC patients (46%) are enrolled for follow-up, 20% were discharged due to no indications for follow-up and 24% were discharged after failing to make contact with the clinic more than 1 month after an appointment was not attended; 10% of patients were discharged after moving area or after being referred to adult services once older than 18 years.

## Discussion

The results of this study suggest that the novel ARC is meeting its goals. All patients who were referred were seen, with more new patients in total than intended; both findings reflective of the high level of accessibility achieved. That referrals came from primary healthcare sources who were not told of the service confirms the perceived need for a youth-specific health service.

Interestingly, nearly a quarter of referrals were from paediatricians within the hospital, suggesting that many paediatricians still lack confidence in their ability to address adolescent issues.<sup>21</sup>

The patients seen at the ARC can be considered vulnerable. This study found these patients to have higher rates of risk taking behaviours compared with the New Zealand adolescent population<sup>6</sup> in terms of smoking (77% vs 8%), illicit drug use (42% vs 5%), alcohol consumption (77% vs 61%) and self-harm (60% vs 15–25%).<sup>6</sup> Furthermore, the ARC is seeing patients predominantly from lower socioeconomic neighbourhoods, demonstrating excellent accessibility for a cohort of the population who encounter greater difficulties when accessing health care.<sup>6,11</sup>

The large Maori component of ARC patients (greater than the population average),<sup>8</sup> reflects another major success of the ARC service as Maori adolescents frequently have greater difficulty in accessing health services<sup>22</sup> and have poorer health outcomes compared with non-Maori.<sup>22,23</sup>

In addition to being vulnerable, the adolescents seen had multiple health issues. 20% of patients seen in the ARC were referred for mental health related issues, a higher rate compared to previous research in which psychological conditions accounted for 5.4% of reasons for adolescent healthcare consultation.<sup>2</sup>

Nearly one-third of ARC patients were referred onto other services, as would be expected given their complexity. The high referral rate may also reflect that the ARC Paediatrician had a greater knowledge of the available youth-targeted services and more established relationships with the referral services. Certainly the clinic is meeting its aim of seeing complex adolescents rather than patients who could be easily managed in primary care. Whilst the clinic is meeting its aim of providing Jadelle, it could be providing more as funding is available for 104 Jadelle insertions per year.

The paucity of male patients accessing the ARC is an area of concern. Globally, adolescent males access health care less than females<sup>24</sup> but not to this extreme. This may be explained, at least in part, by the fact that contraception accounted for a large proportion of referral reasons and that the greatest proportion of referrals came from the sexual health clinic, which has a higher female to male ratio.<sup>25</sup> There is limited evidence on how to target and/or keep males accessing health care.<sup>24,25</sup>

The major deficiency of the ARC is the lack of documentation of HEeADSS assessments. The high non-documentation rates for at-risk behaviours limit the accuracy when drawing comparisons between the ARC audit results and corresponding national data. Therefore, uncertainty remains as to whether the true prevalence of ARC patient at-risk behaviours has been under or over represented. We would argue that HEeADSS assessments were completed in the vast majority of patients but deliberately not documented due to concerns about confidentiality.

Confidentiality is recognized as a cornerstone of effective adolescent health care. The assurance of this is vital to the physician-patient relationship.<sup>3,4,10</sup> There are concerns about how confidential electronic records are,<sup>26</sup> especially in comparison to paper records.<sup>27</sup> Electronic records can be easier to view with an increased potential for breaches in privacy.<sup>27</sup>

The media has been quick to highlight when breaches have occurred which may explain consumers' concerns.<sup>28</sup> Adolescents are likely to forgo medical care if they are worried about confidentiality especially for sensitive issues such as sexual and mental health problems.<sup>9,10,13</sup>

However, good medical record keeping is essential.<sup>29,30</sup> Medical records are needed to ensure continuity of care for the patient, act as an aide memoire, facilitate communication between different members of the health team and are vital for defending against complaints.<sup>30</sup> Nevertheless medical records are often found wanting.<sup>29</sup>

As a result of this study, the problem of where and how to record HEeADSS assessment has been highlighted. Several solutions have been tried. One was to lock the letter with access only to the author. This proved untenable as correspondence to the referrer was expected and there were concerns about what would happen if the author of the letter was unavailable. Next a separate letter with all the HEeADSS information was made. However, this created more work for the administration staff and still left the problem about where this letter was stored.

Currently we are trailing using a HEeADSS proforma to record the information. This gets scanned into the patient records but is not sent to the patient or referrer. Whilst it can still be accessed it is hoped that since it is filled in by hand it wouldn't be given as much notice in comparison with a typed letter and is less likely to be sent out inadvertently. Whether this is successful remains to be seen.

## Conclusion

The ARC demonstrates that a secondary level hospital can offer accessible and holistic care to vulnerable adolescents. The major teething problem for this new service has been how to ensure confidentiality whilst enabling accurate consultation recording. This is a work in progress. In addition, this study only established that care was provided but no qualitative information in regards to the care, which remains the next question in the clinic's development.

**Competing interests:** Nil.

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## ***In vitro* comparison of four rapid antigen tests for group A streptococcus detection**

Arlo Upton, Cathy Lowe, Joanna Stewart, Susan Taylor, Diana Lennon

### **Abstract**

**Aims** To examine the analytical sensitivity of four rapid antigen tests (RADT) for detection of group A streptococcus (GAS).

**Methods** The sensitivities of four RADT kits to detect clinical and reference strains of GAS at different dilutions were compared. Test results were read by two people, and differences in interpretation were settled by a third reader.

**Results** A total of 697 tests were performed. For all kits, detection increased with increasing colony counts of GAS. One kit [ulti med Products, Deutschland, GmbH (UM)] was found to have the highest sensitivity, although there was no significant difference between it and one other kit (Testpack Plus). All kits were only faintly positive or negative at low colony counts.

**Conclusions** The sensitivity of RADT for detecting GAS is related to inoculum size and the faint appearance of a positive test at low colony counts contributes to inter-observer variability. Sore throats with low colony counts have been shown to be clinically relevant.

Non-suppurative complications of pharyngitis due to group A streptococcus (GAS), i.e. acute rheumatic fever (ARF) and acute post-streptococcal glomerulonephritis (APSGN), continue to disproportionately afflict socially disadvantaged children in New Zealand (NZ). Rates of ARF and APSGN in Māori and Pacific children in NZ are among the highest in the world.<sup>1,2</sup>

Antibiotic treatment of GAS pharyngitis can prevent the development of ARF,<sup>3</sup> and a school-based programme which identifies and treats children with GAS pharyngitis could result in fewer cases of ARF and perhaps APSGN.<sup>3,4</sup> The NZ Ministry of Health (MOH) has indicated that they wish to reduce the incidence of ARF in Māori and Pacific people to Pakeha (NZ European) rates by 2020.<sup>5</sup> There are several school-based sore throat clinics running in high risk communities in North Island, with the specific aim of reducing the incidence of ARF.<sup>6</sup>

Sore throat is one of the top 10 presenting symptoms in primary care;<sup>7</sup> however, the signs and symptoms of bacterial and viral pharyngitis overlap making differentiation on clinical grounds problematic. A throat swab for culture (48 hours incubation) is the current gold standard for diagnosing GAS throat infection,<sup>8</sup> but throat swab culture does not allow for point of care diagnosis and treatment, and responding to a positive culture result requires subsequent re-contact with the patient.

Disadvantaged children, often Māori or Pacific, in addition to suffering from preventable diseases disproportionately, are well documented as having limited ability to access healthcare.<sup>9</sup>

An attractive alternative to culture is rapid antigen detection tests (RADT). In contrast to culture, RADTs can be performed at the time the patient presents and provide a result in less than 15 minutes. It has been demonstrated in adults that compliance to antibiotic therapy for GAS throat infections is higher when a RADT is used for point of care diagnosis.<sup>10</sup> However, to date, the implementation of RADTs has been hampered by sensitivity concerns necessitating back up culture for all negative throat swab RADT for GAS.<sup>11</sup>

Presently, and in contrast to point of care pregnancy tests, RADTs for GAS are not funded by the NZ government. Pharmac have expressed interest in funding RADTs if a testing strategy with appropriate test performance can be identified.<sup>12</sup> In addition to *ruling in* GAS pharyngitis among high risk (for ARF) children, RADTs may also have a role in *ruling out* GAS pharyngitis in low risk settings; which could have a positive impact by reducing unnecessary empiric antibiotic prescription.<sup>13</sup>

Norris *et al* have recently shown that antibiotic prescription in Te Tairāwhiti (an area with a high incidence of ARF) is higher among those less likely to require it (urban, non-Māori living in areas with lower socioeconomic deprivation scores), and lower among those with greatest need.<sup>14</sup>

GAS RADTs are usually considered to be of moderate complexity. None of the kits used in this study are Clinical Laboratory Improvement Amendment (CLIA)-waived (as pregnancy tests for home use are). Thus, some training is recommended if non-laboratory personnel, such as school nurses, whānau workers, GP practise nurses etc, are performing the tests.

As a precursor to a planned clinical study examining the possible role for RADTs in selected schools, and perhaps other sites, in NZ, we performed a laboratory study comparing the *in vitro* test performance of four RADTs for GAS.

## Methods

The four RADT kits known to be commercially available in NZ in mid-2011 were included in the study [ulti med Products, Deutschland, GmbH (UM), SD-Bio, Standard Diagnostics, Hagal-dong, Korea (SD), Clearview Exact, Inverness Medical, Bedford, UK (CV), and Testpack Plus, Inverness Medical, Bedford, UK (TP)]. Their NZ suppliers were contacted by the senior author, and all sought and obtained agreement from the manufacturers to supply approximately 200 test kits free of charge for the study.

GAS strains used were a combination of a reference strain (ATCC 19615) and strains isolated from patient throat swabs. Clinical isolates were identified as GAS by colonial appearance on blood agar (beta-haemolytic and >0.5 mm colony size) and latex agglutination testing (PathoDX<sup>®</sup> Strep Grouping, Remel, Lenexa, Kansas).

Following overnight incubation (CO<sub>2</sub>, 37°C), on sheep blood agar, fresh GAS colonies were diluted in saline to a concentration of approximately 10×10<sup>6</sup>/L (MacFarland 0.5 by turbidimetre). In order to establish more accurate counts of bacteria, 1 mL of solution was plated onto blood agar and incubated overnight in CO<sub>2</sub> at 37°C. The number of colonies present was used to calculate colony forming units (CFU)/mL. RADTs were tested using different volumes of the GAS solution (10–100 mL), starting at 100 mL and reducing the volume (and corresponding total colony count) to a discriminating volume near the cut off between negative and positive results. A total CFU count was calculated using the colony count and the volume used, e.g. colony count=140 CFU/mL and volume used=100mL gives total colony count used in testing of 14×10<sup>3</sup> CFU.

Tests were performed as per the manufacturer's instructions. All four kits were laid out on the bench, and the order of kits was changed in a random fashion each day. A negative control was performed for all kits at the beginning of the study.

Test results were read by a final-year Medical Laboratory Science student (CL), who was blinded to the inoculum size, and a Clinical Microbiologist (AU). When their interpretation of a test was disparate a microbiology scientist also read the result, and a consensus was reached. Test results were reported in a graded fashion (positive, faint/positive and faint/negative). The last category was used when the investigators thought they could detect a line indicating a positive result, but it was so faint that they could not be certain.

Organisms known to colonise the oropharynx were used for specificity testing and included: group one (*Streptococcus anginosus*, *S. salivarius*, *S. mitis*, *S. mutans*, *S. sanguinis*, and *S. dysgalactiae*), group 2 (*Bacteroides melaninogenicus*, *Fusobacterium nucleatum*, and *Veillonella parvula*), group 3 (*Neisseria sicca*, *N. pharyngitis*, *Moraxella catarrhalis*, *Haemophilus influenzae*, and *H. parainfluenzae*), and group 4 (*Escherichia coli*, *Pseudomonas aeruginosa*, *Candida albicans*, *Staphylococcus aureus*, and *S. epidermidis*).

Specificity testing was performed using the two RADTs found to have the highest sensitivity. Groups of commensal organisms were made up to at least 0.5 MacFarland by mixing one colony of each organism in sterile saline.

Binary logistic regression was used to determine whether a difference in the detection rate across kits could be found. Absolute colony count and kit were included as explanatory variables. Initially their interaction was also included. The outcome was whether the test was negative or not.

## Results

A total of 697 tests were performed for determination of sensitivity (Table 1) using 10–100 mcL of solution giving CFU/test between  $4.875 \times 10^3$  and  $3.5 \times 10^6$ . There was weak evidence that the difference in the kits was influenced by the colony count ( $p=0.07$ ) with the greatest difference being at the lower colony counts. When the interaction was removed from the analysis to examine the overall effect of kits, there was strong evidence of an effect of both colony count and kit (both  $p<0.0001$ ), with detection increasing with concentration.

Kit UM had the highest estimated rate, which was significantly higher than SD and CV ( $p<0.0001$  and  $p=0.008$  respectively) but no difference could be demonstrated between UM and TP ( $p=0.15$ ) (Table 1).

Approximately 30% of the results included as ‘positive’ were barely discernable (faint/negative); if these were not included as positive the overall sensitivity dropped considerably for all RADTs by between 18 and 38.3% (Table 1).

Specificity testing using the UM (three tests on each organism group=12 tests in total) and TP (one test on each organism group=4 tests in total) kits were all negative.

Technical errors where no result was available occurred for all kits but most frequently for TP. All technical errors were due to a reagent not being added in the correct sequence or at all.

**Table 1. Percentage RADT tests positive at different colony forming units**

Test	Colony-forming units per test					Total tests (% positive)	% positive with faint/negatives considered negative
	<15×10 <sup>3</sup>	15≤20×10 <sup>3</sup>	20≤40×10 <sup>3</sup>	40≤80×10 <sup>3</sup>	≥80×10 <sup>3</sup>		
RADT	Number of tests performed (percentage positive)						
Clearview	38 (68.4)	52 (67.3)	44 (75.0)	27 (88.9)	14 (100.0)	175 (75.4)	37.1
SD Bio	38 (21.1)	25 (17.3)	45 (48.9)	28 (82.1)	14 (100.0)	177 (42.9)	24.9
Testpack	35 (48.6)	49 (85.7)	43 (90.7)	27 (92.6)	14 (92.9)	168 (81.0)	54.2
Ulti-med	37 (70.3)	53 (83.0)	45 (91.1)	28 (100.0)	14 (100.0)	177 (86.4)	54.8

## Discussion

This study confirms the relationship between the sensitivity of RADTs for detection of GAS and inoculum size (i.e. colony count). Lasseter et al had similar findings in their laboratory study.<sup>15</sup> We found that the two best performing RADTs had *in vitro* sensitivities >90% when there were at least  $20 \times 10^3$  CFU per test. This relationship has also been identified in clinical studies; combining two throat swabs improves the sensitivity of both culture and RADT compared with a single swab.<sup>16</sup> An incubation step prior to RADT has been found to improve the sensitivity of TP.<sup>17</sup>

The issue of inoculum size is clinically important. Significant GAS infection (with symptoms, antibody titre rise, and risk for ARF) can occur in children despite only small numbers (fewer than ten colonies on bacterial culture plate) of GAS isolated from the throat swab. Thus, in order for a RADT to replace culture it must be able to detect GAS pharyngitis in those children with low bacterial load.<sup>18</sup>

To our knowledge, there is only one other study comparing the *in vitro* sensitivity of RADTs for GAS detection.<sup>15</sup> In this study, TP had superior sensitivity to three of the four comparator RADTs, and was found to be easiest to use overall. The only comparator (to TP) examined in both this study and ours was CV.

There was a suggestion that the sensitivity of the kits may be influenced by the colony count. At the lowest colony count ( $<15 \times 10^6$  CFU) UM was more sensitive than the other kits, including TP (70.3% vs. 48.6%) despite not being able to demonstrate an overall difference in sensitivity between UM and TP. The authors did note that at the lowest colony counts, some of the TP kits that were negative at 10 minutes (the upper time limit for the test to be read) became positive if left another two or so minutes.

We found TP to be easiest to read but not easiest to use; the majority of our technical errors were with TP; mostly due to forgetting to add the third reagent. As TP was the only kit that requires a third reagent, it is likely that if TP alone was used in a clinical setting the person performing the test would remember to add all three reagents.

None of the RADTs were easy to read at low colony counts. The positive lines were extremely faint precipitating some dispute between investigators (and calling in a third scientist for arbitration). This highlights the importance of education around reading results, especially when RADTs are utilised in the community by non-laboratory staff.

It is possible that our study design (adding from 10 to 100 mcL of GAS solution to the RADT reagents) may have negatively impacted the test performance by diluting the amount of GAS antigen available for absorption and migration through the membrane, as the membrane can only take so much liquid volume before saturation. However, this would have affected all RADTs equally. In addition, it is possible that the different volumes of inoculum used impacted on test results.

