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## Severe early childhood caries: a modern (neglected) epidemic?

Philip J Schluter, Jesse Kokaua, Martin Lee

A recent series in the *Lancet* argued that oral health carries a large societal burden and radical action is needed. Part of this radical action is a re-thinking of the primary healthcare importance and integration of oral health service delivery. Fundamental to this is understanding the epidemiology and promoting evidence-based preventive strategies. This paper is deliberately designed and written for the *New Zealand Medical Journal* to bring Canterbury children's oral health to the forefront of a wider New Zealand readership, demonstrate the current considerable inequalities, and urge us to rethink the status quo both locally and nationally. Looking at the most recent available data, we observed that: 1) Severe early childhood caries rates in Canterbury's is high—at nearly one in five children. 2) Rates in our Pacific children (40.1%) and Māori children (26.2%) are sadly much higher—and likely reflect social determinants of health inequities (such as poverty) between children rather than intrinsic cultural differences. 3) One in 20 of these children also required teeth extraction(s). 4) These come at considerable individual and societal costs, and have long-term consequences. 5) Despite the best efforts of many over a long period of time, too many children continue to suffer from a heavy oral health burden. If we wish to valve our children's oral health, then radical action is indeed required.

## A detailed analysis of quality improvement and patient safety within undergraduate health professional curricula in Aotearoa New Zealand

Susan Shaw, Karina Donaldson

The education of health professionals requires attention to a wide range of skills and knowledge. It is a priority to ensure that quality and safety are included in curricula. A previous study (Robb et al, 2017) asked educators key questions about quality improvement and patient safety. This paper extends that work by presenting analyses of curricula across a wide range of professional education programmes in Aotearoa New Zealand. It found relevant concepts are addressed within curricula and suggested an extended set of terms for identifying and describing them.

## Reduced community antibiotic dispensing in New Zealand during 2015–2018: marked variation in relation to primary health organisation

Mark Thomas, Andrew Tomlin, Eamon Duffy, Murray Tilyard

We studied the amount of antibiotics dispensed by community pharmacies in New Zealand. The total amount of antibiotics dispensed by community pharmacies in New Zealand decreased each year between 2015 and 2018. While community antibiotic dispensing decreased in all district health boards (DHBs) and in all primary health organisations (PHOs) there were marked differences between the 20 DHBs, and between the 35 PHOs, in the size of the annual reductions in antibiotic dispensing. We recommend a further 25% reduction in total community antibiotic dispensing for non-Māori and non-Pacific people, but a 2% increase in total community antibiotic dispensing for Māori and Pacific people. Unnecessary antibiotic prescribing should be reduced in all population groups, but there is also a need for increased appropriate antibiotic prescribing for Māori and Pacific people.

## Hazardous drinking and general practitioner visits in the past year

Angela Jury, Ashley Koning, Jennifer Lai, Charito Tuason, Terry Huriwai, Sarah Hetrick

Māori and non-Māori under 45 who are risky drinkers have different patterns of general practitioner (GP) visits. While young non-Māori are more likely to visit a GP if they drink hazardously, providing an opportunity for screening, access to GPs is similar for Māori regardless of their drinking behaviour. Young Māori males are the least likely to visit a GP overall, highlighting the need to prioritise strategies that improve equity in service access.

## Lipid monitoring in a community cohort of people taking statins: who is tested and is testing associated with subsequent alteration in therapy?

Harrison Beadel, Andrew Halim, Paul Bridgford, Ben Hudson

Statins are widely used and current clinical guidance suggests regular (typically annual) cholesterol testing in patients receiving these medicines. We found that about half of patients in our cohort had been tested within this timeframe. Interestingly, there was only a small difference in the likelihood of a change in treatment between those who were tested and those who weren't (23% vs 19%). There is little evidence to guide optimal testing for patients taking statins—it may be that annual testing is too frequent. We call for a stronger evidence base to inform us of the best approach to monitoring this large group of patients.

## VOICES: South Island pilot survey of bereaved people

Kate Reid, Ray Kirk, Pauline Barnett, Ann Richardson, Annabel Ahuriri-Driscoll

The VOICES survey, modified for the New Zealand context, is an acceptable tool for bereaved relatives to voice their thoughts on end of life care for their loved one. Further modifications to the survey would be useful before a national survey is considered. The data and comments offered by bereaved relatives is helpful to policy makers and health practitioners across healthcare settings to support and improve end-of-life-care. The vast majority of relatives acknowledged their loved on was treated with respect and dignity across all settings and there was good communication. Most people wish to die at home but very few manage to do so, improved coordinated community services would assist but relatives felt their family member died in the right place.

## Erionite in Auckland bedrock and malignant mesothelioma: an emerging public and occupational health hazard?

Martin S Brook, Philippa M Black, Jennifer Salmond, Kim N Dirks, Terri-Ann Berry, Gregor Steinhorn

Erionite, a rock mineral known to cause a type of lung cancer known as malignant mesothelioma (MM) has been found in rocks within the Auckland region. Erionite becomes hazardous when natural processes or human activities result in small particles of erionite dust getting into the air. Recent advances in international literature highlight the potential risk of occupational and public exposure to erionite from construction activities. New Zealand has elevated rates of MM yet the effect of erionite exposure, potentially from dust created during earthworks, is unknown.

# Invest in prevention to improve child oral health in the long-term

Jonathan M Broadbent

In this issue of the *New Zealand Medical Journal,* Schluter, Kokaua and Lee characterise the prevalence of severe early childhood caries (S-ECC) among five-year-olds seen in Canterbury District Health Board's Community Oral Health Service as an epidemic. Certainly the prevalence is of epidemic proportions, with nearly one in every five affected by S-ECC, rising to one in four among Māori and two in five among Pasifika. Schluter et al describe dentistry as a neglected area of health policy[1] and so has every dental public health specialist in New Zealand.[2] 'Wicked problems' are those which have deep social roots that can't be solved from inside the healthcare system—oral health inequalities have been described as such. Here we have a wicked problem that is a neglected one too.

In the early 20th century, at a time when oral health in New Zealand was far worse than today, the first letter ever published in the *New Zealand Dental Journal* optimistically described a pathway to a tooth decay-free New Zealand. That hasn't been achieved, but improvements have occurred following radical moves such as fluoridation of water supplies in the 1960s (in around half the country), widespread introduction of fluoride toothpaste in the 1970s, and introduction of preventive care visits in the School Dental Service in the 1980s, while oral health took a backwards step with changes to the welfare state in the 1990s.[3] In the 2000s, the Strategic Vision for Oral Health (2006) laid out seven action areas to change New Zealand's dental care system moving into the 21st century. Most action has focused on the first item, involving the winding-up of the School Dental Service and introduction of a 'Hub & Spoke' Community Oral Health Service model. Is the vision of that conversion complete? It has been interpreted differently throughout the country, with many mobile 'spoke' clinics being limited to providing checkups or (reportedly) having few miles on the odometer. There have been some advantages, but the hub and spoke model has not brought about a clear improvement in the average number of decayed, missing and filled teeth (dmft) among New Zealand five-year-old children. This statistic has changed little in the past 20 years—it was 1.8 in 1998 and 1.8 in 2018.[4]

Schluter et al state "The likelihood of children's annual visits to dental clinics ameliorating this crisis is remote", and they are right. Canterbury District Health Board (and others) have hard-working oral health teams who attempt to enrol and serve as many children as possible. Visiting the dentist does have benefits for oral health-related quality of life,[5] but the incidence of dental caries and overall 'dmft' scores (count of decayed, missing and filled teeth) won't improve by getting children into the dental chair for checkups and treatment. It does not matter whether the clinic is a traditional school clinic or a 'reoriented' hub/spoke clinic—most dental treatment still just converts the 'd' component of dmft to 'm' or 'f'. If our only approach is to treat dental caries, oral health services will perpetually "chase the tail" of early childhood caries. That is why we need to start with a preventive approach, and the best prevention takes place outside the dental clinic.

Some children have difficulty in accessing health services. Perhaps their parents/guardians can not get away from work or have other children to care for. Nationally, oral health educators or 'health navigators' could help to facilitate access to care[6] and serve in a role that is integrated with other


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New Zealand health service priorities. It is not just dental professionals who need to keep track of high-risk children. Community-based educators could help facilitate vaccinations, deliver essential medications and oral care products, or help arrange transport of children to healthcare facilities. They might even help in the advent of a future pandemic wave—a flexible workforce of people who know communities well could contribute to contact tracing. Dental caries can often be prevented or 'arrested' by applying a fluoride varnish to the teeth,[7] but it needs to get on the teeth in order to be effective (preferably early). Other countries have had successful fluoride varnish application in preschool settings[8] and oral health educators or Kaiāwhina have already been used to 'lift the lip' and apply fluoride varnish in Hawke's Bay preschools.[6]

In terms of wider oral health promotion efforts in New Zealand, the 2014 budget set aside $10,000,000 for a planned social marketing campaign and a very exciting nationwide toothbrush distribution programme for children.[9] However, it seems there has been difficulty in getting that programme off the ground, because so far the output has been limited to a tooth fairy advertisement, recommending the brushing of teeth. The tooth fairy campaign seems to have been successful but very disappointing if it remains a one-off effort. Social marketing should be ongoing, and there are many other oral health messages that need to be heard, not just toothbrushing. Besides, toothpaste companies already promote their products but the challenge is getting them into the hands of every child (supervised, of course). The second side to the oral health promotion plan was indeed a nationwide preschool/school toothbrushing intervention, but that hasn't been seen. Toothbrush programmes can save a lot of money[10] and can be really acceptable and effective among tamariki.[11]

Some have called for a new strategic vision for oral health or a new national oral health survey, but there is so much unfinished business. The Strategic Vision for Oral Health calls better oral health promotion,[12] but not every DHB has a properly funded oral health promotion team. It also calls for expansion of community water fluoridation,[12] but the fluoridation bill languishes, despite the fact that it would make a difference for oral health and even save the country money.[13] Warning labels, advertising regulations and health taxes could be applied to sugary drinks and confectionery, and this is another area of inaction. It is disappointing that New Zealand is not leading the way in efforts to improve the food environment in which children are raised. Improved access to dental care for young adults could also make a difference to child oral health, because young adults are frequently parents of young children. Low-income young adults need to be able to access preventive and emergency dental care, at a minimum, in order to help improve things for the next generation. Preventive dental care is most effectively delivered by parents at home, and they need to know how.

Dental clinicians are busy at the coalface working within the existing system to care for their patients—they get results, but only for the patient in the dental chair. The wider health professions might help us manage our S-ECC epidemic—it is such a highly prevalent and visible disease that it can frequently be spotted by non-dental health professionals with nothing more than a torch and a few moments to take a look at the teeth. 'Lifting the lip' might nudge some towards adopting appropriate dental self-care practices and making an early dental appointment.

The Schluter et al paper provides an epidemiological vantage point, suggesting that the status quo dental care system is not resulting in change. Not surprising, since change is needed in order to effect change. Only politicians can practice dentistry on the grand scale and effect radical change in order to get different results. What will be the next big thing in prevention to improve oral health of New Zealand children?

**Competing interests:**
Nil.

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# Severe early childhood caries: a modern (neglected) epidemic?

Philip J Schluter, Jesse Kokaua, Martin Lee


## ABSTRACT

**AIMS:** There is mounting concern that there is increasing severity in the oral health burden of children who have dental caries. This study aims to describe the current dentally examined rates of severe early childhood caries (S-ECC) among children aged five years within the Canterbury District Health Board (CDHB) region, overall and by major ethnic groups.

**METHODS:** A retrospective analysis of routine oral health data collected from all children aged five years attending the CDHB child oral health services for their routine oral health check between 1 January 2018 and 31 December 2019, inclusive.

**RESULTS:** The sample included 10,766 children, of whom 1,822 (16.9%) were Māori, 499 (4.6%) were Pacific and 8,445 (78.4%) were non-Māori/non-Pacific. Overall, 1,980 (18.4%) were classified as having S-ECC, and significant ethnic differences emerged between Māori, Pacific, non-Māori/non-Pacific children (26.2%, 40.1% and 15.4%, respectively; p<0.001).

**CONCLUSIONS:** Despite considerable public investment, Canterbury's children are carrying a heavy oral health burden, which is unequally shared. Risk factors for and the consequence of this burden have significant health and wellbeing implications, now and for the future. Systemic changes and interventions are necessary to redress this childhood oral health epidemic.


"Baby teeth do not matter as they fall out anyway" and "all children eventually get holes in their teeth" are but two common perceptions in New Zealand.[1] But baby teeth do matter; the evidence is unequivocal. Early childhood caries (ECC) has significant short- and long-term impacts—both for the affected individual and our society.[2] Children with ECC may experience pain, swelling, reduced quality of life, eating limitations, speech articulation/language development difficulties/delays which deleteriously affects learning and playing, increased absences from pre-school/school, reduced socialisation and self-esteem, and increased orthodontic need in their permanent dentition.[2–6] The costs to the country are substantial and growing. For the 2017/2018 financial year, district health board (DHB) funding for oral health totalled NZD$197.2 million, with child oral health services (COHS) accounting for NZD$98.42 million, adolescent dental services costing NZD$42.17 million, and hospital dental services spending NZD$49.68 million.[7] The cost of dental treatment under general anaesthesia (GA) was estimated at NZD$2,400 per case, but it can be considerably more.[8] Between 2004/2005 and 2014, the number of children receiving dental treatment under GA increased by 66.9%,[9] and hospital admissions rates for these treatments was greatest among children aged three to four years.[10] Dental caries does not occur when there is a normal commensal plaque; an ecological change is required to create a pathogenic plaque that leads to more enamel demineralisation than remineralisation.[11] Frequent intake of food and drink containing fermentable carbohydrate leads to a fall in the resting pH of dental plaque and a collapse in species diversity—the microbially diverse commensal plaque is replaced by a pathogenic plaque

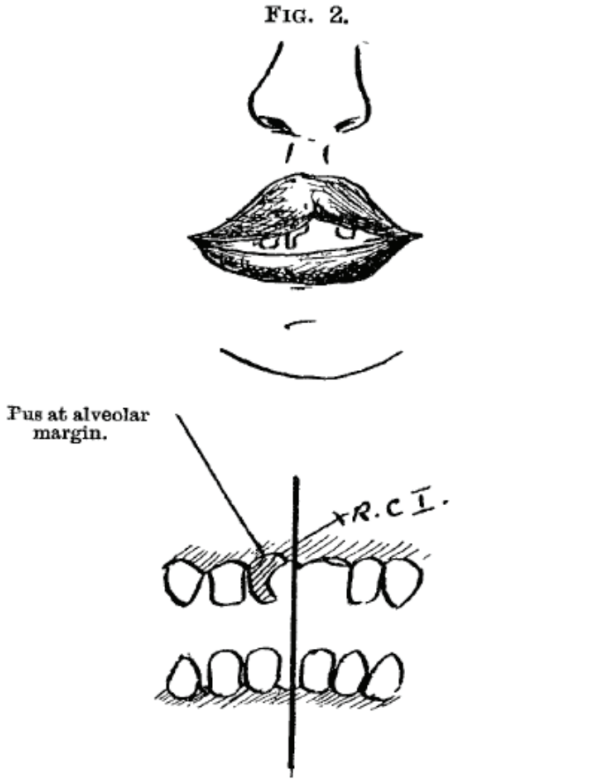
consisting mostly of acidogenic and acid-tolerant organisms.[12] The rate and degree of teeth destruction is modified by fluoride exposure.[13] Although largely preventable,[2,7] dental caries is the most common chronic disease of childhood and among the primary reasons for hospital admissions of children in New Zealand.[14]

Significant caries-free rate improvements have been made in recent years for New Zealand children aged five years,[7,15] although unacceptably wide inequalities among different ethnic and socioeconomically disadvantaged communities persist.[15–17] Pacific children carry the heaviest burden, followed by Māori, while non-Māori/non-Pacific children enjoy the lightest burden.[7,15] Nationally, in 2018, 64.3% of Pacific children aged five years had at least one tooth affected, compared to 59.2% of Māori children and 30.9% of non-Māori/non-Pacific children.[18] These ethnic disparities exist elsewhere;[2] with, for example, Pacific children aged five to nine years in the US having much poorer oral health than their national counterparts.[19] Although dental caries is one of the most common chronic diseases, and recognised that it disproportionately affects disadvantaged communities, children, and ethnic minority groups, oral health is often taken for granted.[20] This led a former US Surgeon General to describe it as a complex silent epidemic that demands attention.[20] More recently, a *Lancet* series focused on oral diseases and their marked inequities, characterised it as a neglected global public health challenge that requires radical action.[2,21] While the improvement in the caries-free rate of New Zealand's five-year-old children gives cause for celebration, the continued significant ethnic and social inequalities do not. Moreover, there is mounting concern that there is an increasing severity in the oral health burden carried among those children with caries.[2] So while fewer children may be experiencing caries, those who do have caries appear to be more severely afflicted.

The decayed-missing-filled teeth (dmft in deciduous and DMFT in permanent dentition) index is a measure of caries severity;[22] it has been used for 80 years and measures the number of decayed, missing (extracted due to caries) and filled teeth or alternatively, tooth surfaces. Most children have no decayed, missing or filled teeth (ie, dmft=0) and therefore the distribution is highly positively skewed and produces mean dmft scores that do not reflect the severity of the disease among those who have it. Alternatives have been suggested, including a category of severe early childhood caries (S-ECC), described by Drury and colleagues in 1999,[23] and adopted by the American Academy of Pediatric Dentistry.[24] S-ECC defines a long-recognised subtype of dental caries that is rapid in onset, involves multiple teeth and frequently affects the anterior teeth. Prior to the introduction of the term S-ECC, the condition had various other names, mostly associated with putative causes, such as 'nursing caries', 'baby bottle tooth decay', and 'comforter caries'. This last nomenclature was coined by Harries, in a 1911 *Lancet* article.[25] Harries documented several cases of children with extensive caries, including one of a three-year-old girl; his sketch is reproduced (with permission) in Figure 1. Incidentally, the young girl had been admitted with measles—another avoidable condition we are still grappling with over 100 years later.

Children with S-ECC carry an even greater physical and mental health burden than those with ECC,[26] and a greater risk of requiring dental treatment under GA.[27] However, despite its 20 years formal history and international use, the epidemiological evidence-base for S-ECC within New Zealand is modest. This study primarily aims to describe the dentally examined rates of S-ECC among children aged five years within the Canterbury DHB (CDHB) region, overall and by major ethnic groups, to highlight the large and disproportionate burden shared by our young tamariki. A secondary aim is to concurrently present data on the rate of missing (due to caries) deciduous teeth through extraction.

**Figure 1:** Dr Eric HR Harries' 1911 hand-sketch of a three-year-old girl's "Comforter caries" case study (reprinted from *The Lancet*, 178(4602), Harries E.H.R., "Comforter" caries, p. 1327-8, Copyright (1911), with permission from Elsevier).




CASE 2.—A female, aged three years, admitted for measles. Shows some hypertrophy of upper lip. Pus at root of carious right central incisor; left central incisor has disappeared. Breast-fed for 17 months. No evidence of rickets or syphilis. Other teeth sound. R.C.I., Right central incisor.

# Methods

## Design

A retrospective analysis of routine oral health data collected between 1 January 2018 and 31 December 2019, inclusive.

## Target population

All children aged five years attending the CDHB COHS within the Canterbury region for their routine oral health check. Age five years is the first year of primary schooling for the majority of New Zealand children, and examinations are typically conducted at these schools.

## Measures

For children aged five years, S-ECC is defined by having a ≥1 cavitated, missing (due to caries), or filled smooth surfaces in their primary maxillary anterior teeth or a decayed, missing or filled tooth surfaces score (dmfs) ≥6.[23] S-ECC indication was derived directly from the dental examination recordings. Missing teeth due to caries was also noted, and indicated if one or more teeth had been extracted. Demographic information was collected at enrolment with the COHS. Age was calculated from the difference between assessment date and date of birth. Ethnicity was determined by child's parent or caregiver. For children with multiple ethnic identifications, a single ethnicity was assigned using the hierarchy: (i) Māori; (ii) Pacific; (iii) Asian; (iv) Middle Eastern, Latin American, and African (MELAA); and, (v) European/other.[28] Here, categories (iii)-(v) were combined and relabelled as non-Māori/non-Pacific.

## Procedure

Dental services are delivered by dental and oral health therapists at community dental clinics and in mobile dental units.

Routinely collected demographic and oral health information are entered into an electronic oral health record 'Titanium'.[29] The diagnosis of caries includes the use of radiography, where clinically appropriate, and extractions and fillings not due to caries and carious lesions not involving dentine are excluded. A research database was created, extracted from the Titanium database by ML, which only included the oral health and demographic variables outlined above, and no identifying information.

### Statistical analysis

Reporting of analyses were informed by the REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) guidelines.[30] Data were imported into Stata SE version 16.0 (StataCorp, College Station, TX, US) for all statistical analyses. Descriptive statistics were calculated and reported for the demographic and oral health variables. Sample demographics were compared against StatsNZ 2018 Census figures for children aged 0–9 years within the CDHB region.[18] Fisher's exact test was employed for categorical comparisons, and with $\alpha=0.05$ was used to define statistical significance. Relative risk (RR) and associated 95% confidence intervals (CIs) were calculated using a binomial generalised linear model with a log-link function, and adjusted for age.

### Ethical approval

Upon application to the New Zealand's Health and Disability Ethics Committee (HDEC), this study was deemed as a minimal risk observational research that did not met the requirement necessary for formal ethics committee review. All methods were performed in accordance with HDEC's relevant guidelines and regulations.[32] The research databases did not contain any personally identifying information, was only accessible via password protection, and was securely stored on the CDHB's and University of Canterbury's servers.

## Results

### Participants

Over the study period, dental examination data were available from 10,766 children, of whom 5,215 (48.4%) were girls and 5,551 (51.6%) were boys, and their mean age was 5.5 years (range: 5.0, 6.0 years). Using the prioritised ethnicity groupings, 1,822 (16.9%) were identified as being Māori, 499 (4.6%) were Pacific, and 8,445 (78.4%) were non-Māori/non-Pacific. This ethnic distribution is broadly similar to the StatsNZ 2018 Census prioritised ethnic figures for children aged 0–9 years within the CDHB region, estimated at 17.2% Māori, 4.7% Pacific and 78.0% non-Māori/non-Pacific.

### Severe-ECC and missing teeth

Overall, 1,980 (18.4%) were classified as having S-ECC, and significant ethnic differences emerged between Māori, Pacific, non-Māori/non-Pacific children (26.2%, 40.1% and 15.4%, respectively; Fisher's exact test, $p<0.001$); see Table 1. For deciduous tooth extraction, overall 618 (5.7%) had at least one tooth extracted, and again significant ethnic differences emerged between Māori, Pacific, non-Māori/non-Pacific children (10.0%, 11.6% and 4.5%, respectively; Fisher's exact test, $p<0.001$); see Table 1. In each case, the prevalence of S-ECC and extracted deciduous teeth was highest for Pacific children, intermediary for Māori children, and lowest for non-Māori/non-Pacific. Compared to non-Māori/non-Pacific children, the RR of S-ECC was 2.6 (95% CI: 2.3, 2.9) for Pacific and 1.7 (95% CI: 1.5, 1.9) for Māori children, while the RR of at least one deciduous tooth extraction was 2.6 (95% CI: 2.0, 3.4) for Pacific children and 2.2 (95% CI: 1.9, 2.6) respectively for Māori children.

## Discussion

Right now, almost one in every five children in Canterbury has S-ECC. This and other oral diseases are likely to have far-reaching sequelae into the affected children's and societies' foreseeable futures. Moreover, two in every five Pacific children and over one in every four Māori children aged five years have experienced S-ECC, reinforcing the gross inequity patterns previously observed both locally and globally.[2,31] Furthermore, compared to non-Māori/non-Pacific children, Pacific and Māori children were 2.6 and 2.2 times as likely to have had at least one tooth extracted, respectively, due to caries. In the New Zealand Oral Health Survey 2009, 1.4% of children aged 2–4 years and 4.9% of children aged 5–11 years had one or more primary teeth missing due to dental decay.[32] When combined, 3.9% of children aged

**Table 1:** The distribution of S-ECC and those with one or more deciduous tooth extraction, stratified by ethnic identification, and the estimated relative risk (RR) together with associated 95% CIs.

| | **Total** | **Indications** | | | |
|---|---|---|---|---|---|
| | N | n | (%) | RR* | (95% CI) |
| **S-ECC** | | | | | |
| Māori | 1,822 | 478 | (26.2) | 1.7 | (1.5, 1.9) |
| Pacific | 499 | 200 | (40.1) | 2.6 | (2.3, 2.9) |
| Non-Māori/non-Pacific | 8,445 | 1,302 | (15.4) | 1.0 | (reference) |
| **At least one deciduous tooth extraction** | | | | | |
| Māori | 1,822 | 182 | (10.0) | 2.2 | (1.9, 2.6) |
| Pacific | 499 | 58 | (11.6) | 2.6 | (2.0, 3.4) |
| Non-Māori/non-Pacific | 8,445 | 378 | (4.5) | 1.0 | (reference) |

Note: *adjusted for age.

2–11 years had one or more primary teeth missing, with higher rates in Pacific (6.1%) and Māori (5.7%) children.[32] While not directly comparable, due to the age differences and cumulative age effect associated with tooth loss, it is notable that 4.5% of Canterbury's five-year-old children (11.6% of Pacific and 10.0% of Māori children) had teeth missing in this study; rates, a decade on, that appear considerably higher than those observed within the national study. Perhaps, like that asserted within the Northland study results,[31] Canterbury's children high rates may be partly attributable to the lack of community water fluoridation within the region.[16]

Although unable to be reliably captured and investigated within these data, it must be strongly emphasised the oral health patterns observed here are likely predominantly, if not entirely, due to social determinants of health inequities between children rather than intrinsic cultural differences. While Māori and Pacific children are more likely to have early childhood dental decay, the issue, though seemingly straightforward, is not as simple as parents ensuring their children brush their teeth. Nor is it an issue of belonging to a Pacific or Māori family, except their families are more likely to experience conditions that make dental care a lower priority. These issues afflict many families who live with socioeconomic pressures, in regions with non-fluoridated water supplies, and for whom contact with dental or any health professionals are only made if absolutely necessary. Mixed health messages around the importance of baby teeth only exacerbate the ongoing dental care behaviours as children get older. The solutions are complex and their pathways require application to multiple levels, but require the engagement of many non-English first-language communities to be effective.

The statistics presented here suggest that we have an ongoing paediatric oral health crisis—a crisis that is not confined to New Zealand.[33] Situated within our current oral health delivery model, the logical response is a call for even greater funding and resourcing;[34] although it has been argued that the current downstream treatment-dominated, increasingly technology-focused system of oral health care is trapped in an interventionist cycle that does not tackle the underlying causes of disease nor address oral health inequalities.[21] And so, our current system is perhaps unintentionally designed for oral health services to perpetually "chase its tail".[21] The likelihood of children's annual visits to dental clinics ameliorating this crisis is remote, and has not succeeded to date. Instead, a radical rethinking and reframing of oral health care is needed. Watt and colleagues provide a road-map for such action, which emphasises upstream health promotion and disease prevention, and includes: improving epidemiology and oral health surveillance

systems; reform of oral health-care systems; integrated community-based models of workforce training; tackling oral heath inequalities; moving upstream to maximise oral health improvements; addressing commercial determinants of oral diseases; advancing and prioritising oral research agendas; and improving global advocacy.[21] Elements of this proposed reform have also been independently advocated within a local context.[7,35] However, operationalisation of these initiatives are non-trivial, and require forward looking co-designed strategies and partnerships. For instance, a major challenge for many health disciplines is how to effectively engage with multicultural communities, not just Māori and Pacific, deliver on the Crown's Treaty obligations, and deal with health inequalities. Understanding and working with communities is vital. It might be that messaging and social media platforms,[36] delivery at non-conventional venues such as churches or other community settings, and employing ethnic-specific oral health champions will be more effective in engaging the families of the most vulnerable children in those communities.[7]Common risk factors shared across a range of oral health and other non-communicable diseases, such as childhood obesity, would benefit from coherent and comprehensive regulation.[7,21] For instance, poor quality, low cost, convenience diets increase the likelihood of both childhood obesity and poor oral health outcomes. Both are common to more deprived communities where many Māori and Pacific people reside. Redressing and rebalancing the underlying commercial determinants of health, particularly sugar, through upstream polices, taxes, and more strongly regulated advertising and product placement is necessary. For Pacific communities, the associated reduction of refined sugar and a promotion of traditional daily diets (not the feast menus often associated with Pacific cuisine) is likely to improve oral health as well as reduce obesity.

The silos separating oral health and general healthcare need to be dissolved, thereby enabling both systems in their health promotion and service delivery.[35] To this end, the CDHB and Pegasus Health (the largest Primary Health Organisation within the region, catering for 445,000 enrolled patients) have entered into a data-sharing arrangement which will inform medical practices about the oral health of their enrolled children and ensure children are accessing oral health services. Recognising the relationship between oral health and health conditions and hospital admissions,[31] this shared formation will help inform and provide earlier detection for prevention measures aimed at reducing children's disease burdens. However, further integration of staff, services and resources is likely to yield even better population outcomes.

While no panacea, universal community water fluoridation appears one obvious upstream population-wide proven intervention. Nationally, approximately 52% of children reside in fluoridated regions.[16] Yet children and adolescents living in areas with fluoridated water have, on average, a 40% lower lifetime incidence of dental decay.[37] The only documented side effect of fluoridation at levels used in New Zealand is minimal fluorosis.[13] Currently, local authorities continue to have the legal authority to fluoridate water supplies; the bill to shift this decision to DHBs has been waiting (for over two years) for its second reading in Parliament. The challenge for the regions with little fluoridation, such as Canterbury and Northland, along with other local authorities who refuse community water fluoridation, is to recognise the significant preventable harm that this decision is causing their constituents. And that this burden of this harm falls heaviest on our most vulnerable. The anti-fluoridation lobby employ many arguments and tactics; most of which lack robust evidence or have credible backing.[38] Within New Zealand, the individual's right to refuse to undergo medical treatment in the form of community water fluoridation was employed as a legal challenge, although dismissed by the New Zealand Supreme Court ruled with its 27 June 2018 judgement.[39] Despite this, community water fluoridation continues to be a contentious issue in Canterbury and beyond; although not within the scientific community.

