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Robin Gauld, Carol Atmore, Jo Baxter, Peter Crampton, Tim Stokes

The 2018 year signalled the 80th anniversary of the Social Security Act 1938. In order to implement this legislation, a historic compromise between the government and the medical profession created institutional arrangements for the New Zealand health system that endure to this day. The 2018 year also marked commencement of a Ministerial review of the New Zealand health system. This article considers two intertwined arrangements which stem from the post-1938 compromise that the Ministerial review will need to address if goals of equity and, indeed, the original intent of the 1938 legislation are to be delivered upon: general practice patient charges; and ownership models. It describes the problems patient charges create, and options for ownership that the Ministerial review might contemplate.

Self-harm in adults: a comparison between the middle-aged and the elderly

Yu Mwee Tan, Gary Cheung

This study compared self-harm in two age groups (45–64 years versus 65 years and above). Self-harm is defined as the direct, deliberate act of hurting or injuring the body, but without necessarily wanting to die as in suicide attempt. We found some key differences between the two age groups. Older people are more likely to report physical illness as a stressor, have a history of depression and be diagnosed with depression. Their intent is stronger and they have a higher risk of dying of all causes in the 12 months after their self-harm attempt. Suicide prevention in older people should address the emotional sequelae (including depression) of physical illness.

Specialist mental health care for older adults in New Zealand—an exploration of service models and routine data

Ruth Cunningham, Debbie Peterson, Adam Sims

This paper used a survey of DHBs and information reported to the Ministry of Health for the Northern part of New Zealand to investigate what mental health services are provided to older adults (from the age of 65). Two in every 100 older adults access mental health services each year. Many have already been in contact with mental health services before turning 65. Better and more consistent data collection and reporting is needed to understand the mental health needs of older adults.

The development and first six years of a nurse-led chest pain clinic

Andrew McLachlan, Chris Aldridge, Mildred Lee, Courtney Harper, Andrew Kerr

People who experience chest pain in the community that isn't considered life-threatening can wait a long time to be reviewed by specialist services. Most patients with narrowed arteries can be identified with a simple history and treadmill test that can be carried out by suitable trained and qualified nurses. In our health board we developed and have audited a nurse-led chest pain clinic for over six years and found the clinic was safe and effective and sees patients much quicker than the traditional model.

Lifetime risk of primary total knee replacement surgery in New Zealand from 2000 to 2015

Isobella S Henzell, Lifeng Zhou, Chris Frampton, Gary Hooper, Ilana Ackerman, Simon W Young

This study found that a person's lifetime risk of requiring a total knee replacement has increased significantly from 2000 to 2015. Currently the lifetime risk of total knee replacement for males and females is approximately one in six.

Video or verbal? A randomised trial of the informed consent process prior to endoscopy

Cameron Schauer, Tiffany Floyd, Jerry Chin, Alain C Vandal, Alex Lampen-Smith

Discussion prior to gastroscopy and colonoscopy, including risks and benefits is poorly done and usually varies widely between clinicians and hospitals. We attempted to use a video to improve this, but found that it did not change outcomes. Despite very poor recollection of what was discussed, patients in both the video and verbal explanation groups reported understanding of the procedure and satisfaction. Further work needs to be completed to improve this important process.

SF-12 indicators of health following the 22 February 2011 Christchurch earthquake

Megan J Pledger, Janet McDonald, Jacqueline Cumming

On average, people experiencing the 22 February, 2011 Christchurch earthquake had changes in their health status over time. On average, their physical and mental health initially improved (2011/12), then declined and reached a low point in 2013/14 and then improved. This is consistent with theories about people's health status and recovery following a disaster, although it usually happens over a shorter time frame.

Addition of explicit guidance to acute pancreatitis guidelines increases compliance with amylase measurement recommendations

Serin Cooper Maidlow, Michael Ardagh, Rosie Callender, Oliver Thomas

Clinical guidelines provide a source of evidence-based recommendations for healthcare professionals, allowing them to deliver the best care for their patients in accordance with local procedure and up-to-date research. A bullet point, called a 'Practice Point', was added to a hospital's guidelines which provided advice on managing acute pancreatitis (inflammation of the pancreas), to clarify and highlight when a particular blood test should be done and when it should be avoided. This led to a significant increase in compliance with this recommendation. This shows that clarity of recommendations affects compliance with clinical guidelines, and this is important because small changes like this can actually make big improvements in patient care.

Examining the accuracy of the New Zealand B4 School Check universal health service anthropometric measurements of children

Burt Hatch, Andrew R Gray, Rachael W Taylor, Maha Hanna, Anne-Louise Heath, Julie Lawrence, Rachel Sayers, Barry Taylor

Child weight data from the New Zealand B4 School Check assessment service was compared to data collected as part of a study that followed the World Health Organization protocol for weight measurement. This indicated that the New Zealand B4 School Check assessment service tends to overestimate child weight. This overestimation is greater when New Zealand B4 School Check assessments occur on colder days, suggesting that it is due to excess clothing. The New Zealand B4 School Check service monitoring child growth could be improved by including standardised procedures to account for non-removal of clothing.

Minimal risk of PFOS residues in eel to Māori consumers

Ian C Shaw, Te-Rina King-Hudson

PFOS was used extensively in fire retardants used to fight fires. It is banned in most parts of the world because of its toxicity—some studies have shown that it causes cancer. Taranaki Regional Council have shown that it is present in eels from a stream near to a place that fire-fighting foam has been used. Since eels are a Māori traditional kai (food), we have estimated eel consumption by Māori from two whanau and used this to estimate PFOS intake. We found that PFOS residues in eel are unlikely to be of concern from a cancer perspective, but are just below the highly conservative tolerable daily intake set by Food Standards Australia New Zealand (FSANZ).

The 'elephants in the room' for New Zealand's health system in its 80th anniversary year: general practice charges and ownership models

Robin Gauld, Carol Atmore, Jo Baxter, Peter Crampton, Tim Stokes

ABSTRACT

The 2018 year signalled the 80th anniversary of the Social Security Act 1938. In order to implement this legislation, a historic compromise between the government and the medical profession created institutional arrangements for the New Zealand health system that endure to this day. The 2018 year also marked the commencement of a Ministerial review of the New Zealand health system. This article considers two intertwined arrangements which stem from the post-1938 compromise that the Ministerial review will need to address if goals of equity and, indeed, the original intent of the 1938 legislation are to be delivered upon: general practice patient charges; and ownership models. It describes the problems patient charges create, and options for ownership that the Ministerial review might contemplate.

In the UK, 2018 marked the celebration of the 70th anniversary of the founding of the National Health Service (NHS), including the principles on which it was founded and how it functions with its focus on universal access to a full spectrum of services. Yet this was not the world's first effort to create a national health service. Indeed, some 10 years prior, the New Zealand Government passed its Social Security Act 1938.[1] This included goals of creating a national health service, along with other universally accessible state services such as education and social support. As with the NHS, the New Zealand legislation was underpinned by a series of values and principles. For health, and very importantly, these included that healthcare access should be universal and a right, with no barriers for patients to receive needed care; and that all New Zealanders should have equal access to the same standards of treatment.[2]

As noted elsewhere, these goals were not achieved.[2] Instead, a historic compromise

following passage of the 1938 legislation between the government of the day and the New Zealand branch of the British Medical Association (NZBMA) led to a very different health system canvas that endures to this day. The compromise followed considerable negotiation between the government and NZBMA.[3] For its part, the government sought to place all health professionals on the government payroll, as is the case for teachers and police in New Zealand. It wanted to expand investment in public hospitals and health services, such as primary care and general practice (at the time, very underdeveloped and only in certain parts of the country), and ensure that barriers—geographical and financial—to accessing care were removed.

Most doctors worked in community settings at the time, with their own practices (and general practitioners (GPs) continue to do so today), and the government proposed a form of national insurance to cover patient costs. This would likely have

resulted in a form of capitation payment, based on the number of enrolled patients with a practice and no direct patient charges to patients at point of service. The NZBMA's view, strongly held, was that this would erode the doctor-patient relationship. Its argument was that direct patient charges brought a strong focus on accountability to the patient. If a third party, the government, became involved, the 'personal arrangements' between doctor and patient would be affected through shifting a doctor's focus away from the patient and towards the demands of government.[4] While this was in counterposition to the views of the UK BMA's vice-president at the time, who visited New Zealand, and argued that fee-for-service medicine was equivalent to selling goods over the counter, and that doctors should not have to be concerned with presenting an invoice to patients, the NZBMA view prevailed.

The rest is history, and the price of that compromise is still resonating down the years. It is timely, in the 80th anniversary year of the 1938 legislation, to debate the adequacy of the institutional arrangements that resulted from the compromise. It is also timely for such debate as a New Zealand Government health system review, expected to deliver interim recommendations in mid-2019 and a final report early 2020, gets underway. Announced in May 2018, this review, expected to be "wide-ranging and firmly focused on a fairer future", is in response to a series of issues emphasised by the Minister of Health. These include a need to deliver equally well for all, to improve services for increasing numbers of older people and those with chronic diseases, and to focus more strongly on primary and community care in order to reduce pressure on hospital and specialist services. Undoubtedly, and in order to achieve these aims, the review will need to confront how New Zealand primary care and general practice are funded, including whether a break with the past and a completely new model is needed. It will also need to consider interrelated issues of ownership that stem from the historic compromise. The rest of this article outlines some of the issues and debates. It suggests options for the review to consider in terms of patient charges and ownership models, for primary care, general

practice providers, and the public—the funders and clients of our health services—to debate.

The problem with patient charges

New Zealand is in a peculiar position when it comes to general practice access and access to other health services. It is considered routine by New Zealanders to pay a fee to see a GP or practice nurse, and broadly accepted as 'how things work' in the health system. Yet all public hospital services, including outpatient and emergency services, are free of charge. One short-lived government attempt to install hospital charges in the early-1990s was a costly failure. In an attempt to balance hospital costs with general practice costs, it was administratively complex and politically damaging.[5] The public and health professionals all know that hospital treatment is accessible, with no payment barrier. It is simply tradition and discouragement that stop the public from using public hospitals more than they currently do for healthcare needs that could be at least as adequately provided by general practice. In general, district health boards (DHBs) as funders of public hospitals have never explicitly sought to move into the general practice market. That said, recognising the financial difficulties for patients who seek hospital consultations, some DHBs, all of which provide public hospital services and fund primary care, have implemented initiatives to encourage seeing a GP as an alternative. These range from providing payment vouchers to be used to access a private GP through to developing free general practice services adjacent to the emergency department.

The combination of fees to see a GP alongside free public hospitals is unusual globally.[6–8] Most health systems feature payments across the spectrum of care, or none at all. The UK NHS provides free general practice and hospital services as was the intent of the New Zealand Social Security Act 1938. The result in New Zealand is a significant percentage of the population routinely reporting service access barriers and avoiding medical and associated services through inability to pay.[9] For example, the 2016/17 New Zealand Health Survey revealed 28% of respondents reporting unmet need for GP services,

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with 14.3% citing unmet need due to cost barriers and 20% of those living in the most socioeconomically deprived areas indicating cost as a reason.[10] A 2016 Commonwealth Fund survey showed 18% of New Zealand respondents reporting cost-related barriers to care, behind only Switzerland (22%) and the US (33%). Only seven percent of UK and German respondents reported such barriers, with the Netherlands and Sweden on eight percent.[11]

Clearly, general practice and other payments pose a challenge for many New Zealanders and place them in an unenviable position. Barriers to GP services are inequitably distributed with highest rates among Māori, Pacific and those living in socioeconomically deprived areas.[10] These barriers and their impacts are reflected in The Commonwealth Fund's 2017 data, which show New Zealand ranked eighth out of 11 countries for health equity.[12] Patient fees have arguably played a part in this ranking.

The cost barriers persist despite considerable government investment via the Primary Health Care Strategy of the 2000s, and associated development of Primary Health Organisations (PHOs), with goals of reducing charges for enrolled patients.[13] Funding to reduce charges was provided on a population basis, meaning some PHOs and associated general practices continue to have lower charges than others.[14] Those on lower-incomes in higher socioeconomic status areas have smaller capitation subsidies unless they have a Community Services Card, while wealthier patients enrolled in poorer areas benefit from reduced charges through higher capitation payments. Most GPs, for their part, benefitted through introduction of PHOs from increased capitation payments but remain reliant on patient charges for a significant portion of their income. Indeed, implementation of the Primary Health Care Strategy and PHOs was premised on this model.[15] Any PHO or general practice wishing to eradicate patient charges has had to factor this into their business model and overall income. As such, it is very unusual for a general practice to deliver free services though small numbers of 'third sector' (non-government, non-profit) practices do exist in New Zealand serving vulnerable populations.[16,17] The usual approach, often associated with a general practice being funded via the Very Low Cost Access (VLCA) scheme, which does not cover total costs, has been to make consultations 'low cost'—perhaps $10–20. This continues to pose a barrier for those on low incomes, although to be fair, successive governments have incrementally removed patient charges for children up to age 13, with further reductions in patient charges for people on lower incomes and children under 14 being introduced by the beginning of 2019.

Do patient charges support a healthcare model fit for the future?

This is a fundamental question. New Zealand's GPs are ageing with increasing pressure to manage and treat a wider range of patients. This pressure is in parallel with implementation of alliance organisational models which are required across the health system with a focus on strengthening system integration.[18,19] The implication is that services are shifted from hospitals to primary care settings, with the government review likely to provide further impetus for this. In practice, if patient charges for traditional general practice services continue, this means developing mechanisms for ensuring that GPs and associated providers are paid for specific services such as management of particular patient groups and conditions to avoid cost shifting on to patients. GPs, after all, are largely private business people albeit in receipt of government subsidies. No conversation around shifting services to primary care can occur without discussion around payment. Similarly, development of newer models of delivering primary care such as 'healthcare homes'[20] will still have to work within current funding arrangements and patient charges if these are not reformed. This may mean it is not possible to realise the full benefits of these models, especially with respect to equity, as there is still a financial barrier to access.

The GP private ownership model, in existence since before the 1938 legislation, is also increasingly in question. On the one hand, there are opportunities with stronger community care emphasis, for GPs to grow new services and income streams. GPs with special interests (GPSIs), offering convenient low-level specialty consultations, are a case in point. On the other hand, GPs in many

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areas have long highlighted difficulties in attracting younger GPs into business ownership, meaning practices are often hard to sell. As a result, other ownership models, such as corporate ownership and community trusts, with GPs being remunerated in various different ways from salary through to profit-sharing and co-payments, have grown around New Zealand.[21,22] The landscape is complex and not ideal for a small country. Further research is needed into the business ownership model, including whether this is fit for purpose for the future in meeting the increasingly complex health needs of diverse communities, whether GP owners are comfortable with the model, whether younger GPs find ownership an attractive proposition and what the alternatives are.

Some alternative ownership arrangements

There are two broad alternatives to the present situation, if universal access to New Zealand's health system and delivering on the original 1938 goals are aims. Indeed, the 2018 '80th anniversary' Ministerial review may choose to focus on establishing the values that underpin the New Zealand health system in order to contextualise its deliberations. These values could well be those envisioned in 1938, as outlined above. At the heart of this is the question of how GPs are viewed and how they view themselves within the health system. The status quo has been that they either see themselves as private practitioners with a government contribution to costs or as public servants with a private patient co-payment.[23–25] But is this fit for purpose into the future?

If the Ministerial review reconfirms the 1938 goals and values, one alternative would be full funding for general practice services. In practice, this could involve raising capitation rates and continuing to ensure that these provide a viable income for private GPs and business owners. Patient charges would need to be abolished. A more radical alternative would be for government to salary all GPs and gradually purchase clinics, evolving these to align with present policy directions that support development of larger facilities capable of providing a broad range of general practice and community-based specialist services. Of course, there are advantages and disadvantages for any ownership model, funding arrangement and method of organisation. For example, Table 1, drawn from previously published work,[26,27] summarises some of the pros and cons of different ownership arrangements.

Table 1: Summary of strengths and weaknesses of different ownership arrangements in New Zealand primary care.*

Characteristic	Ownership		
	Private non-profit	Private for-profit**	Government
Direct accountability to government	+	+	+++
Willingness to cater to diversity	+++	+	++ / +++
Likelihood of producing public goods and quasi-public goods	+++	+	+++
Able to experiment with new policy options	+++	++	++
Likelihood of exploiting information asymmetries between patients and providers	+	+++	+
Likelihood of disguised profit distribution (disguised profit)	+++	+	+
Responsiveness to increases in demand	+	+++	++
Likelihood of blunting more extensive policy development	+++	+++	+

* + small   ++ intermediate   +++ large.
** Private for-profit ownership can be further divided into proprietary-style general practice to entrepreneurial investor-owned organisations (see below).

While few would challenge the assertion that primary healthcare is an essential service that should be available for the entire population, and that government has a fundamental responsibility to ensure its effective and equitable provision, the ability of government to deliver on this responsibility is determined to some extent by ownership. Ownership typologies, such as that illustrated in Table 1, have blurry boundaries and, in health as elsewhere, ownership type can be a poor predictor of organisational behaviour.[28,29] Nevertheless, ownership is an important consideration because it confers governance responsibility (ultimate control) for an organisation, and accountability for its actions. Further to this schema, there is a spectrum of for-profit behavior in health, from proprietary-style general practice to entrepreneurial investor-owned organisations. Proprietary health services are independent, owner-operated organisations (typical of general practices in New Zealand, Australia and the UK), and investor-owned are often part of multi-facility systems the owners of which may have little if any direct contact with the institution or the populations being served.

There is growing, anecdotal agreement within the GP community that cost has become an unacceptable barrier for many people accessing general practice services in New Zealand. Whether the trajectory for healthcare services continues on the current path where people who cannot afford to access primary care services have to wait until they are sick enough to get it for free, or shifts to one where funding truly follows the patient into freely accessible community-based services focused on personal and whānau wellbeing will be a key question for the government review. Of course, whether private-for-profit ownership models, reliant on profit generation, will ever be able to deliver on a goal of free patient services needs to be analysed and debated; in particular, whether free access and private ownership are compatible. History suggests that government, regardless of political persuasion, would need to provide confidence to the practice ownership community that incomes would be adequate—for example, GP salaries could be based on the hospital senior medical officer pay scale; GPs would need to give away demands, made strongly when negotiating the historic post-1938 compromise and since,[4] to be able to generate income independently from the state. Given the challenges facing our society of an ageing population living longer with multiple health conditions[30,31] and increasing inequity, how such questions are answered is of critical importance to us all.

The ideas expressed in this article are those of the authors in their individual capacities and do not necessarily represent those of the organisations they work for or on behalf of.

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Self-harm in adults: a comparison between the middle-aged and the elderly

Yu Mwee Tan, Gary Cheung

ABSTRACT

AIM: In New Zealand, men aged 45–49 years and 85 years and above have one of the highest suicide rates. As the population in New Zealand ages, it is anticipated that the absolute number of late-life suicides will rise. Self-harm is one of the better predictors of future suicide. The aims of this study are to: (i) characterise middle-aged (45–64 years) and older-aged people (65+ years) who have self-harmed; and (ii) determine whether there are differences between the two age groups.

METHOD: Clinical data were retrospectively collected on people aged 45+ years who presented with a self-harm attempt to a large emergency department in New Zealand from 2010 to 2013. Further clinical information for the 12-month period following their presentation was also collected.

RESULTS: Three hundred and seventy-one middle-aged (56.6% female) and 49 older-aged (38.8% female) people presented with a total of 513 and 56 self-harm attempts respectively during the study period. The older-aged group was more likely to report physical illness as a stressor (p=0.001), have a history of depression (p<0.0001) and be diagnosed with depression at the time of their attempt (p<0.0001). Suicidal intent was more common among the older-aged people who have self-harmed (p=0.004), and they had lower survival rates in the 12 months after their self-harm attempt (risk ratio=7.5; 95% CI=3.1 to 18.1).

CONCLUSION: The significant differences between older-aged and middle-aged people who have self-harmed highlights the need for age-specific suicide interventions, with particular focus on addressing physical illness and depression in older-aged people.

Suicide is a worldwide phenomenon that remains not fully understood despite the immense effort put into researching this public health issue. The World Health Organization estimates an annual global-age-standardised suicide rate of 11.4 per 100,000 population.[1] The latest suicide statistics published by the New Zealand Ministry of Health came from 2015; it reported the age-standardised suicide rate was 11.1 per 100,000 population.[2] The highest suicide rates have been among males (2.7 male suicides for every female suicide) and Māori. Figure 1 shows suicide rates from 2006 to 2015 by life stages (ages 15–24, 25–44, 45–64 and 65+) reported by the Ministry of Health. A different pattern, however, is observed when the male and female suicide rates are analysed separately and by five-year age groups. Figure 2 shows that from age 65 years, male suicide rates

increase with age; and men aged 85 years and over had the highest suicide rates (32.4 per 100,000) among all age groups between 2008 and 2017 in New Zealand.[3] Suicide has been notably less common in our indigenous Māori population aged 45 years and above, and even rarer in those above 60.[4] This is in contrast with the over-representation of suicide in Māori youth.[2]

There is a growing body of literature on late-life suicide in New Zealand. For example, depression, loneliness and poor self-reported health were associated with death wishes in older people;[5] and the older the person, the less likely they were to have contact with psychiatric services in the month prior to suicide, but most older people had been in contact with their general practitioner within one month of suicide.[6] Local research on middle-aged suicidal behaviour remains limited, with

Figure 1: New Zealand age-specific suicide rates by life stages (ages 15–24, 25–44, 45–64, 65+) from 2006 to 2015 (deaths per 100,000).
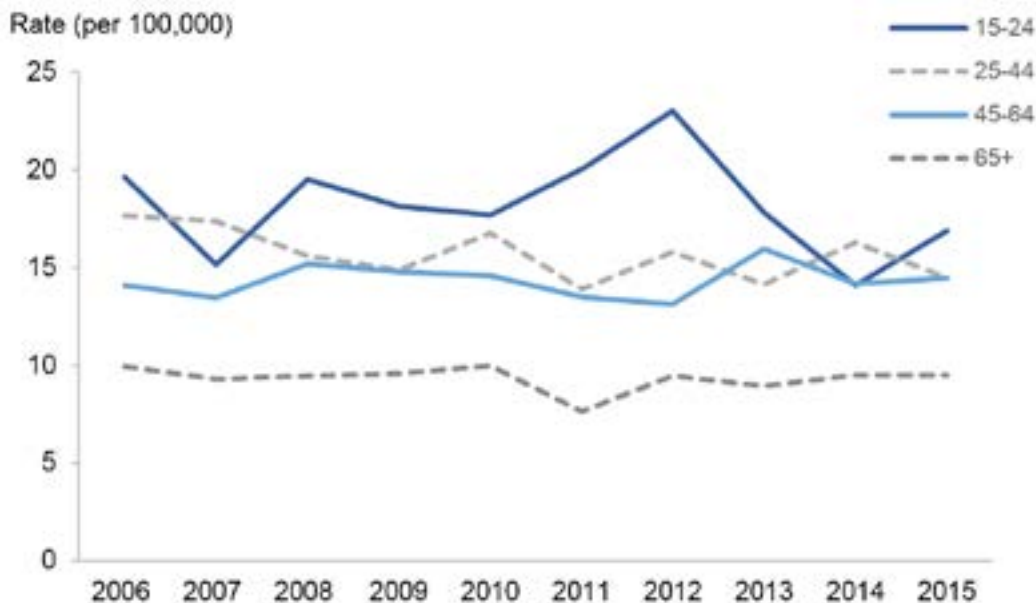
Source: Ministry of Health (2017).[2]

the main focus being on its prevalence and incidence rather than risk or protective factors. Beautrais et al found that over a 12-month period, the prevalence of suicide attempts was identical in the middle-aged (45–64 years) and older-aged (65+ years) groups, but prevalence of suicidal ideation in the middle-aged was higher.[7] However, the overall prevalence of suicidal ideation

and suicide attempts was higher in those younger than 45 years old when compared with those over 45. A study on alcohol-related hospital presentations found that the middle-aged group (41–60 years) was the second-highest age group presenting with alcohol-related presentations, and that middle-aged females were more likely to present with deliberate self-harm when

Figure 2: New Zealand male and female mean-age-specific rates by five-year age group from 2008 to 2017 (deaths per 100,000).*
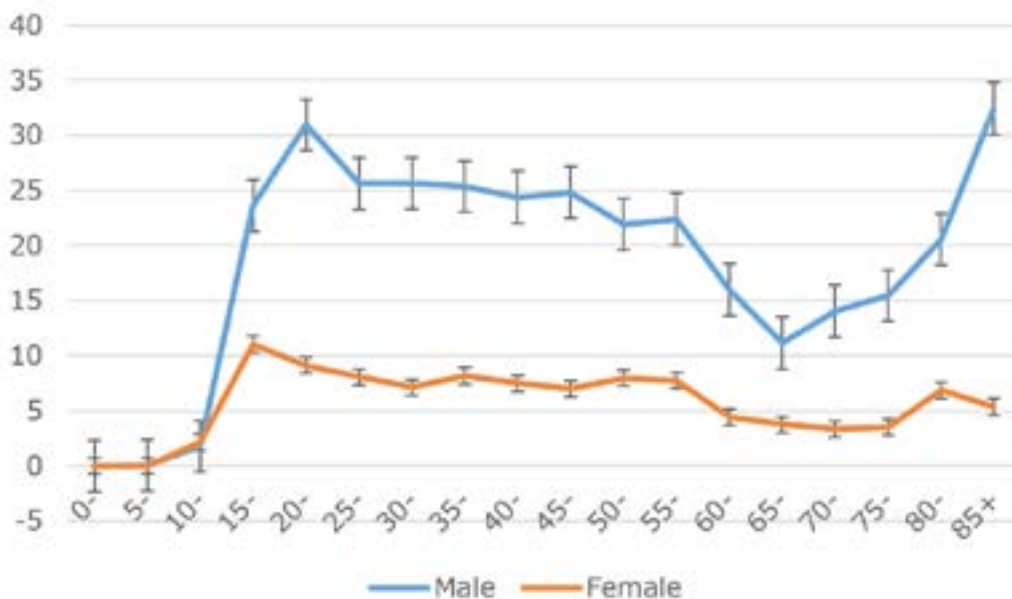
*2008–2013 Ministry of Health figures; 2014–2017 Coroner provisional figures.
Source: Cheung G (2018).[3]

compared with their male counterparts.[8] Self-harm is defined as the direct, deliberate act of hurting or injuring the body, but without necessarily wanting to die as in suicide attempt.[9]

World Health Organization reported that a history of past suicide attempt is one of the better predictors for future suicide, particularly in older people.[1] International studies have estimated at least four suicide attempts for every late-life suicide, in contrast to 25 attempts for every suicide in younger populations.[10] This discrepancy highlights the increased lethality of late-life suicide attempts. For example, a US study reported older-aged people had increased suicidal intent, overall poorer physical health and subsequent poorer survival rates from suicidal attempts.[11] Physical comorbidities, pain and functional impairment are among the more common stressors specific to late-life suicide, as opposed to interpersonal difficulties, financial or employment issues and legal difficulties in young and middle-aged populations in US and Korean studies.[12,13] Compared with the younger age group (35–64 years), older people in a UK study were more likely to be widowed and living alone, report higher suicidal intent and have a history of depression.[14] None of the previous New Zealand studies, however, looked specifically at differences in suicides or suicide attempts between older-aged people and other age groups. The aims of this study were to: (i) characterise middle-aged and older-aged people who presented to a large emergency department following a self-harm attempt; and (ii) determine whether there are differing characteristics and factors associated with self-harm in the two age groups. Identifying age-specific factors could assist in tailoring suicide preventions and interventions for each age group.

Methods

Setting
This was a retrospective study of people aged 45 years and above who presented to the emergency department (ED) in Middlemore Hospital, Counties Manukau District Health Board (CMDHB), Auckland. CMDHB serves one of the largest populations among the 20 district health boards in New Zealand with an estimated population of 509,060 in 2014, which is approximately 11% of the New Zealand population.[15] CMDHB has a catchment of 120,380 people aged 45–64 years and 54,900 people aged 65 years and older.[15] It has proportionally more people in the most deprived section of the population than the national average with 36% of the residents living in areas defined as the most socioeconomically deprived.[15] It is also the most ethnically diverse region of New Zealand, with 38% of the population identifying as European or other, 24% as Asian, 21% as Pacific and 16% as Māori.[16] However, the ethnicity mix of the population varies by age, with younger groups having higher proportions of Māori, Pacific and Asian peoples than the population aged 65 years and over.

This study focused on self-harm presentations over a three-year period from 1 July 2010 to 30 June 2013. Self-harm was defined in this study using the National Institute for Health and Care Excellence guidelines as "self-poisoning or injury, irrespective of the apparent purpose of the act".[17] An index self-harm attempt was defined as the first presentation for each person within the study period. Non-intentional (ie, accidental) attempts were excluded.

Approval was obtained from the Health and Disability Ethics Committee (reference: 14/STH/71), the CMDHB Mental Health Research Group and CMDHB Research Committee (reference: 14/CEN/196).

Data sources
The CMDHB clinical coding department used the International Classification of Diseases (ICD)-10-AM 6th Edition codes (X60–X84 or "Intentional self-harm") to code self-harm ED presentations. However, this coding process only applied to patients who stayed in ED for longer than three hours. To capture those patients who stayed in ED for less than three hours, we cross-checked the CMDHB consultation-liaison psychiatry service database. According to the local hospital guidelines, all patients presented to ED with self-harm were referred for psychiatric assessment by the CMDHB consultation-liaison psychiatry service. Both of these systems were reviewed to ensure that all self-harm attempts of people aged 45 years and above within the three-year period were included in the study.

Data collection

The first author, a psychiatry trainee, reviewed and coded the electronic hospital and psychiatric records of the included cases with the following data extracted:

(i) Demographics: age at attempt, gender, ethnicity, marital status, employment status and living situation.

(ii) Background history: physical illness, non-psychiatric hospitalisation in the 12 months before attempt, terminal illness at time of attempt, past mental health history, past suicide or self-harm attempts, under care of mental health services at time of attempt, history of depressive disorder and antidepressant use at time of attempt.

(iii) Self-harm attempt: Date of attempt, location, suicide note, mode of presentation to ED, method, blood alcohol level, acute stressors (death of first-degree relative, perceived physical illness, terminal illness in first-degree relative or carer stress, family discord, changed relationship or death of friend, separation, financial trouble, employment change, legal difficulties),[18] psychiatric diagnosis at time of attempt and follow-up by mental health services after attempt. Each self-harm presentation was classified using three of the suicidal behaviour categories described in the Colombia Classification Algorithm of Suicide Assessment (C-CASA):[19] (1) suicide attempt (ie, with an intention to commit suicide), (2) self-injurious behaviour with no suicide intent and (3) self-injurious behaviour where the suicide intent was unknown (ie, when the suicide intent was not able to be determined from the medical/psychiatric records).

(iv) Outcomes following an index self-harm attempt: death (resulting from attempt), re-attempted self-harm within 12 months, date of re-attempt(s), suicide within 12 months, survival at 12 months and diagnosis of dementia or cognitive impairment within 12 months. Details around deaths were collated from electronic coronial reports, hospital discharge summaries or electronic patient details.

Statistical analysis

SPSS version 22 was used for data analysis. An independent t-test (two-sided) was used for continuous variables and a chi-squared test (two-sided) for discrete variables when comparing the differences between the middle-aged group (45–64 years) and the older-aged group (65+ years). A Fisher's exact test was used for discrete variables when more than 20% of the cells contained less than five expected cases. Statistical significance was set at 1% (p<0.01) to reduce the risk of Type I error given the large number of study variables. Adjusted residuals were calculated to identify specific cells making the greatest impact (applying the ±2 criteria) on statistical significance. Risk ratios (with 95% CI) were calculated for reporting the outcomes of index attempt in the older-aged group versus the middle-aged group by using an online calculator (https://www.openepi.com/TwobyTwo/TwobyTwo.htm).

Results

A total of 421 people aged 45 years and above presented to the ED following a self-harm attempt during the three-year study period. One person (a 49-year-old female) was excluded because her case was an accidental overdose. The final sample included 420 people, with a total of 569 self-harm attempts during the study period. Of the 569 self-harm attempts, 470 (82.6%) came from the ED clinical coding system and 99 (17.3%) from the consultation liaison-psychiatry database. Table 1 shows the baseline characteristics of the middle-aged group (45–64 years) and older-aged group (65+ years). There were 13 people aged 80 years and above in the older-aged group and their self-harm attempts are summarised in Table 2.

There were 371 people (56.6% female) and 49 people (38.8% female) in the middle-aged and older-aged groups respectively. Compared to the older-aged group, middle-aged people were more likely to be married or in a de facto relationship (60.8% vs 40.8%, p<0.0001) and unemployed (51.0% vs 15.4%, p<0.0001); but less likely to be European (65.0% vs 89.8%, p<0.0001) and living alone (26.3% vs 55.1%, p<0.0001). Compared to the middle-aged group, older-aged people who have self-harmed were more likely to have a physical illness (87.8% vs 57.4%, p<0.0001), and a non-psychiatric admission in the 12 months prior to their index attempt (51.0% vs 32.1%, p=0.009).

Table 1: Baseline characteristics of the middle-aged group (45–64 years) and older-aged group (65+ years).

