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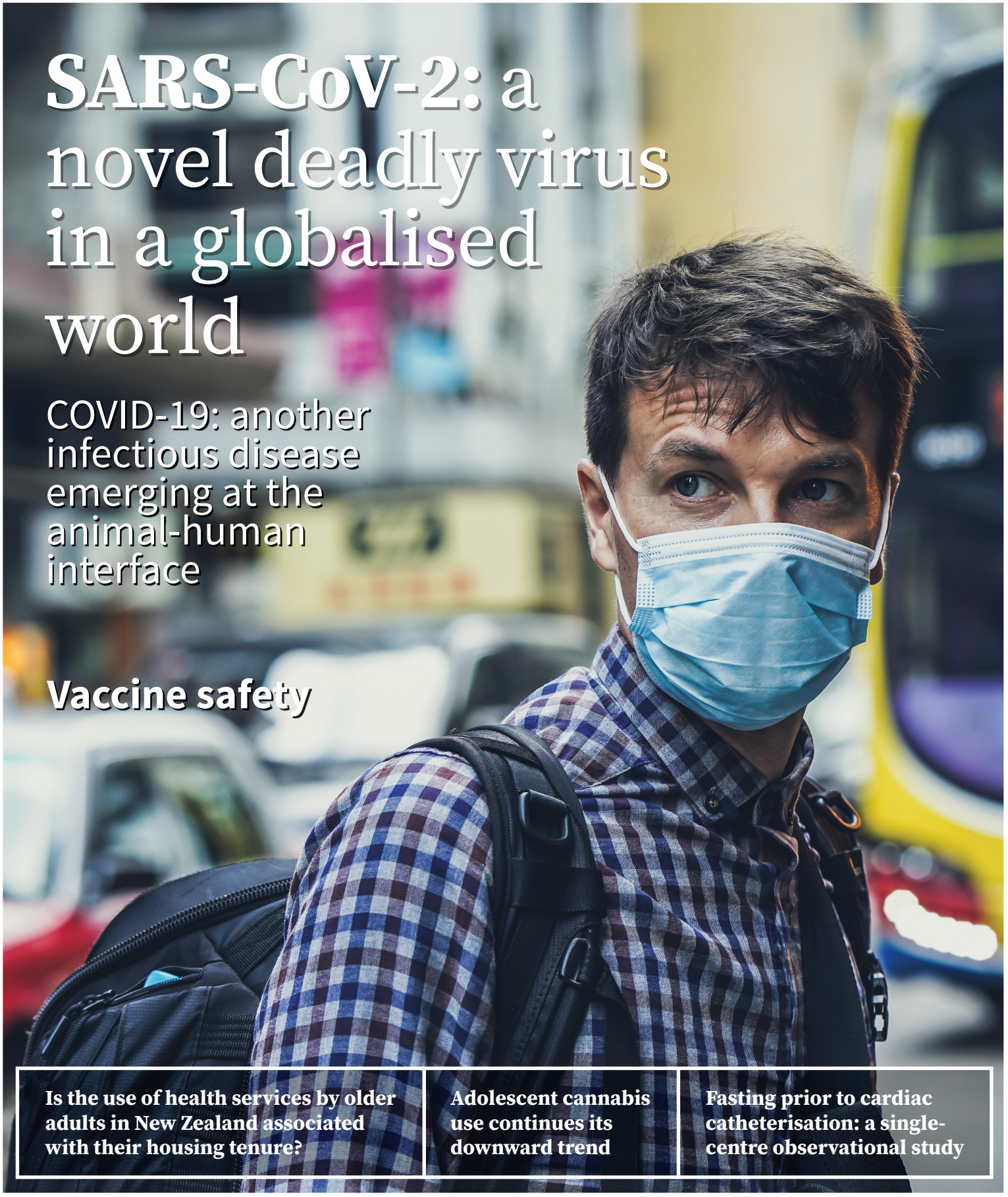

SARS-CoV-2: a novel deadly virus in a globalised world

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Vaccine safety

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Adolescent cannabis use continues its downward trend

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Fasting prior to cardiac catheterisation: a single-centre observational study

Sheila Bacus, John Parsons, Jocelyne Benatar, Jithendra Somaratne, Mark Webster, Rachael Parke

Patients are fasting longer than recommended prior to cardiac catheterisation. The most common symptoms related to fasting was hunger and thirst. There was no episode of aspiration with contrast medium. Pre-hydration was underutilised in patients at risk of contrast induced nephropathy. Further studies are needed to evaluate the need for fasting prior to elective coronary angiogram and angioplasty.

Is the use of health services by older adults in New Zealand associated with their housing tenure?

Megan Pledger, Phoebe Dunn, Janet McDonald, Jacqueline Cumming, Kay Saville-Smith

This paper looked at the use of health services by public renters, private renters and owner-occupiers across three age groups—55–64, 65–74 and 75+. Older renters are more likely to live in poorer health than owner-occupiers and are more likely to use some public health services and yet they are more likely to have unmet health needs.

The prevalence of microvascular complications in Waikato children and youth with type 1 diabetes has reduced since 2003

Sukhbir K Sandhu, Vickie M Corbett, Lynne Chepulis, John Goldsmith, Priya Joseph, Sonya K Fraser, Joanna M McClintock, Ryan G Paul

HbA1c is a measure of how well blood sugar levels have been controlled during the last 10-12 weeks. It is an indication of how well controlled someone's diabetes is. Microvascular complications include those that relate to the small blood vessels of the body, commonly the eyes, the kidneys and nerves). Our study shows that fewer patients with type 1 diabetes are experiencing microvascular complications due to their disease than what was reported in 2003, despite the fact that there has been only minimal changes in blood glucose levels during this 14-year period.

Use of rehabilitation after hip and knee replacement in New Zealand: a national survey

Deborah L Snell, K Anne Sinnott Jerram, Jennifer A Dunn, C Jean Hsieh, Gerben DeJong, Gary J Hooper

In this study we surveyed New Zealanders six months after a hip or knee replacement to find out whether they used rehabilitation before and/or after their operation and if the amount of rehabilitation they used varied depending on where they lived. There were 608 people in the study sample. Most reported very good outcomes after their operations but delays starting rehabilitation post-operatively were associated with poorer pain and function outcomes. More rehabilitation was used after joint replacement compared with before, especially for people having knee replacements. Most rehabilitation was clinic-based physiotherapy and there were trends to more use of rehabilitation by people living in larger urban centres. Our findings suggested that broadening options for rehabilitation, for example home-based and telemedicine opportunities, might improve use of rehabilitation resources.

Intensive care unit utilisation post-oesophagectomy

Michael O'Grady, Rebecca Firth, Ross Roberts

The goal of this study was to see if patients needed to go to ICU after surgery to remove the oesophagus, a major operation usually done for cancer of the oesophagus. Often patients don't need much ICU support and occasionally this can cause surgery to be cancelled, as capacity in ICU is limited. We found half of patients did need ICU level support. This means there is potential to avoid ICU admission in up to half of these patients; however, we currently don't have a good way of predicting which patients these will be. This is an area for further investigation for us.

Population-level exposures associated with MRSA and ESBL-*E. coli* infection across district health boards in Aotearoa New Zealand: an ecological study

Matthew R Blakiston, Joshua T Freeman

The study's findings provide insight into the potential contribution of population-level exposures to variation in the incidence of MRSA and ESBL-*E. coli* infection between populations (DHBs) within New Zealand; an MRSA/ESBL-*E. coli* endemic high-income country. Several MRSA and ESBL-*E. coli* infection-associated exposures are in principle modifiable. It may be that policy measures to reduce rates of household crowding and socioeconomic deprivation could present potentially novel approaches to reducing AMR. Similarly, reducing community antimicrobial use in the population may help reduce MRSA and ESBL-*E. coli* infections. As New Zealand devises and implements an AMR response plan, these findings highlight potentially novel opportunities to reduce the burden of AMR.

The role and functions of community health councils in New Zealand's health system: a document analysis

Gagan Gurung, Sarah Derrett, Robin Gauld

Community/consumer health councils (CHCs) are usually established within district health boards (DHBs) to help address gaps in community engagement in the health sector. This literature review found that the main role of the CHCs appeared to be to advise and make recommendations to concerned DHBs and their governance and management structures about health services planning, delivery and policy. Although they were mainly engaged in information sharing and consultation, their influence on DHB decision-making is not known. As the concept is evolving and more CHCs are being set up in New Zealand, this information may be useful for setting up new CHCs in New Zealand and elsewhere.

Vaccine safety

Stewart Reid

The article covers adverse event reporting following vaccination, the difference between events which occur after vaccination and events which are caused by vaccination, the comprehensive safety monitoring required when vaccines are first introduced, international vaccine withdrawals because of safety concerns and some vaccine changes in New Zealand where safety was an important consideration. Finally, recent developments in vaccine safety monitoring are outlined.

SARS-CoV-2: a novel deadly virus in a globalised world

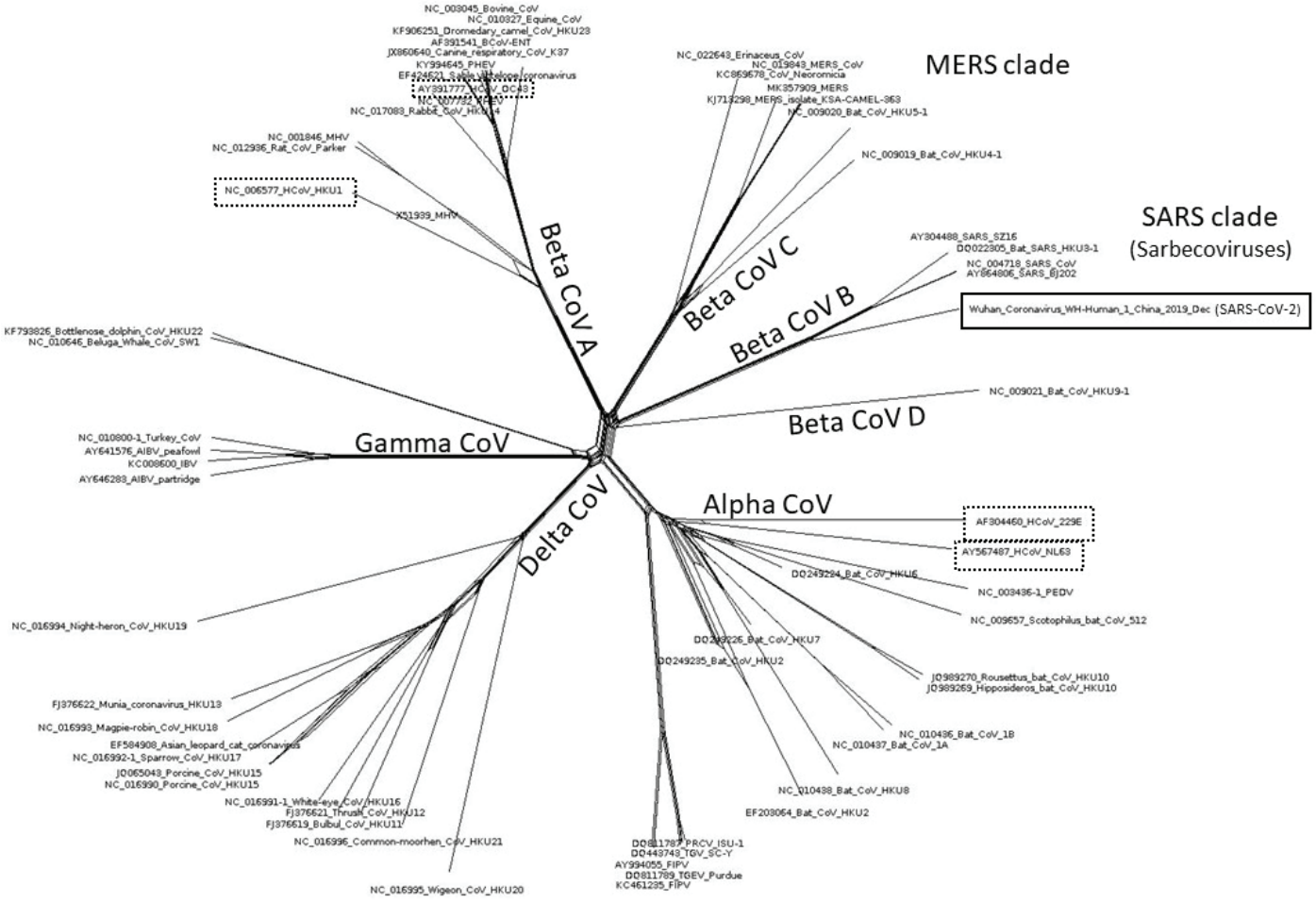
Meik Dilcher, Anja Werno, Lance C Jennings

When the first reports of a cluster of mysterious atypical pneumonia cases connected to a seafood and live-animal market in Wuhan, capital of Hubei province of China appeared on 31 December 2019, visions of the 2002/2003 SARS epidemic immediately came to mind. All diagnostic tests for common respiratory pathogens, including SARS and the closely related MERS coronaviruses were negative and rumours spread that a novel coronavirus might be the cause. Closure of the market in Wuhan was initiated by Chinese officials in an attempt to contain the outbreak.

One week later, on 7 January, Chinese scientists presented data on the identification of a novel coronavirus after obtaining a whole genome sequence of the virus from a patient sample via deep metagenome sequencing.[1] The virus was provisionally named 2019-nCoV (2019 novel coronavirus) and is now officially designated as SARS-CoV-2 (Severe Acute Respiratory Syndrome coronavirus 2).[2] The genome sequence was shared with the scientific community on 10 January, allowing Chinese and international scientists to quickly develop real-time PCR-based detection assays. The first publicly available real-time PCR assay was published on 17 January by a German research group.[3] A fervid hunt for the source of the outbreak started, with the main focus on the live animal market. It was believed that the initial transmission of the virus occurred from a wild animal to humans (zoonotic transmission) and was the cause of these pneumonia cases. However, it was believed that no human-to-human transmission had occurred. Retrospective analysis showed that almost half of the initial 41 cases had no epidemiological link to the live animal market, indicating that the live animal market might have been an accelerator of the outbreak, rather than the source. One-third of the hospitalised cases, mainly those with underlying medical conditions, had to be admitted to ICU, 12 developed acute respiratory distress syndrome similar to SARS and MERS, and six later died.[4] Soon after on 18 January, the number of confirmed cases and fatalities increased and family clusters[5] and infections among healthcare workers indicated that person-to-person transmission must have occurred. This led Chinese officials to introduce extensive quarantine measures and to close down metropolitan regions inhabited by tens of millions of people starting from 23 January, halting public transport, travel and trade in an attempt to control further spread, coinciding with the Chinese Lunar New Year's festival. However, the number of reported cases grew further to almost 10,000 within four weeks (end of January) with more than 200 fatalities, suggesting a case fatality rate of approximately 2%, which is low compared to 10% for SARS-CoV and up to 35% for MERS-CoV. In comparison, 298,120 laboratory-confirmed cases and 812 deaths were reported in Australia during the 2019 influenza season, with a case fatality rate of 0.27%.

The risk of mortality due to a pathogen is heavily influenced by the characteristics of the affected population, including age and available healthcare resources. Measles illustrates this pointedly as the risk of fatality due to the virus in developed countries increases 100-fold in developing countries, influenced by limited healthcare resources. The same applies to the basic reproduction number R_0 (R nought) that describes the expected number of cases directly generated by one infected person in a susceptible population. For SARS-CoV-2, R_0 has been estimated to be 2.68,[6] but this number is not constant and is affected by infection control practices such as quarantine and respiratory hygiene, which can decrease R_0 and stop an outbreak. In a population without these countermeasures R_0 can be much higher.

Figure 1: Phylogenetic tree of coronaviruses including novel coronavirus SARS-CoV-2 (solid box outline) and common cold coronaviruses OC43, HKU1, 229E and NL63 (dashed box outline).



In China, the country's impressive rapid response and quarantine measures have not stopped the virus spreading widely to all Chinese provinces, crossing borders to neighbouring countries and via international travel to distant continents. After initial hesitancy the WHO finally declared the outbreak a public health emergency of international concern (PHEIC) on 30 of January.[7] Human-to-human-transmission outside of China had been detected, while spread to countries with limited healthcare resources was perceived as a significant additional challenge.

SARS-CoV-2

Coronaviruses are a big family of RNA viruses with a broad host spectrum including birds, sea mammals, rodents, civet cats, raccoon dogs, camels, bats, reptiles, fish and humans. So far coronaviruses pathogenic to humans include four viruses with global distribution, OC43, HKU1, NL63 and 229E contributing to up to 30% of upper respiratory tract infections (URTI) each year similar to the common cold and two additional localised/sporadic coronaviruses, SARS-CoV and MERS-CoV, that infect the lower respiratory tract and can cause acute respiratory distress syndrome (ARDS). Phylogenetic analysis based on a sequence alignment of whole genome sequences revealed that SARS-CoV-2 is a member of the SARS clade (lineage B) of beta coronaviruses (Sarbecoviruses) with 79.5% sequence similarity to human SARS virus and 96.2% sequence similarity to a bat coronavirus isolated from horseshoe bats in the Yunnan province of China.[8] This suggests that bats, the known source for SARS-CoV might also be the zoonotic reservoir of SARS-CoV-2. It is highly likely that an intermediate host animal, possibly a pangolin (so far unpublished) traded at the Wuhan live-animal market, has transmitted the virus from bats into an immunological naïve human population. Metagenomic surveys show that bats are among the most abundant sources for novel viral sequences and that more

than 200 strains of coronaviruses have been described from bats,[9,10] 50 of which are SARS related. Bats are also the reservoir host for many highly pathogenic viruses like Ebola, Marburg, Nipah, Hendra and Rabies. They are one of the oldest mammalian groups with a unique immune system, which allows them to be asymptomatic carriers of these viruses, with the exception of Rabies. In addition, they have a long lifespan, often live in large colonies and can fly across large geographical regions. Like Ebola virus, where outbreaks frequently originate from bush meat markets in Africa, this coronavirus outbreak seems to be linked to live-animal markets in China. The Wildlife Conservation Society recently emphasised that poorly regulated live-animal markets mixed with illegal wildlife trade offer a unique opportunity for viruses to spill over from wildlife hosts into the human population.[11] But in contrast to most African countries, China is well connected via international flights with the rest of the world. The modern phenomenon of globalisation has the potential to assist the efficient and rapid dispersion of this novel pathogen.

Bats and humans share the same cellular receptor, ACE2, which interacts with the SARS-CoV and SARS-related coronavirus spike protein, enabling entry into and efficient replication in primary human airway cells deep in the lungs and cells of the intestine. Preliminary data suggest that SARS-CoV-2 is using the same cellular receptor for cell entry.[1,12,13] In addition to coughing and sneezing, transmission via the faecal-oral route may also be possible. But there appear to be additional host factors that determine the severity of the disease, since most infected people with SARS-CoV, MERS-CoV or SARS-CoV-2 only display mild symptoms and mainly people with comorbidities develop more severe clinical outcomes.