We did not focus on specificity testing as clinical studies have consistently demonstrated excellent specificity (>95%). Lasseter et al found 100% specificity in their laboratory evaluation.<sup>15</sup> We conclude that UM and TP were the most sensitive kits; all kits were simple to use although our technical errors were mostly with TP.

The TP kit was thought to be clearest to read. However, our findings support the current recommendation that RADTs are not used as stand-alone point of care tests in the community without culture back-up. The sensitivity and negative predictive value are insufficient to be reassured by a negative test in a symptomatic patient. In addition, at low colony counts the tests are difficult to read and intra-observer variability is common.

On the basis of this study, we have elected to employ the UM kit for a clinical study which will determine whether or not flocculated swab technology is able to sufficiently improve the sensitivity of the RADTs such that they can be used for the diagnosis of GAS pharyngitis as a point of care test at high risk schools and in primary care.

**Competing interests:** Nil.

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## The current state of ototoxicity monitoring in New Zealand

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### Abstract

**Aim** To explore medical oncologists' and audiologists' knowledge and attitudes regarding ototoxicity monitoring, and to gain an understanding of monitoring currently being implemented at District Health Boards (DHBs) nationwide. We also aimed to identify ways in which audiological outcomes for patients receiving potentially ototoxic treatments could be improved, including examining whether the formulation and implementation of a national ototoxicity monitoring guideline is necessary.

**Method** Complementary telephonic interviews were conducted with 16 senior or charge audiologists and seven senior medical oncologists from DHBs across New Zealand, and their responses analysed.

**Results** Responses indicate a comprehensive understanding of ototoxicity across both disciplines; however there is limited familiarity with ototoxicity monitoring protocols. Patients across New Zealand undergo significantly variable ototoxicity monitoring; local practices range from no routine monitoring to audiological assessment prior to each cycle of chemotherapy. No routine audiological follow up is conducted post completion of treatment at any DHB, in contrast with international guidelines. Twenty-two of 23 participants were in favour of development of a national ototoxicity monitoring guideline.

**Conclusion** There is significant discrepancy in how ototoxicity monitoring is conducted across New Zealand, and implementation of a national ototoxicity monitoring protocol may improve audiological outcomes for patients receiving ototoxic chemotherapy.

Ototoxicity is the functional impairment of the inner ear and eighth cranial nerve secondary to compounds toxic to the inner ear, including therapeutic pharmaceutical agents.<sup>1</sup> Various antineoplastic medications are known to cause ototoxicity, particularly the platinum-based compound cisplatin, which is used with both palliative and curative intent across a wide range of malignant disease.

Cisplatin has the potential to cause progressive bilateral irreversible high-frequency sensorineural hearing loss associated with tinnitus, which may manifest during treatment or be delayed for several months after the completion of therapy.<sup>2</sup> The primary mechanism of such hearing loss is thought to be apoptosis<sup>3</sup> of the outer hair cells at the base of the cochlea.<sup>4</sup> This apoptotic pathway is activated secondary to an imbalance between the production of reactive oxygen species and depletion of anti-oxidant enzymes induced by cisplatin.<sup>5</sup> Other evidence suggests spiral ganglion cells and the stria vascularis are affected in addition to damage to the organ of Corti.<sup>3</sup>

The incidence of ototoxicity is estimated between 3%<sup>6</sup> to 100%,<sup>7,8</sup> where some studies show up to 100% of patients receiving high dose cisplatin (150–225 mg/m<sup>2</sup>) who are tested with extended-high frequency audiometry being affected.<sup>8</sup> This variability in ototoxic effect is attributable to both audiological testing methods and to the range of inter-individual susceptibility to cisplatin.

Monitoring using high frequency pure tone audiometry is likely to detect a greater incidence of hearing impairment than conventional audiometry, as shifts in hearing thresholds occur earlier at these higher frequencies.<sup>8</sup>

Risk of cisplatin ototoxicity appears to increase at extremes of age, with elderly patients and the paediatric population being particularly at risk.<sup>9</sup> Other individual risk factors include renal impairment, pre-existing hearing impairment or noise exposure,<sup>2</sup> poor general medical state including hypoalbuminaemia and anaemia,<sup>10</sup> concomitant cranial irradiation,<sup>11,12</sup> and inherited polymorphisms in genes responsible for cisplatin metabolism.<sup>13,14</sup>

Total cumulative dose is an important factor,<sup>9,15</sup> as well as dose per cycle of treatment,<sup>16</sup> and timing of monitoring relative to cycle of chemotherapy. Method of administration is an additional consideration, with rapid intravenous bolus administration associated with increased risk of inducing ototoxicity.<sup>17</sup>

Further serious toxic side effects of cisplatin include nephrotoxicity and neurotoxicity.<sup>6</sup> Other medical treatments commonly associated with ototoxicity include aminoglycoside antibiotics such as gentamicin, loop diuretics such as furosemide, salicylates, and antimalarial medications, as well as cranial irradiation.<sup>18</sup>

Baseline audiological assessment and routine follow up during treatment and beyond allows early detection of cochlear damage, providing an opportunity for intervention and rehabilitation.

There is no nationally accepted ototoxicity monitoring protocol in New Zealand, and the current state of monitoring is poorly understood. This project aimed to explore knowledge of and attitudes towards ototoxicity monitoring of both medical oncologists and audiologists, as well as patterns of monitoring currently being conducted, and attitudes towards potential development of a national clinical guideline.

## Methods

This project was conducted in two phases. The initial phase involved interviewing senior audiologists from 16 of New Zealand's 20 District Health Boards (DHBs). These senior audiologists had an average of 16.4 years' experience working in clinical audiology. Four DHBs were excluded as they did not conduct any ototoxicity monitoring, referring their patients to larger centres.

The second phase comprised a corresponding tailored telephone questionnaire with senior medical oncologists at each DHB or regional centre responsible for provision of medical oncology services. Oncologists had an average of 16.9 years' experience working at consultant level. Due to the centralisation of services, there were fewer potential participants in the oncology branch of the study. Eight DHBs have resident medical oncologists, with the remaining 12 DHBs providing a satellite service staffed by oncologists travelling from major centres. Seven of eight potential participants were interviewed, with one declining to participate.

Participants were asked a range of open- and closed-ended questions in three broad categories (appendix 1): (1) prior knowledge of and attitudes towards ototoxicity monitoring; (2) details of baseline and follow up monitoring procedures in place at their DHB; and (3) views on potential

improvements to ototoxicity monitoring. Ethical approval was obtained for each phase separately via the University of Canterbury Human Ethics committee (Refs: HEC 2010/77/LR and HEC 2012/27/LR-PS).

## Results

**Knowledge of ototoxicity monitoring**—All oncologists and 88% of audiologists interviewed identified cisplatin as a medical treatment that may permanently affect hearing. 86% of oncologists and 19% of audiologists additionally identified carboplatin as a cause, while all audiologists and 71% of oncologists also identified aminoglycosides as such.

Cranial irradiation was less frequently identified, with 43% and 13% of oncologists and audiologists respectively recognising this. Other treatments identified by oncologists included: furosemide, antiepileptics, and antibiotics generally; audiologists additionally reported aspirin, alcohol, loop diuretics, anti-tuberculosis medications and anti-malarials as potentially affecting hearing.

All participants across both disciplines correctly categorised the configuration of hearing loss resulting from cisplatin ototoxicity as high frequency. A wide range of the incidence of such hearing loss was estimated by both audiologists and oncologists (0-75%), with a number (4 oncologists and 4 audiologists) preferring not to answer. Many oncologists commented on the difficulty in estimating this, due to the inter-patient variability. They collectively mentioned several factors contributing to this variability: cisplatin schedule including dose and method of administration (bolus versus infusion), cumulative dose, and the definition of hearing loss (objective on audiometry or subjective reporting).

75% of audiologists and 86% of oncologists reported the likelihood of developing tinnitus in response to cisplatin chemotherapy as either “moderate” or “very likely”. All oncologists and 88% of audiologists reported patients receiving cisplatin to be either “unlikely” to “slightly likely” to develop balance disturbances as a result of chemotherapy.

No oncologists were able to name a formal ototoxicity monitoring protocol, whilst three audiologists named the American Speech and Language Hearing Association (ASHA) guideline,<sup>19</sup> one the American Academy of Audiology (AAA) guideline,<sup>20</sup> and one the Brock Scale for Ototoxicity Monitoring.<sup>15</sup>

Oncologist opinions on the benefits of ototoxicity monitoring included:

- Early detection of hearing loss, prior to the development of subjective impairment.
- To enable changes to be made to the chemotherapy regime including stopping cisplatin if clinically indicated.
- Documentation of change in hearing to enable lodgement of an Accident Compensation Corporation (ACC) claim for treatment injury.

Several oncologists mentioned limitations in altering effective treatment plans, due to a lack of suitable alternatives to cisplatin. Oncologists also discussed the importance of intent of treatment (palliative versus curative) in considering modification of treatment plans. Other responses included referral for appropriate support services and

incidental finding of pre-existing hearing loss or other otological problems as benefits of monitoring.

Audiologist's opinions on the purpose of monitoring mirrored those of oncologists: early identification of hearing loss allowing adjustments to treatment, differentiation of pre-existing hearing loss from that related to treatment, to enable compensation for hearing aids, and to plan possible future aural rehabilitation.

The importance of baseline monitoring was rated as either "moderately important" or "very important" by 86% of oncologists. One oncologist rated it as "somewhat important", along with other baseline organ function testing such as renal and lung function. In comparison, all audiologists rated baseline audiometry as "very important".

The majority of both oncologists and audiologists (100% and 88% respectively) agreed that it was primarily the prescribing oncologist's responsibility to inform the patient of the potential risk to their hearing. Oncologists additionally assigned a degree of responsibility to the registrar performing the consent process and also to the wider team involved in treatment. Audiologists also considered ENT or other specialists referring for cisplatin therapy, audiologists themselves, and oncology nurses to carry some of this responsibility.

**Current ototoxicity monitoring practices**—Patients receiving potentially ototoxic chemotherapy being managed at all but one centre undergo some form of routine ototoxicity monitoring; however the nature of this is highly variable between treatment centres.

Referral for audiology is invariably in paper or electronic form. 19% of audiologists reported baseline audiology appointments are confirmed in the form of a telephone call to the patient, whilst 57% of oncologists reported their protocols dictate a formal check to ensure baseline audiometry has been performed prior to first chemotherapy being administered.

When chemotherapy is commenced prior to baseline audiometry this is a measured decision due to urgency in instigating treatment, rather than due to administrative error. A report of baseline results is made available to oncology, with timeframes ranging from immediately to a formal report being sent in 2-4 weeks. Baseline tests conducted by audiologists are reported in Table 1.

**Table 1. Battery of baseline tests conducted by audiologists interviewed (total audiologists = 16)**

<b>Audiological test</b>	<b>Number</b>
Case history	11
Otoscopy	15
Tympanometry	15
Pure tone audiometry	16
Speech audiometry	16
High frequency audiometry	15
Otoacoustic emissions	9

All DHBs conducting ototoxicity monitoring perform baseline audiometry, and the aforementioned variability between practices appears in ongoing monitoring. Frequency of audiological follow up ranged from preceding every cycle of cisplatin, to every two to three cycles depending on dose, to baseline and end of treatment only.

There was some discrepancy between reports of oncologists and audiologists in who decides both whether further monitoring should occur and the timing thereof. 38% of audiologists reported that they decide the timing of further monitoring, whilst 86% of oncologists reported that they make this decision as per local protocols.

Audiologists reported conducting largely the same battery of tests during follow up assessments as during the initial assessment. Three audiologists conducted shorter case histories, while one department didn't repeat OAEs unless there was a change in hearing, and four didn't repeat bone conduction if air conduction thresholds were unchanged. Two audiologists didn't repeat tympanometry at subsequent assessments.

No DHB performed routine monitoring beyond the end of chemotherapeutic treatment, with any further audiological assessment triggered by symptoms of hearing impairment being reported by the patient. Asked about the ideal duration of monitoring beyond treatment completion, oncologists were largely unsure, while audiologists suggested durations ranging one month to two years.

There was significant discrepancy between oncologists' and audiologists' accounts of how audiology reports are utilised. Oncologists invariably reported that audiology data affect clinical treatment decisions, specifically modification of the chemotherapy regime if significant hearing impairment is found.

Conversely, there was considerable uncertainty amongst audiologists as to how the data they generate are used. 94% of audiologists reported that they either didn't know how the data were used, suspected they weren't used at all, or were merely "hopeful" they influenced treatment decisions. Only one audiologist expressed confidence that audiological assessment guided treatment decisions.

**Potential improvement in monitoring practices**—All oncologists and 81% of audiologists felt there was room for improvement in ototoxicity monitoring at their DHB. Suggestions from oncologists were: better collaboration between audiology and oncology, implementation of follow up monitoring beyond the completion of treatment, and auditing of local practices to determine both how rigorously protocols are adhered to and how monitoring influences patient outcomes.

Audiologists' suggestions were: better communication between audiology and oncology, provision of a standardised national protocol, greater awareness in audiology departments of current local protocols, that balance assessment be included in protocols, up-skilling of oncologists to increase awareness of ototoxicity, increased staffing resources in audiology to enable prompt follow up to be conducted, and streamlining of referral processes to ensure no patients are missed.

All audiologists and all but one oncologist were in favour of a national protocol guiding ototoxicity monitoring, however several participants from both professions expressed concern regarding the availability of resources required to increase monitoring. They stated that any protocol would need to be evidence based, cost effective, and agreed upon by oncologists and audiologists nationally prior to its

implementation. 86% of oncologists and 94% of audiologists felt a national protocol would help audiology departments to obtain funding for equipment required for ototoxicity monitoring.

## Discussion

Hearing loss and tinnitus have the potential to cause severe social, vocational, and educational consequences. An effective ototoxicity monitoring programme detects cochlear injury prior to the onset of symptoms, allowing potential intervention to halt the progression of inner ear damage.

There are currently no national guidelines or protocols for ototoxicity monitoring, and there was little awareness of amongst both oncologists and audiologists of protocols that have been proposed overseas. Six of the seven treatment centres represented herein conducted ototoxicity monitoring according to a local protocol. While baseline monitoring occurs with consistency across these treatment centres, there is a substantial degree of variability in follow up ototoxicity monitoring.

Two large American governing bodies, ASHA and AAA have issued clinical practice guidelines for patients receiving potentially ototoxic treatments.<sup>19,20</sup> In addition to comprehensive baseline testing, AAA clinical guidelines recommend follow up evaluations prior to each cycle of platinum-based chemotherapy.<sup>20</sup> This regime is currently occurring at only one treatment centre in New Zealand, though one other centre conducts this frequency of monitoring for patients receiving high-dose cisplatin therapy.

ASHA recommends that follow up audiometry should be conducted during the 24 hours preceding cisplatin administration, and should include pure tone audiometry (PTA) extending to the high frequencies, as well as speech audiometry, tympanometry and bone conduction testing if any change in PTA is noted.<sup>19</sup> Where performed, subsequent assessments at the treatment centres in question were largely comprehensive, meeting these guidelines.

The duration until stabilisation of hearing loss following discontinuation of chemotherapy is poorly understood.<sup>21</sup> Knight et al.<sup>21</sup> showed a median time to hearing impairment of 135 days post termination of cisplatin in a paediatric population. Berg et al.<sup>22</sup> showed an average of 5.6 months (range 1–50 months) following end of treatment until the onset of hearing impairment, also in a paediatric population.

The wide range of ideal duration of monitoring reported by participants from both disciplines is consistent with a scarcity of quality data on this topic in the literature. AAA guidelines recommend follow up audiometry for “a few months” following completion of chemotherapy, and suggest this could be coordinated with a medical follow up visit.<sup>20</sup> One to 2 years of monitoring is recommended for patients who have additionally received head and neck irradiation.<sup>20</sup>

ASHA guidelines recommend follow up assessment as soon as treatment is complete, and again three and six months post treatment. Any deterioration in hearing on these assessments should instigate weekly follow up for as long as progression of impairment is observed.<sup>19</sup> The current lack of any routine post-treatment follow up in New Zealand represents a missed opportunity for identification of patients requiring audiological intervention.

Audiometry involving measurement of high frequencies (>8 kHz) is critical in early detection of damage to hair cells at the basal turn of the cochlea<sup>8,23,24</sup> before injury progresses to the hearing frequencies involved in communication. Both AAA and ASHA recommend comprehensive baseline testing should include conventional PTA, high frequency audiometry (HFA), tympanometry, speech audiometry, and otoacoustic emissions (OAEs).<sup>19,20</sup>

It is well established that OAEs can identify change in auditory function significantly earlier than conventional PTA,<sup>25</sup> whilst being less time consuming and more cost-effective. Only nine audiologists reported using any form of OAEs; however the baseline test battery was otherwise comprehensive and consistent with the aforementioned guidelines.