Characteristic	Middle-aged group (45–64 years) n=371	Older-aged group (65+ years) n=49	p-value	Adjusted residual[a]
Gender				
Male	161 (43.4%)	30 (61.2%)	0.018	
Female	210 (56.6%)	19 (38.8%)		
Age in years, mean (SD)[b]	51.9 (5.3)	75.2 (8.1)	<0.0001	
Ethnicity				
European	241 (65.0%)	44 (89.8%)	<0.0001	3.5
Māori	71 (19.1%)	0		3.4
Pacific Islander	19 (5.1%)	0		
Asian	37 (10.0%)	3 (6.1%)		
Other	3 (0.8%)	2 (4.1%)		
Marital status*				
Married or de facto	220 (60.8%)	20 (40.8%)	<0.0001	2.7
Single	92 (25.4%)	10 (20.4%)		
Divorced	40 (11.0%)	2 (4.1%)		
Widowed	10 (2.8%)	17 (34.7%)		8.5
Unknown	9	0		
Employment status*				
Employed	151 (45.1%)	6 (15.4%)	<0.0001	3.6
Unemployed	171 (51.0%)	6 (15.4%)		4.2
Retired	13 (3.5%)	27 (69.2%)		12.5
Unknown	36	10		
Living alone*				
Yes	97 (26.3%)	27 (55.1%)	<0.0001	
No	272 (73.7%)	22 (44.9%)		
Unknown	2	0		
Past mental health history				
Yes	255 (68.7%)	28 (57.1%)	0.104	
No	116 (31.3%)	21 (42.9%)		
Past suicide or self-harm attempts*				
Yes	145 (39.2%)	20 (43.5%)	0.575	
No	225 (60.8%)	26 (56.5%)		
Unknown	1	3		
Under care of mental health services at time of self-harm				
Yes	78 (21.0%)	11 (22.4%)	0.819	
No	293 (79.0%)	38 (77.6%)		

Table 1: Baseline characteristics of the middle-aged group (45–64 years) and older-aged group (65+ years) (continued).

History of depressive disorder*				
Yes	95 (25.9%)	26 (53.1%)	<0.0001	3.9
Depressive symptoms but not meeting diagnostic threshold	98 (26.7%)	5 (10.2%)		2.5
No	174 (47.4%)	18 (36.7%)		
Unknown	4	0		
Antidepressant use at time of attempt*				
Yes	161 (43.5%)	15 (30.6%)	0.086	
No	209 (56.5%)	34 (69.4%)		
Unknown	1	0		
Presence of a physical illness				
No	158 (42.6%)	6 (12.2%)	<0.0001[c]	4.1
Pain	28 (7.5%)	6 (12.2%)		
Oncology	13 (3.5%)	1 (2.0%)		
Ophthalmology	5 (1.3%)	2 (4.1%)		
Neurology	27 (7.3%)	8 (16.3%)		2.2
Cardiovascular	32 (8.6%)	3 (6.1%)		
Respiratory	12 (3.2%)	2 (4.1%)		
Orthopaedics	10 (2.7%)	3 (6.1%)		
Endocrinology	16 (4.3%)	0		
Gastroenterology	18 (4.9%)	0		
General	8 (2.2%)	1 (2.0%)		
Multiple[d]	44 (11.9%)	17 (34.7%)		4.3
Non-psychiatric hospitalisation in the 12 months prior to self-harm				
Yes	119 (32.1%)	25 (51.0%)	0.009	
No	252 (67.9%)	24 (49.0%)		
Terminal illness at time of attempt				
Yes	2 (0.5%)	2 (4.1%)	0.069[c]	
No	369 (99.5%)	47 (95.9%)		

[a]Adjusted residuals are reported only when they are greater than 2 and p<0.01.
[b]Two sample t-test used.
[c]Fisher's exact test used.
[d]Defined as those with illnesses involving at least two body systems.
*Cases with missing data were excluded from analysis for each characteristic.
Note: Percentages may not add up to 100 due to rounding.

Table 2: A summary of the self-harm attempts by people aged 80 years and older (n=13, all New Zealand European).

Age	Gender	Marital status	Living situation	Self-harm method & intent	Main stressor(s)	Psychiatric diagnosis	Significant physical problem(s)
80	F	Married	Home with husband	Overdose; suicidal intent	Exacerbation of chronic pain	Depression	Rheumatoid arthritis
81	M	Married	Home with wife	Overdose; suicidal intent	Financial strain	Depression, anxiety, cognitive impairment	Interstitial lung disease
82	F	Widowed	Nursing home	Overdose; suicidal intent	Family discord	Nil	Chronic back pain, diverticular disease
83	M	Married	Home with wife	Overdose; suicidal intent	Terminal cancer	Depression	Metastatic bladder cancer
84	M	Widowed	Home	Carbon monoxide poisoning; suicidal intent	Wife's death a month ago	Cognitive impairment	Nil
85	M	Widowed	Home	Overdose; suicidal intent	Pain; anniversary of wife's death	Depression, cognitive impairment	Chronic back and abdominal pain
86	F	Widowed	Nursing home	Ingested alcohol; no suicidal intent	Adult son recently left country; rest home staff changes	Depression, cognitive impairment	Nil
86	F	Widowed	Home with caregiver support	Throat laceration; suicidal intent	Physical health issues; family discord	Depression	Bilateral macular degeneration, nasal lesion of unknown etiology
87	M	Married	Home with wife	Laceration both wrists; suicidal intent	Acute exacerbation of dyspnoea	Depression, cognitive impairment	Recent pneumonia, cardiac failure
91	F	Widowed	Nursing home	Overdose; suicidal intent	Family discord	Depression	Recent myocardial infarction
92	M	Widowed	Nursing home	Stabbing & asphyxiation; suicidal intent	Back pain of several weeks	Depression	Back pain
94	M	Widowed	Home	Overdose; suicidal intent	Deteriorating eyesight leading to loss of independence; friends' deaths	Nil	Deteriorating eyesight, recent pneumonia
96	M	Married	Home with wife	Overdose & asphyxiation; suicidal intent	Chronic pain	Nil	Chronic pain, tonsillar cancer

M = male; F = female.

There were a total of 513 and 56 self-harm presentations in the middle-aged and older-aged groups respectively during the study period (Table 3). Older-aged people were less likely to self-present to the ED (35.8% vs 62.4%, p<0.0001) and their attempts were more likely to have been done with suicidal intent (75.0% vs 51.7%, p=0.004). Middle-aged people were more likely to have a positive blood alcohol level compared with older people (33.1% vs 12.5%, p<0.0001). However, older-aged people were less often tested for their blood alcohol level upon presentation compared with middle-aged people (32.1% vs 14.8%, p<0.0001). Yet once the untested population was excluded from analysis, there was no statistically significant difference in the proportion testing positive for blood alcohol in the two age groups (p=0.012).

Table 3: Cross-sectional characteristics of all self-harm attempts in the middle-aged (45–64 years) and older-aged (65+ years) groups.

Characteristic	Middle-aged group (45–64 years) n=371	Older-aged group (65+ years) n=49	p-value	Adjusted residual[a]
Number of self-harm attempts	513	56		
Intent				
Suicide attempt	265 (51.7%)	42 (75.0%)	**0.004**	3.3
Self-injurious behaviour, no suicidal intent	190 (37.0%)	11 (19.6%)		2.6
Self-injurious behaviour, suicidal intent unknown	58 (11.3%)	3 (5.4%)		
Blood alcohol level				
Positive	170 (33.1%)	7 (12.5%)	**<0.0001**[d]	3.2
Negative	267 (52.0%)	31 (55.4%)		
Untested/unknown	76 (14.8%)	18 (32.1%)		3.3
Location*				
Home	461 (90.4%)	46 (82.1%)	0.550	
Other	49 (9.6%)	10 (17.9%)		
Unknown	3	0		
Suicide note				
Yes	42 (8.2%)	9 (16.1%)	0.050	
No	471 (91.8%)	47 (83.9%)		
Self-presentation to ED*				
Yes	274 (62.4%)	19 (35.8%)	**<0.0001**	
No	165 (37.6%)	34 (64.2%)		
Unknown	74	3		
Method				
Overdose	289 (56.3%)	34 (60.7%)	0.034[b]	
Laceration	49 (9.6%)	4 (7.1%)		
Exsanguination	1 (0.2%)	0		

Table 3: Cross-sectional characteristics of all self-harm attempts in the middle-aged (45–64 years) and older-aged (65+ years) groups (continued).

Burning	5 (1.0%)	1 (1.8%)		
Drowning	1 (0.2%)	1 (1.8%)		
Hanging	5 (1.0%)	0		
Asphyxiation	5 (1.0%)	2 (3.6%)		
Gunshot	2 (0.4%)	0		
Exposure to gas	2 (0.4%)	1 (1.8%)		
Intoxication	3 (0.6%)	1 (1.8%)		
Poisoning	6 (1.2%)	3 (5.4%)		
Vehicle	4 (0.8%)	1 (1.8%)		
Other[c]	12 (2.3%)	0		
Multiple	129 (25.1%)	8 (14.3%)		
Acute stressors				
*Perceived physical illness**				
Yes	135 (26.6%)	26 (48.1%)	**0.001**	
No	372 (73.4%)	28 (51.9%)		
Unknown	6	2		
*Death of first-degree relative**				
Yes	37 (7.3%)	7 (13.0%)	0.176[b]	
No	471 (92.7%)	47 (87.0%)		
Unknown	5	2		
*Terminal illness in first-degree relative/carer stress**				
Yes	38 (7.5%)	4 (7.4%)	1[b]	
No	470 (92.5%)	50 (92.6%)		
Unknown	5	2		
*Family discord**				
Yes	252 (49.6%)	20 (37.7%)	0.100	
No	256 (50.4%)	33 (62.3%)		
Unknown	5	3		
*Changed relationship/death of friend**				
Yes	38 (7.5%)	3 (5.6%)	0.786[b]	
No	469 (92.5%)	51 (94.4%)		
Unknown	6	2		
*Separation**				
Yes	109 (21.5%)	4 (7.4%)	0.014	
No	398 (78.5%)	50 (92.6%)		
Unknown	6	2		

Table 3: Cross-sectional characteristics of all self-harm attempts in the middle-aged (45–64 years) and older-aged (65+ years) groups (continued).

Financial trouble*				
Yes	128 (25.3%)	6 (11.3%)	0.023	
No	378 (74.7%)	47 (88.7%)		
Unknown	7	3		
Employment change*				
Yes	106 (20.9%)	7 (13.5%)	0.203	
No	401 (79.1%)	45 (86.5%)		
Unknown	6	4		
Legal difficulties*				
Yes	39 (7.7%)	2 (3.7%)	0.411[b]	
No	468 (92.3%)	52 (96.3%)		
Unknown	6	3		
Psychiatric diagnosis at time of attempt				
Nil psychiatric diagnosis	87 (17.0%)	8 (14.3%)	**<0.001[b]**	
Personality disorder	93 (18.1%)	1 (1.8%)		3.1
Psychotic disorder	29 (5.7%)	0		
Bipolar affective disorder	20 (3.9%)	0		
Depressive disorder	131 (25.5%)	29 (51.8%)		4.1
Anxiety disorder	12 (2.3%)	1 (1.8%)		
Post-traumatic stress disorder	5 (1.0%)	0		
Adjustment disorder	50 (9.7%)	3 (5.4%)		
Grief	6 (1.2%)	2 (3.6%)		
Organic cause	3 (0.6%)	2 (3.6%)		2.3
Cognitive impairment	11 (2.1%)	4 (7.1%)		2.2
Intellectual disability	5 (1.0%)	0		
Substance use disorder	53 (10.3%)	5 (8.9%)		
No diagnosis documented[e]	8 (1.6%)	1 (1.8%)		
Follow-up by mental health services				
Yes	383 (74.7%)	47 (83.9%)	0.125	
No	130 (25.3%)	9 (16.1%)		

[a]Adjusted residuals are reported only when they are greater than 2 and p<0.01.
[b]Fisher's exact test used.
[c]Other methods included injecting self with air, hitting face with objects and inserting foreign bodies into genitalia.
[d]p-value = 0.012 if untested patients were excluded from analysis.
[e]Diagnosis unknown as no documentation of any diagnosis in records.
*Events with missing data were excluded from analysis for each characteristic.
Note. Percentages may not add up to 100 due to rounding.

Table 4: Outcomes of index attempt (N=420).

Outcome	Middle-aged group (45–64 years) n=371	Older-aged group (65+ years) n=49	Risk ratio and 95% CI (older-aged group vs middle-aged group)
Death from index self-harm	2 (0.5%)	2 (4.1%)	7.6 (1.1, 52.8)
Re-attempted within 12 months*			
Yes	72 (19.7%)	6 (12.5%)	0.6 (0.3, 1.4)
No	294 (80.3%)	42 (87.5%)	
Unknown	5	1	
More than one attempt within 12 months	71 (19.1%)	2 (4.1%)	0.2 (0.1, 0.9)
Suicide within 12 months*			
Yes	3 (0.8%)	2 (4.3%)	5.2 (0.9, 30.4)
No	364 (99.2%)	45 (95.7%)	
Unknown	4	2	
Survival at 12 months*			
Yes	360 (97.6%)	40 (81.6%)	7.5 (3.1, 18.1)
No	9 (2.4%)	9 (18.4%)	
Unknown	2	0	
Diagnosis of dementia or cognitive impairment within 12 months*			
Yes	18 (4.9%)	13 (31.0%)	6.3 (3.4, 12.0)
No	351 (95.1%)	29 (69.0%)	
Unknown	2	7	

*Cases with missing data were excluded from analysis for each characteristic.
Note. Percentages may not add up to 100 due to rounding.

Older-aged people were more likely to identify 'perceived physical illness' as a stressor for their self-harm (48.1% vs 26.6%, p=0.001). Separation and financial trouble were stressors more commonly reported by the middle-aged group, although they did not reach statistical significance when compared with the older-aged group (p=0.014 and 0.023 respectively). Older-aged people were more likely to receive a diagnosis of depressive disorder, organic cause or cognitive impairment, while middle-aged people were more likely to have a diagnosis of personality disorder.

Table 4 shows the outcome of the 420 index self-harm attempts. The older-age group had a higher fatality rate from the index attempt than the middle-aged group (risk ratio=7.6; 95% CI=1.1 to 52.8). They were less likely to have more than one

repeat self-harm attempt within 12 months following their index attempt (risk ratio=0.2; 95% CI=0.1 to 0.9) but their survival rate (from death of all causes) was lower (risk ratio=7.5; 95% CI=3.1 to 18.1) than the middle-aged group. Of the five suicides within 12 months of the initial attempt, only one coronial report was available. Information about the remaining four were obtained from electronic psychiatric records.

Discussion

This study found some key differences between older-aged and middle-aged people who have self-harmed. The older-aged group was more likely to: (i) report physical illness as a stressor; (ii) have a history of depression or to have been diagnosed with depression at the time of attempt; (iii) not be tested for

blood alcohol toxicology at time of attempt; and (iv) have higher suicidal intent and lower survival rates in 12 months.

A significant difference was found in Māori representation between the two age groups: 19.1% in middle-aged and none in older-aged. The lower proportion of older Māori living in the CMDHB area may partly explain this finding: 11.5% of the 45–64 age group, 7.8% of the 65–74 age group and 4.8% of the 75+ age group identified themselves as Māori.[16] In addition, the stigma of mental health illness and access to culturally appropriate services could be factors resulting in a lower rate of older Māori presenting to ED following self-harm. We also have very little understanding of whether there is any difference in cultural management practices for self-harm behaviour in older Māori, which might not include presenting to ED. However, our finding is consistent with other New Zealand studies[4] that have noted suicides in older Māori are rare, and the hospitalisation rates for self-harm attempts for older Māori are significantly lower than non-Māori. This disparity between age groups could potentially be explained by the protective effects of the valued status and revered role held by older Māori people in their society. The Interpersonal Theory of Suicide proposed that a lack of social connectedness and perceived burdensomeness could lead to suicidal thoughts.[20] Māori elders may be protected from such suicide risk as their role in their society becomes increasingly important with age. This hypothesis could also explain the lack of older Pacific Island self-harmers in our study. However, there is also a marked discrepancy in life expectancies between Māori/Pacific Islanders and New Zealand Europeans, which may also explain the lower representation of Māori and Pacific Islanders in the older-aged self-harmers.

Perceived physical illness was the most frequently reported stressor for the older-aged group, which is consistent with other international studies.[21] It was also the only significantly different stressor from the middle-aged group. The older-aged group had a significantly higher rate of non-psychiatric hospitalisation in the 12 months prior to the self-harm presentation than the middle-aged group, which may be a reflection of the burden of physical comorbidities in older people. A recent study on psychiatric inpatients (65+ years) admitted following a self-harm attempt found that their Cumulative Illness Rating Scale scores rated significantly higher in comparison with non-suicidal patients of similar demographics and psychiatric history, which suggested that physical illness and its sequelae were more common among patients who have self-harmed than those who have not.[22] The impact of physical illness such as pain (especially poor pain control) and functional impairment have been reported as common reasons leading to hopelessness and distress in coping with their illnesses.[13,21,23] These emotional struggles could lead to increased suicide risk, particularly when independence and dignity is threatened and they start perceiving themselves as a burden. In accordance with the Interpersonal Theory of Suicide, this self-perceived burdensomeness could then lead to suicidal thoughts.[20]

51.8% of the older-aged group had a diagnosis of depressive disorder at the time of self-harm. Although depression is often under-reported and under-diagnosed in older people, our finding is in keeping with those reported in other late-life suicide attempt studies where about 55% of the attempted suicides were associated with a major depression.[24] A history of depression and diagnosis of depressive disorder at the time of a self-harm attempt were more frequently observed in the older-aged group. This is possibly reflective of the hypothesis that physical comorbidities cause an exacerbation of depression in older people, and that it is the depression itself that results in increased suicide risk.[22,25] The strong association between depressive disorders and late-life suicidal behaviour particularly supports this.[14,23] Depression was the most frequent psychiatric diagnosis present in this study, which is consistent with international literature about the importance of depression in suicidal behaviour.[23,26,27] Personality disorder was significantly less common in the older-aged than the middle-aged, a finding that is consistent with previous studies.[23] Despite the high rates of depression in this study, only about 20% of patients in both age groups were known to mental health services at the time of attempt. This low rate of mental health involvement is, unfortunately, a common occurrence found in other studies.[28,29]

Depression may be less commonly recognised as it can manifest differently in older-aged people, with somatic symptoms more commonly reported than affective symptoms. This may contribute to its under-recognition and hence reduced referral to mental health services.

Blood alcohol levels were not tested in nearly a third of the older-aged who have self-harmed, while they were tested in 85% of the middle-aged group. This was despite the finding that both age groups had similar rates of substance use disorders diagnosed at the time of a self-harm attempt. Other studies have also noted similar differences, where up to 43% of older-aged who have self-harmed or died by suicide were not tested for blood alcohol levels.[27,28] It is likely that blood alcohol levels were more frequently tested in the middle-aged group because alcohol dependence is a more commonly known suicide risk factor in younger populations.[30] This is noteworthy because both acute alcohol intoxication and chronic alcohol use has been associated with suicidal behaviour.[31] Acute intoxication has been linked to disinhibition, impulsivity, impaired judgment, dysphoria and increased suicidal ideation; whereas chronic alcohol use can lead to physical illnesses, psychiatric disorders and social impairments, which are recognised suicide risk factors. Moreover, substance use disorders in general have been identified as the second-most common psychiatric disorder related to late-life suicide,[32] and this study has confirmed this finding. A total of 12.5% of our older-aged group had positive blood alcohol levels, which is lower compared with rates in international reviews of late-life suicides or self-harm attempts.[32,33] The lack of testing in a large proportion of the older-aged group in this study is likely to confound this finding. However, a recent study noted that older-aged people with positive blood alcohol levels were more likely to repeat suicidal behaviour within 12 months of their initial attempt,[28] which suggests that alcohol is an important factor in late-life suicidal behaviour.

The older-aged group who have self-harmed also presented with characteristics that mirrored international research,[26,34] with 82.1% of the attempts being at home and with high suicidal intent. Self-harm attempt by older-aged people was also more likely to be a suicide attempt when compared to self-harm attempt by middle-aged people, similar to findings from other studies.[14,35] This higher intent was also reflected in the significantly lower number of self-presentations to the ED in comparison to the younger group.

Limitations

Several limitations need to be acknowledged. This was a single-centre study in a largely urban setting with a unique age and ethnicity structure, thus limiting generalisability of the results to other regions of New Zealand. Selection bias remains a possibility, as we focused only on ED presentations and would have missed those who presented to their general practitioner and unreported attempts. Information quality also varied and was dependent on the quality of documentation by clinicians. There was a proportion of electronic records with missing data due to incomplete documentation. Furthermore, diagnoses were based on the clinical judgment of the assessing clinicians rather than using standardised scales or structured clinical interviews. Heterogeneity in the experience and clinical knowledge of the assessing clinicians could affect the quality of clinical assessments. In this study, one researcher extracted and coded the data; we did not examine inter-rater reliability and acknowledge this as a limitation. However, the first author consulted the second author whenever there was any uncertainty about data extraction or coding and they would go through all the clinical material before final data entry. Outcomes were potentially under-reported for people who moved away from Auckland, due to the lack of a national electronic clinical recording system in New Zealand. Misclassification bias was also an issue, as limited access to coroner reports meant that causes of death were uncertain for some and may have been attributed to natural causes. These possibilities might have potentially led to an underestimation of self-harm repetition or suicides. A prospective study design would have reduced the risk of information loss, as active follow-up through patient interviews would have been possible via such a design—and would have allowed more consistent testing of blood alcohol levels. Type I error should

also be considered. We have endeavoured to reduce this risk by increasing the significance level of p-value. Type II error remains a limitation though, with the small sample size limiting the power of this study.

Conclusion

This is the first study in New Zealand demonstrating key differences between the middle-aged and older-aged groups, where depression and physical illnesses were significant factors in the latter group. Older-aged people were also a particularly vulnerable group with poorer outcomes. The principal clinical implication of these findings is that there is a need for tailored suicide intervention programmes for each age group. For example, particular focus placed on managing the psychological impact of physical comorbidities and better screening of depression in older-aged people. More importantly, as life expectancy increases, our older population cohort will continue to grow. 'Baby-boomers' (those born between 1946 and 1964) are also entering their later years. As this cohort ages, it is anticipated that the absolute number of late-life suicides will rise. More work is needed to explore whether the findings of this study will be replicated in larger samples and multiple centres around New Zealand, and whether there are differences within other age groups.

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Specialist mental health care for older adults in New Zealand—an exploration of service models and routine data

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ABSTRACT

AIMS: Older people experiencing mental distress are commonly overlooked in research and policy in New Zealand, partly due to lack of consistent national service provision and collation of information. This study aimed to: 1. Describe service arrangements for older people's mental health; 2. Describe mental health service use from age 65, where data is available.

METHODS: DHBs were surveyed to determine mental health service delivery and funding models for adults aged 65 and older. PRIMHD was used to explore demographic and clinical characteristics of older people using mental health services in Northern and Midland DHBs between 2009 and 2015.

RESULTS: DHBs vary in funding, access and reporting arrangements for older people's mental health services. Most services provide information into PRIMHD, but this is often partially complete. In the Northern and Midland regions, 2.2% of older adults access specialist mental health services. People aged 65–74 were more likely to have previously used mental health services, live in deprived areas, have functional mental health conditions and have high treatment intensity than older age groups.

CONCLUSIONS: National consistency in data collection and service delivery for older people is needed. Further investigation is needed to understand the needs of people with prior mental health service contact.

Specialist mental health services in New Zealand report data into the Programme for Integration of Mental Health Data (PRIMHD), the Ministry of Health's single national mental health and addiction information collection of service activity and outcomes data for health consumers.[1] While PRIMHD dates back to 1 July 2008, it has become more inclusive and reliable over time as more agencies (especially non-government agencies) have started contributing data.[2] A much clearer picture of mental health services and mental health service users is emerging as the PRIMHD database matures and increases in quality.

However, mental health services for those aged 65 and over are administered differently by region, and sometimes within regions, because of historical differences in the structuring of health services. This influences reporting into PRIMHD for mental health service users aged 65 and over, with incomplete reporting for central and southern regions. Consequently very little is known about people aged 65 and over accessing mental health services, and this group is generally excluded from reporting and research on mental health service users in New Zealand.[3] For example, the Office of the Director of Mental Health does not report on service use for this age group.[4]

The aims of this paper are to:

- understand the methods used to collect and report data on mental health services use over the age of 65 by different DHBS.

- describe the group of people aged 65 and over treated by mental health services, in the areas which consistently report this information to PRIMHD (the Northern and Midland DHB regions).

- describe the patterns of service contact for this group, by age.
- estimate the total size of the population aged 65 and over using mental health services in New Zealand.

Methods

Survey of DHBs

An email survey was sent to all 20 New Zealand DHBs in September 2017. Surveys were sent to clinical leaders or managers of old age psychiatry services where these details could be accessed through web searches or the authors' connections. Where no response was received, DHB management was approached (and this was treated as an Official Information Act request in two cases). The survey asked about service organisation, funding and data collection.

Analysis of PRIMHD data

Population

All adults aged 65 and older who had contact with mental health services in the Northern (Northland, Waitemata, Auckland, Counties Manukau) and Midland (Waikato, Bay of Plenty, Lakes, Tarawhiti, Taranaki) DHB regions of New Zealand between 2009 and 2015 (inclusive). These DHBs have been identified by the Ministry of Health as consistently reporting information about service use for people aged 65 and over into PRIMHD (personal communication, M Dwyer, Ministry of Health). Data from NGOs in these regions was not included because of incompleteness. Most of the New Zealand population is concentrated in the top two-thirds of the North Island, with approximately 320,000 over 65 living in the Northern and Midland DHB regions in 2013, which represents more than half of those over 65 in New Zealand.[5]

Data sources

Data was accessed from the Programme for Integration of Mental Health Data (PRIMHD), which has recorded all public secondary and tertiary mental health service contacts across New Zealand since mid-2008. Anonymised PRIMHD data from the Northern and Midland regions were obtained from the Ministry of Health.

This study had ethical approval from the Southern Health and Disability Ethics Committee (ref: 16/STH/196).

Analysis

A cross-sectional analysis examined the sociodemographic and clinical characteristics of people aged 65 and over who were in contact with DHB mental health services in the Northern and Midland regions in each year (2009 to 2015). Patterns of service use were described using information on activity type and team type from PRIMHD. Patterns for the most recent year (2015) are presented here. Trends over time were also examined.

Service activities were categorised into treatment contacts and non-treatment activities (support and coordination). Face-to-face treatment contacts were sub-categorised into inpatient, community, home-based and crisis contacts. Other types of treatment contact such as group programmes and substance abuse services were not examined separately because of small numbers.

The demographic distribution of service users aged 65+ in 2013 was compared to the 2013 census population in Northern New Zealand to estimate the proportion of the resident population using services. These estimates were then used to estimate the total number of older people likely to be using mental health services across all of New Zealand, based on the assumption that age/sex/ethnicity specific prevalence of service use in the two studied regions (Northern and Midland) would also apply in the other regions.

Results

DHB survey

Table 1 shows the results of the survey of DHBs, which covers the information reported by the survey respondents. Where information from other sources suggested a different policy, this is indicated by a footnote. All DHBs have specialist mental health services for older people, but for the most part those who are using adult services prior to age 65 remain in these services rather than being transferred to older people's services when they reach the age of 65. Those who were previously in contact with adult mental health services are usually not eligible to be seen by older people's services until at least two years after their last appointment with adult services, although this varies by region.

Table 1: DHB survey results.

DHB	Specialist mental health service (MHS) for those aged 65+?	Who is eligible for older people's services? Is there a stand-down period from adult services?	What happens when current service users turn 65?	Does your service report into PRIMHD?	How is your service funded?
Northland	Yes	2 years^	Remain	Yes	Mental health
Waitemata	Yes	2 years^	Remain	Yes	Mental health
Auckland	Yes	2 years^	Remain	Yes	Mental health
Counties Manukau	Yes	2 years^	Remain	Yes	Mental health
Waikato	Yes	1 year	Remain	Yes	Mental health
Lakes	Yes	2 years	Remain	No*	Mental health
Tairawhiti	Yes	No history of mental illness pre-aged 65	Remain	Yes	Mental health
Bay of Plenty	Yes	Unknown	Varies	Yes	Mixed
Taranaki	Yes	2 years or aged 75+	Remain	Yes	Mental health
Hawkes Bay	Yes	No history of mental illness pre-aged 65	Remain	Unknown	Mixed
Whanganui	Yes	No stand down period	Remain unless coexisting dementia	Unknown	Mental health
Mid Central	Yes	No stand down period	Remain	Yes	Mental health
Wairarapa	Yes	No eligibility criteria	Unknown	Unknown	Older people
Hutt Valley	Yes	18 months	Varies	No – to Health of Older People	Mixed
Capital Coast	Yes	No stand down period#	Remain	No	Older people
Nelson Marlborough	Yes	2 years but flexible	Generally re-main until 75	No except those in MHS	Older people
West Coast	Yes	No stand down period	Remain	Yes	Mental health
Canterbury	Yes	2 years	Varies	Yes	Mixed
South Canterbury	Yes	Relaxed entry criteria	Varies	Unknown	Unknown
Southern	Yes	No stand down period	Remain	No – to Disability Support Services	Disability

^Northern region criteria: Aged 65+ not seen by adult services in past two years; people with dementia at any age; people better served by specialist service, *as part of the Midland region Lakes does report to PRIMHD, #other sources suggest that those who have used services prior to 65 are usually not seen by specialist older people's services.

Table 2: Characteristics of older people treated by mental health services in the Northern and Midland regions in 2015 calendar year.

	65–74 yrs		75–84 yrs		85+ yrs	
	n	**%**	**n**	**%**	**n**	**%**
Total	3,253		2,808		1,737	
Ethnicity						
Māori	331	10.2	202	7.2	647	6.8
Pacific	137	4.2	95	3.4	286	3.0
Asian	153	4.7	118	4.2	361	3.8
European/other	2,632	80.9	2,393	85.2	8,241	86.4
Gender						
F	1,772	54.5	1,601	57.0	1,106	63.7
M	1,481	45.5	1,207	43.0	631	36.3
Deprivation quintile^						
Q1	401	12.9	382	14.2	260	15.6
Q2	425	13.7	366	13.7	249	15.0
Q3	656	21.1	653	24.4	478	28.7
Q4	758	24.4	632	23.6	382	23.0
Q5	871	28.0	649	24.2	294	17.7
Diagnosis						
Schizophrenia	367	11.3	132	4.7	41	2.4
Bipolar disorder	222	6.8	105	3.4	32	1.8
Dementia	178	5.5	381	13.6	266	15.3
Organic	219	6.7	311	11.1	242	13.9
Substance use	155	4.8	41	1.5	6	0.4
Anxiety	191	5.9	138	4.9	63	3.6
Depression	298	9.2	212	7.6	93	5.4
Missing*	1,623	49.9	1,488	53.0	994	57.2

*Missing = no diagnostic information recorded in PRIMHD or "no diagnosis" or "diagnosis deferred" recorded ^Q1 least deprived, Q5 most deprived.

A mix of funding streams were reported, including health of older people, mental health and disability support services, with a mix of these sometimes occurring within a single DHB. The majority report some data to PRIMHD, but this may not be complete for all reporting DHBs. Eight DHBs either indicated not reporting to PRIMHD or were unclear on this point.

Characteristics of service use

Table 2 shows the characteristics of mental health service users aged over 65 in Northern and Midland DHBs in 2015. The vast majority of older service users were European, and the proportion increased with age, from 81% of service users in the 65–74 age group to 86% of the 85+ age group. The majority were also female, and the proportion increased with age, with women making up nearly two-thirds of service users aged over 85.

A deprivation gradient in area of residence was evident in the among the 65–74 age group, with over half of those being seen by services living in quintiles 4 and 5. This gradient was not present in the oldest age group.

**Table 3:** Mental health service treatment contacts among older people in the Northern and Midland regions 2015.

	65–74 yrs		75–84 yrs		85+ yrs	
	n	%	n	%	n	%
Total having any treatment 2015	3,253	100	2,808	100	1,737	100
New to services in 2015	970	29.8	1,209	43.1	822	47.3
Specialist older people services	2,168	66.7	2,551	90.9	1,613	92.9
Adult services only	1,085	33.4	257	9.2	124	7.1
Inpatient admissions	366	11.3	290	10.3	125	7.2
Crisis attendances	373	11.5	192	6.8	110	6.3
No. treatment contacts per person						
1	539	16.6	524	18.7	448	25.8
2–5	1,030	31.7	1,101	39.2	733	42.2
6–10	589	18.1	522	18.6	313	18.0
11–20	588	18.1	410	14.6	168	9.7
21–50	423	13.0	214	7.0	70	4.0
>50	84	2.6	37	1.3	5	0.3
	mean	SD	mean	SD	mean	SD
Mean no. treatment contacts	11.54	19.4	8.13	11.0	5.74	7.8
Mean no. home visits	3.85	8.5	3.84	6.7	2.93	5.3
Mean no. community visits	4.44	13.6	2.20	4.3	1.08	2.2
Mean inpatient admission length (days)	42.04	50.1	33.30	37.3	28.23	29.0

In terms of diagnosis, the most common diagnoses in the 65–74 age group were for functional disorders (bipolar disorder, schizophrenia, depression). This balance shifted to dementia and organic disorders in the older age groups. However, there was a substantial amount of missing diagnosis data, which became greater at older ages.

Table 3 shows the types of treatment contact by age. In the 65–74 age group, two-thirds had at least one service contact with specialist older people's services; the other third only had contact with adult services. In the 85-plus age group 93% had some contact with specialist older people's services. The majority of those seen in all age groups were not new to services. Only 30% of 65–74 year-olds were new to services, while 47% of those aged 85-plus were not known to have accessed mental health services previously in the DHBs examined. There were 781 inpatient admissions across all age bands in 2015, and 675 crisis attendances, with the youngest age group having the highest proportion of service users accessing these high-intensity services.