Interestingly, coronaviruses have the biggest genomes of all RNA viruses, with genome sizes up to 32 kilobases (kb), coding for a large number of proteins including 4 structural, 16 non-structural and 6–8 accessory proteins, some of which are counteracting the innate immune response. It has been shown that the ORF3b-gene of SARS-CoV-2 encodes a completely novel putative protein of unknown function.[14] Usually, the larger the size of an RNA genome, the bigger the impacts on the fitness of the virus due to the high mutation rate of RNA viruses and accumulation of unfavourable mutations. Coronaviruses have adapted by encoding an exonuclease conferring proof-reading activity and by using mechanisms like recombination (possibly even with members of different virus families),[15] horizontal gene transfer, gene duplication and alternative open reading frames to expand their genetic variability and capacity to infect new hosts.[16] What we have seen so far indicates that SARS-CoV-2 has maintained viral fitness and is readily transmitted from human to human.

Coronavirus disease (COVID-19)

Knowledge of COVID-19, the disease caused by SARS-CoV-2, its severity and the range of symptoms is constantly evolving.

Reported clinical findings include fever (less frequent than in SARS and MERS) and respiratory symptoms, most prominently a dry cough. Other findings include ground-glass radiological lung opacities, normal or reduced leukocyte and thrombocyte counts, hypoxaemia, deranged liver and renal function.[4] In addition, SARS-CoV-2 causes severe respiratory illness in approximately 16–20% of all infected cases, a much higher rate than influenza. Even in developed countries, high numbers of patients with severe respiratory illness can overwhelm the healthcare systems. In a case report investigating a familial cluster of COVID-19 pneumonia, some members of the family also presented with diarrhoea.[5] It is likely that SARS-CoV-2 infections, like other respiratory pathogens, will range from asymptomatic infection to severe acute respiratory syndrome, potentially associated with more severe outcomes in patients with existing comorbidities. There is currently little or no information on infections in pregnant women.

Because of the non-specific nature of these symptoms, it is essential that healthcare practitioners obtain a detailed travel history of suspected cases with respiratory symptoms to ensure that those meeting the current suspected case definition undergo testing for a range of viral respiratory pathogens, including SARS-CoV-2.[17] The specimen types currently recommended for testing are nasopharyngeal and oropharyngeal swabs in ambulatory patients and sputum or endotracheal aspirate in patients

with more severe respiratory disease.[18] It is important to note that at this point in time there is no robust evidence about the optimal specimen for testing. Most respiratory viral pathogens replicate in the nasopharyngeal epithelium. It was observed during the pandemic with Influenza A(H1N1) 2009 that in severe lower respiratory disease nasopharyngeal swabs could give false-negative results.[19] It remains to be seen to what extent this applies also to SARS-CoV-2.

Not enough is known about the usefulness of non-respiratory specimens including serum or plasma, urine or faecal specimens for the diagnosis of COVID-19 but guidance will be updated as new information comes to light.

Our understanding of the transmission of this virus and its virulence is evolving at a fast pace. The incubation period range for SARS-CoV-2 infection is between two days and 12 days, and in some conservative models up to 16 days, with a mean incubation time of 6.4 days.[20] Another study describes an incubation period range of 0–24 days with a mean incubation time of three days.[21] While it appeared that droplet spread was the transmission route, new information suggests aerosol transmission is occurring. In addition, in contrast to other enveloped viruses, coronaviruses are fairly stable for several days on surfaces such as door handles,[22] probably the result of the high amount of spike proteins in their envelope. During the SARS and MERS outbreaks, 'super-spreaders' caused significant nosocomial outbreaks, with up to 82 cases occurring in a single hospital related to one infected person.[23] In an investigation of hospitalised COVID-19 patients from Wuhan, 57 out of 138 (41%) patients were associated with presumed nosocomial transmission.[24] This reinforces the importance of adherence to strict infection control practices in the hospital setting.

However, the limited understanding of the transmission dynamics of SARS-CoV-2 has made the development of robust and meaningful guidelines for infection control, quarantine and containment very challenging.

Where to from here?

The emergence of SARS-CoV-2 is a new reminder of the importance of monitoring the unintended consequences of globalisation of the world we live in. As the ability to fly across the globe is an expectation for many of us, it also harbours challenges, such as containment of potential pathogens. It took the Plague years to spread across Europe in the 14th and 15th century, while it took SARS-CoV-2 only 13 days from the identification of a cluster of cases in Wuhan to spread to countries outside China. As of 12 February 2020, 44,685 laboratory-confirmed cases have been reported from mainland China and 518 confirmed cases in 27 countries outside of China with 1,116 fatalities. The actual number of infected cases is likely to be much higher.

In line with the International Health Regulations (2005) facilitating the timely sharing of information with the World Health Organization (WHO),[7] the international scientific community and the world, the concept of 'One Health' encourages us to look at the interaction of our environment, animal and human health. The example of COVID-19 illustrates well that emerging infectious diseases are not the sole responsibility of the medical profession. It requires rapid and robust communication systems across countries, across political systems and across professional boundaries to ensure that novel pathogens are quickly identified, characterised and contained, if possible.

Competing interests:
Nil.

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COVID-19: another infectious disease emerging at the animal-human interface

David R Murdoch, Nigel P French

The ongoing novel coronavirus outbreak is an example of yet another infectious disease emerging at the animal-human interface, causing considerable concern and disruption as it spreads across international borders. It is remarkable to think that we didn't know about this new coronavirus a few weeks ago, yet it now dominates news headlines globally, has caused major disruptions to travel and trade, and over 200 publications on the outbreak are already listed on PubMed this year. In New Zealand, temporary entry restrictions into the country have been placed on foreign nationals travelling from or through mainland China, New Zealand residents recently arrived from China are asked to self-isolate for two weeks, and specific diagnostic testing for the newly discovered virus is now available in at least three diagnostic laboratories. The country's tourism industry and tertiary institutions are already counting the economic cost.

We also have some new names. The novel coronavirus has been named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) by the International Committee on Taxonomy of Viruses,[1] while the disease associated with it is now referred to as COVID-19. Plenty of opportunity for confusion there.

Much of what we have been witnessing is a result of the rapid sharing of information, possibly more than with any other outbreak. The early messaging to the world about the initial stages of the outbreak contrasts with the delayed sharing of information that characterised the start of the SARS epidemic in 2002–2003. Indeed, within days of the first reports in December 2019 of a mystery cluster of pneumonia cases in Wuhan we heard about the discovery of a new presumptive aetiological agent, shortly followed by the freely available genome sequence of the virus.[2] China has been rightly commended for this excellent investigative work and transparency. Dissemination of the genome sequence data led to the rapid development of diagnostic tests and has already prompted early efforts to develop an effective vaccine. The successful culture of SARS-CoV-2 in a Melbourne laboratory was quickly followed by the sharing of extracted nucleic acid from the virus for use as diagnostic test positive controls (including to New Zealand). We have also seen unprecedented sharing of near real-time data on case numbers, deaths and geographic spread. Medical journals are scrambling for papers on COVID-19 and, equally, health professionals and academics are scrambling to publish early findings. A well-publicised error in an early report[3] (claiming, with incorrect evidence, that SARS-CoV-2 can be transmitted by people without symptoms) reminds us that key quality checks should not be circumvented in the effort towards timely dissemination of sound information to the scientific and health communities.

While the pace of activity may have caught out many, the background to the situation we are facing is of no surprise. This sort of outbreak has been anticipated for some time and it will happen again. Indeed, although there are still many unknowns, the unfolding scenario is predictable in many ways, largely because we have seen similar situations before. This is not the first time we have encountered a previously unknown or new strain of a virus emerge in human populations who have close contact with wildlife and other animals, whose spread is accelerated by modern human transportation pathways and crowded urban environments, and with notable healthcare-associated transmission. The SARS

epidemic in 2002–2003,[4] the 2009 H1N1 influenza pandemic,[5] the emergence of MERS coronavirus in 2012[4] and the 2014–2016 West African Ebola outbreak[6] are the obvious recent examples associated with spread across international boundaries and appreciable morbidity and/or mortality in humans. All have been associated with considerable global anxiety and disruption. So, we have some familiarity with the broader context, but are now trying to better understand key details in order to inform the public health response to this new infectious disease.

Based on available information, the current picture of COVID-19 is of a disease that ranges clinically from a mild respiratory syndrome to life-threatening pneumonia affecting both lungs, with severe disease associated with increasing age and comorbidity.[7,8] We are still learning about disease severity, transmissibility, controllability and the identification of a presumed animal reservoir. Latest case fatality rate estimates for COVID-19 are ~2%, more than in the influenza H1N1 2009 pandemic (<1%), but less than with SARS (10%) and MERS (40%). It is important to bear in mind that the denominator in these calculations may be underestimated due to failure to account for mild cases of the disease, and that most of the case series published to date are on patients with disease severe enough to warrant hospitalisation. Metrics, such as the basic reproduction number (R_0), indicate that transmissibility of SARS-CoV-2 is similar to influenza, but much less than measles. We have little information on the prevalence of asymptomatic infection and whether there is appreciable transmission from asymptomatic cases, important pieces of information for infection control purposes. There has also been little information on COVID-19 in children, raising questions about whether severe disease is less common in this age group. Some of the early cases series from China reported a relatively high prevalence of apparent transmission within the healthcare environment. All these characteristics will be refined as more information comes to hand.

China has made huge efforts to contain the outbreak through rigid enforcement of infection control measures, including widespread use of isolation and the curtailing of social gatherings. In doing so they have effectively created the largest quarantine in human history. Even though COVID-19 has spread to many other countries, the vast majority of cases are still within mainland China, and ongoing transmission outside China has been limited so far. The world is watching eagerly to see whether the containment efforts in China, together with border control measures implemented by other countries, will be effective in minimising further spread. Even the most optimistic would regard more widespread transmission as likely, but the hope is that the pace and extent can be limited. There are also real concerns about ongoing transmission becoming established in low-income countries with less developed health systems, the consequences of which could be devastating.

The precise origin of the COVID-19 virus is yet to be determined, but epidemiological evidence indicates that several zoonotic transmission events occurred in December 2019 at Wuhan's Huanan Seafood Wholesale Market, a live animal and seafood market where wild animals were traded. Molecular evidence showed the virus to be most closely related to a coronavirus isolated from a horseshoe bat from Yunnan Province. Horseshoe bats are understood to be maintenance hosts for SARS-related coronaviruses and COVID-19 may have emerged in a similar way to SARS—from sequential recombination events between the precursors of bat SARS-related coronaviruses, prior to spill-over to an intermediate host and then zoonotic transmission.

Public health authorities have a tough job at times like these. They are tasked with making major decisions in the face of key knowledge gaps, while dealing with rapidly changing information and conflicting pressures and opinions coming from many directions. Given the uncertainties and the potential serious consequences of the outbreak, they can justify taking a precautionary approach as we learn more about the disease. We have seen this in many jurisdictions. The decision by New Zealand to place temporary entry restrictions on foreign nationals travelling from or through mainland China was a brave one and is unprecedented. However, it is in line with the actions of other countries and was, in

part, justified by authorities on the basis of New Zealand's isolated island geography (making it easier to prevent border incursions) and position as a major gateway to many small South Pacific nations.

How prepared is New Zealand for this sort of outbreak? We will only really know in its aftermath (and if it arrives), but there have been considerable efforts by the country's health system to prepare as best it can. At this stage, while there are no cases in New Zealand, the focus has been on keeping COVID-19 out of the country. The likelihood of maintaining this status is low, and now is the time to be preparing for an anticipated upsurge in respiratory disease in the community and increased pneumonia hospitalisations. The New Zealand Influenza Pandemic Action Plan has been in existence since 2002,[9] with several subsequent revisions, and provides a framework for pandemic responsiveness. While focused on influenza, it contains many principles that should apply to the current COVID-19 epidemic. There is also a chance that transmission of SARS-CoV-2 may coincide with our next seasonal epidemic of influenza, creating additional pressure on the health system.

Pathogens spread through populations by various pathways and means of contact. Understanding the complex systems that drive occurrence is essential for informing strategies to tackle emerging and re-emerging infectious diseases, and this usually requires responses from multiple disciplines and an awareness of what is happening globally. Consequently, professionals and researchers from a wide range of disciplines must work together and with communities to prevent and control infectious disease impacts through actions at all levels. "One Health" is the longest running of a number of approaches that aim to break down the artificial barriers between human, animal and ecosystem health researchers, so that they work together to attain optimal health for people, animals and the environment.[10] This approach makes particular sense in New Zealand given the country's relatively isolated island ecosystem vulnerable to introduced pest and pathogens, economic dependency on agriculture and the physical environment, well-connected scientific community and an existing indigenous Māori world view and knowledge system that emphasises holism and interconnectivity between humans, animals and the environment.[11] Indeed, New Zealand has the opportunity to be a global leader here, and considerable efforts are already underway in the effort to establish this transdisciplinary approach.[11]

Episodes of zoonotic spill-over leading to sustained transmission of new infectious diseases in humans appear to be increasing in frequency. As a consequence, pandemic preparedness must be a priority for the global health agenda and for New Zealand. This is the time for coordinated action. As always, this outbreak will provide numerous learnings for us all.

Competing interests:
Nil.

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Fasting prior to cardiac catheterisation: a single-centre observational study

Sheila Bacus, John Parsons, Jocelyne Benatar, Jithendra Somaratne, Mark Webster, Rachael Parke

ABSTRACT

AIM: Previous generation contrast agents were associated with high rates of nausea, vomiting and risk of aspiration leading to recommendations to fast prior to the procedure. However, modern contrast agents are well tolerated with a low risk of aspiration. Our current guidelines recommend fasting four to six hours before elective and semi-urgent cardiac catheterisation despite a lack of evidence to support this. We sought to determine the duration and effects of fasting at our centre.

METHODS: A single-centre prospective observational study in patients undergoing elective cardiac catheterisation over a six-month period between 7 August 2017 to 7 February 2018 at Auckland City Hospital, New Zealand.

RESULTS: One thousand and thirty patients with a mean age of 66±12 years underwent catheterisation. Sixty-seven percent were male, 26% had diabetes, 72% had hypertension and 23% had stage 3 or worse chronic kidney disease. The mean duration of fasting was 11.6±4.9 hours with 80% fasting longer than recommended. One hundred and eight (48%) patients with documented chronic kidney disease did not receive recommended pre-hydration. The most common symptoms related to fasting were hunger (47 %), nausea (3.9%) and vomiting (0.8%). Hypertension (4.1%) and hyperglycaemia (0.8%) occurred due to missed medication. There were no reports of aspiration.

CONCLUSION: Most patients were fasted for significantly longer than recommended and pre-hydration was underutilised in patients at high risk of contrast-induced nephropathy. There were no episodes of aspiration with modern contrast agents. Further studies are required to evaluate the need for fasting prior to non-emergency cardiac catheterisation.

Angiography is a common procedure, undertaken in almost 20,000 patients in New Zealand in 2017.[1] In the early days of cardiac catheterisation, available contrast agents frequently caused nausea and vomiting, with an associated risk of aspiration pneumonitis. Fasting patients for angiography, except in the emergency setting, became standard practice with recommendations that patients be fasted for four to six hours prior to procedures despite the lack of robust evidence to support this.[2] Angiograms undertaken with modern contrast media have low complication rates.[3] Observational studies in patients undergoing emergency angiograms for ST elevation myocardial infarction show an extremely low risk of aspiration even in high-risk groups requiring intubation.[4]

Delays and rescheduled procedures because patients are insufficiently fasted have a large impact on patients and the optimal allocation of limited health resources. Anecdotal data suggests that patients are fasted for long periods as angiography lists are rejigged to accommodate emergencies or unexpectedly long cases. Prolonged fasting can increase the risk of contrast-induced nephropathy and hypoglycaemia in vulnerable patients.[3,5,6]

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This prospective study was undertaken to describe the duration and effects of fasting practices in patients undergoing elective coronary angiography at Auckland City Hospital.

Methods

A prospective, observational study was undertaken of consecutive patients undergoing elective coronary angiography and percutaneous coronary intervention (PCI) at a single institution, Auckland City Hospital, over a period of six months. All patients who underwent elective coronary angiography and PCI between 7 August 2017 and 7 February 2018 were included in this study.

Ethical and institutional approval was obtained prior to the study commencing. The study was approved as low risk, with individual informed consent not required. Patients were instead given the choice to opt out of data collection up to a month following their procedure. For outpatients, study information sheets were sent out two weeks before the scheduled procedure together with the patient's appointment letter. For hospital inpatients, a ward staff nurse gave the patient an information sheet at least one day prior to their procedure.

A worksheet collected data on baseline demographics, length of fasting and adverse events. Cardiac Investigation Unit staff nurses were trained to complete these forms and data was collected from the time of commencement to completion of the angiogram.

Data on the procedure, including contrast volume, was collected from the catheterisation report.

The primary endpoint was the frequency of adverse events associated with fasting such as hunger, hyper/hypotension, nausea, vomiting and aspiration. Secondary endpoints were the duration of fasting, frequency of patient-reported outcomes such as thirst, sore throat, disorientation and dry mouth and the use of anti-emetic medication.

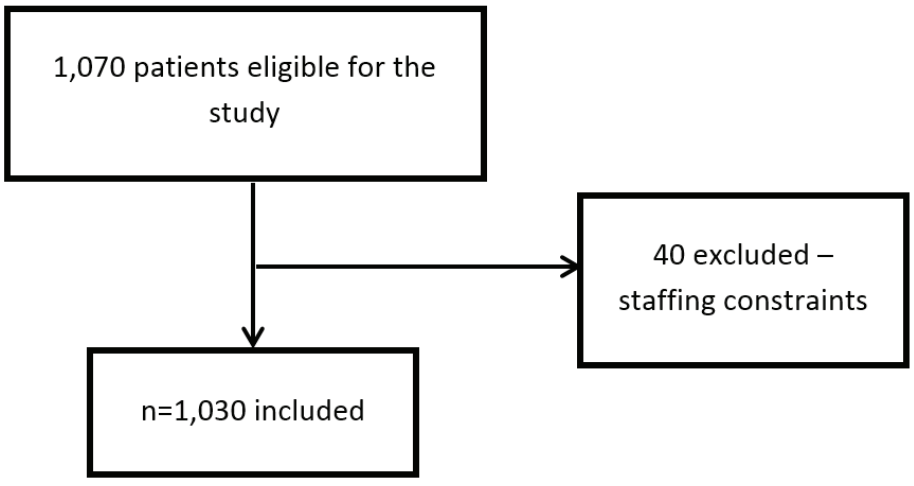
Definitions

Hypertension was defined as blood pressure above 140/90mmhg[7] and hypotension below 90/60mmhg.[8]Hyperglycaemia was defined as capillary blood sugar on finger-stick above 11mmol/L[9] and hypoglycaemia below 4mmol/L.[10]

The renal association criteria (The UK eCKD Guide) were used to define chronic kidney disease.[11]

Data was entered into a Microsoft Excel database. Statistical analysis used Statistical Analysis System (SAS) including Student T-Test and ANOVA for continuous data measurement. Results are presented as number (%) or mean (standard deviation) if parametric and median (interquartile range) of non-parametric.