New Zealand's accident compensation (ACC) system covers treatment injuries via the Accident Compensation Act 2001, which may include compensation for hearing loss attributable to cisplatin therapy. Documentation thereof with sequential audiometry facilitates navigation of the ACC claim process, and both oncologists and audiologists alike were aware of this.

Agreement on the need for a standardised national ototoxicity monitoring protocol was unanimous amongst audiologists, and was agreed upon by all but one oncologist. A national guideline would offer clarity to both disciplines on best practice, and ensure patients nationwide can expect the same quality surveillance.

Until an approved method of otoprotection is established and the incidence of ototoxicity can be reduced, harm minimisation via effective audiological monitoring and rehabilitation are the mainstays of management. Comprehensive systematic ototoxicity monitoring provides the earliest possible detection of hearing loss,<sup>23</sup> allowing modification of treatment regimens as appropriate.

A peer reviewed national best practice guideline would encourage comprehensive monitoring across New Zealand's DHBs, and thereby improve audiological outcomes for patients receiving potentially ototoxic cancer treatment.

**Competing interests:** Nil.

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## **Appendix 1.**

### **Interview Questions – Oncologists**

#### **Demographic information**

At which DHB location do you work most often?

What other DHBs do you work at (incl. satellites)?

How long have you worked in your current position?

How long have you worked at this DHB?

How long have you worked in the NZ hospital system?

Have you worked in hospital-based oncology overseas? If so, what country and for how long?

When and where did you obtain your FRACP or equivalent to become a consultant medical oncologist?

Where did you learn about ototoxicity monitoring? (e.g. University programme, on the job, own reading, conferences?)

#### **Prior knowledge**

As far as you know, what types of medical treatments can permanently affect hearing?

What proportion of patients receiving cisplatin chemotherapy would develop hearing loss (0/25/50/75/100)?

*[If Aminoglycosides are mentioned above:]* What proportion of patients receiving aminoglycosides would develop hearing loss (0/25/50/75/100)?

If they did develop a hearing loss from ototoxicity, what configuration would it be likely to be? (e.g. flat/HF/LF?)

How severe is the hearing loss likely to be? (e.g. mild/mod/severe/profound?)

What impact do you think this hearing loss would have on their daily life (none/slight/mod/severe)?

How likely is it that these patients will also develop tinnitus (unlikely/slight/mod/very)?

What impact do you think this tinnitus would have on their daily life (none/slight/mod/severe)?

Are these patients also likely to develop balance problems (unlikely/slight/mod/very)?

What impact do you think these balance problems would have on their daily life (none/slight/mod/severe)?

What is the purpose of ototoxicity monitoring?

What benefits are there for the patient in ototoxicity monitoring?

What is your knowledge of ototoxicity monitoring protocols?

Can you name some protocols?

Are you aware of any New Zealand Audiological Society (NZAS) or New Zealand Association of Cancer Specialists (NZACS) ototoxicity protocols or best practice guidelines regarding monitoring?

### **First appointment**

Can you describe in as much detail as you can the referral process that leads to a patient receiving potentially ototoxic treatments being seen by Audiology?

Waitlists vary, so are there any assurances or checks that are made to make sure the patient is seen before their first ototoxic treatments (e.g. chemotherapy/radiation/aminoglycosides), or do they, as far as you know, just get the first available appointment?

How important is a baseline audiogram (not/somewhat/mod/very)?

When these patients arrive at the oncology clinic, how informed do you think they are about the risk to their hearing from their treatment (uninformed/slight/mod/well)?

Where do you think most patients get this information?

How informed do you think patients are about the risk to their hearing from their treatment by the time they arrive at audiology (uninformed/slight/mod/well)?

Whose responsibility should it be to inform the patient about the potential risk to their hearing?

Does your DHB have ototoxicity monitoring protocols?

What audiometric data would you want to be collected?

After the first set of results (baseline?) is obtained, do you receive a copy of the results?

How long would it typically take for this report to arrive?

How do you, the referring clinician, use this audiometric information?  
Does it influence treatment choices?

Who decides if the patient needs to be seen *again* by Audiology?

Who decides *when* this appointment will take place?

### **Subsequent appointments**

Do you receive reports from subsequent audiometric assessments?

Who decides when the ototoxicity monitoring appointments stop?

How long after treatment should ototoxicity monitoring appointments stop?

## **Improvement**

Do you think anything needs to be done at your DHB to improve ototoxicity monitoring practice or hearing and balance outcomes for patients receiving potentially ototoxic treatments?

What suggestions do you have?

What would you like to see happen?

Is there a need for greater instruction/awareness among oncologists? Among audiologists?

Would you be in favour of a national ototoxicity monitoring protocol to be used by all DHBs?

If there was one, would you follow it?  Yes  No  Don't know

To the letter, or would you modify it to suit your clinic?

If protocol suggested an item of audiological equipment that your Audiology department didn't currently have, how easy would it be for them to obtain it?  Easy  Difficult  Don't know

Would having a national protocol make it easier for them to get that equipment (in terms of lobbying for it); or more assessment time, or would it ease any other the other constraints?

## **Interview Questions – Audiologists**

### **Demographic information**

At which DHB location do you work most often?

What other DHBs do you work at (incl. satellites)?

How long have you worked in your current position?

How long have you worked at this DHB?

How long have you worked in the NZ hospital system?

Have you worked in hospital-based audiology overseas? If so, what country and for how long?

Where did you obtain your Audiology qualification and when?

Where did you learn about ototoxicity monitoring? (e.g. University programme, on the job, own reading, conferences?)

### **Prior knowledge**

As far as you know, what types of treatments can permanently affect hearing?

What proportion of patients receiving cisplatin chemotherapy would develop hearing loss (0/25/50/75/100)?

*[If Aminoglycosides are mentioned above:]* What proportion of patients receiving aminoglycosides would develop hearing loss (0/25/50/75/100)?

If they did develop a hearing loss from ototoxicity, what configuration would it be likely to be? (e.g. flat/HF/LF?)

How severe is the hearing loss likely to be? (e.g. mild/mod/severe/profound?)

What impact do you think this hearing loss would have on their daily life (none/slight/mod/severe)?

How likely is it that these patients will also develop tinnitus (unlikely/slight/mod/very)?

What impact do you think this tinnitus would have on their daily life (none/slight/mod/severe)?

Are these patients also likely to develop balance problems (unlikely/slight/mod/very)?

What impact do you think these balance problems would have on their daily life (none/slight/mod/severe)?

What is the purpose of ototoxicity monitoring?

What benefits are there for the patient in ototoxicity monitoring?

What is your knowledge of ototoxicity monitoring protocols?

Can you name some protocols?

Are you aware of any NZAS ototoxicity protocols or best practice guidelines regarding monitoring?

### **First appointment**

Can you describe in as much detail as you can the referral process that leads to a patient receiving potentially ototoxic treatments being seen by Audiology?

Waitlists vary, so are there any assurances or checks that are made to make sure the patient is seen before their first ototoxic treatments (e.g. chemotherapy/radiation/aminoglycosides), or do they just get the first available appointment?

How important is a baseline audiogram (not/somewhat/mod/very)?

When these patients arrive at the audiology clinic, how informed do you think they are about the risk to their hearing from their treatment (uninformed/slight/mod/well)?

Where do you think most patients get this information?

Whose responsibility should it be to inform the patient about the potential risk to their hearing?

Does your Audiology dept have ototoxicity monitoring protocols?

Are they written down?

Is it compulsory to follow them or are they guidelines?

How often are they followed (never/sometimes/most of the time/always)?

How much time is typically allocated for a first appointment with this type of patient?

What audiometric data is typically collected?

Where did this list or practice come from?

Just what's done here/hospital protocol of unknown origin

Hospital protocol of known origin:

Existing published protocol:

Followed exactly  Modified

What's asked for by referring clinician

What factors influence what you measure?

Clinical necessity

Best practice

Equipment owned by DHB

Equipment owned but not always available (e.g. being used).

Available time for appointment

Audiologist training or knowledge

Other:

After the first set of results is obtained, are reports sent to anyone? If so, who?

How long would it typically take for this report to be sent?

How do you think this audiometric information is used by the referring clinician?

Does it influence treatment choices?

Who decides if the patient needs to be seen *again* by Audiology?

Who decides *when* this appointment will take place?

### **Subsequent appointments**

What is done differently on subsequent assessments compared to the first?

How long is this appointment typically?

Is a new report sent each time? Or is the file just updated?

Who decides when the ototoxicity monitoring appointments stop?

How long after treatment should ototoxicity monitoring appointments stop?

## **Improvement**

Do you think anything needs to be done at your DHB to improve ototoxicity monitoring practice or hearing and balance outcomes for patients receiving potentially ototoxic treatments?

What suggestions do you have?

What would you like to see happen?

Is there a need for greater instruction/awareness among audiologists? Among oncologists?

Would you be in favour of a national ototoxicity monitoring protocol to be used by all DHBs?

If there was one, would you follow it?  Yes  No  Don't know

To the letter, or would you modify it to suit your clinic?

If protocol suggested an item of equipment you don't currently have, how easy would it be for you to obtain it?  Yes  No  Don't know

Would having a national protocol make it easier for you to get that equipment (in terms of lobbying for it); or more time, or would it ease any other the other constraints?

## Are hearing losses among young Māori different to those found in the young NZ European population?

Janet E Digby, Suzanne C Purdy, Andrea S Kelly, David Welch, Peter R Thorne

### Abstract

**Aim** This study was undertaken to determine if young Māori have more permanent bilateral hearing loss, or less severe and profound hearing loss than New Zealand (NZ) Europeans.

**Methods** Data include hearing-impaired children from birth to 19 years of age from the New Zealand Deafness Notification Database (DND) and covering the periods 1982–2005 and 2009–2013. These were retrospectively analysed, as was information on children and young people with cochlear implants.

**Results** Young Māori are more likely to be diagnosed with permanent hearing loss greater than 26 dB HL, averaged across speech frequencies, with 39–43% of hearing loss notifications listed as Māori. Māori have a lower prevalence of severe/profound losses ( $n=1571$ ,  $\chi^2=22.08$ ,  $p=0.01$ ) but significantly more bilateral losses than their NZ European peers ( $n=595$ ,  $\chi^2=9.05$ ,  $p=0.01$ ). The difference in severity profile is supported by cochlear implant data showing Māori are less likely to receive a cochlear implant.

**Conclusions** There are significant differences in the proportion of bilateral (compared to unilateral) losses and in the rates and severity profile of hearing loss among young Māori when compared with their NZ European peers. This has implications for screening and other hearing services in NZ.

Based on overseas data, permanent hearing loss in children and young people is thought to affect approximately 3 to 5 children and young people in every 1000 in high income countries, and up to 25 of every 1000 in low income countries.<sup>1,2</sup>

Permanent hearing losses include those which are sensorineural (related to disease or injury in the inner ear and auditory nerve), conductive (related to disease or injury in the outer or middle ear) or mixed (sensorineural/conductive) in origin. Transient losses such as those associated with otitis media are excluded from this definition.

While modern technology and educational support can now ameliorate some of the effects of hearing loss, late detection has a significant effect on children's ability to learn language, their participation in education and their social inclusion.<sup>3</sup>

Moderate and mild hearing losses are diagnosed later, on average, than more severe hearing losses, even with the advent of newborn hearing screening.<sup>4,5</sup> There is some evidence that children with mild hearing loss perform more poorly socially and educationally.<sup>6</sup>

Understanding differences in prevalence with respect to population demographics is helpful for the development of appropriate screening, diagnostic and intervention policies and practices, which ensure early detection and allow more effective

intervention. However, no prevalence or epidemiological research has been undertaken to confirm whether there is indeed a difference in the prevalence and severity profile of Māori and New Zealand (NZ) Europeans or whether differences in service provision exist. As a result, public health officials and those working with hearing-impaired children are unsure whether the burden of disease is spread evenly in the population, or whether some ethnic groups may be more likely to present with hearing loss.<sup>7</sup>

A number of general research and monitoring sources, described below, point to a possible difference in prevalence of permanent hearing loss between Māori and other ethnic groups.

These include four Household Disability Surveys between 1991 and 2006<sup>8</sup> which sampled a subset of individuals of all ages responding to the New Zealand Census and asked basic questions about hearing loss. (These surveys defined people 'who have difficulty hearing or cannot hear what is said in a conversation with one other person and/or a conversation with at least three other people' as being deaf or hearing impaired.)

The surveys indicated that Māori have higher rates of hearing loss and higher rates of unmet need for technology and equipment when compared with non-Māori. Although the surveys provide some information about hearing loss in the New Zealand population, there are a number of limitations with this data as the surveys are quite general, not age specific and categorise hearing disability in different ways.<sup>9</sup>

The B4 School Check data also suggest the possibility of higher rates of hearing loss (of all types) among Māori. The B4 School Check aims to screen all children before they reach school, and to identify and provide intervention to those children identified with the targeted conditions, including hearing loss.<sup>10</sup>

The programme aims to screen the hearing of all children not already under the care of an otolaryngologist or audiologist following their fourth birthday. Those not screened before they reach school should be screened after they start school. This screening involves pure tone audiometry, usually conducted by a Vision Hearing Technician. If the child passes this test, no further referrals are required. Should the child be referred on the audiometry screening, tympanometry is also conducted.

Searchfield, Bae and Crisp examined data from B4 School Checks completed in 2011 and found higher rates of *referral* from hearing screening for Māori children (9%) compared with non-Māori (5%).<sup>11</sup> It is important to note that high referral rates for Māori may be the result of higher rates of middle ear disease as not all children who 'refer' on the B4 School Check hearing screen will be diagnosed with a permanent hearing loss.

Finally, data from New Zealand's Universal Newborn Hearing Screening and Early Intervention Programme (UNHSEIP) can be examined to see whether ethnic differences exist. Implementation of this programme began in 2007 and the last eight district health boards (DHBs) to be included within the roll-out began screening between July 2009 and July 2010. The large Auckland DHBs (Counties Manukau, Waitakere and Auckland) had all begun screening by April 2010.

Referral data reported from the UNHSEIP show 2.7% of Māori babies were referred as a result of a positive screen between April 2012 and December 2012, the most recent period for which data are available.<sup>12</sup> This is double the 1.3% referral rate for those of NZ European ethnicity. This may be due to higher prevalence of middle ear problems among Māori children<sup>13,14</sup> when compared with their NZ European counterparts, although it is possible that this difference reflects differences in rates of permanent hearing loss.

Only 57% of diagnostic data were available to describe outcomes for children referred through the UNHSEIP during this period. These data show 13.8% of Māori babies for whom audiological assessments were completed were diagnosed with permanent hearing losses, compared with 10.8% of NZ European children (n=198). These data are difficult to interpret due to the low reporting rates, however they show that the higher rates of referral from the newborn hearing screen do flow through to diagnoses of permanent hearing losses.

The role of cytomegalovirus in the aetiology of deafness among New Zealand children and young people is also yet to be investigated, although overseas studies show this contributes to approximately 10–20% of childhood deafness before the age of 5 years.<sup>15</sup> The New Zealand data suggest differences in exposure to cytomegalovirus among different racial groups, with serologic data in 3 year olds showing highest exposure in Māori and Pacific Island groups.<sup>16</sup>

To determine potential differences in hearing loss prevalence and severity between Māori and NZ Europeans, we analysed cases contained in the New Zealand Deafness Notification Database (DND) and children implanted by the Northern Cochlear Implant Programme which is the public provider for cochlear implants for all children and young people living in areas north of Taupo.

## Method

The DND was New Zealand's annual reporting system from 1982 to 2005 and between 2010 and the present day for new cases of permanent sensorineural, conductive or mixed hearing loss among those under 18 years old.

The database was managed initially by the National Audiology Centre, then the Auckland District Health Board. It was not in operation from 2006–2009, due to a pause in Ministry of Health funding but it was restarted in 2010 by the New Zealand Audiological Society and has been funded by the Ministry of Health since 2012.

All notifications are provided by audiologists, originally through a paper form and more recently using an on-line process. Notifications since 2010 have used a refined set of inclusion criteria. Children born overseas and unilateral hearing losses are now included in the database, reflecting an improved understanding of the importance of unilateral hearing losses<sup>17</sup> and acknowledging the potential impact of immigration on deafness statistics.<sup>18</sup>

It is thought that the majority of new cases of hearing loss were notified to the database during the time periods under consideration, but the exact proportion cannot be calculated because of the lack of specific local prevalence rates, by age, for permanent hearing loss.

Throughout its operation the DND has been the only nationwide source of local information from which the prevalence of permanent hearing loss among young people may be estimated, and from which the characteristics of hearing loss among these young people can be understood.

Originally, the database categorised cases by 'race', and later this was shifted to 'ethnicity'. The earlier notification form allowed only one code per case and these codes have been further grouped into the following categories: NZ European, Māori, Pacific Island, Asian, Other or Unknown.

Notifications to the current database are already coded in this way. Only data from those cases recorded as Māori and NZ European are reported here.