Service use intensity decreased with age. At all ages the largest proportion of people had 2–5 service contacts over a year. For those over 85, 68% had 1–5 service contacts over the year. The highest numbers of service contacts (over 20 in the study year) were mainly seen in the youngest age group. The mean number of treatment contacts decreased with age. Home visits were reasonably consistent for the age groups; community visits dropped off with age, as did mean length of admissions.

Figure 1: Trends over time in age distribution.

Numbers of people in contact with services over time, by age group
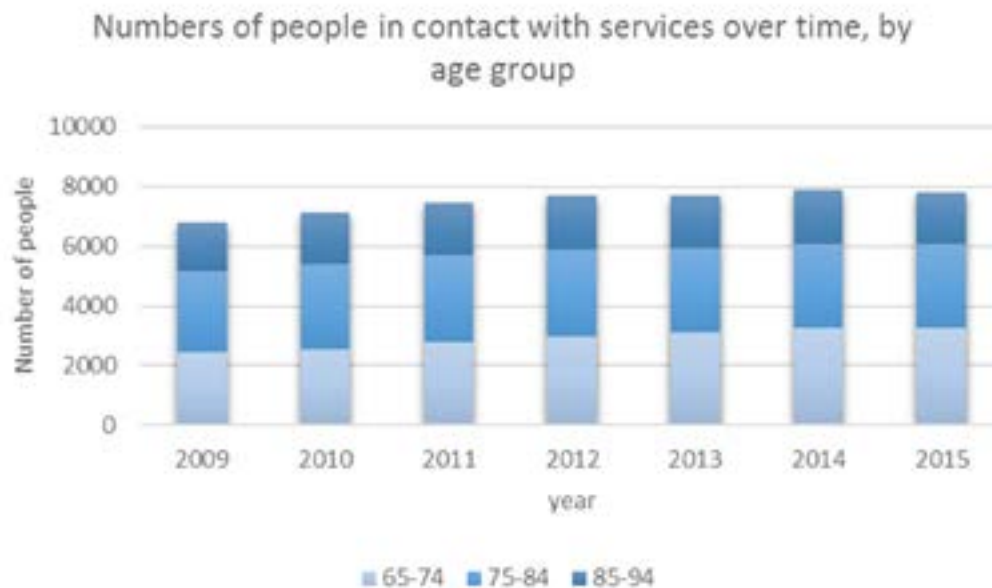
Trends over time

The total number of people aged 65 and older in contact with specialist mental health services in the Northern and Midland regions increased from 6,780 in 2009 to 7,798 in 2015, an annual rate of increase of around 2.5% (Figure 1). This was mainly driven by increased volumes in the 65–74 age group.

Over the seven years for which data was available, the proportion of older people in contact with services for whom no diagnosis information was recorded in PRIMHD remained high, increasing from 46% missing in 2009 to 53% missing in 2015. The proportion with a functional diagnosis remained stable at 25–27% and the proportion with an organic or dementia diagnosis reduced from 29% in 2009 to 21% in 2015.

Comparison to the census population

The group using mental health services in 2013 were compared to the 2013 census population in the Northern and Midland regions. Overall 2.2% of the population aged 65 and older were treated by mental health services in 2013. The proportion of the population accessing services increased with age, ranging from 1.7% of 65–69 year-olds to 3.4% of those aged 85 and over. Extrapolating to the New Zealand population, this would equate to approximately 13,700 people aged 65 and older treated by mental

health services across New Zealand over a year (based on 2013 census population), assuming the same age, sex and ethnicity distribution of service use in areas not reporting to PRIMHD as was seen in the Northern and Midland regions.

Overall there were similar proportions of European, Maori and Pacific older adults accessing services (2.5% of Pacific, 2.8% of Maori and 2.6% of European), but a lower proportion of Asian older adults using services (1.4%). There was a higher proportion of women accessing services than men: overall 2.4% of women and 2.0% of men over 65 had contact with services. A similar gender pattern was seen across age and ethnic groups with a higher proportion of women than men accessing services in all but the 85+ age group and the Pacific group where similar proportions of men and women were accessing services (data not shown).

Discussion

This study has demonstrated that it is possible to characterise older people using specialist mental health services using routine data, despite national inconsistencies in service provision and reporting.

While all DHBs have specialist mental health services for people over 65, there is variability in the way services are provided and funded, who has access to these services, and reporting of the information

collected by these services. The majority of services are providing some information to PRIMHD, but this is often only partially complete, particularly where funding is mixed (only mental health funded service contacts are usually entered into PRIMHD). Services also have different ways of managing people who have required mental health services before the age of 65, with no nationally consistent service model. Gaps in the provision of old -age mental health services are likely to remain hidden while the reporting of data is so inconsistent.

Using the available data, it was possible to characterise those aged 65 and over in contact with mental health services, who represented 2.2% of the population in that age group. Those accessing services are predominantly female and European, reflecting the demographic distribution of older New Zealanders. However, a disproportionally lower number of older Asian adults access mental health services, which may be concerning. The younger group accessing services (aged 65–74) differed from the older age groups in terms of living in more deprived areas, having a higher proportion of functional mental health conditions (schizophrenia, bipolar disorder and depression), being more likely to be cared for by adult (as opposed to geriatric) services, and having a higher treatment intensity. It is notable that only 30% of those aged 65–74 were new to services in 2015, and it is likely that the service use patterns seen reflect an ongoing history of mental illness.

The findings support previous research showing a wide variation of how older adult services are configured and structured across different DHBs with different funding arrangements. In their 2017 survey of psychiatry of old age services and staffing, Cheung and colleagues found that 44% of services are funded as mental health services, 37% from geriatric medicine/disability funding streams and 19% jointly funded between these two streams.[6] The slightly different findings here (with a higher proportion of services reporting mental health funding) may relate to more complete data in our survey, but also suggest some confusion among clinicians and managers around funding streams, as the two surveys were both completed in 2017.

This research supports the two streams of potential referrals to older adult services, as those with longstanding mental health problems are joined by those who develop psychiatric symptoms in later life. However, the transition between general adult and older person mental health services is not always clear.[7] Ideally this should be based on needs-based criteria rather than age-based criteria.[8] Protocols have been developed in the UK to support this philosophy but evidence suggests these have not always been used to assist direction and navigation through services.[8] Another study has shown a lack of coordinated transfer between these types of services, with many patients transferring during relapse of their illness.[9] The question of protocols or agreements to transition into older adult services was not surveyed in detail in this survey, but from the information gathered there were inconsistencies in the reported transition to older adult services with the use of a stand-down period of two years applied across the majority of DHBs but others having no stand-down period or eligibility criteria. However, we found that by the age of 75 by far the majority (90%) of patients were under the care of older adult services.

The earlier and coordinated transfer of patients in to older adult service is supported by research that compared unmet needs of patients who remained in adult services versus those who transferred into older adult services. Patients in older adult services had fewer unmet needs than a similar group who remained with general adult services.[10] However, if an aged-based transfer protocol was applied (eg, all those over 65 moved to older age services) this would likely cause a much greater burden on older adult services, thus requiring greater levels of resourcing to support the increased demand.

Interestingly the mean number of patient contacts reduced with increasing age. This may be due to the higher use of residential care or the higher prevalence of dementia with increasing age. Management in the home situation may require more intensive follow-up than those seen in residential settings where more day-to-day support is available.

This research supports similar findings in the UK, where there is an absence of good-

quality national data on specialist older persons mental health services.[11] Good service models should ideally support the needs of those with functional illnesses as well as those with dementia.[12] Despite the large amount of missing diagnostic information (as seen throughout the PRIMHD data set) this study highlights the broad range of diagnoses currently seen among older adult service users, and shows that services must accommodate the needs of both functional and dementia-related presentations. It also identifies the need for a high -quality national mental health service-use dataset for people aged over 65 to appropriately inform decisions about future service delivery. The quality and completeness of the PRIMHD dataset depends on the information provided by clinicians and others involved in service provision, including the information in discharge summaries and other documentation, and so clinician engagement with the PRIMHD dataset will be key to improving quality.

Other routine data sets could also be used to better understand the mental health of older New Zealanders. In particular, the InterRAI data set (interrai.co.nz), which includes data collected in needs assessments of older adults for home care and aged residential care is a potentially rich source of information.

Although there is a need for better national consistency in terms of PRIMHD data collection, we have shown here that the existing data can address important questions. Annual reporting of mental health service use statistics in the 65-plus age group (in addition to existing reporting) could be possible, even if only for the Northern and Midland regions. This study has shown that more research is needed to understand the differences between two apparent distinct groups of service users within the 65+ age group—those with pre-existing mental illness and those who have never used services before. Further investigation is needed, particularly to understand the needs of the group with prior mental health service contact, a group who international research suggests have high but often unmet health needs.[10]

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The development and first six years of a nurse-led chest pain clinic

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ABSTRACT

AIM: Chest pain is a common symptom that creates significant anxiety for patients until a diagnosis can be offered. However, hospital cardiology services can struggle to cope with referral demands from primary care. The aim of this paper is to describe the development and implementation of a nurse-led chest pain service, its care processes and clinical outcomes to show feasibility, safety and sustainability.

METHOD: We retrospectively analysed referral, demographic, cardiovascular risk, management and clinical outcome data relating to patients assessed in the nurse-led chest pain clinic in a large metropolitan district health board.

RESULTS: Between January 2010 to December 2016, 3,587 patients attended the clinic, median 2.6 weeks (IQR 2–3) from referral to attendance. 1,921 (54%) were male and 2,059 (57%) were less than 60 years old. Most patients, 3,059 (85%), had an exercise tolerance test (ETT) and of those, 294 (10%) were positive, 572 (18%) non-diagnostic and 2,193 (72%) negative. Cardiovascular disease (CVD) prevention medication was added or modified for 1,150 (32%) patients, all patients who smoked were offered cessation support and all patients were provided with tailored lifestyle advice depending on their absolute CVD risk. Of the 319 (9%) referred for a diagnostic coronary angiogram, 205 (64%) had important coronary disease. The majority of patients, 2,088 (58%) were able to be discharged without any further investigation planned. Over a median follow-up period of 3.6 years, we identified 14 (0.4%) cardiac-related deaths, median (IQR) 2 (1–4) years from review to death.

CONCLUSION: The nurse-led clinic offers an enhanced prevention focus that is sustainably managing large numbers of patients with outcomes similar to international studies and within recommended local timeframes.

Chest pain is a non-specific, very common symptom,[1] which is a significant concern for both patients and clinicians, posing a diagnostic challenge in primary care.[2] The majority of patients with chest pain will have no coronary disease but the consequences of missing a coronary diagnosis can significantly increase the risk of adverse events.[3] Thus, priorities are to identify people with signs of acute coronary syndrome (ACS) and admit acutely to hospital for assessment and appropriate management.[4] Patients with less convincing signs and symptoms of coronary artery disease require a focused assessment and, when indicated, functional testing; this is usually performed in the outpatient setting, by doctors.[5]

Nurse-led clinics have been shown to improve access to healthcare in a variety of settings and health issues. There is international literature on the efficacy of nurse clinics in cardiology[6–8] and chest pain clinics.[9–11] However, little information is available in New Zealand, where pathways from registered nurse (RN) into specialised roles are inconsistent and influenced by the geographic location, healthcare environment, leadership and the nurses themselves.[12]

The Counties Manukau community in Auckland, New Zealand, is ethnically diverse, growing rapidly each year, with over a third of residents living in areas of high socioeconomic deprivation.[13] By 2009, this rapid growth in the population was

contributing to an increasing number of referrals of people to the existing, under resourced, cardiologist-led services.

This paper reports on the development and implementation of a nurse-led service for patients referred from their general practitioner (GP) for assessment of chest pain. The clinic process, the cohort of patients reviewed and clinic outcomes are described.

Method

An initial audit identified long waiting times for patients with non-acute chest pain, which is a key performance indicator (KPI) for the cardiology service. A small team comprising a service manager, senior nurse and a cardiologist performed a literature search to assess the feasibility of a nurse-led service. The team formulated standards of care that were expected to be met in a nurse-led clinic. A training and credentialing schedule was developed by the team, including didactic teaching (eight sessions covering all aspects of chest pain assessment, functional testing and management), practical exercise tolerance test (ETT), electrocardiogram (ECG) review and focused cardiac physical assessment and recognition of important clinical signs. We were conscious of organisational and role conflict barriers which have been reported elsewhere,[14] but these were not encountered with this process. All referrals were triaged by a cardiologist, patients with unstable symptoms such as typical, rest symptoms were admitted and patients with unexplained chest pain either typical or non-typical were referred to the chest pain clinics. One clinic a week is run by a cardiologist and all other clinics are nurse led, with over 80% of chest pain referrals being managed in a nurse-led service.

To date, five experienced nurses led by a nurse practitioner have been credentialed and currently run clinics on a regular basis.

To improve the service delivered to patients with stable chest pain and provide the highest quality care, a KPI was agreed to see patients less than three weeks from the date of referral. The clinical focus is on identifying occlusive coronary artery disease with rapid escalation for investigation and intervention, when clinically appropriate. The secondary focus is on promoting CVD risk reduction and providing reassurance where there is low suspicion of cardiac chest pain.

The nurses take a structured history and conduct a cardiac physical assessment. Following this, an EET is performed by a cardiac physiologist, if indicated and reviewed with a cardiologist who works alongside the clinic. Patients are provided with lifestyle and medical management advice or are referred for further investigation and management.

Care provided and decisions made are evidenced-based using contemporary guidelines. Positive exercise tests were concluded from the clinical history, diagnostic ECG changes and exercise-induced symptoms or haemodynamic changes consistent with ischaemia.[15,16] Continuous quality improvement, clinical audit, teamwork, and learning and ongoing clinical development have also been built into the clinic structure.

Each patient is entered into an electronic data base and clinical decision support tool (New Zealand Acute Coronary Syndrome Quality Improvement (ANZACS-QI), CVD and Diabetes module),[17] which collects demographic information, CVD risk factor variables such as smoking history, blood pressure, CVD history, lipid and glycaemic measures as well as body mass index (BMI) and cardiac pharmacotherapy. Using the New Zealand version of the Framingham equation, a five-year CVD absolute risk is estimated. Individual risk is then communicated to each patient, using the Heart Forecaster tool,[18] a visual representation of CVD. An individualised "my CVD plan" is generated by the system and printed to support the patient's understanding of what they could do to reduce CVD risk. All patients are also offered one of the many self-management resources produced by the New Zealand Heart Foundation relevant to managing their own CVD risk.

Data including change in medications, referral information and further testing organised (eg, coronary angiogram) is captured in a secure password-protected spread sheet. Every three months the team audit the database and update results and record any admissions, hospitalisations or deaths. If patients are unexpectedly admitted to hospital or die, a review is undertaken with the wider cardiology team.

Figure 1: Percentage age range of attendees by ethnicity.
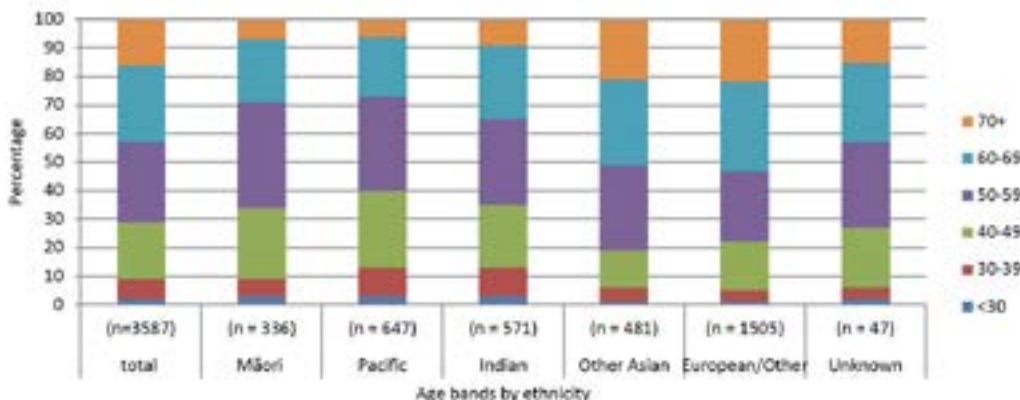
In January 2018 (mean follow-up time of four years), we performed an electronic reconciliation using the hospital databases to identify all admissions, subsequent medical clinic reviews and deaths. Most patients continue to reside in the Counties Manukau (CMDHB) catchment area, however, follow-up data was not available for 147 (4%) patients now living out of area.

Statistical

Descriptive statistics for continuous variables, which is time from clinic to death were summarised as mean with standard deviation, and median with inter quartile range (IQR). Categorical data are reported by frequency and percentage and Chi-squared test was used for testing relationship between categorical variables. All P-values reported were two tailed and a P-value <0.05 was considered significant. Data was analysed using SAS statistical package, version 9.4 (SAS Institute, Cary, NC).

Local ethics committee approved this study as an audit, and local research protocol approval was granted

Results

Referral and demographics

Between 1 January 2010 and 1 December 2016, 3,587 patients were referred for review in the nurse-led chest pain clinic. The majority were male, 1,921 (54%), who were younger than females (mean age, male 59yrs vs female 62yrs). The majority were of working age (Figure 1) and the European cohort were older.

Waiting time data from referral to attendance was available from the middle of 2013 to the end of the audit in December 2016 (Figure 2). The target from referral to attendance is three weeks or less, the median waiting time in the nurse clinic was 2.6 weeks (IQR 2–3).

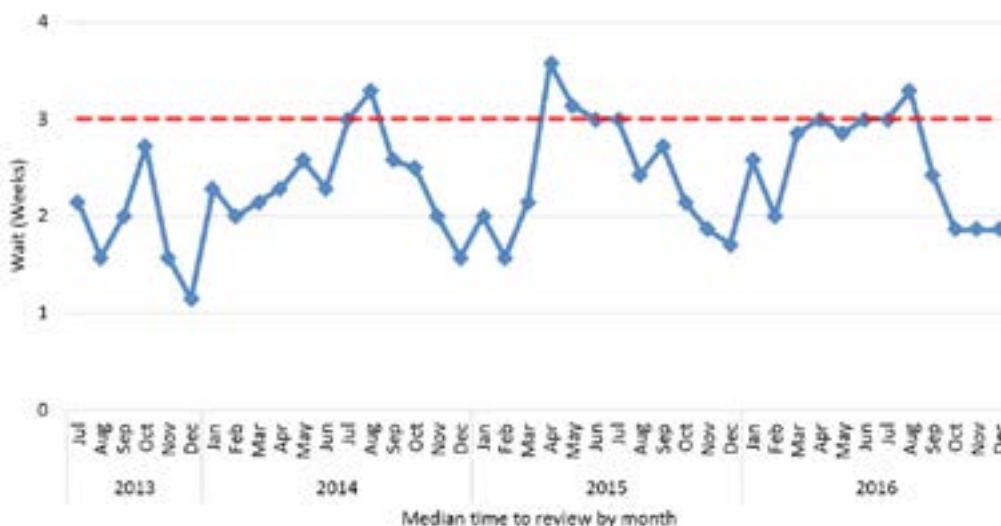**Figure 2:** Monthly median waiting time from referral to attendance at chest pain clinic.

Table 1: CVD risk assessment and management.

CV risk factors	n=2,933
Smoking	
Never	1,796 (61%)
Past	740 (25%)
Current	397 (14%)
Systolic blood pressure (SBP)	
Median (IQR)	130 (118–140)
SBP >130/80	631 (22%)
Low density lipoproteins (mmol/l)	n=2,925
Median (IQR)	2.8 (2–3.5)
High density lipoproteins (mmol/l)	n=2,925
Median (IQR)	1.2 (1–1.5)
Body Mass Index (kg/m²)	
<25	559 (19%)
25–<30	1,046 (36%)
≥30	1,296 (44%)
Missing	32 (1%)
Premature family history of CVD	858 (29%)
Personal history of previous CVD event	
Ischaemic heart disease	255 (9%)
Angina	196 (7%)
Myocardial Infarction	174 (6%)
PCI /CABG	183 (6%)
Stroke/transient ischaemic attack	70 (2%)
Peripheral vascular disease	15 (1%)
Type 2 diabetes	590 (20%)
HbA1c (mmol/mol)	
Median (IQR)	57 (49–70)
HbA1c >63mmol/mol	211 (36%)
ECG confirmed atrial fibrillation	33 (1%)
Baseline CVD medication use	n=2,901
Aspirin	1,108 (38%)
Clopidogrel	32 (1%)
Warfarin	23 (1%)
Angiotensin converter enzyme inhibitor	1,991 (69%)
Angiotensin II Receptor Blocker	242 (8%)
Beta Blocker	618 (21%)
Thiazide	334 (12%)
Calcium Antagonist	459 (16%)
Other drug therapy for hypertension	55 (2%)
Statin	1,310 (45.2%)
Other lipid lowering drugs	65 (2%)

The ethnicity of the patients reflects our diverse local community with the majority of patients identified as European/other 1,505 (42%), Māori 336 (9%), Pacific Islanders 647 (18%), Indian 571 (16%), Asian 481 (14%) and 47 (1%) had no ethnicity recorded.

CVD risk

The median (IQR) five-year CVD risk score was 9% (6–15), risk factor variables are outlined in Table 1 and were available for 2,933 (82%) patients with complete medication data available for 2,901 (81%). Unavailability of lipid values was the main reason for missing data.

Functional testing

Most patients, 3,059 (85%), underwent an exercise tolerance test (ETT) using a standard exercise protocol.[19] Of those, 294 (10%) were positive, 572 (18%) non-diagnostic and 2,193 (72%) negative. Of the 528 (15%) patients who did not have an ETT, 166 (31%) were discharged with no further planned intervention (Table 2). The reasons for not performing an ETT were due to unstable symptoms requiring more definitive investigations or having no symptoms suggesting ischaemic heart disease or being physically unable to complete the test.

Following clinic review, 1,558 (43%) patients had further interventions (Table 2) to investigate concerning signs and symptoms. Of the 2,193 (72%) patients with a normal ETT result, 405 (13%) patients were referred for more investigations due to typical symptoms or signs of other issues such as valvular abnormalities or arrhythmia. Of the patients with a positive ETT result, 288 (98%) and non-diagnostic ETT, 551 (96%), respectively were referred for further investigation.

A small number of patients, 72 (2%), were admitted to hospital for unstable symptoms and/or an ETT result that suggested significant coronary artery disease.

CVD risk management

All patients were encouraged and supported to set lifestyle-related goals in the clinic. The majority 2,933 (82%) had data entered into the ANZAC QI electronic risk assessment and management section that generates a patient-specific plan, based on the patient's CVD risk factors, and informs lifestyle advice, including smoking cessation, exercise and healthy eating.

All patients who smoked, 397 (13.5%), were offered brief advice to quit, cessation support and 118 (30%) accepted pharmacotherapy (nicotine replacement therapy (NRT) or Varenicline) in clinic to assist smoking cessation. CVD prevention literature from the Heart Foundation, including translations to cover local languages, were available.

One thousand one hundred and fifty (32%) patients had a new medication added, or an existing medication modified, for example, stopping aspirin in people with a low CVD and a normal assessment (Figure 3).

Table 2: Investigations organised following review in clinic by ETT results.

|	ETT result				
	Total investigations	Normal (n=2,193)	Positive (n=294)	Non -diagnostic (n=572)	No ETT (n=528)
Angiogram	319 (9%)	6 (0.3%)	257 (87%)	19 (3%)	37 (7%)
CTCA	336 (9%)	99 (4.5%)	9 (3%)	199 (35%)	29 (6%)
ESE/DSE	582 (16%)	107 (5%)	7 (2%)	296 (52%)	172 (33%)
TTE	227 (6%)	134 (6%)	14 (5%)	25 (4 %)	54 (10%)
ECG/Event monitor	94 (3%)	59 (3%)	1 (0.3%)	12 (2%)	22 (4%)
Admitted from clinic	72 (2%)	*3 (0.1%)	43 (15%)	1 (0.2%)	25 (5%)

CTCA—CT coronary angiogram.
ESE—exercise stress echocardiogram.
DSE—Dobutamine stress echo cardiogram.
TTE—trans thoracic echocardiogram.
*Two patients with arrhythmia, one patient with concerning symptoms.

Figure 3: Medications modified in clinic.
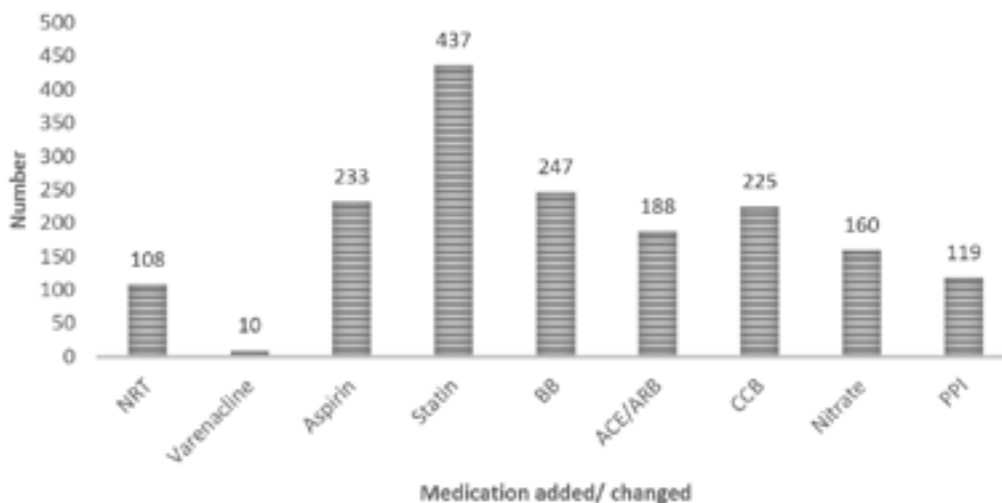
Subsequent management

The majority (691, 77%) of the patients referred for further investigations required no additional interventions or follow up (Table 3), with 136 (15%) requiring an additional review in the medical outpatient clinic.

A small number, 23 (7%) of the 336 patients referred for CT coronary angiogram (CTCA) identified coronary artery disease and required further investigation with coronary angiogram with 10 (3%) requiring percutaneous coronary intervention (PCI), six (2%) coronary artery bypass graft surgery (CABG) and seven (2%) required more intensive medical management.

Of the 319 patients referred for an angiogram, nine (3%) declined the procedure, 39 (12%) had no disease and were offered appropriate reassurance, 66 (21%) had mild to moderate coronary disease, managed with medical therapy, 205 (64%) had important coronary disease (50% or greater stenotic lesion) with 109 (34%) requiring PCI, 68 (21%) CABG and 28 (9%)

had severe coronary disease not amenable to intervention and were managed medically.

Subsequent cardiology contact

The majority of patients, 1,957 (55%) were clinically assessed and discharged without the need for further investigations or follow up; 3,010 (84%) have not been admitted under the cardiology service and 2,441 (68%) had no further contact with the cardiology outpatient service by the end of our audit period.

We did refer 70 (2%) patients for medical specialist review (eg, rheumatology, diabetes, renal), 24 (0.7%) were referred to the health psychology service for significant stress/anxiety support and 158 (4%) to the hyperventilation clinic for disabling evidence of disordered breathing contributing to their symptoms.

An audit of mortality rates over the course of the study identified 69 (2%) deaths, median (IQR) two years (1–4yrs) from clinic review to date of death (Table 4). The majority, 55 (80%), of deaths were from

Table 3: Results of follow-up investigations.

Results	Total (n=903)	TTE (n=227)	ESE (n=414)	DSE (n=168)	ECG/event (n=94)
No further review required	691 (77%)	164 (72%)	327 (79%)	130 (77%)	70 (75%)
Further intervention*	136 (15%)	50 (22%)	51 (12%)	22 (13%)	13 (14%)
Did not attend	76 (8%)	13 (6%)	36 (9%)	16 (10%)	11 (11%)

*Follow up in medical clinic.

Table 4: Mortality rate by ETT results.

	ETT result				
	All (n=3,587)	Normal (n=2,193)	Positive (n = 294)	Equivalent (n = 572)	Not done (n = 528)
Deceased	69 (2%)	29 (1%)	6 (2%)	8 (1%)	26 (5%)
Time from clinic to date of death (year)	2.21	2.83	3.99	1.21	1.26
Median (IQR)	(0.98 – 3.83)	(1.61 – 4.33)	(3.16 – 6.26)	(0.92 – 2.91)	(0.71 – 3.25)

non-cardiac causes, mainly cancer with 14 (20%) attributed to a cardiac cause. Each death was reviewed and we identified four patients who had died from cardiac causes within three months of their clinic review. Of these, three patients had been admitted to hospital from clinic and subsequently died during or just after their hospitalisation. One patient who had an atypical presentation and non-diagnostic ETT died within one month while awaiting outpatient stress echocardiogram. This case was reviewed by a medical-led morbidity and mortality meeting; no fault was attributed to the assessment process.

Discussion

Chest pain clinics, including nurse-led clinics, have been well reported internationally but are less well documented in New Zealand.[5] These clinics first emerged in the US in the 1990s and the UK's National Health Service recommended their development in the UK in the early 2000s. Evaluation of these clinics has shown that patients can be efficiently and effectively treated;[20] however, a 2007 multi-site randomised control trial was not able to establish that they were always more effective or cost-effective than routine care.[21] Despite this, rapid access chest pain units are now common in the UK[22] and research into organisational factors has helped explain differences between service models.[23] This report of our experience in the Counties Manukau region demonstrates a sustainable model for our local context.

We have developed a well-assimilated process that accepts referrals from GPs directly into a nurse-led service supported by an interdisciplinary team. The service is seeing a large number of patients within agreed timeframes, offering safe and efficient diagnostic and preventive care. The majority of our patients (85%) were assessed with an ETT and 57% were able to be discharged back to their GP with very low rates of re-referrals, admissions or mortality. Of the 319 (9%) referred for coronary angiogram, two thirds had evidence of flow limiting coronary artery disease, the majority requiring intervention. These outcomes are similar to those described in recent retrospective analyses of overseas nurse-led chest pain clinics, which have identified appropriate use of investigations[24] and a reassuringly low incidence of readmission, mortality[25] and ACS up to one year from clinic review.[26]

In 2010, and updated in 2016, the UK's National Institute for Health and Care Excellence (NICE)[27] recommended a change in testing protocol from ETT to clinical evaluation/pre-test risk stratification and diagnostic imaging. This has been taken up with caution and variability across UK clinics; ETT has the advantages of being generally safe,[19] a long history of experience, widespread availability,[28] relatively low cost compared to other forms of non-invasive cardiac testing[29] and no radiation exposure. Pragmatically using a mix of clinical assessment and functional testing with an exercise testing protocol remains the standard of care in New Zealand.[19]

Our standard of preventive care also aligns with effective approaches demonstrated in overseas nurse-led cardiology clinics. All of our patients had input and support around managing their CVD risk, including smoking cessation if needed, and one third had medication modification. A 2015 systematic

review and meta-analysis of 12 randomised trials of nurse-led clinics for patients with CVD found a decreased risk of all-cause mortality and myocardial infarction, and increased patient adherence to medications. The included studies only looked at short-term outcomes, and were primarily limited to younger, male populations, but offer moderate quality evidence supporting a preventive nursing model of care.[7]

The management of non-acute chest pain and detection of underlying CAD in the outpatient setting is an important service for patients and their GPs. This paper describes nurses working in a team model that manages a large cohort of patients, providing a quality and timely assessment of chest pain with access to functional testing. Clinical outcomes are similar to those of effective nurse-led models overseas.

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Lifetime risk of primary total knee replacement surgery in New Zealand from 2000 to 2015

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ABSTRACT

AIM: To estimate the lifetime risk of total knee replacement surgery (TKR) including unicompartmental knee replacement surgery (UKR) for osteoarthritis (OA) in New Zealand, and to identify if lifetime risk is changing over time.

METHOD: Data on primary TKR procedures performed for OA from 2000 to 2015 in New Zealand was obtained from the New Zealand joint registry. Life tables and population data were sourced from Statistics New Zealand and the Ministry of Health of New Zealand. Lifetime risk of TKR was calculated for each year from 2000 to 2015 using registry population data and life tables.

RESULTS: The overall lifetime risk of TKR in New Zealand increased markedly from 2000 to 2015, with females having an overall greater lifetime risk increasing from 9.4% in 2000 to 16.8% in 2015, a relative increase of 78%. However, males showed the greatest increase in risk from 8.1% in 2000 to 16.0% in 2015, a relative increase of 97%.

CONCLUSIONS: Current lifetime risk of knee replacement in New Zealand is approximately one in six for males and females. This lifetime risk has increased significantly from 2000 to 2015. These results can be used to guide public health policy planning and division of public health resources.

Osteoarthritis (OA) is a common condition affecting over 15% of adult New Zealanders.[1] It represents a significant public health challenge internationally, with the lifetime risk of developing symptomatic OA of the knee estimated to be up to 47%.[2] The incidence of OA increases with age, with a significant rise after the age of 60.[2] With New Zealand's ageing population, we can expect OA to become more common in the future.[3] It is estimated that by the late 2030s, the over-65 age group will make up over one-quarter of the population.[4] Additionally, not only is the population ageing, but this group of society is more likely to remain healthy and physically active for a longer period compared to previous generations.[5,6]

OA of the knee is the most common indication for joint replacement in New Zealand,[7] which relieves pain and restores function.[8,9] While current data shows that the number of joint replacements has increased,[7] it is important for future healthcare planning to be guided by comprehensive population-level data incorporating around disease burden and healthcare utilisation.[10] The 'lifetime risk' measurement considers population life expectancy and all-cause mortality to provide a cumulative measure of risk.[11,12] This gives a more tangible measure for both health professionals and policymakers to assess utilisation in the community and plan the allocation of resources.[13]

Recently, Ackerman et al compared the lifetime risk of TKR for osteoarthritis between countries, including Australia, Denmark, Finland, Norway and Sweden, in 2003 and 2013 using registry data.[10] Prior to this, data on this lifetime risk of TKR surgery was limited, using incomplete national datasets from observational studies or

administrative databases.[10,13–15] Registry data, which collect reliable and more complete national data, has enabled robust and precise estimates of the lifetime risk of TKR. All patients undergoing knee replacement in New Zealand are registered in the New Zealand joint registry (NZJR) for which there is 98% compliance.[16]

This study aimed to answer the following questions concerning patients undergoing primary knee replacement (UKR and TKR):

1. What are the population characteristics (age and gender) and changes over time in New Zealand?

2. What is the lifetime risk of knee replacement and how has risk changed over a 15-year period?

3. What are the utilisation rates (by age and gender) in New Zealand, and how have they changed from 2000 to 2015?

Methods

Study design

A national, population level retrospective analysis was undertaken.