Figure 1: Study flow.



Results

A total of 1,070 elective cases were performed over six months, of which 1,030 were included in this study—40 patients were not included as staff were too busy to complete checklists (Figure 1). No patients opted out of data collection.

Participant characteristics

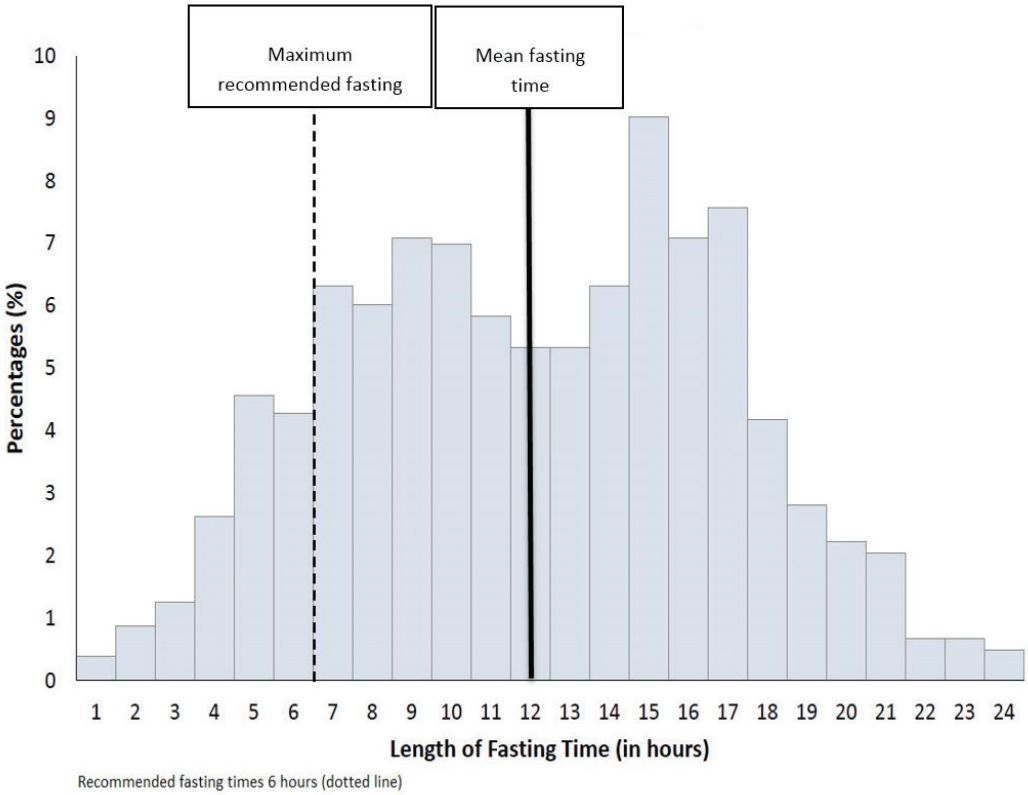
The mean age of participants was 66±11.9 years and 68% were male (Table 1). The ethnic distribution is reflective of the Auckland and Northland population with 66% European and 14% Māori participants. Cardiovascular risk factors were present in

Table 1: Patient characteristics.

Demographics	**n=1,030**
Age, years	66 (11.9)
Gender	
Male	698 (68%)
Female	332 (32%)
Ethnicity	
Māori	147 (14%)
European	682 (66%)
Indian	75 (7%)
Pacific Islander	70 (7%)
Asian	56 (5%)
Cardiovascular risk factors	
Hypertension	746 (72%)
Dyslipidaemia	714 (69%)
Diabetes	270 (26%)
Chronic Kidney classification	n=977
1 Kidney damage with normal GFR	299 (31%)
2 Kidney damage with mild GFR	453 (46%)
3a Mild to moderate GFR	132 (13%)
3b Moderate GFR	52 (5%)
4 Severe GFR	20 (2%)
5 Kidney failure	21 (2%)
Procedure	
Angiogram only	709 (69%)
Angiogram and angioplasty	321 (31%)
Pre-hydration (eGRF < 60ml/min/1.73m^2)	117 (52%) *

*Percentage meant to be pre-hydrated.
Results are presented as mean (SD) or number (%).

Figure 2: Length of fasting in hours.



the majority of patients with hypertension the most frequent (72%). Renal dysfunction, defined as an eGFR <60ml/min/1.73m^2 was present in 23%. The majority of study participants underwent elective coronary angiography only (69%).

Table 2: Complications of fasting presented as number (%).

Complication	n=1,030
Hunger	485 (47.1)
Headache	120 (11.6)
Hypotension	62 (6)
Hypertension	42 (4.1)
Nausea	40 (3.9)
Arrhythmia	13 (1.3)
Hyperglycaemia	8 (0.8)
Vomiting	8 (0.8)
Vasovagal syncope	8 (0.8)
Hypoglycaemia	7 (0.7)
Aspiration	0 (0.0)

Length of fasting

The mean length of fasting was 11.6 hours (±4.9) with 80% of patients (n=821) fasting longer than recommended (Figure 2).

Complications

The most common complication was hunger at 47.1% (Table 2), while headache occurred in 11.6% of study participants, and nausea and vomiting in 3.9% and 0.8% respectively. Of the 40 patients who experienced nausea, 26 required anti-emetic drugs. Hypotension was recorded in 6% of patients, hypertension in 4.1% and hyperglycaemia in 0.8%. Hypoglycaemia (0.7%) and vasovagal syncope (0.8%) were uncommon. There were no reports of aspiration.

Of the 225 classified as having renal dysfunction, 108 (48%) were not pre-hydrated as per guidelines and catheter laboratory protocols.

Other patient-reported outcomes are listed in Table 3.

Table 3: Other patient-reported outcomes presented as number.

Others reported symptoms	Total (n=92)
Thirst	33
Dry mouth	32
Dizziness	18
Light-headedness	6
Tired and drowsy	1
Sore throat	1
Disorientation	1

Discussion

This study found that in this cohort, the incidence of clinically important complications was low, but the average length of fasting was significantly longer than guideline recommendations.

Despite recommendations that patients are fasted three to six hours for solid food and up to two hours for clear liquids pre-procedure,[2,12,13] 80% of patients included in this study were fasted longer than recommended. Reasons for this are complex, but may include the dynamic changes to angiogram lists based on urgency and complexity of cases leading to delays.

Hospital and national guidelines are based on extrapolations from anaesthetic studies showing that fasting reduces aspiration pneumonia in patients undergoing general anaesthetic.[14] However, there is little published data to support fasting prior to angiogram, a procedure usually undertaken with conscious sedation.[2,12,13] The largest observational study to date, which included 1,916 non-fasted patients, had no cases of aspiration pneumonia.[15] Moreover, patients with ST elevation myocardial infarctions have angiograms without fasting with few adverse outcomes.[15,16] Risk of vomiting and aspiration are low even in the setting of emergency coronary artery bypass graft surgery following angiography (0.1%).[4,17] Joint guidelines from the Royal College of Anaesthetists and Royal College of Emergency Medicine recommended no fasting for minimal sedation.[18]

The population enrolled in this study were relatively healthy adult participants without the increased risk of aspiration pneumonia, similar to other studies.[19] Specific risk factors common in patients undergoing angiogram, such as older age, renal insufficiency and diabetes mellitus, can increase the risk for complications of fasting. The risk of the dehydration includes electrolyte disturbances[20] and contrast-induced nephropathy.[5] This is especially important in those who have chronic kidney disease.[3,5] Hydration (orally or intravenously) is key to reducing acute kidney injury in those with chronic kidney disease. Protocols are in place to identify and pre-hydrate those at risk of contrast-induced nephropathy. However, we found that almost half of patients with renal dysfunction were not pre-hydrated, increasing the risk of acute kidney injury.

Those with diabetes are particularly disadvantaged by prolonged fasting for two reasons; diabetes medications need to be taken with food and fasting increases the risk of hypoglycaemia. A number of patients had hyperglycaemia due to missed medications and worryingly, some developed hypoglycaemia.

The most common complaints from patients related to discomfort due to hunger and thirst. This finding is in agreement with a review in the perioperative setting, which showed significantly higher hunger and thirst scores in patients who were fasted compared to patients who received water, coffee and carbohydrate drinks.[19] This may not be medically important, but can impact significantly on the patient experience. Elderly patients in particular do not tolerate these symptoms well and this can negatively affect their wellbeing.

Strengths and limitations

This study was undertaken in a single centre and may not be generalisable to other cardiac catheterisation units. However, there were few exclusion criteria and patients were enrolled sequentially, suggesting this was representative of the normal patient cohort.

Data was collected by different staff nurses who may have had a different interpretation of the outcome variables. This was mitigated by training all staff on data collection prior to the study start and having detailed descriptions of predefined endpoints available.

There were challenges determining the exact duration of fasting. Patients were considered to have stopped fasting at the end of their procedure. This was a pragmatic decision as the actual time resumption of food intake occurred was not recorded. Actual total fasting duration may be longer than that reported.

The most important limitation was that no data was collected to reliably assess rates of contrast-induced nephropathy as the majority of patients were discharged home post-procedure, without further laboratory values being obtained. Further research is needed to better assess the impact of fasting on development of acute kidney injury.

Conclusion

This study found that patients were fasted for longer than recommended and that despite guidelines recommending its use, pre-hydration was underutilised in patients at high risk of contrast-induced nephropathy. There were no episodes of aspiration found. Further studies are required to determine whether there is any role for fasting patients prior to non-emergency cardiac catheterisation.

Competing interests:
Nil.

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Is the use of health services by older adults in New Zealand associated with their housing tenure?

Megan Pledger, Phoebe Dunn, Janet McDonald, Jacqueline Cumming, Kay Saville-Smith

ABSTRACT

AIM: To explore associations between tenure and the health service use of older New Zealanders.

METHODS: Analysis of pooled data for adults aged 55+ from three New Zealand Health Surveys (2013/14, 2014/15, 2015/16) comparing owner-occupiers, private renters and public renters.

RESULTS: Public renters, and in some age groups private renters, reported more visits to the GP and a higher proportion reported using a public hospital service in the last year. Renters were less likely than owner-occupiers to have used some privately paid services (visiting a dental health worker or optician). Renters averaged lower co-payments for their last GP visit, but financial barriers to accessing a GP, after-hours medical centre use and not collecting prescriptions were more likely to be reported by renters than owner-occupiers—particularly those that rent publicly.

CONCLUSIONS: New Zealanders are simultaneously living longer while having declining opportunities to enter home ownership. Older renters are more likely to live in poorer health and, overall, are more likely to use some (public) health services than owner-occupiers yet are more likely to have unmet health needs. The increasing reliance on renting among older people has implications for population health and wellbeing, health service delivery and transitions to residential care.

Internationally and within New Zealand, research has demonstrated an association between housing tenure and health, with home owners generally in better health than renters.[1–8] This could be due to features of the home (eg, quality or security) or neighbourhood (eg, safety) influencing health; or individual characteristics such as socioeconomic status or health may influence housing tenure.[9,10] In addition, the relationship between tenure and health varies between countries, reflecting different housing contexts, including the availability, quality and security of rental tenure.[11–13]

New Zealand has had high rates of home ownership but this has been declining, including among older people.[14,15] At the same time, New Zealand, along with many other developed countries, is experiencing population ageing, with the number and proportion of older people projected to increase.[16,17] This combination of structural ageing together with a tenure revolution has implications for the future need for and provision of health services for older people.

The New Zealand Healthy Ageing Strategy focuses on supporting people to age well and recognises many older people are healthy.[18] However, older age can come with increasing levels of disability, frailty and complex comorbidities, and life expectancy in New Zealand has increased faster than health expectancy.[17] Older people are higher users of health services; in New Zealand, over 65-year-olds comprise 15% of the population but account for 42% of health service use, and the proportion of health spending on older people is projected to increase.[19] The capitation funding for Primary Health Organisations recognises the higher health

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needs of older people through higher subsidy rates for those aged 65 and older (along with other health-need related characteristics, such as being Māori, Pasifika or holding a high-use health card) but does not consider tenure.[20]

A range of factors influence an individual's use of health services, including: health status, the price of services, incomes, individual preferences, whether they are covered by health insurance and characteristics such as age, gender and ethnicity.[21–25] The price users pay for health services is affected by government policies as well as insurance coverage. Even within New Zealand's public health system, the price of health services varies: emergency department, outpatient and inpatient services in public hospitals are provided free of charge, whereas primary healthcare services have charges depending on the patient's age, Community Services Card or High Use Health Card status, and the PHO and general practice they are enrolled with. Other services such as adult dental care and optometry are paid for privately, and a proportion of the population also hold supplementary private health insurance (covering user charges in primary healthcare and/or care provided by private hospitals or specialists).[26]

Our earlier research, using data from New Zealand Health Surveys, has shown a health gradient for older New Zealanders, with owner-occupiers in the best health, followed by private renters, while public renters have the poorest health.[27] This paper goes on to consider the implications for patterns of health service use and access to care among older renters compared to owner-occupiers. The poorer health status of renters may mean they are (appropriately) higher users of health services than owner-occupiers but cost or other barriers could negate this.

Methods

The New Zealand Health Surveys (NZHS) are national surveys of the New Zealand population aged 15 and over that are conducted annually.[28] The surveys use a complex sampling design, including a step to increase the sample sizes of particular ethnic groups (Māori, Pacific and Asian), but have been weighted to produce a representative sample.[28] Data from the core NZHS questionnaire allows comparison across years.[28] Data for adults aged 55 and over from the 2013/14, 2014/15 and 2015/16 NZHSs were pooled (totalling 15,626 respondents). Confidentialised, unit record files (CURFs) were provided through Statistics New Zealand. The Victoria University of Wellington Ethics Committee advised ethical review was not required to undertake this analysis.

Demographics and measures of healthcare utilisation were compared across three housing tenures: a) owner-occupiers and those living in homes held in a family trust (initially analysed separately but combined due to the similarity of results), b) private renters living in homes owned by private landlords or trusts, and c) public renters in homes owned by city councils, Housing New Zealand and other state-owned organisations. Data were analysed in three age groups: 55–64, 65–74, 75+ years to see if results were a continuation of earlier life experience or changed in older age.

Survey responses were either numerical, a fixed choice with two categories (eg, yes/no) or a list of predetermined categories. The first type of response is presented as weighted means for each tenure group. Tests of differences in means between a) private renters and public renters and b) private renters and owner-occupiers were done using regression for each age category. Responses to other questions were presented as percentages. Tests for differences in percentages between tenure groups were analysed using logistic regression or generalised logistic regression. The resulting p-values were for differences between the marginal means of each tenure group. (For further detail about methods, see[27].)

Results

Demographics

Demographic data reported previously[27] show 83% of the sample were owner-occupiers/family trust (62% and 21% respectively; referred to as owner-occupiers hereafter), 12% were private renters and 5% were public renters. Tenure proportions were similar across age groups, except for slightly more owner-occupiers in the 65–74 year age group (86%). The oldest age group had a higher proportion of women, particularly for private and public renters (66% and 64%) while the other age groups had

fairly even proportions of men and women. New Zealand European/Others made up the highest proportion of owner-occupiers (87%). Public renters had higher proportions of Māori (22%) and Pacific people (17%) compared to private renters and owner-occupiers.

Public, then private, renters were more likely to be living alone. Public renters had the lowest, and owner-occupiers the highest, average personal income with the exception for those aged 75+ where there was no significant difference between private renters and owner-occupiers (14% missing data for this question).

Overall health status—SF-12

The Medical Outcomes Study Short Form version 2.0 (SF-12) is an internationally validated instrument which was used to gain an overall measure of physical and mental health[29] (see Figure 1). Both showed a health gradient: public renters in the poorest physical and mental health, followed by private renters, with owner-occupiers in the best overall health. Self-reported physical and mental health conditions, risk factors and health behaviours also showed owner-occupiers generally had the best health and public renters the poorest (for full details of these results, see[27]).

Health service utilisation

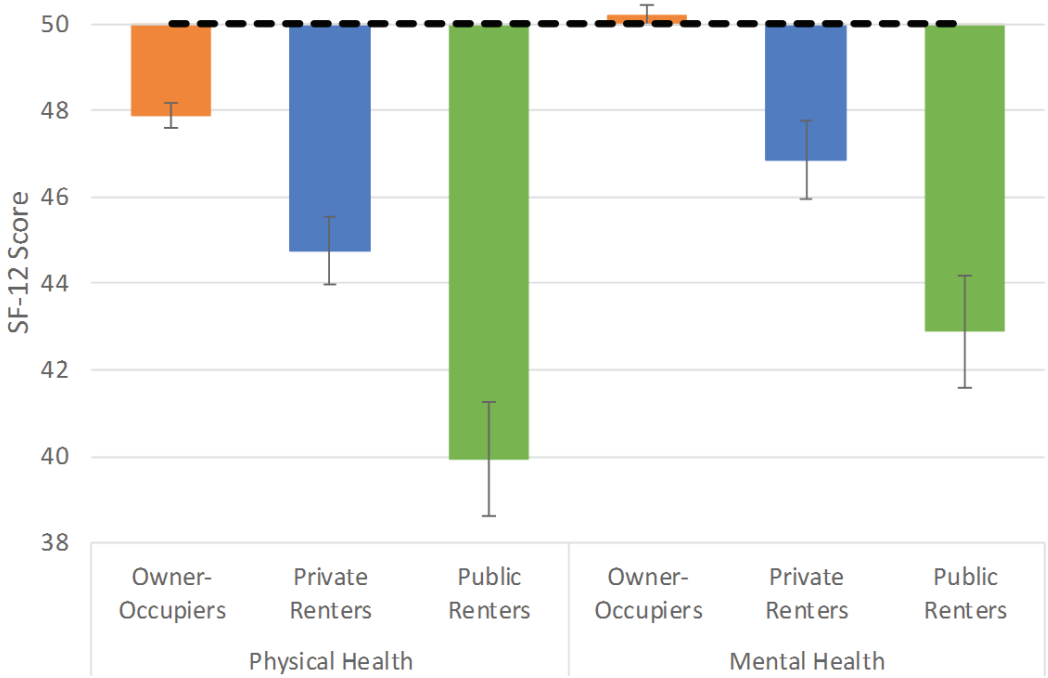
In the text, we focus on health service utilisation results, which are both statistically and practically significant (p value <0.05 and, where relevant, a five-percentage-point difference between groups). Main results (including confidence intervals) are shown in Tables 1–4.