The original database (1982–2005) contained records which did not meet the criteria applied to the database at the time (e.g. some unilateral losses were included as were acquired losses and some born overseas) and as a result, some cases from this database were removed. This decision was made on the basis that, even if the criteria were not always applied, they would have been for some unknown proportion of cases. Hence it is better to exclude all cases not meeting the official inclusion criteria in place at that time. The reduced dataset does not differ materially from the original, larger dataset, including the proportion of notifications belonging to Māori and NZ European groups.

Key characteristics of the two datasets can be found in Table 1.

**Table 1. The proportion of cases analysed in the two datasets compared with the population of the 1982-2005 datasets**

Characteristics	1982–2005 dataset	2009–2013 dataset
Age range	Between zero and 18 years of age at diagnosis	Between zero and 19 years of age at diagnosis
Unilateral	No	Yes
Bilateral	Yes	Yes
Acquired	No	Yes
Cases first diagnosed	January 1982–December 2005	January 2009–October 2013
Severity	Mild (26-40 dB HL), moderate (41–65 dB HL), severe (66–95 dB HL) and profound (>95 dB HL) hearing losses	Recorded where 4 thresholds available to match most recent codeframe used in 1982–2005 dataset
Method of notification	Mailed paper notification forms	Online notifications
Sample with complete ethnicity data	n=1692	n=763
Sample with ethnicity and severity data	n=1265	n=306

Over recent years, evidence for the detrimental developmental effects of mild and moderate hearing losses has increased<sup>19,20</sup> and this may have led audiologists to become increasingly aware of the need to notify mild and moderate hearing losses during the database’s operation.

In addition, the length of time it takes to identify mild and moderate hearing losses is likely to also be a key difference in the later dataset (2009–2013) which contains more children and young people whose hearing loss was diagnosed early when compared with the earlier 1982–2005 dataset, due in large part to the introduction of newborn hearing screening.

Ethnicity data for 294 children and young people from the Northern Cochlear Implant Programme (NCIP) were also analysed. These data include the vast majority of children and young people who have received a cochlear implant in the northern region of New Zealand (an area covering approximately half the New Zealand population) since the first implant was provided to a child, in 1989. Data from the Southern Programme were not included as these contain incomplete ethnicity information.

## Results

Table 2 compares the proportion of notifications of NZ European and Māori ethnicities from the 1982–2005 and 2009–2013 datasets, with the proportion of these ethnicities contained in Census data from Statistics New Zealand (taken from 1996 and 2006 to provide an indication for the time period under consideration).

**Table 2. Proportion of cases in the two datasets by ethnicity compared with the population**

Dataset/Ethnicity	Proportion in 1982–2005 dataset (priority coded)	Proportion in 1996 Census under the age of 20 (priority coded) <sup>19</sup>	Proportion in 2009–2013 dataset (multi-coded) Bilateral only, 2009–2013	Proportion in 2006 Census under the age of 20 (multi-coded)
NZ European	40%	63%	49%	62%
Māori	39% n=1692	24%	43% n=763	22%

A Chi-squared analysis was conducted on a merged dataset containing records from 1982–2005 and 2009–2013 to determine whether differences exist between NZ European (n=775) and Māori groups (n=796) in terms of their severity of hearing loss profile.

The analysis shows (Table 4) significant differences; Māori are less likely to be severely or profoundly hearing impaired and are more likely to have mild-moderate hearing loss when compared to their NZ European counterparts (n=1571, Chi-squared=22.08, p=0.01). Figure 1 shows the number of cases in each of the groups.

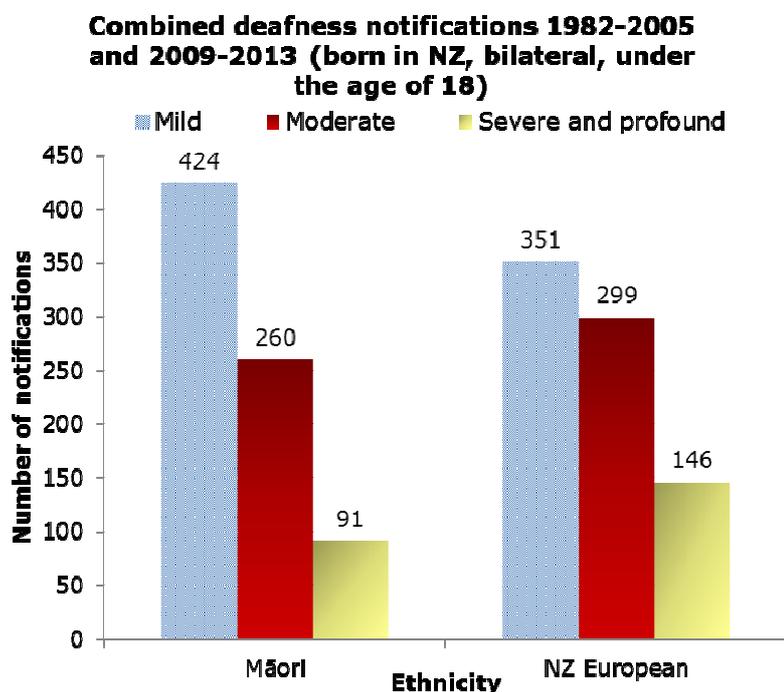
One way to better understand severity of hearing losses among children and young people in the population is to compare the proportion of Māori and NZ European groups who have been provided with cochlear implants.

Cochlear implants have typically been provided to children with profound hearing loss, although in recent years children with less severe losses have been implanted in cases where the child is not receiving adequate benefit from hearing aids, including in cases of Auditory Neuropathy Spectrum Disorder (ANSO).

A clinical team comprising the child’s surgeon, their audiologist, habilitationist and counsellor make candidacy decisions based on a set of considerations. The ratio of children recorded as Māori: NZ European within the current 2009–2013 DND was therefore compared to the ratio of children with cochlear implants.

Fewer Māori children and young people in the Northern region have cochlear implants (1:1.79 Māori:NZ European) than exist in the 2009–2013 DND (1:1.49 Māori:NZ European). The relatively low number of implants provided to Māori children and young people by the Northern Cochlear Implant Programme may reflect differences in the way Māori access these services, differences in intervention choices and/or the smaller numbers of more severe hearing losses among young Māori.

**Figure 1. The number of Māori and NZ European cases by severity of hearing loss, for the combined DND dataset (1982-2005 and 2009-2013).**



Māori children and young people are more likely than their NZ European contemporaries to have bilateral hearing loss. An analysis of the current DND (2009-2013) showed a higher proportion of bilateral compared to unilateral hearing losses in Māori than in NZ European (n=595, Chi-squared=9.05, p=0.01; Table 4). (Unilateral losses were not consistently reported in the earlier database as only bilateral hearing losses met the inclusion criteria for this database.)

**Table 3. Percentage of bilateral and unilateral hearing losses in 2009–2013 DND, categorised by ethnicity**

Samples	Percentage bilateral	Percentage unilateral
NZ European (n=211)	61%	39%
Māori (n=338)	81%	19%
Both ethnicities (n=46)	77%	23%

## Discussion

The majority of notifications to both databases were from children and young people recorded as NZ European or Māori. Proportionately greater numbers of notifications were recorded as Māori than in the demographics of the NZ population.<sup>21</sup> The data were only analysed for Māori and NZ European as these comprised the majority of records in both databases.

The other coded ethnicities (Pacific Island and Asian) as well as those that had no known ethnicity data were too small in number to analyse in detail and therefore these are not included in this analysis.

The numbers of Pacific Island children in the database is considerably smaller than those of Māori and/or NZ European. Rates of hearing loss among this group are 9.8% for the 1982–2005 dataset and 11% for the 2009–2013 dataset. These figures are similar to the proportions (7.5% and 11%) of Pacific Island young people the NZ population under 20 years of age in similar periods. This finding is however difficult to interpret due to the small number of cases in this group.

Māori may be underrepresented in the DND due to the higher proportion of milder hearing losses which are more likely to go undiagnosed,<sup>22</sup> or be diagnosed late.<sup>23</sup> If this is the case, then Māori may have even higher rates of hearing loss than suggested by this analysis. It may also be that disparities in access to, and through, the health system<sup>24</sup> could have concealed cases from the database.

Systemic disparities in health outcomes, differences in exposure to the determinants of health, and poorer health system responsiveness in Māori and Pasifika groups compared with the NZ European population may also be factors influencing deafness statistics.<sup>25</sup>

Furthermore, factors such as maternal health have already been found to contribute to significant differences in the prevalence of other conditions between Māori and NZ Europeans, suggesting that other health disparities may also contribute to differences in hearing loss statistics. Differences in hearing loss prevalence between various ethnicities have been reported in overseas studies.<sup>25</sup>

The DND is a national database that receives notifications from audiologists throughout the country, but because there are no epidemiological data available it is not possible to determine how accurately the database reflects the number of children with hearing losses throughout New Zealand.

There is no mandated reporting and so it is up to individual audiologists to provide the information and to do so accurately. Audiologists around the country are reminded regularly to complete the forms and there is an iterative process to query data which is incomplete or contradictory. There is an ongoing focus to try to increase the proportion of new diagnoses meeting the database criteria that are notified to the database. This is difficult as there are no data available to allow calculations of the number of notifications which may be missing in a given year.

Notifications within the 1982–2005 dataset were classified by birth hospital and/or area making regional differences difficult to detect. The 2009–2013 dataset shows that those DHB areas with higher numbers of notifications than their population would suggest are those DHBs with a higher proportion of Māori and/or Pacific populations (e.g. Counties Manukau, Northland, Bay of Plenty, Tairāwhiti), however some DHBs are not contributing notifications to the database at the expected rate, and so no conclusions can yet be drawn from these differences.

Both DND datasets contain severity data which are consistent with international evidence that, for high income countries, permanent mild and moderate hearing losses are much more prevalent than severe and profound hearing losses<sup>26</sup>. The significant

difference in the severity profiles evident in the DND database may be due to a genetic preponderance of more mild degrees of hearing loss among Māori, or because middle ear problems which are more likely among Māori<sup>27</sup> are thought to result in milder degrees of sensorineural hearing loss over time.<sup>28</sup>

It is also possible that some of the older children have permanent conductive hearing loss resulting from repeated bouts of otitis media and this could be more prevalent in Māori, who have higher rates of middle ear disease than NZ Europeans. The cause of hearing losses contained in the 1982–2005 dataset cannot be determined and this information is not independently verified in the 2009–2013 dataset.

One way to validate the hearing loss severity profile evident in the NZ DND is to compare the NZ European data to another similar population. Severity data coded using similar criteria were available for another largely European population containing bilateral hearing losses from Colorado, as in Table 4. The Colorado sample received intervention services at some point between birth and the age of three years. The Colorado data shows a similar severity profile to the current NZ European group.

**Table 4. Hearing loss severity profiles in New Zealand compared with Colorado, United States (Personal communication, Allison Sedey, 13 February 2014.)**

Samples used	1982–2005 bilateral deafness notifications, born in NZ, under the age of 18				Hearing impaired children in Colorado who received early intervention services between birth and 3 years	
	NZ Māori		European		Born 2006 to 2012	
	n=	%	n=	%	n=	%
Mild (26–40dB HL)	331	53%	270	42%	99	37%
Moderate (41–65 dB HL NZ, 41–70 dB HL Colorado)	214	34%	240	37%	102	38%
Severe and profound (>66 dB NZ and >70 dB HL Colorado)	79	13%	131	20%	67	25%
<b>Total</b>	<b>624</b>	<b>100%</b>	<b>641</b>	<b>100%</b>	<b>268</b>	<b>100%</b>

Evidence that Māori children have a higher prevalence of mild-moderate hearing loss is important for both the New Zealand Universal Newborn Hearing Screening and Early Intervention Programme and for the B4 School Check.

Future reviews of the newborn hearing screening protocols should consider this evidence, looking for ways to minimise disadvantage for Māori, particularly as current screening technologies are not currently able to consistently identify mild hearing losses. The B4 School Check should also consider this evidence when reviewing the hearing level below which a child passes their hearing screen.

Families may have less understanding of the impact of mild and moderate hearing losses, as affected children may appear to hear some of the time in advantageous listening conditions, particularly at home. This may influence whether families will treat the condition seriously and, for example, support the use of hearing aids which improve speech and language outcomes for children with mild hearing loss when fitted early and appropriately.<sup>30</sup>

Thus, detection of mild hearing losses via screening should be supported by good education programmes and appropriate habilitation options for families.

The analysis of the more recent DND dataset, which includes both unilateral and bilateral notifications, showed significantly higher rates of bilateral hearing losses among Māori (and lower rates of unilateral hearing losses) compared with their NZ European counterparts.

The 3.34:1 ratio found in the current study is higher than previous reports from overseas, which show varying ratios of bilateral:unilateral hearing loss from 2.6:1<sup>29</sup> to 0.78:1.<sup>30</sup> Sample differences and different definitions of unilateral hearing loss are likely to contribute to this variation in the literature, making it difficult to draw conclusions about population differences.

This paper describes broad differences in hearing losses between NZ European and Māori children and young people, across a range of aetiologies. Different patterns are likely to emerge when examining smaller groups, such as those children with microtia or atresia, for example.

Understanding of the genetic causes of deafness has developed significantly in recent years. Mutations in the connexin 26 gene are known to be responsible for a significant proportion of cases of prelingual non-syndromic deafness.<sup>32</sup>

Previous studies have shown variations in the carriage rate of these mutations in different populations and there may be differences between people of Māori and NZ European descent which could be investigated.<sup>33</sup>

As knowledge of genetic causes of hearing loss grows further, genetic testing following a diagnosis of hearing loss is becoming more commonplace but is still not universally undertaken and there may be differences across populations in acceptance of this testing. There are also many cases of hearing loss which are not explained by current genetic models.

There are systemic disparities in health outcomes, differences in exposure to the determinants of health, and poorer health system responsiveness for Māori when compared with the NZ European population.<sup>24</sup>

Understanding differences in prevalence among ethnic groups is important to aid in the early detection of and effective intervention for children and young people with hearing loss. The improved understanding of ethnic differences may assist in improving policies and practice associated with the detection of and intervention for children and young people with hearing loss.

This analysis confirms the value of the DND in helping to improve understanding of the rates and severity of hearing loss among various groups. The DND is important as it enables understanding of the type and characteristics of hearing losses diagnosed in New Zealand children and young people. These data assist public health professionals, clinicians and managers to identify and plan services for children and young people identified with hearing loss.

All degrees of hearing loss, from mild to profound, can have a significant impact on learning, behaviour and the psychosocial wellbeing of children and young people and hence it is important that parents and health professionals should be encouraged to

refer children of any age with suspected hearing loss to audiological services for a complete diagnostic assessment.

**Competing interests:** Janet Digby currently manages the Deafness Notification Database for Accessable which manages this in turn for the Ministry of Health.

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## Appendix 1. Exclusions from the dataset

The table below contains the number of cases in each of the categories which were excluded from the original and hence from this analysis. Some records were excluded for more than one reason and hence the number of excluded cases in each category does not sum to the total number of cases excluded.

Cases were included where either the audiometric data met the 26 dB HL average over four frequencies, or where the severity level had been coded separately and was listed as mild or greater based on the codeframe used between 1996 and 2005 (mild losses within this codeframe start at a 26 dB HL average).

### Reasons for excluding cases from the 1982–2005 dataset

Types of records excluded from the 1982–2005 dataset	Number excluded
Initial number of records	5025
Duplicates	163
Outside years of operation of database (1982–2005)	576
Number excluded as they did not contain a year of confirmation	146
Born overseas	426
Ethnicity listed as other than Māori or NZ European	745
Missing ethnicity information or unknown ethnicity	982
Acquired hearing losses	216
Unilateral hearing losses	2557
Outside the severity range for the database (mild to profound) and missing or incomplete severity information (n=1215)	2413
Outside the database's age range of 0–18 years	12
Total cases included in main analysis	1265

## The potentials and challenges of electronic referrals in transforming healthcare

Yulong Gu, Jim Warren, Martin Orr

### Abstract

Referrals are traditionally defined as sending a patient to another program or practitioner for services or advice. The increasing adoption of electronic referral systems (eReferrals) requires a more complex model and shared understanding of what a referral is. eReferrals are designed to support writing referrals and automating referrals processing, and sometimes triaging. The reported benefits of eReferrals include secured delivery of referrals, improved efficiency, access to care, quality of care and continuity of care, better quality of documentation and communication, as well as reduced cost.

Improvement in the time to prioritise referrals, more reliable and transparent referral handling, and better-supported hospital-community communications have been observed in regional eReferral trials in New Zealand. In the authors' opinion, teleconsultation and virtual shared care relationships have the potential to transform healthcare delivery, and they can be facilitated by eReferral technology. But the opportunities introduced by information technologies for eReferrals present several complex and contentious issues. This paper explores the potential roles and models for eReferral and its challenge to what constitutes a medical consultation. Future research is needed to understand how to facilitate and fund virtual clinics, and to support mentorships among healthcare professionals as well as for health consumers.