Data sources

Data on all primary TKR and UKR procedures performed for OA from 1 January 2000 to 31 December 2015 in New Zealand was obtained from the NZJR. The NZJR was established in 1999 by the New Zealand Orthopaedic Association, and collects data on all patients undergoing total hip replacement (THR) and TKR within New Zealand in both the public and private sectors.

De-identified, aggregate data on the number of surgical procedures and the number of patients receiving TKR and UKR in each year were obtained from the New Zealand Joint Registry (NZJR). The extracted data included gender, date of birth, hospital where the TKR or UKR was performed, side and operation type.

Complete life table data for the years '2000–2002', '2005–2007', '2010–2012' and '2012–14' were obtained from Statistics New Zealand. Life table data for 2003/2004 and 2008/2009 were not available, as Statistics New Zealand did not produce it. The number of people expected to be alive at the beginning of each age group for the years 2000–2002 was also used for the year 2003, and similarly the numbers for 2005–2007 was used for 2004 and 2008, and the ones for 2010–12 used for 2009. The numbers of people expected to be alive for year 2012 were sourced from the life table data '2012–14'. The numbers for year 2015 were sourced from the abridged life table data for years '2013–2015'.[4]

New Zealand resident population by gender and age group for years 2000, 2001–2012, 2013–2015 were sourced separately from Counties Manukau District Health Board,[17] the Population Statistics of Statistics New Zealand and the Ministry of Health with data produced by Statistics New Zealand.[4]

Data analysis

Data were categorised into pre-specified age groups for demographic analysis of the patients with TKR and analysis of the utilisation rates: <40 years, 40–49 years, 50–59 years, 60–69 years, 70–79 years and ≥80 years. A 'standardised lifetime risk' method was used to calculate the lifetime risk of TKR (including combined TKR and UKR, TKR only and UKR only), taking into account age-specific surgical rate (usually in five-year age group) and survival probabilities from standard life tables. The life table method of estimating lifetime risk is a standard method which permits multiple decrements to cater for competing risks.[14] Specifically, the lifetime risk at a particular year is the sum of the products of 1) the utilisation rate, which is calculated for each age group by dividing the number of people having TKR operations by the corresponding age group and gender specific population, and 2) the survival probability or the number of people expected to be alive at the middle point of each age group stratified by gender. Lifetime risk of TKR was calculated for the years 2000–2015 by gender for New Zealand. Confidence intervals (95%CI) were estimated using the method proposed by Sasieni et al.[20] Simultaneous bilateral TKR was counted as one TKR procedure to avoid potential overestimation of lifetime risk. Where staged (non-simultaneous) bilateral TKR procedures were performed within the same year, only the first procedure was included in the dataset.

Similar to previous methods,[21,22] overall and age-specific utilisation rates for TKR were calculated in 2000 and 2015 for New Zealand data. This was calculated by dividing the number of procedures from the New Zealand joint registry by the relevant population (with regard to gender and age group)

Table 1: Population characteristics and TKR demographics.

	Population data			TKR data from NZJR							
	Population size	% Female	Life expectancy*	Number of primary TKR[†]	% Female[‡]	% Aged < 40 years[‡]	% Aged 40–49 years[‡]	% Aged 50–59 years[‡]	% Aged 60–69 years[‡]	% Aged 70–79 years[‡]	% Aged ≥80 years[‡]
New Zealand											
2000	3,838,070	50.9	78.4 years	3,014	56.6	0.8	2.3	12.5	31.3	41.6	11.5
2015	4,596,295	50.9	81.7 years	7,265	51.8	0.2	2.2	17.4	38.1	32.3	9.9

*Data on population life expectancy at birth were obtained from OECD.Stat.
[†]Bilateral procedures performed within the same year were counted as two TKRs.
[‡]Proportion of those who received primary TKR at each time point.

for that year. These are reported as TKR utilisation rates per 100,000 populations, with separate calculations for males and females. Where bilateral TKRs were performed, these were counted as two operations to avoid underestimating the true utilisation of TKR, different from the approach in the estimation of the lifetime risk.

Results

What are the population characteristics (age and gender) and changes over time in New Zealand?

The population size of New Zealand has grown by 758,225 people since 2000 and the life expectancy has increased by 3.3 years (Table 1). The number of TKRs per year has increased from 3,014 in 2000 to 7,265 in 2015. The percentage of TKRs performed on females has decreased from 56.6% in 2000 to 51.8% in 2015. The proportion of TKRs performed in younger patients is increasing. In 2000 and 2003, the greatest proportion of TKRs were performed in the 70–79 year age group, however in 2013 and 2015 the greatest number have been performed for the 60–69 year age group. The number of TKRs performed in the 70–79 years age group and ≥80 year age group has decreased from 41.6% to 32.3% and from 11.5% to 9.9% respectively.

What is the lifetime risk of knee replacement and how has risk changed over a 15-year period?

The lifetime risk for TKR in New Zealand increased markedly from 2000 to 2015 (Table 2). A statistically significant increase

was evident given there was no overlap of the 95% confidence intervals in 2000 and 2015. The lifetime risk of TKR in New Zealand for males in 2000 was 8.1% (7.63–8.54) increasing to 15.9% (15.37–16.53) in 2015. The lifetime risk of TKR for females in 2000 was 9.4% (8.92–9.87), increasing to 16.8% (16.16–17.33) in 2015. The lifetime risk of TKR in New Zealand was higher for females than males at each time point (Figure 1).

In contrast to TKR, there has been no increase in lifetime risk of UKR from 2000 to 2015 in New Zealand (Figure 1). The lifetime risk of UKR for males was consistently higher than for females. The lifetime risk of UKR for males in 2000 was 1.0% (0.84–1.15) and in 2015 was 1.8% (1.63–2.01). For females, the lifetime risk of UKR in 2000 was 0.8% (0.70–0.98) and in 2015 it was 1.5% (1.30–1.63).

What are the utilisation rates (by age and gender) in New Zealand, and how have they changed from 2000 to 2015?

The comparison of age-specific utilisation rates for TKR in New Zealand between 2000 and 2015 demonstrate an overall increase in utilisation rates in all age groups for males and females. In both 2000 and 2015, the utilisation rates in the 70–79 year age group were the highest, and this group also saw the greatest increase between the years (Table 3). The 50–59 and 60–69 year age groups utilisation rates almost doubled between 2000 and 2015. The difference in the overall utilisation rate by year for both females and males was statistically significant (P<0.0001, Chi Square Test).

Table 2: Lifetime risk of TKR from 2000 to 2015.

Year	Lifetime risk (95% CI)	
	Females	Males
2000	9.39 (8.92–9.87)	8.08 (7.73–8.54)
2001	9.09 (8.62–9.57)	8.52 (8.06–8.99)
2002	8.87 (8.40–9.33)	7.46 (7.04–7.89)
2003	8.97 (8.51–9.43)	7.80 (7.37–8.23)
2004	11.98 (11.45–12.52)	11.15 (10.61–11.68)
2005	13.89 (13.32–14.47)	13.46 (12.88–14.04)
2006	14.47 (13.89–15.05)	13.25 (12.68–13.81)
2007	15.48 (14.88–16.07)	14.17 (13.60–14.74)
2008	13.97 (13.42–14.53)	13.98 (13.43–14.54)
2009	16.03 (15.43–16.62)	14.35 (13.78–14.92)
2010	15.58 (15.00–16.16)	14.49 (13.92–15.06)
2011	15.53 (14.95–16.10)	14.44 (13.88–15.00)
2012	15.82 (15.25–16.39)	13.78 (13.24–14.31)
2013	15.88 (15.32–16.45)	14.41 (13.87–14.95)
2014	16.89 (16.31–17.46)	15.73 (15.17–16.28)
2015	16.75 (16.16–17.33)	15.95 (15.37–16.53)

Data are presented as percentages.
Simultaneous bilateral TKR was counted as one TKR procedure to avoid potential overestimation of lifetime risk.
Where staged bilateral TKR procedures were performed within the same year, only the first procedure was included in the dataset.

Figure 1: Comparison of lifetime risk of TKR and UKR.
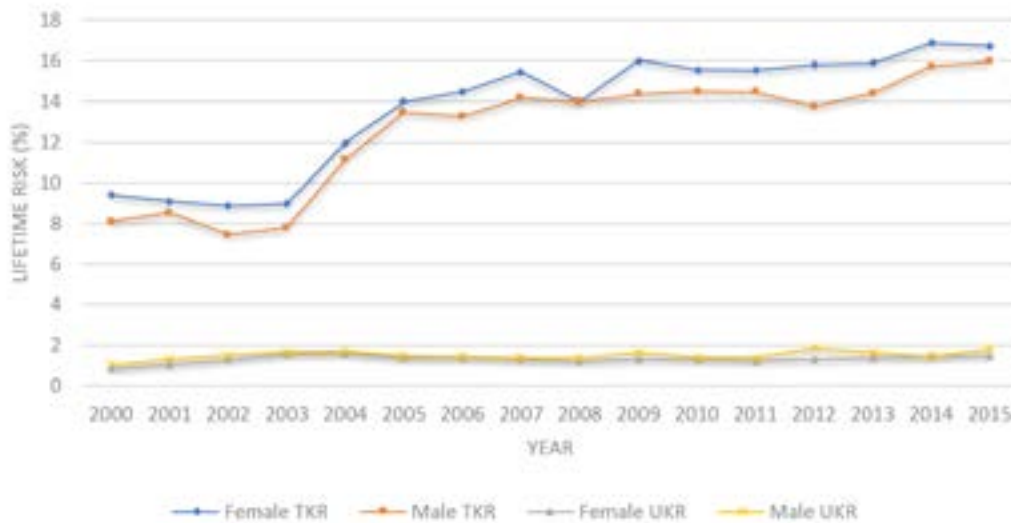
Table 3: Comparison of age-specific utilisation rates for TKR.

	Utilisation rate* per 100,000 people						
	Overall	<40 years	40–49 years	50–59 years	60–69 years	70–79 years	≥80 years
Females†							
2000	101	2	18	120	396	697	362
2015	173	1	30	232	599	896	436
Males‡							
2000	92	1	13	104	428	722	452
2015	177	1	34	253	689	900	520

*The overall utilisation rate was calculated using the total number of procedures for females (or males) as the numerator and the number of females (or males) in the population as the denominator. Age-specific utilisation rates were calculated using the number of procedures for each age group as the numerator and the age-specific population as the denominator. Bilateral procedures performed within the same year were counted as two TKRs for calculating utilisation rates to avoid underestimating the true utilisation of TKR.
†The difference in the overall utilisation rate by year for females was statistically significant (P<0.0001, Chi Square Test).
‡The difference in the overall utilisation rate by year for males was statistically significant (P<0.0001, Chi Square Test).

Discussion

This study found the lifetime risk of total knee replacement in New Zealand to be 8.1% for males and 9.4% for females in 2000. In 2015, the lifetime risk of TKR was 15.9% for males and 16.8% for females. The lifetime risk has increased significantly in the last 15 years for both males and females. Lifetime risk measurements provide a more considered assessment of joint replacement burden than incidence or utilisation rates as they also take life expectancy and age-specific mortality into account.[22,23]

The lifetime risk of TKR increased most rapidly in New Zealand between 2004 to 2008. This period correlates with the Ministry of Health introducing a 'Joint Initiative' funding drive in 2004, aiming to increase the rate of publicly funded major joint replacements. The sustained increase for the four years following this may represent 'catch up' of previous unmet need. In New Zealand, it is government policy that there should be nationally consistent access to surgery. Prioritisation tools such as the Clinical Priority Access Criteria (CPAC) score and the Hip and Knee prioritisation tool developed by the Orthopaedic Working Group of the National Waiting Times Project are used to varying degrees across the country.[24] When the clinical priority criteria were introduced, two crucial issues were whether they would correctly and consistently prioritise patients according to symptoms and ability to benefit from surgery, and whether the thresholds would be chosen so as not to leave patients with clear needs untreated.[25]

As a similar analysis approach was used, the New Zealand lifetime risk of TKR can be directly compared to previously published data for Australia, Denmark, Finland, Norway and Sweden in 2003 and 2013.[10] In 2013, lifetime risk for females ranged from 9.7% in Norway to 21.1% in Australia, and for males raged from 5.8% in Norway to 15.4% in Australia. Similar to our New Zealand findings, all countries showed an increase in lifetime risk of TKR between 2003 and 2013, and the lifetime risk of TKR for females was consistently higher compared to males for all six countries. While the overall lifetime risk percentages were most similar between New Zealand and Australia, the lifetime risk percentage relative increases between 2003 and 2013 were most similar for females in New Zealand to females in Denmark, and for males in New Zealand to males in Sweden. In 2003, the lifetime risk for females in New Zealand was 8.9% (8.51–9.43), this increased to 15.9% (15.32–16.45) in 2013, a relative increase of 77%. In 2003, the lifetime risk for females in Denmark was 5.8% (5.69–5.99), this increased to 10.9% (10.65–11.06) in 2013, a relative increase of 85%. For males in 2003, the lifetime risk in New Zealand was 7.8% (7.37–8.23), this

increased to 14.4% (13.87–14.95) in 2013, a relative increase of 85%. In 2003, the lifetime risk in Sweden was 4.9% (4.79–5.07), this increased to 8.9% (8.69–9.06) in 2013, a relative increase of 80%. Given the 95% CIs did not overlap in any of these cases, the difference between 2003 and 2013 for these countries was significant.

The international variation in health systems is likely to contribute to the differences in lifetime risk of TKR seen between countries. These include differences in healthcare funding, workforce issues, access to surgery, local indications and variation in symptom thresholds for which surgery is offered.[26,27] The difference in availability and implementation of OA prevention and management programmes incorporating physiotherapy, disease education and exercise prior to considering surgery is also very important and variable worldwide. Orthopaedic surgeons in Nordic countries appear more likely to consider non-surgical management given their range and availability of OA prevention programs.[28–31] This approach has been taken up by orthopaedic surgeons in cities in New Zealand to reduce the waiting lists, however in regional and rural towns across New Zealand these resources are scarce, making uptake of non-surgical management difficult.[5] Patient knowledge and expectations may also play a role in their attitude towards conservative versus surgical management. In addition, it is not known whether conservative management programmes can ultimately reduce an individual's lifetime risk of surgery.[29]

The international variation in lifetime risk of TKR is less likely to be explained by differences in knee OA prevalence or severity distribution,[10] but obesity, aging population and life expectancy may be influencing factors. Obesity is known to contribute to the increasing demand for knee arthroplasty,[32,33] particularly in younger individuals.[34] According to the 2015/16 national health survey, 32% of New Zealand adults are obese, which is a substantial increase from 27% in 2006/7.[35] The prevalence of obesity in New Zealand is higher than Australia, Denmark, Finland, Norway and Sweden.[18] The ageing population may influence the observed increase in lifetime risk of TKR over the study period, with more people aged >80 years receiving TKRs. However, the improvements in implant design and surgical technique have also resulted in a decreasing threshold for offering younger patients these procedures.[5] In New Zealand, this is seen by the percentage increase of 50–59 year-olds and 60–69 year-olds undergoing TKR in 2000 compared to 2015 (Table 1). The higher lifetime risk of TKR for females across the countries could be a result of the longer life expectancy for females.[18] These three factors, obesity, aging population and life expectancy, are also likely to have the greatest impact on the future demand for TKRs in New Zealand.

The healthcare systems in Australia and New Zealand are most similar, both offer universal healthcare (taxpayer-funded system) and both have parallel private health systems where the patient has a choice of surgeon and decreased waiting times.[10,13] The proportion of people with private health insurance in Australia is considerably higher than in New Zealand. In 2013, 54.9% of Australians had private insurance while only 29.7% of New Zealanders were privately insured.[18] While increasing utilisation figures could reflect an over-servicing within New Zealand, it is unlikely that TKRs are being performed on patients with minimal symptoms, as over 50% of the replacements in New Zealand are performed within public hospitals, who must comply with national health scoring criteria to identify patients with significant discomfort and functional loss.[5]

This study has several key strengths, including the use of comprehensive national registry data, the inclusion of both TKR and UKR data, and the calculation of annual lifetime risk estimates which allows trends over time to be examined. There are also some study limitations to acknowledge. Firstly, we assessed TKR and UKR separately, however the diagnosis and indications for both procedures are similar, and the decision as to which procedure to perform will vary. As a percentage of all knee replacements performed in New Zealand, UKR declined from 17% in 2000 to 8% in 2015, which may explain the lack of any increase in lifetime risk of UKR despite the overall increase in lifetime risk of any knee replacement (UKR or TKR) seen in this study.

This decrease in incidence of UKR over time in New Zealand may reflect a general trend for surgeons to prefer TKR over UKR for the diagnosis of OA and this data trend is comparable to the UKR data from Australia, Denmark, Finland, Norway and Sweden shown by Ackerman et al.[10] Secondly, similar to previous studies, when calculating lifetime risk we treated each year separately using a cross-sectional approach rather than a cohort approach between years to avoid overestimation of the lifetime risk. Within each particular year, if the patient had a TKR regardless of simultaneous bilateral or two at separate times, they were treated as one patient and thus counted in the numerator.

Ethnicity was not included in our analysis as the joint registry reporting compliance rate is not adequate.

This study found the current lifetime risk of knee replacement in New Zealand is approximately one in six for males and females. We identified a significant increase in the lifetime risk of primary TKR over a 15-year period. These data, considered in combination with estimates of the OA burden over time, can be helpful in policy settings to inform population health strategies, motivate uptake of primary and secondary prevention strategies and direct training of the surgical workforce.

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Video or verbal? A randomised trial of the informed consent process prior to endoscopy

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ABSTRACT

AIM: Informed consent (IC) prior to endoscopy is often inconsistently and poorly performed. We compared use of video-assisted consent to standard verbal consent for enhancing patients' recollection of procedural risks, understanding and fulfilment of expectation.

METHOD: Two hundred patients attending for gastroscopy or colonoscopy were randomised to either video-assisted consent (n=100) or verbal consent (n=100). The primary outcomes measured via a questionnaire were the recollection of procedural risks (sum of all correct answers for risk recall items) and patient experience compared to information provided in the consent process. Secondary outcomes included reported patient understanding and staff satisfaction between groups.

RESULTS: There was no difference between video or verbal groups in terms of risk recall scores (p=0.46), with less than half the patients able to recall more than two risks. There was a signal towards improved recall of bleeding as a potential risk in the video as compared to the verbal arm but it did not reach statistical significance (p=0.059). Patients' perceived understanding and fulfilment of expectation was high (>96%) in both groups. Seventy-one percent of the staff preferred using the video over the verbal IC.

CONCLUSION: Video-assisted consent made no significant difference to the IC process in terms of patient recollection or experience compared to usual verbal IC. Despite very poor recollection of procedural risks, patients in both the video and verbal groups reported understanding of the procedure and satisfaction with the IC process. Reasons for this mismatch are unclear. Further action to prioritise information delivery during IC is required. Future studies in this field should include patient-centred outcomes as a measure of success.

Informed consent (IC) lies at the crux of patient-centred care in medicine. It affirms patient autonomy and should convey vital information, including the nature, risks, benefits and alternatives of a procedure.[1] Despite its acknowledged importance and purpose, IC in endoscopy is inconsistently performed.[2–5] Even when performed, it does not always fulfil its purpose with patients having seemingly limited understanding.[6,7] Patient dissatisfaction and complaints may arise as a result.[8–10]

Traditionally, IC involves a verbal discussion prior to a procedure. Differences in the process arise from inherent variations by different health professionals discussing the procedure and patient variability of comprehension based on educational, ethnic, cultural and socioeconomic factors.[7,11] Inconsistency is amplified by variation and uncertainty of what should be discussed and in particular, risks of the procedure. Endoscopy guidelines state IC of risk should be "procedure-, circumstance- and patient-specific, even if the likelihood is very small."[1]

Different interventions have been trialled to improve the IC process. While extended discussions appear effective at improving patient understanding for research consent,[12] both time and staff constraints in endoscopy may limit feasibility and practicality of this. Increasingly, multimedia education tools such as video

are acknowledged as useful aids for this purpose.[13] Endoscopy-specific studies have demonstrated that patients may score better in knowledge-based tests with video IC for endoscopy.[3,14–16] In addition, there is no increase in anxiety and improved satisfaction, consistent with an understanding that patients prefer full disclosure.[14,15,17–21]

Use of video-assisted IC has not been widely adopted in gastrointestinal endoscopy. The absence of population-specific evidence in light of known patient variability, in conjunction with lack of evidence of feasibility or acceptability to both patient and clinician may explain this. Clinical equipoise remains as to the best method to obtain IC in terms of patient satisfaction, preference and provision of information.

We hypothesise that a video-assisted IC on the day of the procedure may be more effective and preferred by patients and staff as a means to educate and consent than traditional verbal IC.

Materials and methods

The study was performed at Tauranga Hospital, a secondary centre with 349 inpatient beds, servicing the Western Bay of Plenty in New Zealand including a catchment of over 230,000 people. The majority of endoscopy cases are triaged directly to endoscopy from community referrals.

Participants

All consecutive patients aged 18 years or older scheduled for an outpatient gastroscopy, colonoscopy or both between 1 June 2017 and 1 December 2017 were considered for enrolment in the trial. Patients were excluded if they were having a procedure other than colonoscopy or gastroscopy such as Endoscopic Retrograde Cholangiopancreatography (ERCP) or a planned therapeutic intervention such as dilatation or variceal banding. Further exclusions included patients who would ordinarily require a third party to sign consent (due to age, intellectual disability, lack of capacity, those visually or hearing impaired) and patients with a language barrier such that an interpreter was required.

Study design

Consistent with standard practice in our department, all patients were sent an information booklet containing details of the procedure at least one week prior to their appointment. Upon arrival to the unit and before randomisation, eligible patients were given a written participation information sheet explaining the purpose and requirements of the study. If agreeable to participation, patients were then randomly assigned to either the 'verbal' or 'video' group with allocation concealed in opaque envelopes, along with the patient questionnaire. Envelopes were pre-made, shuffled and then distributed to participants by administration staff not involved in the remainder of the trial.

The control group received the standard practice of verbal, nurse-led consent. All nurses participating had successfully completed competency training, including direct observational practice evaluation in taking IC.

Intervention and video design

Two videos were created, professionally filmed and narrated by a nurse investigator (TF). The videos were 3.5 minutes long and designed to cover all aspects of legal IC. Subtitles were included to highlight individual risks as they were mentioned. Validity of the videotape script content was established by submission to the Gastroenterology Department and Hospital Media Staff.

The intervention was the demonstration of the video, played in the patient bed space and displayed on an A5-sized tablet with the use of earphones in order to minimise contamination bias with neighbouring patients. Following the video, patients had the opportunity for further discussion and to ask questions. Patients were then asked to sign a standard hospital consent form and fill out the questionnaire.

Outcomes

The primary outcomes measured were the recollection of procedural risks (sum of all correct answers for risk recall items) and patient experience. Following the procedure and prior to discharge, patients were asked to record if they felt their experience was "similar, better or worse" than the video or verbal explanation that was provided to them. Secondary outcomes included breakdown of individual risk recall items, patient perception about understanding and taking of IC, risks, alternatives and anxiety.

Outcome assessment

The questionnaire consisted of 22 items (see supplementary file), designed and adapted from earlier validated studies where available.[5,22] The majority of the questionnaire was formatted using tick boxes, intended to limit ambiguity. It was divided into three segments: baseline demographic variables, knowledge and preference/expectation.

To assess knowledge, an open format asking about risks of the procedure was adapted.[23] Participants were asked to list the risks that they could recall. In addition, we asked at the end of IC whether patients felt "more anxious/less anxious/no different".

Post-procedure, after the sedation had worn off, participants were given back the study questionnaire to complete the remaining two questions regarding the experience of the procedure as compared to the explanation received during their IC.

At the end of the study period, a separate questionnaire was given to participating nurses to gather feedback on the effect of use of the video on time and patient flow within the department.

Statistical analysis

We aimed to detect an effect size in the sense of Cohen (proportion of the baseline pooled standard deviation) of 0.5 at 80% power for a False Discovery Rate-corrected significance level of 2.5%.[24] To do so, we required 78 participants per arm; assuming 20% missing values, 98 participants per arm were required to meet these criteria. We therefore aimed to recruit 100 participants per arm.

The primary analysis was carried out in an intention-to-treat analysis set. Linear regression was used to analyse the risk recall score. Logistic and proportional odds regression were used to analyse binary and multinomial outcomes respectively. Rare categories (<5%) in multinomial outcomes were collapsed with an adjacent category. The models were assessed for adjustment by baseline demographic variables during a blind review, absent of any knowledge regarding allocation.

Figure 1: Study design and exclusions.
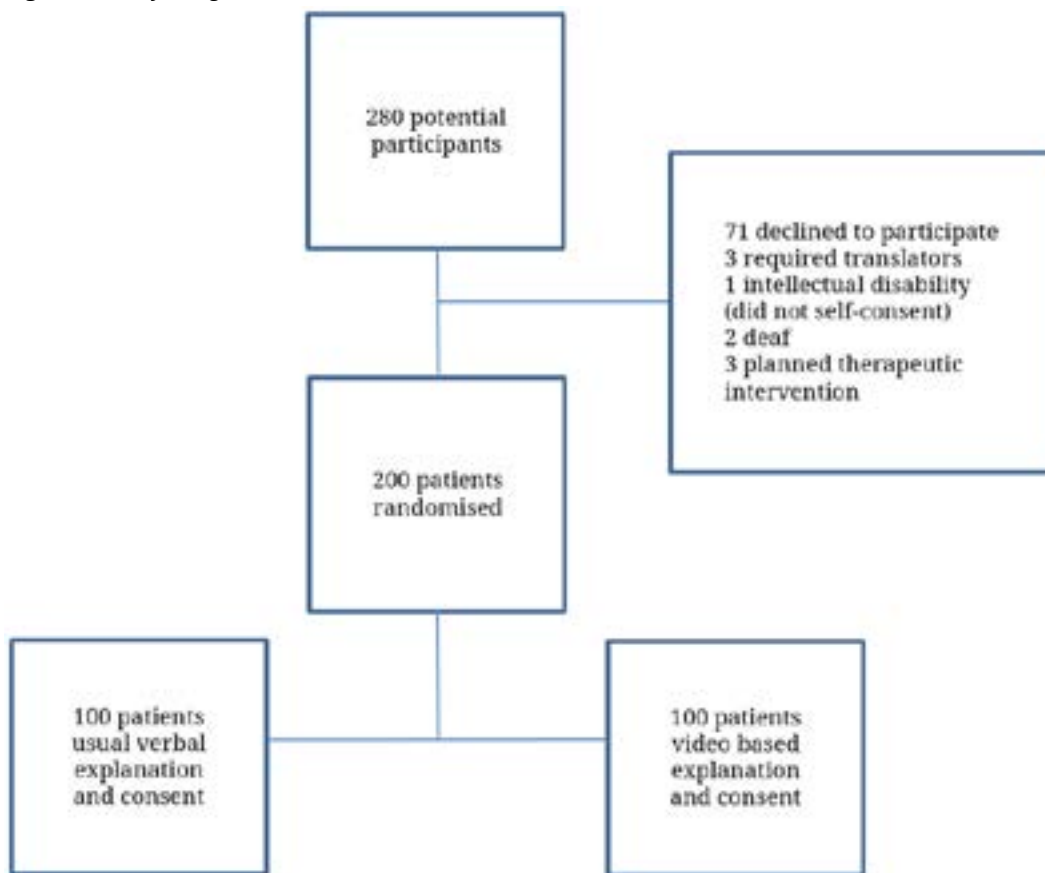
Missing data was multiply imputed in 15 replications of the data set. Subgroup analyses were carried out in prespecified categories (prior procedure, level of education, type of procedure) using interactions between subgroup indicator and group allocation. The nominal significance level was set at 5% against two-sided alternatives, and multiplicity controlled using False Discovery Rate.

Results

A total of 280 potential participants were assessed for the study, with 80 excluded, leaving 100 patients randomised to each of the verbal and video groups (Figure 1). The majority of patients were in the 50–75 year-old age group (Table 1). Considerably more patients in verbal arm attended university (44%) with more in the video arm having been educated to a high-school

Table 1: Baseline patient characteristics.

Demographic feature	Verbal (n=100)	Video (n=100)
Age (years)		
18–50	29	25
50–75	55	64
>75	16	11
Gender (Female)	47	57
Highest education level		
Did not complete high school	21	20
High school	34	56
University graduate	44	24
Ethnicity		
NZ European	87	89
Māori	8	5
Other	5	6
Languages spoken		
English	100	100
Te-Reo	2	1
Other	2	1
Procedure		
Gastroscopy	32	34
Colonoscopy	54	56
Both	14	10
Previous endoscopic procedures		
0	40	39
1	21	27
2	10	10
>3	26	23
Did not complete	3	1

level (56%). Ninety-two percent of patients in the video group indicated they received the pre-endoscopy information booklet, read it and found it useful. This is compared to 98% in the verbal group, with all except one patient reporting it was useful.

There was no significant difference in means between the total number of correctly identified risks recalled in the video compared to the verbal group: difference of means 0.11 (95% CI (-0.19, 0.41) p=0.46). Similarly, there was no significant difference between the groups in the reported patient experience: experience better compared to experience similar or worse OR 0.86 (95% CI (0.45, 1.63) p=0.55). A total of 192/196 patients from both groups reported that the procedure was as expected or better than what was explained to them during the IC process (Table 2).

Table 2: Procedural experience relative to explanation during IC.

	Verbal n=98	Video n=98
Better, n (%)	33 (34)	31 (32)
Similar	62 (63)	66 (67)
Worse	3 (3)	1 (1)

There was a signal towards improved recall of bleeding (Table 3) as a potential risk in the video as compared to the verbal arm, but it did not reach statistical significance (p=0.059). There is mild evidence for an effect on this particular recall risk, with significance noted in two of the sensitivity analyses (see Appendix). Following bleeding and perforation, there was a marked drop-off in recollection in both groups of the

remaining five risks that were discussed, with only one person in the video group recalling missed pathology as a risk (Table 3).

Nearly all patients in both arms of the study (>96%) felt following the IC process that they had a good understanding, knew what to expect and why the procedure was taking place. Very few had questions remaining at the conclusion of their IC (Table 4).

Patients verbally consented reported to be less anxious about the procedure (Odds Ratio Estimate 0.38: 95% CI (0.18–0.82) p=0.014). This result was supported by the sensitivity analyses (see Appendix).

Following the study, all nurses who took part completed the survey to measure feasibility and acceptability.

12/17 (71%) preferred the video over verbal IC. 8/17 (47%) thought it saved time, 4/17 (24%) thought it took more time and 5/17 (29%) thought it made no appreciable difference.

Discussion

This study revealed that video-assisted consent made no significant difference to the IC process in terms of patient recollection compared to the usual verbal IC performed by an experienced nurse. A new and unanticipated finding of the trial was a striking inability to recall risk, despite utilising a combination of techniques shown to be of benefit in other studies, including written information sent to the patients one week prior to examination.[25] This result may represent an overestimation of true information retention as the questionnaire was provided to patients immediately following

Table 3: Recollection of individual risks.

Risk correctly identified	Video n=81	Verbal n=76	Odds ratio (95% CI)	P value
Bleeding, n (%)	79 (96)	64 (84)	5.37 (0.94–30.8)	0.059
Perforation	45 (56)	53 (70)	0.63 (0.29–1.36)	0.24
Infection	32 (40)	30 (39)	1.18 (0.63–2.21)	0.60
Pain	14 (14)	10 (13)	1.36 (0.52–3.56)	0.52
Sedation risk	18 (22)	12 (16)	1.39 (0.67–2.91)	0.38
Procedure failure	2 (2)	11 (14)	0.51 (0.17–1.57)	0.24
Missed pathology	0 (0)	1 (1)	0.40 (0.02–6.7)	0.53

Table 4: Patient perception.

Question	Verbal (n=98)	Video (n=99)
Do you feel you understand what the procedure involves?		
Yes, n (%)	98 (100)	99 (100)
Do you understand why you are having the procedure?		
Yes	98 (100)	99 (100)
When I signed the consent form I still had questions		
Yes	10 (10)	3 (3)
After the test: I felt like I knew what to expect		
Yes	96 (98)	96 (97)

their IC. Further subgroup analyses did not demonstrate differences based on education, ethnic, or endoscopic experience. Insofar as we are aware, this is the first paper that specifically assesses and reports patient recollection of specific risks in the endoscopy setting. Clinicians need to be aware of this poor recollection and may need to consider modifying how to prioritise information delivery during the IC process. It should also serve to highlight to other specialities, with procedures or operations more complex or riskier than endoscopy, that special care and adequate time must be taken to allow patients to comprehend and question during the IC process.