Primary care

Table 1 shows primary care utilisation. Most respondents said they had a GP clinic or medical centre they usually attend when feeling unwell or injured, with no significant differences between tenure groups. Most older people had seen a GP in the past year. Among 55-64 year olds, public renters were more likely to report seeing a GP and both public and private renters in this age group reported more visits: annual visits averaged 5.5 for public renters, 4.4 for private renters and 3.3 for owner-occupiers.

Private renters aged 65–74 and public renters aged 75+ were less likely to have seen a practice nurse without seeing a GP

Figure 1: Average SF-12 Physical Health Score and SF-12 Mental Health Score for owner-occupiers, private renters and public renters aged 55+.



The dashed line represents the population average for each statistic for New Zealanders aged 15+.

Table 1: Health service utilisation: primary care.

	Housing tenure						p-value: private vs public renters	p-value: private renters vs o-occupiers
	Public renters		Private renters		Owner-occupiers			
	Statistic	95% CI	Statistic	95% CI	Statistic	95% CI		
Have a GP clinic or medical centre that you usually go to when you are feeling unwell or are injured (%)								
55–64	99.1	(96.8, 99.7)	95.3	(93.3, 96.7)	98.3	(97.7, 98.7)	0.0004	0.0007
65–74	98.8	(96.5, 99.6)	94.0	(89.8, 96.5)	98.9	(98.5, 99.2)	0.0082	0.0033
75+	95.9	(88.3, 98.7)	97.6	(91.6, 99.4)	99.5	(99.1, 99.7)	0.5448	0.2381
All	98.2	(96.3, 99.1)	95.5	(93.8, 96.8)	98.8	(98.5, 99.0)	0.0111	0.0000
Seen or been visited by a GP about own health in the past 12 months (%)								
55–64	91.9	(87.9, 94.6)	83.9	(80.8, 86.7)	86.6	(85.1, 87.9)	0.0003	0.1210
65–74	90.5	(86.2, 93.6)	87.9	(82.7, 91.7)	92.5	(91.4, 93.5)	0.3602	0.0492
75+	92.9	(87.6, 96.1)	95.6	(90.1, 98.1)	95.8	(94.5, 96.8)	0.3475	0.8946
All	91.7	(89.3, 93.7)	87.7	(85.3, 89.8)	90.7	(89.9, 91.4)	0.0120	0.0167
Number of times saw a GP in the past 12 months (mean)†								
55–64	**5.5**	(5.0, 6.0)	**4.4**	(4.0, 4.8)	**3.3**	(3.1, 3.4)	0.0023	0.0000
65–74	**6.5**	(5.3, 7.6)	**4.6**	(4.1, 5.1)	4.1	(3.9, 4.3)	0.0027	0.0555
75+	5.4	(4.7, 6.1)	5.2	(4.7, 5.7)	4.8	(4.7, 5.0)	0.7002	0.1613
All	**5.7**	(5.2, 6.2)	**4.7**	(4.4, 5.0)	**3.9**	(3.8, 4.0)	0.0006	0.0000
Seen a practice nurse without seeing a GP at the same visit or appointment in past 12 months (%)								
55–64	32.3	(26.8, 38.2)	36.5	(32.4, 40.9)	37.2	(35.3, 39.3)	0.2459	0.7535
65–74	45.1	(38.4, 52.1)	40.9	(35.4, 46.7)	51.9	(49.8, 54.0)	0.3665	0.0007
75+	39.0	(32.7, 45.7)	47.9	(41.6, 54.3)	53.6	(51.3, 55.9)	0.0417	0.0970
All	37.7	(34.0, 41.6)	40.4	(37.1, 43.7)	45.9	(44.6, 47.2)	0.2889	0.0015
Number of times saw a practice nurse without seeing a GP at the same visit in past 12 months (mean)†								
55–64	1.8	(1.2, 2.4)	**1.6**	(1.4, 1.8)	**1.3**	(1.2, 1.4)	0.4808	0.0285
65–74	2.2	(1.8, 2.7)	1.9	(1.5, 2.3)	1.7	(1.6, 1.9)	0.3165	0.3811
75+	1.8	(1.4, 2.2)	3.4	(1.6, 5.3)	2.2	(1.9, 2.5)	0.0913	0.2021
All	1.9	(1.6, 2.3)	2.1	(1.6, 2.6)	1.7	(1.6, 1.8)	0.5056	0.0887
Visited an a˜er-hours medical centre in the past 12 months (%)								
55–65	4.5*	(3.0, 6.6)	7.6	(5.8, 9.9)	9.2	(8.1, 10.3)	0.0228	0.1794
65–74	9.7*	(6.4, 14.4)	7.7*	(4.9, 11.8)	8.0	(6.9, 9.2)	0.4509	0.8637
75+	-	-	9.4*	(6.6, 13.0)	7.7	(6.7, 9.0)	-	0.3354
All	7.0	(5.4, 9.1)	8.0	(6.5, 10.0)	8.4	(7.8, 9.1)	0.4144	0.6669
Number of times visited an a˜er-hours medical centre in the past 12 months (mean)†								
55–64	1.8	(1.3, 2.3)	1.6	(1.3, 1.9)	1.4	(1.3, 1.6)	0.6294	0.2140
65–74	2.1	(1.5, 2.6)	1.6	(1.0, 2.3)	1.3	(1.2, 1.4)	0.3488	0.3071
75+	-	-	1.7	(1.0, 2.3)	1.3	(1.2, 1.4)	0.6286	0.2937
All	1.8	(1.5, 2.1)	1.6	(1.4, 1.9)	1.4	(1.3, 1.4)	0.4521	0.0555

Table 1: Health service utilisation: primary care (continued).

Charge for last visit to the GP (mean, $)								
55–64	**24.6**	(22.3, 26.8)	**30.8**	(29.1, 32.5)	**36.9**	(35.9, 37.9)	0.0000	0.0000
65–74	**23.1**	(21.0, 25.2)	**28.9**	(27.0, 30.8)	**34.4**	(33.5, 35.3)	0.0001	0.0000
75+	27.6	(24.3, 31.0)	31.2	(28.8, 33.7)	33.7	(32.6, 34.8)	0.0936	0.0765
All	**24.9**	(23.4, 26.5)	**30.4**	(29.3, 31.6)	**35.2**	(34.5, 35.9)	0.0000	0.0000
Charge for last practice nurse visit (mean, $)								
55–64	7.4	(3.1, 11.8)	11.3	(9.0, 13.7)	12.9	(11.8, 14.1)	0.1199	0.2412
65–74	5.6	(2.1, 9.1)	9.7	(6.7, 12.7)	8.2	(7.3, 9.0)	0.0870	0.3214
75–84	7.4	(3.8, 10.9)	6.2	(3.4, 9.0)	8.0	(7.0, 8.9)	0.6250	0.2262
All	6.8	(4.4, 9.1)	9.5	(7.9, 11.1)	9.7	(9.2, 10.3)	0.0631	0.7575
Charge for last a˜er-hours visit (mean, $)								
55–64	**42.1***	(28.5, 55.6)	**60.7**	(48.8, 72.6)	58.7	(53.5, 63.9)	0.0428	0.7555
65–74	-	-	-	-	57.3	(52.8, 61.7)	-	-
75+	-	-	-	-	55.0	(49.1, 60.9)	-	-
All	**39.6**	(30.9, 48.3)	**60.8**	(53.3, 68.2)	57.5	(54.4, 60.5)	0.0003	0.4086

Estimates with a relative sampling error (RSE) of 30–50% are marked with an asterisk (*) and should be used with caution. Any estimates containing fewer than 30 respondents are suppressed (-).
Results with shading highlight indicate differences that are both statistically significant (p value <0.05) and likely to be practically significant (five percentage-point difference between groups). Results in **bold** indicate a statistically significant difference (p value <0.05).
†For those who used this service.

at the same visit. The number of visits to a practice nurse alone in the past year was significant only for private renters aged 55–64 (mean 1.6) compared with owner-occupiers (1.3). There were no significant differences in the proportion of respondents who had visited an after-hours medical centre (AHMC) in the past year or the number of visits to an AHMC.

Among the younger two age groups, public then private renters were charged a lower fee for their last GP visit than owner-occupiers. There were no significant differences between average charges to see the practice nurse.

Secondary care

Table 2 shows secondary care service utilisation. Among the 55–64 age group, public then private renters were more likely than owner-occupiers to have used a service at or been admitted to a public hospital (44%, 35% and 27% respectively). Public renters aged 65–74 were also more likely than the other two tenure groups to have used these services.

Renters were more likely than owner-occupiers to have used an emergency department (ED) in the last year (significant differences for private renters aged 55–64 and public renters aged 65–74). Owner-occupiers made fewer ED visits in the last 12 months than renters among the two younger age groups.

Among those aged 55–64, public renters were more likely to have used an inpatients department in the last year, and private renters were more likely than owner-occupiers to have used an outpatient department. Fewer than 10% of owner-occupiers had used private hospital services in the last 12 months; the number of renters using these services was too small for analysis.

Dental and other healthcare workers

Overall, renters were less likely than owner-occupiers to have visited a dental healthcare worker in the last year (Table 3). Differences were significant for private

Table 2: Health service utilisation: secondary care.

	Housing tenure						p-value: private vs public renters	p-value: private renters vs o-occupiers
	Public renters		Private renters		Owner-occupiers			
	Statistic	95% CI	Statistic	95% CI	Statistic	95% CI		
Used a service at, or been admitted to a public hospital as a patient in last 12 months (%)								
55–64	43.6	(37.7, 49.7)	35.3	(31.5, 39.3)	26.8	(25.1, 28.5)	0.0307	0.0001
65–74	51.9	(45.2, 58.6)	42.1	(36.9, 47.6)	36.9	(34.8, 39.0)	0.0146	0.0734
75+	56.4	(49.3, 63.2)	49.2	(44.2, 54.2)	45.5	(43.2, 47.9)	0.1231	0.1878
All	49.3	(45.2, 53.4)	40.4	(37.4, 43.4)	34.5	(33.3, 35.7)	0.0005	0.0004
In the last 12 months, at a public hospital… **a. used the emergency department (ED) (%)†**								
55–64	24.2	(19.1, 30.1)	18.1	(15.2, 21.3)	12.0	(10.9, 13.2)	0.0630	0.0003
65–74	26.9	(21.4, 33.2)	18.4	(14.5, 23.1)	15.1	(13.8, 16.6)	0.0172	0.1455
75+	29.4	(22.6, 37.3)	22.9	(17.2, 29.8)	21.1	(19.0, 23.3)	0.2062	0.5974
All	26.3	(22.6, 30.5)	19.3	(17.3, 21.6)	15.2	(14.3, 16.1)	0.0025	0.0005
b. used an outpatients department (%)†								
55–64	25.2	(20.2, 30.9)	22.4	(18.9, 26.2)	15.7	(14.4, 17.0)	0.4019	0.0005
65–74	31.9	(25.9, 38.4)	27.6	(23.4, 32.3)	22.9	(21.1, 24.8)	0.2643	0.0546
75+	30.9	(25.0, 37.5)	27.8	(23.5, 32.6)	25.6	(23.4, 28.0)	0.4338	0.3832
All	28.6	(25.3, 32.2)	25.0	(22.5, 27.7)	20.4	(19.3, 21.5)	0.0859	0.0011
c. used an inpatients department (%)†								
55–64	17.6*	(12.9, 23.6)	11.0	(8.9, 13.6)	7.6	(6.7, 8.6)	0.0290	0.0090
65–74	22.2	(17.2, 28.2)	16.4	(12.6, 21.0)	11.9	(10.6, 13.3)	0.0908	0.0427
75+	29.2	(23.1, 36.1)	24.0	(19.3, 29.5)	19.9	(17.8, 22.2)	0.2339	0.1500
All	21.9	(18.6, 25.7)	15.5	(13.7, 17.5)	11.9	(11.1, 12.7)	0.0025	0.0009
Number of visits to an ED at a public hospital about own health in last 12 months (mean)†								
55–64	2.0	(1.7, 2.3)	**1.8**	(1.5, 2.1)	**1.3**	(1.3, 1.4)	0.5017	0.0027
65–74	2.8	(1.6, 4.0)	**2.0**	(1.6, 2.4)	**1.4**	(1.3, 1.5)	0.1936	0.0075
75+	1.9	(1.5, 2.4)	1.6	(1.4, 1.8)	1.6	(1.5, 1.8)	0.1650	0.8760
All	2.2	(1.8, 2.6)	**1.8**	(1.6, 2.0)	**1.4**	(1.4, 1.5)	0.0649	0.0008
Used a service at, or been admitted to, a private hospital in last 12 months (%)								
55–64	-	-	6.9*	(4.5, 10.3)	9.2	(8.0, 10.4)	-	0.1434
65–74	-	-	-	-	9.9	(8.6, 11.4)	-	-
75+	-	-	-	-	7.5	(6.3, 8.9)	-	-
All	-	-	5.9	(4.5, 7.8)	9.0	(8.3, 9.8)	-	0.0007

Estimates with an RSE of 30-50% are marked with an asterisk (*) and should be used with caution. Any estimates containing fewer than 30 respondents are suppressed (-).
Results with shading highlight indicate differences that are both statistically significant (p value <0.05) and likely to be practically significant (five percentage-point difference between groups). Results in **bold** indicate a statistically significant difference (p value <0.05).
† For those who used this service.

Table 3: Health service utilisation: dental health care, other healthcare workers.

	Housing tenure						p-value: private vs public renters	p-value: private renters vs o-occupiers
	Public renters		Private renters		Owner-occupiers			
	Statistic	95% CI	Statistic	95% CI	Statistic	95% CI		
Visited a dental healthcare worker in the last year (%)								
55–64	28.5	(23.1, 34.5)	35.2	(31.1, 39.6)	57.3	(55.4, 59.3)	0.0624	0.0000
65–74	20.7	(15.7, 26.8)	31.4	(25.8, 37.5)	53.0	(50.9, 54.9)	0.0093	0.0000
75+	14.6*	(10.7, 19.8)	33.2*	(23.1, 45.3)	39.3	(36.9, 41.8)	0.0014	0.3047
All	22.7	(19.5, 26.2)	33.8	(29.8, 38.0)	51.7	(50.5, 52.9)	0.0000	0.0000
Seen an optician or optometrist in last 12 months (%)								
55–64	11.4	(8.6, 15.0)	19.4	(16.1, 23.1)	24.4	(22.6, 26.3)	0.0012	0.0132
65–74	22.2	(17.5, 27.7)	17.1	(13.2, 21.8)	30.1	(28.2, 32.1)	0.1376	0.0000
75+	22.2	(17.8, 27.3)	29.7	(23.3, 37.0)	33.9	(31.6, 36.1)	0.0843	0.2435
All	17.3	(14.9, 20.1)	21.3	(18.7, 24.1)	28.5	(27.3, 29.7)	0.0478	0.0000

Estimates with an RSE of 30–50% are marked with an asterisk (*) and should be used with caution.
Results with shading highlight indicate differences that are both statistically significant (p value <0.05) and likely to be practically significant (five percentage-point difference between groups).

renters in the younger two age groups and public renters in the oldest two age groups. Among the two younger age groups, owner-occupiers were more likely to report seeing an optician or optometrist. The number of respondents who visited other health professionals (eg, pharmacist, physiotherapist, chiropractor) or who had seen a listed medical specialist (eg, cardiologist, oncologist, respiratory physician, geriatrician) in the last year was too small to allow for analysis or showed no significant differences.

Unmet need

Among 55–64 and 65–74 age groups, renters were more likely to report cost as a barrier to visiting a GP, an AHMC or dental health carer or to picking up one or more prescription items (Table 4).

Public renters in the two younger age groups and private renters aged 55–64 were more likely to report lack of transport had prevented them visiting a GP.

Health insurance coverage

Too few public renters were covered by any health insurance for analysis. Among the 55–64 and 65–74 year olds, owner-occupiers were more likely than private renters to have health insurance (Table 4).

Discussion

In the 55–64 and 65–74 year age groups, renting—particularly publicly—rather than owning was associated with higher use of some public health services, including GP visits, public hospital or ED use in the last year. The same general trend was seen across the majority of variables relating to use of public primary and secondary care services even when not statistically significant. There were very few significant differences between tenure groups among those aged 75 years and over. Our earlier work showed poorer health among renters compared with owner-occupiers,[27] so higher health service use may appropriately reflect need.

Renters were generally less likely to report using privately paid services such as dental and optician services, potentially adversely impacting their health.[30,31] Very few public renters had health/medical insurance or had used a service at a private hospital in the last year.

While public renters made more visits to the GP in the two younger age groups, they were also charged the lowest co-payment. However, there are indications that high levels of unmet need remain, with renters more likely to report lack of transport or

Table 4: Unmet need.