### Background

The United States National Library of Medicine has defined 'referral and consultation' as "the practice of sending a patient to another program or practitioner for services or advice which the referring source is not prepared to provide".<sup>1</sup> The *Cole's Medical Practice in New Zealand* states that "referring involves transferring some or all of the responsibility for some aspects of the patient's care. Referring the patient is usually temporary and for a particular purpose, such as additional investigation, or treatment that is outside your scope of practice".<sup>2</sup> Within the New Zealand context, different types of referrals with different levels of clinical responsibility transfer are already recognised. For example, the Ministry of Health guideline to obstetric referrals recognises four types and distinguishes between consultation referrals and transfer of care referrals.<sup>3</sup>

In addition to referring for a physician consultation, the referral model also encompasses requests to other services such as clinical laboratory services, physical therapy services, occupational therapy services, outpatient speech-language pathology services, radiology and other imaging services, as well as radiation therapy services.<sup>4</sup> Traditional referrals often default to referring a patient for a face-to-face consultation with a physician or other service provider. However, electronic referral systems

(eReferrals) have the potential to “transform the primary-specialty care interface by enabling a move away from a narrow reliance on visit-based care”.<sup>5</sup>

## **What is a ‘medical consultation’?**

In cases of referring for consultation by a specialist or other clinicians, a relevant question is what constitutes a medical consultation. To the best of our knowledge, there is no definition published by the Medical Council of New Zealand (MCNZ) or Royal New Zealand College of General Practitioners (RNZCGP). But the structure of patient consultation has been suggested to include introductions, information gathering, exploring the patient’s thoughts, feelings and ideas, education (including to negotiate the choice of treatment), and closure (e.g., mini-summaries).<sup>2</sup>

MCNZ also states that in providing good clinical care, practitioners are expected to consult and take advice from colleagues when appropriate.<sup>6</sup> In the context of referral discussions herein, we use the term ‘medical consultation’ to include consultations between a clinician and a patient as well as between healthcare professionals.

## **What should be included in a referral?**

MCNZ states that when you refer a patient, you should provide all relevant information about the patient’s history and present condition.<sup>6</sup> The RNZCGP standard for general practice further defines the essential information to be included in referrals as:

- Special considerations: interpreter needed, language, disability, transport
- Current problem
- Current medical warnings
- Long-term medications
- The reason for referral
- Background information and history
- Key examination findings
- Current treatment
- Appropriate investigations and results.<sup>7</sup>

The referral document itself, traditionally sent as a paper-based letter but more and more electronically delivered, forms part of the patient’s medical record; and therefore, must meet legal requirements to describe and support the management of health care, as well as to facilitate continuity of care, e.g., by initiating the transfer of care process.

## **eReferrals: from automation to transformation**

eReferral have been introduced in many countries, including Finland, Denmark, Norway, Netherlands, Australia, and New Zealand (NZ).<sup>8</sup> eReferrals aim to support the writing of referrals, particularly by auto-populating patient information from electronic medical records, and to automate the processing, and sometimes triaging, of referrals at the receiving end.

The benefits associated with eReferrals include secured delivery of referrals, improved efficiency, access to care, quality of care and continuity of care, better quality of documentation and communication, as well as reduced cost.<sup>9-12</sup> In NZ regional eReferral trials at Hutt Valley, Northland, Canterbury and Waikato district health boards, improvement in the time to prioritise referrals<sup>13</sup> as well as benefits to referral handling and hospital-community communications<sup>14,15</sup> have been observed. For instance, rapid secure delivery of eReferrals and the ability to track an individual eReferral's status, addressed the issue of uncertainty in paper referral processing.

The functions implemented and achieving sustained uptake in the NZ eReferral trials include auto-population of patient information (such as demographics, medical history and medications) from the GP electronic medical records to eReferral forms, decision support by embedding referral criteria and collecting appropriate information for referral triage in structured condition- or investigation-specific eReferral forms, and electronic communication.<sup>13-17</sup>

The NZ experience suggests that eReferrals offer the capability for faster, more reliable and more transparent referral from community to secondary services, and have laid a foundation for further support and innovation in healthcare processes.<sup>13-15</sup> The potential to transform healthcare delivery with eReferrals and other technologies may start with facilitating teleconsultation and a virtual shared-care relationship, e.g., with the support for electronic communication.

### **eReferral potential: initiating and facilitating teleconsultation**

Although referral itself does not determine the nature or mode of subsequent care delivery, eReferral technology can provide a pathway into use of teleconsultation. Information and communication technologies, ranging from telephone to video conferencing and remote presence robots, have made it possible to provide healthcare services without in-person interactions. The 'remote consultation', or sometimes called 'teleconsultation', is defined as "consultation via remote telecommunications, generally for the purpose of diagnosis or treatment of a patient at a site remote from the patient or primary physician".<sup>18</sup>

Teleconsultation, supported by shared patient records, is seen as 'cheap green care' that can deliver direct patient care remotely or support the GP to treat patients in primary care with remote support by specialists. It is also associated with reduced number of in-person referrals and subsequently more effective use of health facilities.<sup>19,20</sup> With eReferral's capacity to support electronic communication between clinicians at both ends of the referral, teleconsultation naturally occurs for cases where advice is given regarding patient management.

A study in Kaiser Permanente Colorado comparing teleconsultation and traditional in-person consultations found that the utility of information provided by consultants and satisfaction with consultations did not differ between the two modes; they also found that more traditional consultations than teleconsultation requested transfer of patient care, or assistance with diagnosis or initiating treatment.<sup>20</sup>

Increasing use of 'advice only' eReferrals has been reported in the NZ setting, indicating uptake of teleconsultation as facilitated by the eReferral technology; for instance, the Northland implementation of web based referral triage with electronic

messaging back to the referrer has been associated with ready access to specialist advice.<sup>17</sup> The Canterbury experience in providing online feedback by GP triagers for community referred radiology service suggests that it can also help shape referrer's understanding of referral criteria and management options.<sup>21</sup>

In terms of patient teleconsultation, there are standards published by MCNZ with regard to treating patients and prescribing medicine without face-to-face consultation.<sup>6</sup> The MCNZ statement on telehealth particularly highlights the risks in providing treatment without physical examination; it recommends "if a physical examination might add critical information then you should not proceed until a physical examination can be arranged. In some circumstances it may be reasonable to ask another practitioner in the patient's location to conduct a physical examination on your behalf".<sup>22</sup> However, it is believed that no physical examination is necessary in a third of general practice consultations, suggesting the potential and appropriateness for teleconsultation.<sup>2</sup> And video consulting is associated with advantages, including to enable fair and equitable access to care, which may apply particularly to rural, Māori and Pacific patients.<sup>2</sup>

### **eReferral potential: supporting mentorship and shared care relationship**

Related to eReferral's potential to facilitate teleconsultation, the relationship between referrers, e.g. GP, and the referral recipients, e.g. specialist, is strengthened with timely and applicable responses. Therefore, eReferrals offer the opportunity to foster (and document) virtual mentorship which is traditionally established in informal consultations, sometimes called 'curbside' consultations.<sup>23,24</sup> Such virtual mentorship may relate to a particular patient, as case-based education; it may also develop the mentee's capacity to manage similar patients.

In addition to providing a medium for mentorship, eReferral may facilitate a virtual shared care environment. The use of eReferral in San Francisco General Hospital is reported to support virtual 'co-management' (shared care) of certain conditions by allowing iterative communication between primary care provider and designated specialist reviewer (triager).<sup>5</sup>

A developmental potential for eReferrals could be to integrate or even merge with shared care record systems as part of the virtual shared care environment for managing patients, especially those with long term conditions. This will not only help to maintain 'mentoring' relationships between primary care clinicians and secondary (or other) services, but also promote patient engagement and shared decision making by supporting patient access to their own medical record and facilitating patient-clinician communication via an electronic patient portal.

### **Developing an eReferral model**

As part of the patient medical record, eReferrals have the same medico-legal and ethical roles in the delivery of care as paper-based referrals. Achieving the full potential of eReferral technology requires understanding their relationship to provider responsibilities. For instance, eReferral-enabled teleconsultation may indicate no discharge of responsibility from the referring clinician, which is different from the transfer of care in a traditional referral process. This may introduce contention

regarding the medico-legal ramification surrounding eReferral technology. Therefore, the accountability issues need to be thought through in designing eReferral systems, along with other issues such as the quality of information, the workload and workflow for both the referrers and the referees.

The Northland experience recognised that it can take longer to triage a referral electronically; and to undertake ‘noncontact work’ (potentially providing teleconsultation advice) takes even longer – up to 15 minutes per referral for a complex patient.<sup>17</sup> Moreover, the volume of this noncontact work is increasing with GPs seeing the value in requesting advice rather than requesting a clinic appointment.<sup>17</sup> But this inevitably challenges the current ‘face-to-face first specialist assessment’ funding model, opening the question of how the eReferral receiving end is to support the work by specialist triagers. Research is needed to explore eReferral delivery models, including funding models and the enabling system and policy framework to facilitate ‘virtual clinics’ that provide teleconsultation services via eReferrals.

The meaning of medical consultation may change with eReferral technologies maturing and possibly merging into shared care record systems. And the role of eReferral may also change in the future shared care environment that supports mentorships among healthcare professionals, the spectrum of collaboration, stepped care model, and shared decision making with the patient. In the authors’ opinion, eReferral has the potential to transform the healthcare delivery process by facilitating teleconsultation and shared care, e.g., through a model as proposed in Figure 1.

**Figure 1. eReferral pathways**

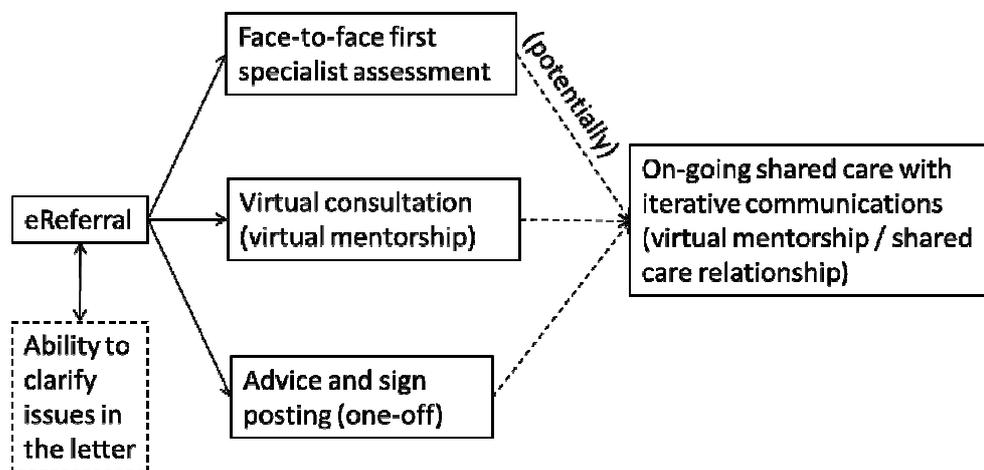


Figure 1 demonstrates the potential of eReferrals to enable multiple referral pathways that include the traditional visit-based care, virtual consultation (with detailed reply to the referrer and potentially supporting virtual mentorship in managing the patient in the community) and shared care, as well as advice and ‘sign posting’ (e.g., an appropriate service to refer to). In addition, the face-to-face first specialist assessment could lead to not only the one-off contact with the patient (and the referrer via clinical

letter); but also on-going shared care and on-going support to the community-based referring clinician (virtual mentorship/shared care relationship).

Similarly, virtual consultation could potentially develop into on-going shared care and could be used on an on-going basis to provide support to the referrer in a shared care relationship. However, complex and contentious issues remain; for instance, who, among the referrer, the referral receiving clinician and the patient, makes the decision to choose between the referral pathways? Traditionally, triage is undertaken at the referral receiving end; but will the power dynamics change, e.g., towards a stepped care approach, with the technological capacity to support virtual clinics and shared care?

Research is needed to understand the change of responsibility, of power and decision making in referring. Studies to collect evidence and lessons regarding eReferral development and implementation are also needed to evaluate the technology impact, to understand what eReferrals might become and what it should *not* be, as well as to promote sustainable use of the technology.

## Conclusion

It is the opinion of the authors that teleconsultation and virtual shared care relationships have the potential to transform healthcare delivery, and they can be facilitated by eReferral technology. However, research is needed to inform the re-design of a sustainable and enabling health care system and appropriate policy framework, and to gather evidence and lessons for achieving the potential of the technology.

**Competing interests:** Nil.

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## Childhood obesity in New Zealand: time to look at stronger measures?

The recently released report entitled *Tackling Obesity* by the New Zealand Medical Association<sup>1</sup> has focused our attention on the disturbing problem of obesity in this country.

The prevalence of obesity in New Zealand continues to rise, and a recent international comparative study ranked New Zealand the fourth-worst OECD country behind the United States, Mexico and Hungary.<sup>2</sup> In New Zealand, 1 in 10 boys (10.4%) aged 5–14 years are obese with girls showing a similar prevalence (11.0%).<sup>3</sup>

Māori children are almost twice as likely to be obese as non-Māori, while Pacific children are approximately 4 times more likely to be obese as non-Pacific children.<sup>3</sup> Obesity is a multisystem condition associated with a clustering of complications, including hypercholesterolemia, type 2 diabetes, and cardiovascular diseases, even in children and adolescents.<sup>4</sup>

A major concern is the knowledge that obese children tend to become obese adults, and therefore carry with them the increased risk of chronic diseases, and health care costs, into later life.

An increased prevalence of obesity and overweightness in children represents a shift to a positive energy balance. A disparity between energy intake (through diet) and energy expenditure results in an accumulation of energy which is stored as fat.

Contemporary society allows relatively free access to high-energy, high-fat foods for children which is undoubtedly part of the problem. However, physical activity is also a key factor in the energy balance equation and in our opinion requires more attention. Indeed our forbearers recognised the importance of physical activity in children's lives (probably for physical development rather than health) and introduced specified time requirements for teaching physical education which incorporated at least 3 separate 30-minute periods per week, excluding organised games in primary school and a total of 2 hours per week up to Form 5 (Year 11) in secondary school.<sup>5</sup> However in 1987, under the instruction of the Minister of Education a new syllabus was introduced which emphasised the need for frequent physical activity and daily physical education, but removed the directive statements regarding time allocation for physical activity.

The latest curriculum statement, the New Zealand Curriculum (2007) combines health and physical education (with some home economics) as a learning area and while continuing to advocate for regular physical activity has also removed any time allocation contingency for physical education in schools. The absence of time allocation regulations has seen a reduction in the quantity of physical education and related subjects being timetabled into schools in New Zealand.<sup>6</sup>

Low physical activity levels, poor fitness and obesity during childhood have strong negative effects on adult health outcomes. Therefore, one obvious place to start would

be to mandate more physical education in schools. Just how much time spent in physical activity would be required to make inroads into the body mass problems of New Zealand school children?

In a previous study we found that New Zealand children (aged 10–14 years) were increasing body mass at a rate of approximately 375 and 325 grams per year (for boys and girls respectively), or about 1 gram per day.<sup>7</sup> If we assume that all of this increase in body mass is fat, which has an energy value of about 7 kcal.g<sup>-1</sup>, then New Zealand 10–14 year olds are storing approximately 49 kcal of fat per week.

Using Ridley and co-workers compendium of energy expenditure for youth,<sup>8</sup> we find that most moderate-intensity physical activities likely to be used in physical education classes (ball games, athletics, tag, and unstructured play) conservatively expend approximately 5 METS of energy (1 MET is the energy required to sustain resting metabolism). By estimating the resting metabolic rate in children using an equation from Schofield (1984),<sup>9</sup> we can then calculate the total energy expenditure of a typical physical education class. A 30-minute physical education class at moderate-intensity would expend approximately 168.75 kcal (= 5 [METS] × 0.025 [resting metabolic rate as estimated by Schofield's equation in kcal.kg<sup>-1</sup>.min<sup>-1</sup>] × 45 (average body weight of 10–14 year olds in kg, <sup>7</sup>) × 30 [minutes active]).

Incorporating at least 3 such classes in every school each week would not only reduce the burden of obesogenic disease but would increase the declining fitness<sup>7</sup> and skill levels,<sup>10</sup> of New Zealand children.

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## Smokefree 2025: patterns and trends in references to the smokefree goal in political speeches and press releases

In March 2011, in response to a recommendation from the Māori Affairs Select Committee,<sup>1</sup> the New Zealand Government adopted the goal of achieving a smokefree nation by 2025. Achieving this goal will require robust policies that the tobacco industry and its associates will inevitably contest.<sup>2</sup> Politicians from all parties will need to be resolute in the face of industry opposition, and demonstrate their commitment to the Smokefree 2025 goal.

The frequency with which politicians refer to the 2025 goal provides one measure of their commitment to a smokefree nation, and may help assessment of where political support exists and where it may need to be cultivated. Using a novel automated approach, we report on an analysis of political press releases and speeches that examined how the Smokefree 2025 goal featured in New Zealand's political discourse.