The Ministry of Health's 2006 strategic vision for oral health called for bold changes, including a much greater emphasis on prevention and early intervention;[40] however, there is scant evidence that this

has either happened or worked. While there have been small improvements in the proportion of children with no caries and overall caries severity, we believe this has obscured a polarisation of the burden of disease—we have not measured what matters but have made what we do measure matter. Despite the gallant and implacable efforts of oral health staff we will continue to witness appalling and inequitable child tooth decay rates.[34] On the grounds of preventable morbidity and the stark inequitably experienced by our most susceptible, we argue that good oral health is a basic human right for all children. Now is the time to act.

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# A detailed analysis of quality improvement and patient safety within undergraduate health professional curricula in Aotearoa New Zealand

Susan Shaw, Karina Donaldson


## ABSTRACT

**AIM:** To extend a previous investigation published in the *New Zealand Medical Journal* in 2017 into the state of quality improvement and patient safety teaching within health professional curricula and inform further investigation. This detailed analysis of actual curricula investigated the extent to which the nine quality and safety domains outlined by New Zealand's Health Quality & Safety Commission (HSQC) are included in eight health professional degrees in disciplines covered by the Health Practitioners Competence Assurance (HPCA) Act as they were delivered to 2,869 students in 2019. An extended set of terms was identified for exploring the key concepts.

**METHOD:** The key concepts within the nine quality and safety domains previously published by HSQC were identified and used to conduct electronic searches of undergraduate curricula. A detailed analysis of the findings indicated that a range of terms, beyond those used in the descriptions in the 2017 study, were utilised to convey the key concepts. An extended list of terms was developed, and further analyses undertaken to check the context of them and ensure relevance. The final analysis identified the terms from the extended list across curricula. Further cross-checking was undertaken to verify the meaning and context of them.

**RESULTS:** The development of an extended list of terms relating to the quality and safety domains enabled a detailed analysis of eight undergraduate health professional curricula preparing students for registration under the HPCA. All the quality and safety domains are represented within health professional degrees and one curriculum in particular was identified as an exemplar in relation to the extent the domains were incorporated. The extended list of terms provides a tool for exploring these domains in other curricula and institutions.

**CONCLUSION:** This detailed analysis of curricula presents a more reassuring picture of the presence of quality improvement and patient safety within undergraduate education in Aotearoa New Zealand than had been previously presented following interviews with educators. An extended list of terms relating to the HSQC domains identified during this analysis adds to the interprofessional vocabulary for considering quality and safety as curricula are continuously evaluated and refined. The curriculum of one discipline provides an exemplar of how key concepts may be incorporated across all levels of a programme of study.

Improvement science is an acknowledged field of expertise[1] which is rightfully used in analysing healthcare practice and therefore an appropriate context from which to interrogate the education of health professionals. The World Health Organization has published guidance on patient safety in health professional curricula.[2]

There are various approaches to investigating curricula. Asking educators to comment on whether elements exist in curricula is one of these and was used in the 2017 study.[3] Others have also used this process, for example when investigating the presence of falls education relating to elderly in Australian and New Zealand Universities.[4] The authors of which noted those estimating the time spent on content may not have been actually providing the teaching, reflecting a weakness of such an approach. The analysis of documents is another approach for investigating curricula and a recent investigation of simulation in education and its relationship to patient safety[5] is an example of this.

The HSQC website states its priority is "… to reduce patient harm from healthcare associated infections, surgery, medication and falls" and its programme areas as "… medication safety, infection prevention and control, adverse events, reducing harm from falls, health quality evaluation, consumer engagement, reducing perioperative harm and mortality review."[6] The concept of improvement features within HSQC publications as does 'improvement science' which is a logical fit within such an agency as it provides an area of expertise from which to explore practice. It is appropriate to consider improvement in the context and content of health professional education as it is likely to influence patient safety.[7]

In 2016 the HSQC published 'A framework for building quality and safety in the New Zealand health system'.[8] Based on international models, this guidance outlines capabilities for various groups involved in the healthcare sector. The groups are defined as consumers/whanau, those participating in the health and disability workforce, team leaders, quality and safety experts, leaders and governance. The publication outlines a 'capability framework'. A section dedicated to each group outlines knowledge and actions relating to each domain. This guidance document is intended to inform preregistration education programmes. The seven domains in the capability framework are all included within the nine quality and safety domains referred to by Robb et al[3] with the addition of evidence-based practice and using information technology (see Table 1). In utilising the list of nine domains in our analysis we addressed those initially documented by HSQC to inform preregistration education in New Zealand and the two additional domains included in the interviews of educators published in 2017.

The Faculty of Health and Environmental Sciences (the Faculty) at Auckland University of Technology (AUT) delivers a wide range of health professional education programmes across undergraduate and postgraduate

**Table 1:** Comparison between HSQC Capability Framework and Quality and Safety domains.

| HSQC Domains of the New Zealand Capability Framework (2016) | Quality and Safety Domains (Robb et al, 2017) |
|---|---|
| Partnership with consumers/patients and their families/whanau | Patient-centred care |
| Quality and safety culture | Quality and safety culture |
| Leadership for improvement and change | Leadership for change |
| Systems thinking | Systems thinking |
| Teamwork and communication | Teamwork and communication |
| Improvement and innovation | Improvement science |
| Quality improvements and patient safety knowledge and skills | Patient safety |
| | Evidence-based practice |
| | Using information technology |

levels and for many health professional groups. The wide range of programmes, large number of students, and a detailed curricula database position the Faculty well to undertake extensive curricula analysis of health professional curricula in New Zealand. All programmes accredited by Responsible Authorities (RAs) under the HPCA[9] meet specified criteria and therefore have fundamental similarities regardless of the institution in which they are offered. The findings presented in 2017,[3] following interviews with educators, did not completely resonate with the understandings of curriculum content across the clinical programmes within the Faculty. In addition, we were confident that the knowledge outlined in the capability framework was being taught. The intention of this analysis was to explore how quality and safety was presented in our curricula in order for us understand and then address specific gaps.

The Faculty offers health professional education programmes which prepare graduates in at least a dozen disciplines. This analysis was limited to those for which undergraduate degrees are recognised by RAs under the HPCA Act as suitable preparation for professional registration. The eight programmes in this group are nursing, midwifery, oral health (dental therapy/hygiene), physiotherapy, paramedicine, occupational therapy, podiatry and medical laboratory science. Some disciplines offer programmes at postgraduate level leading to professional registration, as in psychotherapy and psychology, while an undergraduate diploma in health science is recognised by the Medical Sciences Council as equipping graduates to apply to register as anaesthetic technicians. An undergraduate degree is offered in counselling, but this does not lead to statutory registration and other health-sector programmes

**Table 2:** Summary of clinical health professional programmes offered by AUT and number of students enrolled during 2019.

| Discipline/profession | Programme offered by AUT | Number of students |
|---|---|---|
| **Disciplines included in Robb et al (2017)[3] analysis and offered as undergraduate programmes at AUT*** | | |
| Dental hygiene, dental therapy | BHSc (Oral Health) | 139 |
| Medical Laboratory Science | Bachelor of Medical Laboratory Science | 141 |
| Midwifery | BHSc (Midwifery) | 328 |
| Nursing | BHSc (Nursing) | 872 |
| Occupational Therapy | BHSc (Occupational Therapy) | 288 |
| Physiotherapy | BHSc (Physiotherapy) | 605 |
| Podiatry | BHSc (Podiatry) | 110 |
| **Other disciplines with undergraduate degrees offered by AUT*** | | |
| Paramedicine | BHSc in Paramedicine | 386 |
| **Programmes taught at AUT that require postgraduate qualifications for registration** | | |
| Psychotherapy | Master of Psychotherapy | 45 |
| Psychology | Postgraduate Diploma in (Counselling or Rehabilitation) Psychology | 9 |
| **Programmes taught at AUT that require undergraduate diploma qualification to register** | | |
| Anaesthetic Technology | Diploma in Applied Science | 92 |
| **Disciplines taught at AUT that do not require registration for practice** | | |
| Counselling** | BHSc in Counselling | 51 |

*included in analysis **does not have a Responsible Authority under the HPCA.

deemed non-clinical such as health administration, public and environmental health and case management are also offered.

There are seven health professional disciplines included in the study carried out by Robb et al[3] with undergraduate degrees offered by AUT which are accredited by RAs to equip graduates to apply for registration to practise. During 2019, paramedicine was recognised as a profession under the HPCA and was added into this analysis as it has close synergies with other programmes offered within that category and is an undergraduate pre-qualifying clinical degree offered by AUT. The programme has yet to be accredited by the new RA but is routinely reviewed and monitored by the relevant Australian agency. This was most recently completed in 2019.

Overall AUT had 3,066 students enrolled in clinical health professional programmes during 2019. The analysis of the undergraduate degree programmes with RA accreditation presented here relates to the study pathway of 2,869 enrolled during the 2019 academic year.

# Method

The design of education programmes within the health professions is extensively researched. One of the greatest challenges is what to include when faced with burgeoning amounts of knowledge and information. The processes of documenting, mapping and tracing elements within curricula in this field is long-established.[10,11]

The Faculty at AUT has an extensive bespoke curriculum database, established over the last nine years, which includes fields for curricula components within each course. This means the learning outcomes, content list, learning and teaching strategies and assessment events are all documented and searchable including an audit trail of any changes and rationale for them. The first author works alongside discipline teams to maintain the quality of curricula, teaching practice, student learning and academic administration. The second author is responsible for the design, management and ongoing evaluation and refinement of the curriculum database which provides invaluable information for recording the history of curriculum design, student pathways through it and recognition of previous learning. The database is pre-populated with requested changes prior to Boards of Studies meetings and approved amendments are confirmed live in the database during board meetings and immediately available for teaching teams to upload to students for subsequent semesters of study. The analyses presented below were undertaken through interrogation of this database as curricula were documented within it at the end of semester two, 2019. We followed an iterative process of exploring the HSQC terms, developing an extended list of terms and carefully searching the curriculum documents for them in order to consider their context before making a judgement about whether or not they truly reflected the concepts in question. Our process involved initial searches of the database for the title of each domain. We informally discussed the findings with colleagues from the disciplines and curriculum developers in relation to the 2017 paper.[3] Detailed investigation involved four iterations of searching terms within the HQSC description of each domain. Each iteration began with the two authors discussing questions about the language commonly used within various curricula, commonalities and differences and how to broaden or narrow the next query. The data, indicating the specific curriculum, the course, the component of the course (learning outcome, content), the surrounding text, and the frequency were then collated by an administrator. Further conversations took place about the meaning of the terms and their position in the text to ensure they were accurately represented and not included out of context before agreeing on further questions to refine the next analysis. The process was complete once there were clear and contextual examples of all the domains across the range of programmes.

## Identifying the concepts

The previous 2017 study[3] utilised a summary/description of each of the nine quality and safety domains. We began this analysis by highlighting key terms within the descriptions and reproduce a modified version of that table below with the key terms used to conduct our initial search of the curriculum highlighted.

**Table 3:** Key curriculum concepts within nine quality and safety domains.

| **Domain** | | **Description used in interviews** (Robb et al, 2017[3]). **Bold text** identifying terms searched in AUT curriculum database. |
|---|---|---|
| 1. | Improvement science | Use **improvement science** methods and tools to **analyse** and **define gaps** in the **quality of care**, **monitor** the quality and **reliability processes a**nd **outcomes of care**, and **design, test and implement changes** to **continuously improve** the **safety and quality of care.** |
| 2. | Patient safety | Use a **human factors** and **systems-based** approach to understand and **respond** to **adverse events** and **inform the design** of **safer** and more **reliable safety systems**. |
| 3. | Quality and safety culture | A **culture** where **reporting** and **learning** are the **norm** in the **context** of **mutual respect** and **transparency**. |
| 4. | Evidence-based practice | Able to **locate** and **critically appraise evidence** to identify **bias** and determine **validity**. **Integrate** best **research** with **clinical expertise** and **patient preferences** and **values** to achieve **optimal outcomes** for patients. |
| 5. | Patient-centred care | **Empowering patients/consumers** and their **families/whanau** to **interact** with **healthcare providers** to achieve *outcomes* consistent with their **preferences**, **needs** and **values.** |
| 6. | Teamwork and communication | **Collaborating** effectively with **others** across **professional, organisational and cultural boundaries** to achieve shared **quality and safety goals** and ensure care is **continuous** and **reliable.** |
| 7. | **Leadership** for **change** | Doing what is **right** and setting **examples** for others. |
| 8. | Systems thinking | Appreciating **healthcare** as a **complex** and **dynamic adaptive** collection of **interrelated and interdependent** components with a common purpose or aim. |
| 9. | Using Information Technology | Using **information technology** to **manage knowledge, mitigate error** and support decision-making. |

The first analysis of the terms highlighted in Table 3 above revealed very few matches between curricula documentation and the exact language used in the titles of the nine quality and safety domains. For example, the terms 'improvement science' and 'systems thinking' did not appear at all. Other terms appeared rarely such as: 'information technology', and 'adverse events', which each appeared once.

During this first level of analysis it became apparent that concepts relevant to the domains were present in AUT curricula but the language varied. An extended list of terms relating to each domain was developed and is presented in Table 4 along with information from curricula to illustrate the context of them. For example, 'improvement science' does not appear but clearly the concepts of quality improvement, control and assurance are present.

# Results

Following the development of an extended list of terms, a detailed search of the learning outcomes and content lists of the eight degree programmes was undertaken. This involved searching curricula for terms and carefully reading the learning outcomes and content lists for each course to consider

**Table 4:** Extended list of terms relating to each domain with contextual examples.

| HSQC domain title/term | Extended term | Example of context (course learning outcome or item from content list) |
|---|---|---|
| Improvement science | Quality improvement | Apply principles of interprofessional healthcare and quality improvement to facilitate collaborative practice with the healthcare team. |
| | Quality assurance | Demonstrate knowledge of current quality assurance practices. |
| | Quality control | Discuss quality control requirements of blood transfusion practices. |
| | Reflection | Reflect on professional practice utilising a model of reflection and engage in critical questioning of themselves and others. |
| Patient safety | Cultural safety | Demonstrate professional responsibility and competency through accountability, advocacy, safe practice (including legal, ethical and cultural safety) using reasoned judgement. |
| | Safe practice | Demonstrate collegiality, appropriate attitude and safe practice while engaging in all preclinical and clinical environments. |
| | Cultural competence | Demonstrates partnership, cultural competence, and Tūranga Kaupapa in relation to lactation and breastfeeding. |
| | Safety | Critically discuss the ethical, legal, safety and biophysical effects for a range of imaging techniques. |
| **Quality and safety culture—see 1 and 2 above** | | |
| Evidence-based | Evidence | Critically evaluate the evidence supporting assessment and treatment techniques for a range of complex clinical situations seen in the community environment. |
| | Research | Facilitate the transition from student to registered nurse within a practice environment, exploring professional issues and integrating knowledge, research and practice. |
| Patient-centred | Needs | Analyse and apply science and nursing knowledge to the complex needs of individuals, families and populations in the context of community nursing practice. |
| | Individual | Explore the implications of complex health issues for nursing care and for the client (individuals and families/whānau/significant others) across the lifespan. |
| | | Evidence-informed and appropriate individualised breastfeeding support both antenatally and postpartum. |
| | | Develop and defend patient care treatment plans according to best practice. |
| | Outcomes | Risk reduction interventions are identified and developed to improve patient outcomes and create a safe practice environment. |
| | | Plan, monitor and adapt exercise-based rehabilitation to promote optimal health outcomes for people with acute and chronic conditions across the lifespan. |
| | Client/ person/ family-centred | Partnership and family-centred/person-centred practice. |
| | Service users | Work in accordance with good professional practice with other professionals, support staff and service users. |
| | Context | Considers the responsibilities of the health professional in relation to drug therapy and with regard to political, social and cultural considerations. |

**Table 4:** Extended list of terms relating to each domain with contextual examples (continued).

| | | |
|---|---|---|
| Teamwork and communication | Teamwork | Interprofessional collaboration (including working with formal and informal carers, teamwork, delegation, supervision and direction). |
| | | Practice effective teamwork as a basis for inter-professional learning. |
| | Collegiality | Demonstrate the ability to value diverse perspectives in a variety of situations while interacting in partnership with colleagues and clients. |
| Leadership | | Demonstrate effective leadership and communication. |
| | | Nursing leadership skills for supervision, delegation and mentoring. |
| Systems thinking | Analysis | Critically analyse human factors and the impact on healthcare. |
| | | Identify and analyse the interaction between person, environment and occupation. |
| | | Critically analyse ways health professionals can act, within their scope of practice, to promote or enable changes in policy and legislation at national, local government or service provision levels. |
| | | Reduction of clinical risk through risk identification, analysis, treatment and review. |
| | Data | Relate analytical data to the patient's history; and demonstrate theoretical knowledge in consultation with laboratory colleagues. |
| Information technology | IT | Information literacy (computer skills, IT media, library sourcing) |
| | /ware | Discuss the use of middleware, software and hardware in the clinical laboratory. |
| | Information system | Describe the underlying concepts, management and architecture of a laboratory information system. |
| | Patient information | Managing and transferring patient information. |
| | Information management | Information management, technology and documentation. |

the context of them. One programme (paramedicine) stood out for the extent to which it incorporated the quality and safety domains across its curriculum. The results of analyses for paramedicine are presented separately as an exemplar of a cohesive and comprehensive approach to key concepts within a health professional education curriculum. Analyses for the other seven pre-qualifying/registering undergraduate degree programmes in relation to the level within curricula at which the domains are explicitly addressed is presented in Table 5.

Note: Levels relate to curricula design with level 5 representing the first year of undergraduate study and level 7 designating the final (and exit) level of the qualification. While levels are often linked to years within programmes (level 5—year one, level 6—year two, level 7—third year) it does not follow that each year has an equal number of points at the corresponding level. Domain 3 was not easily distinguishable from domains 1 and 2, these concepts were covered but closely embedded.

## Analysing the curriculum—examples of extended terms from curricula

A further reading of the learning outcomes and content lists across the programmes was then undertaken to identify specific learning outcomes and content items that illustrated the terms from the extended list. Examples of text from curricula are presented below with reference to the quality and safety domain and the discipline/programme to which it relates.

## Curriculum analysis—paramedicine as an exemplar

Throughout the lengthy process of searching and reading these curricula the paramedicine degree stood out for its attention to concepts closely related to the quality and safety domains. The paramedicine curriculum includes a compulsory level seven course on clinical risk management that aims to identify and develop risk reduction interventions to improve patient outcomes and create a

**Table 5:** Summary of explicit key concepts and curricula levels from nine domains in curricula of eight undergraduate degree programmes.

| | | Nursing | Midwifery | Physiotherapy | Occupational therapy | Podiatry | Oral health | Medical laboratory Science | Paramedicine |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Improvement science | 6,7 | 7 | 7 | 6,7 | 6,7 | 7 | 5,6,7 | All addressed—see case study below |
| 2. | Patient safety | 5,6,7 | 5,6,7 | 6,7 | 5 | 5,6,7 | 5 | 6,7 | |
| 3. | Quality and safety culture | Links 1&2 | Links 1&2 | Links 1&2 | Links 1&2 | Links 1&2 | Links 1 & 2 | Links 1 & 2 | |
| 4. | Evidence-based practice | 5,6,7, | 5,6,7 | 5,6,7 | 5,6,7 | 6, | 6, | 7 | |
| 5. | Patient-centred care | 5,6,7 | 5,6,7 | 6,7 | 6,7 | 6,7 | 6,7 | 7 | |
| 6. | Teamwork and communication | 5,6,7 | 5,6,7 | 5,6,7 | 5,6,7 | 5,6,7 | 5,6,7 | 7 | |
| 7. | Leadership for change | 7 | 5,6,7 | 7 | 6 | | | | |
| 8. | Systems thinking | 5,6,7 | 5,7 | 5,6,7 | 5,6,7 | 5,6, | 5,7 | 5,7 | |
| 9. | Using information technology | 5,6,7 | 5 | 5 | 5 | 5 | 5 | 5,6,7 | |

**Table 6:** Examples of curriculum information (learning outcomes and content lists) from nine domains in curricula of seven undergraduate degrees.

| Domain | | Curriculum text | Discipline |
|---|---|---|---|
| 1. | Improvement science | Apply principles of interprofessional healthcare and quality improvement to facilitate collaborative practice with the healthcare team. | Nursing |
| | | Demonstrates practice reasoning to assess risk, identify known and potential complications and plan appropriate collaborative care. | Midwifery |
| | | Plan, monitor and adapt [discipline practice] to promote optimal health outcomes for people with acute and chronic conditions across the lifespan. | Physiotherapy |
| 2. | Patient safety | Adverse reactions and interactions. | Nursing |
| | | Medication safety during the childbirth continuum. | Midwifery |
| | | Quality assurance and safety. | Medical Laboratory Science |
| | | Demonstrate professional responsibility and competency through accountability, advocacy, safe practice (including legal, ethical and cultural safety) using reasoned judgement. | Nursing |
| | | Consistently demonstrate safe accountable clinical practice and interpersonal skills, which are legally, ethically and culturally appropriate. | Podiatry |
| | | Demonstrate a knowledge and application of health and safety requirements. | Medical Laboratory Science |
| | | Cultural safety and healthcare. | Midwifery, Nursing, Occupational Therapy, Oral Health, paramedicine, physiotherapy, podiatry |
| | | Discuss health and safety practices in a clinical setting. | Oral health |

**Table 6:** Examples of curriculum information (learning outcomes and content lists) from nine domains in curricula of seven undergraduate degrees (continued).

| | | | |
|---|---|---|---|
| 3. | Quality and safety culture | See 1 & 2 above | |
| 4. | Evidence-based practice | Articulate and adapt practice, supported by [discipline] knowledge and evidence based research of contextual health factors and professional issues, to meet client's needs. | Nursing |
| | | Demonstrates practice reasoning to assess risk, identify known and potential complications and plan appropriate collaborative care. | Midwifery |
| | | Justify the diagnosis, assessment and safe management of a range of complex acute case scenarios using clinical reasoning and best available evidence. | Physiotherapy |
| | | Critically reflect on own understanding of evidence-based practice processes. | Occupational therapy |
| 5. | Patient-centred care | Partnership and family-centred/person-centred practice. | Nursing |
| | | Reflect on practice in relation to Te Tiriti ō Waitangi. | |
| | | Articulate and adapt practice, supported by [discipline] knowledge and evidence based research of contextual health factors and professional issues, to meet client's needs. | Midwifery |
| | | Applies practice reasoning to clinical decision making in order to provide safe effective care. | |
| | | Demonstrate the ability to value diverse perspectives in a variety of settings while interacting in partnership with colleagues and clients. | Oral health |
| | | Develops the skills involved in assessment, diagnosis and management of the diabetic foot in partnership with the patient, their whānau and the wider community. | Podiatry |
| 6. | Teamwork and communication | Apply principles of interprofessional healthcare and quality improvement to facilitate collaborative practice with the healthcare team. | Nursing |
| | | Interprofessional collaboration (including working with formal and informal carers, teamwork, delegation, supervision and direction). | |
| | | Discuss the interprofessional team involvement and management in the care of the complex patient in the acute care environment and evaluate the role of the [discipline practitioner] within this team. | Physiotherapy |
| | | Practice effective teamwork as a basis for inter-professional learning | Midwifery, nursing, occupational therapy, oral health, paramedicine, physiotherapy, podiatry |
| 7. | Leadership for change | Principles of leadership and management related to practice. | Nursing |

**Table 6:** Examples of curriculum information (learning outcomes and content lists) from nine domains in curricula of seven undergraduate degrees (continued).

| | | | |
|---|---|---|---|
| 8. | Systems thinking | Analyse health and environmental issues occurring within Aotearoa New Zealand/Analyse contemporary developments in Aotearoa New Zealand from a hauora Māori perspective. | Midwifery, nursing, occupational therapy, oral health, paramedicine, physiotherapy, podiatry |
| | | Critically analyse ways health professionals can act, within their scope of practice, to promote or enable changes in policy and legislation at national, local government or service provision levels. | Occupational therapy |
| | | Critically discuss New Zealand/Aotearoa health, disability and social context and potential for systems change. | |
| | | Critique the impact of cultural, ethical, legal and socio-political contexts on [discipline practice] and patient experience. | Nursing |
| | | Critically analyse ways health professionals can act, within their scope of practice, to promote or enable changes in policy and legislation at national, local government or service provision levels. | Occupational therapy |
| | | Identify and apply information from a range of sources to guide thinking and actions. | |
| 9. | Using information technology | Information literacy (computer skills, IT media, library sourcing). | All programmes |
| | | Managing and transferring patient information. | Nursing |
| | | Information management, technology and documentation. | |
| | | Identify and apply information from a range of sources to guide thinking and actions. | Occupational therapy |
| | | Discuss the regulatory framework, safety, and ethical issues relevant to laboratory information system. | Medical laboratory science |
| | | Describe the underlying concepts, management and architecture of a laboratory information system. | |

safe practice environment. The inclusion of safety and quality concepts extends well beyond that single course and examples of how the domains are addressed across the paramedicine curriculum are presented in Table 7.

Paramedic educators were not interviewed for the 2017 paper[3] and the profession has only recently been granted registered practitioner status under the HPCA in Aotearoa New Zealand. In the absence of a New Zealand regulator this programme has been accredited and regularly monitored by the Australian regulator. The extent to which the HQSC domains are included in this curriculum is likely to reflect the culture of the discipline with its emphasis on safety and the contexts in which students and educators practise.

# Discussion

The analyses of the eight undergraduate degree programme curricula indicate that while the terms used in the 2017 study[3] to describe the quality and safety domains are not clearly and consistently identifiable at the level of their title, it is apparent that all of these disciplines appreciate conceptual elements within the domain descriptions and many closely related terms (from the extended list). This raises questions about how the domains are understood, how the terms or concepts within curricula are best elucidated and illustrates how language varies between disciplines. The domains are addressed but the language used does not always align with the domain titles published by HQSC.

**Table 7:** Examples of how the paramedicine curriculum addresses the quality and safety domains.

| Quality and safety domains | | Examples from paramedicine curriculum |
|---|---|---|
| 1. | Improvement science | Analyse and debate the merits of clinical risk reduction strategies and programmes. |
| 2. | Patient safety | Critically analyse human factors and the impact on healthcare. |
| 3. | Quality and safety culture | Describe structured approaches to risk management. |
| | | Analyse and debate the merits of clinical risk reduction strategies and programmes. |
| | | Inter-professional insights into communication styles that escalate risk. |
| | | Reduction of clinical risk through risk identification, analysis, treatment and review. |
| | | Human cognition, performance and error. |
| | | Sentinel events and adverse events. |
| 4. | Evidence-based practice | Critically discuss evidence-based examination, working diagnosis, and determination of acuity in the [clinical] practice setting. |
| 5. | Patient-centred care | Provides the student [discipline] with reasoning and decision-making frameworks and the ability to analyse and develop evidence-based practice. |
| 6. | Teamwork and communication | Practice effective teamwork as a basis for inter-professional learning. |
| | | Crew Resource Management, including team dynamics and situational awareness. |
| 7. | Leadership for change | Demonstrate effective leadership and communication. |
| 8. | Systems thinking | Determine ethical and legal parameters of clinical risk management. |
| 9 | Information technology | Documentation (electronic systems), information literacy. |

Improvement science: This concept appears to have minimal currency within curricula across these disciplines. The terms 'quality improvement', 'quality assurance', 'quality control' and 'reflection' were found across curricula and the learning outcomes that illustrate them encapsulate the concepts within the description of the quality and safety domain. Curricula text relating to improvement science incorporates references to risk, collaboration and teams which suggests improving practice is presented in the context of ongoing consideration and communication.

Patient safety: The concept of safety appears in these curricula and often within the context of culture. Of note is the reference to 'cultural safety' and 'cultural competence' which indicates a holistic approach to wellbeing and hopefully reflects an appreciation of Te Tiriti o Waitangi, which is essential for healthcare practice in Aotearoa New Zealand.

Quality and safety culture is presented in HSQC documentation as a separate domain. However, within this analysis, for all but the paramedicine programme, the relevant concepts were addressed within the first two domains. Presenting those terms again as an analysis of a separate domain would create duplication and construct an artificial record of the extent to which they occur.

Evidence-based practice: This is a concept that is well understood across curricula

within the Faculty. The terms 'research' and 'evidence' relating to information, practice and decision-making can be found across programmes and levels within them. There were examples of learning outcomes which did not explicitly refer to evidence but clearly required it for the outcome to be achieved, such as when planning care. This concept had good currency across curricula which corresponds with the findings of the 2017 study[3] that it was one of the domains that featured more strongly in interviews with educators. The findings of this current work and the previous study reflect New Zealand's strong emphasis on evidence-based practice, evident in the national Accident Compensation scheme (ACC)[12] and in relation to the evaluation and sourcing of pharmaceuticals (Pharmac),[13] is also borne-out in health professional curricula.

Patient-centred care: This is a concept that required considerable investigation. Some disciplines refer to 'clients' rather than 'patients' which is an understandable range of terminology. As with 'patient safety' these terms were always positioned within wider contexts that expect information to be sought and considered in relation to care. References to 'diversity', 'adaptation', 'partnership' and the social location of patients within 'whanau/family' and 'community' are also apparent where these terms were found in these curricula.

Teamwork and communication: Teamwork was embedded across all curricula in this analysis, initially within the first semester of study as all students (others than those in the medical laboratory science programme) are required to engage in a group project that contributes to a summative assessment result. As with other terms within this analysis, 'teamwork' and 'communication' appear in the curriculum alongside other concepts, specifically 'interaction' and 'collaboration'. 'Team' referred to working with colleagues and patients/clients, which positions patients as having a key role in the planning and evaluation of their care.

Leadership for change: The analysis did not identify the title of this domain at all. Leadership appeared less than any other term across the programmes. Three programmes do not appear to address it at all while five programmes address it at least once and within those midwifery includes it at each of the three levels in its curricula. Given these qualifications are designed to equip beginning practitioners it is not surprising leadership has such as low profile within curricula, and especially in relation to bringing about change. Paramedics and midwives practice independently in acute settings and it follows that they are the programmes which reference leadership. The nursing curriculum logically includes leadership as it is a large profession with layers of staffing and communication, but other disciplines are unlikely to utilise the concept in terms of beginning practitioners.