Despite the lack of recollection of procedural risks, nearly every patient in both groups reported that they understood the procedure, felt like they knew what to expect, why it was being performed and only very few had questions remaining at the conclusion of the process. Following the procedure, they felt their experience was similar or better to what was discussed during the IC. This result is very encouraging and reassuring. One supposition to explain these incongruous findings is that perhaps one cannot equate recall with understanding or comprehension, which may be more complex. It has been described that "people often make reasonable decisions but cannot later recall the premises that supported the reasoning or the process that led to the conclusion. Nevertheless, they might well have understood it at the time."[26] As medical professionals, we rely heavily on

objective, categorical and quantitative data to guide clinical practice and the available studies on IC reflect this. To our knowledge, this is the only study in endoscopy IC to report on patients' perception of this process regarding both their feeling of understanding and fulfilment of expectations. Patient satisfaction is a key factor in reducing misunderstanding, disputes and complaints, with legal cases frequently due to failures in communication as opposed to failures in treatment.[27] Perhaps patient satisfaction, infrequently measured in studies,[28] as well as objective recall could be integrated into future outcomes or measures of success in trials of IC.

Regarding the amount of information provided during IC, other endoscopy video IC studies measured recollection of procedural risks based on only three items. With the aforementioned ambiguous guidance as to what should be discussed, it is naturally of concern to the authors that in our study, only 1/157 responses could recall missed pathology. The risk of this has been found to be 2–6% for cancer[29,30] with 43% of metachronous colorectal cancers attributed to missed lesions on prior colonoscopy.[31] However, the reported 0.06% risk of perforation,[32] or 0.1–0.3% risk of post-endoscopy infection[33] is often emphasised and better recalled. The poor recollection of risks, perhaps augmented by a stressful pre-operative setting, may inform clinicians, endoscopy units and future studies of IC to modify how they prioritise information delivery during the IC process.

Lastly, acceptability and feasibility to staff is vital for any new intervention. The majority of nurses preferred using the video, and nearly half thought it saved time. This may be an underestimation, confounded by the learning curve with additional time taken to run the study. Limitations of this study include the lack of blinding of the nursing staff to patient allocation group, which was not feasible in our setting. Despite a clear and user-friendly questionnaire there were substantial missing observations arising from incomplete survey forms. After randomisation there were considerable differences in baseline demographics of the two groups. Although these differences may in principle have led to chance bias, the blind review and adjustment for demographic covariates allays this risk. Decreased anxiety in the verbal arm, perhaps a reflection of the inherent reassurance with human interaction is difficult to confirm, as a formal State-Trait Anxiety Inventory (STAI) questionnaire[34] was not utilised in favour of a single simplified and non-validated question "more anxious/less anxious/no different".

In summary, this study showed no difference between video-assisted or verbal IC in terms of recollection of procedural risks, which were poorly recalled, or patient fulfilment of expectation, experience or perception of understanding, which was universally high. Further action to prioritise information delivery during IC is required. Future studies in this field should include patient-centred outcomes as a measure of success.

Appendix

Supplementary files

1. Sensitivity analyses: Complete data (no imputation).

	Reference category	Quantity estimated	Estimate (95% CI)	P value
Risk recall score	N/A	Difference of means	0.062 (-0.22, 0.34)	0.66

	Reference category	Quantity estimated	Estimate (95% CI)	P value
Experience better	Experience similar or worse	Odds ratio	0.82 (0.43, 1.56)	0.55

Feeling	Reference category	Odds ratio estimate, (95% CI)	P value
Less anxious	No difference or More anxious	0.18 (0.069, 0.46)	0.0004

Risk correctly identified	Odds ratio estimate, (95% CI)	P value
Bleeding, n (%)	16.8 (2.32–398.6)	0.019
Perforation	0.62 (0.29–1.31)	0.21
Pain	1.64 (0.64–4.44)	0.32
Infection	1.14 (0.60–2.19)	0.69
Allergy	1.46 (0.65–3.39)	0.36
Failure	0.20 (0.03–0.98)	0.069
Missed pathology	0.96 (0.005–141)	0.98

2. Sensitivity analyses: Unadjusted data (imputed data only).

	Reference category	Quantity estimated	Estimate (95% CI)	P value
Risk recall score	N/A	Difference of means	0.11 (-0.19, 0.41)	0.47

	Reference category	Quantity estimated	Estimate (95% CI)	P value
Experience better	Experience similar or worse	Odds ratio	0.92 (0.50, 1.68)	0.78

Feeling	Reference category	Odds ratio estimate, (95% CI)	P value
Less anxious	No difference or More anxious	0.48 (0.24, 0.95)	0.036

Risk correctly identified	Odds ratio estimate, (95% CI)	P value
Bleeding, n (%)	5.07 (1.22–20.98)	0.026
Perforation	0.65 (0.34–1.27)	0.20
Pain	1.20 (0.50–2.87)	0.68
Infection	1.18 (0.63–2.21)	0.60
Allergy	1.44 (0.69–2.98)	0.33
Failure	0.50 (0.19–1.13)	0.16
Missed pathology	0.18 (0.00–35)	0.53

3. Sub-group analysis based on patient baseline characteristics.

Previous scope	Risk recall score (difference of mean)	P value
No	0.07 (-0.39–0.53)	0.77
Yes	0.17 (-0.021–0.56)	0.37
Education		
Did not complete high school	0.68 (0.05–1.31)	0.04
High school	-0.05 (-0.45–0.36)	0.20
University	0.1119 (0.45–0.68)	0.69
Procedure		
Colonoscopy	0.03 (0.42–0.35)	0.86
Gastroscopy	0.29 (-0.16–0.73)	0.21

4. Subgroup analysis of patient experience with "experience better" compared to reference category of "experience similar or worse" for video vs verbal groups.

Subgroup	Odds ratio estimate, (95% CI)	P value
No previous scopes done	0.62 (0.25, 1.56)	0.31
Previous scopes done	1.21 (0.53, 2.76)	0.65
Education: Did not complete high school	0.56 (0.14, 2.20)	0.41
Education: high school level	1.03 (0.44, 2.37)	0.95
Education: university level	0.95 (0.28, 3.21)	0.93
Undergoing colonoscopy	0.62 (0.25, 1.53)	0.30
Undergoing gastroscopy or both	1.32 (0.57, 3.03)	0.51

Consent questionnaire

Age:
- ☐ 18–30
- ☐ 30–50
- ☐ 50–75
- ☐ >75

Gender:
- ☐ Male
- ☐ Female

Nationality you identify with:
_____
_____
_____

Languages spoken:
_____
_____
_____

Would you prefer consent in a different language:
- ☐ Yes | Which?_____
- ☐ No

Highest educational level:
- ☐ Did not complete high school
- ☐ Completed high school
- ☐ University or graduate

Procedure (tick both if appropriate):
- ☐ Colonoscopy
- ☐ Gastroscopy

Previous endoscopy experience:
- ☐ 0 (First time)
- ☐ 1
- ☐ 2
- ☐ >3

Tick which is most appropriate:
- ☐ I learn/understand best by watching
- ☐ I learn/understand best by listening
- ☐ I don't mind which

- ☐ I received endoscopy written booklet
- ☐ I read the endoscopy written booklet

I felt the written information sent out to me was useful.
- ☐ Yes ☐ No ☐ Don't know

I think the main objective of informed consent procedure is to:
- ☐ Improve my understanding
- ☐ Show evidence of understanding and agreement
- ☐ Protection of legal rights of doctors
- ☐ It is a formality only
- ☐ I don't really know

Do you think this informed consent process is:
- ☐ Too Long
- ☐ Too brief
- ☐ Fine as is

Knowledge:

Do you understand the details of the proposed test (ie, what the procedure entails?)

☐ Yes ☐ No

Were you told about the risks of the test?

☐ Yes ☐ No

If yes, please list these:

_____

_____

_____

Were you told about the benefits of this test?

☐ Yes ☐ No

Were you told about alternate methods other than this test?

☐ Yes ☐ No

Was the discussion/video helpful in you making the decision about undergoing this test?

☐ Yes ☐ No

After procedure:

Was the procedure compared to the informed consent process:

☐ Similar to explanation I had

☐ Better than explanation I had

☐ Worse than explanation I had

I felt like I knew what to expect:

☐ Yes ☐ No ☐ Don't know

Following the consent/explanation:

☐ I felt more anxious

☐ I felt less anxious

☐ I felt no different

At the end of the video/discussion with nurse [delete one], I still had questions:

☐ Yes ☐ No ☐ Don't know

To nurses at end of study:

Following randomisation process, we asked the nurses:

Do you prefer use of:

☐ Video consent:

☐ Standard consent (verbal)

☐ Don't know

Use of video consent:

☐ Saved me time

☐ Took me more time

☐ No difference in terms of time

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SF-12 indicators of health following the 22 February 2011 Christchurch earthquake

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ABSTRACT

AIM: To explore the health status of people who experienced the magnitude 6.3 earthquake in Christchurch on 22 February 2011, across time and in comparison with other New Zealanders.

METHODS: Data from five New Zealand Health Surveys (2011/12, 2012/13, 2013/14, 2014/15 and 2015/16), which each sampled around 13,000 people, aged 15+ years, living in New Zealand. Respondents completed the SF-12 questionnaire and were asked if they experienced the earthquake. About 1,000 respondents in each survey had. The survey data were pooled and the physical and mental health composite scores were created from the SF-12 data.

RESULTS: Those who experienced the earthquake had, on average, better mental and physical health composite scores in 2011/12, although not all scores were significantly better. In 2013/14, all mental and physical health composite scores indicated, on average, worse health status, and for men the differences were significant. The age groups most affected were 45–64 for women and 45–64 and 65+ for men. Some improvement occurred from 2014/15 onwards.

CONCLUSION: The pattern of an initial improvement in health, followed by a deterioration and subsequent improvement follows the heroic/honeymoon/disillusionment/reconstruction model of response to a disaster.

This paper describes the health status of people who were in Christchurch on 22 February 2011 when a magnitude 6.3 earthquake struck the city.[1] The earthquake was an aftershock to the magnitude 7.1 Darfield earthquake that had occurred in the region on 4 September 2010.[2] The February earthquake was more damaging to Christchurch as it was closer to the city (only 6km south east of Christchurch), had a shallow epicentre at only 5km deep and because the buildings in Christchurch had been weakened by the earlier earthquake.[1]

The aftershock was also more harmful to humans, with 185 deaths and 164 people seriously injured, as the earthquake happened at lunch time during a work day when people were more likely to be outside in the older and more built-up part of the city, whereas the earlier earthquake occurred at 4:35am when most people would have been at home asleep in generally single-level dwellings.[3,4]

The earthquake not only affected people's health at the point of the disaster but also during the recovery. In the aftermath of the 22 February 2011 Christchurch earthquake (C22Feb11E) a great deal of extra physical labour was required of some people to continue their daily lives—removing liquefaction from properties, carrying water in neighbourhoods where the water system had been broken, building outside toilets where the sewer system no longer worked or walking rather than driving due to damaged or blocked roads. And for a much longer period there was also a degree of mental and emotional labour, as people sought to cope with changes to daily life, such as changes to the location of schools or their closure; the location of workplaces or their closure and changes in income; loss of

sporting, religious and social infrastructure; disruptions as the built environment was repaired; accommodation issues and housing repairs; as well as supporting family members also undergoing similar issues.[5] There were also issues with insurance and government agencies to get the funds necessary to repair damaged homes and other property, which for some people was onerous and lengthy. The All Right? survey undertaken in September 2016 reported 20% of respondents with a property claim with EQC or an insurance agency still hadn't had their claim settled.[6]

There was evidence of strong community support immediately after the earthquake with the Student Volunteer Army and the Farmy Army donating their labour and, in the latter case, machinery, as well as longer-term efforts to encourage resilience.[7–10]

The population of Christchurch also changed in the years following the C22Feb11E, with the older population more likely to stay in Christchurch, but with an outward flow of younger people, mostly into neighbouring districts but also to other parts of New Zealand and overseas.[11] As the rebuild started, young males flowed into Christchurch from New Zealand and overseas but there was a continued outflow of young females.[11]

Following a major disaster such as an earthquake, psychological symptoms such as anxiety, depression and post-traumatic stress can be experienced by some people and may persist for many years.[12–14] A number of studies have reported psychological distress following the Christchurch earthquakes, with some evidence of a relationship between the level of exposure to the earthquake and its after-effects, and severity of symptoms.[15–20]

One study found some short-term but no long-term increases in the dispensing of prescriptions for anxiety and depression, and the authors say that this "may reflect a number of factors, including minimal overall effects of the earthquakes on the mental health of the population, minimal help-seeking in medical settings, a possible beneficial impact of increased availability of free counselling, primary healthcare services and a range of other social supports, and possible beneficial effects of disasters on the mental health of the population."[21]

A Wellbeing survey of greater Christchurch residents, who were randomly selected from the electoral roll, was conducted six-monthly from September 2012.[22] The surveys ranged from 2,381 to 3,100 respondents with response rates ranging from an initial 52% with a low of 34% in September, 2015. In September 2012, 74% of respondents rated their overall quality of life as good or extremely good, dropping slightly to the lowest point in September 2013 (73%) and then rising to a stable 82% in April 2016, September 2016 and June 2017.[22] Those reporting stress in the last 12 months which had a negative effect (most of the time or always) has declined slowly from a value of 23% in September 2012 to 18% in June 2017. These results suggest most people are recovering from the earthquake, but a reasonable number are still experiencing negative impacts.[22]

The California Department of Mental Health has produced a model for the phases of response to a generic disaster over time (Figure 1).[23] The model suggests that emotional responses become more negative as people wait for the event to occur (eg, tornadoes) reaching a low as the event occurs. This is followed by an upswing as people enter the heroic phase which peaks in a honeymoon period. This is followed by a long decline during a disillusionment phase as it becomes apparent that returning to a life that was similar to before the event is going to take some time and be disruptive across many aspects of their life. Finally, a gradual upswing occurs as people's lives move on, reconstruction occurs and there is hope for better things. During this later stage there may also be trigger events that change people's emotional responses sharply, such as anniversaries, or in the case of earthquakes, aftershocks.

Typically, with earthquake events there is little advanced warning of a severe earthquake, and among the general population that was the case with the C22Feb11E, even though an aftershock of the C22Feb11E's magnitude was not unexpected from a geological perspective, given the earlier magnitude 7.1 Darfield Earthquake.[1,24]

Figure 1: A simplified version of the phases of response to a disaster over time.
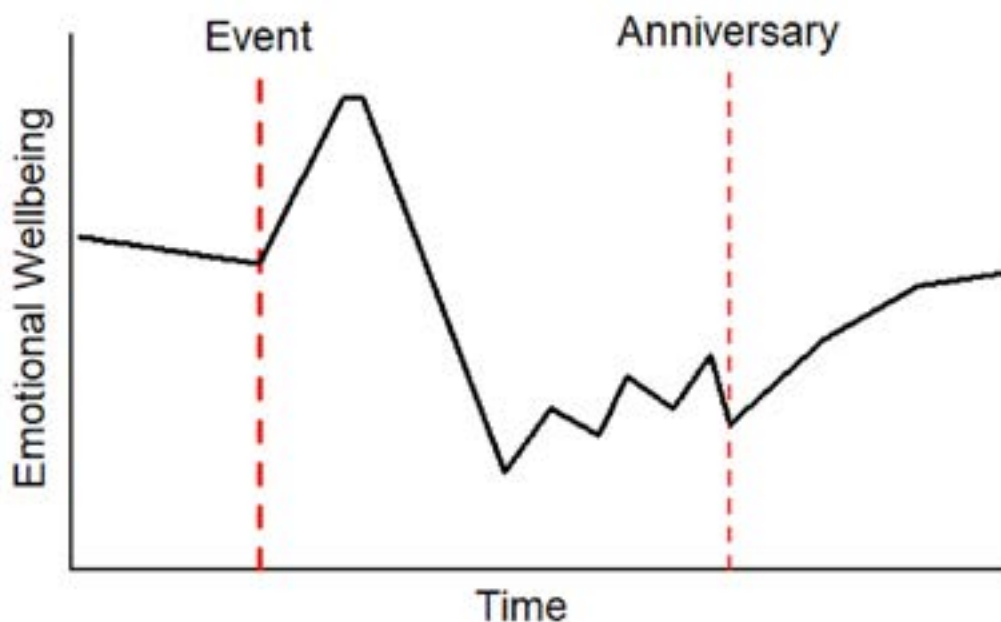
Source: California Department of Mental Health (2012), based on Zunin & Meyers (2000), cited in Britt 2012, p33.[23]

Methods

The Ministry of Health has been running rolling surveys of New Zealanders about their health and health service use since 2011.[25] Each survey runs from July in one year until the end of June in the next. The surveys all contain a similar core module but also include modules that rotate in and out of the survey on a yearly basis, eg, alcohol use and sexual and reproductive health. The data in this study come from five New Zealand Health Surveys (NZHS), NZHS 2011/12, NZHS 2012/13, NZHS 2013/14, NZHS 2014/15 and NZHS 2015/16.[25]

Each survey contains roughly 13,000 respondents aged 15 years or older. The respondents selected were living in private or non-private dwellings and were from the New Zealand usually resident population. Non-private dwellings include such places as aged-care accommodation and student hostels. However, people in hospitals, prisons, dementia units or those in hospital-level aged care accommodation were excluded as well as people in meshblocks with sparse populations and New Zealand's off-shore islands.[25] The surveys were done in people's homes with a mix of face-to-face interviewing and computer-assisted interviewing, the latter being used for sensitive topics.[25]

The surveys used a complex method of sampling that included oversampling Māori, Pacific and Asian peoples, but the survey has been weighted to produce a representative sample.[25] Estimates produced by these weights form unbiased estimates of population values. The data set also includes a set of 100 replicate weights which create 100 further estimates. The variance of these estimates around the unbiased estimate gives the sampling variance. For this paper, Sudaan was used to do these calculations.[26]

As a result of C22Feb11E, a question was added into these five surveys asking whether respondents were residents of Christchurch on the day of that earthquake.[25] This variable has been analysed to compare the health status of those who were residents and those who were not residents and the difference has been labelled the Christchurch earthquake effect.

For the purposes of the question, respondents who were residents of Christchurch but were away on that day were asked to respond with "yes", whereas visitors to Christchurch on that day were asked to respond with "no".[25] This way of counting people matches the way Statistics New Zealand counts the subnational usually resident population.[27] However, this mis-specification of people experiencing the

C22Feb11E will likely cause the Christchurch earthquake effect to be underestimated as some of those who experienced the earthquake could be in the comparison group and those who did not experience the earthquake, potentially only its aftermath, could be in the intervention group.

The C22Feb11E was felt differently across Christchurch with some areas having extreme damage and some areas being relatively unharmed. It was followed by a sequence of aftershocks which added to the severe disruption of the social and physical environment. Most residents remained in Christchurch, but some moved to other parts of New Zealand and some moved overseas.[28] Therefore, the Christchurch earthquake effect will vary between people according to how respondents experienced the earthquake on the day and how they were affected by the aftermath. Those who left Christchurch, but remained in New Zealand, had the potential to be included in the health surveys but those who moved overseas did not.

The five health surveys each contain the SF-12 questionnaire and the data from these surveys were pooled to create the SF-12 statistics.[29] Eight subdomain scores were created from self-reported responses to either one or two of the 12 questions and scaled to have a mean of 50 and a standard deviation of 10. A physical health composite score and a mental health composite score were created based on a weighted sum of the eight subdomains. The weights were created by performing a principal component analysis on the eight subdomain scores. The composite scores were also scaled to have a mean of 50 and a standard deviation of 10 with higher values indicating better health status. If a respondent had missing values for one or two questions in the SF-12 than the missing values were replaced with the average response of respondents of the same age and sex. This meant responses from an extra 981 people could be included and raised the proportion of respondents able to be given composite scores from 98.0% to 99.5%. A respondent with three or more missing values had their responses dropped from this analysis. The analysis was done using the survey weights so that the composite scores represent population values.

The reason for pooling the data across the surveys was to create weights on the subdomain scores across all years, rather than creating separate weights for each survey's subdomain scores. This meant that the composite scores could be compared over time. Four sets of composite scores were calculated: 1) a set each for males and females across the entire survey and 2) a set each for males and females who experienced the C22Feb11E. As each population group have had their composite scores standardised to have a mean of 50 and standard deviation of 10, it meant that the males' and females' scores cannot be compared against each other. The composite scores were plotted for the people who experienced the C22Feb11E, with 95% confidence intervals, about the mean level of 50. Any 95% confidence interval that does not cross the 50 line indicates a significant difference at the 5% level.

The composite scores were also plotted for males and females who experienced the C22Feb11E, with their 95% confidence intervals, for age groups 15–29, 30–44, 45–64, 65+. As each age group has different average composite scores, rather than the population average of 50, a regression analysis was done for each age group and sex to see whether the composite scores were similar across years, with year coded as a classification variable.

It is possible that all respondents' scores in the survey follow a similar pattern to those who experienced the C22Feb11E. To check whether this was so, the physical health and mental health composite scores for all respondents in the surveys were modelled with the Christchurch earthquake effect as the independent variable and age group, ethnicity and NZDep2006 as confounders in a linear regression and done separately by sex and year. NZDep2006 was not available in the 2015/16 survey, so it was replaced by NZDep2013 for that year.

Finally, a regression with the previous variables plus a year by Christchurch earthquake effect interaction was done to check whether Christchurch was different to the rest of the country across years.

Table 1: The number, weighted and unweighted proportions of respondents in the four New Zealand Health Surveys who were or were not in Christchurch for the 22 February 2011 earthquake.

In Christchurch for earthquake				Others			Total
Survey	n	%[1]	%[2]	n	%[1]	%[2]	n
2011/12	1,043	8.3	12.3	11,553	91.7	87.7	12,596
2012/13	995	7.6	9.8	12,014	92.4	90.2	13,009
2013/14	981	7.4	8.1	12,328	92.6	92.0	13,309
2014/15	1,003	7.4	10.6	12,494	92.6	89.4	13,497
2015/16	1,015	7.4	10.3	12,766	92.6	89.7	13,781

Note: 1—unweighted percentage; 2—weighted percentage.

Results

Table 1 shows that roughly 1,000 respondents reported being in Christchurch for the C22Feb11E in each of the five surveys. In the first survey after the earthquake, 8.3% reported being there compared to 7.4–7.6% in later surveys.

Figure 2 presents a graph of the composite scores for female respondents who were living in Christchurch at the time of the earthquake. From observation, both the Physical and Mental Health Composite Scores were significantly above 50 in 2011/12 and the Mental Health Composite Score was significantly below 50 in 2013/14.

Figure 2 also presents a graph of the composite scores for male respondents who were living in Christchurch at the time of the earthquake. Both the Physical and Mental Health Composite Scores were significantly above 50 and in 2011/12 and significantly below 50 in 2013/14.

The two subdomains that had the greatest influence on the change in the composite scores between 2011/12 and 2013/14 were 'Role Physical' for the physical health composite score and 'Vitality' for the mental health composite score—for both men and women. The raw data that these subdomains scores are based on are presented in Table 2.

Figure 2: Average composite scores for females and males who were in Christchurch at the time of the February 2011 earthquake based on the SF12 questionnaire.

SF-12 Composite Score by Year
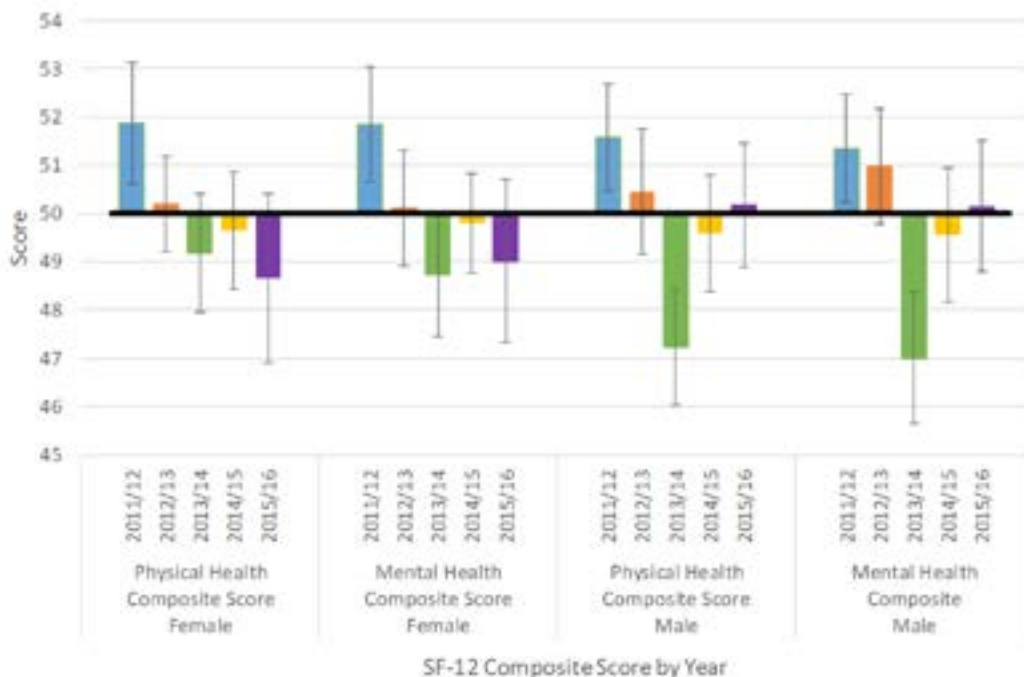
Table 2: The distribution of responses to questions from the SF-12 questionnaire that have the most influence on the changes in the composite scores between 2011/12 and 2013/14.

	Female		Male	
	2011/12 %	2013/14 %	2011/12 %	2013/14 %
'Role Physical' component questions				
During the past four weeks, how much of the time have you accomplished less than you would like as a result of your physical health?				
All of the time	2.3	2.4	1.2	3.5
Most of the time	2.5	5.2	3.6	7.6
Some of the time	6.3	12.5	6.3	9.4
A little of the time	9.0	13.1	5.8	10.9
None of the time	80.0	66.8	83.0	68.7
During the past four weeks, how much of the time were you limited in the kind of work or other regular daily activities you do as a result of your physical health?				
All of the time	2.1	1.6	1.3	4.5
Most of the time	2.9	6.4	2.7	6.9
Some of the time	6.7	11.0	6.1	10.4
A little of the time	6.8	12.6	6.2	11.5
None of the time	81.5	68.4	83.7	66.8
'Vitality' component question				
How much of the time during the past four weeks...did you have a lot of energy?				
All of the time	5.8	2.7	8.7	2.4
Most of the time	48.0	33.3	54.5	43.9
Some of the time	27.0	37.1	25.5	31.0
A little of the time	14.9	18.3	8.4	12.7
None of the time	4.4	8.6	2.8	10.1

The physical and mental health composite scores for males and female who were in Christchurch at the time of the February 2011 earthquake, by age group, appear in Figure 3. From observation, across nearly all age groups and for both component scores, men generally start off with greater health status score, then drop to a lesser score around 2013/14 and then improve. For women, across both component scores, the two younger ages groups appear to be having a small but uninterrupted decline, the 40–65 age group follow a pattern similar to the men and the oldest age group appears to have a rise across years.

A regression analysis was done for each age group and sex to see whether the composite scores were similar across years. For females, there was a significant difference between years for those aged 45–64 in both the physical health (p=0.0001) and mental health composite scores (p=0.0000). For males, there was a significant difference between years for those aged 45–64 in both the physical health (p=0.0007) and mental health composite scores (p=0.0012), and also for males aged 65+ (p=0.0205, p=0.0133 respectively). There was a significant difference between years for men aged 15–29 for their mental health composite scores (p=0.0468).

Table 3: The Christchurch earthquake effects from a regression model by year and sex with age group, ethnicity and NZDep2006 (or NZDep2013 in 2015/16) as confounders.

		Christchurch earthquake effect for the			
		Physical Health Composite Score		Mental Health Composite Score	
		Estimate	95%CI	Estimate	95%CI
Females					
Year	2011/12	0.96	(-0.35, 2.27)	0.28	(-0.98, 1.54)
	2012/13	-0.50	(-1.51, 0.52)	-0.97	(-2.23, 0.29)
	2013/14	-1.99	(-3.14, -0.84)	-2.89	(-4.16, -1.62)
	2014/15	-0.55	(-1.91, 0.81)	-0.92	(-1.98, 0.14)
	2015/16	-0.90	(-2.42, 0.62)	-1.31	(-3.01, 0.40)
Males					
Year	2011/12	0.48	(-0.81, 1.78)	0.09	(-1.11, 1.28)
	2012/13	-0.30	(-1.72, 1.13)	0.27	(-1.11, 1.65)
	2013/14	-3.95	(-5.26, -2.65)	-4.33	(-6.04, -2.63)
	2014/15	-0.69	(-1.95, 0.56)	-1.23	(-2.57, 0.10)
	2015/16	0.19	(-1.02, 1.40)	0.24	(-1.11, 1.59)

Figure 3: Physical and Mental Health Composite Scores by age and sex for people who were in Christchurch at the time of the February 2011 earthquake based on the SF12 questionnaire.
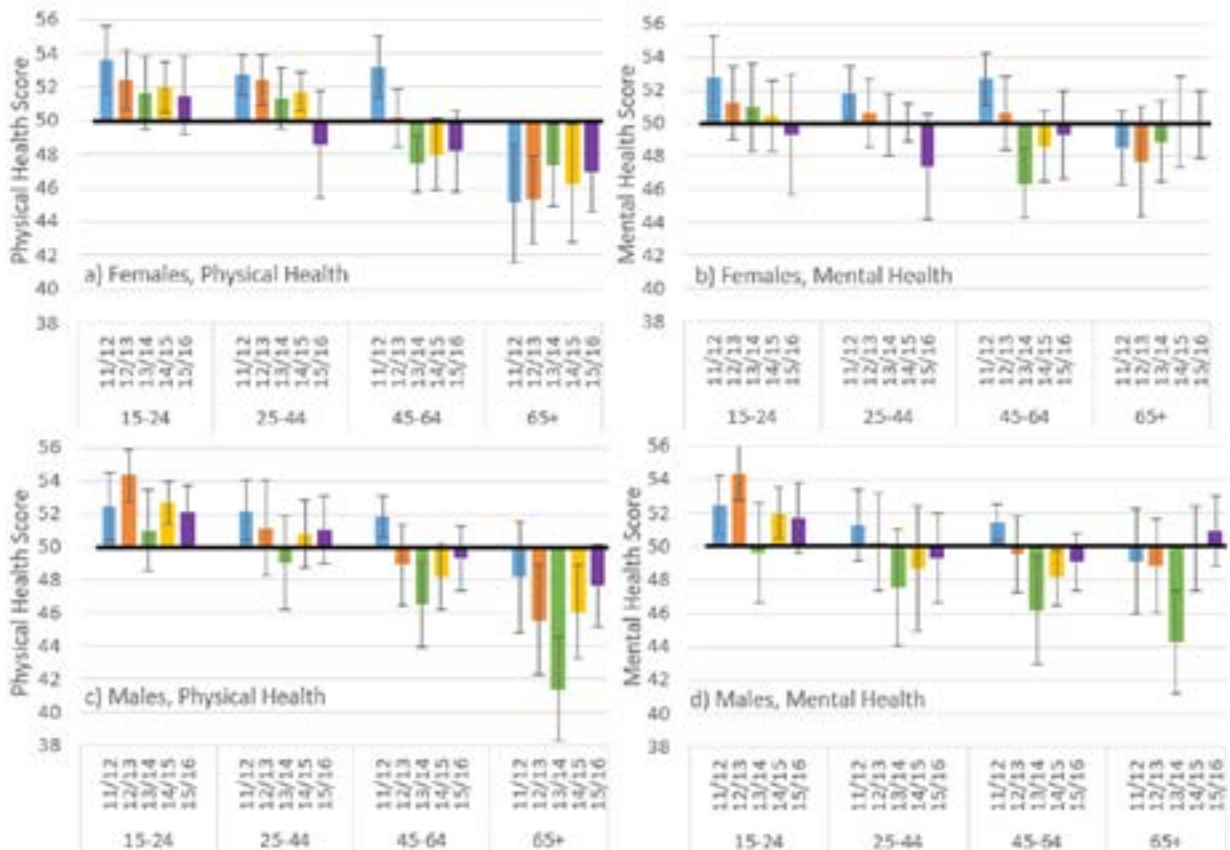
It is possible that all the respondents' scores in the survey follow a similar pattern to those who experienced the C22Feb11E, ie, everyone across the country had high scores in 2011/12 and low scores in 2013/14. To check whether this was so, the physical health and mental health composite scores for all respondents in the surveys were modelled with the Christchurch earthquake effect as the independent variable and age group, ethnicity and NZDep as confounders in a linear regression, done separately by sex. These effects appear in Table 3, where zero would indicate no difference between the two groups. From observation, all effects are positive in 2011/12, decrease until 2013/14, and then increase again with males having positive effects in 2015/16. However, the only significant differences found, across both sexes and for both composite scores, was for 2013/14.

Pooling the data and comparing across years shows that for both males and females and for both composite scores there were significant Christchurch by year interactions. For females and the physical composite score the p-value for the interaction was p=0.0076; in the other three cases, the p-values for the interactions were all p=0.0000.

Discussion

The strength of this analysis is that it compares an identical measure across five surveys, representing five years of time. Although the surveys are cross-sectional, the respondents were selected and weighted to be representative of the population. The data to compare pre-quake SF-12 scores to post-quake SF-12 scores are not available, however, the Christchurch data are self-referencing across the years, ie, the way the SF-12 scores change over time is correct.