	Housing tenure						p-value: private vs public renters	p-value: private renters vs o-occupiers
	Public renters		Private renters		Owner-occupiers			
	Statistic	95% CI	Statistic	95% CI	Statistic	95% CI		
Had a medical problem but did not visit a GP because of cost in past 12 months (%)								
55–64	30.8	(26.0, 36.0)	18.2	(15.1, 21.8)	7.8	(6.9, 8.8)	0.0001	0.0000
65–74	24.3	(19.4, 30.0)	12.8	(9.7, 16.6)	5.8	(4.9, 6.8)	0.0004	0.0002
75+	15.0*	(10.6, 20.8)	5.5**	(3.0, 9.9)	4.4	(3.5, 5.7)	0.0027	0.5431
All	24.8	(21.7, 28.2)	13.8	(11.6, 16.3)	6.3	(5.8, 7.0)	0.0000	0.0000
Had a medical problem but did not visit a GP because had no transport to get there in past 12 months (%)								
55–64	14.9	(11.3, 19.3)	7.8	(5.8, 10.3)	1.1	(0.8, 1.4)	0.0021	0.0000
65–74	14.6*	(10.2, 20.5)	4.7*	(3.0, 7.3)	1.4*	(1.0, 1.9)	0.0007	0.0023
75+	-	-	-	-	2.3	(1.8, 3.0)	-	-
All	13.4	(10.9, 16.4)	6.3	(4.9, 8.0)	1.4	(1.2, 1.7)	0.0000	0.0000
Had a medical problem outside regular o° ice hours but did not visit an AHMC because of cost in past 12 months (%)								
55–64	27.7	(21.6, 34.8)	15.6	(11.8, 20.4)	6.9	(5.7, 8.3)	0.0026	0.0001
65–74	17.7*	(11.4, 26.3)	10.7*	(7.1, 15.8)	5.3	(4.3, 6.6)	0.1099	0.0165
75+	-	-	-	-	4.0**	(2.2, 7.1)	0.3155	0.3743
All	20.4	(16.2, 25.2)	12.5	(10.0, 15.4)	5.7	(4.9, 6.6)	0.0032	0.0000
Got a prescription but did not collect 1+ items from the pharmacy/chemist because of cost in past 12 months (%)								
55–64	24.8	(20.2, 29.9)	11.4	(9.1, 14.2)	3.4	(2.8, 4.2)	0.0000	0.0000
65–74	20.7	(15.2, 27.4)	7.2*	(5.3, 9.8)	2.7	(2.2, 3.4)	0.0001	0.0002
75+	9.4*	(6.0, 14.4)	-	-	2.0*	(1.4, 2.7)	-	-
All	19.6	(16.6, 23.0)	8.3	(6.8, 10.2)	2.9	(2.5, 3.3)	0.0000	0.0000
Avoided going to a dental healthcare worker because of the cost in past 12 months (of those needing to see a dental healthcare worker but unable to) (%)								
55–64	56.7	(50.7, 62.4)	49.9	(45.8, 54.0)	30.8	(29.0, 32.6)	0.0646	0.0000
65–74	38.5	(32.3, 45.1)	36.0	(30.6, 41.7)	22.5	(20.8, 24.3)	0.5565	0.0000
75+	20.3	(15.8, 25.8)	15.8*	(9.9, 24.2)	14.0	(12.4, 15.7)	0.3221	0.6160
All	42.1	(38.4, 45.8)	38.3	(33.9, 42.9)	24.2	(23.0, 25.4)	0.2165	0.0000
Covered by any health or medical insurance (%)								
55–64	-	-	17.9	(14.4, 22.2)	44.8	(42.9, 46.8)	-	0.0000
65–74	-	-	15.4*	(11.3, 20.6)	30.6	(28.5, 32.8)	-	0.0000
75+	-	-	17.4**	(8.1, 33.3)	17.0	(15.3, 18.8)	-	0.9489
All	3.8*	(2.6, 5.6)	17.2	(13.7, 21.3)	33.7	(32.4, 35.0)	0.0000	0.0000

Estimates with an RSE of 30–50% are marked with an asterisk (*) and should be used with caution, those with an RSE over 50% are marked with a double asterisk (**) and should be considered unreliable for most practical purposes, any estimates containing fewer than 30 respondents are suppressed (-).
Results with shading highlight indicate differences that are both statistically significant (p value <0.05) and likely to be practically significant (five percentage-point difference between groups).

cost impeded a necessary visit to a GP, AHMC or dental health worker or to collecting a prescription item. Poor access to primary care and medications can be associated with poorer outcomes or costly secondary care.[32,33]

A strength of this paper is that it draws upon a large, nationally representative dataset and adds to the literature on the relationship between tenure and health service use. Limitations include the self-reporting of health service use measures and the cross-sectional nature of the study, which means we are unable to make any conclusions regarding causality. However, tenure provides a marker of potential health need. Determining the mechanisms through which associations between tenure, health and use of health services operate will be important for directing future policy and interventions. These could include addressing features of rental housing that may impact on health (eg, through the provision of suitable rental stock for older people, security of tenure or regulations about insulation[34]) and ensuring health services address the needs of renters (eg, through supporting housing modifications when needed to enable continuing home care).

Further research exploring the relationship between tenure and use of other health and care services utilised more among older adults—such as home care and aged residential care—would be valuable in building up a broader picture of service use among older public and private renters. Many older people want to continue to live at home, supported by health services as needed,[18] and this may also be less costly than residential care services. However, in other countries, older renters have been shown to be more likely to enter residential care.[35–40] Aged residential care accounts for around 60% of New Zealand's district health board expenditure on support services for older people,[19] and so any relationship between tenure and transition to residential care will be particularly important in assessing future demand and the budgetary implications associated with a growing proportion of older renters.

New Zealand has a growing number and proportion of older adults, and at the same time, falling home ownership rates. Although the analyses here demonstrate association not causation, if renting does in part lead to increases in service use, rising numbers of older renters living in poorer health than owner-occupiers could mean an increase in demand for some health and care services in future—and additional personal and government expenditure as a result to ensure that the health needs of the population are met. Some groups are particularly vulnerable to these changes, with higher rates of renting among Māori and Pacific people and older females (aged 75+). As older renters were also more likely to be on lower incomes and living alone, policy-makers will need to consider how they can better support older renters through health and social services delivery, housing and income support.

Competing interests:
Access to the data used in this study was provided by Statistic New Zealand under conditions designed to keep individual information secure in accordance with requirements of the Statistics Act 1975. The opinions presented in this article are those of the authors and do not necessarily represent an official view of Statistics New Zealand.

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The prevalence of microvascular complications in Waikato children and youth with type 1 diabetes has reduced since 2003

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ABSTRACT

AIMS: To determine whether glycaemic control and the prevalence of microvascular complications in Waikato children/youth with type 1 diabetes (T1D) has changed since 2003.

METHODS: A retrospective review was performed of clinical records of children and youth with T1D who were under the care of the Waikato Paediatric and Young Adult Diabetes Services between March 2016 and March 2017. Comparisons were made to published data from the same service in 2003.

RESULTS: Despite a more than two-fold increase in insulin-pump therapy since 2003, glycaemic control was not significantly improved in either children or youth. However, since 2003 there has been a significant reduction in the prevalence of diabetic retinopathy (24.6% vs 6.0%; P=0.003) and nephropathy (6.0% vs 25.4%; P=0.002), while symptomatic diabetic neuropathy remains rare. This reduction occurred despite a significant increase in obesity and hypertension, and no significant difference in the rates of dyslipidaemia or smoking.

CONCLUSIONS: There has been a marked reduction in microvascular complications in Waikato youth and young adults with type 1 diabetes, but the reasons for the reduction are not clear given there has been no significant improvements in glycaemic control.

It is well known that good glycaemic control in type 1 diabetes (T1D) prevents, delays and slows the progression of microvascular complications such as diabetic retinopathy and nephropathy.[1] Conversely, poor glycaemic control in T1D, as reflected by high mean haemoglobin A1c (HbA1C), is associated with a greater risk of these complications and death from any cause.[2] Accordingly, international guidelines recommend a target HbA1c of less than 53mmol/mol (7%) for children and youth with T1D.[3,4] To further prevent microvascular and macrovascular complications in T1D, International Society for Pediatric and Adolescent Diabetes (ISPAD) guidelines recommend pharmacological treatment of hypertension and low-density lipoprotein concentrations (LDLc) >3.4mmol/L.[3] However, despite these recommendations, most young people with T1D, particularly youth, ethnic minorities and those more socioeconomically deprived, do not meet these glycaemic targets.[3,5,6]

Recent technological advances such as insulin pump therapy (continuous subcutaneous insulin infusion; CSII), flexible insulin regimens, longer-acting insulin analogues and flash and continuous glucose monitoring (FGM and CGM), have been associated with improved glycaemic control[7,8] and reduced prevalence of microvascular complications in patients with T1D,[9,10] but not in all populations.[11] Consequently, the temporal changes in glycaemic control and

the prevalence of microvascular complications in young people with T1D outside of Europe and the US are not clear, particularly in New Zealand.

Youth with T1D in the Waikato are cared for by two diabetes services, the Waikato Paediatric Diabetes Service (patients <15 years of age) and the Youth and Young Adult Diabetes Service (patients 15–24 years of age). Compared with similarly aged unselected cohorts worldwide, children and youth with T1D in the Waikato region in 2003 were shown to have comparable glycaemic control and burden of microvascular disease with a mean HbAc of 77mmol/mol (9.2%), and prevalence of diabetic retinopathy and nephropathy of 26.4% and 25.4%, respectively.[12]

Given the recent technological advances in managing T1D and the lack of data on temporal changes in outcomes in youth with T1D, the aim of this study was to determine whether glycaemic control and rates of microvascular disease have improved in children and youth with T1D in the Waikato region since 2003.

Methods

A retrospective review of clinical records was carried out for all children (0–15 years; n=111) and youth (16–24 years; n=144) with T1D under the care of the Waikato Paediatric Diabetes and Youth and Young Adult Diabetes Services from 1 March 2016 to 28 February 2017 (the '2017' cohort). This data was compared to published data from 2003 (n=251), which reports on patients with T1D born after 1 Jan 1978 who had attended the Waikato Diabetes Unit.[12] This earlier dataset was available as published data only, and the authors of the current study had no access to the raw data.

The diagnosis of T1D in all patients in both the 2003 and 2017 cohorts was based on diagnostic hyperglycaemia with positive anti-GAD or anti-IA2 antibodies and/or ketonuria, ketoacidosis or severe insulin deficiency at presentation. Variables including demographic data, duration of diabetes, insulin regimen (CSII versus multiple dose injections (MDI)), smoking status, HbA1c, co-diagnosis of coeliac disease, body mass index (BMI) and blood pressure (BP) at their first clinic appointment in the study period were recorded. Socioeconomic status was determined using the New Zealand deprivation score,[13] and urban-rural profiling was performed using the New Zealand Department of Statistics database.[14] HbA1c results from patients in the 2017 cohort who had been diagnosed with T1D within the last six months were excluded from analysis (n=19), except for comparison of patient characteristics between the 2003 and 2017 cohorts (Table 1). HbA1c targets were as per ISPAD[3] and American Diabetes Association (ADA) guidelines[15] at the time of the study, with <58mmol/mol (<7.5%) for patients ≤17 years of age, and <53mmol/mol (<7.0%) for patients ≥18 years of age. HbA1c was measured in the laboratory in 2003 and in the laboratory or point of care device in 2017, all of which were aligned to DCCT methodology. All diagnoses of coeliac disease were confirmed by duodenal biopsy. For children, overweight and obese were defined as BMI >85th centile and BMI >95th centile, respectively, using the National Center for Chronic Disease Prevention growth charts.[16] For youth, overweight and obese were defined as BMI >25kg/m^2 and BMI >30 kg/m^2, respectively. All blood pressures were measured manually and hypertension was defined as a systolic BP >130mmHg and/or diastolic BP >80mmHg in youth, and a systolic BP >120mmHg and/or diastolic BP >70mmHg in children. LDLc were typically obtained from non-fasting laboratory results within the study period and as per ADA guidelines, dyslipidaemia was defined as an LDLc ≥2.6mmol/L in patients ≥10 years of age.[15] Patients were deemed to smoke if they had any chronic tobacco intake during the study period, though the smoking status was not available for 12 patients. During the study all children attended at least one clinic appointment, while 28 youth (19%) did not attend any clinic appointments. The data for patients who did not attend a clinic was obtained from primary care records, and from our diabetes retinal photoscreening database. Body weight measurements were not available for three patients, and a further three patients had had no coeliac serology performed.

For assessment of microvascular complications, analyses were restricted to patients that had had T1D for >10 years. As elsewhere in New Zealand, Waikato patients

with T1D have a routine urinary albumin:creatinine ratio (UACR) performed annually and retinal photoscreening at least every two years. Persistent microalbuminuria was defined as a UACR >2.5mg/mmol in males and >3.5mg/mmol in females on at least two out of three consecutive collections. All patients with an elevated UACR typically had a repeat UACR repeated within three months. Albuminuria was defined as a UACR >30mg/mmol. Ophthalmologists report retinal photoscreening as no retinopathy, non-proliferative retinopathy or proliferative retinopathy. Only one patient had no recent retinal photoscreening, and this patient and one other patient did not have a recent UACR. The methods and frequency of complication screening did not differ between the 2003 and 2017 cohorts. All hospital admissions for each patient within the study period were also recorded. Diabetic ketoacidosis (DKA) was defined as a metabolic acidosis with ketonaemia. Non-DKA diabetes-related admissions included non-acidotic ketonaemia, hyperglycaemia, hypoglycaemia and sepsis. Ethical approval was sought, but not required, as this was classified as an audit.

Statistical analyses

Data are presented as mean ± standard error of the mean (SEM). Statistical analyses were performed using two-tailed Student *t*-tests or Mann-Whitney *U* tests for parametric and non-parametric continuous variables, respectively, and Pearson's Chi-square tests for binary variables. Spearman's correlations were used to determine if there was a relationship between HbA1c and either length of disease or socioeconomic status. Comparisons were also made between the 2017 cohort and the 2003 Waikato cohort.[12] These comparisons are limited to the published data only, because the raw data from 2003 is not available. However, differences between means (eg, HbA1c values) for the two data sets were calculated using GraphPad Software that required only mean, SEM and n values (Graph Pad, San Diego, US). Significance was defined as a P value <0.05.

Results

Description and glycaemic control of the study cohorts

Demographic and clinical characteristics from both the 2017 (n=255) and 2003 (n=237) cohorts are displayed in Table 1. Patients in the 2003 cohort were slightly older, with a slightly longer duration of diabetes (Table 1). Patients in the 2017 cohort were more likely to be male (58% vs 46%; χ^2=7.59; P=0.006) and have coeliac disease (9.4% vs 2.4%; χ^2=11.84; P<0.001) than those in 2003. Patients in the 2017 cohort were also more likely to be overweight or obese, but this was due to increased obesity of females only (48.6% vs 28.9%; χ^2=21.59; P<0.0001; Table 1). No patients in either cohort were pregnant. There was a similar increase in the use of CSII between 2003 and 2017 in both children (16.3%; χ^2=10.45; P=0.001) and youth (13.2% χ^2=8.42; P=0.004). The mean HbA1c was lower in children only, but this did not reach statistical significance (Table 1). Only 14% of patients ≤17 years of age and 10.3% of patients ≥18 years of age in the 2017 cohort met the recommended age-specific targets of an HbA1c <58mmol/mol and <53mmol/mol, respectively.

Glycaemic control in the 2017 cohort

There were no differences in the mean HbA1c in the 2017 cohort between genders (P=0.44), between those that live in urban areas and those that live rurally (P=0.10) or between those that have or don't have coeliac disease (P=0.95; Figure 1). In contrast, those on CSII had a lower HbA1c than those on multiple daily injections of insulin (MDI; P=0.01). Youth and Māori had a higher HbA1c than children and non-Māori (both P=<0.001), respectively. Mean HbA1c was positively correlated with worsening socioeconomic deprivation (r_s=0.263, P<0.001), and positively correlated with duration of diabetes (Figure 2; r_s=0.182; P=0.006).

Microvascular complications and hospital admissions

The analysis of microvascular complications in the 2003 cohort were restricted

Table 1: Patient characteristics of the 2003[12] and 2017 study cohorts.

	2003 (n=237)[12]	**2017 (n=255)**	**P**
Mean age (years)	16.7±0.4[1]	15.6±0.4	0.05
Mean duration of diabetes (years)	7.2±0.4[1]	6.1±0.3	0.027
Male (%)	46	58	0.006
Māori (%)	8.4	14.1	0.038
Coeliac disease (%)	2.4	9.4	< 0.001
Thyroid disease (%)	1.6	2.0	0.830
Overweight or obese (%) Male (%) Female (%)	29.1 29.3 28.9	38.4 32.2 48.6	0.024 0.478 <0.001
Mean HbA1c (mmol/mol; %) - All - <16 years - 16–24 years	 78±4 (9.3)[1] 79±15 (9.4)[1] 78±7 (9.3)[1]	 75±2 (9.0) 71±3 (8.6) 79±4 (9.3)	 0.494 0.589 0.900
CSII use (%) - All - <16 years - 16–24 years	 9.3 7.1 10.9	 23.9 23.4 24.1	 <0.001 <0.001 0.004
% of patients currently smoking	7.6 (18)	10.6 (27)	0.25
% of patients with lipids measured (n) % LDLc ≥2.6mmol/L (n) % LDLc ≥3.4mmol/L (n) % Statin use (n)	75 (166) 54 (89) - 0.5 (1)	73 (152) 54 (82) 19 (29) 0 (1)	0.61 1.00 - -
% of children with BP measured (n) % with SBP ≥120mmHg (n) % with DBP ≥70mmHg (n) ACEi/ARB use (%)	89 (88) 2.2 (2) 3.4 (3) 0	72 (80) 18 (14) 14 (11) 1.8 (2)	<0.001 <0.001 <0.001
% of youth with BP measured (n) % with SBP ≥130mmHg (n) % with DBP ≥80mmHg (n) ACEi/ARB use (%)	98 (135) 8.1 (11) 7.4 (10) 7.4 (10)	85 (123) 18 (22) 18 (22) 2.1 (3)	<0.001 0.01 0.005 0.005

SBP = Systolic Blood Pressure; DBP = Diastolic Blood Pressure; ACEi = Ace Inhibitor; ARB = Angiotensin II receptor blockers.
Continuous variables are presented as mean ± SEM.
[1] S.E.M was calculated from the original 2003 publication[12] using SD = (confidence interval / 3.92) *)

Figure 1: Differences (mean ± SEM) in HbA1c (mmol/mol) levels between demographic groups (*n*=236). HbA1c values for patients diagnosed less than six months ago (*n*=19) were excluded. Asterisks denote significant differences between groups (**P=0.01; ***P<0.001).

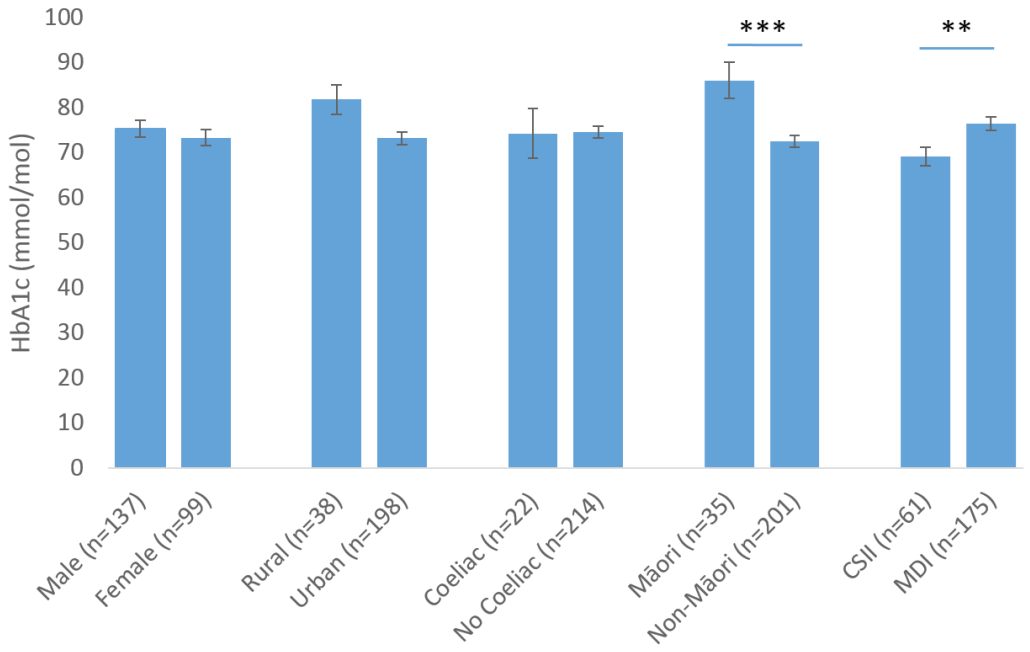

Figure 2: Relationship between mean HbA1c and duration of disease (years since diagnosis) (*n*=236). HbA1c values for patients diagnosed less than six months ago were excluded from this analysis.