We sourced documents from an archive of communications by government ministers<sup>3</sup> and a commercial repository of national press communications.<sup>4</sup> We divided communications between April 2010 to December 2013 into eight time periods for analysis: two prior to and six after the Government adopted the Smokefree goal. We extracted text and metadata from each source into a purpose-built database, then used open source software<sup>5-8</sup> to develop algorithms for initial text standardisation, extract metadata, and exclude duplicate communications.

To identify documents referring to tobacco control issues, or the Smokefree 2025 goal, we 'stemmed' relevant words to their root<sup>9</sup> and used key-term matching against these stems (e.g., 'smoke', 'smokefre', 'cigarette', 'tobacco', 'nicotin', '2025'). All documents flagged as potentially relevant were checked manually to exclude false positives.

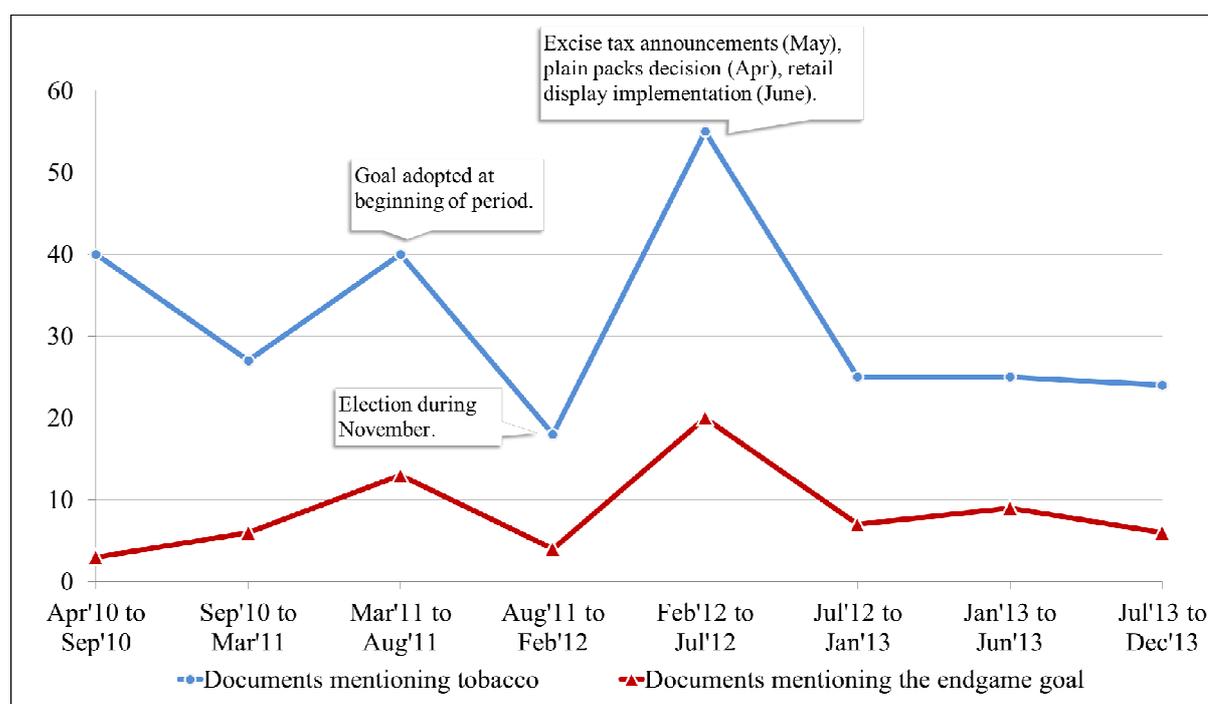
Wherever possible, we assigned a primary author and political affiliation by calculating an 'author certainty' indicator from politicians' names featured in the documents; this process used rules relating to name position in the document and known party association. Where multiple potential authors were identified, we assigned the first occurring name as primary author. Documents flagged as having low authorship certainty (817, ~4%) were manually examined.

We analysed 20,352 documents with between 2,033 and 2,790 examined in each time period. Out of 384 potentially relevant documents, 254 were confirmed as containing substantive tobacco references, with 68 of those mentioning the smokefree goal. Of these, 251 with a tobacco reference and 68 (all) with a goal reference were attributed to a primary author, and all were attributed to a political party.

Between 18 and 40 (0.9–1.4% of the total) communications mentioned tobacco at least once in each period except February–July 2012 (55, 2.2%). All periods but two contained between three and nine references to the goal. The exceptions were two peaks during the announcement period in March 2011 (13 references) and in Feb–July

2012 (20), which coincided with several tobacco control policy developments (see Figure 1). Goal references fell to four during the period around the general election in November 2011. Between July 2012 and the end of 2013, goal mentions remained reasonably constant (six to nine), well below the two peaks described above. This pattern was largely mirrored by references to any tobacco control issue.

**Figure 1. Communications referencing tobacco issues and the 2025 goal\***



\* Until November 2010 the goal most used was for 2020, and was a non-government goal. From November 2010 to March 2011 it was the Māori Affairs Select Committee goal, not a government goal.

Further analysis revealed that references to the goal were unevenly distributed across politicians and political parties. Speeches or releases from Tariana Turia (Associate Minister of Health with responsibility for tobacco control, Māori Party) accounted for 40 (59%) of the goal references. Ian Lees Galloway (the Labour Party Associate Spokesperson on Health) mentioned the goal five times, Associate Minister of Health Jo Goodhew (National Party) mentioned the goal four times, and Hone Harawira of the Mana Party accounted for three mentions. Health Minister Tony Ryall (National Party) made two references.

Minister Turia (69) and Minister Ryall (50) made more references to tobacco issues than any other politician (all others made fewer than 15 references). Minister Ryall's tobacco references focussed primarily on government targets and support of smokers in hospital and primary care settings (35 of the 50), but did not link these targets to the 2025 goal.

The Māori Party accounted for over a third (35%) of communications mentioning tobacco issues and two-thirds (66%) of communications mentioning the 2025 goal. These figures show a striking commitment to the smokefree goal and tobacco control in general as the Māori Party currently holds 3 seats in the 121-seat parliament. By contrast, Labour (34 seats), accounted for 13% of the tobacco and 10% of goal references and the Mana Party (1 seat) accounted for 6% of tobacco and 4% of goal references. The governing National Party (59 seats) accounted for 32% of tobacco and 13% of goal references.

There are some limitations to our analyses. For example, the data were skewed toward Government (National Party and Maori Party) communications, since one source was ministerial documents. Also, some parties or individual politicians (e.g., backbench or opposition members) depositing communications in the commercial repository may have been underrepresented if they did not submit all of their releases or speech transcripts. Nevertheless, the communications analysed came from every party, and 108 of the 121 sitting members, in New Zealand's Parliament. Furthermore, the proportion of documents in the dataset attributable to each party loosely paralleled the number of parliamentary seats that party held, suggesting the two overlapping sources yielded reasonably representative coverage (data available upon request). Moreover, we aimed not to present an exhaustive analysis of all of the political discourse, but to explore patterns evident in written communications intended for wide distribution and media up-take.

All health professionals should be concerned that, despite the government's adoption of the Smokefree 2025 goal, discussion of the goal was neither a sustained nor a prominent feature in New Zealand politician's press releases and public speeches. Nor should we expect political parties to focus on tobacco in the election lead-up; the dip in tobacco-related references during the 2011 election period suggests politicians do not see tobacco control as a high priority election issue.

Discussion of the goal was strikingly unbalanced across the parties, and depended heavily on the contribution of a single politician, Minister Turia, who will retire from Parliament after the General Election in 2014. As Associate Minister of Health with responsibility for tobacco control, Minister Turia would be expected to refer most often to the smokefree goal. However, Smokefree 2025 is a major public health goal and achieving it will require cross-government action, so it is reasonable to expect that all politicians with responsibility for or interests in health and other relevant policy areas would also refer frequently to the goal.

Continued progress toward Smokefree 2025 depends on politicians, the media and the public to actively embrace the 2025 goal. This will require the Ministry of Health, other key government and non-governmental agencies, health practitioners and the tobacco control community to promote and advocate the goal. Politicians' overwhelming support for removing tobacco from open display in stores and introducing plain packaging suggests a strong latent interest in tobacco control.

As the New Zealand election campaign develops, we must continue to emphasise the goal's world leading nature, the strong support it has among the public<sup>10</sup> and health professional, and the enormous health gains and reductions in health inequalities that will follow from its achievement.<sup>11</sup> Such evidence would help politicians to see the merit in becoming more closely identified with the goal.

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## Dangers of “EDTA”

This letter is intended to raise medical practitioners’ awareness of the dangers of two similar sounding forms of edetate: edetate calcium disodium and edetate disodium. Edetate disodium has been reported as causing fatality when either confused with edetate calcium disodium or used outside of indication. This risk is currently increased in New Zealand due to difficulties in sourcing edetate calcium disodium and greater availability in hospital pharmacies of the disodium form.

Edetate (ethylenediamine tetraacetate, EDTA) is available as edetate calcium disodium (variously described as calcium disodium versenate, calcium disodium EDTA, sodium calcium edetate, calcium EDTA or Versenate) and as edetate disodium (also described as disodium EDTA or disodium edetate); either drug may simply be referred to as EDTA.

Both are parenterally administered chelating agents; albeit with differing uses and toxicity. Edetate calcium disodium is indicated for “the reduction of blood levels and depot stores of lead in lead poisoning (acute and chronic) and lead encephalopathy, in both paediatric and adult populations.”;<sup>1</sup> whereas edetate disodium has existing indications for use in “selected patients for the emergency treatment of hypercalcaemia and for the control of ventricular arrhythmias associated with digitalis toxicity.”<sup>2</sup>

It is important to note that the disodium form avidly binds calcium and can induce hypocalcaemia, tetany and even cardiac arrest with three deaths reported in the United States during the period 2003–2005.<sup>3</sup> In these cases edetate disodium was administered for: lead chelation in a child, treatment of autism in another child, and the removal of “heavy metals” in an adult. All deaths a result of cardiac arrest and in each case the drug was either mistaken for edetate calcium disodium or used for an unapproved indication.<sup>4</sup>

These deaths prompted a Federal Drug Administration (FDA) investigation resulting in the withdrawal of approval for edetate disodium in the US market due to limited indication and the availability of alternative products offering superior risk-benefit profiles.<sup>5</sup>

It is important to be aware that this drug is both currently available in New Zealand and included in the PHARMAC Pharmaceutical Schedule (Section H) listing of pharmaceuticals that may be used in District Health Board (public) hospitals.<sup>6</sup> Its inclusion in the Schedule as an antidote (specifically for “Removal and Elimination”) likely following a hospital pharmaceuticals review by a Hospital Pharmaceuticals Subcommittee and the Pharmacology Therapeutics Advisory Committee (PTAC).<sup>7</sup>

It is of concern that recent survey (March to April 2014) of 24 New Zealand hospital pharmacies identified no facility with sufficient stock of edetate calcium disodium to fully manage a (lead poisoned) adult patient. However, edetate disodium was present in five hospitals. This raises the potential for either confusion regarding the correct form of “EDTA” or use of edetate disodium outside of its current indications—with

potentially fatal consequences. This also highlights the broader issue of the inappropriate use of abbreviations in prescriptions.

Clinicians are reminded that these similarly named drugs are not interchangeable, and both medical practitioners and hospital pharmacists are urged to review their requirement for edetate disodium and consider removal of this drug from pharmacy shelves.

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## Pharmacy-based screening for atrial fibrillation in high-risk Māori and Pacific populations

Atrial fibrillation (AF) increases exponentially with age and patients have a five times higher risk of ischaemic stroke. While AF may be associated with symptoms such as palpitations, chest pain, shortness of breath, or oedema, many are asymptomatic. Thus incidence rates likely underestimate the true burden of this condition.

In New Zealand (NZ) AF data are limited for Māori and Pacific populations. The Māori Community Heart Study reported an AF prevalence of 2% among rural Māori and 1% in urban Māori aged 20–64 years.<sup>1</sup> However, a recent cohort study investigating AF in NZ octogenarians using both electrocardiography (ECG) and medical record review found a 30% prevalence of AF in Māori aged 80–90, and a 21% prevalence in non-Māori aged 85.<sup>2</sup> US data report a higher prevalence of AF in Pacific peoples than non-Pacific.<sup>3,4</sup>

AF meets all the WHO criteria for routine screening,<sup>5</sup> namely (1) AF is an important health problem; (2) There are acceptable treatments; (3) Facilities exist for the diagnosis and treatment of AF; (4) AF has a latent and symptomatic stage; (5) There are screening tests that are non-invasive and acceptable; (6) The natural history of AF is well understood; (7) There are agreed upon policies on whom to treat; (8) Screening costs are low and cost effective; (9) Case finding can be continuous; and (10) Suitable diagnostic tests exist (previously pulse-taking followed by a 12-lead ECG<sup>6</sup>).

In the past, systematic community AF screening has not been considered cost-effective given the time, effort and inconvenience required to undertake 12-lead ECGs. However, technological advances in ECGs are set to change this paradigm. Multiple electronic devices are now available which can provide reliable detection of AF, without the need for a standard 12-lead ECG. The FDA-approved AliveCor<sup>®</sup> heart monitor is one diagnostic tool that has the potential to make community-based mass screening feasible.

The heart monitor is a cheap (US\$200), accurate (sensitivity 98%, specificity 97%<sup>7</sup>), highly portable medical device that snaps onto the back of an iPhone and wirelessly communicates with an app on the phone. By placing fingertips on two electrodes on the back of the case a medical quality, single-channel ECG is produced in the app. The ECGs are automatically sent to a website where they are analysed and the presence of AF determined within 30 seconds. In the near future, the diagnostic algorithm will be available on the device.

In NZ, community pharmacists, the health professional seen most often by adults, are increasingly becoming involved in screening for health conditions and delivery of brief interventions. As a result, this group could be utilised to screen for undiagnosed AF in high-risk populations. Australian researchers have recently completed a cross-sectional study using pharmacies to screen for undiagnosed AF in 1004 adults aged ≥65 years (utilising the AliveCor<sup>®</sup> heart monitor).<sup>8</sup>

The incidence of asymptomatic AF was found to be 1.0% in this population<sup>9</sup>, and the screening process was found to be cost effective for stroke prevention and improving quality of life<sup>10</sup>. However, results of this study are not directly transferable to the NZ health environment, and thus a study was undertaken in late 2013/early 2014 to determine the feasibility of using the AliveCor<sup>®</sup> monitor to screen for undiagnosed AF in a high risk primary care population, using a community pharmacist in Auckland as the first point of contact for screening.

The study participants included Māori and Pacific people aged  $\geq 55$  years who visited the All Seasons Pharmacy in Te Atatu, Auckland. Potential participants were approached when they attended the pharmacy and invited to participate, with screening undertaken by a pharmacist once eligibility had been confirmed and consent obtained.

Participants completed a questionnaire and the ECG was undertaken using the AliveCor<sup>®</sup> device. Patients were informed immediately of the result and if AF positive referred back to their usual GP for a 12-lead confirmatory ECG. The GP managed any further referrals as required. All ECGs produced by the heart monitor were checked by a cardiologist.

A total of 121 people were recruited over 14 weeks, with a 3% refusal rate. Overall 37% of participants were Māori and 63% were Pacific, 48% were women, the average age was 65.4 years (SD=7.6 years), and 61% had between 8–12 years of schooling (26% had less than 8 years or no education and 13% had more than 12 years). Heart health data are summarised in Table 1.

**Table 1: Self-reported ‘heart health’ of participants**

<b>Heart health</b>	<b>N=121</b>
<b>Current smoker</b>	21%
<b>Currently taking warfarin</b>	12%
<b>Had a family member that had problems with their heart or blood vessels at an early age (father/brother &lt;55 years, mother/sister &lt;65 years)</b>	29%
<b>Had been told they had:</b>	
An abnormal heart beat	20%
Diabetes	35%
Angina	11%
High blood pressure	62%
Stroke or transient ischaemic attack	16%
Heart attack	8%
High cholesterol	59%

Twenty (17%) participants were found to have AF when screened (Table 2). The false positives observed all occurred early in the study and the quality of the tracings was ‘poor’ according to the cardiologist. We therefore believe these false positives were due to incorrect handling of the device, which was corrected through further training of the pharmacists.

Overall, two (1.7%) of the 121 people screened had a new diagnosis of AF, and two known AF cases appeared not to be receiving warfarin, giving a total of four people

(3%) that could benefit from an intervention. Pharmacists and participants found the heart monitor easy to use, and participating GPs had overwhelmingly positive feedback on the study.