The results show that both physical and mental health composite scores were greater in the years directly after the earthquake and then decreased, markedly for men, in 2013/14 and have increased since then. This shape is consistent across age groups for men and in the older age groups for women. For the younger two age groups for women there appears to be a continuing small decline in scores. With these data, we cannot prove that the changes in SF-12 composite scores are directly related to the

C22Feb11E and its aftermath. It could be that these changes are related to the earlier Darfield earthquake in 2010 or some other incidents. However, the C22Feb11E was such a devastating event, was followed by many large aftershocks, and changed the social and physical environment to such a degree that it is implausible to think it had no impact. Similarly, with these data, we cannot discriminate between the effects of the earthquake itself and the earthquake's aftermath, eg, the effects of dealing with insurance companies and government agencies. In one sense that does not matter because all those things are not separable occurrences; rather, they all evolved from the initial event. However, it is something to be aware of when interpreting the results.

There is some variation in the proportion of people who said they were in Christchurch during the C22Feb11E over the five surveys, more noticeably in the weighted estimates than in the non-weighted estimates. Both the weighted and non-weighed estimates hint that people experiencing the C22Feb11E were being lost to the survey after the first year—possibly by moving overseas or by not wishing to say they were in Christchurch on that day. All Right? research found that 64% of Christchurch people said they felt guilt that others were more affected by the earthquakes.[9] It could be that some people may have felt that they had not suffered enough to put themselves into a group that might get extra attention.

The NZHS, being a nationwide survey, could capture people who experienced the C22Feb11E and had moved to other places in New Zealand. However, the numbers moving are not that discrepant from prior general turnover. Using 2013 census data, StatsNZ concluded that 89% of people who lived in greater Christchurch in 2008 still lived there in 2013.[30] Using 2006 census data, 91% of people who lived in greater Christchurch in 2001 still lived there in 2006.[31]

The severe dip in health that is seen in this data is not seen in the 10 Wellbeing surveys and the four All Right? surveys that were run over roughly the same time period (both Sept 2012–June 2017 so far).[9,22] However, there was evidence of greater disillusion in the 2013/14 Wellbeing survey. The percentage of respondents saying they were not confident or not very confident in the

decisions being made by central and local government agencies was at its highest in April 2014 (41% versus a low of 34%),[22] while the percentage saying they were satisfied or very satisfied with the opportunities the public had to influence earthquake recovery decisions was also at its lowest percentage in April 2014 (24% versus a high of 32%).[22]

There are differences in the way the NZHS and the Wellbeing and All Right? surveys were conducted that means there are caveats on any comparisons. Firstly, they capture different respondents. The latter two surveys do not contain people living in New Zealand, but outside of Christchurch, who experienced the earthquake while they also captured people who had moved to Christchurch since the earthquake. The NZHS are nationwide surveys and are not directly about the C22Feb11E, unlike the Wellbeing and All Right? surveys which were clearly about their respondents' responses to the C22Feb11E. In the NZHS, the question asking respondents if they experienced the C22Feb11E was the last question asked of respondents on each of the surveys and so would not have influenced their earlier responses about their health status. The different focus of the NZHS may have elicited different responses to the Wellbeing and All Right? surveys.

Clearly, the results from the SF-12 analyses show that the 2013/14 survey was different to other years. Differences were seen in the average physical and mental health component scores for men and the average mental health component scores for women. There are several ways this could be interpreted—1) this is a natural progression in the recuperation of people after a devastating event, 2) there was something unusual in the conduct of the surveys or 3) there was some other trigger event preceding/during the collection of data in the 2013/14 survey.

1. A natural progression

It is clear from the literature that there is a hero effect and a honeymoon phase after an initial shock event and this is consistent with our data. The time frame that this pattern evolved over is somewhat different to the graph in Figure 1 which shows that for a generic disaster, the hero effect/honeymoon phase lasts for about three months when disillusion sets in and hits rock bottom six months after the event, with things beginning to improve markedly from the first anniversary. However, the C22Feb11E was not just an event that had an effect on one day; large aftershocks continued for some time and the indirect effects of the earthquake lasted many years after the event and for some people it is still ongoing.[6] The data seem consistent with Figure 1 but over a longer time frame.

2. The survey

The NZHS are run with a high degree of professionalism and rigour, so it's unlikely there was a mistake in any professional sense. However, the way respondents are selected into the survey could have had some effect. People are captured into the survey if their meshblock, home and then they themselves were randomly chosen to be sampled. Since the earthquake affected different parts of Christchurch in different ways it could be that in 2013/14 there was a random over-sampling of the worst affected areas. However, out of the approximately 100 meshblocks sampled in the Canterbury DHB area in each survey, it is estimated that around 85 were sampled from Christchurch in each survey.[32] The NZHS 2013/14 survey would have had to have been extremely unlucky to get such a poor choice of meshblocks to make such a difference.

The respondents who said they were in Christchurch during the 2011 earthquake were compared across the surveys by sex, age, age group, ethnicity and NZDep score to see if there was any difference between surveys. At this level, the respondents who experienced the C22Feb11E do not look any different across years.

3. Potential triggers

Strong earthquakes occur in New Zealand all the time but there were two relevant earthquakes that may have affected the recovery of those experiencing the C22Feb11E. Two strong earthquakes occurred in Seddon, roughly 300km NNE of Christchurch: a 6.5 magnitude earthquake on 21 July 2013 and a 6.6 magnitude earthquake on 16 August 2013.[33] Both occurred at the start of the interviewing period for the 2013/14 survey. These earthquakes also initiated some controversy over whether it would "kick off" the Alpine Fault, a fault line that in the past has caused magnitude 8 earthquakes.[34]

While aftershocks were still happening as a result of the C22Feb11E in 2013/14, they were clearly tailing off and for many people there would have been a sense of the geologic event coming to an end. With a new earthquake sequence occurring in Seddon, it is possible that it reminded Christchurch people of their own experiences in the earthquake and a feeling that earthquakes were a never-ending uncontrollable occurrence.

Another group of potential trigger events to hit Christchurch during 2013 and 2014 was a series of floods.[35,36] In some areas of Christchurch the floods were made worse as the land had dropped by half a metre due to the C22Feb11E.[35] The affected homeowners were left in doubt about whether their homes would be red-stickered or, if remediation was possible, which agency, if any, was required to pay for the work.[35]

Since those surveys were undertaken, Christchurch has come through even more troubles. In November 2016, a magnitude 7.8 earthquake struck 95km north of Christchurch.[37] In February 2017, fires on the Port Hills of Christchurch spread across 2,000ha and in April 2017, the remnants of cyclone Cook caused widespread flooding.[38,39] Although they show remarkable resilience, these events are likely to put further pressure on the health and wellbeing of people in Christchurch.[39]

Conclusion

The pattern of an initial improvement in health, followed by a deterioration and then subsequent improvement appears to follow the heroic/honeymoon/disillusionment/reconstruction model of response to a disaster although the time frame appears to be extended.

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Addition of explicit guidance to acute pancreatitis guidelines increases compliance with amylase measurement recommendations

Serin Cooper Maidlow, Michael Ardagh, Rosie Callender, Oliver Thomas

ABSTRACT

AIM: *Hospital HealthPathways* is an online database of local clinical guidelines produced by a dedicated team for use within Canterbury District Health Board (CDHB) hospitals. A 'Practice Point'—a bullet point making explicit a recommendation within the body of a clinical guideline—was added to the guideline for acute pancreatitis, instructing users to avoid serial measurements of serum amylase levels. The aim was to explore whether the addition of this Practice Point affected compliance with the amylase measurement recommendations.

METHOD: The number of serum amylase tests requested for patients admitted with acute pancreatitis by GPs and doctors working in the emergency department, general surgery and other departments was audited using the CDHB's online clinical information system. A data set from a six-month period ending three months prior to the addition of the Practice Point, collected for a previous study, was used with the author's permission as a control group. A new data set from a six-month period starting three months after the addition of the Practice Point formed the experimental group.

RESULTS: Compliance rose by 13% after the addition of the Practice Point. Before the Practice Point was added to the guideline, 82 of 126 total patients (65%) had amylase measured only once, on admission, in compliance with the *Hospital HealthPathway* guideline. After the addition of the Practice Point, 142 of 182 patients (78%) had one measurement of amylase. This improvement was seen where patients were referred directly by their GP to the general surgical teams and patients managed by other specialties. Variation in compliance seen over the six-month experimental group period was significant, but did not show a clear trend of either improvement or decay in compliance.

CONCLUSION: This supports the hypothesis that the simple intervention of clarifying a key point within a clinical guideline can have a significant positive effect on compliance. This is an important consideration for guideline authors and institutions publishing clinical guidelines, as poor compliance by clinicians is reported in studies. The intervention in this study is a simple change for guidelines based online, and the significant effect could contribute to improvement in patient-centred, financial and clinical domains.

Clinical guidelines are evidence-based recommendations designed to guide decision making in healthcare. Compliance with guideline recommendations within clinical practice has been shown to streamline and coordinate processes of patient care.[1] A range of factors influence whether healthcare professionals use and comply with these guidelines.[2] The factor which is most open to intervention is the guideline itself.[3] This study focuses on whether a simple alteration to clarify and highlight a key point in a clinical guideline increased compliance with the recommendation in question.

Many studies of different aspects of clinical guidelines and their utilisation have been carried out as guidelines continue to proliferate. Compliance with recommendations made within guidelines has often been shown to be poor.[4] A range of reasons and solutions are put forward in the relevant literature. It has been shown (in the main via surveys of clinicians) that guidelines that are perceived to be easy to read are more likely to be followed; and that poorly accessible, complex or vague guidelines are less likely to be followed.[5–7] A study carried out in 2017 into factors affecting compliance with clinical guidelines within Canterbury District Health Board (CDHB—healthcare provider for the Canterbury region of New Zealand) showed that a change in the platform of clinical guidance (from online documents written by separate departments to *Hospital HealthPathways*—an interactive website of 'pathways' written and curated by a dedicated team) was associated with an increase in use and compliance by clinicians. In addition, it reduced the variation in practice among different types of clinician.[3]

Method

The clinical guideline chosen for intervention was a *Hospital HealthPathways* guideline for the investigation and management of acute pancreatitis (see Figure 1). *Hospital HealthPathways* is a web-based collection of guidelines consisting of recommendations on local best practice for the assessment and management of common medical conditions, written by a clinical editor and subject matter expert for use within CDHB.[8]

In CDHB, adults with acute pancreatitis may present to Christchurch Public Hospital or Ashburton Hospital. Christchurch Public Hospital is the largest tertiary, teaching and research hospital in the South Island of New Zealand, where patients with pancreatitis are managed by resident medical officers (RMOs) under the supervision of consultant general surgeons in the emergency department, surgical assessment and review area, and on surgical wards. Ashburton Hospital is a 74-bed secondary-level acute medical and surgical hospital, where patients are managed by RMOs and senior medical officers (SMOs) in an acute assessment unit or on a general ward.

The guideline recommended that measurement of serum amylase should be used to make a diagnosis of pancreatitis, and measurements of serum complete blood count, electrolytes, urea, creatinine and CRP should be used to monitor patient progress thereafter (see Figure 1).

Local expert opinion held that further measurements of serum amylase did not change management and therefore testing should be limited to a single diagnostic measurement of serum amylase. In May 2017, a 'Practice Point' (a highlighted bullet point) was added to the guideline, clarifying these recommendations by specifying that "amylase and lipase are useful for diagnosis only. Serial measurements are not useful to assess severity or monitor progress".

No other changes in the format were made, and there was no change to the content of the guideline. Although subject matter experts involved in writing the clinical guidelines were notified by email when the Practice Point went live, no RMOs or other staff received any notification from the *HealthPathways* team. Between the two time periods, an electronic clerking and clinical notes system, Cortex, was introduced to the surgical wards in Christchurch Hospital. Cortex did not alter how tests are requested, but is largely accessed via iPads, offering RMOs an alternative, point-of-care platform from which it is possible to review patients' test results and access *HealthPathways* guidelines (although during these time periods there was not a *HealthPathways* App or a specifically mobile device-friendly website).

Compliance with this recommendation lends itself to straightforward and clear data collection and analysis. Although in CDHB blood tests are requested using a paper-based ordering system, results are made available on the DHB's online clinical information system. The number of amylase measurements requested for each patient was assessed using the CDHB's online clinical information system. Based on the number of amylase measurements performed, initial investigation could be categorised as either compliant (one amylase result only) or non-compliant (any more than one amylase result).

A data set of patients from a six-month period between August 2016 and February

Figure 1: CDHB *HealthPathways* guidelines for acute pancreatitis, highlighting Practice Point and serum monitoring recommendation.

Figure 1: CDHB *HealthPathways* guidelines for acute pancreatitis, highlighting Practice Point and serum monitoring recommendation (continued).
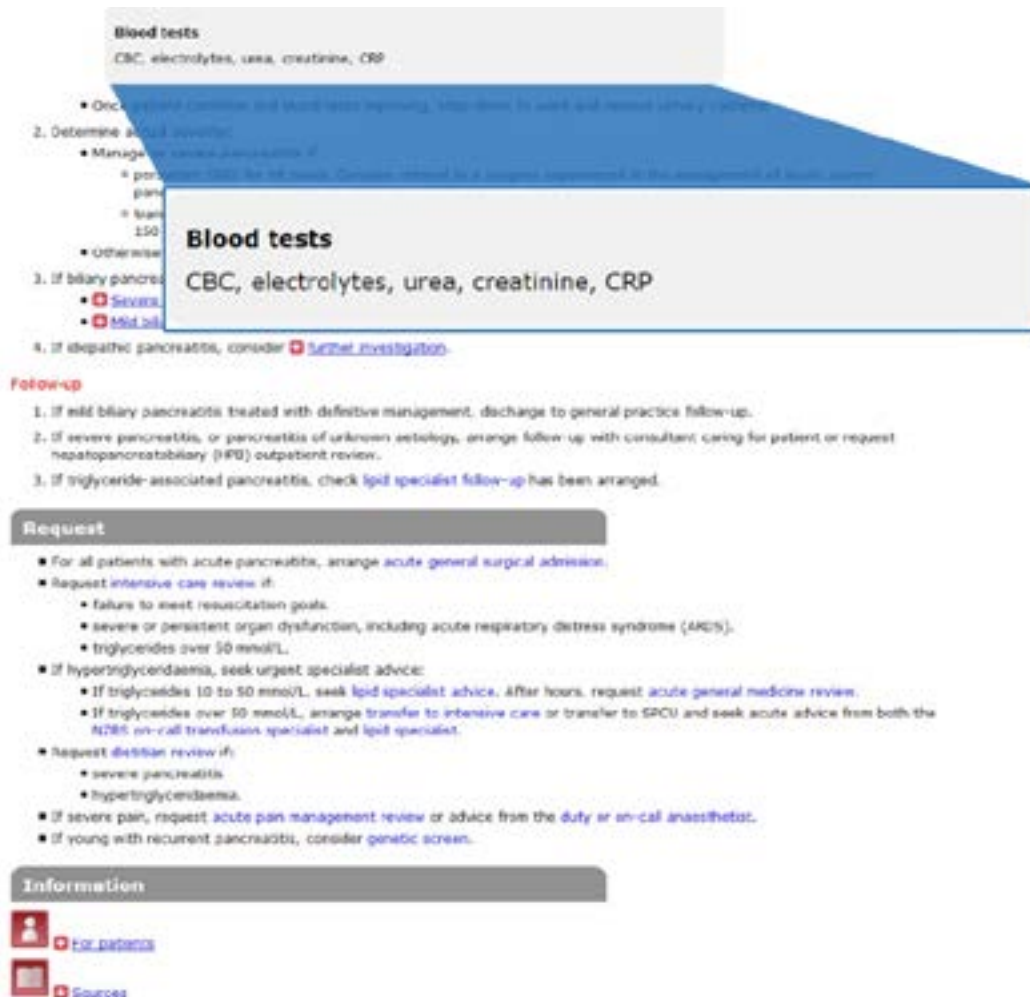
2017, collected for a previous study, was used with the author's permission as a control group. This time period ended three months prior to the change in format of the guidelines.[3] A new data set of patients from a six-month period between August 2017 and February 2018 formed the experimental group. This time period started three months after the change in guideline format. The time periods each included RMO training quarters 3, 4 and 1; during each six-month period, three separate cohorts of house officers and three separate cohorts of registrars rotated through the medical and surgical specialties.

Patients were identified by an information analyst from the CDHB's Decision Support team using ICD-10-CM codes K85.0 to K85.9, which includes all diagnostic codes for acute and subacute pancreatitis.[9] Patients were included if their discharge diagnosis was documented as acute pancreatitis or a subgroup of acute pancreatitis. Patients were excluded if they had chronic pancreatitis or known pancreatic malignancy; they were discharged with a different diagnosis; if their records were inaccessible; or if the diagnosis of pancreatitis was made using pancreatic lipase levels alone.

One researcher examined the admission dates and discharge summaries of the included patients, and subsequently accessed the corresponding laboratory results using the CDHB's online clinical information system. The number of times amylase levels were measured during that admission was then recorded.

Table 1: Compliance with guideline recommendations on amylase measurement before and after addition of Practice Point.

No. of amylases	2016–2017	%	2017–2018	%	P value (95% ci)*
1 (compliant)	82	65%	142	78%	
More than 1 (non compliant)	44	35%	40	22%	
Total	126		182		0.017

*P value calculated using χ^2.

Results

Of an initial 203 patients, 11 (6%) were excluded as they had chronic pancreatitis or known pancreatic malignancy. Nine (4%) were excluded as acute pancreatitis was diagnosed on lipase measurement alone. One was excluded as the full records were not accessible.

Before the Practice Point was added to the guideline, 82 of 126 total patients (65%) had amylase measured only once, on admission, in compliance with the *Hospital Health-Pathway* guideline. After the addition of the Practice Point, 142 of 182 patients (78%) had one measurement of amylase, illustrating a 13% increase in compliance between the two time periods. This is a significant finding (P=0.017, 95% confidence interval).

Of the 44 incidences of non-compliance before the Practice Point was added, 30 (24%) had two amylase measurements, eight (6%) had three measurements, three (2%) had four, two had five, and one had eight. After the addition of the 'Practice Point', 28 of the 40 incidences of non-compliance (15%) had two amylase measurements, 10 (6%) had three measurements, one had four, and one had five. Of the non-compliant incidents, the specific number of subsequent amylase measurements did not change significantly before

and after the change in format (P=0.095–0.403, 95% confidence interval).

When the route of referral is taken into account, the results demonstrate that the improvement in compliance following implementation of the Practice Point is seen in those patients who were referred directly by their GP to the general surgical teams and those few patients managed by other specialties (eg, rural medicine, gastroenterology, general medicine or healthcare of the elderly). The rate of compliance for patients initially assessed in the emergency department was actually shown to decrease slightly, although compliance in this group was already relatively good and the change was not statistically significant (p=0.546, 95% confidence interval).

Compliance varies significantly over the six-month period in the experimental group, with the greatest variance observed in December (p=0.029, 95% confidence interval, calculated using test for equality of proportions). The start of the RMO training year at the end of November may have contributed to this, as newly qualified house officers may be less familiar with the guidelines. However, given the subsequent marked improvement seen in January, this interpretation should be accepted with caution. The month-to-month variation in compliance suggests neither a clear trend

Table 2: Referral method and compliance with guideline recommendations on amylase measurement.

	2016 –2017			2017–2018			P value (95% ci)*
	Compliant	%	Non compliant	%	Compliant	%	Non compliant	%	
ED → general surgery	50	78	14	22	66	73	25	27	0.546
GP → general surgery	28	58	20	42	52	81	12	19	0.014
Other	4	29	10	71	15	56	12	44	<0.001

*P value calculated using χ^2.

Figure 2: Month-to-month compliance with guideline recommendations on amylase measurement three months following addition of Practice Point.
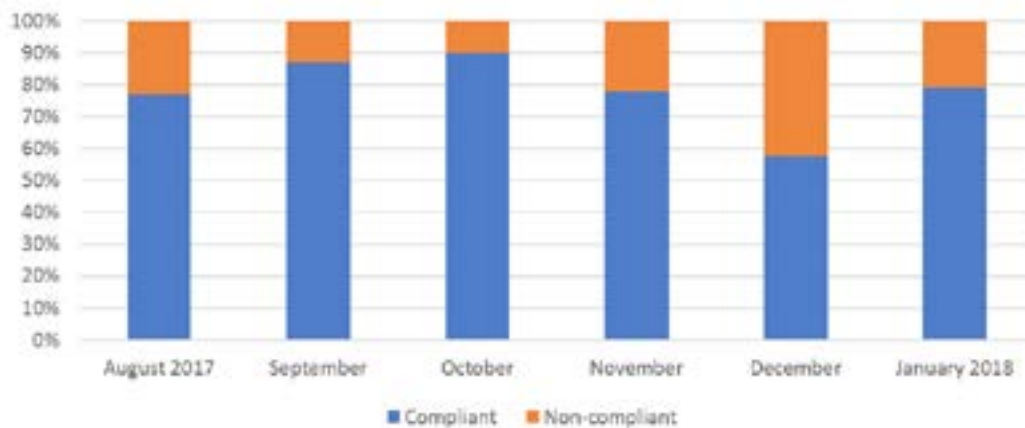
of improvement nor decay in knowledge. In a healthcare environment with high variability and low predictability, it is likely that the inconsistency of this change over time represents random variation, or the possible influence of variables beyond the scope of this study.

Discussion

These results show a significant increase in compliance with the guideline recommendation to avoid serial serum amylase measurements for patients with acute pancreatitis after this recommendation was made explicit. This supports the findings of current literature that clinicians are more likely to comply with clearer guidelines.[6,7] These results are also in line with the previous study examining compliance with *Hospital HealthPathways* in Christchurch Public Hospital, which noted that a change in how a clinical guideline is presented can lead to improved compliance with that guideline.[3]

Movements such as 'Choosing Wisely' (an initiative begun by the American Board of Internal Medicine) are advancing dialogue around avoiding unnecessary medical tests and treatments.[10] As with any diagnostic test, reasons unnecessary measurements of serum amylase should be avoided are patient-centred (venepuncture can be associated with risks, eg, pain and site infection); financial (processing each sample costs $5.46); and clinical (more investigations increase the risk of encountering erroneous or false positive results).[11] If the average

number of amylase measurements before adding the Practice Point had not changed, 54 more amylase measurements would have been taken over the six-month period following its addition.

Despite the continued publication of clinical guidelines based on empirical evidence, studies have tended to reflect a lack of compliance by healthcare professionals with these recommendations.[4] These findings suggest that RMOs caring for these patients are both using and complying with the local hospital guidelines. The significant effect seen following this simple intervention has implications for guidelines developers seeking to maximise quality patient care. As the style and format of a clinical guideline is under the control of its author, changing these is an efficient way to affect levels of compliance with the guideline. Like *Hospital HealthPathways*, many clinical guidelines can now be accessed online, and therefore alterations can be made quickly and easily.[12] Other factors which have been found to affect compliance, such as characteristics of the doctor, patient and the setting in which guidelines are accessed and utilised are not so simple to alter.[3] Closure of the audit loop via feedback to those clinicians with a front-line role in caring for patients has been shown previously by the same department to improve both compliance rates and outcomes.[13] These measures together therefore have the potential to amplify the individual benefits of each, leading to even greater improvements.

Although overall compliance was increased after the addition of the Practice Point, incidences of non-compliance continued to occur, and ongoing improvement over time was not clearly shown. In order to improve compliance further, other measures (such as guideline review as part of departmental induction, or use of e-ordering with built in alerts) are likely to be necessary.

As this study design is retrospective and purely quantitative, reasons for non-compliance with the guidelines were not examined. The online clinical information system did not record information pertaining to who requested the amylase measurement, and therefore characteristics of the healthcare professionals involved were unavailable for comparison. There is also the potential for confounding factors such as different rotating junior staff or departmental education to have influenced the results.

The findings from this interventional study imply that how recommendations are written and presented within clinical guidelines affects how they are used. If applied judiciously, financial, clinical and patient-centred improvements could potentially be achieved as a result of one simple addition to the guideline.

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Examining the accuracy of the New Zealand B4 School Check universal health service anthropometric measurements of children

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ABSTRACT

BACKGROUND: The aim of the current study was to determine whether anthropometric data from the New Zealand B4 School Check (B4SC) universal health service assessments are comparable to research grade anthropometric data.

METHODS: B4SC anthropometric data were obtained for a subsample (n=394) of children who participated in the Prevention of Overweight in Infancy (POI) randomised control trial. B4SC anthropometric measures were compared to POI anthropometric values that had been interpolated to align with the date of the B4SC assessment.

RESULTS: Interclass correlation coefficients between values from the two sources (0.93–0.98) suggested that across all these measures, most variation depended on between child effects rather than between source effects. A paired t-test found no evidence for differences between POI and B4SC height values. B4SC weights were a mean of 0.45kg heavier, and BMIs a mean of 0.41kg/m^2 greater. Exploratory analyses demonstrated that greater overestimation of weight by the B4SC was associated with assessments on colder days.

CONCLUSION: B4SC measurements of weight were greater than values obtained from interpolating the POI standardised research assessments. Interestingly, this overestimation was inversely associated with the average temperature on the day when the B4SC occurred. These findings suggest that universal health services that monitor growth in children could be improved by including standardised procedures to account for non-removal of clothing.

The primary objective of the New Zealand Well Child/Tamariki Ora universal health service is to provide support for *whānau* (extended family), families and caregivers in order to promote healthy growth and development in our *tamariki* (children). One component of this service measures the height and weight of children to screen for and/or monitor any growth abnormalities. When children reach four years of age, these physical measurements occur as part of the eighth well child contact, referred to as the *B4 School Check* (B4SC).[1]

As with any measure, the accuracy of the B4SC anthropometric assessments may be affected by several factors. These possible sources of errors include those introduced by departures from the best-practice assessment protocol. For example, when measuring weight, the World Health Organization protocol prescribes steps to account for children's clothing.[2] These steps are not prescribed in the B4SC protocol. In the World Health Organization protocol,[2–4] if a participant is weighed while wearing clothing, their recorded weight is calculated by subtracting the estimated clothing weight from their measured weight. The absence of these steps in the B4SC protocol[1] could lead to inflation of weight measurements, with the magnitude of this bias varying by factors associated with the weight of

unaccounted clothing, including perhaps age, gender, daily temperature or season. Errors in measurements are also possible if practitioners deviate from the protocol in systematic or non-systematic ways.

Given that a primary purpose of the B4SC anthropometric assessments is to monitor individual child growth and provide information to guide appropriate clinical follow-up, it is of interest to quantify the accuracy of these assessments and consider how any errors, both systematic and non-systematic, may affect their usefulness. One approach to doing this is to compare them to measures obtained for the same children in separate gold standard assessments. Between 2009 and 2016, participants in the Prevention of Overweight in Infancy (POI) randomised control trial[5–7] had their weight and height measured at 0.5, 1, 1.5, 2, 3.5 and 5 years of age, following strict WHO protocols.[2–4] The objective of the current study was to examine whether anthropometric assessment data from the B4SC are comparable to research grade anthropometric data collected during the POI study. First, we examined the agreement of measurements between B4SC and POI values for each of: height, weight, BMI and BMI z-scores. Second, we conducted paired sample t-tests and calculated 95% Limits of Agreement (LoA) to respectively identify any systematic differences (biases) between the two datasets using the continuous data and describe the usual range of differences between the two measurement sources. Third, we compared the level of agreement using categorical definitions of weight status. Finally, we explored whether differences in anthropometric values could be accounted for by season or daily temperature, based on the assumption that these variables could plausibly influence how much clothing children wore when being assessed for their B4SC.

Methods

Participants

For the present study, data were collected on a subset of children who took part in the Prevention of Overweight in Infancy (POI) study.[5,6] The POI study was a four-arm randomised controlled trial that investigated the impact of providing additional education and support to parents regarding infant sleep (Sleep group); breastfeeding, diet and physical activity (FAB group); or both (Combination group); compared to usual care (Control group). A detailed description of the trial is available in the study protocols.[5,6] Only healthy, full-term infants were eligible and the final sample size was 802. The height and weight of these children was assessed when they were 0.5, 1, 1.5, 2, 3.5 and 5 years of age. The present study initially included all children from the POI study who had available B4SC data, whose parents consented to POI researchers accessing this data, and who also had complete anthropometric data at the 3.5 and 5-year assessment periods (n=454). Children were excluded if, for the POI study, assessments did not take place in the clinic (n=34) or they wore more clothing than prescribed in the protocol and were unwilling to remove this when being measured (n=26). This ensured that POI data examined here all met the strict POI anthropometric protocol. Based on these exclusion criteria, the final sample consisted of 394 children.

Demographic information was obtained at baseline (late pregnancy) from questionnaires (maternal age, education, ethnicity and self-reported pre-pregnancy height and weight; level of household deprivation) and hospital records (infant gestational age, sex and birth weight).

POI anthropometric data collection

Within the POI study, children's height and weight was measured when they were 0.5, 1, 1.5, 2, 3.5 and 5 years of age. These assessments took place when children and their parent(s) attended a clinic session. Measurements were obtained by a researcher trained in following the WHO Child Growth Standards protocol.[3,4] A copy of the protocol was available at the clinic as a reference for measurers along with laminated illustrations presented on the walls around measurement equipment. Weight was measured using Tanita WB-100 MA/WB-110 MA scales. Height was measured using a Harpenden stadiometer (Holtain Ltd, UK). The scales and stadiometer were recalibrated weekly.

Before measuring height and weight, children were requested to remove all outer clothing except for underwear and singlet. The researcher noted if this was not possible. Children's height was measured

when they stood in the centre of the stadiometer with their feet 2–3cm apart, their heels, buttocks and upper back touching the upright; and their head in the Frankfurt plane. Weight was measured when children were standing on the centre of the scale with no support, arms relaxed and weight distributed evenly across both feet. Practitioners recorded readings immediately, with height being rounded to the nearest 0.1cm and weight being rounded to the nearest 100g. Height and weight were measured twice, or three times if readings differed by more than a specified tolerance (0.7cm for height, 100g for weight). The final height and weight reading was calculated as the mean of the two closest readings unless all three measurements were equally spaced, in which case, the mean (or equivalently, the median) of all three was used. All researchers received training from the same lead anthropomorphic measurer (MH), who was under the direct supervision of BT. Inter-rater reliability was monitored twice yearly with MH measuring 10 of the same participants as each of the other anthropomorphic measurers. At each time point, inter-rater reliability for height and weight was excellent (ICC >.93).

B4SC anthropometric data collection

B4SC height and weight data were obtained from the New Zealand Ministry of Health for children of parents in the POI study who consented at the POI session when their child was five years old to these data being obtained by the POI study investigators. As a detailed description of the B4SC height and weight measurement protocol is provided elsewhere,[1] only brief details are provided here.

B4SC assessments are undertaken by registered nurses (or other registered health practitioners) who have received standardised training from instructors approved by the New Zealand Ministry of Health. Although assessments are supposed to be undertaken close to children's fourth birthday they may also take place when children are five years of age. Child weights are to be measured using either Seca 862 or Tanita WB-100 S MA floor scales, or Seca 770 or Tanita HD-351 weighing scales. Heights are to be measured using a Leicester Height Measure portable stadiometer (or Seca 214 portable stadiometer).

Stadiometer and scales are to be calibrated at least every six months.

Height and weight measurements should be taken after children have removed shoes, any heavy outer clothing and headwear. However, unlike the POI study, no procedures are specified if this is not possible. For height measurement, children are to stand in the centre of the stadiometer with their feet 2–3cm apart; their heels, buttocks and upper back touching the upright; and their head in the Frankfurt plane. Practitioners should immediately record the height reading rounded to the nearest 0.1cm. For weight, children are to stand on the centre of the scale with no support with their arms relaxed and their weight distributed evenly across both feet. Practitioners are to immediately record the weight reading rounded to the nearest 100g. Practitioners are instructed to initially take two measures of height and weight by measuring height then weight and then again measuring height then weight. A third reading is to be taken if height readings differ by more than 0.5cm or weight readings differ by more than 500g. The final height and weight reading is calculated as the mean of the two closest readings. Only the final height and weight is recorded in the national system and anecdotal evidence suggests that dual measurements are not always undertaken. As with the POI study, the final height and weight reading was calculated as the mean of the two closest readings unless all three measurements were equally spaced, in which case, the mean (or equivalently, the median) of all three was used.

Thus, although the B4SC and POI study anthropometric assessment procedures are similar, there are also some notable disparities. The B4SC does not account for instances when children do not remove shoes or heavy outer clothing. Also, while instruments in the POI study were recalibrated weekly, B4SC protocol only requires instruments to be recalibrated every six months.

Rescaling POI measures to match age at B4SC

Because the B4SC height and weight assessments occurred at different times to POI assessments, measures from POI and B4SC are not directly comparable. However, because there were additional POI assessment periods, five before (0.5, 1,

1.5, 2, 3.5 years) and one after (at five years) the B4SC, values of POI height and weight were estimated at the date of the B4SC based upon superimposition by translation and rotation (SITAR) growth curve models (using the *sitar* package for R, version 1.0.10).[8] As described by Cole et al,[9] these models utilise a spline curve and nonlinear random-effects model to simultaneously estimate a sample average growth curve along with subject specific deviations from this curve in terms of three subject-specific parameters. These parameters are termed: size, which shifts the individual curve along the y-axis (anthropometric measure); tempo, which shifts the individual curve along the x-axis (age); and velocity, which stretches or shrinks the scale of age to make the curve shallower or steeper. Specifically, each model is represented by:

$$\hat{y}_{it} = a_i + h\left(\frac{t - b_i}{\exp(-g_i)}\right)$$

where $\hat{y}_{it}$ is the anthropometric value for child i at time t, $h(t)$ is a natural cubic spline function of age, and the subject-specific random effects are a_i (size), b_i (tempo) and g_i (velocity).