Systems thinking: This is another domain title that has no currency across these curricula. While there is evidence across most levels in all disciplines that relevant concepts are covered this relates to considering a range of information and appreciating sources of it when making decisions and reflecting on practice.

Information technology: This is another domain title that has a minimal profile when searching curricula across these disciplines. While all students undertake a compulsory course in the first semester which refers to 'IT literacy' there is barely any other mention other than within the medical laboratory science programme, which includes a considerable emphasis on technology in practice. However, the small number of places in which the terms appear does not mean technology is not present in curricula. The learning approaches, assessments and processes relating to practical/clinical experiences of students all embed and require technological skill and ongoing adaptation. The disciplines themselves have information technology embedded in practice with the roll-out electronic patient records.[14]

There are considerable challenges encountered when trying to identify references to singular domains within curricula. This speaks to the cohesion, integration and holistic nature of curricula and of planning care and delivering practice. Quality and safety are foundational concepts and should be seen as integrated and valued for their complexity rather than siloed, despite the ease with which simple and discreet information can be investigated.

There are clear differences in professional culture between disciplines. The podiatry and medical laboratory science curricula present a strong emphasis on technical skill and what may be seen as a medicalised approach. This medicalisation is also clear in paramedicine learning outcomes and content but always alongside explicit reference to patients, colleagues or the wider context. The midwifery and nursing curricula notably have a more explicit emphasis on human engagement with colleagues and patients while making decisions and reflecting on practice.

In reflecting on the 2017 paper,[3] it is reasonable, given the complexity of language when trying to investigate terms, that individual educators may not appreciate the presence or extent of any given term in a curriculum. This is confounded further when curricula are interprofessional, and include both generic and specialised content. This study extends the previous work with a detailed analysis of curricula.

There are two limitations of these analyses. The first is that curricula as constantly evaluated and refined, and while we welcome ongoing evolution, it can be difficult to choose a moment in time to analyse with any definitive outcome. Another limitation is that we only explored the learning outcomes and content lists. A further analysis could extend to the learning and teaching strategies and assessment design of courses within curricula.

In the process of investigating these curricula we identified an extended list of terms that may be used to assist with exploring the health and safety domains in the education of health professionals in Aotearoa New Zealand. Further studies that include more institutions and programmes across institutions would provide further insights as curricula constantly evolve with the aim of providing the best outcomes for patients.

# Conclusion

It is our hope that this work extends that previously carried out into the presence of the quality and safety domains in undergraduate health professional curricula.[3] The paramedicine degree is presented as an exemplar of the domains being comprehensively addressed. As a result of this analysis we present an extended list of terms for developing and investigating curricula in relation to the HSQC domains. The iterative process we followed of carefully searching curricula and considering the context of each term may also be transferrable to other similar investigations. It would be interesting to conduct interviews again using this extended list of terms.

This analysis could be extended to other programmes including postgraduate pre-qualifying pathways and those disciplines which are not yet formally registered. While AUT provides pre-qualifying/registration education programmes for a good number of disciplines and students within Aotearoa New Zealand, a wider analysis involving other providers and professional groups would further inform the understanding of safety and quality in relation to the education of practitioners.

Beyond analysing other curricula and using the findings to inform development, the question of how learning impacts on patient experience and outcomes requires attention. Finding ways to explore how student learning makes a difference in practice would enable us to more fully evaluate quality improvement and patient safety in relation to health professional education.

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Nil.
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# Reduced community antibiotic dispensing in New Zealand during 2015–2018: marked variation in relation to primary health organisation

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## ABSTRACT

**AIMS:** The overall rate of community antibiotic dispensing in New Zealand in recent decades has been high when compared with many other nations, but since 2015 has consistently declined each year. We aimed to determine whether the magnitude of reductions in community antibiotic dispensing in New Zealand between 2015 and 2018 differed in relation either to the patient's demographic features or in relation to the primary health organisation of the patient's registered general practitioner.

**METHODS:** Demographic data on all patients registered with a general practice in New Zealand, and on all community pharmacy antibiotic dispensing for these patients during 2013–2018 were obtained from national healthcare databases. The rates of dispensing for patients registered with a general practitioner were measured as antibiotic courses dispensed per 1,000 population per day, and as defined daily doses per 1,000 population per day.

**RESULTS:** Total community antibiotic dispensing in New Zealand, measured as defined daily doses per 1,000 inhabitants per day, decreased by 13.8% during 2015–2018, an average annual reduction of 4.6% per year, with especially large reductions in dispensing of amoxicillin/clavulanate, fluoroquinolones and macrolides. The reductions in dispensing were greatest in children aged 0–4 years old, but lesser reductions were seen in all age groups. Antibiotic dispensing declined regardless of patient ethnicity or level of socioeconomic deprivation. There were marked differences between primary health organisations in the size of the reductions in antibiotic dispensing during 2015–2018, which ranged between 4.8% for the Te Tai Tokerau PHO to 21.5% for the Ngati Porou Hauora Charitable Trust PHO.

**CONCLUSIONS:** Total community antibiotic dispensing has reduced significantly in New Zealand between 2015 and 2018, with large disparities between primary health organisations in the size of the reductions. The overall rates of antibiotic dispensing remain high for non-Māori and non-Pacific people, and prescribers should aim to further reduce inappropriate antibiotic prescribing for these populations. However, the overall rate of antibiotic dispensing for Māori and Pacific people may now approximate an optimal level. Prescribers should aim to further reduce inappropriate antibiotic prescribing, but also to increase appropriate antibiotic prescribing for these populations.

Concern about the rising prevalence of resistance to antibiotics in a wide range of bacteria has stimulated efforts in many countries to reduce inappropriate antibiotic use. In New Zealand, during each winter between 1998 and 2016, PHARMAC conducted a national "Wise use of antibiotics" campaign to "focus on the responsible use of antibiotics, particularly with regard to the treatment of colds and flu", and since 2017 has conducted a broadly similar "Keep antibiotics working" campaign "aimed at informing Kiwis that taking antibiotics won't fix a cold or flu".[1,2] Other educational programmes, such as the Antibiotic Guideline first published in 2013 by the Best Practice Advocacy Centre (bpac$^{nz}$) and revised in 2015 and 2017,[3] and numerous articles and online resources produced by bpac$^{nz}$,[4] the Goodfellow Unit[5] and the Ministry of Health[6] have encouraged wise use of antibiotics in New Zealand.

These campaigns and resources, together with other publicly available information, are likely to have increased public and professional concern about the immediate and long-term adverse impacts of inappropriate antibiotic use, and led to reductions in community antibiotic dispensing. The total amount of antibiotics dispensed in the community in New Zealand had increased each year until 2012,[7] but since 2015 has declined each year.[8] However, when compared with other similar nations, the level of community antibiotic dispensing in New Zealand has been high.[9–11] For example, during 2015 in New Zealand there were 3.01 antibiotic courses dispensed per 1,000 inhabitants per day.[11] This rate of dispensing was 3.3 times greater than in Sweden, 2.1 times greater than in Denmark, 1.7 times greater than in Canada, and 1.3 times greater than in the US.[11]

Primary health organisations (PHOs) play an important role in encouraging the provision of high-quality healthcare by general practitioners (GPs) at their contracted practices. We postulated that, during recent years, there may have been significant variation between PHOs in their efforts to discourage inappropriate antimicrobial prescribing. We therefore examined community antimicrobial dispensing in New Zealand between 2013 and 2018 to better understand the changes in dispensing that had occurred during this period, and to determine whether there were significant disparities between PHOs in the magnitude of these changes.

# Methods

Data was obtained from two national healthcare databases managed by the Ministry of Health. Our study included all patients registered with a New Zealand general practice in the first quarter of each year 2013–2018 and listed in the PHO Enrolment Collection. This database contains information on each patient's date of birth, gender, prioritised ethnicity, estimated level of socioeconomic deprivation, the practice with which they are registered, and the PHO of the practice. Patients were assigned to one of six ethnic groups: Asian, European, Māori, MELAA (Middle Eastern, Latin American and African), Pacific and Other.[12] Each patient's level of socioeconomic deprivation was estimated using the New Zealand Deprivation Index based on data in the 2013 Census of Population and Dwellings, with patients allocated to deprivation quintiles (quintile 1 = the least deprived and quintile 5 = the most deprived).[13]

Data on all antibiotic medicines dispensed in the community, from 1 January 2013 to 31 December 2018, were obtained from the National Pharmaceutical Collection. Pharmaceuticals in this dataset are classified under the Anatomical Therapeutic Chemical (ATC) system.[14] Data for each antibiotic dispensing included the antibacterial agent, its formulation, quantity dispensed and daily dose information. Records for each patient from the two national datasets were linked using an encrypted form of their National Health Index (NHI) code.

Antibiotic dispensing was measured both as number of antibiotic courses dispensed per 1,000 population per day, and as defined daily doses (DDDs) per 1,000 inhabitants per day (DIDs). Repeat prescriptions were not included when measuring the number of antibiotic courses per 1,000 population per day but were included when measuring DIDs.

Our analysis of changes in antibiotic dispensing within New Zealand PHOs included 31 PHOs, two of which were

divided regionally for funding purposes into sub-PHOs: Compass Health-Capital and Coast, and Compass Health-Wairarapa; and Midland Health Network-Lakes, Midlands Health Network-Tairawhiti, Midlands Health Network-Taranaki, and Midlands Health Network-Waikato.

We used published data quantifying national rates of community antibiotic dispensing in other countries during 2013–2018, to provide comparisons with New Zealand rates.[15–21] Data published by the Ministry of Health[22] and the Health Quality and Safety Commission[23] were used to investigate potential associations between the magnitude of change in antibiotic dispensing for each PHO, and the PHO's performance with regard to other measures of the quality of care they provided. These measures of quality of care included: rates of childhood immunisation coverage at two years of age, provision of smoking cessation advice, dispensing of urate lowering therapy to people with a recent hospitalisation for gout, or provision of influenza vaccination to people with a recent hospitalisation for asthma.

We used Poisson regression to test for trends in the rates of antibiotic dispensing during 2015–2018. We calculated the Pearson product moment correlation using Fisher's transformation to examine the correlation between PHO levels of antibiotic dispensing in 2015 and changes in antibiotic dispensing between 2015 and 2018.

# Results

A total of 4,269,050 people were registered with a general practice in 2013 and 4,509,851 people in 2018. These study populations represented approximately 96% of the estimated total New Zealand population of 4,442,100 in 2013, and 92% of the estimated total New Zealand population of 4,885,350 in 2018.[24] In 2015, 3,697,012 antibiotic courses were dispensed by community pharmacies to 1,763,044 registered patients and in 2018, 3,501,247 courses were dispensed to 1,751,851 registered patients. Antibiotic courses dispensed to registered patients constituted 90.2% of all antibiotic courses dispensed in the community in New Zealand in 2013, and 91.9% of all antibiotic courses dispensed in the community in 2018.

## Changes in dispensing for patients registered with a GP

Total annual community antibiotic dispensing in New Zealand, for patients registered with a GP, whether measured in antibiotic courses dispensed per 1,000 population per day (Figure 1a), or in DIDs (Figure 1b), remained relatively stable from 2013 to 2015, but then declined from 2015 to 2018. Total antibiotic dispensing measured in DIDs decreased, by 5.6% between 2015 and 2016, by 3.1% between 2016 and 2017, and by 5.8% between 2017 and 2018, an average annual reduction of 4.6% between 2015 and 2018. This average annual reduction was comparable in magnitude to reductions

**Figure 1:** Rates of total community antibiotic dispensing measured in courses dispensed per 1,000 population per day (a), and in DDDs per 1,000 inhabitants per day (DIDs) (b), in New Zealand and other countries, during 2013–2018.

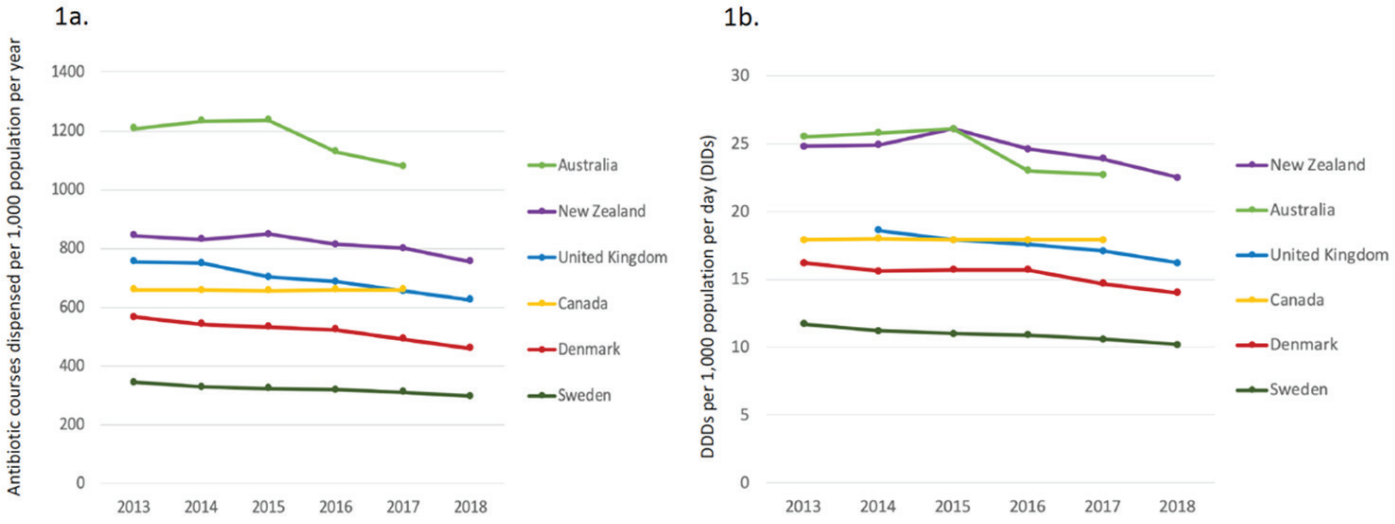




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**Table 1:** Annual community dispensing of antibiotics by class and agent (for penicillins), measured in DDDs per 1,000 population per day (DIDs), during 2013–2018.

| | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | average annual reduction 2015 to 2018 |
|---|---|---|---|---|---|---|---|
| Penicillins total | 13.05 | 13.15 | 14.26 | 13.14 | 12.85 | 11.99 | - 5.3% |
| Penicillin V | 0.42 | 0.37 | 0.38 | 0.36 | 0.38 | 0.34 | - 3.6% |
| Flucloxacillin | 1.83 | 1.74 | 1.73 | 1.79 | 1.69 | 1.71 | - 0.4% |
| Amoxicillin | 6.08 | 6.38 | 6.92 | 6.62 | 6.68 | 6.18 | - 3.6% |
| Amox/clav | 4.73 | 4.65 | 5.23 | 4.37 | 4.09 | 3.76 | - 9.4% |
| Cephalosporins | 0.94 | 1.00 | 1.04 | 1.04 | 1.02 | 1.00 | - 1.4% |
| Macrolides | 2.34 | 2.27 | 2.25 | 2.05 | 2.02 | 1.79 | - 6.7% |
| Tetracyclines | 6.55 | 6.60 | 6.66 | 6.57 | 6.25 | 6.04 | - 3.1% |
| Trimethoprim and cotrimoxazole | 1.32 | 1.33 | 1.32 | 1.30 | 1.26 | 1.28 | - 1.2% |
| Fluoroquinolones | 0.51 | 0.51 | 0.49 | 0.48 | 0.43 | 0.38 | - 7.7% |
| Total* | 24.78 | 24.93 | 26.09 | 24.64 | 23.87 | 22.48 | -4.6% |

*Note: the total includes relatively small numbers of dispensings for antibiotics not listed in the table.

occurring over the same period in Australia (6.5%), Denmark (3.6%), the UK (3.2%), Sweden (2.4%) and the Netherlands (1.9%).

Table 1 shows the annual rates of community dispensing (measured in DIDs) of the most commonly prescribed antibiotics, for patients registered with a GP, during 2013–2018. Total annual dispensing of antibiotics peaked in 2015 and then consistently declined during each subsequent year ($p<0.001$ for each antibiotic class or agent). The largest average annual reductions in community antibiotic dispensing during 2015–2018 were for amoxicillin/clavulanate (9.4%), fluoroquinolones (7.7%) and macrolides (6.7%).

## Changes in dispensing by patient demographics

Total annual community antibiotic dispensing declined significantly ($p<0.001$) in all age groups during 2015–2018, with the largest reductions in children aged 0–4 years, whether measured in antibiotic courses dispensed per 1,000 population per day (Figure 2) or in DIDs (data not shown).

Total community antibiotic dispensing, measured in DIDs, during 2013–2018, declined significantly in all ethnic groups ($p<0.001$), and at all levels of socioeconomic deprivation ($p<0.001$). (Figures 3a and 3b).

## Changes in dispensing by DHB and PHO

There were marked differences between the 20 DHBs, and between the 29 PHOs and six sub-PHOs, in the rates of change in total community antibiotic dispensing, measured in DIDs, during 2015–2018. The magnitude of the reductions in dispensing during this three-year period ranged from 7.5% for the Tairawhiti DHB to 18.8% for the Waitemata DHB (Figure 4a) with a median reduction of 11.5% for the Canterbury DHB. During the same period, the median reduction was 12% for the Central PHO, with reductions ranging from 4.8% for the Te Tai Tokerau PHO to 21.5% for the Ngati Porou Hauora Charitable Trust PHO (Figure 4b).

We compared the 35 PHOs to determine whether those with the largest percentage reductions in antibiotic dispensing

**Figure 2:** Rates of total community antibiotic dispensing measured in courses dispensed per 1,000 population per day, in relation to patients' age, during 2013–2018.

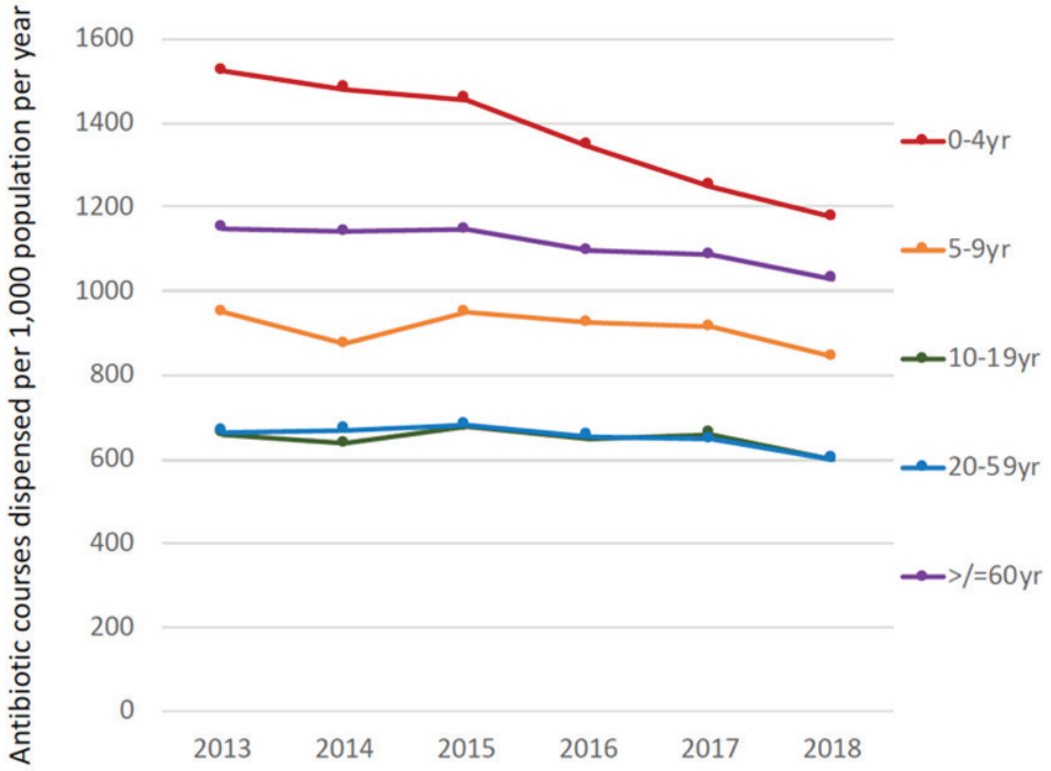



**Figure 3:** Rates of total community antibiotic dispensing, measured in DIDs, in relation to patients' ethnicity (a), and socioeconomic deprivation quintile (b), during 2013–2018.

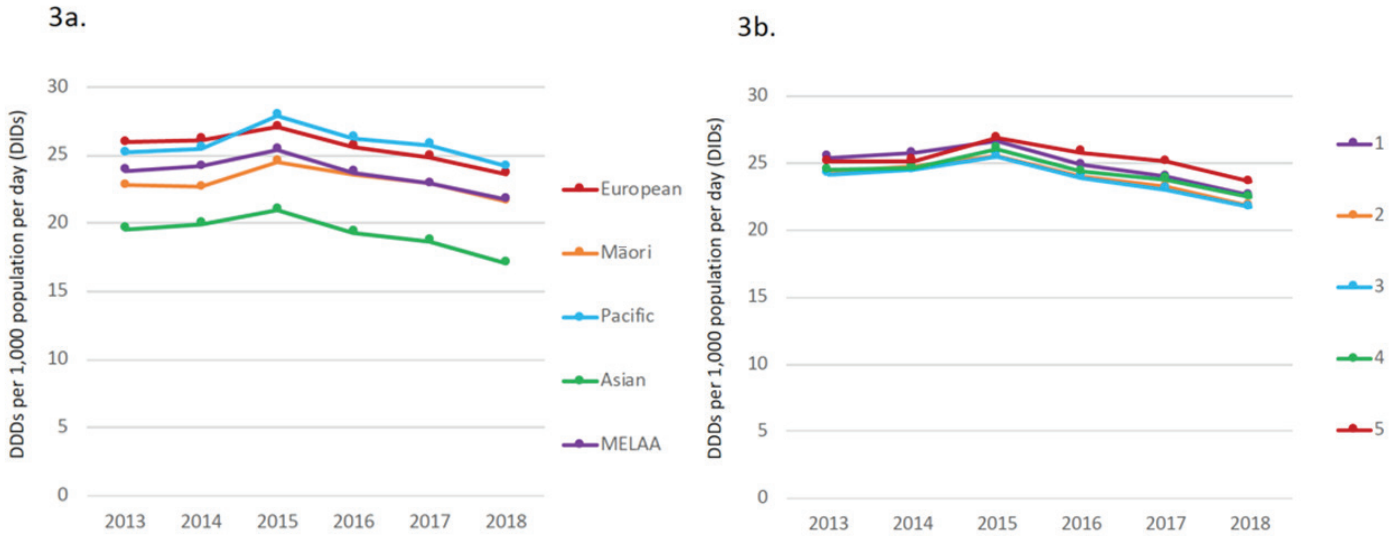
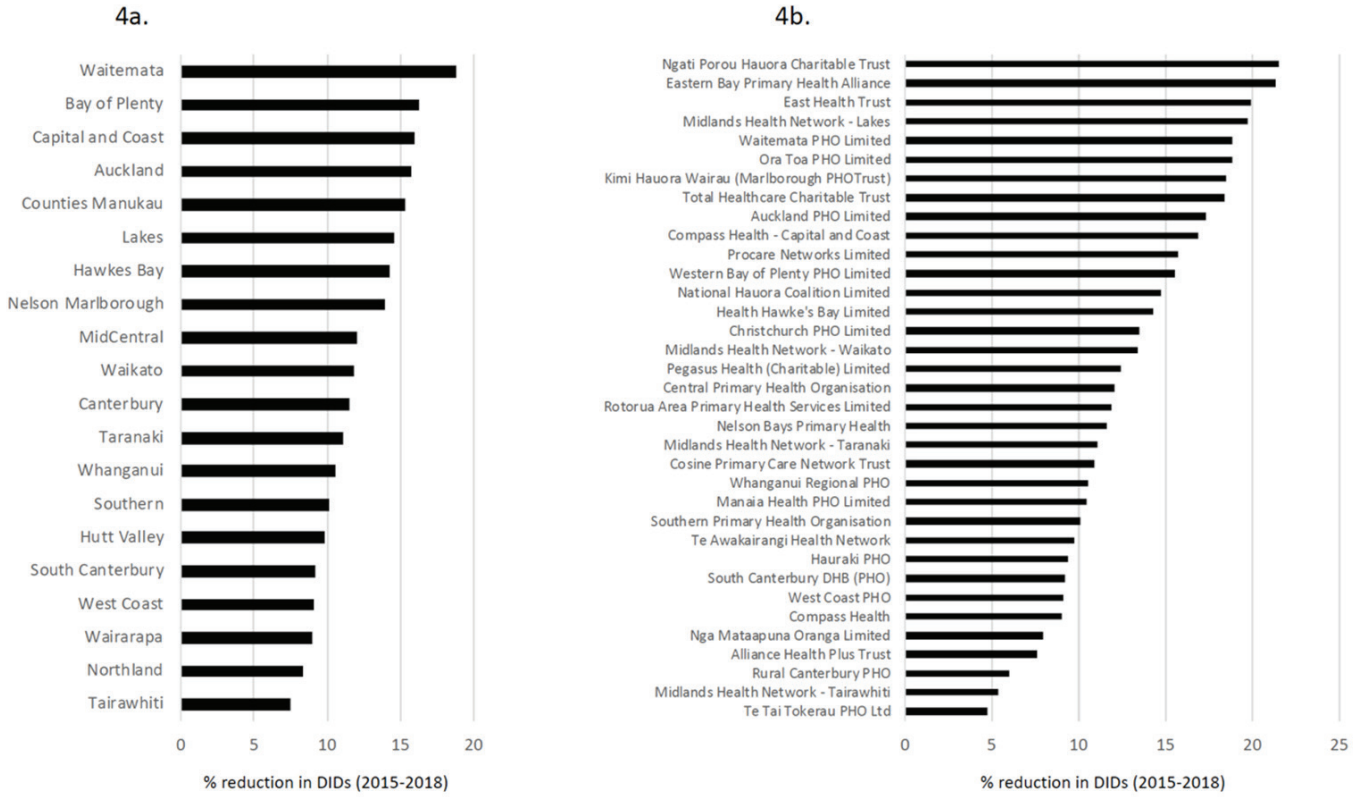


**Figure 4:** Change in the level of total community antibiotic dispensing measured in DIDs, during 2015–2018, for each DHB (a), and for each PHO (b).




(measured in DIDs) during 2015–2018 had begun with the highest rates of antibiotic dispensing during 2015, or were PHOs that had performed particularly well with regard to other measures of the quality of healthcare. There was no correlation between the PHO rate of dispensing during 2015 and the size of the reduction in dispensing during 2015–2018 (correlation coefficient: 0.32, 95% CI: -0.02–0.59). Nor were there any significant correlations between the rate of change in community antibiotic dispensing for each PHO during 2015–2018, and the PHO rates of childhood immunisation coverage at two years of age, provision of smoking cessation advice, dispensing of urate lowering therapy to people with a recent hospitalisation for gout, or provision of influenza vaccination to people with a recent hospitalisation for asthma, during the same period (data not shown).

# Discussion

There has been a significant decline in the rate of community antibiotic dispensing in New Zealand in recent years. This decrease in antibiotic dispensing, as measured in DIDs, is clearly apparent from 2015, but had been preceded by a decrease in antibiotic courses dispensed to children under five years of age since 2012.[8] Similar sustained declines in total community antibiotic dispensing have also occurred in the Netherlands since 2012,[20] in Denmark since 2014,[19] in the UK since 2015[16] and in Australia since 2016.[15] The average annual reduction in total community antibiotic dispensing in New Zealand during 2015–2018, measured in DIDs, was 4.6%, which was comparable to, or larger than, those observed during the same period, in many other nations (Australia: 6.5%; Denmark: 3.6%; Sweden: 2.4%; UK: 2.1%; Netherlands: 1.9%; France: 0.3%; Canada: 0%).[15–21] The greatest reduction

in antibiotic dispensing in New Zealand was for children aged 0–4 years, and this was also the case in the US,[25] Denmark[19] and Sweden.[21] The marked similarities between these countries in the year of onset of the decline, the magnitude of the reductions and the age group with the largest reductions in antibiotic dispensing strongly suggests that comparable changes in community and medical attitudes to antibiotic use have occurred in many developed countries.

Despite the reductions in dispensing during 2015–2018, New Zealand had a higher rate of total community antibiotic dispensing during 2018 (22.5 DIDs) than many other developed countries, such as the UK (18.2 DIDs), Denmark (13.98 DIDs), Sweden (10.15 DIDs) and the Netherlands (10.05 DIDs).[16,19–21] These marked differences might lead one to conclude that total community antibiotic dispensing in New Zealand is approximately two times higher than is required to maintain a healthy population, and by implication that approximately 50% of antibiotic dispensing in New Zealand is inappropriate. However, New Zealand differs from these European countries in that it is a nation with a markedly higher incidence of infectious diseases in Māori and Pacific people,[11,26] who frequently also suffer from socioeconomic deprivation. Concern has been expressed that initiatives aimed at reducing antibiotic prescribing might exacerbate the worse health outcomes experienced by Māori and Pacific people.[27] We found broadly comparable reductions in total antibiotic dispensing, regardless of ethnicity or level of socioeconomic deprivation, suggesting that many patients and GPs saw significant opportunities to reduce inappropriate prescribing for all population groups in New Zealand. We have previously shown large increases in antibiotic prescribing during the winter in New Zealand in all ethnic groups, suggesting that inappropriate antibiotic prescribing for self-limiting upper respiratory tract infections is at least as common in Māori and Pacific people as it is in people of other ethnicities.[11]

We have recently suggested that appropriate targets for annual total antibiotic dispensing in New Zealand may be approximately 1.5 antibiotic courses per 1,000 population per day for people who are not of Māori or Pacific ethnicity, and 2.5 antibiotic courses per 1,000 population per day for Māori and Pacific people—1.66 times higher in Māori and Pacific people, to account for their increased burden of bacterial infectious diseases.[28] Achieving these targets would require a 26% decrease in total antibiotic dispensing for people who are not of Māori or Pacific ethnicity, from their 2018 dispensing rate of 2.03 antibiotic courses per 1,000 population per day, and a 2% increase in total antibiotic dispensing for Māori and Pacific people from their 2018 dispensing rates of 2.45 antibiotic courses per 1,000 population per day.