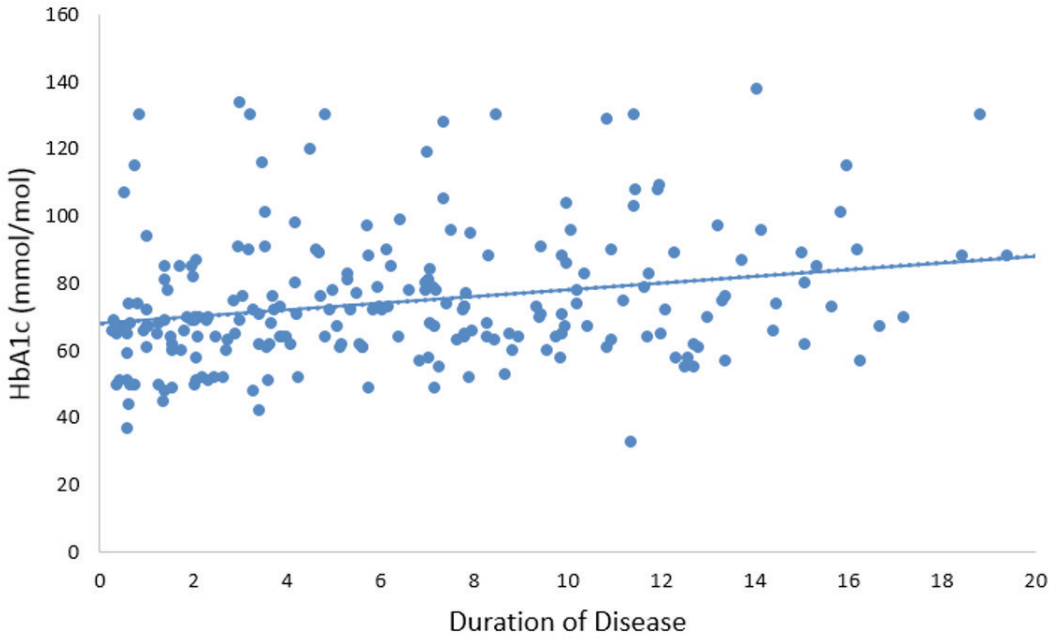

Table 2: Prevalence of microvascular complications in patients with T1D for more than 10 years.

	2003 (n=67)	2017 (n=67)	P
Diabetic retinopathy (%) Proliferative (%) Non-proliferative (%)	24.6 8.2 16.4	6.0 0 6.0	0.003
Diabetic nephropathy (%) Proteinuria (%) Microalbuminuria (%)	25.4 7.5 17.9	6.0 0 6.0	0.002
Symptomatic diabetic neuropathy (%)	3.0	3.0	1.00
Current smokers (%)	13.4	11.9	0.80
LDLc ≥ 2.6 mmol/L	61.2	53.7	0.48

LDLc = Low Density Lipoprotein cholesterol.

to those with a duration of diabetes of ≥10 years (n=67),[12] so the same restrictions were applied to the 2017 cohort for comparison (n=67). The prevalence of both diabetic retinopathy and nephropathy was significantly lower in the 2017 cohort than in the 2003 cohort, including no patients with vision-threatening retinopathy or overt proteinuria (Table 2). Symptomatic diabetic neuropathy remains rare. The decrease in microvascular complications occurred despite no significant change in the rates of smoking or dyslipidaemia, and at least a two-fold increase in systolic and/or diastolic hypertension in both children and youth (Table 1). Only 11 youth and no children had either a systolic blood pressure ≥140mmHg or diastolic blood pressure ≥90mmHg. However, at least 15% of children and youth in the 2017 cohort had no documented assessment of blood pressure at their clinic appointments, which is an increase from 2003. Approximately one quarter of patients ≥10 years of age did not have their lipid studies performed in either cohort (Table 1). In those patients who were assessed, despite over half having dyslipidaemia and approximately one-quarter having systolic and/or diastolic hypertension, the use of lipid-lowering therapy and ACE inhibitors (ACEi) or angiotensin II receptor blockers (ARBs) remains low. Two of the four patients with persistent microalbuminuria were treated with ACEi/ARBs. No patients were on alternative antihypertensive treatment to ACEi/ARBs. Only one of the 29 patients in the 2017 cohort with a known LDLc ≥3.4mmol/L were treated with statin therapy.

Twenty patients (7.8%) in the 2017 cohort were admitted with DKA during the study period. A further 27 patients (10.6%) had a diabetes-related admission other than DKA in the study period. This equated to 1.2 inpatient days per patient year, compared with 1.6 inpatient days per patient year in 2003. Youth were more likely than children to have a diabetes-related admission (23.6% versus 13.5%; P=0.04), primarily due to a greater proportion being admitted with DKA (12.5% versus 1.8%; P=0.002). Approximately 35% of patients admitted with DKA were readmitted at least once more with DKA within the study period.

Discussion

Despite the availability of longer acting insulin analogues, an almost three-fold increase in CSII use and their ability to improve glycaemic control,[17] it is disappointing that the mean HbA1c in Waikato youth with T1D has not changed over the past 14 years. Furthermore, less than one in six children and youth in the 2017 cohort were meeting their recommended glycaemic targets. Although we and others have shown that this stage of life continues to be the most difficult to obtain tight glycaemic control,[18,19] results appear more promising in other centres. Indeed, the mean HbA1c is lower (between 65 to 68mmol/mol) with at least two-fold greater rates of achieving the same glycaemic targets in similarly aged cohorts in other Australasian[20] and in European centres.[21,22] However, the median HbA1c of 74mmol/mol in our

youth is comparable to other international centres.[9,18,19] Moreover, despite a marked increase in both CSII and CGM use in youth in the T1D exchange in the US, glycaemic control has deteriorated in this population over the past decade.[19]

As seen both nationally and worldwide, patients from more socially deprived populations and ethnic minorities (Māori) in our study had a higher HbA1c than their peers.[6,23,24] But in contrast to these international studies, it is not clear why patients living in rural areas in our 2017 cohort did not have poorer glycaemic control than their urban counterparts. It is also not clear, why in contrast to other cohorts, that gender had no effect on glycaemic control in our study.[9,18,19] Nevertheless, with the lack of change and persistence of poor glycaemic control in Waikato youth, it is surprising that there was a marked decrease in the prevalence of diabetic retinopathy and neuropathy in those with T1D for more than 10 years. The reasons for this decrease, particularly the absence of both proliferative retinopathy and overt proteinuria, are not known, given there was an increase in obesity and mild hypertension, and no decrease in other vascular risk factors such as smoking and dyslipidaemia. Furthermore, it is also not clear why the prevalence of diabetic retinopathy and nephropathy in Waikato youth appears to be lower than in European and American youth with T1D.[5,9,25,26] Potential explanations for the lower complication burden in the 2017 cohort include the small sample size, and the limitation that assessment between only two time points may not detect any significant improvements in glycaemic control associated with the benefits of 'metabolic memory'.[1] However, it would be useful if future studies evaluated the cause of some of these observations. Nevertheless, others have also shown a marked decline in the incidence of diabetic retinopathy and nephropathy without significant temporal improvements in HbA1c levels.[27,28] Therefore, other factors that were not investigated in this study, such as glycaemic variability and time within normoglycaemia are likely important.[29,30] The latter is difficult to know because CGM and FGM are not funded in New Zealand, FGM only became available in late 2017, and patients can purchase directly from the vendor without notifying their diabetes team. However, we estimate that CGM or FGM was used by less than 10% of patients in the 2017 cohort and no patients in the 2003 cohort when their parameters were measured.

A further possibility for the reduction in complication burden is the addition of a clinical psychologist and dietitian who joined the endocrinologists and diabetes nurse specialists in the Waikato Paediatric and Youth and Young Adult teams from 2006. It is widely recognised that both a psychologist and dietitian are key members of the multidisciplinary team in improving glycaemic control by addressing the high prevalence of psychosocial stressors and disordered eating in these age groups.[4]

However, the definitive reasons for the temporal decrease in microvascular complications in this study are not known, as the raw data from the 2003 cohort was not available. In particular, the glycaemic control, gender, duration of diabetes, clinic attendances, ethnicity and blood pressures were not reported specifically for those in the 2003 cohort in which the analyses for microvascular complications were performed. Inferring this data from the total cohort data may result in bias, which is relevant given that the 2017 cohort were on the whole younger, had a shorter duration of diabetes and were more likely to be male, with the latter associated with increased microalbuminuria.[31] But of note, in addition to no differences in smoking or dyslipidaemia, the 2017 cohort who had had T1D for more than 10 years were likely to be more obese, hypertensive and/or Māori than their peers in 2003, all of which independently increase the risk of diabetic complications.[24] Another limitation of this study are that for consistency, arbitrary rather than centile cut offs were used to define hypertension, that may underestimate hypertension in children and overestimate hypertension in youth.

The increase in obesity from 2003 in our study may just reflect the increase in childhood obesity in the general New Zealand population;[32] but children and youth with T1D are now more obese than their peers in other Australasian centres and internationally.[20,33,34] It is not clear why this increase only occurred in females, or

whether any supraphysiological dosing of insulin or increased carbohydrate intake to avoid or treat hypoglycaemia is responsible. Nevertheless, prevention and management of excess weight gain is important because obesity appears to be an independent risk factor for diabetic microvascular and macrovascular complications, and other comorbidities, including reduced quality of life.[35]

Although the rates of DKA in our cohort are similar to those seen internationally, it is concerning that one in every 13 of our youth with T1D are admitted with DKA each year, given the associated adverse neurocognitive outcomes.[36,37] It is also concerning that despite the increase in the prevalence in hypertension and dyslipidaemia in our study, the percentage of patients prescribed antihypertensive and lipid-lowering therapy has decreased. Moreover, only half of youth with persistent microalbuminuria were treated with ACEi/ARBs. Similarly low rates of ACEi/ARB use in this age group have been reported in other cohorts internationally, which is thought largely due to clinical inertia from committing youth to lifelong treatment.[9,28] Although the low rates of screening and treatment of hypertension and dyslipidaemia in our study are explained in part by non-attendance at clinic appointments, work is required to improve screening for these risk factors in primary and secondary care given that there is likely contact when the youth receives their prescription for insulin. Further work is also needed to reduce the clinical inertia in treating vascular risk factors in youth with T1D, particularly given that lipid-lowering therapy and ACEi/ARBs are safe and effective treatments in adolescence and greatly reduce the microvascular and macrovascular disease burden in adulthood.[38]

In conclusion, despite a pleasing local decrease in the prevalence of microvascular complications, our study suggests that teams caring for youth with T1D need to continue to focus on identifying and addressing the barriers to improved glycaemic control and reduction of modifiable vascular risk factors. These interventions should also be focused on reducing the inequity in outcomes between Māori and non-Māori youth with T1D.

Competing interests:
Nil.

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Use of rehabilitation a˜ er hip and knee replacement in New Zealand: a national survey

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ABSTRACT

AIMS: Our objective was to describe rehabilitation used before and after joint replacement in New Zealand and evaluate variation based on geography and ethnicity.

METHODS: In this descriptive cross-sectional questionnaire-based study we recruited participants 45 years or older (n=608) from the New Zealand Joint Registry six months after primary total hip, total knee or uni-compartmental knee replacement.

RESULTS: The cohort was predominantly New Zealand European (89.9%). The average age of participants was 68.2 years. Less rehabilitation was used pre-operatively (31.0%) than post-operatively (79.6%) and total hip replacement participants reported using less rehabilitation (63.3%) than those after total knee (90.7%) or uni-compartmental knee (80.3%) replacement ($p<0.01$). There were trends towards more pre-operative rehabilitation for participants living in larger urban areas, most evident for total hip replacement ($p<0.05$).

CONCLUSIONS: Participants reported generally positive outcomes six months after primary total hip, knee and uni-compartmental knee replacement. However, differences in use of rehabilitation services before and after joint replacement were evident depending on joint replaced. Broadening setting options for rehabilitation might improve use of rehabilitation resources.

Long-term outcomes following primary hip and knee joint replacement are favourable with most patients experiencing positive functional outcomes over time.[1,2] However, up to 30% of patients following knee replacement and a smaller number of those following hip replacement report little or no improvement with respect to ongoing pain, restricted range of motion and unsatisfactory function.[2–4] There may be differences in recovery depending on type of joint replaced. For example, it is generally agreed that individuals take longer to recover and require more rehabilitation following total knee compared with total hip and uni-compartmental knee replacement.[4–6] Various demographic and clinical factors may influence these outcomes. These include age, gender, general health and comorbidities, post-operative complications, surgical wait time and use of rehabilitation.[1,4] The latter is the focus of this study.

Rehabilitation, particularly exercise-based physiotherapy is generally accepted as standard before and after hip and knee replacement[7,8] and is a set of interventions designed to optimise functioning and reduce disability.[9] However, protocols for rehabilitation before and after joint replacement vary widely across studies and countries and the optimal mix of setting, mode and intensity of rehabilitation remains unclear.[10,11] Pre-operative interventions include a focus on education and an opportunity to address physical and psychosocial issues that may impact on surgery outcomes, such as anxiety and depression, pain management, nutrition, smoking and exercise expectations.[4,12] Rehabilitation in the post-operative phase can include occupational therapy and physiotherapy to target pain management, levels of activity, participation and quality of life.[4,13]

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There are a small number of published studies characterising rehabilitation services used by patients before and after joint replacements in some countries such as the US.[14,15] However, in New Zealand little is known about the extent to which hip and knee replacement patients receive rehabilitation care and how use of rehabilitation varies on the basis of ethnicity. For example, while the issues are complex, differing rates of joint replacement uptake may be possible between Māori and non-Māori, consistent with two published studies we could find;[16,17] however, no studies have considered whether there is variability in terms of use of rehabilitation before and after joint replacement on the basis of ethnicity. Use of rehabilitation services may also be impacted by economic barriers,[18,19] where access to health services might depend on where a person lives and access to funding for services.[20]

Study objectives

The objectives of this study are to: i) describe the extent to which New Zealanders use rehabilitation before and after joint replacement, and ii) to consider whether there is variation based on geography and ethnicity.

Methods

Study design and recruitment strategy

The role of rehabilitation (ROR) study is a cross-sectional questionnaire-based study investigating the use of rehabilitation before and during the first six months following primary total hip or knee, or uni-compartmental knee replacement in New Zealand.

Participants were recruited from the New Zealand Joint Registry (NZJR) in order to achieve a national sample with geographical diversity. Because of the large numbers of registered primary hip and knee replacements, NZJR obtains patient-reported outcome information from randomly selected patients across the country to achieve an annual response of 20%. This was the sampling frame for this study. Flyers for the study were included in six-month post-operative NZJR mail outs between June 2015 and July 2016, and all patients returning flyers with their contact information were approached as soon as flyers were returned and invited to participate in the study.

The study received ethical approval from the University of Otago Human Ethics Committee (ref H14/070).

Participant selection

Patients registered and followed by the NZJR after primary hip or knee joint replacement in either private or public systems in New Zealand were eligible to participate in the study. Patients who met the following criteria were included: i) age 45 years or older, ii) underwent an elective unilateral total hip or knee, or uni-compartmental knee replacement for osteoarthritis six months prior to recruitment, and iii) agreed to participate in the study. We excluded patients with any previous operation on the index joint and any non-elective joint replacements following fractures.

Data collection

Contact information was supplied monthly from the NZJR (name, preferred contact information) for potential participants meeting inclusion criteria who had agreed to being contacted by the study team. Potential participants were then contacted within one month of contact details being made available by a research assistant to discuss the study and invite participation.

Once recruited, ROR participants completed questions in booklet form regarding timing, type, intensity and duration of any rehabilitation following referral for joint replacement (pre- and post-operatively). Demographic and clinical questions were also included. Questionnaires were available for completion either online (eg, Survey Monkey™) or by mail depending on the preference of the participant. Additional clinical information (procedure type, date of surgery, body mass index, comorbidity classification) was collected from the NZJR. This minimised participant burden by avoiding duplication of data collection.

ROR study variables

Demographic variables included age, gender, ethnicity, education, work status, funder (public/private insurance/self). Clinical and surgical variables included other pre-existing medical conditions/comorbidities (self-report/American Society of Anaesthesiologists (ASA) classification[21]); body mass index, procedure type (total hip, total knee, uni-compartmental knee) and time on surgical waiting list (weeks). Rehabilitation variables included time from surgery to first rehabilitation session (weeks); pre- and post-operative rehabilitation type (physiotherapy, occupational therapy, other), setting (home, outpatient, community centre, other),

frequency of sessions per week, total hours of rehabilitation); and number of post-operative follow-up reviews with the surgeon. Outcomes were evaluated using the six-month post-operative Oxford Hip and Knee scores[22,23] accessed from NZJR and a brief measure of quality of life (WHOQOL-8).[24,25]

Data analyses

Data were analysed using SPSSv24.0.[26] First, we characterised the sample in terms of demographic status, health (eg, comorbidities, body mass index), procedure type, geographic location, funding source, participation in pre- and/or post-operative rehabilitation therapies and outcomes, using descriptive statistics. Second, for those who obtained rehabilitation services, we identified the setting (eg, outpatient, at home, community centre), time from operation to first rehabilitation session, rehabilitation duration, frequency (times per week), and intensity (minutes per session x number of sessions per week/number of weeks of rehabilitation; total hours), and how rehabilitation services and practice patterns varied on the basis of geography and ethnicity.

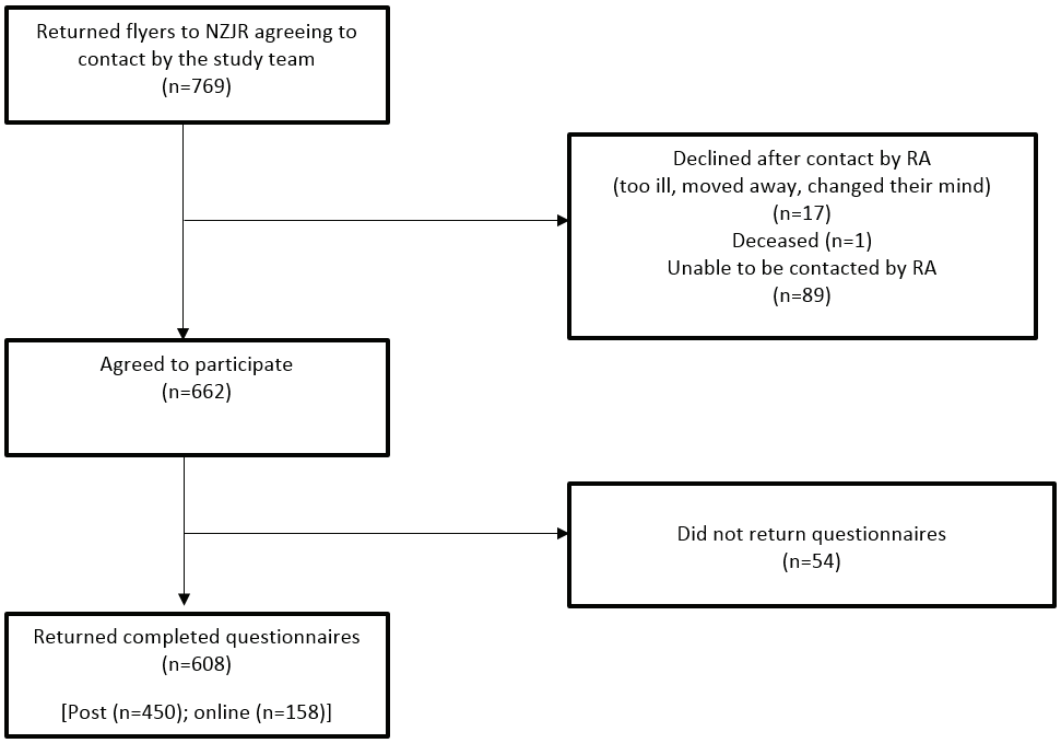
Bivariate analyses tested relationships between demographic and clinical variables and rehabilitation pre- and post-operatively. For discrete variables, we created contingency tables (cross-tabs) and used chi-squared tests to determine the significance of two-way associations. For continuous variables with normal distributions, Pearson correlation, two-sample t-tests, or analysis of variance were used. For variables with non-normal distributions, non-parametric tests were used including Spearman correlation, Mann Whitney U or Kruskal-Wallis tests as appropriate.