Because the random effects are subject-specific, model estimates allow the prediction of person-specific anthropometric estimates at any age, here the time of the B4SC for each child. Separate models were fitted to obtain values of height (in cm) and weight (in kg), which were then used to calculate BMI (kg/m^2). POI and B4SC BMI (kg/m^2) values were converted to age and sex standardised z-scores using the WHO child growth standards.[2] In preliminary analyses, we examined if differences between POI and B4SC anthropometric values depended upon age at B4SC. Regression analyses indicated no significant linear or quadratic associations between age at B4SC and any anthropometric difference scores (both *p*>.53). These results are important in that they go towards ruling out possible systematic bias in POI anthropometric values due to variation of child's age at B4SC.

Statistical analysis

All statistical analyses were conducted using *R 3.4.2.*[10] Interclass correlation coefficients (ICC) were calculated (using the *psych* package version 1.7.8)[11] to estimate the agreement between B4SC and POI values for height, weight, BMI and BMI z-scores. Paired t-tests were conducted to examine whether measures of height, weight and BMI differed between B4SC and POI data. Limits of agreement (95% LoA) for the difference between B4SC and POI values (of height, weight, BMI and BMI z-scores) were calculated using the formula by Bland and Altman.[12] The 95% LoA calculated in this way assume that differences between values are normally distributed and that the mean and standard deviation of the differences are constant across the range of measurement. These assumptions were checked by visual inspection of (a) histograms for the calculated differences between B4SC and POI values and (b) Bland-Altman plots. Bland-Altman plots display the difference between two paired measurements against the mean of the paired measurements. The mean of the differences along with 95% LoA are displayed as horizontal lines. Simple linear regression models were used to examine whether differences between B4SC measurements and POI values depended upon the magnitude of the mean of the two values (ie, whether any bias differed for children with lower or higher values of that measure). To further describe agreement between B4SC and POI weight-for-height values, we also calculated linear weighted Cohen's Kappa (using the *rel* package version 1.3.1)[13] when participants were categorised according to BMI z-score cut-offs listed in the Well Child/Tamariki Ora Programme Practitioner Handbook: normal weight (0.4[th] percentile ≤ BMI z-score <91st percentile), overweight (91st percentile ≤ BMI z-score ≤98th percentile), and obese (BMI z-score >98th percentile).[1] ICC values of 0.95 and Kappa values of 0.7 or higher were considered to indicate acceptable consistency. Linear regression models were used to explore associations between each of season and temperature and differences between the two sets of measurements. Data for mean daily temperature in Dunedin was obtained from a database held by the University of Otago's Department of Physics.[14] This database contains records of temperature measured by a weather station located at the University of Otago Dunedin Campus. Two-sided *p*<0.05 was considered to be statistically significant.

Results

Sample characteristics

As presented in Table 1, of the 394 children with anthropometric data available for this study, the majority were of New Zealand European ethnicity (80.2%), and most were from households within moderate (42.8%) or low (38.7%) levels of deprivation. The sample was evenly divided regarding child sex (50% male, 50% female), and 49% of the mothers were primiparous.

Reliability between B4SC and POI anthropometric values

Reliability between POI values and B4 School Check values of height, weight, BMI and BMI z-scores was examined by calculating interclass correlation coefficients

Table 1: Child, maternal, paternal and family characteristics at baseline.

Demographic characteristic (n = available data)	Descriptive statistic[a]
Child sex (n=394)	
Male	197 (50.0%)
Female	197 (50.0%)
Child prioritised ethnicity (n=394)	
New Zealand European	316 (80.2%)
Māori	27 (6.9%)
Pacific	7 (1.7%)
Other[b]	44 (11.2%)
Maternal age at birth of child (n=394)	32.7 (4.7SD)
Maternal parity (n=394)	
Primiparous	193 (49.0%)
Previous children	201 (51.0%)
Maternal ethnicity (n=394)	
New Zealand European	342 (86.9%)
Māori	13 (3.3%)
Pacific	5 (1.3%)
Other[b]	34 (8.7%)
Paternal age at birth of child (n=317)	35.2 (5.8)
Paternal ethnicity (n=394)	
New Zealand European	276 (70.0%)
Māori	16 (4.1%)
Pacific	4 (1.0%)
Other[b]	98 (24.9%)
Household deprivation level (NZDep deciles, n=390)	
8–10 (High)	72 (18.5%)
4–7	167 (42.8 %)
1–3 (Low)	151 (38.7%)

[a]Descriptive statistic presented as n (%) for categorical variables and Mean (SD) for continuous.
[b]Other includes ethnicities identified as Asian, Middle Eastern, Latin American, African and 'other'.

Table 2: Paired-sample t-test statistics for B4SC and POI anthropometric values.

Measure	B4SC mean (SD)	POI study estimate mean (SD)	Mean difference (95% CI)	Paired t-test,	*p*-value
Height (cm)	105.69 (4.35)	105.70 (4.10)	-0.003 (-0.09, 0.09)[b]	t(393) = -0.07,	*p*=0.95
Weight (kg)	18.35 (2.38)	17.90 (2.26)	0.45 (0.40, 0.51)[c]	t(393) = 16.88,	*p*<0.001
BMI (kg/m²)	16.38 (1.39)	15.97 (1.31)	0.41 (0.36, 0.46)	t(393) = 16.43,	*p*<0.001
BMI z-score[a]	0.72 (0.87)	0.45 (0.85)	0.27 (0.24, 0.30)	t(393) = 16.43,	*p*<0.001

[a] Z-score calculated with reference to WHO 2006 standards.
[b] Result of 0.01 (-0.07–0.10) with 1 outlier removed.
[c] Result of 0.46 (0.41–0.51) with 1 outlier removed.

(ICC) and 95% Confidence Intervals (95% CI), following the method of Shrout and Fleiss[15] referred to as ICC(3,1). This particular ICC is based on a two-way mixed effects model, assumes each child is measured by a fixed procedure (B4 School Check vs. POI) and represents the ratio of between child variance to total variance. The ICCs for height, weight, BMI and BMI z-score were 0.98 (95% CI: 0.97, 0.98), 0.97 (95% CI: 0.97, 0.98), 0.93 (95% CI: 0.92, 0.95) and 0.93 (95% CI: 0.91, 0.94) respectively.

Mean difference between B4SC and POI values of height

A paired-sample t-test indicated that height measurements from the B4SC data were not significantly different from values from POI study data (*p*=0.95). The Bland-Altman plot for POI and B4SC values of height are presented in Figure 1. This figure does not depict any clear variation in the magnitude of the scatter of height differences as a function of mean height. The LoA indicated that for 95% of children the B4SC estimate

Figure 1: Bland-Altman plot for height.
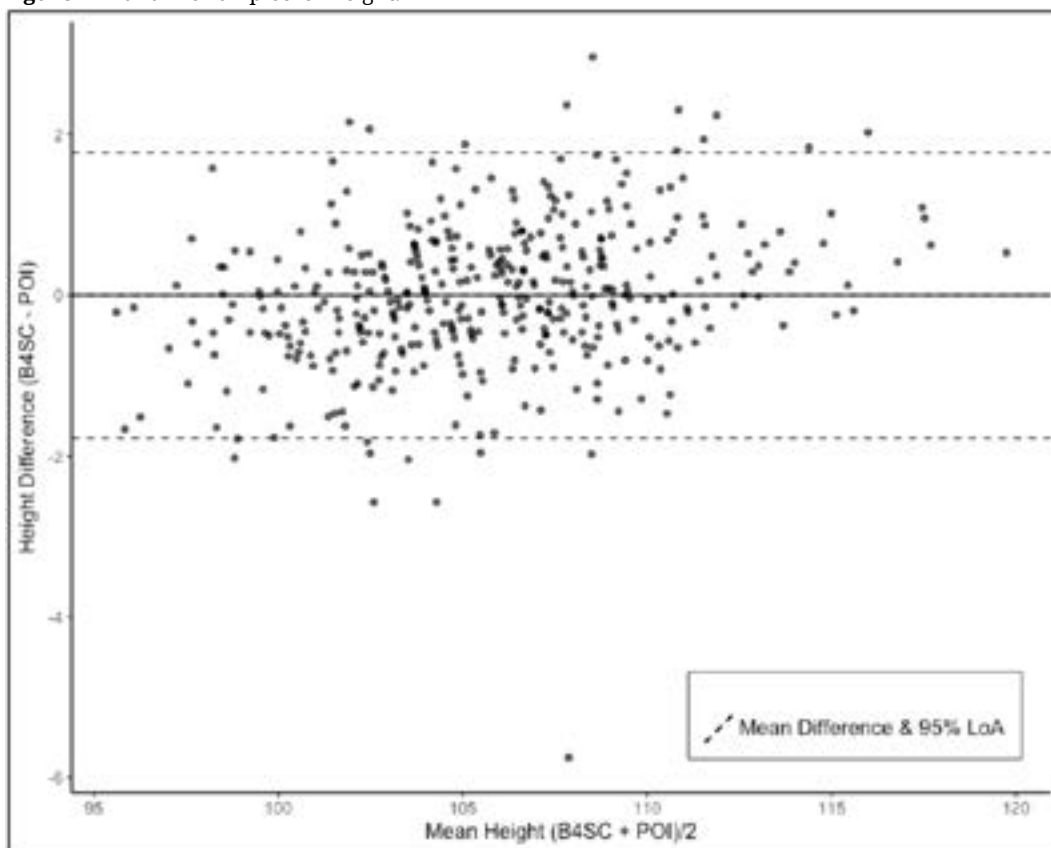
of height would be between 1.78cm less and 1.77cm more than the POI estimate of height.

However, regressing height difference onto the mean height indicated that the difference between the two measures appeared to vary. An increase in the mean of the B4SC and POI height of 1cm predicted a statistically significant (p<0.001) but small increase in the difference between these two values of 0.06cm. Based on intercept and slope estimates from the regression it was calculated that the linear regression slope crossed the mean difference of height when the mean of POI and B4SC height was 105.7cm. This suggests that, although on average B4SC and POI height values did not significantly differ, this was moderated by mean height value. Hence, when mean height was greater than 105.7cm, B4SC height measurements were on average greater than POI height values. When the mean of B4SC and POI height was below 105.7cm, B4SC height measurements were on average below POI values.

Mean difference between B4SC and POI values of weight

A paired sample t-test indicated that weight measurements from the B4SC data were a mean of 0.45 kg (95% CI: 0.40–0.51) higher than the POI values (p<0.001). Although there was one obvious outlier in the distribution of difference scores results from the paired t-test only changed slightly when it was removed (mean difference of 0.46kg; 95% CI: 0.41–0.51). The Bland-Altman plot for POI and B4SC values of weight is presented in Figure 2 and does not depict any clear indication that the scatter of the weight differences varied as a function of mean weight magnitude. The limits of agreement indicate that for 95% of children the B4SC measurement of weight would be between 0.59kg below and 1.5kg above the POI estimate of weight.

As with height, regressing weight difference onto the mean weight indicated that the difference between the measurements appeared to vary. An increase in the

Figure 2: Bland-Altman plot for weight.
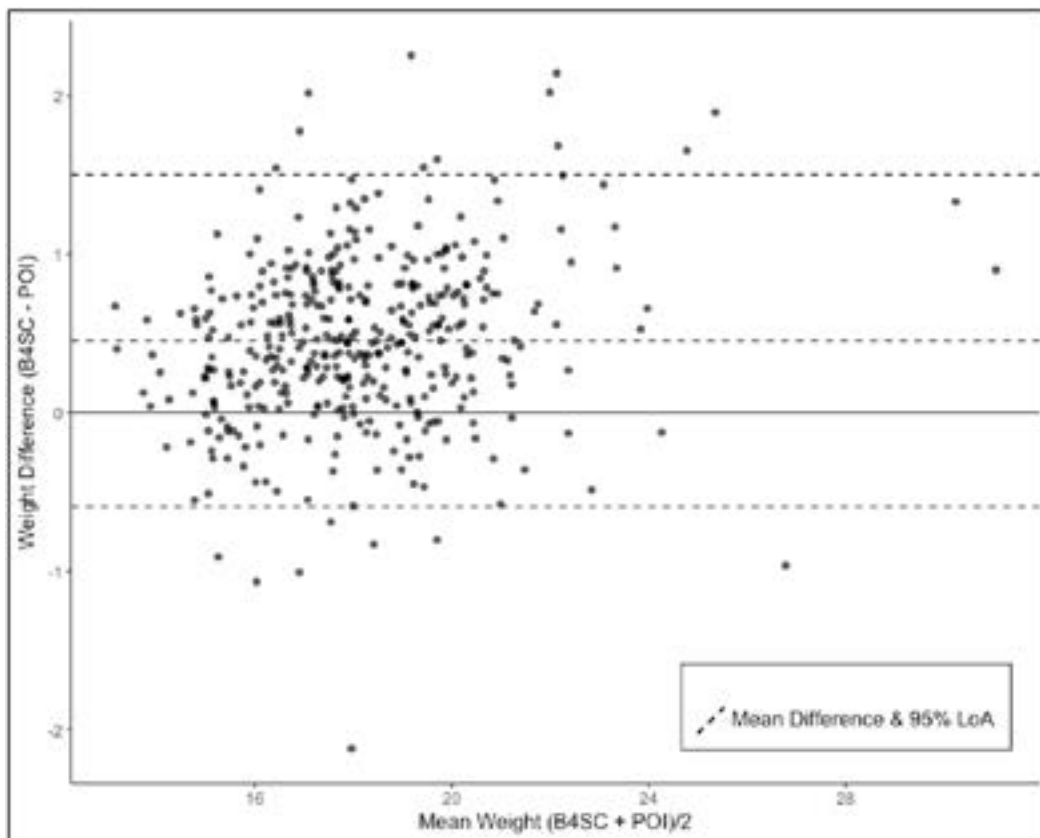
mean of the B4SC and POI weight of 1kg predicted a statistically significant (p<0.001) but small increase in the difference between these two values of 0.05kg.

Mean difference between B4SC and POI values of BMI

A paired sample t-test test indicated that BMI measurements from the B4SC were a mean 0.41kg/m^2 (95% CI: 0.36–0.46) greater than the POI BMI values (p<0.001). Similarly, B4SC BMI z-scores were also on average greater than POI BMI z-score values (mean difference of 0.27; 95% CI: 0.24–0.30; p<0.001). No obvious outliers were evident in the distribution of differences between B4SC measurements and POI values for BMI or BMI z-scores. Bland-Altman plots for POI and B4SC values of BMI and BMI z-scores are presented in Figures 3 and 4 respectively. In both plots, the scatter of differences for BMIs and BMI z-scores do not appear to depend upon magnitude of BMI/BMI z-score means. For BMI, the limits of agreement indicate that for 95% of children the B4SC measurement would be between 0.56 kg/m^2 below and 1.37kg/m^2 above the POI estimate. For BMI z-scores the limits of agreement indicated that for 95% of children, the

B4SC measurement would be between 0.37 z-scores below and 0.92 z-scores above the POI estimate. Linear regression indicated that differences were not associated with the magnitude of the mean of the values for BMI-z-score (p=.17) but were for BMI (p=.0004). In particular, an increase in the mean of the B4SC and POI BMI values of 1kg/m^2 predicted an increase in the difference between these two values of 0.07kg/m^2.

Agreement between B4SC and POI categorisation from BMI z-scores

Agreement between B4SC and POI overweight/obesity classification from the BMI z-scores was examined using the confusion matrix presented in Table 3. The overall agreement between the B4SC and POI categorisation based on BMI z-score cut-offs was 88%. Taking into account chance agreement, linearly weighted kappa was 0.66 (95% CI 0.58–0.74). Of the 53 children who were classified as overweight or obese (above 91st percentile) according to POI, 96% were classified as overweight or obese by the B4SC. Of the 83 cases indicated as at or above the 91st percentile in the B4SC, 61% were also classified as such based on POI values.
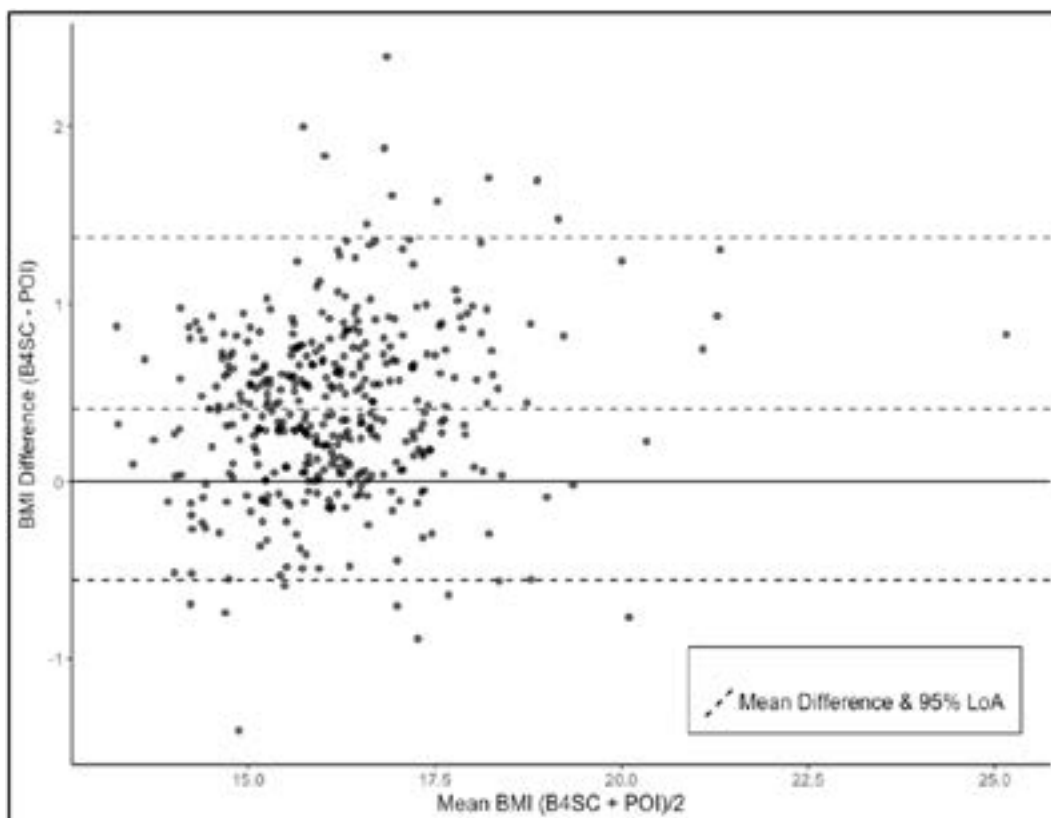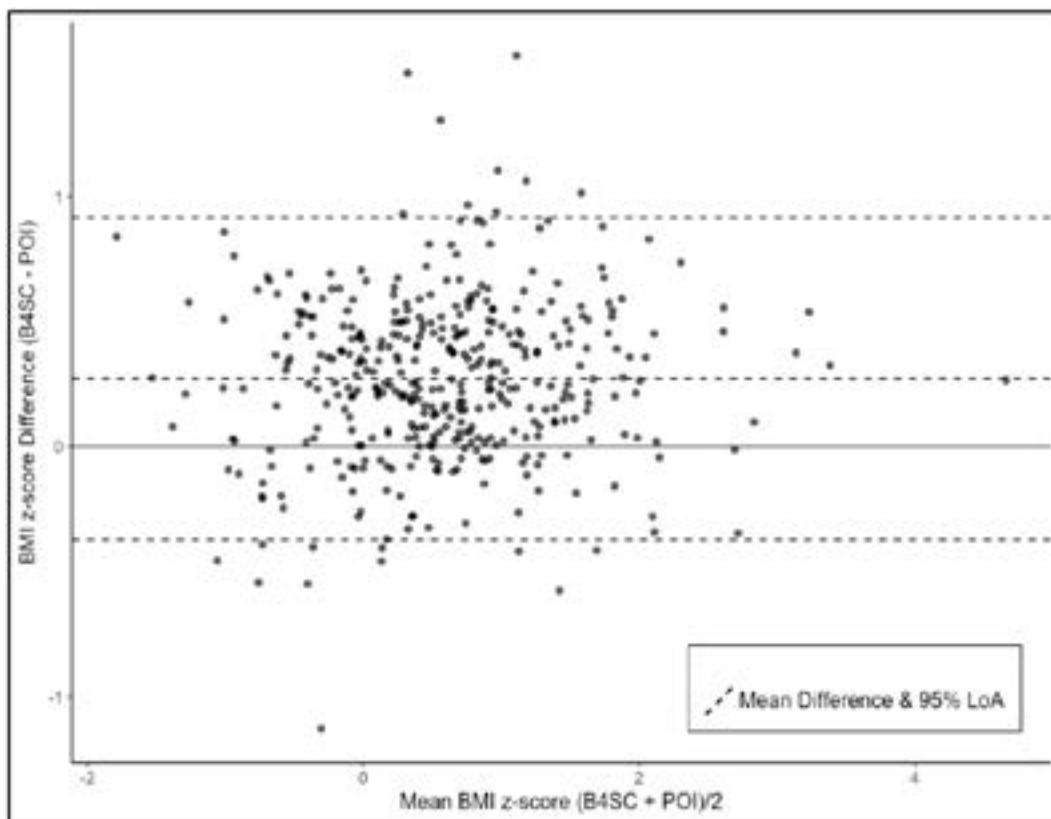
Figure 3: Bland-Altman plot for BMI.

Figure 4: Bland-Altman plot for BMI z-scores.

Exploring effects of season and daily temperature

Two sets of additional analyses were conducted to explore whether differences between POI values and B4SC measurements could be accounted for by seasonal factors influencing B4SC assessments. In the first approach we examined whether the anthropometric difference score (POI subtracted from B4SC) differed significantly between seasons (classified based on Australasian meteorological temperate zone definitions.[16] Table 4 presents the unadjusted mean difference scores for height, weight, BMI and BMI z scores for each season. Linear regression did not indicate any significant effects of season on any of these anthropometric difference scores.

We also examined whether anthropometric difference scores were associated with mean daily temperature at the time of B4SC assessment. Results from separate

Table 3: Confusion matrix for B4SC and POI classifications based on WHO BMI z-score cut-offs listed in Well Child/Tamariki Ora Programme Practitioner Handbook.[1]

Normal		Classification from POI values			
		Overweight	Obese	Total	
Classification from B4SC values	Normal	309	2	0	311 (78.9%)
	Overweight	30	25	2	57 (14.5%)
	Obese	2	13	11	26 (6.6%)
	Total	341 (86.5%)	40 (10.2%)	13 (3.3%)	Grand total = 394

Underweight defined as BMI z-score <0.4th percentile.[1]
Normal weight defined as BMI z score ≥0.4th percentile but <91st percentile.[1]
Overweight defined as BMI z-score ≥91st but ≤98th percentile.[1]
Obese defined as BMI z-score >98th percentile.[1]

Table 4: Mean of differences between POI estimates and B4SC measures by season of B4SC assessment.

Measure	Summer (n=78) mean (SD)	Autumn (n=93) mean (SD)	Winter (n=107) mean (SD)	Spring (n=116) mean (SD)
Height (cm)	0.06 (0.89)	-0.01 (1.06)	-0.02 (0.86)	-0.03 (0.83
Weight (kg)	0.53 (0.64)	0.38 (0.49)	0.49 (0.50)	0.43 (0.52)
BMI (kg/m^2)	0.46 (0.56)	0.35 (0.47)	0.44 (0.50)	0.39 (0.45)
BMI z-score	0.30 (0.38)	0.23 (0.31)	0.30 (0.33)	0.26 (0.31)

linear regression models (presented in Table 5) indicated that mean daily temperature was significantly associated with differences between B4SC measurements and POI values for weight, BMI and BMI z-scores, but not height. Scatter plots and estimated linear regression lines are presented in Figure 5 to illustrate these results further. Taken together these results demonstrate that B4SC measures of weight (and consequently measures of BMI) are greater than POI values when assessed on colder days. Additional regression analyses indicated that associations between mean daily temperature and each of weight, BMI and BMI z-score differences were not moderated by children's sex or household deprivation level.

Discussion

This study compared anthropometric measures obtained from two different methods of data collection; the B4SC and POI study, with the latter being of research standard. Between study agreement, estimated using ICCs for height, weight, BMI and BMI z-score were all satisfactory or very close to the target of 0.95, suggesting that variation depended on between child effects

rather than between source effects (ie, B4SC vs POI). No significant differences were observed between POI and B4SC values of height. By contrast, weights, and thus BMIs, were somewhat higher for B4SC and the mean discrepancy was of potential clinical relevance (0.45kg, 0.41kg/m^2, and 0.27 using z-scores). This bias was also highlighted by the categorical comparisons of weight status showing that the B4SC overestimated the proportion of children who were likely to have high body weights.

Few comparable studies exist with which to compare our data. A similar study from the US compared child anthropometric data measured as part of a public health nutrition programme to anthropometric data measured using a "gold standard" protocol similar to that in the POI study.[17] The ICC estimates of reliability from this study (obtained for a sample of 97 children aged 4–5 years) were 0.94 for height, 0.96 for weight, 0.90 for BMI and 0.86 for BMI z-scores, broadly comparable to our findings.

There may be several possible factors that could explain why B4SC values of weight are greater than those calculated from the POI study. It is notable that on average the B4SC

Table 5: Difference between POI estimates and B4SC measures predicted by mean daily temperature at time of B4SC assessment.

Predicted difference score (B4SC–POI)	Regression estimates β (S.E.)	
	Intercept,[a] p-value	**Slope,[b] p-value**
Height (cm)	-0.001 (0.15), p=0.995	-0.0002 (0.01), p=0.988
Weight (kg)	0.70 (0.09), p<0.001	-0.02 (0.01), p=0.003
BMI (kg/m^2)	0.61 (0.08), p<0.001	-0.02 (0.01), p=0.007
BMI z-score	0.42 (0.5), p<0.001	-0.01 (0.00), p=0.002

[a] Intercept is estimated difference score when mean daily temperature is 0 degrees Celsius.
[b] Slope is estimated change in difference score for a one degree Celsius increase in mean daily temperature.

Figure 5: Difference between POI estimates and B4SC measures predicted by mean daily temperature at time of B4SC assessment.
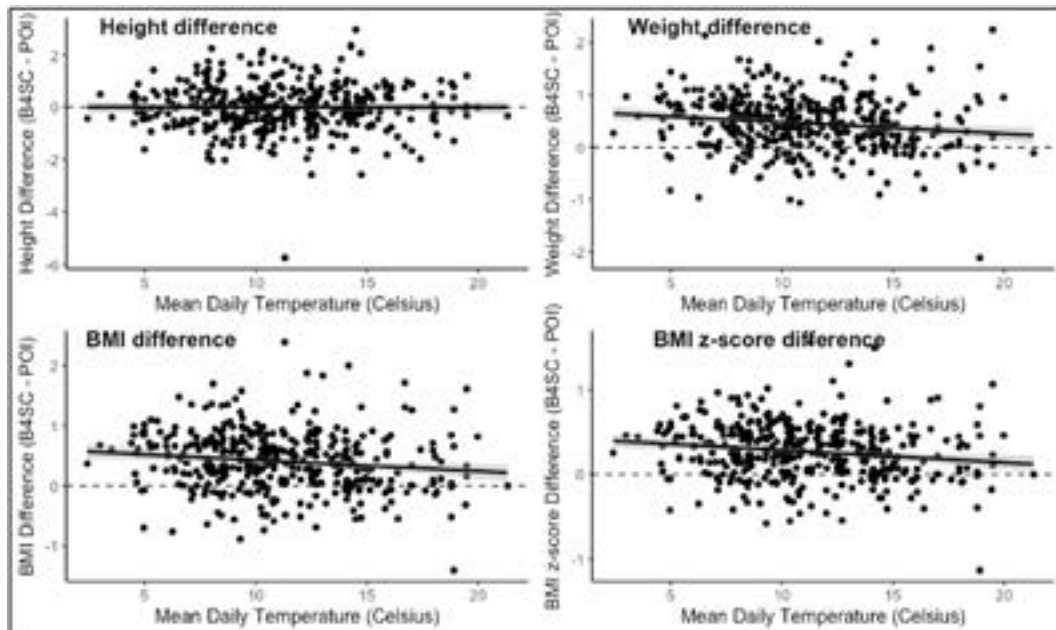
overestimated weight by 0.45kg, and this overestimation became more pronounced for heavier children. Moreover, additional analyses demonstrating that (relative to POI values) B4SC weight values were greater on colder days but not in the colder seasons as a whole. One plausible explanation of these findings is that the overestimation may be in part due to the B4SC having some variability in protocols around clothing. As noted previously, the B4SC protocol recommends removing extra clothing but does not provide guidance on what to do if this is not possible (eg, for cultural reasons or if the child refuses), unlike the POI protocol. Elsewhere, the WHO protocol (also followed in POI) suggests weights for different clothing items that may be subtracted from a measured weight if heavy outer clothing is not removed. The findings seem unlikely to be due to something such as winter weight gain, given there was no trend in weight over the entire season.

This study is not without limitations that should be addressed in further research. It should be noted that it is also possible that the B4SC values of weight are greater than those from the POI study due to methodological limitations of B4SC, such as scale calibration (POI was weekly and B4SC six-monthly) or limitations of the interpolation used in the present study. In particular, anthropometric measurements from the B4SC were compared to values from the POI study that were estimated using interpolation to account for assessments not occurring concurrently. This limitation may have introduced an additional source of variability between the measurements, making the estimates of agreement conservative. Generalisation of results is also limited because the sample only included children from one specific region while regions across New Zealand differ in terms of temperature variation.[18] Thus, further research is required to examine if weight estimate discrepancies in other regions are accounted for by daily temperature.

Conclusions

In conclusion, the current study demonstrates that values of child weight and BMI obtained during the B4SC were greater than estimates obtained from standardised research assessments conducted as part of the POI study. This difference is particularly notable for weight and may be due to differences in assessment protocols. A recommended improvement in the B4SC protocol would to be to provide a list of average weights for different items of clothing that could then be subtracted from the measured weight if clothing is not removed before measurement. Further research should investigate whether this approach improves the anthropometric measurments conducted as part of the B4SC.

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Minimal risk of PFOS residues in eel to Māori consumers

Ian C Shaw, Te-Rina King-Hudson

Concerns about the safety of traditional Māori food in south Taranaki, New Zealand have been prompted by recent reports of residues of perfluorooctanesulfonic acid (PFOS; Figure 1) derived from firefighting foam in south Taranaki (specifically in the environs of a fire training facility near to the Oaonui Stream) groundwater (0.36µg/L; not used for drinking water), water cress (1.4µg/kg; very low level) and eels (410µg/kg) harvested from the Oaonui Stream in the same region. Monitoring focused on the Oaonui Stream because it flows past a fire training facility where PFOS-containing firefighting foams might have been used. PFOS residues were not detected in mussels from the coastal region near to the Oaonui Stream outlet. These results are included in a data report provided by the Taranaki Regional Council.[1] They refer to samples (n=6) taken on 10 May 2018 (water samples) and 18 July 2018 (eel and watercress samples) as part of the Council's monitoring programme.

Rationale for risk assessment

In this risk assessment, the highest PFOS level in eels will be used to reflect a worst-case exposure scenario. PFOS exposure will be calculated based on the eel residue level and a Māori eel consumption estimate, because eel is a traditional Māori food. Eel-consuming Māori PFOS exposure levels will be compared with exposure levels in rat carcinogenicity studies as a means of assessing worst-case cancer risk.

Chemical properties, food residues and biological half-life of PFOS

PFOS is very hydrophobic (estimated $LogK_{ow}$ = 4.49, water solubility = $3.2x10^{-3}$mg/L at 25°C[2]) and so would be absorbed by the lipid-based cell membranes of microorganisms, which form the basis of the aquatic food chain. Concentration up the food chain (bioaccumulation) leads to high levels in top or near top creatures (eg, eels). Eels' longevity means that they inhabit contaminated environments for a long time and constantly accumulate hydrophobic chemicals such as PFOS—this is the worst-case food residues scenario.

The hydrophobicity of PFOS means that it binds to lipoproteins in blood and resides in biological membranes, which likely accounts for its long serum half-life of >5 years[3] and its incredibly long biological half-life of approximately 90 years[4] in humans.

Is PFOS carcinogenic?

There is conjecture about whether or not PFOS is carcinogenic. Studies in rats have shown a statistically significant increase in hepatocellular adenoma at a 20ppm (mg/kg) in diet PFOS dose.[5] Nakayama et al (2005)[6] linked PFOS workplace exposure to prostate and bladder cancer in humans, but these human carcinogenicity findings were later refuted.[5] However, an extensive and comprehensive review of occupational and environmental PFOS exposure concluded that there is no causal link between PFOS and cancer in humans.[7] Despite this, the United States Environmental Protection Agency (USEPA) in a comprehensive PFOS human health risk assessment acknowledged the uncertainties relating to human carcinogenicity, but concluded that there is "suggestive evidence of carcinogenic potential for PFOS".[8]

Interestingly, the molecular structure of PFOS (Figure 1) and a consideration of its chemical reactivity does not suggest that there is a potential covalent reaction pathway between PFOS and nucleic acids because perfluorocarbons are generally chemically inert due to their strong C-F bonds. This means that PFOS is unlikely to be a genotoxic carcinogen, which is supported

Figure 1: Molecular structure of PFOS—it is chemically inert because of the strong C-F bonds.
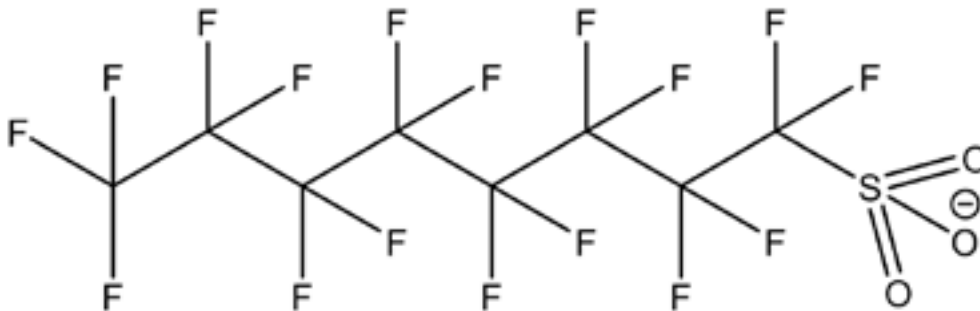
by genotoxicity studies being uniformly negative.[8] This suggests that if PFOS is carcinogenic then it is via a non-genotoxic mechanism, and again this is supported by negative genotoxicity studies,[8] or that a carcinogenic impurity is present in technical PFOS (akin to carcinogenic dioxin contaminants in Agent Orange[9]). Indeed, the PFOS preparation used by Butenhoff et al was technical grade (86.9% pure)[5] and so might have contained carcinogenic impurities.