Achieving these targets by increasing appropriate antibiotic prescribing and reducing inappropriate antibiotic prescribing may be expected to improve health outcomes for all people, but will require increased awareness of the impact of ethnicity on the burden of infectious diseases in New Zealand. It does not make sense that the rate of dispensing of penicillins for people aged 5–20 years of age was only 1.45 times higher in Pacific people, and 1.24 times higher in Māori people than in people of other ethnicities, when the incidence of rheumatic fever was 63 times higher in Pacific people and 27 times higher in Māori people, than in people of other ethnicities.[11]

Many doctors and patients are likely to be concerned that reducing community antibiotic dispensing may lead to adverse health impacts. However, studies conducted in England and Sweden found that large, sustained reductions in antibiotic dispensing were not associated with an overall increase in the rate of serious infections.[29,30] These, and similar findings from other studies, have contributed to a growing awareness that antibiotics have been widely overprescribed in many countries, and that inappropriate antibiotic "treatment" of self-limiting respiratory infections (such as colds and influenza) and other minor illnesses, rarely confers any significant benefit, frequently causes relatively minor adverse effects (such as diarrhoea and rash),[31] occasionally causes severe adverse effects (such as anaphylaxis)[32] and selects for the spread of antibiotic resistant bacteria.[10] Improved public education about the benefits of reducing inappropriate antibiotic

consumption, and medical education about the benefits of adhering to treatment guidelines, will be required to ensure that people in New Zealand achieve the benefits that will result not only from reduced inappropriate antibiotic use, but also from increased antibiotic use for those conditions for which it is beneficial.

The strengths of this study include the inclusion of demographic and antibiotic dispensing data for more than four million people (over 90% of the total New Zealand population) during a six-year period. The large amount of information recorded in New Zealand's high-quality, comprehensive, national databases enabled us to analyse antibiotic dispensing by age, ethnicity, socioeconomic deprivation, geographic region and general practice administrative organisation (PHO). Weaknesses of the study include the inability to measure the amount of antibiotic issued by school or community-based programmes for the management of sore throats and skin infections in children and young people. In some regions of New Zealand in recent years, antibiotic courses issued by these programmes have comprised a large proportion of antibiotic courses given to school-aged children.[33,34] Furthermore, we were unable to measure the quantity of antibiotic medicines dispensed by general practices using medicines obtained through practitioner supply orders. It is possible that in some practices this may have been a relatively common method of circumventing both the potential costs to patients and the perceived inconvenience of having medicines dispensed by a pharmacy.

We have noted with particular interest the striking variation between PHOs in the magnitude of their annual reductions in antibiotic dispensing during 2015–2018. We suggest that, taking into account the ethnicity of the population they serve, all PHOs might aim to achieve a 5% annual reduction in total antibiotic dispensing, a target that was achieved by approximately one-third of New Zealand PHOs during the 2015–2018 period. Achieving sustained reductions in inappropriate antibiotic dispensing during the coming decades will be beneficial for the health of the people of New Zealand, both in the short term and in the long term.

**Competing interests:**
Nil.

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# Hazardous drinking and general practitioner visits in the past year

Angela Jury, Ashley Koning, Jennifer Lai, Charito Tuason, Terry Huriwai, Sarah Hetrick


## ABSTRACT

**AIM:** To quantify the relationship between any general practitioner (GP) visit and hazardous alcohol use, and whether this differs by sociodemographic factors.

**METHOD:** Hazardous alcohol use (scores 8+ Alcohol Use Disorders Identification Test) and any past year GP visits were examined using 2016/17 New Zealand Health Survey data from 13,598 adults. Sub-group analyses examined whether the association differed by age, sex or ethnicity (Māori/non-Māori), and socioeconomic status (NZDep2013) in post-hoc analyses.

**RESULTS:** Results differed for Māori and non-Māori. Regardless of drinking behaviour, Māori males aged 15–24 years were least likely to visit a GP. Among Māori in each demographic group, GP visits were similar for people meeting hazardous drinking criteria and safer drinkers. Conversely, among non-Māori males aged under 45 and non-Māori females aged 15–24 and 45–64 years, GP visits were 10–13 percentage points higher among people meeting hazardous drinking criteria than safer drinkers. GP visits were lower for people meeting hazardous drinking criteria living in more deprived areas.

**CONCLUSION:** Multiple strategies need to be prioritised to address service access particularly for young Māori, and support people drinking at hazardous levels. This includes increasing access to services in various settings, enhancing existing primary health services (eg, cultural responsiveness, alcohol screening, brief interventions), addressing access barriers, and health promotion.


Alcohol use is a risk factor for both mental and physical health problems, and is associated with an increased risk of suicide and premature mortality.[1] The Global Burden of Disease Study found alcohol consumption (regardless of pattern of use) was the seventh leading risk factor for deaths and disability adjusted life years globally, and the leading risk factor for deaths among people aged 15–49 years.[1] Hazardous drinking is defined by the World Health Organization as a pattern of alcohol consumption that increases a person's risk of psychological and physical harm, including high blood pressure, cardiovascular diseases, diabetes, liver damage and some cancers.[2] This includes people who use alcohol over the recommended levels (no more than 10 standard drinks a week for women and 15 for men, see www.hpa.org.nz).

Each year about one in five adults in New Zealand (748,000 people) drink alcohol at hazardous levels.[3] Often there is a long delay between the onset of hazardous drinking and treatment, indicating an unmet need for prevention and earlier intervention.[4] To meet the needs of people experiencing and at risk of alcohol-related harm earlier, primary care has an important role in expanding access to and choice of services.[5] Primary care services are an important first point of contact with the health system for people who may be experiencing problems related to their own or whānau members' alcohol use. An earlier New Zealand study in 2000 found 16% of people who accessed general practitioners (GPs) in Auckland met hazardous drinking criteria.[6] Regular screening and discussions about alcohol use in primary health settings may help reduce

the onset of more severe issues and improve access to treatment.[7]

Considering the impact of alcohol on physical and mental health, the question remains about whether people meeting hazardous drinking criteria access GP services more or less than those with lower-risk alcohol use? National and international studies report mixed results, with some showing increased access, and others showing decreased access.[8–10] One US study, for example, found the impact of alcohol use on primary care utilisation depended on sex and ethnicity.[10] In general, GP use differs across age, sex and ethnic groups.[3] However, these factors have not been investigated in relation to hazardous drinking and GP visits in New Zealand.

This study firstly aimed to quantify the relationship between hazardous alcohol use and any past year GP visit using data from the New Zealand Health Survey (NZHS), and secondly, to determine the nature of any association with age, sex or ethnicity.

# Methods

## Data collection

The NZHS is conducted face-to-face every year; and over samples Māori, Pacific and Asian ethnic groups (see health.govt.nz). In 2016/17, the survey included 13,598 adults aged 15+ years living in the community. Information collected includes sociodemographic factors, healthcare utilisation, long-term physical health problems, mental health issues and behavioural health patterns such as alcohol and other substance use. Ethical approval for the survey was granted by the New Zealand Health and Disability Multi-Region Ethics Committee.

## Measures

The following measures from the 2016/17 NZHS were included in the analysis.

*Any past year GP visit*. People were asked if they had seen or been visited by a GP about their own health in the past 12-months (yes/no).

*Alcohol use.* Hazardous drinking was identified using the Alcohol Use Disorders Identification Test (AUDIT).[2] The AUDIT contains 10 items measuring alcohol intake, drinking behaviours and alcohol-related problems within the past 12 months. The AUDIT produces a score between 0 and 40, with scores 0–7 reflecting no current issues or safer drinking levels; scores 8 and over (AUDIT 8+) reflecting hazardous (potentially "risky") alcohol use; and scores 20–40 suggesting a need for referral for diagnostic assessment and treatment.[11] Despite limited New Zealand research, the AUDIT has good face validity locally and numerous overseas studies have confirmed the AUDIT's test-retest reliability, construct validity and sensitivity to change in the identification of hazardous drinking.[12]

*Other substance use*. Self-reported use of any other substances for recreational or non-medical purposes in the past 12-months.

*Sociodemographic characteristics*. Sociodemographic characteristics included age group (15–24; 25–44; 45–64; 65+ years), sex (female/male) and ethnicity (Māori/non-Māori). Due to small sample sizes in some population groups, people identifying as Asian, Pacific and/or New Zealand European/Other were combined into non-Māori for the purposes of this study. Socioeconomic deprivation was examined in post-hoc analyses based on NZDep2013 quintiles (quintiles 1 and 2 reflect least deprived areas; 4 and 5 most deprived areas).

## Statistical methods

All survey data were weighted to account for the sampling design. In the first stage of analysis, descriptive statistics were reported. In the second stage, the association between hazardous drinking with any past year GP visit was examined using chi-square analyses, and reported with 95% confidence levels.

The association of hazardous drinking with any past year GP visit was examined in sub-groups based on age, sex and ethnicity to examine whether the effect of hazardous drinking on GP visits differed in relation to these sociodemographic variables. Post-hoc analyses examined whether the association between hazardous drinking and any GP visit differed in relation to socioeconomic deprivation. Chi-square analyses of subgroups were undertaken given the categorical nature of the data and ease of interpretation.

Analyses were undertaken using Stata Version 15 (StataCorp, College Station, Texas, US).

# Results

## Sample characteristics

Of the 13,598 adults aged 15+ years who took part in the survey, just over half were female (51.27%). Approximately two-thirds of survey participants were aged 25–64 years (17.54% 15–24; 32.49% 25–44; 31.34% 45–64; 18.64% 65+ years).

In total, 12.88% of participants identified as Māori (5.18% Pacific, 12.54% Asian and 69.40% New Zealand European/Other).

Overall, one in five (19.52%) adults met hazardous drinking criteria (AUDIT 8+; 1.34% AUDIT 20+) and 12.07% had used one or more other substances in the past year.

## GP visits

At a population level, no association between hazardous drinking and greater or lesser rates of past year GP visits were found (see Table 1). In total, 76.54% of people who met hazardous drinking criteria had visited a GP in the past year and 77.60% of safer drinkers.

**Table 1:** Relationship between hazardous drinking (AUDIT 8+) and sociodemographic variables with any GP visit in the past year, N=13,598.

| | **Any GP visit in the past year (%)** | | |
|---|---|---|---|
| | **Yes (n=10,859)** | **No (n=2,727)** | **p value (Chi-square)** |
| **Hazardous drinking (AUDIT 8+)** | | | |
| Yes (n=2,526) | 76.54% [74.27, 78.68] | 23.46% [21.32, 25.73] | |
| No (n=10,938) | 77.60% [76.41, 78.74] | 22.40% [21.26, 23.59] | .39 |
| **Age group** | | | |
| 15–24 (n=1,558) | 65.96% [62.78, 69.00] | 34.04% [31.00, 37.22] | |
| 25–44 (n=4,344) | 70.55% [68.68, 72.34] | 29.45% [27.66, 31.32] | |
| 45–64 (n=4,334) | 81.28% [79.77, 82.69] | 18.72% [17.31, 20.23] | |
| 65+ (n=3,350) | 93.20% [91.84, 94.35] | 6.80% [5.65, 8.16] | <.001 |
| **Sex** | | | |
| Male (n=5,833) | 72.70% [71.01, 74.32] | 27.30% [25.68, 28.99] | |
| Female (n=7,753) | 81.73% [80.52, 82.88] | 18.27% [17.12, 19.48] | <.001 |
| **Ethnicity** | | | |
| Māori (n=2,745) | 72.81% [70.32, 75.16] | 27.19% [24.84, 29.68] | |
| Non-Māori (n=10,841) | 78.00% [76.85, 79.11] | 22.00% [20.89, 23.15] | <.001 |

Note: Values insides the brackets [ ] represents the 95% confidence intervals.

**Table 2:** Association between hazardous drinking (AUDIT 8+) and any GP visit in the past year in relation to age, sex and ethnicity, N=13,598.

| | **Percentage (%) of GP visits in past year across age groups** | | | |
|---|---|---|---|---|
| | **15–24** | **25–44** | **45–64** | **65+** |
| | (n=1,559) | (n=4,352) | (n=4,336) | (n=3,351) |
| **Māori males** | | | | |
| AUDIT 8+ (n=398) | 48.03% [34.94, 61.40] | 65.00% [55.35, 73.56] | 85.17% [76.19, 91.15] | 91.43% [73.53, 97.61] |
| AUDIT <8 (n=672) | 51.05% [39.38, 62.61] | 65.12% [56.15, 73.13] | 77.34% [68.69, 84.15] | 95.79% [90.04, 98.29] |
| | p=.74 | p=.98 | p=.16 | p=.35 |
| **Māori females** | | | | |
| AUDIT 8+ (n=408) | 67.28% [54.38, 78.00] | 71.85% [64.30, 78.34] | 78.94% [69.12, 86.26] | 96.18% [83.41, 99.21] |
| AUDIT <8 (n=1,226) | 72.64% [64.53, 79.49] | 74.12% [68.57, 79.00] | 84.43% [79.55, 88.31] | 91.61% [85.17, 95.41] |
| | p=.45 | p=.61 | p=.23 | p=.33 |
| **Non-Māori males** | | | | |
| AUDIT 8+ (n=1,150) | 70.09% [60.31, 78.33] | 69.67% [64.43, 74.45] | 79.85% [74.92, 84.03] | 95.02% [90.74, 97.38] |
| AUDIT <8 (n=3,553) | 57.33% [51.17, 63.26] | 57.77% [53.97, 61.48] | 79.71% [76.59, 82.51] | 94.42% [92.40, 95.93] |
| | p<.05 | p<.001 | p=.96 | p=.75 |
| **Non-Māori females** | | | | |
| AUDIT 8+ (n=570) | 83.63% [73.45, 90.42] | 83.07% [76.25, 88.24] | 91.58% [86.28, 94.96] | 87.88% [68.47, 96.04] |
| AUDIT <8 (n=5,487) | 73.15% [67.81, 77.89] | 79.19% [76.71, 81.47] | 81.50% [79.13, 83.66] | 92.31% [90.00, 94.12] |
| | p=.056 | p=.26 | p=.001 | p=.42 |

Note: Values insides the brackets [ ] represents the 95% confidence intervals.

There were statistically significant associations between GP visits with age, sex and ethnicity (see Table 1). GP visits were lowest in the 15–24 age group (65.96%) and increased with age. Nearly all adults aged 65+ years had visited a GP in the past year (93.20%). The proportion of females visiting a GP was higher (81.73%) than males (72.70%). Over three-quarters of non-Māori (78.00%) had accessed a GP and 72.81% of Māori.

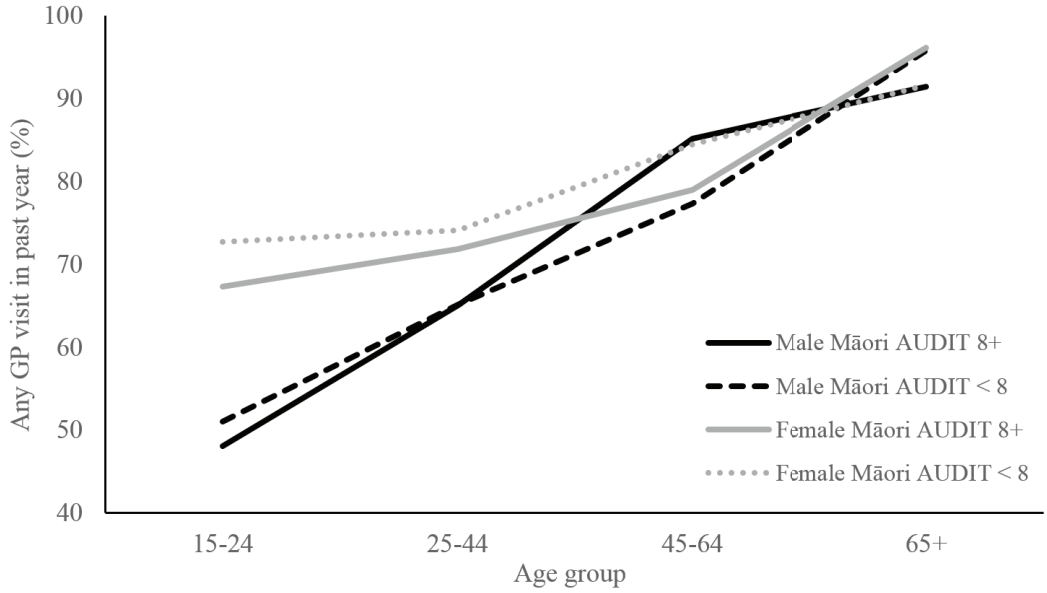
## Effects of age, sex and ethnicity

Sub-group analyses were undertaken to determine whether the association between hazardous drinking and any GP visit differed in relation to age, sex or ethnicity.

Table 2 indicates GP visits tended to increase with age for both males and females. Among people aged under 45 years who met hazardous drinking criteria, GP visits were greater among females than males.

*Māori males*. Across all age groups, no associations between hazardous drinking and any GP visit were found for Māori males. That is, GP visits for Māori males were similar for those who did and did not meet hazardous drinking criteria. Overall, Māori males aged 15–24 years were least likely to have visited a GP in the past year regardless of drinking behaviour (see Figure 1) (48.03% hazardous drinking; 51.05% safer drinking).

**Figure 1:** Association between hazardous drinking (AUDIT 8+) and any GP visit in the past year among Māori males and females across different age groups.




*Māori females*. Figure 1 indicates GP visits were similar among Māori females who met hazardous drinking criteria and those who did not across all age groups.

*Non-Māori males*. Among non-Māori males aged under 45, a significantly greater proportion of people who met hazardous drinking criteria had visited a GP in the past year than safer drinkers (approximately 70% and 57% respectively). Among non-Māori males aged over 45, no association between hazardous drinking and GP utilisation was found (see Figure 2).

*Non-Māori females*. Like non-Māori males, a greater proportion of non-Māori females aged 15–24 and 45–64 years who met hazardous drinking criteria had visited a GP than safer drinkers (see Figure 2). Among non-Māori females aged 15–24 years who met hazardous drinking criteria, 83.63% had visited a GP compared to 73.15% of safer drinkers (91.58% and 81.50% respectively among non-Māori females aged 45–64 years). No significant association between hazardous drinking and GP utilisation was found among non-Māori females aged 25–44 and 65+ years.

**Figure 2:** Association between hazardous drinking (AUDIT 8+) and any GP visit in the past year among non-Māori males and females across different age groups.

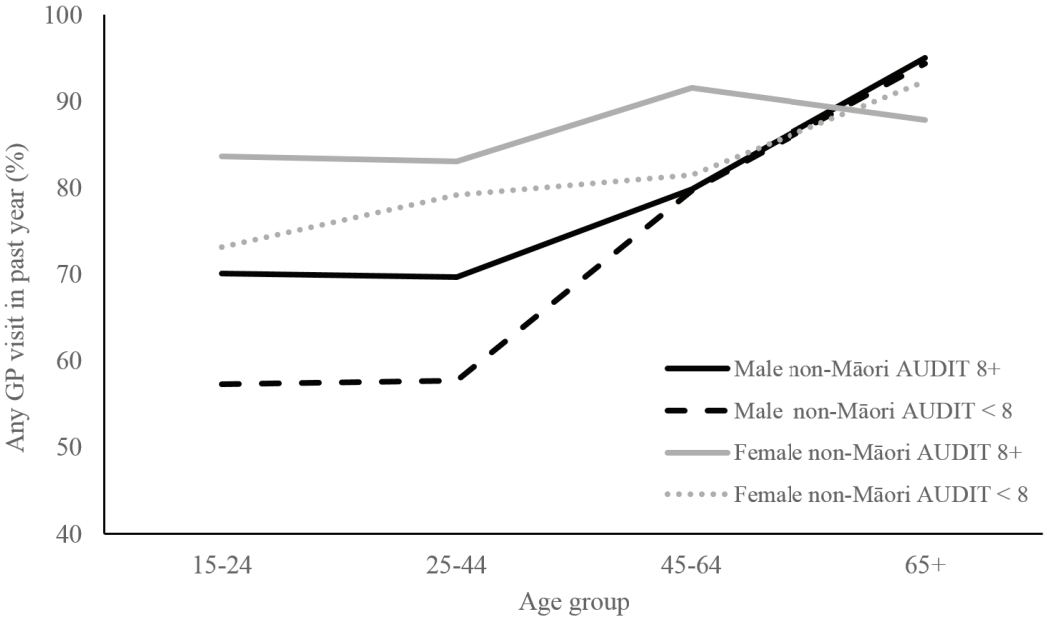
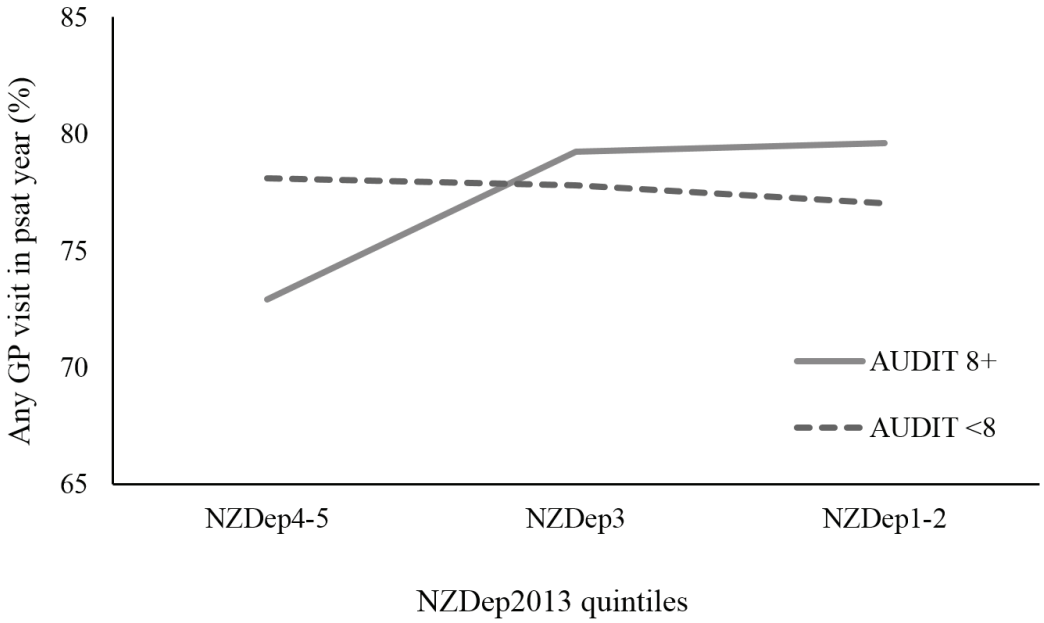


**Figure 3:** Association between hazardous drinking (AUDIT 8+) and any GP visit past year across socioeconomic deprivation quintiles.




In summary, no associations between hazardous drinking and GP visits for Māori were found. For non-Māori, there was a positive association between hazardous drinking and GP visits for some age and sex groups.

### Post-hoc analyses

Post-hoc analyses examining the impact of socioeconomic deprivation on the association between hazardous drinking and GP visits showed 72.92% [69.78, 75.85] of people living in more deprived areas (NZDep2013 quintiles 4 and 5) who met hazardous drinking criteria had visited a GP, compared to 78.11% [76.41, 79.71] of people drinking at safer levels, $p<.01$ (see Figure 3). That is, GP visits among people living in more deprived areas who met hazardous drinking criteria were lower than those drinking at safer levels.

## Discussion

### Key findings

The main finding is the association between hazardous drinking and any past year GP visit depends on sociodemographic variables including age, sex and ethnicity.

GP visits among people who did and did not meet hazardous drinking criteria increased with age and tended to be higher among females than males, especially among people aged under 45 years.

Māori people who met hazardous drinking criteria were less likely to have visited a GP in the past year than non-Māori in the same demographic groups, particularly males aged under 45 and females under 65 years. Among young people aged 15–24 years who met hazardous drinking criteria, 48.03% of Māori males had accessed a GP and 70.09% of non-Māori males (67.28% and 83.63% for Māori and non-Māori females respectively). Young Māori males had the lowest rate of GP visits overall, irrespective of drinking behaviour, with only about half visiting a GP in the past year.

When looking at the influence of hazardous drinking within ethnic groups, results differed for age and sex groups. For Māori, GP visits were similar for people who met hazardous drinking criteria and those who did not. In contrast, GP visits were higher for some non-Māori groups who met hazardous drinking criteria. Among non-Māori males aged under 45 years, and females aged 15–24 and 45–64 years, GP visits were 10–13 percentage points *higher* among people who met hazardous drinking criteria than safer drinkers.

Post-hoc analyses demonstrated that in more deprived areas, the percentage of GP visits were lower among people who met hazardous drinking criteria than safer drinkers.

## Limitations

The analyses were not designed to directly compare results for Māori and non-Māori people—findings reported are descriptive only. While deprivation was examined, the descriptive results do not control for this and may partly explain the lower proportion of GP visits among younger Māori people in particular.

While some within group differences were specifically tested, other nuanced differences likely exist. For example, it would be useful to examine the association between hazardous drinking and GP visits among Māori males and females living in more deprived areas in future research. Non-Māori also included multiple ethnic groups, including Asian people who tend to access GPs at a lower rate than non-Asian people.[3]

Further analysis of sub-population groups in the current study was limited by the available sample sizes. Future studies should consider combining several years of NZHS data to enable further insights into subpopulations at greatest risk. GP visits are currently examined by the NZHS, rather than broader primary care use, which would be usefully examined in future health surveys.

## Implications for improving access to primary care for Māori

Results highlight the need to reduce inequalities and improve access to GP services by Māori people, and people living in more deprived areas. The low rate of GP visits among young Māori males is particularly concerning given alcohol is the leading cause of mortality among adults aged under 50 years, primarily due to road injuries and self-harm.[1]

The *Wai2575 Māori Health Trends Report* shows Māori adults are generally more likely to have unmet needs and less likely to see a GP than non-Māori, and that this pattern has not changed much over the last 10 years.[13] Access to healthcare is a key contributing factor in health inequalities. The poor access to primary care by Māori is considered a key factor in the higher rates of illness and hospitalisations for Māori and in generating poorer health outcomes.[14] The strategies used so far to improve health inequalities for Māori have not worked and there is a need to prioritise implementation of new approaches that make a difference.

A range of approaches to improve access to primary care for Māori have been recommended, including addressing individual barriers (eg, choice of appointment times, transport and cost); enhancing existing services (eg, communication skills, addressing racism and health professional attitudes, tailoring health promotion messages, cultural responsiveness and workforce representativeness); and increasing the availability of services in other settings acceptable to Māori (such as kaupapa Māori and community services).[15,16] Greater engagement with Māori may be supported through building relationships with local communities and enhancing cultural competency of the health workforce.

The finding that young Māori males are least likely to visit a GP has significant implications on how to reach this group. Moreover, while young non-Māori (of both genders) who drink hazardously are more likely to visit a GP compared to safer drinkers, the results differ for Māori. Young Māori males and females who drink hazardously visit a GP at the same level, or potentially even less, than safer drinkers. While the reasons for this cannot be explained by NZHS data, findings point to the need for public health approaches to reach young Māori. A multi-pronged approach that supports both prevention and early intervention is required to increase equity in access and outcomes for Māori.

At a policy level it is important that budget announcements to invest NZ$455.1 million in primary health over the next five years (see www.treasury.govt.nz) include kaupapa Māori and other cultural services, and that these services also support people with alcohol and other drug issues, alongside mental health needs. Commitment from the government and health services to improving health equity is also important, along with local initiatives and plans, and new workforce roles to improve access and outcomes for Māori. The principles of partnership with Māori, mana motuhake, and active protection are also key to ensuring decision-making involves Māori communities, hapū and iwi, and that solutions are developed that work for Māori.

## Implications for enhancing responses to hazardous alcohol use in existing primary care services

While GP visits may be for a range of reasons, for people who access these services, this might be an appropriate setting for the provision of screening and brief intervention for hazardous alcohol use.[17]

*Screening*. Alcohol screening in general practice settings is not yet routine practice in New Zealand and is a missed opportunity to recognise and provide early healthcare support and advice.[18] To ensure early identification of people who access GP services, it is recommended that annual screening be undertaken for people aged 15–25 years, and five yearly screening for those aged 35 years and over.[19] Given time pressures on GPs, it is appropriate that practice nurses and other health practitioners take on the role of screening.[20] For screening to be routinely offered, ongoing training and mentoring is needed to maintain health practitioners' awareness, confidence and skills, along with ongoing support for implementation.

Primary health services need to ensure both Māori and non-Māori people are screened for hazardous alcohol use. Some evidence suggests alcohol screening in health services is less likely among Māori people.[21]

*Brief interventions and referrals*. While evidence for the efficacy of brief alcohol interventions is modest,[22] even small reductions in alcohol use can have a positive impact on people's physical health and wellbeing.[23] Moreover, brief interventions have the potential to be feasibly and widely implemented in primary care and other community settings.[21] As with screening, ongoing training and development in brief interventions is required to ensure knowledge and skills are developed and maintained in practice. Where people may require additional support, referral to an addiction practitioner or specialist alcohol and other drug service, is part of a stepped-care approach.[21]

It is important that culturally appropriate screening and brief intervention options are available for Māori. This may require the development of different strategies for Māori that include cultural adaptations of standard screening and brief intervention approaches, and development of co-designed eHealth tools.[24, 25] For example, Takitaki Mai is a cultural adaptation of motivational interviewing which incorporates pōwhiri processes to support engagement with Māori and their whānau.[26] There is also a need to develop primary health roles that work outside the GP context, such as people working in Whānau Ora and those engaged in assertive outreach with kaupapa Māori health and social services.[24,25] Initiatives centred on values such as mana and whanaungatanga, that recognise and respond to whānau, can also help maximise positive outcomes for Māori.

*Other strategies.* While three-quarters of people meeting hazardous drinking criteria visited a GP in the past year, it may be the case that alcohol-related issues were not raised in discussions given many people fear others' reactions and experience self-stigma.[17] Educational programmes, as well as organisational values and policies can help reduce alcohol-related stigma among primary health workers.[27]

A range of non-stigmatising information needs to be available for people wanting to reduce their substance use including self-help strategies and advice on where to go for help.[28,29] Information needs to be tailored and relevant to different population groups, including young Māori males. Access to addiction and mental health literacy programmes may also be important, particularly among younger males.[30] Health literacy information targeting parents and other whānau members which provides information on the harms of hazardous drinking and what to do to keep youth safe is also important.