The approach to missing data was to use list wise deletion, also the default SPSS approach. We believe this was appropriate because of the sample size and the limited amount of missing data (<3%) across variables. Data presented are unadjusted with no correction for confounding variables.

Results

Seven hundred and sixty-nine people meeting inclusion criteria returned flyers to the NZJR. Of these, n=608 were successfully recruited into the study and returned questionnaires (n=158 online and n=450 by post). Figure 1 shows recruitment flow into the study.

Figure 1: Recruitment flow chart.



NZJR = New Zealand Joint Registry; RA = research assistant.

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Description of study sample and outcomes

A summary of participant demographic, clinical and outcome characteristics is provided in Table 1. The average age of participants was 68.2 years. There were fewer men (45.2%) than women; the sample was predominantly New Zealand European (89.6%) and generally well educated, with 69.4% reporting high school- or tertiary-level qualifications. The main funding sources for surgery were private insurance or public funding, and participants waited on average six months for surgery. Evaluation of outcomes indicated a majority of participants (51%) reported an excellent outcome on the basis of Oxford scores using the 4-category set of outcomes from poor to excellent recommended by the NZJR.[27] Mean level of quality of life was also high (mean WHOQOL-8 score 32.4, SD 4.9).

Table 1: Demographic and clinical characteristics of the ROR study sample (n=608).

	Total hip (n=219)	**Total knee (n=313)**	**Uni-compartmental knee (n=76)†**	**Total sample (n=608)**
Demographic characteristics				
Age [(y), mean ± SD][2]**	67.6±8.0	68.7±8.2	**65.2±8.5**	68.2±7.9
Sex [male, n (%)][1]	91 (41.6)	150 (47.9)	34 (44.7)	275 (45.2)
Ethnicity [n (%)][1]				
- New Zealand European	197 (90.0)	276 (88.2)	72 (94.8)	545 (89.6)
- New Zealand Māori	16 (7.3)	16 (5.1)	1 (1.3)	33 (5.5)
- Other	6 (2.7)	21 (6.7)	3 (3.9)	30 (4.9)
Educational qualifications [n (%)][1]				
- No formal qualifications	68 (31.1)	81 (25.9)	19 (25.6)	168 (27.7)
- High school qualifications	68 (31.1)	91 (29.1)	27 (36.5)	186 (30.6)
- Tertiary qualifications	79 (36.0)	129 (41.2)	27 (36.5)	235 (38.8)
- Other	4 (1.8)	12 (3.8)	1(1.4)	17 (2.8)
Work status at time of surgery [n (%)][1]**				
- Employed full time	61 (27.9)	79 (25.2)	**24 (31.6)**	164 (27.0)
- Employed part time	25 (11.4)	49 (15.7)	19 (25.0)	93 (15.3)
- Not employed/retired	126 (57.5)	169 (54.0)	29 (38.2)	324 (53.3)
- Other	7 (3.2)	16 (5.1)	4 (5.2)	27 (4.5)
Funding [n (%)][1]				
- Accident Compensation Corporation	16 (7.3)	29 (9.3)	11 (14.7)	56 (9.2)
- Ministry of Health	121 (55.5)	156 (49.8)	32 (42.7)	309 (51.0)
- Private Insurance	68 (31.2)	117 (37.4)	28 (37.3)	213 (35.1)
- Self	12 (5.5)	9 (2.9)	4 (5.3)	25 (4.1)
- Other	1 (0.5)	2 (0.6)	0 (0)	3 (0.5)
Geographical variables [n (%)][1]				
- Rural (town or area <10,000 people)	81 (37.7)	114 (36.7)	34 (45.3)	229 (38.1)
- Large town (10,000–50,000 people)	30 (14.0)	56 (18.0)	8 (10.7)	94 (15.6)
- Urban/city (>50,000 people)	104 (48.4)	141 (45.3)	33 (44.0)	278 (46.3)

Table 1: Demographic and clinical characteristics of the ROR study sample (n=608) (continued).

Clinical characteristics				
Wait list for surgery pre-op [weeks, mean ± SD][2]	17.2±17.8	28.9±52.5	33.0±47.7	25.2±43.2
Comorbidities [n (%)][1]				
- None	65 (33.2)	84 (29.8)	23 (34.8)	172 (31.6)
- Heart disease	51 (26.0)	71 (25.2)	13 (19.7)	135 (24.8)
- Respiratory disease	7 (3.6)	11 (3.9)	1 (1.5)	19 (3.5)
- Diabetes	6 (3.1)	13 (4.6)	5 (7.6)	24 (4.4)
- Depression or anxiety	4 (2.0)	18 (6.4)	3 (4.5)	25 (4.6)
- Other	63 (32.1)	85 (30.1)	21 (31.8)	169 (31.1)
Body Mass Index [mean ± SD][2]**	27.8±4.4	**30.8±5.1**	28.8±4.6	29.4±5.0
ASA classification [n (%)][1]**				
- 1 (healthy)	32 (15.0)	34 (11.2)	**21 (27.6)**	87 (14.7)
- 2 (mild systemic disease)	141 (65.9)	214 (70.4)	**46 (60.5)**	401 (67.6)
- 3 (severe systemic disease—not incapacitating)	41 (19.2)	55 (18.1)	**8 (10.5)**	104 (17.5)
- 4 (life threatening disease—incapacitating)	0 (0.0)	1 (0.3)	**0 (0.0)**	1 (0.2)
Oxford score 6-months post-surgery [M ± SD][2]**	40.3±7.9	**37.3±9.4**	40.7±7.0	38.7±8.8
Oxford outcome categories3 [n (%)][1]**				
- Poor (<27)	10 (4.7)	**31 (10.0)**	5 (6.7)	46 (7.6)
- Fair (27–33)	18 (8.4)	**40 (12.9)**	4 (5.3)	62 (10.3)
- Good (34–41)	69 (32.1)	**96 (31.0)**	21 (28.0)	186 (31.0)
- Excellent (>41)	118 (54.9)	**143 (46.1)**	45 (60.0)	306 (51.0)
WHOQOL-8 score 6-mths post-surgery [M ±SD][2]	32.2±6.0	30.6±4.5	32.9±4.9	31.4±5.2

** p<0.05 (1 = Chi square; 2 = Kruskall-Wallis test). ASA = American Society for Anaesthesiologists; WHOQOL-8 = World Health Organization Quality of Life 8-item questionnaire. 95% CI = 95% confidence interval. 3. Categories from NZJR.[27] Where significant, data in **bold** delineates where the difference lies. †Bootstrapping not completed for unicompartmental knees due to low sample size.

When demographic and clinical variables were examined by procedure type, the analyses indicated participants undergoing uni-compartmental knee replacements were younger than total knee and total hip participants ($X^2(2)=7.96$, p=0.02) and more likely to be working at time of surgery (% in full- or part-time paid employment: uniknee 56.6; total knee 40.9; total hip 39.3; $X^2(8)=20.03$, p=0.01). Total knee replacement participants demonstrated higher mean body mass index than total hip and unicompartmental knee participants ($X^2(2)=8.61$, p=0.02). The only other significant difference across the three procedure groups was with respect to Oxford scores at six months after surgery with total knee participants reporting greater pain and functional difficulty than both other groups ($X^2(2)=7.96$, p=0.01).

Extent of rehabilitation used (intensity, duration, type)

Table 2 shows the breakdown of pre- and post-operative rehabilitation. These analyses indicated more participants used rehabilitation, mainly physiotherapy, post-operatively (79%) than they did pre-operatively (31.0%). Rehabilitation was mostly outpatient clinic-based compared with home- or community-based (pre-op clinic-based: 56.6%; post-op clinic-based: 68.9%). Of those using pre-operative rehabilitation, although there was wide variability, participants reported an average of 8.3 weeks of intervention, 2–3 sessions a week. Of those receiving post-operative rehabilitation, participants reported waiting on average 2.5 weeks before rehabilitation commenced, with an average of 7.1 weeks of follow up, 1–2 sessions a week.

Table 2: Pre- and post-rehabilitation characteristics (n=608).

	Total hip (n=219)	Total knee (n=313)	Uni-compartmental knee (n=76)†	Total sample (n=608)
Pre-op characteristics				
Any rehabilitation before surgery [yes, n (%)][1]	72 (32.9)	98 (31.5)	18 (23.7)	188 (31.0)
Type of rehabilitation [n (%)][1]				
- Occupational therapy	9 (12.3)	8 (7.9)	3 (15.0)	20 (10.3)
- Physiotherapy	39 (53.4)	56 (55.4)	9 (45.0)	104 (53.6)
- Other	73 (34.2)	36 (35.6)	8 (40.0)	69 (35.6)
Session venue [n (%)][1]				
- Home-based	14 (19.4)	27 (27.6)	4 (21.1)	45 (23.8)
- Hospital or clinic based	42 (58.3)	55 (56.1)	10 (52.6)	107 (56.6)
- Community centre	11 (15.3)	14 (14.3)	4 (21.1)	29 (15.3
- Other	5 (6.9)	2 (2.0)	1 (5.3)	8 (4.2)
Pre-op sessions [weeks, mean ±SD][2]	10.4±22.7	6.9±10.1	7.0±5.9	8.3±15.5
Pre-op sessions [frequency per week, mean ±SD][2]	1.7±1.6	2.5±2.0	2.7±2.3	2.3±2.0
Total hours rehabilitation pre-op [mean ±SD][2]**	8.1±22.1	**4.6±6.7**	5.3±5.1	6.0±14.0
Post-op characteristics				
Any rehab after surgery [yes, n (%)][1]**	**138 (63.3)**	284 (90.7)	61 (80.3)	483 (79.6)
Type of rehab [n (%)][1]				
- Occupational therapy	21 (14.6)	22 (7.7)	4 (6.5)	47 (9.6)
- Physiotherapy	105 (72.9)	237 (83.2)	49 (79.0)	391 (79.6)
- Other	18 (12.5)	26 (9.1)	9 (14.5)	53 (10.8)
Session venue [n (%)][1]				
- Home-based	37 (25.9)	45 (16.1)	10 (16.1)	92 (19.0)
- Hospital or clinic based	90 (62.9)	198 (70.7)	46 (74.2)	334 (68.9)
- Community centre	14 (9.8)	34 (12.1)	5 (8.1)	53 (10.9)
- Other	2 (1.4)	3 (1.1)	1 (1.6)	6 (1.2)
Post-op sessions [weeks, mean ± SD][2]	9.4±6.7	9.6±8.4	7.4±4.8	9.3±7.6
Post-op sessions [frequency per week, mean ± SD][2]	1.6±1.2	1.5±0.7	1.5±0.9	1.6±1.0
Total hours rehabilitation post-op [mean ± SD][2]	6.2±5.0	7.9±9.8	5.6±5.7	7.1±8.1
Surgical reviews post-op [mean ± SD][2]**	**1.3±0.6**	1.7±0.8	1.9±1.2	1.6±0.7
Time to rehab [weeks, mean ± SD][2]	2.8±2.4	2.5±2.5	2.1±2.4	2.5±2.4

p<0.05 using non parametric tests (1 = Chi square; 2 = Kruskall-Wallis tests). †Bootstrapping not done because of small sample size. Where significant, data in **bold delineates where the difference lies.

There were no differences by procedure type regarding the intensity, location or duration of rehabilitation pre-operatively. Post-operatively, total hip replacement patients were less likely to use rehabilitation than those after total knee or a uni-compartmental knee replacement (total hip: 63.3%, total knee: 90.7%, uni-knee: 80.3%; $X^2(2)=59.5$, $p<0.01$). There were no differences in the intensity, location or duration of rehabilitation used, but participants undergoing total hip replacement had fewer follow-up appointments with the surgeon than both knee replacement groups (mean number of surgeon visits post-surgery: total hip 1.5; total knee 1.9; uni-knee 1.9; $X^2(2)=16.86$, $p<0.01$). Finally, use of rehabilitation pre- and post-operatively were highly correlated. Participants who used rehabilitation pre-operatively were more likely to

have used rehabilitation post-operatively. Intensity of pre- and post-operative rehabilitation were also correlated in terms of number of hours, session duration, sessions per week and total hours of rehabilitation (total hours: r=0.34, p<0.01; session length: r=0.43, p<0.01; no of weeks of intervention: r=0.29, p<0.01; frequency of sessions per week: r=0.36, p<0.01).

Ethnicity and geographical location

There were no significant differences in use of rehabilitation pre- or post-operatively on the basis of ethnicity. However, nearly 90% of the sample was of New Zealand European ethnicity, with New Zealand Māori making up just 5.5%. The low numbers of non-New Zealand European participants prevented meaningful evaluation of these associations.

Although regional differences in access to surgery were suggested (data not shown), there were no significant differences in use of rehabilitation on the basis of geographical location when this was examined for the full sample. When this was broken down by procedure type the analyses suggested participants undergoing total hip replacement used more pre-operative rehabilitation if they lived in an urban area (60.6%) compared with those living in more rural areas (26.8%; X^2 (2)=6.73, p=0.04). There were no other significant associations between access to rehabilitation by geographical region.

Discussion

We characterised patterns of rehabilitation before and after hip and knee replacement and found differences in use of rehabilitation on the basis of procedure type and to a lesser extent, geography. More pre-operative rehabilitation was used by total hip and knee replacement participants compared with uni-compartmental knee replacement participants. Post-operatively those undergoing total hip replacement used less rehabilitation than the other two groups. There is a large body of evidence indicating those undergoing total knee replacements have slower recoveries with ongoing pain and functional impairment within the first 6–12 months compared with other joint replacement groups.[4–6,28] Thus it is perhaps unsurprising that total knee participants used more rehabilitation. Our participants predominantly used clinic-based physiotherapy both pre- and post-operatively in keeping with findings in international literature.[7,8] Other rehabilitation settings were used less frequently in our sample.

There were trends toward greater use of pre-operative rehabilitation by participants living in larger urban areas, most evident for those undergoing total hip replacement and to a lesser extent for those undergoing uni-compartmental knee replacement. We did not find any other differences in use of rehabilitation on the basis of geography. However, we noticed that a high proportion of participants in our sample live in rural New Zealand or in large urban areas, rather than smaller urban centres. The relationships between use of healthcare services and geography are understudied and depend on the ways these concepts are defined.[29] We speculated, based on experiences of the research team, that people living in rural New Zealand may be more willing to travel to access health services. A percentage of people living in smaller towns adjacent to large urban centres may also use urban health services, although this may depend on the way smaller towns are defined or their location.[29] The way geographical location was managed in the present study may have been too simplistic to capture such complexities in the joint replacement population.

Clinical and research implications

In the absence of data, it is unclear whether low ethnic diversity in our sample reflects poor uptake of joint replacement and use of rehabilitation among minority groups or a systematic response bias to completion of our survey. Potential inequities on the basis of ethnicity and geography may exist in the joint replacement population. Participants responding to our survey were predominantly New Zealand European and rates across ethnicity categories were inconsistent with general New Zealand population statistics.[16,30] Māori make up approximately 15% of New Zealand's population, however just over 5% of participants identified as Māori in the ROR study sample. Given our recruitment and sampling frame, we are not able

to determine whether lack of diversity in our sample reflected lower rates of access to joint replacement and/or use of rehabilitation among non-European groups or low rates of participation in health research. A first step towards resolving this issue would be for the NZJR to routinely report ethnicity information given that the Registry captures more than 95% of all joint replacement surgeries in New Zealand. This may provide helpful baseline information to motivate strategies to address any potential disparities. In addition, development of partnerships with Māori researchers and the Māori community, and more intentional recruitment strategies, may help to bridge the gap between Māori and non-Māori participation in health research.[31]

The ROR study also highlighted the predominance of rehabilitation provided via outpatient clinics. Such settings may inadvertently create geographic and socioeconomic barriers for access to rehabilitation, for example meeting transport costs and therapy surcharges. Services might consider increasing opportunities for home and community-based rehabilitation. There is mounting evidence that there is little difference in outcomes on the basis of setting[10,11,32,33] but broadening options for accessing rehabilitation resources may have considerable benefits, especially for marginalised and minority groups. Other methods and venues, including telemedicine and community outreach have been debated as a means of improving equitable access to health resources more generally.[19]

Limitations

This study has limitations. One limitation is the representativeness of study participants. We were not able to analyse differences between responders and non-responders to determine this. The NZJR captures more than 95% of joint replacements in New Zealand[27] but only samples 20% of this larger group for follow-up collection of patient-reported outcome data. We sampled an even smaller proportion of this 20% taking into account NZJR response rates. However, when we considered demographic and clinical features of the wider NZJR population, our sample is similar across variables such as age, gender, comorbidity levels and procedure type.

It is possible that our sampling method resulted in systematic bias relating to participation in rehabilitation research. Most importantly, our sample may under-represent the experiences of certain subsections of our target population, for example ethnic minority groups, and over-represent the views of those predisposed to do well. We were also not able to determine whether use of rehabilitation was associated with needs or function, or to determine if rehabilitation use described by participants matched that available by health services. Additionally, we asked participants to recall details regarding use of rehabilitation extending back many months and this raises a concern about recall bias. Nonetheless, this analysis drew on the experiences of 608 participants, which makes this one of the larger joint replacement rehabilitation studies. Future research evaluating rehabilitation before and after joint replacement using prospective methods is recommended to address these concerns.

Finally, we did not examine associations between use of rehabilitation and outcomes in this study as our objective was first to describe the landscape of rehabilitation use in the joint replacement population in New Zealand. More robust prospective methods would be recommended for confident examination of associations between these variables.