From the point of view of direct human exposure to technical PFOS (eg, occupational exposure) whether PFOS per se or an impurity results in cancer is irrelevant. However, the situation is quite different for a food exposure scenario where PFOS and the putative carcinogenic contaminant might be separated during transfer through environmental systems (eg, aquatic environment) prior to forming residues in food species (eg, long fin eel) inhabiting the contaminated environment. This might mean that PFOS residues in food species do not mirror cancer risk because the putative carcinogen residues might be separated from PFOS residues.

However, the conflicting evidence about PFOS's carcinogenicity supports implementation of the precautionary principle in a human risk assessment context. To assess human cancer risk, intake and a trigger level are needed. In this assessment, we will use the rat hepatocellular adenoma dose as the 'carcinogenicity' trigger level (this is an extreme worst case because PFOS results in hepatocellular adenoma, which is not malignant) and intake via eel consumption.

Assessing Māori exposure to PFOS from eel consumption

Assessing human PFOS exposure levels via eel consumption is difficult because there are no published data on eel consumption rates in Māori. Informal discussions with some of the whanau of Muriwai marae in Opape and Punawhakareia marae in Rotoiti suggest that the consumption of eels in this group is approximately 1kg/year. Consumption varies throughout the year, increasing in times when eels are traditionally caught and eaten. Since PFOS is very hydrophobic it is likely to accumulate in the body and thus its effects are likely to be cumulative.

Māori PFOS exposure cancer risk assessment

The maximum longfin eel PFOS residue level found was 410µg/kg,[1] which means that approximately 410µg would be ingested per person per year based on our estimated eel consumption. Assuming an average human body weight of 70kg, this equals a dose of 5.8µg/kg body weight/year (approx. 0.016µg/kg body weight/day). This equates to an approximate two-year cumulative dose of 11.6µg/kg body weight. The dose that resulted in hepatocellular adenoma in the rat studies is 20mg/kg in diet.[5] Assuming that a 200g rat (ie, approx. weight of rats in study) consumes 150g food/day,[10] the PFOS intake in the rat study was 15mg/kg body weight/day. Therefore, the PFOS dose that caused hepatocellular adenoma in rats was 15mg/kg body weight/day and the estimated Māori PFOS dose from eel consumption is approximately 0.016µg (0.000016mg)/kg body weight/day (averaged from yearly intake); therefore, the Māori dose is approximately 0.0001% of the 'carcinogenic' dose in rats. Consumption of the yearly eel intake in a single meal would lead to a PFOS dose of 3µg/kg body weight/day, which is approximately 0.02% of the 'carcinogenic' rat dose—these very low PFOS intakes suggests that the cancer risk to Māori consuming 1kg eels per year with PFOS residues akin to those found in the south Taranaki region is negligible.

Food Standards Australia New Zealand PFOS Tolerable Daily Intake

Food Standards Australia New Zealand (FSANZ) set a tolerable daily intake (TDI) for PFOS of 20ng/kg body weight/day based on decreased parental and offspring weight in rat reproductive toxicity studies.[11] FSANZ acknowledge that this TDI is very conservative and was set as an interim measure to protect human health. Our calculated PFOS average daily intake (0.016µg (16ng)/kg body weight/day) is marginally below the FZANZ TDI whereas the 'single meal' PFOS intake (3µg (3,000ng)/kg body weight/day) exceeds the FSANZ TDI by at least two orders of magnitude. The TDI is the amount of a compound that can be consumed daily for a lifetime with no ill effects. Assuming Māori consume 1kg eels per year, the best estimation of daily exposure is our calculated average daily intake, which is just below the TDI.

In conclusion, PFOS residues in eels are likely to be of no concern from a carcinogenicity perspective, but are close to the highly conservative FSANZ TDI when PFOS intake is averaged across a year, but this is of questionable toxicological significance.

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Local experience with methamphetamine associated stroke at a small district health board

Karim M Mahawish, Andrew Bowers, Susan DeCaigney

Methamphetamine use is a major public health concern in New Zealand, affecting users' health, relationships and employment opportunities. The social cost of amphetamine-related harm in New Zealand has recently been estimated to be almost $365 million/year.[1] Wastewater-based epidemiology, which provides objective measures of drug consumption based on the detection of drug residues in wastewater, demonstrates higher levels of methamphetamine consumption in Auckland (402mg/1,000 people/day) compared to many European cities (<200mg/1,000 people/day).[2]

Lakes DHB serves a population of 110,410 of which 35% are Māori. Three hundred and fifty-one of the local population with a mean age of 71 years, experienced a stroke in the period July 2017–June 2018. Between March 2017 and September 2018, 13 patients (five male, 10 Māori) had 15 presentations with stroke symptoms to Lakes DHB following recent consumption of methamphetamine. This represents one in six of all strokes in the under 60 age group. The mean age of patients was 42 years (range 24–59). All strokes were ischaemic, Oxford stroke classification as follows:[3] two lacunar, two posterior circulation, four total anterior circulation and seven partial anterior circulation. The mechanism of stroke after comprehensive work-up is shown in Table 1.

Figure 1: Magnetic resonance diffusion weighted image demonstrating extensive ischaemia of the territory supplied by the right middle cerebral artery.
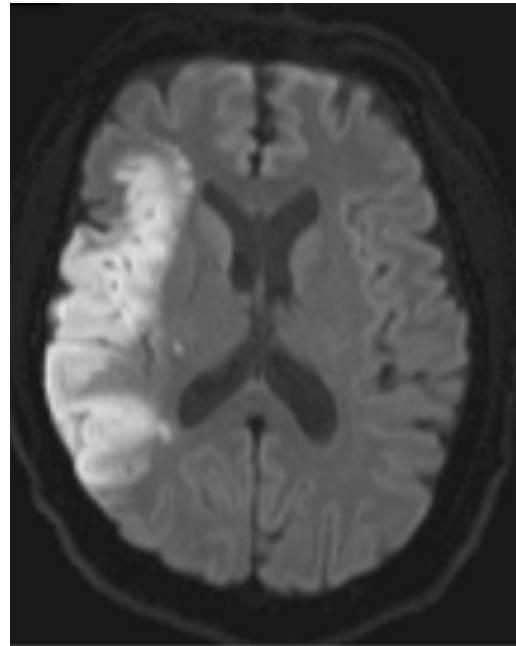

Table 1:

Cause of stroke	Number of stroke presentations
Cardioembolism due to severe dilated cardiomyopathy and apical thrombus	2
Cardioembolism secondary to atrial fibrillation	1
Pseudovasculitis	3
Small vessel disease	2
Large artery atherosclerosis	1
Unknown	6

Figure 2: Magnetic resonance time of flight angiography demonstrating left beaded, stenotic distal carotid and left middle cerebral arteries.

Two patients had an ischaemic stroke (Figure 1) due to severe dilated cardiomyopathy with apical thrombus (Video 1) in the absence of any other significant risk factors, (eg, hypertension, excess alcohol abuse or ischaemic heart disease).

Extra- and intracranial CT and/or MR angiography were performed in nine patients. Clinical and imaging features in combination with negative autoantibody screen were suggestive of pseudovasculitis in the vessel supplying the infarct core in three patients (Figure 2); other intracranial vessels were unaffected. One further patient had intracranial thrombotic vessel occlusion and successfully underwent thrombolysis and mechanical thrombectomy, with an improvement in National Institute of Health Stroke Scale (NIHSS) from 16 to 3. Intravenous alteplase was administered to an additional two patients, resulting in a full recovery (baseline NIHSS 15 & 10); one of these patients was subsequently found to have pseudovasculitis. The average length of stay was 15 days. At discharge, median modified Rankin Score was 2; one-quarter of patients were unable to walk and one patient died during admission due to marked mass effect of the infarcted hemisphere.

Methamphetamine use leads to stroke through the release of norepinephrine and dopamine from pre-synaptic terminals causing hypertension, tachycardia and vasoconstriction. This predictably leads to accelerated atherosclerosis, vasospasm and/or intimal dissection leading to ischaemic stroke; haemorrhagic stroke may also occur as a result of vessel wall rupture.[4] Methamphetamine-induced pseudovasculitis is caused by fibrinoid necrosis of the intima and media with subsequent destruction, leading to vessel rupture and haemorrhage[4] or ischaemic stroke due to narrowing of the vessel lumen and occlusion. While vasculitis is characterised by the presence of inflammatory cellular infiltrates in histological tissue and hence steroid responsive, inflammation is less pronounced or absent in pseudovasculitis[5] and steroid therapy is not usually effective. One patient with pseudovasculitis experienced a repeat ischaemic stroke one week later despite abstaining from methamphetamine (confirmed on urine toxicology screening). Repeat CT angiography demonstrated further luminal narrowing of the affected vessel, suggesting pseudovasculitis as a progressive process.

The pathophysiology of methamphetamine cardiotoxicity is not fully understood, but is

thought to be mediated by catecholamine-induced myocarditis and subsequently to myocardial fibrosis.[6] These patients were treated with anticoagulation and heart failure therapy, with follow-up imaging demonstrating resolution of thrombus and improvement of left ventricular function.

Magnetic resonance imaging findings typical of central pontine myelinolysis was observed in two patients presenting with stroke symptoms in the absence of any previous documented shifts in serum electrolytes or history of alcoholism. This phenomenon has not been documented in the literature previously as being related to methamphetamine use and so the relationship is uncertain.

It is likely that this is the tip of the iceberg. We do not have a local policy on collecting an illicit drug history and so it not always taken or recorded in medical records. Neither is drug screening routinely performed. Further, the history of exposure to methamphetamine could not be relied on, with a number of patients not volunteering their drug taking habits presumably due to perceived social stigma. Finally, patients with minor transient neurological deficits are unlikely have health seeking behavior, leading to further underestimates of the scale of the problem.

All methamphetamine-related strokes observed in our series were ischaemic, in contrast to the 80% incidence of haemorrhages stroke described in the literature.[4] In this review by Lappin et al, the route of administration was a significant factor; haemorrhagic stroke was associated with intravenous drug use (possibly due to septic embolisation) while inhalation was associated with ischaemic stroke. While most of our patients inhaled, only one of our patients used methamphetamine intravenously, possibly accounting for the lower incidence of intracerebral haemorrhage. Publication bias may be another factor; there is a high proportion of fatal intracranial haemorrhage reported in the literature.[4]

Methamphetamine use is a significant public health problem for New Zealand, affecting younger patients. Our experience provides a compelling reason for an illicit drug history to be routinely obtained in patients under 60 years of age presenting with cerebrovascular disease, or those where the aetiology is uncertain. Such

Video 1: Transthoracic echocardiogram demonstrating a large apical thrombus within the left ventricle.
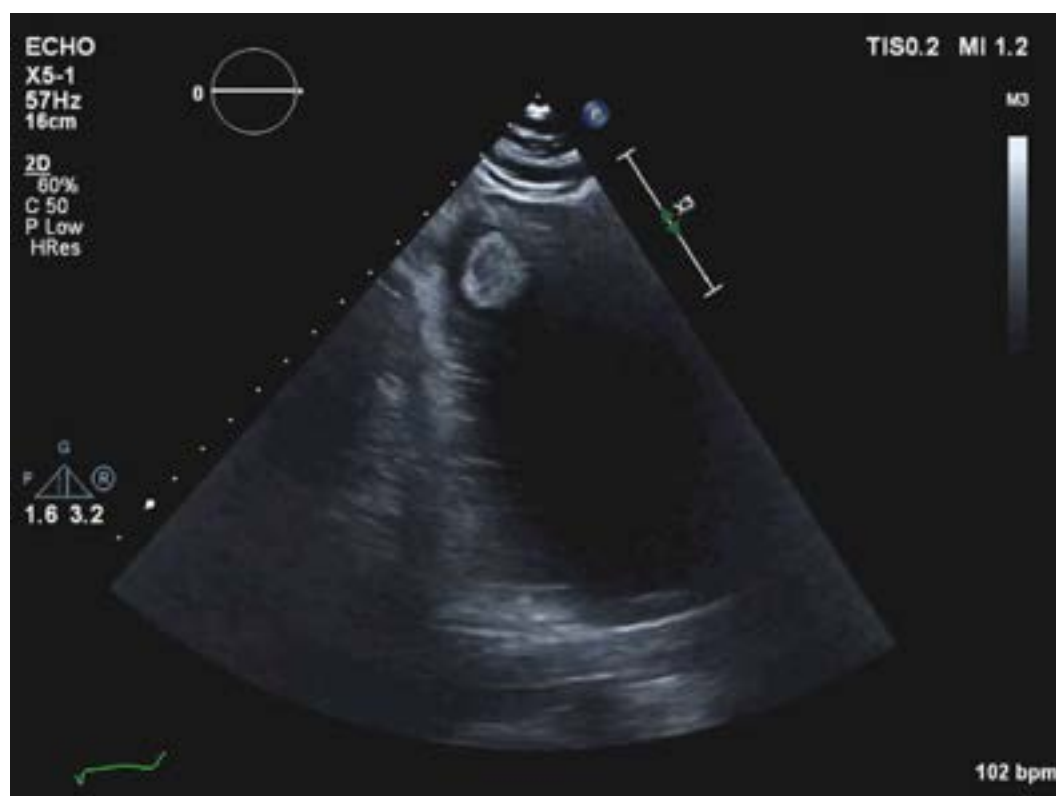
patients should be investigated for pseudovasculitis and dilated cardiomyopathy if appropriate. The significant associated morbidity and mortality of methamphetamine use should be emphasised and abstinence encouraged. Secondary prevention measures including antiplatelet agents, statins and antihypertensives should also be employed since traditional risk factors also contribute to future stroke risk.

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Mind That Child;
A Medical Memoir

Frank Frizelle
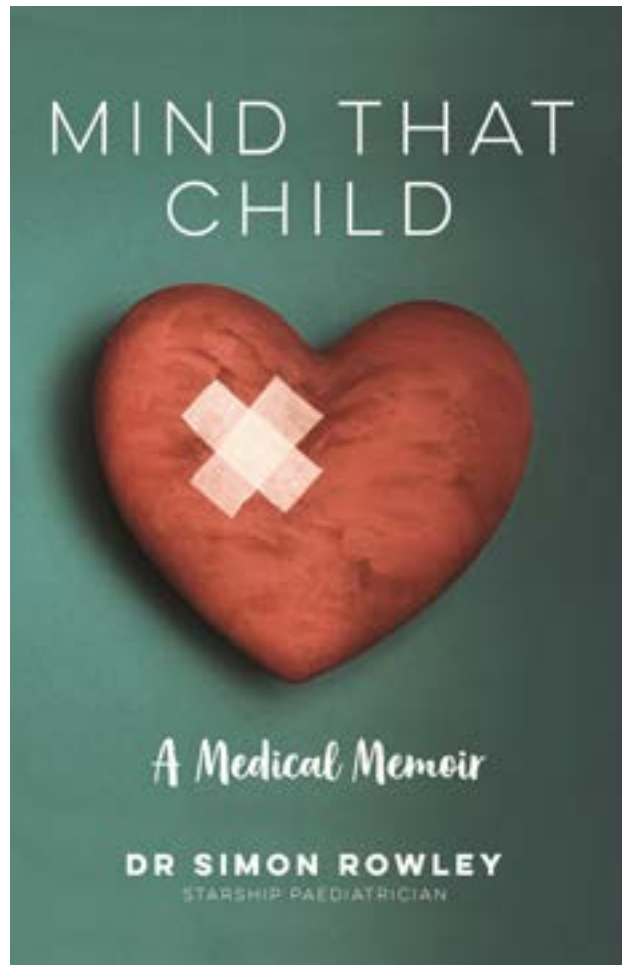
Dr Simon Rowley. Published by Penguin Random House, New Zealand.
ISBN 978-0-14-377198-2. Soft covered, 268 pages. Price NZ$38.00.

This a book that recounts the experience of the Auckland Starship's paediatrician Dr Simon Rowley over his professional lifetime. It is co-authored by ghost writer Adam Dudding, who is a senior reporter from the Stuff website.

The book is an easy and interesting read (even for a surgeon). It covers Simon's early childhood in South Otago, his medical training, paediatric training and subsequent consultant life. The book demonstrates Simon's view about the complementary nature of public and private clinical practice.

Besides covering the life cycle of the paediatrician, the 12 chapters also cover the author's views and experience on some specific paediatric issues such as autism and ADHD, however the subplot for the book is the wider social issues around the development of children, including the effects of poverty on children's (and subsequent adults') health. There are chapters on children raising children, and the influence of the Brainwave trust on trying to change things, as well as an interesting chapter on the period when overseas adoption (especially of children from Russia) was common,

and the issues around this. The narrative is intermixed with patient stories, which add colour and depth as well as, at times, entertainment to the story.

There is an interesting repeating topic of the issue of complaints. The author's frustration and challenge of dealing with them is apparent, in an environment where the medical team are doing their best in an imperfect world. This is something most doctors will be aware of and sympathise with.

The author repeatedly emphasises the impact of health on the most vulnerable of social factors, especially poverty, poor diet, poor quality accommodation, as well as the impact drug taking and alcohol consumption. He makes the point that this damage can become lifelong and multigenerational, and as such are very important factors to manage to improve the health of children.

The book is well written, easy to read and well presented. Most doctors interested in the changing face of medicine over the last 40 years will enjoy this.

Competing interests:
Nil.
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Shirley Joan Chapple

10 March 1934–22 May 2013

With the death of Joan Chapple on 22 May 2013 New Zealand lost its first female plastic and hand surgeon. In a male-dominated environment, Joan struggled to gain acceptance and recognition by her colleagues. Her advocating for the gentle handing of soft tissues with an emphasis on haemostasis, avoidance of tension and the unnecessary use of sutures was slow to gain recognition. However, Joan's contributions to medicine and the community were ultimately recognised when she was made CNZM in 2001.

Joan was born in Te Puke to Kingsley (King) and Winifred Chapple, the middle of five siblings (James, Jocelyn, Joan, John and Jefferson). The children attended Te Matai primary school in rural Bay of Plenty, where their father was headmaster and where of the hundred or so pupils, only the Chapples and one other family were non-Māori. Interestingly, George Plumb, the irascible and stubborn social activist clergyman portrayed in the acclaimed novel, Plumb, written by Joan's cousin Maurice Gee, was closely modelled on their mutual grandfather James Chapple. Joan may have inherited some of his attributes.

Joan first attended Te Puke High School and later boarded at Epsom Girl's Grammar School in Auckland where she was a school prefect in 1951. She became an accomplished cellist and developed a lifelong interest in woodcarving and pottery.

After a medical intermediate year at Auckland University, Joan was accepted to the University of Otago Medical School. She was a diligent and capable student and during her later years, stimulated by Professor Alan Alldred, took a particular interest in orthopaedic surgery. Joan was one of only nine women among over 90 graduates in 1957. She gained distinction in surgery and was awarded the Stanley Wilson Prize.

Returning to Auckland as a house surgeon she was a registrar in plastic surgery in 1961 completing her FRACS in general surgery in 1963 and, following in the footsteps of Jean Sandel in New Plymouth who had gained FRCS in 1947, became the second woman in New Zealand to gain a specialist surgical qualification. Joan travelled to Australia, Britain and Russia for postgraduate training. In Vellore, India, she worked with the celebrated hand surgeon, Paul Brandt, who was pioneering tendon transplantation in the hands of lepers. She finally visited the US, but she was forced to leave prematurely being accused of un-American activities in the aftermath of the McCarthy era.

On her return to Auckland Joan was appointed to a full-time post in the Plastic Surgical Unit at Middlemore hospital, working under William Manchester, later Sir William. As the only woman surgeon, she never felt welcome in the Auckland surgical fraternity. It was understood that she would not attend regular meetings at the men-only Northern Club. In 1972, unmarried, she gave birth to a daughter, Raven. While she asked for only five months maternity leave, this was denied and her job was terminated. It was widely perceived that her dismissal was primarily for moral rather than professional reasons, and it resulted in considerable controversy in the medical and wider community.

Joan was later appointed to a part-time position in the accident and emergency department at Auckland Hospital, and served in this position until her retirement in 1994. She developed and practiced a then unorthodox thesis of wound management avoiding where possible the use of sutures and emphasising the importance of haemostasis, gentle handling of tissues and preservation of tissue blood supply with avoidance of tension and pressure. Although she taught these principles to junior doctors, general practitioners and nurses, who adopted them enthusiastically, her ideas were slow to be accepted by practicing surgeons and her criticism of their techniques aroused some resentment. In 1980 she self-published her ideas in a book entitled *Wound Care and Healing: The Physiological Challenge*. This was based on her experience and included case studies and a unique series of clinical photographs. It was expanded and updated in 2001.

Outside medicine Joan was actively involved in Alliance politics and the International Physicians for Prevention of Nuclear War. She also served on the Auckland University Council. She was passionate about the plight of the underdog and sometimes provided hospitality for disadvantaged people at her property at Karaka Bay. Joan was made a Companion of the New Zealand Order of Merit for services to medicine and the community in 2001. Her retirement was marred by major medical issues, first with colonic and later ovarian cancer.

Joan was a compassionate and caring doctor and a generous and loyal friend. Her gender and unconventional attitudes may have restricted her from reaching her full potential as a surgeon, but she was in many ways ahead of her time. Her achievements were significant, and she will be remembered with affection and respect.

She is survived by her daughter Raven and granddaughter Tilly Lamb.

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This obituary was provided by Mr Alan Kerr FRACS and Raven Chapple.

Herbert Dick Rawson

26 April 1924–23 June 2018

Dick was born at the family home in Kilbirnie, Wellington, to Jack, a general practitioner, and Gladys. He was the second of four children—Evelyn, Beatrice and Bruce. Dick commenced school at Eastern Hutt School and, successfully completing a proficiency examination, gained entry to Wellesley College. When he was 12 years old his father died suddenly leaving Gladys to raise the family. As a consequence of his father's death, and on a hardship scholarship, Dick was sent as a boarder to Christ's College in Christchurch for some male influence. While bullying of junior boarders was the norm at that time, Dick's musical talents became evident as he commenced playing the piano and participated in the Chapel Choir. He was a very capable gymnast, becoming a member of the Gym-eight.

Strongly influenced by his father's choice of career and sister Evelyn's commencing medical training, Dick gained entry to Otago University Medical School in 1942. During this time the family lived in Dunedin and Dick was strongly motivated to study to avoid being enlisted for the army. However, there was time to enjoy participation with the University Dramatic Society. Sadly, Evelyn died in a horse accident during her final year at medical school.

Completing his MB ChB in 1947, Dick worked as a house surgeon at Wellington Hospital. In 1949, working his passage as ship's surgeon, he travelled to Sydney to commence study for his FRACS before returning to Rawene in the Hokianga District for four months general practice to meet his medical bursary obligations. While there he mastered basic Māori. In 1950, in common with many other aspiring surgeons, he travelled to the UK to obtain surgical training, securing positions at Whipps Cross Hospital, St Andrew's Hospital, Essex and then Edinburgh—where he obtained his FRCS(Ed). During 1952 he worked as a surgical registrar at Southampton General Hospital. The next year Doug Short, who had worked in Edinburgh with Dick, recommended he apply for the position he was vacating, as Assistant Medical Superintendent at Nelson Hospital.

Taking up employment at Nelson Hospital Dick covered an extended range of general surgery which included urology, ENT, acute orthopaedic surgery and emergency Caesarean sections. When Dr Low retired in 1955, Dick was appointed to a visiting consultant position providing him the opportunity to become involved in private practice, while continuing his public hospital work. He also became FRACS at that time. From an early stage he specialised in vascular surgery and continued that alongside his wide range of general surgery throughout his 34-year career at Nelson Hospital, as well as in his private practice and operating sessions at Manuka Street Hospital. A younger colleague who operated with Dick over the years felt

a quote from a surgical journal in 2014, also fitted his own experience of Dick: "His operations were swift without being hurried… he was calm… he had a plan for every circumstance". He maintained this role, assisting in the provision of a one in three roster, until his retirement from full-time clinical practice in 1995.

Dick had first experienced a taste of surgical locum work in Nuie in 1978 when he had taken his family with him. On retirement from Nelson Hospital he spent some years undertaking surgical locums throughout New Zealand and in Apia and Rarotonga. In 1987 Dick volunteered for a term with Medecins Sans Frontieres in Sri Lanka, this proving a profoundly moving experience, during which he was ambushed and dealt with horrific war injuries.

At the time Dick commenced work in Nelson, the "cold war" dominated international relationships and with the New Zealand government providing a subsidised pilot training programme, Dick took to the air with enthusiasm, learning to fly tiger moths and Auster planes. Hiring a plane for three pounds an hour, and with no extra cost for parking at regional airports, Dick and friends enjoyed air travel to places such as Christchurch, Wellington and Farewell Spit. When Dick's mother suffered a broken ankle in the late 1950s he met her delightful physiotherapist, Sally Reid, and they married in 1958. Their first child, Jane, was born in 1960 and their second, Tom in 1961. The Rawson family was completed in 1965 with the arrival of quads—John, Anne, Mary and Peter. Despite Dick and Sally's efforts to retain privacy for the family, this event created national and international interest. With four infants demanding attention, it was necessary to employ Karitane nurses to assist with their care during the first few years. A considerably larger house became a necessity and the family moved to Scotland Street, where there was sufficient garden with trees, for the building of tree houses, and the accommodation of a variety of pets, which included pigeons, mice, guinea pigs

and a goat in addition to the traditional cats and dogs. Holidays were spent at the family bach at Marahau, which provided a base for tramping in the Abel Tasman National Park, fishing in Tasman Bay and wind surfing. In 1982 Sally developed aggressive cancer and died within a short time and within two years the quads had left home for tertiary education.

With a love of music and acting, Dick joined the Nelson Repertory Society soon after his arrival in Nelson. He continued this throughout his life and, while working as a locum for six months in Gisborne towards the end of his medical career, gained media attention through a stage performance in the role of Lord Chancellor in Iolanthe. Dick was a member of Nelson Civic Choir and a foundation Member of the National Male Choir of New Zealand in 2000, enjoying a month-long tour of Wales and the UK including appearances on BBC TV. While tramping had been a life-long pleasure, on retirement Dick became an avid solo cyclist covering many thousands of kilometres in numerous countries— including an extended period in Europe when he carried a tent for accommodation.

Dick was passionate about researching his family history and became an active member of the Nelson Historical Society, developing an interest in researching Nelson medical history. He joined the Nelson Alliance Francaise learning to speak French over coffee and cake and this provided the opportunity to participate in an immersion programme in France for a month, to hone his skills. An enthusiastic and creative gardener, he enrolled in an Otago University geology course and became involved in field trips in Otago.

Very committed to and supportive of his family, Dick was the dearly loved husband of the late Sally and the much-loved father of Jane, Tom, John, Annie, Mary and Peter and grandad of nine grandchildren.

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This obituary was prepared with the assistance of Mary and John Rawson and
Mr Harvey Morgan FRACS.

Rivaroxaban in patients with heart failure, sinus rhythm and coronary disease

Heart failure is associated with activation of thrombin-related pathways, which predicts a poor prognosis. The researchers in this study hypothesised that treatment with rivaroxaban, a factor Xa inhibitor, could reduce thrombin generation and improve outcomes for patients with worsening chronic heart failure and underlying coronary artery disease.

In their double-blind randomised trial, 5,022 patients who had chronic heart failure but did not have atrial fibrillation were assigned to either rivaroxaban, 2.5mg twice daily or placebo in addition to standard care after treatment for an episode of worsening heart failure.

The results demonstrated that low-dose rivaroxaban was not associated with a significantly lower rate of death, myocardial infarction, or stroke than placebo.

N Engl J Med 2018; 379:1332–42

The clinical and cost-effectiveness of corticosteroid injection versus night splints for carpal tunnel syndrome

As this issue has not been previously investigated, the authors of this study carried out a randomised study on adults with mild or moderate carpal tunnel syndrome.

Two hundred and thirty-four participants were randomly assigned to night splints or steroid injection. At evaluation at six weeks the researchers found that symptom improvement was significantly better in the steroid injection group. When a review was carried out at six months it confirmed the superiority of the steroid injection treatment. No adverse effects were reported.

It was concluded that a single corticosteroid injection shows superior clinical effectiveness at six weeks compared with night-resting splints, making it the treatment of choice for rapid symptom response in mild or moderate carpal tunnel syndrome presenting in primary care.

Lancet **2018; 392:1423–33**

Statins for primary prevention of cardiovascular events and mortality in old and very old adults with and without type 2 diabetes: retrospective cohort study

This is a report of a study carried out in Spain. The participants were 46,864 people aged 75 years or more without clinically recognised atherosclerotic CVD. Participants were stratified by presence of type 2 diabetes mellitus and as statin non-users or new users. The mean age of the subjects was 77 years; 63% women. The median follow-up was 5.6 years.

The researchers report that statins were not associated with a reduction in atherosclerotic cardiovascular disease (CVD) or all-cause mortality in primary prevention in people without diabetes older than 74 years independently of age subgroup. However, statins were significantly related to a reduction in incidence of atherosclerotic CVD and in all-cause mortality in people with type 2 diabetes mellitus; this effect was substantially reduced after the age of 85 and disappeared in nonagenarians.

These results do not support the widespread use of statins in old and very old populations, but they do support treatment in those with diabetes who are younger than 85 years.

BMJ **2018; 362:k3359**

How Coromandel kept the Influenza Epidemic at Bay

By Major J. Lovell Gregg. N.Z.M.C.

S Bredin's Chemist and druggist store, on the corner of Constable and Coromandel Streets, Newtown, Wellington. Ref: 1/1-024951-G. Alexander Turnbull Library, Wellington, New Zealand. /records/22830783

When the influenza epidemic was at its height in Auckland City I consulted the Chairman of the Coromandel Hospital Board, and it was decided to try and prevent the entrance of the epidemic to our little town of one thousand people.

Coromandel lies due east from Auckland across the Hauraki Gulf a distance of 40 miles from the queen city. Steamers come over every other day. We got wind that a number of people from the affected area were coming by the boat, so we got permission from Dr. Frengley to control the traffic. As Health Officer for Coromandel Peninsula I met the boat in the stream, accompanied by the constable, ordered the captain to drop anchor for the night, and in the early morning (5 a.m.) we took off all the passengers in a launch and quarantined them on Jones Island for 24 hours. After that time I medically examined these fourteen passengers and passed them as quite free of influenza. We then brought them to the wharf at Coromandel and put them through a formalin inhalation chamber which was erected on the wharf. After that they were released. The chambers were 6ft. x 6ft., and half-a-dozen saucers with cotton wool soaked in 40 per cent. formalin were scattered round the room. The caretaker kept the passengers in five minutes.

After this trip, Dr. Frengley, advised from our end, notified the Northern Steamship Company that all passengers must have a medical certificate before they could travel

by boat to Coromandel. Even although they had certificates we put them all through the formalin chamber on the wharf at Coromandel.

We then turned our attention to the roads. On three sides we had affected areas to deal with—on the north road Cabbage Bay, on the east Mercury Bay, and on the south Manaia and Thames. All these places were affected. We called for volunteers to stop all traffic by erecting gates across the three different roads. These were barricaded by locks and bolts. A distance on each road of two miles from Coromandel formalin chambers were erected, and all incomers had to take five minutes of the formalin fumes. Day and night watchmen guarded these barriers, and when just erected the gatesman allowed two "commercials" from Thames to get through to see me. I examined them at my residence and found one with a temperature. They got no further, but were sent back to the place they came from.

We notified the Thames authorities that no one would be allowed past the barricade unless they produced a medical certificate. A large number of travellers were held up at these barriers until I was sent for and examined them (these having no certificates).

We altogether had six inhalation chambers going, and I got the headmaster of the local High School to get the children to attend the chambers. In passing I may state that I found the inhalation of formalin had a most beneficial effect. Amongst the children the ordinary coughs and catarrhs of the throat were cured, and mothers soon found that out.

About the 16th November the epidemic broke out in Manaia, eight miles from Coromandel, amongst the Natives. I was called in and found eight different families, comprising 55 cases, down with it. I immediately got in touch with the Native chief and told him to prevent anyone from visiting the eight affected houses. I had these houses isolated, and Mrs. Gregg canvassed the ladies of Coromandel for invalid foods for the Maoris. They responded well, and I was driven over to Manaia every other day with a loaded conveyance. I spent seven hours every other day for five weeks in these houses, feeding them, dosing them with medicines, and generally treating them. I always managed to leave enough foodstuffs until my next visit. Since I took command of them not a fresh case occurred in the rest of the neighbourhood. Ten of the 55 died. There were 24 cases of pneumonia.

I wore a mask of gauze soaked in carbolic acid, and made a mask for the Native undertaker.

The drugs I mainly used were quinine, strychnine, and iron, with a large supply of mustard leaves.

Thus we kept Coromandel absolutely free from the epidemic and controlled the outbreak in Manaia.

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