## Future research

While the impact of sociodemographic variables on the relationship between hazardous drinking and GP visits were examined in this study, and should be included in future analyses, GP utilisation may depend on other factors that require further examination. This study examined any past year GP visit and results may differ for the frequency of GP use. A better understanding of why some people, particularly young Maori, are less likely to access GPs is also required as this has important implications for interventions going forward.

Future research may usefully examine the impact of alcohol use disorders as indicated by AUDIT scores over 20, as well as the reason for GP visits which may be related to long-term health conditions, substance use or mental health issues. Moreover, the outcomes of primary care interventions aimed at addressing alcohol issues for Māori should be examined, as well as barriers and enablers to access, particularly for younger people.

# Conclusions

Using data from the NZHS, this paper helps highlight priority areas in responding to the one in five people who meet criteria for hazardous drinking each year. To provide effective primary health responses to Māori, particularly younger people, who meet hazardous drinking criteria, there is a need to ensure services are designed and delivered in culturally responsive ways to enhance engagement and provided in a range of settings.

For people who do access GP services, this is an important first point of contact with the healthcare system and opportunities exist for the adoption of routine alcohol screening and brief interventions to improve health outcomes.

Attention is also required to improve GP access for people living in more deprived areas.

Multiple strategies need to be prioritised to achieve equity in service access to support people at risk of hazardous drinking. This includes developing and implementing new approaches that make a difference, addressing individual barriers to service access, enhancing existing primary care services (eg, screening, brief interventions and workforce development), the availability of services in other settings that are acceptable to Māori, and broader health promotion as part of a multi-pronged approach supporting both prevention and early intervention.

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# Lipid monitoring in a community cohort of people taking statins: who is tested and is testing associated with subsequent alteration in therapy?

Harrison Beadel, Andrew Halim, Paul Bridgford, Ben Hudson


## ABSTRACT

**AIM:** To describe patterns of community lipid testing and subsequent therapeutic alteration in a cohort of patients taking statins.

**METHOD:** We conducted a population-based cohort study. Our cohort comprised all people enrolled with a general practice in the Pegasus Health primary care network in Canterbury, New Zealand between 1 January 2016 and 31 December 2017 who were dispensed a statin between 1 January 2016 and 30 June 2016. We defined two six-month study periods: a baseline period (1 January to 30 June 2016) and a follow-up period (1 July to 31 December 2017). We identified statin dispensings for all people in our cohort in both study periods, and identified instances of lipid testing in the 12 months following each person's most recent baseline period dispensing. We examined the effect of gender, ethnicity and socioeconomic deprivation on the likelihood of lipid testing; and compared frequency of alteration of statin dose or type among tested and non-tested people.

**RESULTS:** Data were available for analysis for 32,943 individuals who were dispensed a statin in the baseline period. Lipid testing was performed in 16,199 (49.2%) of individuals. Women were less likely to have been tested than men (OR 0.87, 95% CI 0.83–0.91). Compared to those with European ethnicity, testing was more likely for Māori (OR 1.20, 95% CI 1.07–1.34), Pacific (OR 1.22, 95% CI 1.03–1.44) and Asian (OR 1.41, 95% CI 1.25–1.59) individuals. Socioeconomic deprivation was associated with reduced testing (OR 0.80, 95% CI 0.74–0.87). Dose or type of statin dispensed was altered between baseline and follow-up study periods in 3,762 (23.2%) of those who were tested, and in 3,122 (18.6%) of those who were not tested (OR 1.32, 95% CI 1.25–1.39).

**CONCLUSION:** Almost half (49.1%) of patients had a lipid test within 12 months of baseline period statin dispensing. Lipid testing was more likely for Māori, Pacific and Asian patients than for European patients. Testing was less likely for women and for those with greater socioeconomic deprivation. Subsequent statin therapy alteration was slightly more likely for those who had been tested than for those who had not.


Cardiovascular disease (CVD) is a leading cause of morbidity and mortality,[1] and CVD risk assessment and management have become routine primary care activities.[2,3] Dyslipidaemia is one of several modifiable risk factors for CVD, and measurement of a person's lipid profile is a core component of CVD risk estimation. People with established CVD, and those at increased CVD risk, may be offered treatment with a statin, a class of lipid-lowering medication with strong evidence for CVD risk reduction in both primary and secondary prevention.[4,5] Statins are very widely used: in New Zealand in 2016 atorvastatin was the third most prescribed medicine with 1.34 million

prescriptions,[6] and in the US in 2012–2013, 27.8% of over 40-year-olds and 47.8% of those aged 65–74 years received a statin.[7] In Canterbury in 2017, statins were dispensed to 32.6% of men and 20.5% of women aged 50 and over.

Most clinical guidelines advise lipid monitoring for patients taking statins, though the recommended testing interval is often unclear.[8] There is a lack of empirical evidence to guide optimal testing frequency, but modelling suggests annual monitoring may be cost-effective, and clinical guidelines in New Zealand, the UK and the US suggest at least annual monitoring for patients established on a statin.[2,3,9,10]

Managing test results takes up a significant amount of clinicians' time. A US study from 2004 found that primary care physicians spent an average of 37 minutes reviewing test results per half day of patient consulting.[11] Primary care test use, including lipid monitoring, has increased in recent years and a significant proportion of lipid testing may be inappropriate.[12–14] Despite the large volume of lipid monitoring for patients taking statins, there is little evidence describing how primary care physicians approach lipid monitoring for these patients. This study aimed to describe patterns of community lipid testing and subsequent therapeutic alteration in patients established on statin therapy.

# Methods

## Setting

The study was conducted in Canterbury, New Zealand. We defined two six-month study periods: a baseline period (1 January to 30 June 2016) and a follow-up period (1 July to 31 December 2017). Dispensing data were obtained for both study periods, and lipid testing data were obtained in the 12 months following each patient's most recent baseline period statin dispensing.

## Participants

Data were collected for all patients enrolled at a general practice within the Pegasus Health primary care network between 1 January 2016 and 31 December 2017 who were dispensed a statin in the baseline study period.

## Variables

The study outcome was defined as alteration in dispensed statin type or dose. Exposure was defined as a participant undergoing a lipid test within 12 months of their most recent baseline period statin dispensing. We examined the effect of gender, age, ethnicity, socioeconomic deprivation and baseline statin type on likelihood of receiving a lipid test.

## Data sources

We accessed data maintained by the New Zealand Ministry of Health and by Pegasus Health (Charitable) Limited, a primary health organisation (PHO) based in Canterbury, New Zealand. Pegasus Health oversees funding and provides support for 92 primary care centres in the Canterbury region. In July 2017, 416,628 patients were enrolled in Pegasus Health general practices.

Every person who uses a health service in New Zealand is assigned a unique National Health Index number (NHI number). We used encrypted NHIs (eNHIs) to match patient information from separate databases containing enrolled patient data, dispensing data and laboratory test data. Patient enrolment data include patient demographics and are maintained by PHO registers. Dispensing data were retrieved from the Ministry of Health's Pharmaceutical Collection, a data warehouse that contains claim and payment information for all publicly funded drugs dispensed through community pharmacies in New Zealand. Laboratory test data were accessed from the Ministry of Health's Laboratory Collection.

We used the New Zealand small-area index of relative socioeconomic deprivation (NZDep) as a measure of cohort members' socioeconomic status.[15] This index is based on nine deprivation variables that are collected as part of the New Zealand national census. NZDep scores are mapped to geographic areas which have a median population of 90 individuals. We used our participants' home addresses to assign each an NZDep score.

## Data collection

First, we identified all patients enrolled in Pegasus PHO registers from 1 January 2016 through to 31 October 2017. As these

registers are updated each quarter, this cohort only includes patients who were enrolled throughout all of 2016 and 2017 (the duration of the study period). For these patients, demographic information including date of birth, gender, prioritised ethnicity and deprivation quintile of the patient's residence was collected.

The eNHIs of this cohort were cross-matched with dispensing data to find all patients who were dispensed a statin in the baseline period. We searched for those statins that were publicly funded during the study period (atorvastatin, pravastatin and simvastatin) using their chemical IDs. For each individual, the latest dispensing date within the baseline period was recorded, along with the statin type and dose dispensed. We designated this as the initial dispensing date.

The eNHIs of this cohort were then cross-checked with laboratory test data to identify instances of lipid profile measurement for each cohort member in the 12 months following their initial dispensing date.

The eNHIs were then cross-checked with dispensing data to identify statins dispensed in the follow-up period. The latest dispensing date in the follow-up period was recorded, along with the statin and dose dispensed. We designated this the final dispensing date.

### Study size

We did not determine a sample size *a priori* as we were unable to identify prior studies on which to base such a calculation. Instead we took a pragmatic approach and identified all individuals dispensed a statin in a six-month period.

### Statistical methods

Summary statistics (means, SD and percentages) were used to describe the baseline characteristics of our cohort. We calculated unadjusted odds ratios (ORs) for receiving lipid tests. Binomial logistic regression with covariate adjustment was used to calculate ORs for each variable's contribution to receipt of lipid testing. Unadjusted ORs were used to describe statin dose adjustment for each variable of interest.

### Ethics approval

Ethics approval was granted by the University of Otago Human Ethics Committee for Health (HD18/081).

## Results

### Participants

We identified 34,408 people who had been dispensed a statin at least once in the baseline period. We excluded 1,465 of these people (1,459 due to missing statin dose data, and six due to multiple statin type dispensing) (Figure 1). Data were therefore available for analysis for 32,943 individuals (Table 1). For comparison, we also present demographics for the total enrolled adult (aged >18 years) population at the beginning of the baseline study period (1 January 2016) (Table 2).

### Who gets tested?

In the 12 months following their initial dispensing date, lipid testing was carried out in 16,199 (49.2%) individuals.

After adjusting for age, gender, ethnicity, statin type and dose, and socioeconomic deprivation, women were less likely to have been tested than men (OR 0.87, 95% CI 0.83–0.91). Lipid testing was more likely for Māori (OR 1.20, 95% CI 1.07–1.34), Pacific (OR 1.22, 95% CI 1.03–1.44) and Asian (1.41, 95% CI 1.25–1.59) patients than for European patients. Testing was less likely among those in the most deprived quintile compared to those in the least deprived quintile (adjusted OR 0.80, 95% CI 0.74–0.87) (Table 3).

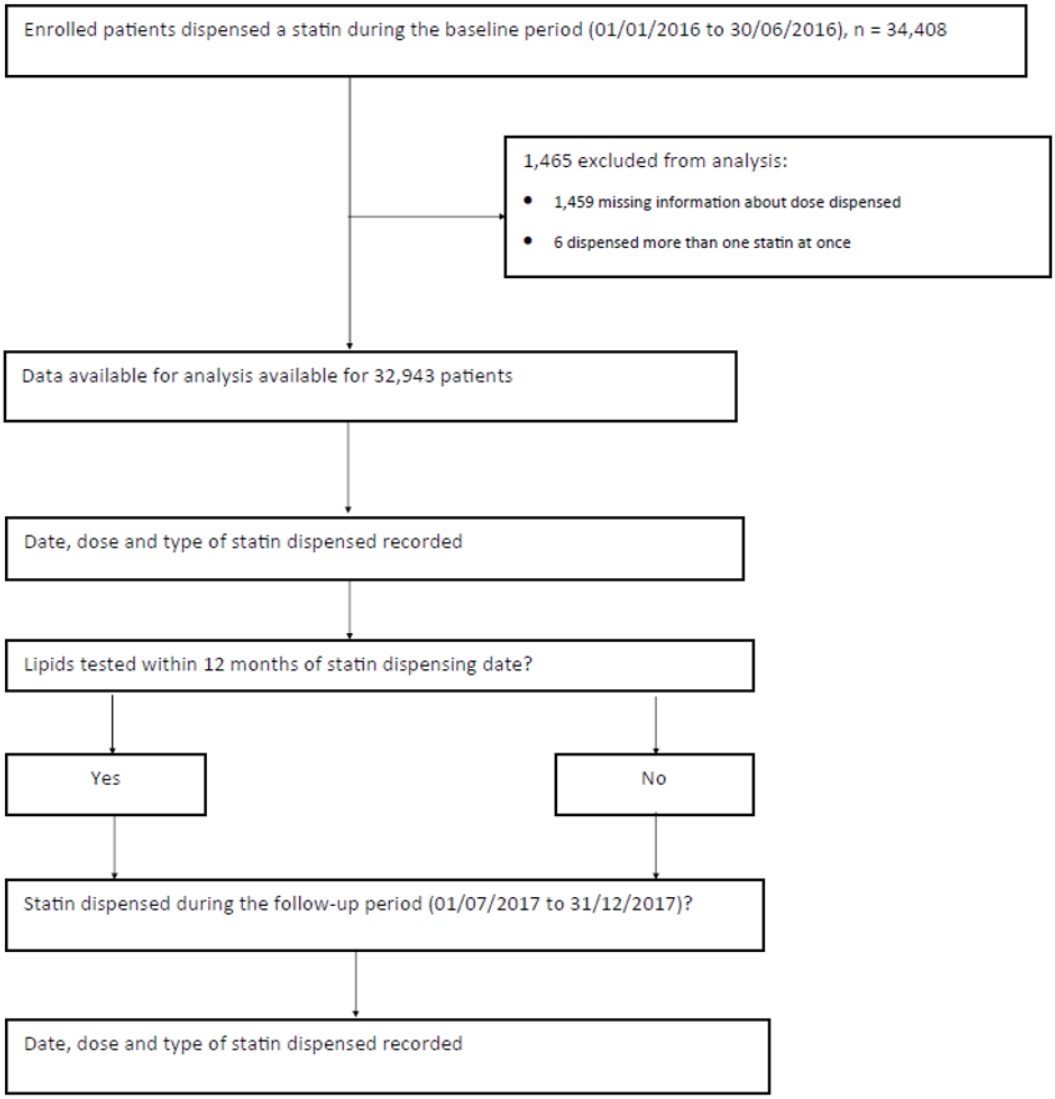
Atorvastatin was the commonest statin type dispensed in both the baseline and follow-up study periods. Compared to those dispensed atorvastatin at baseline, testing was more likely for individuals dispensed pravastatin (56.6% vs 50.6%; OR 1.28, 95% CI 1.03–1.60), and less likely for those dispensed simvastatin (46.5% vs 50.6%; OR 0.94, 95% CI 0.90–0.98).

### Lipid testing and subsequent statin alteration

The majority (29,768/32,943 [90.4%]) of our cohort remained on a statin in the follow-up period. Among these individuals, statin dose or type was altered between baseline and follow-up study periods for 6,884 (20.9%). Of those who had a lipid test 23.2% had a subsequent alteration in their statin therapy compared to 18.6% of those who were not tested (OR 1.32, 95% CI 1.25–1.39) (Table 4).

Of those whose statin therapy was altered, the commonest change was a switch to a different statin type: 12.8% of those tested

**Figure 1:** Enrolled patients dispensed a statin during the baseline period (1 January 2016 to 30 June 2016), n=34,408.




vs 13.5% of those not tested (OR 0.94, 95% CI 0.88–1.00). Statin doses were increased more frequently among those who were tested than those who weren't: 8.4% vs 3.3 % (OR 2.68, 95% CI 2.42–2.97) (Table 5).

# Discussion

## Key results

In this cohort of patients taking a statin almost half (49.1%) of patients had a lipid test within 12 months of baseline period statin dispensing. Lipid testing was more likely for Māori, Pacific and Asian patients than for European patients. Testing was less likely for women and for those with greater socioeconomic deprivation. Subsequent statin therapy alteration was slightly more likely for those who had been tested than for those who had not.

## Strengths and limitations

Our cohort was large and included all patients dispensed a statin during the baseline study period. This approach minimised selection bias. Our dispensing data were sourced from the Ministry of Health Pharmaceutical Collection. This collection records all community pharmacy claims for reimbursement and so is a reliable source of dispensing data. Similarly, our laboratory data were sourced from the regional Laboratory Collection which records all instances of community-requested laboratory use.

**Table 1:** Study cohort baseline population characteristics.

| | Lipid test performed (%) | Lipid test not performed (%) | Total (%) |
|---|---|---|---|
| | 16,199 | 16,744 | 32,943 |
| Mean (sd) age in years | 65.1 (10.6) | 68.6 (11.9) | 66.9 (11.4) |
| **Gender** | | | |
| Female | 6,022 (37.2) | 7,055 (42.1) | 13,077 (39.7) |
| Male | 10,177 (62.8) | 9,689 (57.9) | 19,866 (60.3) |
| **Prioritised ethnicity** | | | |
| Māori | 746 (4.6) | 606 (3.6) | 1,352 (4.1) |
| Pacific | 324 (2.0) | 261 (1.6) | 585 (1.8) |
| Asian | 700 (4.3) | 483 (2.9) | 1,183 (3.6) |
| Other | 198 (1.2) | 130 (0.8) | 328 (1.0) |
| European | 13,482 (83.2) | 14,635 (87.4) | 28,117 (85.4) |
| Unknown | 749 (4.6) | 629 (3.8) | 1,378 (4.2) |
| **Deprivation quintile** | | | |
| 1 (Least deprived) | 5,945 (36.7) | 5,622 (33.6) | 11,567 (35.1) |
| 2 | 3,365 (20.8) | 2,515 (21.0) | 6,880 (20.9) |
| 3 | 2,807 (17.3) | 2,896 (17.3) | 5,703 (17.3) |
| 4 | 2,361 (14.6) | 2,828 (16.9) | 5,189 (15.8) |
| 5 (Most deprived) | 1,441 (8.9) | 1,599 (9.5) | 3,040 (9.2) |
| Unknown | 280 (1.7) | 284 (1.7) | 564 (1.7) |
| **Initial statin** | | | |
| Atorvastatin | 10,494 (64.8) | 10,256 (61.3) | 20,750 (63.0) |
| Pravastatin | 192 (1.2) | 147 (0.9) | 339 (1.0) |
| Simvastatin | 5,513 (34.0) | 6,341 (37.9) | 11,854 (36.0) |
| **Mean (sd) dose (mg)** | | | |
| Atorvastatin | 32.0 (20.2) | 32.1 (20.1) | 32.1 (20.2) |
| Pravastatin | 25.6 (9.0) | 25.9 (13.6) | 25.7 (11.2) |
| Simvastatin | 28.5 (13.8) | 29.7 (14.9) | 29.2 (14.4) |

All data are n (%) unless stated otherwise.

However, we will not have captured self-funded tests, inpatient tests, point of care tests or tests performed outside Canterbury.

We collected dispensing data rather than prescribing data, and similarly test completion rather than test request data. Thus we may have missed some instances where a clinician had requested a test but the test was not performed, and some instances where a prescription was issued but not dispensed. Our findings may not, therefore, represent the totality of clinicians' practice.

We were unable to identify dispensing of non-funded statins, as these are not recorded in the Pharmaceutical Collection.

**Table 2:** Enrolled adult (age >18yrs) population at 1 January 2016.

| | |
|---|---|
| Mean (sd) age in years | 48 (18.3) |
| **Gender** | |
| Female | 158,590 (52.2) |
| Male | 145,528 (47.9) |
| Total | 304,118 (100) |
| **Prioritised ethnicity** | |
| Māori | 19,317 (6.4) |
| Pacific | 6,703 (2.2) |
| Asian | 20,867 (6.9) |
| Other | 4,764 (1.6) |
| European | 252,003 (82.9) |
| Unknown | 464 (0.2) |
| **Deprivation quintile** | |
| 1 (Least deprived) | 101,027 (33.2) |
| 2 | 64,182 (21.1) |
| 3 | 53,869 (17.7) |
| 4 | 49,197 (16.2) |
| 5 (Most deprived) | 28,773 (9.5) |
| Unknown | 7,070 (2.3) |

All data are n (%) unless stated otherwise.

However, at the time of data collection this would only have been relevant for patients taking rosuvastatin.

We were unable to identify patients' lipid level results, so we could not comment on associations between lipid profiles and subsequent statin adjustment. This would be a useful area for further research.

All members of our cohort were enrolled during both the baseline and follow-up periods which eliminated loss to follow-up. This approach may, however, have introduced selection bias. For example, if those more likely to move or not attend primary care and hence become un-enrolled between the study periods are less likely to undergo testing, then we may have over-estimated testing frequency.

## Comparison with other studies

Māori and Pacific people suffer earlier onset of CVD and higher CVD mortality than the non-Māori/non-Pacific population in New Zealand, and this may in part be linked with reduced access to primary care for these populations.[16] We found slightly higher rates of lipid monitoring for Māori and Pacific people than for European patients, which may indicate good levels of clinical engagement; however, only those patients already dispensed a statin were included in this study, which limits any conclusions we may draw about equity of access to care. Our finding of lower frequency of lipid testing for people on a statin with lower socioeconomic status may indicate reduced access to primary healthcare among this population, though socioeconomic status has previously not been found to be linked to reduced use of secondary prevention medication for CVD in New Zealand.[17] In New Zealand, lipid testing requested by a clinician has no out-of-pocket cost for patients, but the cost of accessing primary care, or taking time from work, may be barriers to testing for those on a low income.

**Table 3:** Predictors of lipid testing.

| | Lipid test carried out (%) | Adjusted OR (95% CI) |
|---|---|---|
| **Gender** | | |
| Male | 10,177 (51.2) | 1 |
| Female | 6,022 (46.1) | 0.87 (0.83–0.91) |
| **Prioritised ethnicity** | | |
| European | 13,482 (47.9) | 1 |
| Māori | 746 (55.2) | 1.20 (1.07–1.34) |
| Pacific | 324 (55.4) | 1.22 (1.03–1.44) |
| Asian | 700 (59.2) | 1.41 (1.25–1.59) |
| Other | 198 (60.4) | 1.45 (1.16–1.82) |
| Unknown | 749 (54.4) | 1.08 (0.97– 1.21) |
| **Deprivation quintile** | | |
| 1 (Least deprived) | 5,945 (51.4) | 1 |
| 2 | 3,365 (48.9) | 0.94 (0.88–0.99) |
| 3 | 2,807 (49.2) | 0.93 (0.88–1.00) |
| 4 | 2,361 (45.5) | 0.80 (0.75–0.86) |
| 5 (Most deprived) | 1,441 (47.4) | 0.80 (0.74–0.87) |
| Unknown | 280 (49.6) | 0.95 (0.80–1.12) |
| **Initial statin** | | |
| Atorvastatin | 10,494 (50.6) | 1 |
| Pravastatin | 192 (56.6) | 1.28 (1.03–1.60) |
| Simvastatin | 5,513 (46.5) | 0.94 (0.90–0.98) |

**Table 4:** Changes in statin therapy.

| **Therapy altered n (%)** | | **Statin therapy altered** | |
|---|---|---|---|
| | | **OR (95% CI)** | |
| **Lipid testing** | **Tested** | 3,762 (23.2) | 1.32 (1.25– 1.39) |
| | **Not tested** | 3,122 (18.6) | 1 |

**Table 5:** Types of statin alteration.

| | | **Statin alteration type** | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Decreased dose** | | **Increased dose** | | **Statin type altered** | |
| | | **n (%)** | **OR (95% CI)** | **n (%)** | **OR (95% CI)** | **n (%)** | **OR (95% CI)** |
| **Lipid testing** | **Tested** | 327 (2.0) | 1.10 (0.94–1.29) | 1,355 (8.4) | 2.68 (2.42–2.97) | 2,080 (12.8) | 0.94 (0.88–1.00) |
| | **Not tested** | 307 (1.8) | 1 | 551 (3.3) | 1 | 2,264 (13.5) | 1 |

## Implications for clinical practice and future research

Our findings suggest that adherence to national guidance (which advises annual lipid testing for patients taking statins) is limited, and that alteration in statin therapy is only slightly more frequent among those who have a lipid test than in those who are not tested.

A cautious approach by primary care clinicians to current guidance recommending annual lipid testing may be justified as there is very little evidence to guide frequency of lipid testing in these patients, or indeed to confirm the superiority of treat-to-target over fixed-dose statin prescribing.

Observational studies and observational data from RCTs suggest that, for patients taking statins, CVD risk is reduced in proportion to reduction in LDL.[18] However, rather than comparing treatment to different LDL treatment targets or comparing fixed dose statin therapy to a treat-to-target approach, the majority of trials of statins both in primary and secondary prevention have compared a fixed dose of statin against placebo, or have compared higher and lower fixed statin doses.[19]

A recent RCT comparing lower (<1.8mmol/L) and higher (2.3 to 2.8mmol/L) LDL treatment targets post-stroke or TIA found a reduction in the primary outcome, a composite of major cardiovascular outcomes, in those treated to the lower target.[20] However, no significant differences were seen in all-cause deaths, CV deaths or any other CV outcomes, and this study's findings should be interpreted cautiously as the trial was not registered until nine months after the first participant was enrolled and was terminated early by the sponsor due to a lack of funding—an approach which may lead to exaggerated estimates of intervention effect.[21] In contrast, another recent trial comparing intensive lipid lowering (LDL <1.8mmol/L) with standard therapy (LDL 2.6–3.1mmol/L) in patients with diabetic retinopathy showed no difference in CV events or CV deaths with intensive therapy.[22] Similarly, recent observational data suggest that among people with CVD who are treated with a statin, an LDL target of less than 2.6mmol/L is as protective as a target of less than 1.8mmol/L.[23]

There is little evidence to guide the frequency of lipid monitoring for patients established on statin therapy. Practice guidelines from New Zealand, UK and US all suggest at least annual testing,[2,3,10] but this may in fact be too frequent to provide clinically meaningful results due to the significant within-person variability of lipid levels in patients taking statins, among whom it takes approximately three years for plausible change in LDL to become as large as change due to short-term variation.[24]

Given the large and increasing proportion of the population taking statins, the current uncertainty regarding optimal approaches to statin prescribing and lipid monitoring for patients taking statins, and well-documented primary care workforce shortages,[25] there is a pressing need to develop an evidence base to inform optimal practice in this area.

**Competing interests:**
Mr Beadel reports a grant from Pegasus Health during the conduct of the study.

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# VOICES: South Island pilot survey of bereaved people

Kate Reid, Ray Kirk, Pauline Barnett, Ann Richardson, Annabel Ahuriri-Driscoll


## ABSTRACT

**AIMS:** To test the feasibility of surveying bereaved next-of-kin in the South Island about their perceptions of end-of-life care for people over 18 years of age; to report results; and to identify issues for future research.

**METHOD:** The study used the VOICES (Views of Informal Carers Evaluation of Services) questionnaire from the UK, adapted for use in Aotearoa New Zealand. Identification of next-of-kin for all South Island deaths September–November 2017 was undertaken by a commercial firm specialising in such work. Addresses of next-of-kin were sought from the Electoral Roll, with 1,813 eligible people identified and 272 (15.0%) next-of-kin unable to be traced. Surveys were posted out once only, with options to complete by mail, online, by telephone or with a face-to-face interview.

**RESULTS:** Of the 1,541 surveys distributed, 514 (33.4%) were completed. Results confirmed the suitability of the locally modified VOICES instrument and research process. The quality of care overall was rated most highly in hospice or own home, but only a minority were able to die in these settings. Nevertheless, relatives indicated that most people died 'in the best place'.

**CONCLUSIONS:** The VOICES questionnaire is acceptable to respondents and there are viable methods for seeking a population sample. Aspects of the questionnaire require modification before wider use. The information obtained can help district health boards, hospices other healthcare providers, and consumers in planning for end-of-life care.


From 2016–2038, the number of people dying in New Zealand is predicted to increase by almost 50%.[1] These projections indicate that palliative care requirements will increase by 37.5% in public hospitals, 84.2% in aged residential care (ARC) and 51.8% in hospice care. Palliative care is provided either by specialists or usual care providers such as general practice teams, ARC, district nurses and hospital services.

A 2017 Ministry of Health review noted that "the overarching goal for adult palliative care ... is to provide high-quality care, in all settings and geographical locations, enabling someone to die in an environment that feels, and is, safe and comfortable (p. 2)".[2] The review confirmed support for family/whānau to be a core aspect of care. Consistent with this philosophy, the VOICES (Views of Informal Carers Evaluation of Services) questionnaire was identified as a research instrument that could contribute to the development of policy and evaluation of performance.

The original VOICES study was commissioned by the Department of Health, UK to survey bereaved relatives about the experience of end-of-life care.[3] The questionnaire collects data from two time periods; the last three months of life and the last two days of life. The VOICES questionnaire proved acceptable to bereaved people and generated comprehensive data for policy and monitoring.[4] Versions of the questionnaire have been used successfully in Canada and Sweden.[5,6]

The questionnaire was adapted, with permission, by the Te Arai Palliative Care and End-of-life Research Group (University of Auckland) to accommodate the bi-cultural circumstances of Aotearoa New Zealand. A pilot study of deaths at one Auckland hospital evaluated the appropriateness of the questionnaire and revealed areas requiring amendment, for example including whānau/family, clarifying some questions to take into consideration bereavement practice, enabling face-to-face

**Table 1:** Regional distribution of the sample.

| NoticeMATCH Region | Number of deaths | Next-of-kin unable to be traced | Number of questionnaires mailed to next-of-kin |
|---|---|---|---|
| Nelson-Marlborough | 237 | 12 (5.1%) | 225 |
| Canterbury | 946 | 207 (21.9%) | 739 |
| West Coast | 76 | 6 (7.9%) | 70 |
| Otago | 334 | 34 (10.2%) | 300 |
| Southland | 220 | 13 (5.9%) | 207 |
| | 1,813 | 272 (15.0%) | 1541 |

or telephone completion of the questionnaire rather than relying solely on postal responses and adding room for expanded narrative.[7] The recruitment of respondents had limitations as it included only those who died in hospital but not elsewhere. In New Zealand only 34% of all adult deaths are in DHB facilities, requiring an alternative approach to the target population and recruitment.[1]

The South Island VOICES survey was undertaken by the School of Health Sciences, University of Canterbury on behalf of the South Island Alliance (SIA) of five district health boards (Canterbury, Otago-Southland, South Canterbury, Nelson-Marlborough, West Coast).

This study had three aims: (i) to develop a population-based method of recruiting next-of-kin; (ii) to test the appropriateness of the modified VOICES questionnaire; and (iii) to report on bereaved persons' views on end-of-life care.

# Methods

The target population was all next-of-kin/preferred contacts of people over 18 years of age who died in the South Island during September–November 2017. The term 'next-of-kin' is used for consistency. Next-of-kin data are available from the National Health Index (NHI) database via DHBs, although there are doubts about its accuracy. The Canterbury District Health Board approved access to this information, but the time scale for this project meant that it was not possible to obtain approvals across all five South Island DHBs.