**Table 2. AF results according to age, gender and ethnicity**

Variables	Māori	Pacific	Mean age (years)	Female	Total
Unknown but likely false positive	0	1	55.0	1	1
False positive	3	1	65.8	1	4
Previously undetected AF*	0	2	75.0	1	2
Known AF	4	9	69.7	6	13
<b>Total</b>	<b>7</b>	<b>13</b>	<b>68.0</b>	<b>9</b>	<b>20</b>

\*Includes one person confirmed by cardiologist but not GP confirmed.

This study clearly showed that (1) screening for AF within a pharmacy environment is feasible; (2) the AliveCor<sup>®</sup> iPhone device is highly acceptable to Māori and Pacific populations, as well as health professionals in this environment; (3) AF screening within the pharmacy environment provides an excellent ‘teachable moment’ about heart health; and (4) the AliveCor<sup>®</sup> iPhone device is a cheap, effective and accurate screening tool that has the potential to significantly reduce the chances of an adverse health outcome, and contribute to a reduction in known health inequalities. A larger NZ study is now planned to verify these results.

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## **Should New Zealand do more to help other Pacific nations become smokefree by 2025? The case of Tokelau as a potential example**

The New Zealand Government has the goal of becoming a Smokefree Nation by 2025.<sup>1</sup> It has also supported work to help some Pacific nations meet their obligations under the Framework Convention for Tobacco Control (e.g., a NZ Agency for International Development-funded, six-country project<sup>2</sup>). Here we briefly discuss if it could do more to help its Pacific neighbours, using the example of Tokelau, where one of us works as the Director of Health [ST], and another recently worked on an medical elective [AK].

Tokelau has high smoking rates (46% of adults in one survey<sup>3</sup>) and like other countries, a growing chronic disease burden. In terms of tobacco control, New Zealand has already provided some support to Tokelau in terms of assisting in drafting tobacco control legislation (as per the six-country project detailed above). But there are good self-interest reasons why New Zealand should offer yet more help to Tokelau to advance tobacco control. This is because New Zealand already indirectly pays (via development assistance) for some of the health care in Tokelau. Tokelau residents are also passport-holding New Zealand citizens and may often move to live in New Zealand, and therefore utilise this country's health services for tobacco-related conditions.

Additional practical reasons why New Zealand could particularly consider helping Tokelau with tobacco control include the following:

- “Tokelau Health” is itself aiming to follow the New Zealand smokefree goal example. Also our impression from conversations with people at all levels of Tokelauan society (specifically held by AK in late 2013/early 2014), is that there is strong support for enhanced tobacco control.
- The relatively small size of the population in Tokelau and the small number of retail outlets selling tobacco (n=3), make tobacco reduction and even elimination relatively feasible. Furthermore, tobacco is not known to be grown on any of the atolls (to the best of our knowledge).
- There is no airport on Tokelau and so the smuggling of tobacco can be controlled relatively simply at the point of the single boat service leaving Apia (Samoa). This makes Tokelau somewhat different from most other islands where advancing tobacco control has been considered in some depth (e.g., Niue<sup>4</sup>).
- Finally, Tokelau has a track record for being innovative in some health domains—e.g., having a ban on soft drink sales and restrictions on alcohol sales. It is also the first jurisdiction in the world to have a fully solar-powered electricity grid.

If the New Zealand Government (or tobacco control non-governmental organisations in New Zealand) helped Tokelau to achieve smokefree status over the next decade, then this would potentially provide a valuable example to other countries in the Pacific.<sup>5</sup> It could even be an inspiration to island nations and small countries around the world.

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## An Auckland-based student acupuncture clinic patient profile and utilisation study

There has been an ongoing increase both internationally and nationally in the number of people who are seeking complementary and alternative medicine (CAM).<sup>1-5</sup> A number of studies have examined both attitudes toward CAM, as well as prevalence rates of CAM use in New Zealand.<sup>3-7</sup> According to both international and national data, acupuncture is one of the more widely recognised and utilised CAM treatments.<sup>1-3,5,6,8,9</sup>

At present, there are only two private training establishments in New Zealand that provide a degree qualification majoring in acupuncture based on traditional Chinese medicine (TCM). We were interested in identifying the characteristics of patients who visit a Chinese Medicine Student Acupuncture Clinic in the country's largest city, Auckland.

The aim of this study was to:

- Provide a demographic profile of current patients who attend a Chinese Medicine Student Acupuncture Clinic; and
- Identify the complaints for which patients sought treatment, and whether they had previously consulted another healthcare practitioner regarding their complaint.

During the 4-month data collection period, 229 new patients attended the Clinic, and consent was obtained from 206 patients. Eighty-three males and 123 females ranging from 8 years to 88 years of age (mean age = 44.7 years, standard deviation = 18.4 years) took part in the present study. Data were collected from two questionnaires and were analysed using descriptive statistics, carried out in SPSS (version 20.0) software.

The majority of patients who attended the Clinic were female (60%) and were aged between 30–49 years of age (34%) [Table 1].

**Table 1. Patient demographic information**

Variables	Number (n)	Percentage (%)
<b>Gender</b>		
Male	83	40
Female	123	60
<b>Age (years)</b>		
0–9	1	1
10–17	4	2
18–29	50	24
30–49	71	34
50–64	45	22
65–74	20	10
75 and older	15	7

The majority of patients who sought treatment at the clinic were Chinese (19%) followed by those who identified as being New Zealand European (17%); followed by a number of Asian subgroups and Pacific Island ethnic groups and those who identified as being Māori [Table 2].

**Table 2. Patient ethnicity**

Ethnicity	Number (n)	Percentage (%)
Chinese	40	19
New Zealand European	36	17
Korean	16	7
Taiwanese	11	5
Indian	10	5
Pacific Persons	7	4
Māori	3	2
Other	26	14
Not disclosed	57	27

**Note:** Other refers to patients who identified as being from ethnic groups that comprised less than 5%.

Patients most commonly sought treatment for lower limb (18%), head and neck (16%) and upper limb complaints (14%) and for back pain (14%) [Table 3].

**Table 3. Patients sought treatment for...**

Variables	Number (n)	Percentage (%)
Lower limb	36	18
Head and neck	33	16
Back pain	29	14
Upper limb	29	14
Mood, psychological and fatigue	15	8
Gynaecology and reproductive	12	5
Insomnia	11	4
Gastrointestinal and abdominal	10	4
Acne and skin	7	3
Other	15	10
Not stated	9	4

**Note:** Other refers to conditions that comprised less than 2%.

Forty-four percent of patients reported that they previously consulted another healthcare practitioner regarding their present complaint [Table 4].

**Table 4. Other consultation**

Other consultation	Number (n)	Percentage (%)
Yes	91	44
No	78	38
Not stated	37	18

The majority of those patients who had consulted another healthcare practitioner for their complaint had been to see a general practitioner (20%) [Table 5].

**Table 5. Type of healthcare professional seen in other consultation**

Healthcare professional	Number (n)	Percentage (%)
General practitioner	41	20
Medical specialist	9	4
Physiotherapist	7	3
Other healthcare practitioner	19	11
Not applicable	79	38
Not disclosed	51	24

**Note:** Other refers to consulting a healthcare practitioner that comprised less than 2%.

Patients who attended the Clinic were more likely to be female, and younger or middle-aged; a finding similar to a number of previous studies.<sup>6,7,9</sup> Disregarding incomplete ethnicity data, an almost equal proportion of patients who disclosed their ethnicity identified as being either Chinese or New Zealand European. This finding is similar to earlier studies, which reported higher CAM utilisation rates among New Zealand Europeans compared to other ethnic groups who reside in New Zealand.<sup>6,7</sup>

While Europeans comprise the majority of the New Zealand population (74%) and those who identify as being Asian comprise only 12% of the national population, it may be concluded that a higher proportion of Asian patients are more likely to attend the Clinic, as it is a Traditional Chinese Medicine Clinic.<sup>10</sup>

Research indicates that some Asian sub-groups view Chinese and Western medicine to be complementary to one another.<sup>9</sup> Seven percent of patients identified as being from a Pacific Island ethnic group, while 2% of patients identified as being Māori.

Acupuncture was utilised more for pain management for complaints related to either the lower limb or the upper limb, head and neck area, and for back pain. Almost one-half of patients reported consulting another healthcare practitioner (predominately a general practitioner) regarding their complaint prior to attending the clinic.

Previous studies have reported that individuals tend to seek CAM treatment for conditions that are difficult to treat or manage by conventional Western medicine.<sup>6,8</sup>

Future research in this area will focus on identifying the reasons why patients attend such a clinic, and their views and experiences of acupuncture treatment.

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## **Working mothers are disadvantaged by limited funding for health research**

According to the New Zealand Health Research Council (HRC News, April 2014), females outnumber their male counterparts by a ratio of 2 to 1 at the emerging researcher level, however, males continue to dominate senior research positions by a ratio of 2 to 1.

The New Zealand Ministry of Women's Affairs states that "women have higher participation and completion rates in tertiary education compared to men, and they are increasingly out-numbering men in education achievement" and yet "the lack of women in leadership roles represents a failure to exploit the available talent pool."

A New Zealand study by Goldman Sachs, *Closing the Gender Gap: Plenty of Potential Economic Upside* (2011), reported that University Professors and Associate Professors comprised only 22.5% women and identified the lack of New Zealand women in leadership roles as an area requiring urgent attention.

Over the last few years a number of 'women in science' have experienced situations which contribute to this disparity. Some of these have manifested due to the policies of research funding organisations. Working mothers in the scientific realm can be penalised for two reasons: they have taken extended time off for parental leave and/or are working part-time due to ongoing childcare commitments.

As an example, recently a cohort of women applicants to a local health funding organisation were informed that they were ineligible to apply for 'emerging researcher' grants because the time taken for parental leave was included within the 'calendar years' allowed since completing their PhDs. Fortunately, this organisation was more than happy to revise their policy when this issue was brought to their attention, however, it is known to still exist within some other New Zealand health research funding organisations.

How are working mothers to become 'research leaders' if they are unable to apply for 'emerging researcher' funding due to taking time out from their careers to raise children? The eligibility criterion should reflect work experience, i.e. years of full-time equivalents, rather than calendar years or age of the applicant. For example, guidelines for Marsden Fast Start applicants state that time spent on parental leave and/or on sickness leave is excluded from the year count for eligibility, and HRC Emerging Researcher First Grants have a policy of assessing an applicant's track record "relative to opportunity" taking into account any gaps in work history. Since it can be very difficult for grant assessing committees to compare applicants when their CVs differ significantly due to having taken time out from research, it is important for standard CV templates to include sections specifically for the purpose of explaining such gaps in career.

Although there are men who have taken time out to raise children, women pursuing a career in science can find that male colleagues whom they studied alongside are now Professors, as they have been able to focus fully on their careers, whilst many women

continue to operate on short-term contracts, never knowing if they will have a position the following year. This makes it very difficult to focus on long-term career development.

Emerging researchers are unlikely to be able to obtain ‘mature researcher’ grants, as they are competing with established researchers with an unbroken work history. This makes the availability of appropriate emerging researcher grants even more vital. The HRC and the Royal Society of New Zealand offer two prestigious Career Development Awards (the Sir Charles Hercus Health Research Fellowship and the Rutherford Discovery Fellowship), however, these are limited in number and are highly competitive.

If working mothers are expected to keep pace with their male counterparts, is society going to pay for that in the long run? We are told that the first 3 years of a child’s life are the most important for their continuing development. Being at home full-time also facilitates breastfeeding with its well-known positive effects on child development and health. Although many women realise that choosing to stay at home with their children for the first few important years may affect their careers, they do this for their children’s sake and for society as a whole. Some of these children may even become future leaders, ideally through parental example.

Following a return to work after parental leave, many mothers work on a part-time basis due to ongoing childcare commitments. This puts mothers even further behind those who can dedicate themselves full-time to their careers. Working fewer than a specified number of hours per week can exclude a researcher from applying for particular research funds and makes it even more difficult to survive in the increasingly competitive research environment.

Research outputs are often counted in terms of publication number and quality. For example, the New Zealand Performance Based Research Fund (PBRF) does not accommodate the effect that working part-time has on the expected number of publication outputs. Part-time work undertaken by experienced researchers should be valued on a pro-rata basis.

Among women entering the science workforce there is ongoing attrition through the biological circumstance that women carry the load of bearing and often also of caring for their children, resulting in both depletion of numbers of women available for appointment to senior positions, and in those women who survive in science having less substantial CVs.

To effect change, working mothers need to be seen as valued contributors to the research environment. Funding organisations need to examine their current charters and terms of reference to ensure that they cater for working mothers. Furthermore, more ‘mother-friendly’ research opportunities could be created.

The cosmetic company L’Oreal offers small amounts of money to support female ‘emerging researchers’. However, women in science need continuing support in order to make it past the ‘emerging researcher’ level and through to the more senior leadership positions without the attrition that is still occurring.

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## Missed melanomas – comment

All of us must sympathise with Peter Foreman’s story of the tragic delay in diagnosis and subsequent loss of his son from melanoma.<sup>1</sup> It is not possible to know whether earlier treatment would have been lifesaving. The history of growth over a short period of months is characteristic of nodular melanoma, an uncommon subtype of the disease, which is particularly aggressive when arising in the scalp and frequently leads to death of the patient. Unfortunately they are misdiagnosed in 50% of cases, as they often have no distinctive clinical features.

However, we disagree with his assertion that an adversarial medical-legal system will be beneficial. The resultant defensive practices would inevitably lead to huge increases in costs and innumerable unnecessary surgeries with accompanying complications.

The management of melanoma in New Zealand (NZ) is generally very good. Overall, for all melanomas, NZ outcome results are similar to those in Australia or Canada, with NZ 5-year survival rates for recent patients being 94% for women, and 88% for men. US results are marginally better, but their data does not include the whole population, as ours does. But in all these countries, there are types of melanoma that are much more difficult to detect and treat, including melanomas on the scalp, and nodular melanoma. Melanoma death rates in NZ in those diagnosed up to age 45 have been decreasing slowly, although rates at older ages continue to increase.<sup>2</sup>

Early detection is most effective for common melanomas such as superficial spreading melanoma, which often develop slowly, giving good opportunities for detection. But nodular and some other melanomas may grow more rapidly and may not be benefitted by earlier detection efforts. For every melanoma that occurs, there are many other non-cancer lesions that appear similar, so more intensive detection efforts come at a cost in unnecessary biopsies and anxiety for patients. While we hope earlier detection efforts are worthwhile, and we work on that basis, the extent of its benefits is uncertain.

It is highly likely that mortality from melanoma will be unchanged; rates of death from melanoma have continued to rise, despite annual increases in reported incidence of melanoma.<sup>2</sup> The majority of excised melanomas are in situ or thin (defined as less than 1 mm in thickness). We do not know if “early detection means increased survival rates”—we can only hope that this is true and do our best to identify and remove the aggressive tumours before they have metastasised.

We are engaged in reviewing melanomas diagnosed in the Waikato Region during 2010–2012. Breslow thickness is the most important prognostic feature for melanoma. In our database of 577 invasive melanomas, median depth is 0.8 mm. There are 80 nodular melanomas, which have a median depth of 2.8 mm, and 334 superficial spreading melanoma, with a median depth of 0.65 mm.

The prognosis for thick melanoma is abysmal (10-year survival 60–67%<sup>3,4</sup>; and unfortunately a high proportion of scalp tumours are thick at presentation.<sup>5</sup> Scalp

location has been reported to be an independent predictor of recurrence<sup>6</sup> and fatality.<sup>7</sup> As a recent retrospective review concludes, “Further research is needed to characterise the environmental, microenvironmental, and genetic causes of the increased aggressiveness of scalp melanoma and to identify more effective treatment and surveillance methods.”<sup>6</sup>

The Ministry of Health has recently published *Provisional Standards of Service Provision for Melanoma Patients in New Zealand*.<sup>8</sup> These recognise the need to (a) improve education of health professionals in the recognition of melanoma, and, (b) to provide rapid and expert specialist support in diagnosis and management.

We urge District Health Boards to implement the recommendations.

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## **Dominion Notes: Auckland Mental Hospital**

*Excerpt from Dominion Notes published in NZMJ 1912 March; 11(41):83–87.*

Mr. Ewington, official visitor to the Mental Hospital, reporting to the Government on the overcrowded state of the institution, says:—"I wish the Minister for the department, with representatives of the Auckland daily press, to accompany me over the Mental Hospital any night at, say, 12 o'clock, and witness a scene of horrors, consequent on the absolutely deplorable overcrowding. Even then, they could not fully realise all... The patients' beds are laid on the floor in the passages against the attendants' bedroom doors, and the smell is repelling. The attendants have every night to lift the tables and chairs out of the reading-room to make up a good many shakedown on the floor. Altogether there are about fifty-six shakedown on the floors in the passages and elsewhere. A current of cold air runs along the passages, and we might ask ourselves how we would like to be put to bed under such circumstances, or how we would like to know that while we enjoy a good bed at home our wife, mother, or father are forced to lie on the floor in a passage, such as is the case in the Mental Hospital."