An alternative approach involved engaging NoticeMATCH, a death data collection and notification service, to identify and report on people who died during September-November 2017. Their report was categorised into regional groupings, with boundaries slightly different from those of DHBs. The report included information about people who had died in all settings, including sudden deaths, regardless of whether there had been prior contact with a DHB service. In total, 1,813 summaries for people aged over 18 years were prepared during December 2017. Permission was granted by the Electoral Commission to use the electoral roll to locate postal addresses for next-of-kin identified by NoticeMATCH. There were 272 (15.0%) next-of-kin unable to be traced, resulting in a sample of 1,541 people eligible to be contacted.

The regional distribution of the sample for the three months September–November 2017 is set out in Table 1.

Surveys were posted out with a prepaid return envelope, invitation letter, information sheet and reply slip. Options for respondents were to complete the survey online (via Qualtrics), or by a telephone, skype or face-to-face interview, or to return the completed questionnaire by mail. As this was a pilot survey, only one mail-out was sent.

Modifications to the questionnaire were made with the agreement of the Auckland research group. Ethnicity designation was made consistent with the New Zealand Census. The appearance of the questionnaire, and its bicultural representation, were enhanced by inserting a kowhaiwhai (cultural image) banner across the top of each page. The CDHB Māori Health Team generously wrote a mihimihi and provided a karakia to be included in the invitation letter.

**Table 2:** Main illness of deceased.

| | Frequency | Percent |
|---|---|---|
| Cancer | 153 | 29.8 |
| Heart disease | 103 | 20.0 |
| Neurodegenerative disorder | 81 | 15.8 |
| Respiratory disease | 35 | 6.8 |
| Stroke | 30 | 5.8 |
| Other | 73 | 14.2 |
| None | 39 | 7.6 |
| Total | 514 | 100.0 |

The questionnaire, gender specific to the deceased, was sent to the next-of-kin. Brief demographic and personal information was sought for both the deceased and next-of-kin, but most of the questions addressed the experience with the health system of the deceased in the last three months of life and the last two days of life. Questions addressed respect, communication, pain management and overall care, as assessed by the next-of-kin. Sudden unexpected deaths had been an exclusion criteria with the VOICES survey in UK and the Auckland pilot but were included for this pilot study as NoticeMATCH do not hold details on how the person died, therefore all deaths were surveyed. There were a large number of questions (83) but only a proportion applied to any particular respondent. Pre-testing indicated that the questionnaire would take 30 minutes to complete; this was indicated on the information sheet for respondents.

The Statistical Package for Social Sciences (SPSS) was used to calculate descriptive statistics. For open-ended questions, some responses consisted of a few sentences while others consisted of entire paragraphs or more. Given this, a manifest content analysis was conducted, following Graneheim and Lundman (2004).[8] These findings are not reported here, but referred to as necessary to clarify results.

# Results

Of the 1,541 surveys sent out, 514 (33.4%) were completed. The large majority of deceased were reported as NZ European/Pākehā (82.5%) with 3.3% reported as Māori. Other ethnicities (14.2%) reflected New Zealand Census categories and included UK, European, Australian, Chinese and Lebanese. No Pasifika deaths were reported.

The two main causes of death, cancer and heart disease, are reported as percentages similar to the most recent New Zealand national mortality data[9] and represent half of all deaths in this sample (Table 2).

Nearly one-fifth of people had little or no warning of impending death as they had been unwell for less than one week, or not at all. A further 27% had been ill for up to six months, suggesting some time for them and their families to adjust to a different health and living scenario. A majority (55.6%) had been ill for at least six months to over a year, indicating a long-term adjustment for themselves and their families and the formation of long-term relationships with the healthcare system.

The largest group of deceased (42.6%) were reported as dying in a residential care facility, with 28.7% dying in hospital, 17.5% at home and only 8.3% in hospice (Table 3).

**Table 3:** Place of death.

| | Frequency | Percent |
|---|---|---|
| Own home or with another family member or friend | 89 | 17.5 |
| Residential care facility | 217 | 42.6 |
| Hospital ward | 110 | 21.6 |
| Hospice | 42 | 8.3 |
| Hospital ICU | 36 | 7.1 |
| Hospital A&E unit or ambulance | 9 | 1.8 |
| Elsewhere | 6 | 1.2 |
| Total | 509 | 100.0 |

## The last three months of life

Of the 259 people (50.4%) who spent some time at home during that period, the majority received district or community nursing services (60%), care either from a GP or other doctor (58.7%) or services from a home care worker (51.3%). A smaller number received social work/support worker care (13%), occupational therapy (13%), help from a religious leader (10.8%) or meals-on-wheels (8.9%). Some people clearly received more than one service and 33 (12.7%) did not receive any services at home.

Regarding particular settings and providers of care in the last three months of life (Figure 1), the highest proportion of next-of-kin reported the quality of care as excellent for hospices (79.2%), followed by hospital doctors (74.3%), district nurses (71.1%) and hospital nurses (69.4%). Residential care facilities (57.3%), urgent care (56.6%) and GPs (54.1%) were rated somewhat lower. 'Urgent care' reflects the challenge of obtaining assistance after hours (including calling the ambulance, fire brigade or Healthline). Respondents

**Figure 1:** Last three months of life. Overall quality of care by setting or service provider, South Island 2017.

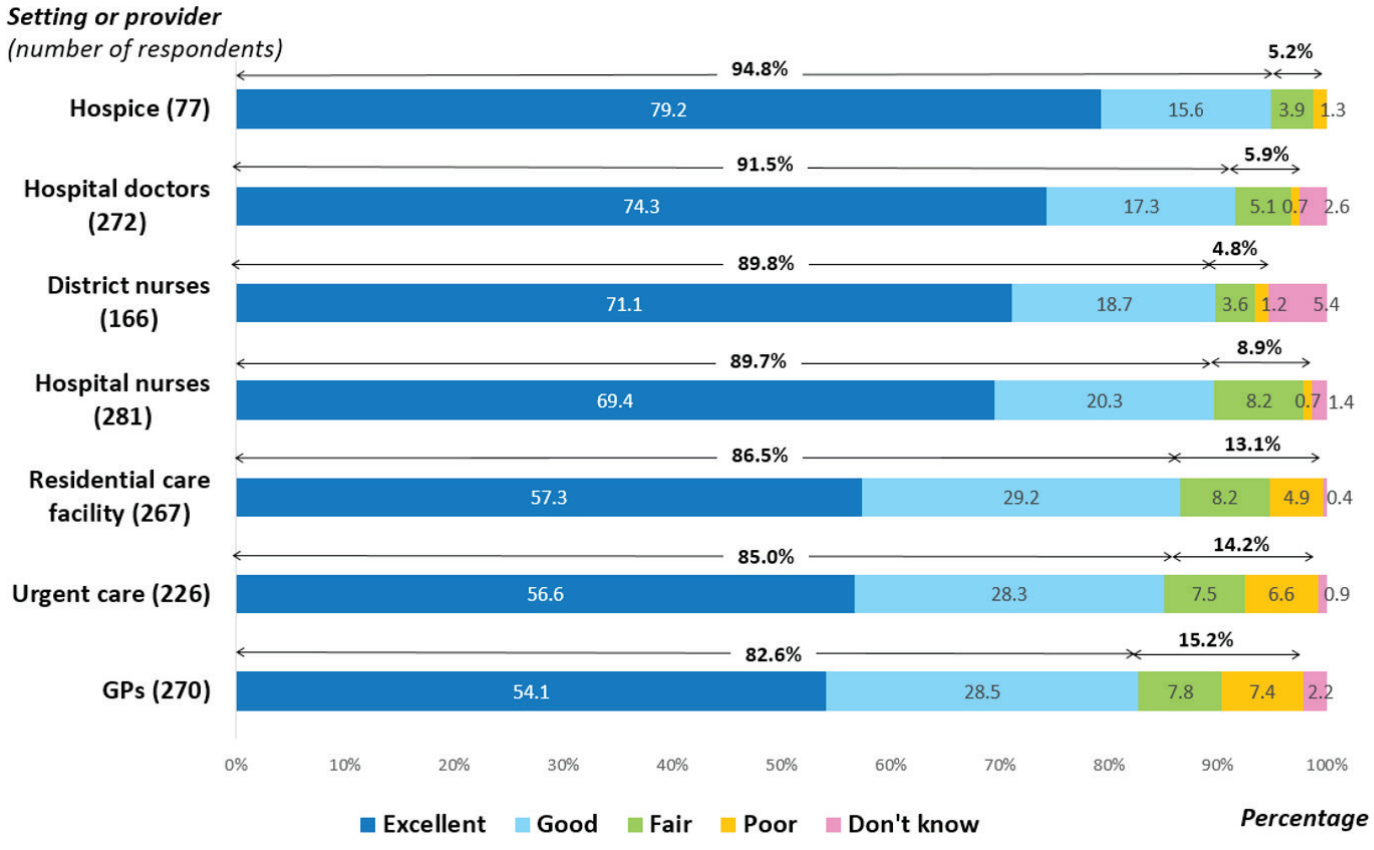
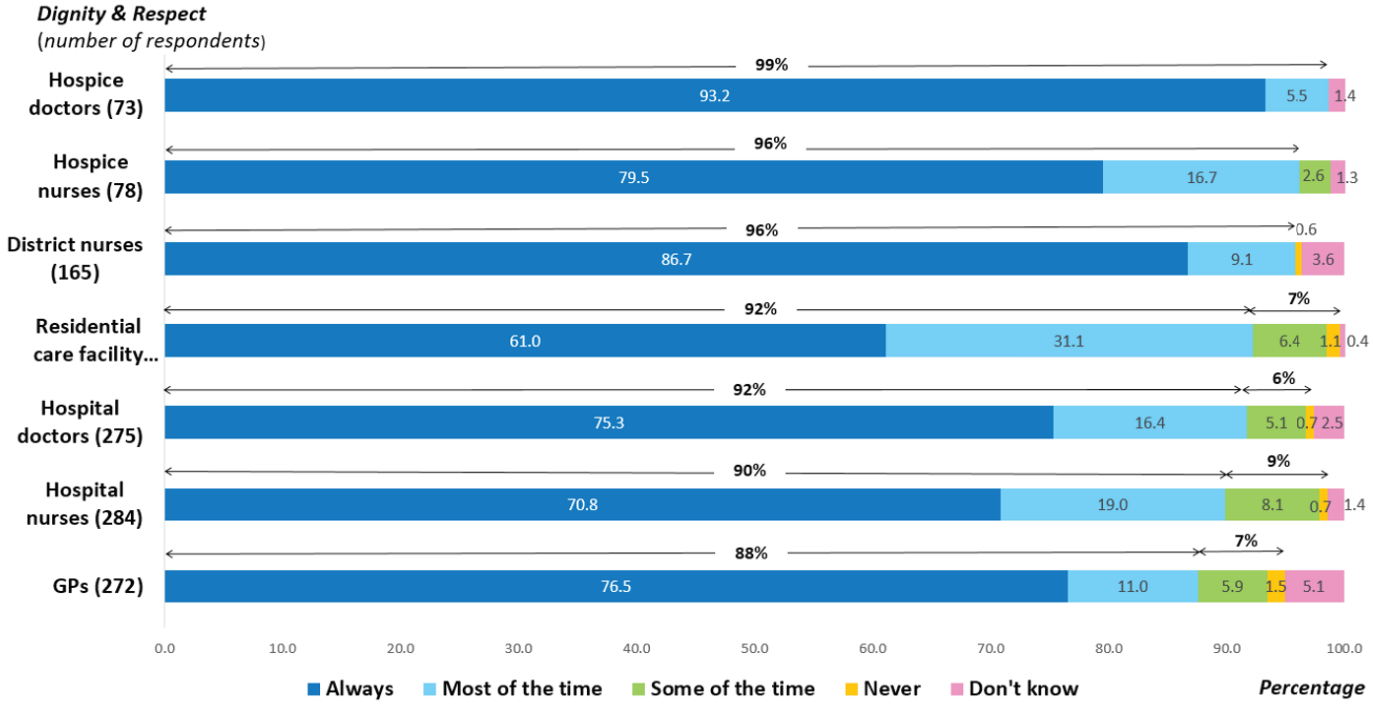


**Figure 2:** Last three months of life. Dignity and respect in the last three months of life, by setting or provider, South Island 2017.




commented on the short-staffing, high workload, low pay and high turnover of staff in ARC facilities. GPs were seen as having complex co-ordination roles as well as time pressures that made home visiting difficult.

As in the UK VOICES survey, next-of-kin were more likely to rate the overall quality of care as 'outstanding' for relatives who had cancer (28.4%) compared with those who had died of heart disease (9.5%) or other named conditions (18.4%).

Besides quality of care, respect and dignity are important components of end-of-life care. Figure 2 reports levels of dignity and respect experienced in the last three months of life, by setting or provider.

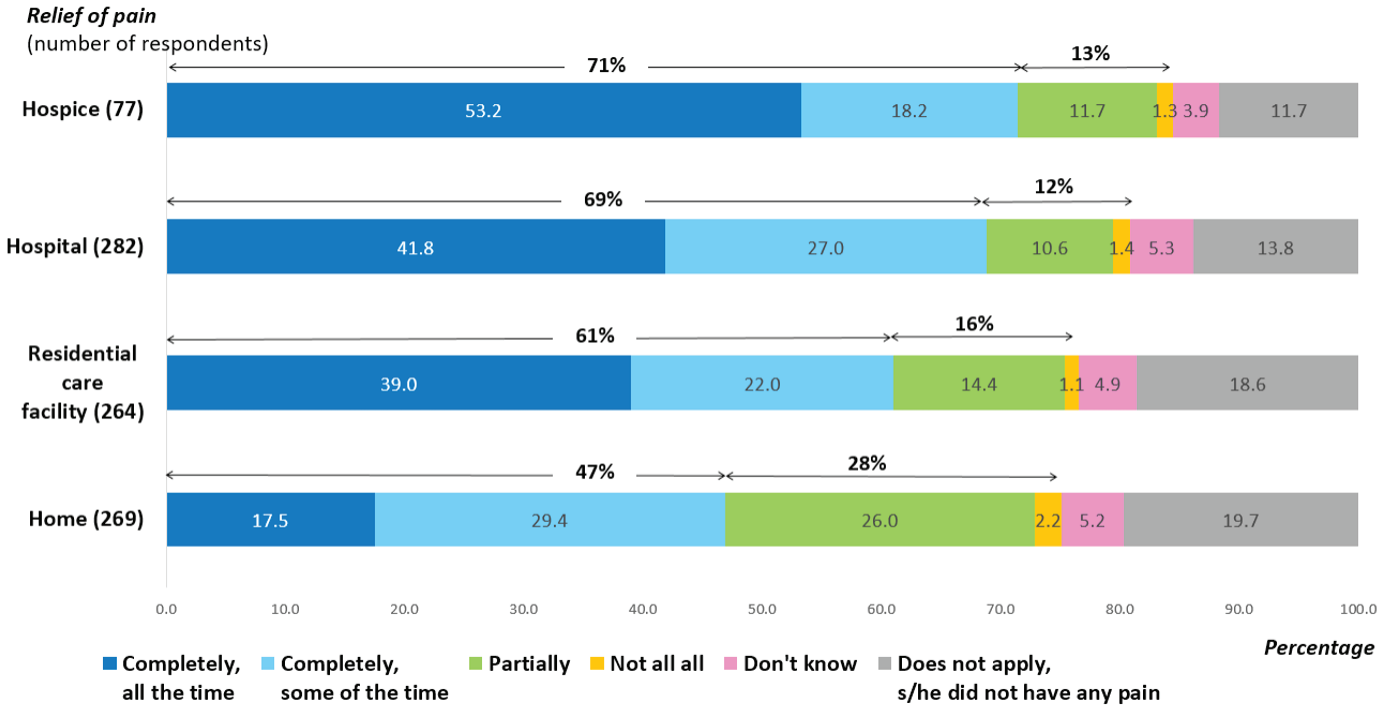
Next-of-kin reported that their relative was 'always' treated with dignity and respect by hospice doctors (93.2%), district nurses (86.7%), hospice nurses (79.5%), GPs (76.5%), hospital doctors (75.3%), hospital nurses (70.8%) and residential care facilities (61.0%).

With respect to perceptions of coordination of care between care services in the last three months of their relative's life, 77% of respondents reported that care services worked well together 'definitely or to some extent' (even though 12.0% of people had not received care). With respect to coordination between hospital and other services, only 33% of respondents reported that the hospital worked well with the GP and other services outside the hospital 'definitely or to some extent,' but 17.6% of people had not received care, and 45.8% of respondents did not know. Clearly there are difficulties in assessing the extent of effective coordination.

Pain relief is often critical at the end of life. Figure 3 reports the respondents' perception of pain relief according to care settings in the last three months of life.

More than half of next-of-kin reported that their relative had complete pain relief all of the time in hospice care (53.2%), with less complete pain relief in hospital care (41%), residential care facilities (39.0%) and home care (17.5%). These percentages may seem low, but some patients did not have pain (ranging from 11.7% in hospice care to 19.7% receiving home care). Respondents reported between 5.2% and 7.4% of patients having their pain 'not at all' or only 'partially' relieved.

**Figure 3:** Last three months of life. Relief of pain by care setting, South Island 2017.

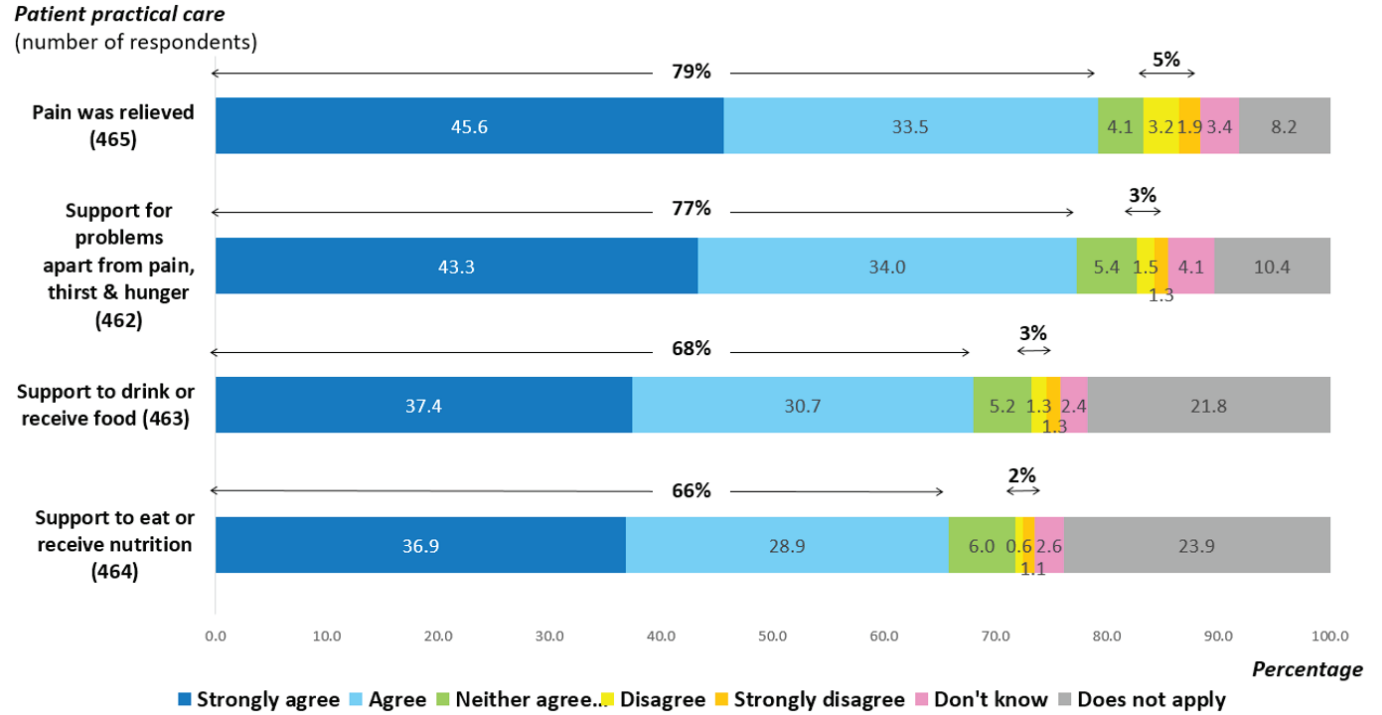



## The last two days of life

This is a trying time for patients and families. Figure 4 presents respondents' perception of practical care provided by health professionals at this time.

There was agreement or strong agreement that their relative's pain was relieved (79%), that support was provided for problems apart from pain, thirst and hunger (77%), that their relative was supported to drink

**Figure 4:** Last two days of life. Overall level of practical care provided by health professionals, South Island 2017.



or receive food (68%), and supported to eat or receive nutrition (66%). The differences in responses to these questions about practical care are negligible, given that the questions did not apply to some patients; ranging from 8.2% for pain relief, 10.4% for support for problems apart from pain, thirst and hunger, to 23.9% for support to eat or receive nutrition.

Emotional care is increasingly recognised as important in end-of-life care. The highest proportion of next-of-kin agreed or strongly agreed that their relative's emotional needs were supported (71%) and that efforts were made to ensure that their relative was in the place they wanted to be (68%). Almost half of the respondents agreed or strongly agreed that their relative's spiritual and/or religious needs were supported (48%). Some respondents felt that the questions did not apply to their relatives; this ranged from 13.2% for emotional needs to 31.7% for religious and/or spiritual needs.

With respect to communication, over 80% of next-of-kin agreed or strongly agreed that they understood information provided to them, were informed about their relative's condition and care, had enough time to ask questions and discuss issues, and had supportive relationships with healthcare professionals. Respondents reported (66%) that their relative was involved as much as s/he wanted to be in decisions about their care, while 23% reported that their relative would have liked to have been more involved.

Many people express a preference for place of death as they approach end-of-life. Of the 202 people who had stated where they wished to die, 61% had expressed the wish to die at home, but in fact only 17.5% did so. A higher proportion died in residential care (42%) compared with an expressed preference of 12%. Some (13%) did not mind where they died. Healthcare staff had a record of the person's preference for only 41% of people, but nevertheless 86.4% of respondents believed that their relative died in 'the right place'.

Other issues emerged. Advance Care Planning (ACP) is new to many people in the community and only 26% of respondents relative had completed the ACP with 51% reporting that this had benefited their relative. In addition, 30 respondents reported their bereavement as a 'sudden death'. The questionnaire was not suited to these circumstances and they were not included in the analysis. Nevertheless, next-of-kin shared their frustration and despair, with the hope of making changes for service improvement. These findings will be reported elsewhere.

# Discussion

This study aimed to test the feasibility of surveying the next-of-kin of deceased. A method of population recruitment proved successful, although further examination of alternatives using DHB/NHI data is necessary. The questionnaire proved acceptable and practical although greater clarity in the definition of 'home' and 'hospital' is needed. Modification of the questionnaire to accommodate 'sudden deaths' is suggested so that next-of-kin could comment on issues such as availability of support and coronial services. The response rate (33.4%), was highly satisfactory from one mail out and compared favourably with similar surveys. The first UK national VOICES survey, for example, used three mail outs to achieve a response rate of 45.7% (2012).[4] The Swedish survey (response rate 37.9%) used a single mail out but was not a population survey and was assisted by a follow-up phone call.[10]

The results confirmed that to die at home is the preference of most people, but this is not a reality for many, influenced by the gap between availability of services and the ability of family to care for them at home. Furthermore, only a small minority receive hospice care. Most people receive end-of-life care from primary healthcare teams, GPs, district nurses, ARC, acute hospitals, and home and community services. People were treated with dignity and respect and received both practical and emotional support, a critical combination[11] of community palliative care.

Palliative care philosophy was present across all settings and practitioners. Families were pleased with the care and attention given by all parts of the health system, but noted that coordination could be improved. Comfort-focused end-of-life care is increasingly understood by whānau/family/friends and is consistent with the fundamental components of palliative care. The importance of whānau/family/friends was shown in

the personal reports of the final three months of life from some next-of-kin of people who spent part of those final months at home.

# Conclusion

Dying is not merely a medical event but a family and social event that is supported by health services and community support agencies working in partnership with families. This strengthens the notion that end-of-life-care is the responsibility of all of society, based on the philosophy and principles of palliative care. Effective symptom management, and psychological and social support can only be achieved when service providers are partners in providing care in an inter-professional way.

Future research will require refinement to the VOICES questionnaire to include provision for sudden deaths, widening its scope to acknowledge allied health professionals, and others (eg, lawyers) who support families with end-of-life care. Greater consideration of cultural needs will ensure better engagement of potential participants. A small comparative study to compare the effectiveness of NoticeMATCH data with DHB/NHI data for locating next-of-kin is essential before considering a national survey.

Based on the findings from this survey, there are a number of priorities for service development including: improve access to and better co-ordination of home care services; strengthening the ARC workforce based on palliative care principles; and supporting community capability and willingness for informal care-giving at end of life.

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# Erionite in Auckland bedrock and malignant mesothelioma: an emerging public and occupational health hazard?

Martin S Brook, Philippa M Black, Jennifer Salmond, Kim N Dirks, Terri-Ann Berry, Gregor Steinhorn


## ABSTRACT

Overseas, emerging research has shown that where erionite is present in bedrock as a zeolite, and then subsequently disturbed and blown into the atmosphere, resulting exposure is associated with health effects similar to those caused by asbestos, including malignant mesothelioma (MM). Erionite-induced MM is thought to be particularly prevalent in the construction and quarrying industries, in regions where rock containing erionite is disturbed. In 2015, the then Government Chief Scientist, Sir Peter Gluckman, reported that erionite was a more potent carcinogen than asbestos, and more recent studies have established its presence in the Auckland Region. However, globally at present, there are no established occupational exposure limits for erionite, standard sampling and analytical methods or exposure mitigation guidelines. Given the many major construction projects being carried out in Auckland at the present time, which involve the removal of large quantities of bedrock containing erionite, an assessment of the health risks such activities pose to the public is needed.