Mr. Ewington urgently and solemnly appeals to the Government to act promptly and adequately in this matter.

In the Hon. Mr. Buddo's reply it was stated the population had increased 30 per cent. during the past ten years, and naturally the number of mentally afflicted people had also increased considerably during that time. The result was that there had arisen a necessity for greater provision for their accommodation.

[The question of the number of inmates is not in dispute; it is a matter of fixing responsibility for failure to make proper provision for them.—Ed. N.Z.M.J.]

Auckland, January 5.

The Public Works Department is inviting fresh tenders for the erection of an auxiliary Mental Hospital at Point Chevalier, near the existing asylum. It is understood the scheme provides for an additional 300 patients and medical officers' quarters. The Department considered the question of erecting a temporary building, 80ft. by 40ft. in the grounds, to relieve the present overcrowding, but, owing to the cost and other difficulties, it was decided to go in for a comprehensive scheme.

A contract has been signed for the erection of the first of the Mental Hospital buildings at Tokanui, near Te Awamutu (Auckland). This is the first of a number of Mental Hospital buildings which are to be erected at Tokanui, with a view to relieving the congestion which exists at the Auckland Mental Hospital.



## Proceedings of the 223rd Scientific Meeting of the Otago Medical School Research Society, Wednesday 9 July 2014

**Optogenetic control of arcuate kisspeptin neurons *in vivo*. S Han, K Czieselsky, A Herbison. Department of Physiology and the Centre for Neuroendocrinology, Otago School of Medical Sciences, University of Otago, Dunedin.**

Gonadotrophin-releasing hormone (GnRH) is secreted in a pulsatile manner from GnRH neurons to drive the pulsatile release of luteinizing hormone (LH). The mechanism underlying this pattern of GnRH secretion is not well-understood. Recent studies have suggested that arcuate nucleus (ARN) kisspeptin neurons might be involved in generating pulsatile pattern of GnRH secretion. We aimed to investigate whether direct activation of ARN kisspeptin neurons could evoke LH pulses in the mouse.

Adeno-associated virus (AAV) carrying channel-rhodopsin-2 (ChR2) was injected bilaterally into the ARN of transgenic Kiss-Cre male mice. This results in the expression of ChR2 selectively in ARN kisspeptin neurons. To activate ARN kisspeptin neurons *in vivo*, an optical fibre was implanted into the ARN in these mice under isoflurane anaesthesia, and pulses of blue light (5 ms duration) were delivered at 2, 5, 10 or 20 Hz for 5 min. Tail-tip blood samples were collected throughout the stimulation protocol, and LH concentrations were assayed using an ELISA.

There was a significant increase in LH concentrations after stimulating ARN kisspeptin neurons ( $n = 5$ ; Interaction:  $F = 8.85$ ,  $P = 0.002$ , two-way repeated measures ANOVA). In particular, 10 and 20 Hz stimulation resulted in a significant, pulse-like rise in LH in the blood ( $0.64 \pm 0.18$  to  $4.31 \pm 1.18$  and  $0.65 \pm 0.21$  to  $4.31 \pm 1.36$  ng/ml with 10 and 20 Hz stimulation, respectively; mean  $\pm$  SEM;  $P = 0.0004$  for both 10 and 20 Hz stimulation; Bonferroni's *post-hoc* test).

These results provide the first direct demonstration that activation of ARN kisspeptin neurons can generate pulsatile LH secretion. The mechanism and pathway through which ARN kisspeptin neurons activate GnRH neurons remain to be elucidated.

**The dynamic relocation test: differences in muscle activity between rotator cuff and superficial shoulder muscles. D Ribeiro<sup>1</sup>, J Shemmell<sup>2</sup>, C Falling<sup>1</sup>, G Sole<sup>1</sup>.**

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Rehabilitation programmes for shoulder injuries commonly include rotator cuff exercises to restore function and optimise joint stability. The “dynamic relocation test” (DRT) is used clinically to assess patients’ ability to recruit the rotator cuff muscles and to improve rotator cuff motor control. At early stages of motor learning, co-contraction is commonly observed, and it is expected to decline as learning occurs. Anecdotal evidence suggests the effectiveness of the DRT may be reduced by patient adoption of compensatory strategies and muscle co-contraction, including the recruitment of superficial shoulder muscles. The aim of this study was: (1) to compare the relative muscle activity between rotator cuff and superficial shoulder muscles during the DRT, and (2) to assess whether muscle activation variability changed over a clinically-relevant number of DRT attempts.

Twenty asymptomatic individuals performed the DRT test ten times, sustaining contractions for ten seconds. Electromyograms were recorded from supraspinatus, infraspinatus, teres minor (Tm), middle deltoid (MD), posterior deltoid (PD), pectoralis major (PM) and latissimus dorsi (LD) muscles.

We found between-muscle differences in the amplitude of muscle activity ( $F = 14.11$ ,  $P < 0.001$ ). Supraspinatus, infraspinatus, Tm, PM and LD presented higher activation levels compared to the other monitored muscles, and appear to be the muscles primarily responsible for executing this task. For assessing changes in variability (expressed as the standard deviation of muscle activation) of each muscle activation change over ten trials, a MANOVA was conducted. Results suggested there were significant changes in muscle activation variability over the ten trials, ( $F = 18.2$ ,  $P < 0.001$ ). However, follow-up analyses through ANOVA, computed for each muscle, showed no statistically significant differences.

The DRT does not isolate a rotator cuff contraction, and superficial shoulder muscles are also engaged during this test. The activation of superficial muscles may reflect: (1) a need for balancing shoulder moments generated by the rotator cuff muscles, and/or (2) the fine-tuning of motor execution. Muscle variability did not reduce over the ten trials, suggesting that ten repetitions may not be enough for motor learning to occur.

**Increased hemodynamic adrenergic load in conscious and anaesthetised type 2 diabetic rats. C Bussey, A de Leeuw, R Lamberts. Department of Physiology and HeartOtago, Otago School of Medical Sciences, University of Otago, Dunedin.**

The rapid increase in type 2 diabetes impacts heavily on cardiovascular health. One clinically important, but often overlooked, consequence is that diabetic patients have greater requirement for surgical treatments; and have increased perioperative cardiovascular complications, even for non-cardiac surgeries. This likely relates to changes in the autonomic nervous system, which normally maintains tight control of

cardiovascular function via  $\alpha$ - and  $\beta$ -adrenoceptors. Thus, we examined how anaesthesia affects adrenergic hemodynamic responses in type 2 diabetes *in vivo*.

Our recently established technique provides conscious hemodynamic measures for direct comparison with anaesthetised measures; combining radio telemeters to record blood pressure and heart rate, with vascular access ports for non-invasive intravenous drug delivery. Hemodynamic effects of  $\alpha$ -adrenergic (phenylephrine; 1-100  $\mu\text{g.kg}^{-1}$ ) or  $\beta$ -adrenergic (dobutamine; 2-120  $\mu\text{g.kg}^{-1}$ ) stimulation were assessed in conscious and anaesthetised (isoflurane; 2%) sixteen-week old male Zucker Diabetic Fatty rats and their non-diabetic littermates ( $n = 7-8$ ). Differences were determined by two-way repeated measures ANOVA with Student-Newman-Keuls post-hoc analysis.

Conscious diabetic rats exhibited increased  $\alpha$ -adrenergic sensitivity, displaying greater increases in arterial blood pressure (diabetic  $95 \pm 4$  vs. non-diabetic  $80 \pm 3$   $\Delta\text{mmHg}$ ; means  $\pm$  SEM,  $P < 0.05$ ). Isoflurane anaesthesia exacerbated and prolonged  $\alpha$ -adrenergic pressure increases in diabetic animals (diabetic  $68 \pm 4$  vs. non-diabetic  $51 \pm 1$   $\Delta\text{mmHg}$ ;  $P < 0.05$ ). Meanwhile,  $\beta$ -adrenergic heart rate increases were reduced in conscious diabetic rats (diabetic  $27 \pm 8$  vs. non-diabetic  $58 \pm 7$   $\Delta\text{bpm}$ ;  $P < 0.05$ ), but normalised during anaesthesia (diabetic  $63 \pm 8$  vs. non-diabetic  $49 \pm 8$   $\Delta\text{bpm}$ ; *NS*).

Type 2 diabetes alters adrenergic function, dynamics and interaction with anaesthesia. Reduced conscious  $\beta$ -adrenergic sensitivity in diabetes may offset sympathetic over-activation. However, anaesthesia enhanced  $\alpha$ -adrenergic responses and normalised  $\beta$ -adrenergic function in diabetes. Increased hemodynamic adrenergic load during acute anaesthetic stress may contribute to surgical cardiovascular complications in type 2 diabetic patients.

**DNA methylation markers of myelodysplastic syndrome. E Rodger<sup>1</sup>, A Chatterjee<sup>1</sup>, P Stockwell<sup>2</sup>, I Morison<sup>1</sup>. <sup>1</sup>Department of Pathology, Dunedin School of Medicine, <sup>2</sup>Department of Biochemistry, Otago School of Medical Sciences, University of Otago, Dunedin.**

Myelodysplastic syndrome (MDS) is one of the most common blood cancers of the elderly. It is characterised by ineffective production of myeloid blood cells (e.g., neutrophils) in the bone marrow, resulting in the presence of defective cells and a decrease in the number of normal cells in the blood. A bone marrow biopsy is currently required to make a diagnosis of MDS, but in many cases the diagnosis remains equivocal. There is a need for a non-invasive diagnostic test for MDS to improve patient care and inform treatment options. MDS is associated with genome-wide changes in DNA methylation at CpG dinucleotides. With this in mind, we aimed to identify recurrent DNA methylation marks in MDS that can be used to develop a blood-based diagnostic tool.

We have established genome-wide methylation maps of peripheral blood neutrophils (8 mL blood) from MDS patients ( $n = 10$ , median age = 79) and age-matched controls ( $n = 10$ , median age = 77) by using reduced representation bisulfite sequencing. This next generation sequencing method uses the restriction enzyme MspI to enrich for CpG-rich regions. Our in-house software package was used to identify 269 significantly differentially methylated MspI fragments (DMFs) with  $>10\%$  difference

(one-way ANOVA: FDR-adjusted  $P$  value  $< 0.0001$ ) in the MDS patients compared to age-matched controls. The DMFs were significantly enriched (modified Fisher's exact test,  $P < 0.01$ ) for gene ontology terms associated with MDS pathophysiology, including regulation of differentiation, apoptosis, DNA transcription, and cell proliferation.

The highest ranked DMFs show a clear separation between the methylation of MDS and control neutrophils and therefore may have significant diagnostic value. To confirm our findings, we are currently validating the top candidates in an independent cohort, which we will then use to develop a blood-based diagnostic test for MDS.

## **Efficacy of oral immunotherapy for the desensitisation of peanut allergy in children**

Peanut allergy is the most common cause of severe and fatal allergic reactions to food so the issue of desensitisation is important. Early studies of subcutaneous immunotherapy for peanut allergy were associated with severe adverse reactions, possibly due to the route of administration.

Small studies suggest peanut oral immunotherapy (OIT) might be effective in the treatment of peanut allergy. This report concerns a randomised trial to test the efficacy and safety of peanut OIT. The participants were children aged 7–16 with proven peanut allergy. The treatment patients were given characterised peanut flour; protein doses of 2–800 mg/day and the control group avoided peanuts.

The primary outcome, desensitisation, was recorded for 62% (24 of 39 participants) in the active group and none in the control group. The desensitisation was accompanied by improved quality of life and a good safety profile. The researchers conclude that “further studies in wider populations are recommended; peanut OIT should not be done in non-specialist settings, but it is effective and well tolerated in the studied age group.”

Lancet 2014;383:1297–304.

## **Surgical safety checklists**

A study published in 2009 showed that implementation of the 19-item WHO Surgical Safety Checklist substantially reduced the rate of surgical complications from 11% to 7% and reduced the rate of in-hospital deaths from 1.5% to 0.8%.

This Canadian study reviews their experience after the Ministry of Health in Ontario mandated adherence to the safety checklist in 2010. Data from 101 hospitals collected for the 3 months before and after the adoptions of the checklists is reviewed and compared. Each cohort included over 100,000 procedures.

The conclusions were that implementation of the surgical safety checklists in Ontario was not associated with significant reductions in operative mortality or complications. There was a significant but small and clinically irrelevant reduction in length of hospital stay (5.11 days before and 5.07 days after the introduction of the checklists).

N Engl J Med 2014;370:1029–38.

## **Antibiotics and tooth staining**

It is well known that permanent tooth discolouration may occur after the use of tetracyclines during the period of tooth development (i.e. the last half of the pregnancy, infancy and up to the age of 8 years).

It is well known that the superficial discolouration of the teeth has been recorded with the use of tetracyclines and the beta-lactam penicillins, particularly if an oral suspension is used. The affected teeth appear to have brown, yellow or grey staining due to deposits on the surface of the teeth. Fortunately the effect is usually reversible by careful brushing or professional cleaning.

Prescriber Update 2014:35(2):26–27.

## John Hamlyn Stewart

*(MB, ChB, FRANZCR, MNZM; 15 September 1922 – 22 March 2014)*

John Hamlyn Stewart was born in Dunedin in 1922. His father had become a medical student after returning from WW1, where he served in Gallipoli, earned an MC on the Somme and flew with the Royal Flying Corps. The Stewart family eventually settled in Takapuna, where his father, Garfield Stewart, was a GP for many years.



John attended Takapuna Primary School and Takapuna Grammar School, with his last 2 years of secondary schooling at Wanganui Collegiate School. After a first year in Auckland, John entered medical school in Otago in 1941 and resided at Knox College. After graduating in 1945 he began as a house officer in Auckland but within 3 months developed active tuberculosis. He spent most of 1946 and 1947 bed-bound; several times he appeared to have recovered and renewed his work on the wards, only to suffer relapses of the disease.

Sir Charles Hercus arranged an appointment for John as a lecturer in the Pathology Department of the Otago Medical School in 1948 and 1949, a physically much less demanding role. As a result of this appointment, his knowledge of pathology provided an excellent background for his ultimate career as a radiologist; he served for many years as an examiner in pathology for the Australasian College (now the RANZCR).

In 1951 John left for the UK, where he planned to train as a physician. He left New Zealand as ship's surgeon on a slow old tramp steamer. As part of his treatment for tuberculosis he had two artificial pneumothoraces, which required regular refills to keep his lungs in a semi-collapsed state. He managed to organise this to occur in Panama, but the crossing of the Atlantic was so slow that his lungs re-expanded and his tuberculosis relapsed. He had to be carried off the ship when it finally docked in Hull. He spent the rest of 1951 and 1952 as a patient in the Brompton Chest Hospital in London.

A career in radiology was suggested to John by Professor Scadding of the Brompton Hospital. He was able to obtain a position as registrar in Oxford, where he completed his radiology training.

John returned to New Zealand in 1955 to be a full-time radiologist at Green Lane Hospital and later at National Women's Hospital, where he was head of department until his retirement in 1985. National Women's was an exciting place to be in the 1960s. John worked closely with Sir William Liley in the development of fetal transfusion; he subsequently travelled the world lecturing about this technique. He was the Rouse Travelling Fellow of the Australasian College of Radiologists in 1972.

John went to Glasgow to learn about the new technique of diagnostic ultrasound and acquired the first ultrasound machine in Auckland for National Women's Hospital. He was a founding member of the New Zealand Ultrasound Society and was the first president of this organisation. The society included radiologists, clinicians and sonographers in its membership; it subsequently merged with its Australian counterpart to form the Australasian Society of Ultrasound in Medicine (ASUM).

John Stewart was an outstanding teacher of radiology registrars, radiographers and sonographers. His dedication to teaching, his wide interests and his enquiring mind led him, after his retirement, to found New Zealand's first branch of the University of the Third Age (U3A). This organisation provides opportunities for continuing education of older people. From its beginnings in Remuera in 1989, U3A now has 81 groups throughout the country. In 1999 John was honoured as a Member of the New Zealand Order of Merit for services to education.

John married Marjorie Horner in Hawera in 1957. Marjorie had an interesting career before her marriage, including 5 years with the NZ High Commission in London and a year at the NZ embassy in Washington DC. In later years she was prominent in the Girl Guide movement and also made a large contribution to U3A. John and Marjorie travelled widely and developed a wide range of international contacts, many of whom becoming close friends.

The Presbyterian Church was important to John's life. He was an elder of St Luke's Church in Remuera for many years. John had a keen and well-informed interest in theology and church history.

After his struggles with tuberculosis as a young man, John kept good health through his later years. His final illness, with gastric cancer, was mercifully brief. John and Marjorie Stewart are survived by a daughter and a son, Fiona (cardiologist) and James (ophthalmologist), and by four grandchildren.

John had a warm personality and a gentle nature. The large attendance at John's funeral in his beloved St Luke's attests to the high regard in which he was held.

George Foote (Radiologist, Auckland) wrote this obituary, with the assistance of John's children, for his late colleague and mentor.