Asbestos-induced malignant mesothelioma (MM) is of worldwide concern but particularly in New Zealand.[1,2] The highest mesothelioma incidence is in the construction and building trades.[2] In addition, non-occupational asbestos induced MM for both men and women is of increasing concern.[1] Studies[1] report that New Zealand is one of a number of high-income countries with elevated incidence of MM (2.6 per 100,000), and that this is a direct result of exposure to airborne asbestos fibres in occupational settings. Indeed, recent reports have highlighted some tragic outcomes of the asbestos disease epidemic here.[3] These include cases of how MM was apparently a consequence of exposure to asbestos in the home, following transfer of the asbestos fibres from the workplace. This was thought to have occurred on the hair and clothes of occupationally-exposed family members.[3]

## Erionite and malignant mesothelioma (MM)

Erionite is a naturally occurring fibrous zeolite mineral, first described by Eakle.[4] Erionite is produced in silica-rich volcanic eruptions, and is then later dissolved by water and recrystallized as zeolites, often in sedimentary rocks.[5] When aerosolised and inhaled, erionite fibres have been associated with health effects similar to those typically seen with exposure to asbestos, such as malignant mesothelioma (MM).[6] Several studies have reported how erionite was found to be the causative agent for the mesothelioma epidemic in the Cappadocia region of Turkey, where there is an extremely high level of mortality (800 cases/100,000 population) from exposure to erionite in rock used to build houses.[2] Most of the affected population had been exposed to erionite


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by inhalation since childhood, resulting in up to 50% of all deaths in three villages.[7,8] Many of the affected people later migrated to Germany and Sweden, and cases of MM caused by erionite were also identified in those Turkish immigrants.[8] Genetic susceptibility was also thought to be a possible factor in determining the susceptibility of the population to MM, specifically the pathogenic role of BAP1 mutations resulting in mesothelioma, and in other cancers globally, as well as in Cappadocia specifically.[9] The prevalence of the BAP1 gene in the global population and its more recent link to other cancers globally, along with studies linking MM to erionite exposure in countries other than Turkey (including the US and Mexico), suggest that the results from Cappadocia may not be accounted for entirely by local conditions or be atypical at global scales. [9]

In the US, the carcinogenic properties of erionite have recently sparked interest in erionite as an occupational and public health hazard, particularly in areas where erionite is found in regional bedrock or sediments. However, data concerning health outcomes there are equivocal. A study of North Dakota quarry and road workers reported only a few cases of pleural changes.[10] Notwithstanding that study, although the long-term health impacts remain uncertain, there is concern about inhalation of airborne dust and particulates containing erionite fibres from gravel pits, quarries, roads, building and construction sites.[10] Thus, erionite is now classified by the International Agency for Research on Cancer (IARC) as a Group 1 carcinogen (ie, carcinogenic to humans).[11] The potency of erionite as a human carcinogen appears to be higher than that of asbestos, particularly for the development of MM.[2] However, in contrast to asbestos, erionite mineral fibres do not have established occupational exposure limits (OELs).[6]

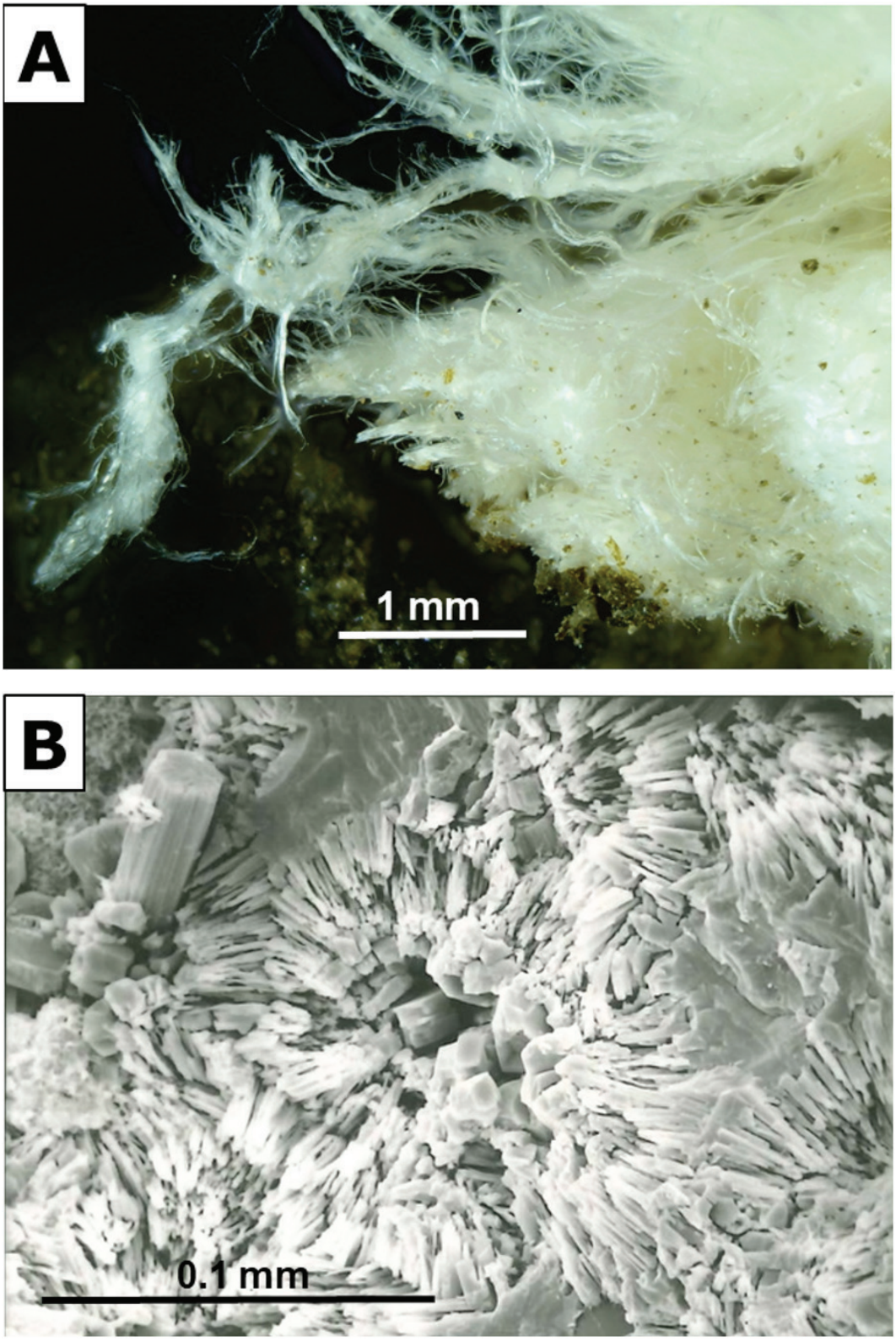
Despite the establishment of OELs for asbestos, controversy remains as to whether short intense exposure to asbestos is particularly harmful since it is complicated by non-linear dose concentration-duration-risk relationships.[12] There is also uncertainty as to how asbestos dose-response may relate to erionite dose-response for a number of reasons.[13] Epidemiological data alone typically lack accurate fibre counts (for erionite or asbestos exposure) and are inconclusive about risks at specific concentrations.[12] Fibres also vary in toxicity due to morphology and chemical characteristics (composition, surface reactivity, biopersistance etc).[14] There even exists considerable heterogeneity in the responses of cells within the same local volume of tissue,[12] and in vitro techniques do not provide accurate estimates of biologically-effective doses (eg, the numbers of fibres accumulated in mesothelial tissue over time).[12] Nevertheless, exposure concentration does appear to part-control the latency interval between first exposure to asbestos or erionite and the development of MM. Indeed, workers in trades with higher levels of exposure (eg, naval personnel removing asbestos from warships; builders; extractive industry workers), may experience shorter latencies compared to those exposed to lower amounts of asbestos.[13] Age at first exposure also appears to be important.[9] Indeed, once a sufficient amount of asbestos or erionite has been inhaled, such as by a six-year-old child growing up in a village or suburb contaminated with erionite, they will develop MM, which suggests that additional exposure(s) may not significantly increase the risk.[13] However, the threshold above which asbestos and erionite will cause MM, varies among individuals due to genetics, exposure to co-factors, the exact characteristics of the mineral fibre inhaled, etc.[13,14]

## Erionite in Auckland

Despite this emerging body of work overseas on causative links between erionite exposure and MM, any effects of erionite on MM in New Zealand have hitherto not been established.[2] This is despite erionite being present, for example, in the Waitemata Group sedimentary rocks and the Waitakere Group volcanic rocks that are present throughout much of the Auckland region (Figure 1).[15] In a report on asbestos exposure in New Zealand by the Chief Science Advisor[2] in 2015, it was mentioned (on page 11) that while most cases of MM are associated with asbestos exposure, erionite is also a risk factor. They then accurately stated that erionite is present in some volcanic ash deposits in New Zealand, but, since the report focused on asbestos, did not further note that erionite is also present in sedimentary rocks such as those underlying

New Zealand's most populous, and fastest-growing region, Auckland. Indeed in the Auckland region, the presence of erionite has been reported by geologists in several studies over the last five decades.[15,16] It is present within the Early Miocene Waitemata Group sediments in association with highly altered andesitic clastic material.[15] These are the sedimentary rock formations, for example, that outcrop as sea cliffs along Auckland's North Shore, the eastern bays, and along Tamaki Drive. Thus, erionite is present and exposed in many locations across the Auckland region.

**Figure 1:** (A) Example of "woolly" erionite in Waitakere Group rock from Te Henga Road Quarry, Waitakere Ranges (Rod Martin); (B) Scanning Electron Microscopy (SEM) image of crystalline erionite (hexagonal crystal and acicular habit) from the Waitemata Group, Hobsonville (sample AU42046).



Over the last decade, Auckland's population growth has led to large transport infrastructure projects such as the Waterview Tunnel and the City Rail Link (CRL), as well as excavations in the city for high-rise building foundations. Most of these excavations are into Waitemata Group rock, and the material is usually loaded onto trucks, transported by road and dumped as fill or in former quarries.[17,18] For example, the Waterview Tunnel project saw two twin tunnels driven mainly through weathered and unweathered Waitemata Group sedimentary rock. The approx. 800,000m$^3$ of spoil (enough to fill 320 Olympic-sized swimming pools) that was excavated from the tunnels was transferred via a conveyor belt to the on-site storage facility. From there, the spoil was trucked to, and filled, the disused Wiri Quarry in Manukau, south Auckland.[20] The current CRL project in Auckland CBD involves tunnelling mainly through Waitemata Group sandstones and siltstone, and the removal of two million tonnes of spoil. Given the scale of these,[21] and other earthworks in the Auckland region and the current uncertainty regarding the precise location and quantity of erionite in the rocks and soils, there is the potential for significant exposure of some of Auckland's population to erionite-bearing rock dust if appropriate dust management strategies are not carefully implemented. The extent of this risk needs urgently quantifying as there are likely to be significant differences in exposure risks between ground engineering workers in Auckland, and areas of Turkey where houses were constructed with erionite-bearing sandstone blocks, as demonstrated by studies in the US.[10]

# Concluding remarks

A recent report[1] claimed that the elevated incidence of malignant mesothelioma in New Zealand is a direct result of exposure to airborne asbestos fibres in occupational settings. There is usually a long latency period (20–40 years) for MM between exposure and diagnosis.[22] Importation and use of crude (raw) asbestos in New Zealand peaked in 1974,[1] yet cases of MM have increased almost exponentially since 1974 and remain high.[2] Some MM cases have been attributed not to direct occupational exposure to asbestos, but from the transfer of asbestos from the workplace to the home. Notwithstanding this, the potential effects of exposure through handling, use and disposal of erionite-bearing rock in both occupational and non-occupational settings in New Zealand remain unknown. The Auckland region is growing rapidly, including excavations for residential, infrastructure and transport works. The corollary is that the effects of airborne erionite need to be established. Indeed, further research on the source occurrence, and airborne transport of erionite would be advantageous, as well as epidemiological research to improve understanding of the extent of exposure to erionite in the population and who is most at risk. This could include developing testing regimes and occupational exposure limits, and then appropriate management of erionite exposure within a hierarchy of controls. Finally, if prediction of future peak MM incidence is based primarily on asbestos exposure and ignores exposure to erionite, then this could be painting an inaccurate picture of the likely future MM trends in the community.

**Competing interests:**
Nil.

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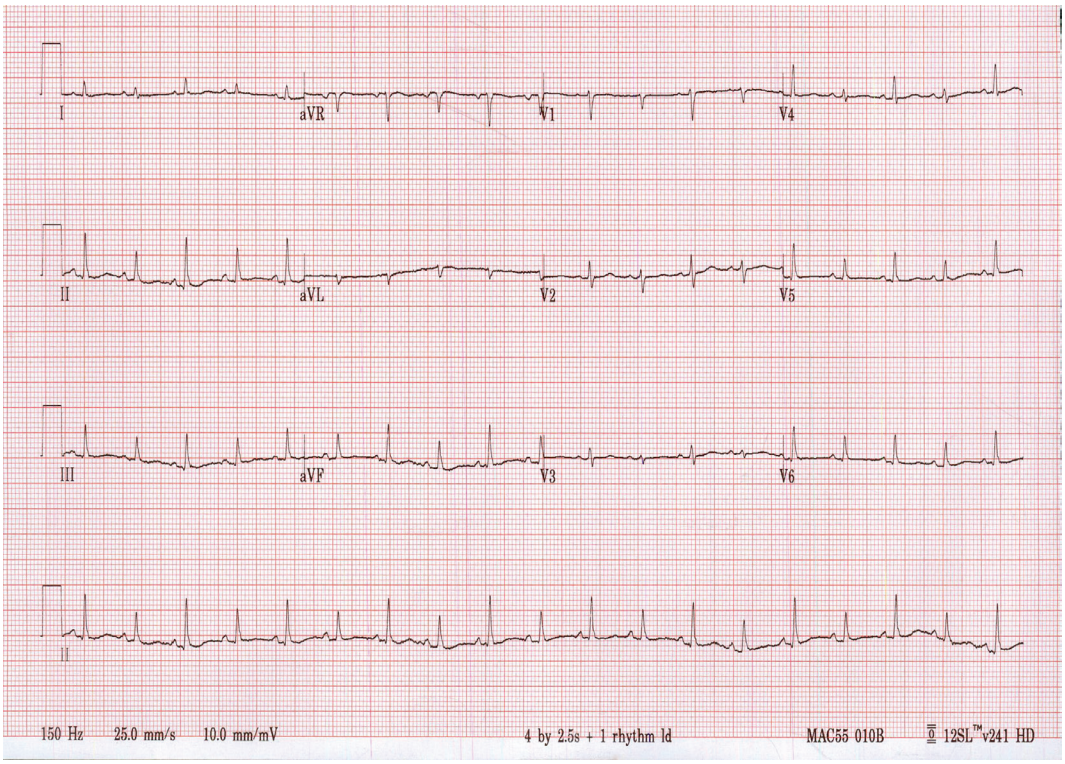
# A swinging heart in cardiac tamponade

Allan Plant, Stuart Tie

A 47-year-old woman with a history of metastatic breast cancer and paroxysmal atrial fibrillation presented with four days of shortness of breath associated with orthopnea. The patient was initially normotensive with a sinus tachycardia of 115bpm, and examined with a raised JVP and muffled heart sounds. An ECG demonstrated sinus rhythm with low voltage QRS complexes and electrical alternans (Figure 1). Echocardiography confirmed a large pericardial effusion with swinging of the heart and collapse of the right atrium in end diastole, and diastolic collapse of the right ventricle (Video 1).

In large pericardial effusion, electrical alternans results from swinging of the heart. This changes the position of the heart within the enlarged, fluid-filled pericardium and is responsible for the beat-to-beat shift in amplitude of the QRS. Although classically associated with large pericardial effusion, QRS alternans has a broad differential diagnosis that includes ischaemia, cardiomyopathy, re-entrant tachycardia, hyperkalemia, pregnancy and digoxin toxicity.[1,2]Ventricular interdependence also occurs as a result of impaired ventricular filling due to increased pericardial pressure; the expansion of the right ventricular free wall that normally occurs as the right ventricle fills during inspiration is impaired, and as a consequence there is displacement of the interventricular septum to the left causing reduced left ventricular filling. The reverse is seen during expiration. This can be identified on echocardiography as a >25% reduction in mitral inflow E velocity

**Figure 1:**



**Video 1:**

during inspiration or a >40% reduction in tricuspid inflow E velocity during expiration.[3] A dilated inferior vena cava which fails to collapse with inspiration can also be seen.[3] These, alongside the diastolic collapse of right heart chambers and swinging of the heart demonstrated in this case, are echocardiographic features of cardiac tamponade.[3] Recognition of a large pericardial effusion via ECG or echocardiography findings described above can facilitate emergent pericardiocentesis. In this case, pericardiocentesis drained 1,125mL of blood-stained fluid containing malignant epithelial cells consistent with breast cancer. The patient subsequently commenced chemotherapy and proceeded to pericardial window formation.

**Competing interests:**
Nil.

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# Opioid dependence with successful transition to suboxone (buprenorphine/naloxone) in a young woman with hereditary coproporphyria

Cindy Towns, Holly Mee, Sam McBride

Acute porphyria attacks are characterised by severe pain with poor response to analgesia. Opioids are often used in high doses. We present a patient with hereditary coproporphyria (HCP) whom developed opioid dependence and was successfully transitioned from high dose fentanyl to suboxone (buprenorphine/naloxone). This is the first documented use of suboxone in the acute porphyrias.

## Case report

A 22-year-old female HCP patient had 14 admissions to hospital with severe abdominal pain over eight months. High fentanyl use and distress with weaning prompted a referral to Addiction Services. It was speculated that withdrawal symptoms were contributing to representation and frequency of admission. Specialist assessment identified a number of concerns including: high dose opioids, persistent use over six months without significant improvement, development of withdrawal symptoms and risk factors for misuse based on standardised tools.[1] A diagnosis of mild-moderate opioid use disorder was made and a decision was made to transition to long-acting maintenance therapy with suboxone. An elective admission was arranged under General Medicine with guidance and daily review by an Addictions specialist. The initial suboxone dose was 2mg, sublingual and gradually increased. Withdrawal was quantified using the Clinical Opioid Withdrawal Scale (COWS).[2] Her fentanyl patch was removed at 8pm with all other oral opioids ceased. Zopiclone and diazepam were available for withdrawal symptoms. Suboxone was commenced once COWS reached 12. COWS measurements occurred hourly and suboxone was administered as needed in increments of 2–4mg. On day two the cumulative dose from day one was administered. The transition was well tolerated and she was discharged on daily suboxone of 16mg on day seven.

Prior to suboxone, she had 14 admissions over eight months (admissions per month=1.75). Her length of stay (LOS) ranged from 1–12 days; mean 3.86 days. Since suboxone there have been eight admissions over 23 months (admissions per month = 0.35). LOS 0–5 days; mean 2.38 days. Under the out-patient guidance of an addiction specialist, she has weaned from 16mg to 12mg (23 months from first prescription) although developed withdrawal features initially. She plans to wean further in the community.

## Discussion

Most porphyrinogenic drugs, ie, those that can precipitate an acute attack, are associated with the induction of CYP450 enzymes that increase hepatic haem turnover (eg, barbiturates, synthetic progestins and sulphonamide antibiotics).[3] Frontline analgesic agents—including paracetamol,

non-steroidal anti-inflammatories and opioids (among others)—are not porphyrinogenic and hence are commonly used to treat the pain associated with acute attacks.[4] However, the severity and recurring nature of the pain in acute porphyria puts these patients at risk of opioid misuse disorders. Analysis of 112 acute attacks describe doses of meperidine/pethidine per admission of 50–10,000mg with a median dose of 1,200mg.[5] The EXPLORE data suggest that 65% of acute porphyria patients have chronic pain with 46% reporting daily symptoms.[6] Qualitative research provides further evidence for chronic pain, poor quality of life and negative impacts on employment and relationships.[7]

Suboxone consists of Buprenorphine and Naloxone in a 4:1 ratio and is approved for analgesia and treatment of opioid dependence.[8] Buprenorphine has a complex pharmacological profile that is significantly distinct from morphine, fentanyl, codeine or methadone. High potency and a slow half-life of association/disassociation (2–5 hours) enable buprenorphine to displace other μ agonists (eg, morphine, methadone) contributing to its efficacy in the treatment of opioid dependence.[9] The prolonged disassociation may provide a therapeutic advantage in the management of chronic cancer and non-cancer pain. Development of tolerance is slower, withdrawal symptoms are milder and there is lower risk of fatal overdose. Evidence from clinical studies runs contrary to previously held beliefs about a perceived 'ceiling effect' with buprenorphine now deemed to have a better safety and efficacy profile than other opioids marketed for pain.[9]The primary disadvantage is that other opioids may become less effective during acute porphyric attacks. The naloxone component of the medication could theoretically cause nausea and vomiting but the quantity in the oral dose is minimal and not well absorbed orally so this is deemed unlikely.

Although suboxone may be effective in mitigating opioid misuse (and associated harms) in porphyria patients, avoiding these risks would clearly be preferable. Givosiran is a novel agent that is demonstrating promise—albeit with small patient numbers—in reducing acute attacks in the acute hepatic porphyrias.[10] This small interfering RNA molecule (siRNA) was approved by the Federal Drug Association (FDA) in November 2019 and is currently in an open label extension stage following a phase III clinical trial.[11]

# Conclusion

Acute porphyria patients are at risk of opioid abuse and dependence. This case demonstrates successful use of suboxone in an HCP patient with recurrent severe pain and opioid dependence. The frequency and duration of hospital admissions have decreased substantially following prescription.

This is the first documented use of suboxone in porphyria. The drug appears to have utility in this setting and is non-porphyrinogenic.

**Competing interests:**
Nil.

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# Perry syndrome: a case of atypical parkinsonism with confirmed DCTN1 mutation: a response

Pawel Tacik, Zbigniew K Wszolek

With great interest, we have read the article entitled "Perry syndrome: a case of atypical parkinsonism with confirmed DCTN1 mutation" by McManus et al published in 24 April edition of the *New Zealand Medical Journal*.[1]

We want to congratulate the authors for this important publication. Perry syndrome is a very rare disease with only handful of cases described around the world.[2] Thus, it is interesting to know that this disease is also present in New Zealand, a country with only about five million inhabitants. It is very likely that the second case published by McManus et al[1] is related to the first case published previously.[3] They do share the same mutation, DCTN1 p.Y78C. It would be important to proceed with genealogical investigations locally and to perform molecular genetic experiments for haplotype sharing. These two approaches will help to determine if those two cases are indeed related.

The article by McManus et al[1] also expands our knowledge on phenotypic presentations of Perry syndrome. Recurrent syncopes have not been previously associated with this condition. Due to postural hypotension seen in the Schellong test, it is possible that the patient's syncopal episodes originated from dysautonomia.[1]

The same mutation, DCTN1 p.Y78C, has also been identified in a Korean family. Interestingly, this family presented with an atypical phenotype consisting of PSP-like Parkinsonism in the absence of psychiatric symptoms, weight loss and hypoventilation.[2,4] Thus, it is feasible that all three families albeit identified and described separately represent one extended kindred.

**Competing interests:**
Nil.

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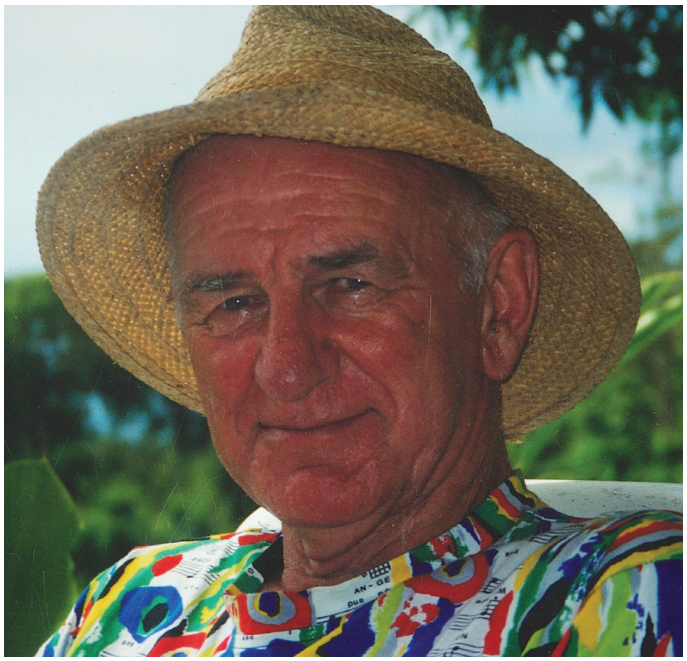
# Rexley Blake Hunton

21 May 1932–24 June 2020



MB ChB (Otago), DTM&H (Liverpool), MRCP (Edin), MRCP (London), FRACP, NZOM

Rex was born in 1932 in Papatoetoe, Auckland. His parents had a poultry farm in Papatoetoe but had to walk away from it in the Great Depression and start again. He was not really sure why he chose medicine, but his mother had several health issues including a stiff leg, and Rex was impressed by the way doctors had helped her. He was good at science and passed his medical intermediate for the University of Otago in 1953. He initially lived with his aunt and put himself through medical school by shovelling coal for the railyards at night, unlike his more traditional fellow students. Artist girlfriend Valerie joined him in Dunedin and they were married in 1958.

Rex's medical career was never conventional. He did not seek controversy for the sake of it, but because he wanted to do what was best. After 18 months as a house surgeon in Auckland, Rex and Valerie, along with their one-year-old son Blake, embarked for the UK in 1961, despite warnings that his career would be forestalled if he did not work as a registrar first. Rex first went to Liverpool, where the Beatles were rising to fame, and studied for a diploma in tropical medicine in hygiene. At that time he had an ambition to work as an outback doctor in Australia, or work in the Pacific. He then sat and passed membership for both the Royal College of Physicians of Edinburgh and the Royal College of Physicians of London, which was a significant achievement.

In 1965, Rex and Valerie returned to New Zealand, now with three young children (daughter Ingrid born in 1962 and son Carl in 1964). He worked for the cardiology unit at Greenlane Hospital and also, on the basis of his overseas qualifications, secured a role with the University of Otago as medical tutor for their final-year students based in Auckland. From 1966 to 1970 he worked at the thyroid clinic at Auckland Hospital with Kaye Ibbertson, and developed an interest in endocrinology. Kaye Ibbertson was very involved with Ed Hilary in the Himalayas

at that time, so Rex was left in charge of the Unit. He then was able to set up a new ward at the hospital with a particular focus in endocrinology.

In 1972 the Dean of the new Auckland medical school, Cecil Lewis, appointed Rex as senior lecturer in community health. Rex and Catholic priest Felix Donnelly were based in the Pink Cottage, next to the new concrete building, which Rex recalled was "approachable and less intimidating than the Medical School". As well as working as a physician, Rex and his colleagues provided counselling services from the Cottage. Rex's focus was always on the importance of human relationships, "getting on with people in the world", in the practice of medicine.

Rex was always interested in people from different and disadvantaged backgrounds—the gay community, the drug culture. He always wanted to learn more about people, and saw the best in them. He and Valerie would take recovering addicts to stay with their family. When Rex worked at what was then called the VD clinic, he met the Hell's Angels, whom Rex and Valerie then welcomed to their home to listen to music. At Rex's invitation, the Hell's Angels gave the Dean's Lecture at the medical school to a packed audience. Rex could see the good in everyone.

He emphasised the doctor-patient relationship, for medical students to see the whole person, not just the illness. With Valerie and others he ran weekends using multimedia playback theatre and psychodrama, for students to interact with each other through music and painting. Felix Donnelly set up Youthline at that time, and there was a lot of crossover with that and the multi-media workshops.

Rex took a busload of students up to the Roma Marae in Ahipara, and in return, 50 Māori from Roma came to visit, slept on the floor of the cafeteria for four days, and were instrumental in setting up a medical school marae. The 1970s saw the rise of communes. Rex was often approached by groups who were running into strife, in places like Colville, Great Barrier Island and the Beeville community on the Hauraki Plains. He would go to help, sometimes also taking students and staff. Along with David Lange (who was later to become Prime Minister), Rex helped start the first New Zealand Citizens' Advice Bureau in Ponsonby.

Hells Angels at Dean's Lecture with Rex Hunton during the 1970s.

He was also a founding member of the Auckland Medical Aid Centre, New Zealand's first abortion clinic, which opened in 1974. They set up a clinic in Remuera offering counselling and termination of pregnancy if this is what the woman wanted. Despite political upheaval, a police raid and protesters outside their home smashing their car, the clinic remained open, led to a change in the law, and eventually to abortion services becoming available for women throughout New Zealand.

In 1985 the Dean asked Rex if he would like to go to help out with some doctor staff problems in the School of Medicine in Papua New Guinea. This was the start of Rex and Valerie's 14-year sojourn in the Pacific. The Marshall Islands followed, and after a brief return to Auckland they moved to the Caroline Islands in 1987. Rex practised medicine and helped set up a medical school to train doctors, and Valerie advanced her wonderful art, using paint and collage and whatever materials she could access in their remote locations. In 1993 they moved to Fiji where there was a growing school of medicine, and finally returned to New Zealand in 1999.

In 2002 Rex was honoured with the New Zealand Order of Merit for devoting many years to improve the quality of health services in New Zealand and in the Pacific.

Rex taught me at Auckland Medical School in the 1970s. He has inspired me, he has been my mentor, and my friend. He is a strong man with a gentle loving soul. I feel blessed to have known him, and had Valerie and him in my life for so many years.

Rex is survived by his beloved soulmate Valerie, daughter Ingrid, sons Blake and Carl, and four grandchildren.

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This obituary was written by Felicity Goodyear-Smith.

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www.nzma.org.nz/journal-articles/rexley-blake-hunton

 

# Spinal Anaesthesia

*By* ALFRED C. SANDSTON, M.D., F.R.C.S.E.

(Read before the Canterbury Division of the British Medical Association).

I may be excused for the comparative scrappiness of this paper when I state that I have had only six days' notice for its preparation; but the subject is an interesting and important one, and these notes may be provocative of discussion both interesting and informing and help to spread some knowledge.

Spinal anaesthesia has a definite place in the surgical armamentarium for operations below the costal margin. It may be used, and has been, for operations higher, but it must always be risky to do so if a full degree of surgical anaesthesia is to be obtained. Jonnesco of Bucharest claims to do mastoid operations by its aid without risk, but his results are open to doubt. The position of spinal anaesthesia as of definite value is well based on the following advantages :—(1) It avoids the necessity of such stringent "alimentary" preparation as general anaesthesia demands. (2) lt allows of oral administration of stimulant and food during the operation. (3) It permits of early feeding after operation. (4) It does away with the exhausting post-operative sickness and starvation, and (5) therefore greatly lessens the risk of precipitating acidosis. (6) It diminishes shock and is the best method of anoci-association. (7) It relaxes muscle, to the greatest degree and is of inestimable value, therefore; in plating fractures, and in suprapubic prostatectomy, reducing dislocations, and so forth. (8) It is useful where anaesthetic help is not obtainable. (9) It is useful in cardiac cases. (10) It helps to avoid post-operative risks such as in pneumonia; in great age, vascular degeneration, low urinary specific gravity, emphysema, and bronchitis. Its disadvantages are not so obvious. (1) The fact that the patient would be able to see and hear what is going on is incontestable, but easily prevented by screen and woollen plugs in the ears. (2) Nervousness is dealt with by morphia or minimum doses of general anaesthetic. (3) Pain of performance is minimum and can be entirely obviated by preliminary novocain and skill in technique. (4) Vomiting occurs sometimes, (5) headache occasionally, (6) pains in the limbs seldom. (7) Shock is very rare, as also (8) interference with respiration, and (9) paresis or paralysis as an after result, so far as I know, never. What solutions should be used? Here we are concerned with (1) the drug and (2) the character of the solution. Two drugs practically hold the field—novocain and stovain. Novocain is admittedly the less toxic, but during the war was practically unobtainable. In addition, it has to be used in about doable the dose of stovain. Hence the difference in toxicity is in practice greatly lessened. Stovain is easily obtainable, and if used with discretion the difference in toxicity is so little as to be negligible. I have been compelled to always use stovain, and so far have never had cause to regret it. Jonnesco uses stovain and strychnine, the object of the strychnine being to hinder the paralysing action of the stovain on the bulbar centres.

The character of the solution has been much varied, but mainly in the direction of weight of solution. Beginning with Barker's weighted solutions loaded with glucose, and ending with Babcock's light solutions acidified with lactic acid. Opinion has definitely been cast for solutions of the same specific gravity as the spinal fluid itself. In cases of shock due to the nature of the patient's trouble or to overdose it is impossible to use the head-low position, nor in cases where it is required, the Trendelnberg position, if the weighted solution is used. Obviously the solution lighter than the spinal fluid has similar, if opposite, disadvantages. The solution which I have always used is that of Billon, prepared and sent out in ampoules by Poulenc Frères. This is isotonic with the spinal fluid and permits of the Trendelnberg position being used at once if desired. In the "Lancet" of about June, 1916, H. M. Page published a number of cases illustrative of the advantage of spinal anaesthesia, and included a number of cases where I had

administered the anaesthetic and the Trendelnberg position was used within a quarter of an hour. These were the first or among the first reported. The drawback of the ampoules is that they tend to become inert by the passage of time due to the destructive effect of alkaline glass on the drug. It is, however, claimed that the glass of the ampoules is non-alkaline.

Technique of injection.—Barker's intraspinal needles are the best on account of the short point, which avoids as far as may be the danger of being half in and half outside the meninges. It is also furnished with a blunt cannula for injecting the anaesthetic through the needle as an additional safeguard against this accident.

The Position of the Patient.—I do not approve of the sitting posture unIess in special cases. In most patients their trouble alone will prevent the use of the sitting position. I always use the lateral posture, with the head and knees curled up, so to speak, and thus open up the interspinous intervals. If there is no contraindication I use the left lateral posture, but I always take care that the side, if it is not a median incision, on which the operation is to take place should be the under side. It should be a point of great importance to withdraw the syringe as quickly as possible after the injection, so that the patient may be at once turned on the back. Otherwise a one-sided anaesthesia will result. This will not so much matter if it is a one-sided operation, but hence the importance of using the lateral posture with the operation side undermost, and concurrently the importance of at once turning them over on the back where it is not a lateral operation.

The site of injection varies with the height of anaesthesia required. Jonnesco distinguishes a medio-cervical, upper dorsal, dorso-lumbar, and lumbar. He varies the dose according to the height of anaesthesia required and the condition of the patient. Failure to observe these conditions, according to him, is responsible for such fatalities as have occurred. I keep to the interval between the second and third lumbar spines, never injecting higher, and often using the fourth interspinous interval if the operation is at or below the perineum. I always enter the point in the middle line. I find this much the more certain and much easier to enter the canal, and, indeed, that this must be so is fairly obvious. The diameter of the spinal canal in cross section lessens much the more as we approach the outer edges. Its greatest diameter is in the middle line. The cannula's point is purposely made short so that the length of its oval exit will be short for the small space involved, and the point of the cannula will in the middle line encounter the greatest diameter of the subdural space. By entering the needle to one side of the middle line the angle of entry must be guessed by which the point will encounter the interlaminar space and the meninges in the middle line. This varies with the depth of the laminae from the surface. Entering the needle in the middle line does away with this variable factor and makes greatly for accuracy of entering the subdural space at its widest point.

I never find it necessary to use a preliminary injection of novocain, as it is as painful as the actual spinal needle, but I often use a tenotomy knife to puncture the skin first. When the patient is turned on the back the procedure varies with the height of anaesthesia required. For operations on the lower limbs or genitals or for inguinal hernia a flat position will give the required height of anaesthesia. For subumbilical incisions and for those in the upper abdomen it is necessary to raise the pelvis on a sandbag and flex the thighs on the abdomen. At the same time the head is raised on a pillow and the body viewed laterally so as to make the lowest point of the concavity of the anteflexed spine not higher than the mid-dorsal region. This position is maintained for five minutes, when in most cases the anaesthetic is fixed and will not travel higher than it has already done. Lowering the heels on to the table with a flat sole reveals the success or failure by paresis of the adductors of the thigh. It is now generally conceded, and is also a fact, that it is better to keep the head low from the first. In this way shock is lessened. But this matter of shock will be dealt with later.

At this point in the technique we see that the height of the anaesthesia is regulated by the two preceding factors, namely, the site of injection and the position of the patient.

Depth of Anaesthesia Regulated by Dose Activity of Solution.—The depth of the anaesthesia also depends on more than one

factor. These are the dose injected and the activity of the solution. The maximum dose of stovain should never exceed .07 grammes or .7 c.c. of a 10 per cent. solution. I have seen shock result from .06 grammes, which I personally never exceed, and the only case in my series where death might possibly have been accelerated by the injection, although this is open to doubt, had only .06 grammes. The patient, however, in this case was a very bad surgical risk in any case. She had a 48-hour-old acute intestinal obstruction with foecal vomiting, and had old-standing valvular disease. I regard the maximum dose as .06 grammes. The activity of the solution is in inverse ratio to its age, but not necessarily in direct proportion. I have used ampoules two years old with success and failed with new ones. The reason is that the slightest trace of alkali neutralises the drug.

Incidents of Anaesthesia—Recognition of Success.—The succession of events after the injection is of interest. At the outset he may feel tingling in the leg or legs, especially if the needle has been somewhat laterally inserted in the subarachnoid space. Gradually the legs feel heavier, and at the end of five minutes, if the soles of the feet be placed flat on the table so that the knees are bent up, the adductors of the thigh being early affected, allow the thighs to fall outward. After that the paralysis quickly extends from below upwards, but does not reach its greatest extent for at least a quarter of an hour. The success of the anaesthesia can be recognised from the flaccidity of the abdominal muscles and the diaphragmatic nature of the respiration in cases where the lower intercostals are parsed. There is no. doubt that where the muscular paralysis is deep the anaesthesia also is deep, but many cases have a perfectly good anaesthesia with but little muscular paresis. In fact, in many cases the best description is spinal analgesia. Often the patient can recognise a touch but can feel no pain. In these cases, however, handling of or traction on the peritoneum will cause pain. In about fifteen minutes from the injection in a good anaesthesia very often the patient will show pallor, sweating, quickened pulse, and end by vomiting. In England, where I gave my first cases (about 35 in number), and also where I saw the anaesthetic given by others; this sequence of events was the common sequel. It has been ascribed to the toxicity of the stovain and its absorption into the blood stream, and it has been ascribed to shock due to splanchnic paralysis, and stasis of capillaries in the splanchnic area. It has been attempted to avert or lessen it by drawing off a large quantity of cerebro-spinal fluid before making the injection. The theory was that as the tension is higher in the cerebro-spinal fluid than in the blood, lessening the pressure will result in a diminished absorption of stovain into the blood stream. I have never seen lowering the pressure have this effect of preventing vomiting, and in 160 cases in which I have not followed this practice I have seldom seen vomiting. I feel sure that it is mainly a toxic effect of the stovain, because where I have had extremely good anaesthesia with all the elements of capillary stasis in the splanchnic area I seldom have had vomiting. I feel sure that I do not get it because I am careful to keep to .06 grammes as a maximum dose and because the ampoules are, in addition, somewhat lowered in stovain content by the time necessary to journey to this country.

In this connection the duration of the anaesthesia comes up for consideration. It varies, of course, with the success of the anaesthesia so far as depth is concerned. A light anaesthesia will not last long. One may, however, repeat that sense of touch is often regained long before the sensation of pain, and the patient may be able to move the toes and to recognise contact with complete analgesia still present. I have continued to operate for so long as one hour forty minutes. This was a case of a woman of about forty, the subject of chronic bronchitis for about 25 years. I did a cervical amputation, anterior colporrhaphy, an extensive colpoperineorrhaphy and ventral fixation for uterine prolapse. I used spinal anaesthesia because I feared the effect of a general anaesthetic on her chest and because the nature of the trouble (probably caused by her chronic cough as much as anything) made cough and post-anaesthetic vomiting more than usually undesirable. In spite of the use of spinal anaesthesia she had some chest exacerbation. However, she did extremely well, and I give the spinal method a good deal of the credit.

ln another case, that of a trained nurse, I used spinal anaesthesia because she suffered severely from vomiting after ether or chloroform. This woman weighed about 20 stone, and had had about fourteen years previously one large ovarian cyst removed, after which she vomited for seven days. Seven years later I removed a second large ovarian cyst and remarked then on the extreme tenuity of the abdominal wall, and warned her of possible hernia. She was violently sick for fully five days after this operation. Now she had a large ventral hernia. The operation took one and a quarter hours and was completely successful. She was not sick.

Looking over my cases, I find I have performed 160 operations under spinal anaesthesia and administered the anaesthetic in 35 others. Less than six vomited during the anaesthesia, and it was a severe feature in no case. Two cases had late vomiting coming on two days after and lasting about a week. I can only put it down to some irritative disturbance of meninges or brain. They got quite well.

A small number complain of frontal headache for about a week. I think it was more evident where much spinal fluid was run off, and I very seldom get it now because I run off the minimum and also insist on careful handling of the patient and a reduced diet after operation. So many feel so well that they eat more than they should, having regard to the confinement to bed.

I may say here that I use the preliminary injection of morphia and atropin, and have them prepared as for a general anaesthetic in case such should be necessary.

In one man of 65 I operated for double scrotal hernia and l felt sure that a serious result was averted by the spinal anaesthetic. He had a chronic nasal trouble and told me that his chest got bad as soon as he lay any time in bed. On the third day after operation he got a hypostatic pneumonia with a temperature of 102 F. He gave me no real anxiety such as I would almost certainly have had after a general anaesthetic, and remained only in his bed the ordinary time. l may say, however, that I am not so satisfied that a spinal anaesthetic is more than usually desirable in cases of grave abdominal trouble, especially those with vomiting due to relatively long-continued acute obstruction. The case that I have mentioned of an old woman about seventy, with oldstanding heart trouble and foecal vomiting, who died before operation and soon after the administration of the anaesthetic, is a case in point. She was given a spinal anaesthetic to save her heart, and just before the incision was made she suddenly collapsed and died. She was desperately ill and must almost have certainly died in any case, but the anaesthetic did not help as one would expect.

Another similar case of an old woman with an acutely strangulated femoral hernia several days old did extremely well for about five days after operation and the stopped. She died suddenly on the fifth day, although she had taken food and so on. She would probably have died in any case, but I think the splanchnic area stasis did not help her.

In two patients I have for various reasons given three successive spinal anaesthesias, but with a few weeks' interval between each administration. One man showed that analgesia helps to avert shock. This poor fellow had both thighs run over by a tramcar. I was not immediately available, and it was attempted to administer a general anaesthetic to clean up the compound fractures. The man so nearly died after a few drops that the anaesthetist desisted. I was sent for and gave a spinal. Both legs were amputated through the thighs, and the man's condition improved as a result of the anaesthetic. He lived 24 hours. It is in this class of case where spinal anaesthesia is desirable and will lessen and prevent shock. Where, however, the shock proceeds from loss of fluid constituents of the body or a combination of loss of fluids and disease in the splanchnic area, it, in my opinion, may be a danger.

Included in my cases I find notes of the following operations performed under spinal anaesthesia:—Prostatectomy, 19; combined operation of internal and external urethrotomy, 2; internal urethrotomy, 11; litholapaxy, 1; hernia, 25; ventral hernia, 3; hydrocele, 3; bone plating, 2; bone grafts, 6; appendectomy, 7; appendectomy with evacuation of pregnant uterus and severe acidosis (this case had a few drops of ether), 1; amputations (single 8, double 2, hip-joint in adult, for sarcoma, 1), 11; appendectomy and salpingectomy, 1; Wertheim hysterectomy, 4;

gallstones (a small amount of ether given), 1; amputation of cervix, anterior colporrhaphy, colpoperineorrhaphy, and ventral slinging of uterus, 2. In addition there were several cases of amputation of the cervix with perineal repair, and a number of minor operations such as removal of semilunar cartilages, needle in foot, orchidectomies, currettage, urethral repair, setting fractures, and so on.

Since writing the above I had occasion to operate on a man of 33 for a strangulated left inguinal hernia of large size. The hernia was reduced before he was operated on, but, feeling that it might strangulate again and knowing the advantage of spinal anaesthesia, I operated under that anaesthesia. He has done well in all respects, in spite of his great age. In this connection I might mention that in one short period of about three weeks I operated for prostatectomy on cases of the ages of 76, 79, 81, 86, and 89. The man of 89 had his 90th birthday a few weeks after his operation. All did well. One of the hernia operations was done under spinal anaesthesia with a successful result on a man of 79.

In conclusion, one may state that those patients who have had an opportunity of comparing their condition under general anaesthesia after one operation with their condition under spinal anaesthesia in another operation soon after always prefer spinal anaesthesia.

**URL:**
www.nzma.org.nz/journal-articles/spinal-anaesthesia

# Abstracts for the 248th Otago Medical School Research Society Summer Student Speaker Awards

Wednesday 8 May 2019

## The cooling efficiency of different dental high-speed handpiece coolant port designs

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High-speed handpieces (HSH) are the most commonly used equipment in today's dental practice, with new designs constantly being developed. Water coolant ports are important features of HSH, as water is required to damage to the tooth from frictional heat produced by the handpieces. The reference temperature increase of 5.5˚C is used as the threshold above which is damaging. The aim of the study was to examine the cooling efficiency of different numbers of water coolant ports on HSHs under cooling conditions used in the dental practice.

Thermocouples were placed in the pulpal chambers of extracted human premolars and temperature changes were recorded during cutting of the tooth with 1-, 3- and 4-coolant port handpieces. The cooling rate was calculated for each coolant port design system and temperature changes were statistically analysed using the Kruskal-Willis Test.

All three sample groups (n=8/group) resulted in a net temperature decrease during the cutting period. There was a pattern of increased cooling rate with increasing number of coolant ports (group: mean ˚C (SD), 1-port: -4.27˚C (0.94), 3-port: -4.66˚C (2.90), 4-port: -5.03˚C (1.08). ($P$=0.681). The calculated cooling coefficient showed a higher cooling rate with an increase in number of ports (1 port: $46.13 \times 10^{-4} K^{-1}$, 3-port: $51.36 \times 10^{-4} K^{-1}$, 4-port: $56.32 \times 10^{-4} K^{-1}$).

Various designs of HSHs with different numbers of coolant ports are available for dental clinicians in the market. Under the clinical conditions simulated, all three coolant port designs resulted in efficient cooling of the tooth and decreased pulpal temperature, with no statistical significance between the handpieces. It is unlikely that the number of coolant ports alone will have a clinically significant impact on the HSH cooling. Further investigations in this area are required to better understand the cooling mechanisms of HSHs.

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## Examination of the cardiac mitochondrial-linked preconditioning mechanism of oCOm-58

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A new class of carbon monoxide (CO) delivery molecules (oCOms) have been developed as potential therapeutic agents in a range of predicted acute ischaemic conditions. Such conditions can include myocardial ischaemia associated with cardiac bypass procedures. In order to improve our understanding of the functional mechanism of oCOms as cardioprotectants, we studied the effects of the fluorescent oCOm-58 analogue on human cardiomyocytes.

Human cardiomyocytes (AC-16) were grown in 96 well black-walled plates and treated at 80% confluency. Specifically, we examined the impact of oCOM-58 (10μM) on cellular CO levels and mitochondrial function in conjunction with the cellular accumulation of the fluorescent degradation byproduct of oCOm-58. A fluorescent wavescan was conducted (SpectraMax-I3C) to identify excitation/emission wavelengths for detecting the oCOm-58 byproduct and applied to the confocal imaging protocol. The CO-fluorescent trap (COP-1, 1μM) and MitoTracker® Red CM-H2XRos dye (Mitotracker, 200nM) were applied to the oCOM-58 treated cells and imaged using a Nikon A1+ inverted confocal microscope at 30–240mins. A two-way analysis of variance with Bonferroni *post-hoc* analysis was conducted (Prism v6) on the FIJI-Image J densitometric analysis from n=3 experiments.

Analysis provided confirmation of oCOm-58 cellular loading and localisation, a cellular accumulation of CO and a temporal change in mitochondrial membrane potential (MMP). Quantification of the fluorescent intensity of the

MMP-dependent MitoTracker dye showed a time-dependent decrease ($P$<0.05) in MMP which correlated with an increase ($P$<0.05) in the cellular localisation of the fluorescent CO-COP-1 product at 80 mins. MMP levels recovered at 240 mins once CO levels had dissipated. A time-dependent increase in the cytoplasmic appearance of the fluorescent oCOm-58 byproduct was noted after 150 mins.

These findings support the hypothesis that CO creates a temporary MMP fluctuation and may explain the cardioprotective effects of oCOms. Further experiments will investigate the impact of oCOms on mitochondrial enzyme activity.

*This work was supported by School of Biomedical Sciences Summer Research Scholarship.*

## Consideration of healthy food, beverage and alcohol policy documents by New Zealand national sporting organisations

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Sports clubs' mandate to keep participants healthy through physical activity may be undermined if they offer and promote unhealthy food and beverages and have substandard alcohol regulations. National Sporting Organisations (NSO's) are sport-specific governing bodies that manage and coordinate affiliated sports clubs. This study aimed to assess New Zealand NSO's nutrition and alcohol policies against a best practice framework developed from the scientific literature.

A literature review was used to inform a best-practice framework for nutrition and alcohol policies for sporting organisations. A web-based search was performed to obtain NSO policy documents, additional policy documents were requested from NSO's following a semi-structured telephone interview. Content analyses of policies and interview transcripts were deductive using the best-practice framework to benchmark policies.

Of the 96 NSOs included in the study, only 17 had nutrition policies. Nine NSOs had policies concerning the free provision of water and seven had policies concerning nutritional information and education to members and staff, and one had a policy that promotes the sale of healthy food and beverages. One NSO recommended fast food outlets as a sponsor for junior clubs. Of the 96 NSOs included in the study, 45 had a specific alcohol policy. Only five had a policy that complies with the Sale and Supply of Alcohol Act, two had a policy to restrict sale and consumption of alcohol at junior sporting events, and one had a policy to restrict alcohol promotions.

Overall, most New Zealand NSO's lack nutrition and alcohol policies and very few are consistent with the best practice frameworks. The best practice framework may inform the development of suitable NSO policies in the future.

*Supported by the Health Sciences Division of Otago University.*

## The outcomes of patients seen at the Joint Clinic, a multidisciplinary chronic disease management program, at five years

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The Joint Clinic was developed to manage patients referred to the orthopaedic department with hip or knee osteoarthritis (OA). The purpose of this study was to audit the outcomes and investigate factors that may influence success or failure of non-operative treatment.

This is an observational cohort study of 337 patients originally seen at the Joint Clinic with hip (n=151, 45%) or knee OA (n=186, 55%), with a mean follow-up of 5.5 years. Questionnaires were sent to all patients, which included questions to assess Oxford hip (OHS) and knee scores (OKS) (0–48, with 48 being the best score). National Joint Registry and hospital records identified any patients undergoing surgery.

Baseline demographic details collected included age, (hip 66.4 y (SD 11.6), knee 68.1 y (SD 9.2)), gender (150 males (45%), 187 females (55%)), body mass index (BMI) (hip 28.4kg/m$^2$ (SD 5.1), knee 32.0kg/m$^2$ (SD 5.7)), OHS 20, (SD 8.7), OKS 19, (SD 7.8) and Kellgren-Lawrence (KL) radiographic grade.

At five years, 185 (55%) patients had undergone or were awaiting total joint arthroplasty, 133 (39%) were still being managed non-operatively, and 19 (6%) had died. Patients with hip OA were more likely to have required surgery (109/151, 72%) than patients with knee OA (76/186, 41%) (chi-square = 32, $P$<0.001). Worse x-ray presentation at baseline was a predictor of surgery with 150/225 (67%) at severe stage (KL 3/4) requiring surgery compared to 33/110 (30%) at mild-moderate stage (KL 1/2) (chi-square= 40, $P$<0.001). There was no association between BMI, gender or age and risk of receiving surgery. At five years the non-operative group had a mean OHS of 23, OKS of 24. The surgical group had a mean OHS of 40, OKS of 38.

Conservative management may be effective in milder disease especially of the knee but has a limited role in hip OA. The results of joint replacement are very successful.

*Supported by a Department of Surgical Sciences, DSM Summer Studentship.*

## Increased major histocompatibility complex class I expression on Langerhans cells following microparticle co-culture

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Microparticles, generated from the membrane vesiculation of cells, possess both immune stimulatory and inhibitory functions. It has been previously reported that microparticles shed from keratinocytes expressing the human papillomavirus type 16 (HPV16) E7 oncogene impaired Langerhans cell (LC) function. This study investigated the regulatory effects of HPV16 E6 and E7 (E6/E7) microparticles on LC surface expression of major histocompatibility complex class I (MHC-I) molecules and LC cross-presentation to CD8+ T cells.

Microparticles were purified from mouse keratinocytes with or without E6/E7. The regulatory effects of co-culture with E6/E7 microparticles on LC surface MHC-I expression were analysed by flow cytometry. The mean MHC-I expression on LC increased following co-culture of E6/E7 (9,989, SD 982, $P<0.01$, n=3) or control microparticles (9,145, SD 537, $P<0.05$, n=3) compared with the no microparticle control (6,737, SD 685, One-way ANOVA, Sidak's multiple comparisons test). There was no significant difference between E6/E7 or control microparticle treatments (n=3). The effect of E6/E7 microparticles on LC cross-presentation was investigated by pulsing microparticle-treated LC with ovalbumin then co-culturing with CD8+ T cells. Preliminary results showed an 8.7% increase in proliferating T cells following control microparticle treatment and a 2.1% reduction with E6/E7. With the addition of brefeldin A, a cross-presentation inhibitor that blocks the translocation of endogenous MHC-I molecules onto the LC surface, proliferating T cells were reduced by 9.3% compared to the untreated control. Interestingly, proliferating T cells were increased following the co-culture of microparticle-treated LC, suggesting a microparticle-driven transfer of MHC-I molecules.

This study provides the first evidence that microparticles shed from keratinocytes increase surface MHC-I expression on LC. Further independent experiments will be conducted to corroborate our cross-presentation findings and offer a potential microparticle-mediated mechanism to enhance CD8+ T cell responses.

*Supported by a summer scholarship from the Dunedin School of Medicine.*

## Long-term clinical benefits of the diabetes community exercise programme (DCEP)

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Inadequate physical activity and unfamiliarity of diabetes self-management can lead to severe health complications in individuals with type 2 diabetes mellitus (T2DM). This prevails in populations at high risk of developing T2DM, including Māori and Pacific people and those living in low socioeconomic areas.

The School of Physiotherapy, University of Otago, designed the Diabetes Community Exercise Programme (DCEP), a 12-week inter-professional and whānau-supported programme, partnering with Wellsouth Primary Health Network. The programme included 45 minutes of exercise and 45 minutes of education twice a week for 12 weeks, followed by a non-compulsory, twice-weekly, 60 minutes maintenance exercise class.

An earlier study by the School of Physiotherapy indicated short-term improvements in physical performance and exercise behaviour from DCEP. This study aimed to prospectively evaluate long-term clinical outcomes from DCEP. Additionally, this study explored whether further health benefits were attained from attending ongoing maintenance classes.

The study evaluated 57 consented DCEP participants (Mean age= 60.44 (yrs), SD=13.72) and 22 people opted to attend maintenance classes. Measures were taken at baseline (T0), at 12 weeks (T1) [after completion of DCEP], six months (T2) and 12 months after the programme (T3).

Friedman's ANOVA showed statistically significant differences ($P<0.05$) between T0 and T3 for median scores of waist circumference (-2.0cm), six-minute walk distance (+54m) and exercise confidence score (+7 points). Additionally, there were statistically significant differences (Wilcoxon's test, $P<0.05$) between the groups that attended the maintenance classes (n=22) and did not attend the maintenance classes (n=35) for weight (-0.7kg), body mass index (-1.2kg/m$^2$) and waist circumference (-0.5cm) from T0 to T3.

Overall, the results imply that participating in DCEP had clinical benefits on health and well-being in the longer-term and these effects improved with attendance of maintenance classes.

*Supported by a Division of Health Sciences Summer Scholarship.*

**URL:**
www.nzma.org.nz/journal-articles/abstracts-for-the-248th-otago-medical-school-research-society-summer-student-speaker-awards

# Abstracts for the 249th Otago Medical School Research Society Research Staff Speaker Awards

Wednesday 24 July 2019

## Measuring dopamine with transporter and auto-receptor blockade during cued reward behaviour: implications for attention-deficit/hyperactivity disorder mechanism and Parkinson's disease treatment

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Dopamine signalling is crucial to motivation, movement and cognitive function, and has been implicated in both attention-deficit/hyperactivity disorder (ADHD) and Parkinson's disease. Methylphenidate increases extracellular dopamine by blocking reuptake via the dopamine transporter. It is an established treatment for ADHD and has been used with poor results as a treatment for Parkinson's disease.

We investigated the dynamics of striatal dopamine release in rats after methylphenidate administration *in vivo* during a signalled reward task using fast scan cyclic voltammetry. Dulled phasic responses led us to test whether dopamine D2 receptor (D2R) mediated autoinhibition might be obscuring an effect of the drug. D2R blocker raclopride was administered as a micro dose simultaneously with methylphenidate, and compared to each drug alone and vehicle.

One-way ANOVA confirmed a significant effect of treatment ($F_{3,15}$=7.057; $P$=0.004) with post-hoc Tukey's tests confirming that the mean dopamine signal after combined treatment (mean±SD 11.1±3.1 nM) was significantly higher than after treatment with saline (3.1±2.0 nM; $P$=0.003), raclopride (5.0±4.0 nM; $P$=0.02), or methylphenidate alone (4.7±3.4 nM; $P$=0.02). There were no differences between saline, raclopride and methylphenidate treatments.

Increased response to the combined treatment implicates D2R mediated homeostatic control of phasic firing as the target for the treatment of ADHD with methylphenidate, enabling down-regulation of phasic firing via up-regulated autoinhibition. Thus, an imbalance in D2R mediated phasic firing homeostasis is likely to play a role in the mechanism of ADHD itself. The substantial rebound of dopamine signal in response to both cue and reward also suggests the potential of the two drug combination to rescue methylphenidate as a treatment for Parkinson's disease. Magnifying dopamine release in conjunction with naturally occurring stimuli has implications for improving current treatments and associated side effects.

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## Understanding the subtleties of development of atherosclerosis and the effect of sex hormones

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The New Zealand Ministry of Health estimates that cardiovascular disease accounts for >32% deaths/year across all age ranges. The underlying pathological change is progressive stenosis (narrowing) of arteries as atherosclerotic lesions develop. Sex differences in atherosclerotic susceptibility are apparent, although the root cause of these differences is not fully understood. One theory is that oestrogen beneficially influences the composition and progression of lesions. However, female hormone replacement therapy has been associated with increased atherosclerotic

risk. Therefore, the aim of this study was to investigate the effect of oestrogen treatment on atherosclerotic lesions.

Twenty-five week old female ApoE$^{-/-}$ mice were treated for eight weeks with subcutaneous bi-weekly injections with either 3µg/g of 17β-estradiol (E2, n=7) or ethanol (vehicle control, n=11). Mice were euthanised by $CO_2$ inhalation followed by fixation with 4% paraformaldehyde. Histological sections (4µm) along the length of the brachiocephalic artery were prepared, photographed and analysed. Atherosclerotic lesions were measured using Fiji-Image J software. Images were sub-divided into four anatomical regions before the lesions were scored (0–6) using a modified clinical scoring system. In addition, different parameters of lesion composition were also scored (0–3) for initial thickening, foam cells, lipid collection and cholesterol crystals.

Comparison (Students *t*-test) of lesions of E2 treated (n=7) to vehicle control (n=11) showed (mean±SEM) no increase in lesion volume (0.14±0.03 *cf.* 0.09±0.02 mm$^3$, *P*=0.215), or stenosis level (31.8±4.3 *cf.* 28.1±4.4%, *P*=0.556). However, the E2 treated group had significantly increased intima thickening score (2.9±0.04 *cf.* 2.7±0.1, *P*=0.04) and a trend for increased cholesterol crystals (1.1±0.3 *cf.* 0.6±0.2, *P*=0.08). Therefore, subtle alterations to lesion composition may underpin anecdotal evidence that E2 treatment increases risk in cardiovascular disease.

*Supported by the National Heart Foundation, New Zealand.*

## A non-coding genetic variant associated with abdominal aortic aneurysm alters *ERG* gene regulation

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Abdominal aortic aneurysm (AAA) is an irreversible weakening and enlargement of the abdominal aorta and a major cause of sudden death in the elderly. Recently, four novel single nucleotide polymorphisms (SNPs) specifically associated with AAA and not with other cardiovascular diseases or risk factors have been identified. These variants are located in non-coding DNA, and it is unclear how they contribute to AAA pathogenesis. Here, we investigated the gene regulatory function for one of the non-coding SNPs associated with AAA, rs2836411, which is located in an intron of the *ERG* gene.

We show that rs2836411 is located in an enhancer element in vascular endothelial and haematopoietic cell types, and that the risk allele significantly reduces enhancer activity in cell culture (*P*<0.0001, Sidak's multiple comparisons test, six biological replicates). Enhancers can regulate the expression of proximal or distant genes by directly contacting them via chromatin looping. To identify whether rs2836411 regulates the expression of *ERG* and/or of distant genes, we identified the chromatin interactions formed. In vascular endothelial cells, which express *ERG*, the SNP region interacts highly within the *ERG* gene, while in vascular smooth muscle cells, which do not express *ERG*, the interactions are distributed across a wider region. This indicates that rs2836411 directly contacts the *ERG* gene promoters. Furthermore, the risk allele correlates with reduced *ERG* expression in aortic and other vascular tissues.

In conclusion, our results indicate that rs2836411 likely affects *ERG* expression by altering enhancer activity. This study links a non-coding genetic association with AAA to the *ERG* gene, thereby providing evidence for a novel gene specifically involved in AAA formation. ERG is involved in vascular development, angiogenesis, and inflammation in atherosclerosis, therefore mechanistically, rs2836411 could contribute to AAA by modulating ERG levels.

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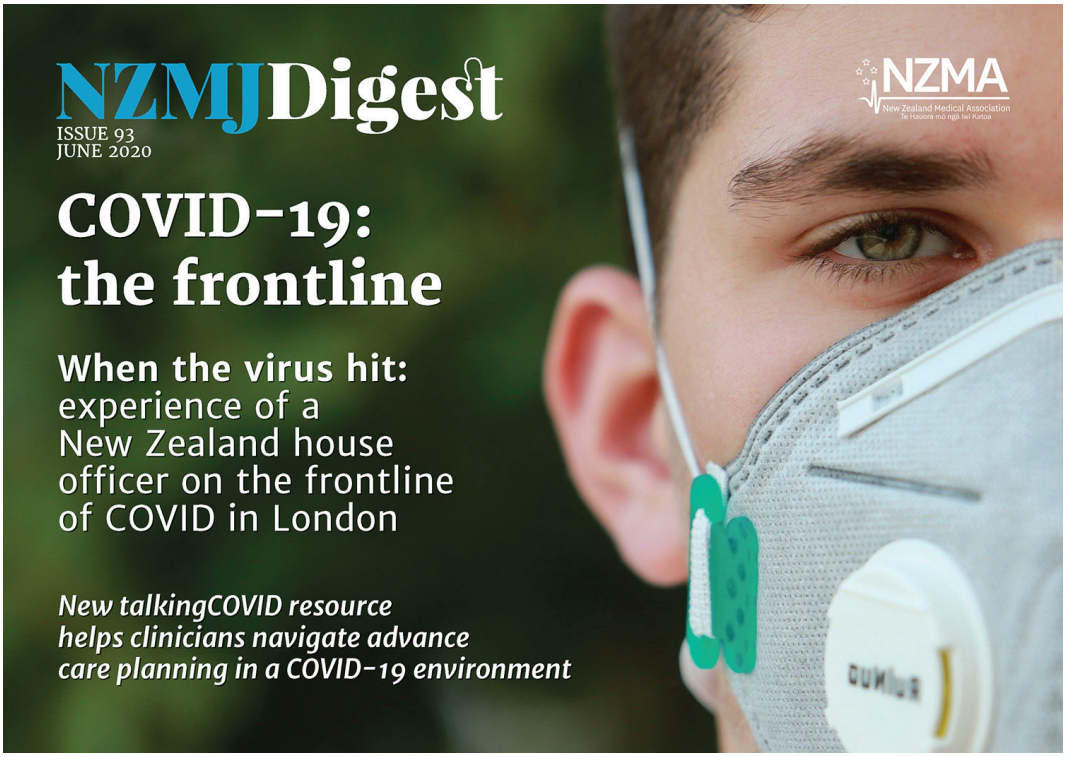


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