Conclusions

In this study participants reported generally positive outcomes six months after primary total hip, knee and uni-compartmental knee replacement consistent with the wider literature describing joint replacement outcomes. However, differences in use of rehabilitation were evident depending on procedure type and delays in starting rehabilitation were suggested. Our data also suggest that broadening setting options for rehabilitation before and after joint replacement by increasing use of home and community-based options, and other approaches such as telemedicine, could improve access to rehabilitation resources.

Competing interests:
Dr Snell reports grants from Canterbury Medical Research Foundation during the conduct of the study.

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Intensive care unit utilisation post-oesophagectomy

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ABSTRACT

AIM: Oesophagectomy is a complex operation, with high rates of morbidity and mortality. Traditional post-operative care often involves admission to an intensive care unit, however with advancing surgical and anaesthetic techniques this may not be routinely required. The objective of this study is to investigate the utilisation of intensive care-specific resources following oesophagectomy in a New Zealand tertiary hospital.

METHODS: All patients undergoing oesophagectomy over a five-year period at Christchurch Hospital, New Zealand were identified and data collected. Utilisation of ICU-specific resources and the occurrence of complications in relation to ICU discharge were recorded.

RESULTS: Fifty-two patients underwent oesophagectomy between 1 January 2015 and 31 May 2019. The majority (75%) were extubated prior to admission to ICU, and only 8% required non-invasive positive pressure ventilation after extubation. Haemodynamic support with inotropic or vasopressor agents was required in 48% of patients. Most complications were managed in a non-ICU setting. The ICU readmission rate was 16%—all but one of these readmissions was following reoperation.

CONCLUSION: This study shows a large proportion of post-operative oesophagectomy patients do not require ICU level support, however in the absence of a reliable pre-operative predictive tool, post-operative ICU care is still required in our setting. An individualised post-operative approach could be explored to help divert stable patients, potentially up to half of the group, away from ICU.

Worldwide, oesophageal cancer is the sixth most common cancer, and the seventh most common cause of cancer-related mortality—responsible for 1 in 20 cancer deaths in 2018.[1] Surgical resection remains the mainstay of treatment for localised oesophageal adenocarcinoma; however, oesophagectomy is a complex surgical procedure with high reported incidence of morbidity (59%) and perioperative mortality (4.5% 90-day mortality).[2] As a result, post-operative care traditionally includes an intensive care unit (ICU) admission. This is currently routine practice for all patients undergoing oesophagectomy in Christchurch Public Hospital, New Zealand; however, due to ICU capacity constraints, elective cases are not infrequently cancelled on the day of surgery. This poses considerable inconvenience and psychological difficulty for the patient and their family, and poses logistical challenges for the surgical team who need to operate in a timely fashion post-neoadjuvant therapy.

In the era of enhanced recovery and with refined anaesthetic and surgical approaches, including early extubation and improved analgesic regimes, our experience was that these patients required minimal ICU-level care and were usually discharged to lower-level care day one post-operatively. If these patients could safely be managed in a non-ICU setting this would circumvent the above mentioned difficulties and could also potentially result in cost saving. The purpose of this audit, therefore, was to examine the utilisation of ICU-level intervention post-oesophagectomy to investigate feasibility and safety of a non-ICU based care post-operative package.

Methods

Study setting

Christchurch Public Hospital is the largest tertiary-level hospital in the South Island of New Zealand, serving a population of approximately 558,830 people. It is one of six specialist oncological hospitals in New Zealand appointed by the New Zealand Government. On average there are 12 oesophagectomies performed per year. Five surgeons performed the oesophagectomies in the study period. There is no formal Enhanced Recovery after Surgery (ERAS) protocol for oesophagectomy; however, the general principles of ERAS are followed. There is no standalone high dependency unit (HDU), and ICU has a high proportion of ventilated patients; therefore, the effective HDU space is low. The highest level of care available outside ICU is in the surgical progressive care unit (SPCU), which has a 1:2 nursing ratio; however, there is no capacity for inotropic support, positive pressure or invasive respiratory support.

Data collection

All patients who underwent an oesophagectomy at Christchurch Public Hospital between 1 January 2015 and 31 May 2019 were identified from electronic database scOPe®. Data were collected from a review of paper and electronic records. This included demographic details, ASA status, length of ICU stay, requirement for ventilatory and inotropic support, inpatient deaths and length of hospital stay. Complications were defined as per the Esophagectomy Complications Consensus Group (ECCG)[3] where possible—limitations exist due to retrospective nature of collection and variation in record keeping standards.

Ethics

The need for the formal approval for the research was waived by the National (New Zealand) Health and Disability Ethics Committee given the provisions of the study being a clinical audit. Locality approval was granted by the Canterbury District Health Board (CDHB)—ref 19189.

Results

Between January 2015 and May 2019, 52 patients underwent oesophagectomy in Christchurch Hospital. Demographic characteristics, ASA status, staging and operative details are presented in Table 1. The indication for resection was adenocarcinoma in the majority of cases (92%), while three patients with squamous cell carcinoma and one with an obstructing gastrointestinal stromal tumour underwent resection. Most procedures were open two-stage thoracoabdominal oesophagectomy (84%). Six patients had synchronous multi-organ resection: one small bowel resection for incidental finding of small bowel GIST, three splenectomies for intraoperative injury, one cholecystectomy and one lung lobectomy.

Table 1: Demographic, pathological and operative details.

Mean age (range)	66.8 (45–78)
Gender	
- Male	46 (88%)
- Female	6 (12%)
Ethnicity	
- European	51 (98%)
- Pacific Island	1 (2%)
ASA Status:	
- I	2 (4%)
- II	23 (44%)
- III	27 (52%)
- IV	0
Oesophageal Cancer Type by AJCC Stage:	
Adenocarcinoma	
- 0	1 (2%)
- I	4 (8%)
- II a	19 (36%)
- II b	5 (10%)
- III	19 (36%)
Squamous Cell Carcinoma	
- I	2 (4%)
- II	0
- III	1 (2%)
Gastrointestinal Stromal Tumour GIST	
- Stage III	1 (2%)
Median operative time in hours (range)	6 (3.5–10)
Operation type	
- Open two stage	44 (84%)
- Minimally invasive two stage	6 (12%)
- Open three stage	2 (4%)

Post-operative data

All 52 patients were admitted to ICU post-operatively. ICU interventions are detailed in Table 2. The median intensive care stay was 23 hours. Thirty-nine patients (75%) were extubated prior to arrival on the intensive care unit, with a further six (12%) extubated that same day in the ICU. Fourteen patients (29%) had hypoxaemia, which required more than face mask or simple nasal prong oxygen—10 of these were managed with high flow nasal prongs, three required CPAP and one patient required BiPAP (one of these routinely used CPAP for obstructive sleep apnoea). Five patients required re-intubation.

All 52 patients had continuous intra-arterial blood pressure monitoring as part of standard monitoring in ICU. Thirty-five patients (67%) were administered fluid boluses on the ICU for either hypotension or low urine output. Twenty-seven patients (52%) did not require any inotropic support while in the ICU. Only one patient required haemodialysis in the ICU for acute renal failure.

Of those who did not require any ICU-level support in the immediate post-operative ICU admission, the median age was 68.3, 48% were ASA II, 52% were ASA III and mean operative time was 5.7 hours. For those who did require ICU level intervention, the median age was 65.7, 7% were ASA I, 38% were ASA II, 55% were ASA III and mean operative time was 6.6 hours.

Eight patients (16%) required re-admission to ICU following complications while on either the SPCU or the general surgical ward. The median total hospital stay was 12 days (range 4–38).

Post-operative complications are presented in Table 3. The most common complication was atrial fibrillation, and this occurred predominantly in the SPCU or ward setting. Seventeen patients (32%) developed hospital-acquired pneumonia post-operatively. Seven patients (13%) required reoperation to resolve major post-operative complications and there were two inpatient deaths. One patient died day 13 from sepsis and multi-organ failure due to an anastomotic leak. The second died day 16 from sepsis and multi-organ failure following chyle leak and hospital-acquired pneumonia. No other patients died within 90 days post-operatively.

Table 2: ICU interventions.

Hours in ICU, median (range)	23 (16–397)
Extubated prior to arrival in ICU	39 (74%)
Extubation in ICU - Day of surgery - Day one post-operative - Day two post-operative - Day three post-operative	 6 (12%) 5 (10%) 1 (2%) 1 (2%)
Hypoxaemia - Requiring more than nasal prongs or O2 mask - Requiring CPAP or BiPAP - Re-intubation	 15 (30%) 4 (8%) 5 (10%)
Arterial blood pressure monitoring	52 (100%)
Fluid bolus administration	35 (67%)
Inotrope-use in ICU - Nil - Phenylephrine - Noradrenaline - Phenylephrine and noradrenaline	 27 (52%) 6 (12%) 12 (23%) 7 (13%)
Haemodialysis	1 (2%)

Table 3: Post-operative complications.

Patients who developed complications ≥ Clavien-Dindo III			12 (23%)
Unplanned re-operation			7 (13%)
90-day mortality			2 (4%)
	ICU	**Ward**	**Total**
Gastrointestinal			
Anastomotic leak	1 (2%)	2 (4%)	3 (6%)
Liver dysfunction	-	1 (2%)	1 (2%)
Ileus	2 (4%)	1 (2%)	3 (6%)
Gastrointestinal bleeding requiring transfusion	-	1 (2%)	1 (2%)
Pulmonary			
Pneumonia	6 (12%)	11 (21%)	17 (33%)
Pleural effusion requiring intervention	-	1 (2%)	1 (2%)
Re-intubation	5 (10%)	-	5 (1%)
Cardiac			
Myocardial infarction	1 (2%)	-	1 (2%)
Atrial dysrhythmia	4 (8%)	14 (27%)	18 (35%)
Ventricular dysrhythmia	1 (2%)	-	1 (2%)
Thromboembolic			
DVT	-	2 (4%)	2 (4%)
Pulmonary embolism	-	1 (2%)	1 (2%)
Stroke	1 (2%)	-	1 (2%)
Urologic			
Acute renal failure	3 (6%)	-	3(6%)
Urinary tract infection	-	4 (8%)	4 (8%)
Urinary retention	-	1 (2%)	1 (2%)
Infection			
Wound infection	-	3 (6%)	3 (6%)
Other			
Chyle leak	1 (2%)	1 (2%)	2(4%)
Tracheostomy	1 (2%)	-	1 (2%)

Discussion

We have conducted a retrospective audit of the use of ICU-specific resources post-oesophagectomy in a tertiary-level hospital in New Zealand. This demonstrates that a large proportion of patients could safely be managed outside of ICU, with possible scope for cost saving and reduced uncertainty around surgical planning associated with day of surgery cancellation related to ICU capacity.

Three quarters of the patients were extubated prior to admission to ICU, in keeping with recent published Australasian data.[4] The rate of readmission to ICU was low and complication rates compare well to international data, and to historical reported rates from this institution.[2,5]

Worldwide there is large variation in the post-operative care protocols following oesophagectomy. A large retrospective study looked at 7,878 patients undergoing oesophagectomy across 162 hospitals in the US.[6] Overall 65% were cared for in ICU post-operatively; however, there was a large range (3.6–100%), showing the wide variability between hospitals. The overall hospital mortality in that study was 6.9% and there was a 43.7% complication rate. Of interest, there was no association between hospital use of ICU and mortality in this

study. Robertson et al[7] and Ghosh et al[8] both looked at patients managed perioperatively in an HDU setting. Each study concluded that patients could be safely managed post-oesophagectomy on a surgical HDU with ICU admission rates of 16% and 16.3% respectively.

Reduction of hospital expenditure is a long-term goal worldwide, however this should not be at the expense of the patient's quality of healthcare. While half of the patients in our study did not ultimately require ICU-level care, the remaining half did—therefore in order to achieve cost and resource saving, prospective identification of which group patients will fall into is needed. Numerous scoring systems have been developed for this purpose. A recent systematic review identified 11 such tools including POSSUM (and variations), and those developed by Steyerberg and colleagues, Ra and colleagues, and Bartels and colleagues. This review did not identify any tool that could safely be applied to clinical practice due to unreliable results, with most model predictions frequently exceeding observed outcomes. Included studies were also limited by biases and small sample sizes.[9]

An alternative approach, described by Ghosh et al, is a pathway in which haemodynamically stable patients were extubated, observed in the post anaesthetic care unit (PACU) and transferred to the HDU, while haemodynamically unstable patients or those unable to be extubated were transferred to the ICU.[8] While Christchurch does not have a defined, standalone HDU, the SPCU could be used in this role (with appropriate equipment, staff training and accreditation). While this does not obviate the need for ICU availability pre-operatively, nor avoid potential day of surgery cancellations, it could result in improved resource efficiency and cost savings. Furthermore, knowledge of a 50% chance of a patient not requiring ICU admission may influence the multidisciplinary decision to proceed on the day of surgery.

The limitations of this study include the retrospective nature of data analysis and the bias inherent with this approach and the relatively small sample size. The strengths are the completeness of the data set.

Conclusion

This study shows a large proportion of post-operative oesophagectomy patients do not require ICU level support; however, in the absence of a reliable pre-operative predictive tool, post-operative ICU care is currently still required. An individualised approach to post-operative care could be explored whereby an assessment period in PACU is utilised to determine if ICU or SPCU is the most appropriate location for ongoing care. Such an approach would have the potential to divert up to 50% of the group away from ICU, utilising this resource more appropriately and with improved cost effectiveness.

Competing interests:
Nil.

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Population-level exposures associated with MRSA and ESBL-*E. coli* infection across district health boards in Aotearoa New Zealand: an ecological study

Matthew R Blakiston, Joshua T Freeman

ABSTRACT

AIMS: National responses to antimicrobial resistance (AMR) require an understanding of the factors driving its development and spread. Research to date has primarily focused on determining individual-level risk factors for AMR-associated infections. However, additional insights may be gained by investigating exposures associated with AMR variation at the population level.

METHODS: We used an ecological study design to describe the association between the incidence rate of methicillin-resistant *Staphylococcus aureus* (MRSA) and extended-spectrum β-lactamase producing *Escherichia coli* (ESBL-*E. coli*) infection and population-level variables among 18 geographically distinct populations, defined by district health boards, in Aotearoa New Zealand. Associations were described using Spearman's correlational analysis.

RESULTS: Positive correlations were found between the incidence of both MRSA and ESBL-*E. coli* infection and household crowding and community antimicrobial use. Positive correlations were also observed between MRSA and socioeconomic deprivation; age <5 years; Māori ethnicity; and Pacific ethnicity. For ESBL-*E. coli*, positive correlations were also observed with Asian ethnicity; Pacific ethnicity; and overseas-born new arrivals. European ethnicity was negatively correlated with both MRSA and ESBL-*E. coli* infection.

CONCLUSIONS: These findings provide insight into the potential contribution of population-level exposures to MRSA and ESBL-*E. coli* infection in New Zealand. Exposures such as household crowding, community antimicrobial use and socioeconomic deprivation, are in principle modifiable and may present potentially novel opportunities to reduce the burden of AMR.

Antimicrobial resistance (AMR) is a major global health threat, undermining the sustainability and safety of modern healthcare.[1,2] The importance of AMR is reflected in the World Health Organization's *Global Action Plan on Antimicrobial Resistance*. The *Action Plan* provides a mandate and framework for member states to develop plans at a national level.[2] At both the national and international level, effective AMR response plans require an understanding of the factors driving AMR development and spread.

Differences in AMR between countries have been attributed to differences in antimicrobial use, per capita income, population density and levels of corruption.[3–6] Other purported causes of AMR variation include poor infection control practices in human healthcare and agricultural settings; poor sanitation; environmental contamination from pharmaceutical runoff; agricultural

antibiotic use; and international travel/migration patterns.[7–10] However, compared to studies identifying risk factors at the level of the individual, relatively few studies have sought to identify exposures associated with AMR at the level of the population and in particular, regional populations within a given country.

Population-level risk factors for AMR are not necessarily the sum of individual risk profiles within a population. Studies designed to identify risk factors for individuals *within* a population cannot identify risk factors to which members of the population are universally exposed. In addition, the transmissibility of AMR means that one individual's risk of having a resistant organism in turn affects the risk profile of others in the population. Additional insights may therefore be gained by investigating variation in AMR rates *between* populations.

In light of this, we performed an ecological study to investigate two specific AMR-associated organisms in Aotearoa New Zealand; methicillin-resistant *Staphylococcus aureus* (MRSA) and extended-spectrum β-lactamase producing *Escherichia coli* (ESBL-*E. coli*). In particular, we sought to gain insight into population-level exposures associated with MRSA and ESBL-*E. coli* infection and any differences between the two organisms.

Methods

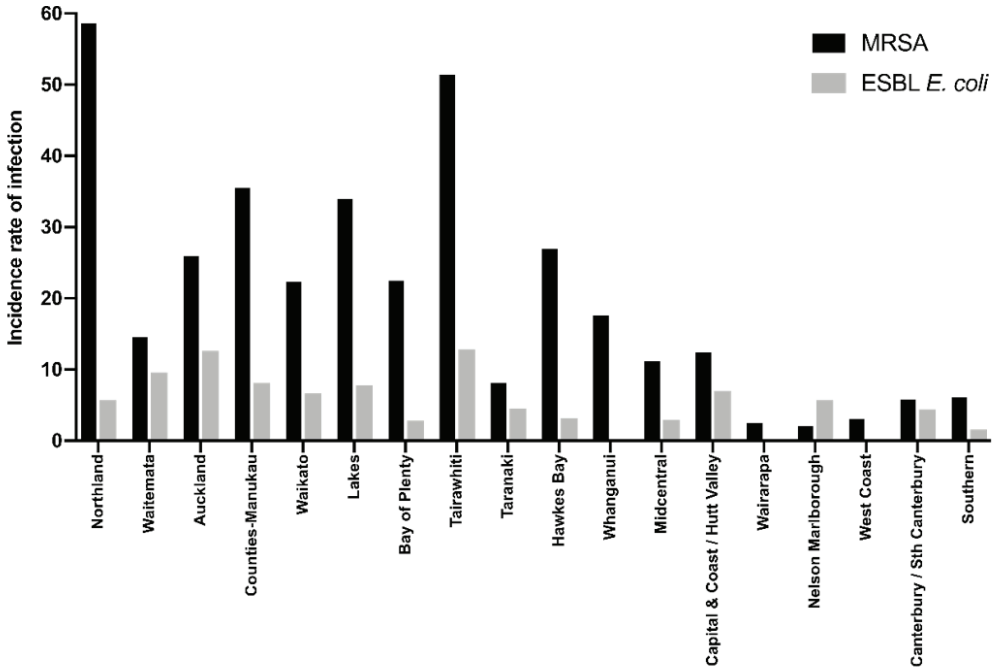
Using an ecological study design and available national surveillance, census and survey data, we investigated the association between MRSA and ESBL-*E. coli* infection and a range of population-level variables among 18 geographically distinct populations defined by district health boards (DHBs). The relationships were described utilising Spearman's (r_s) correlational analysis on GraphPad Prism version 7 (GraphPad Software, CA, USA). Statistical significance was defined as $p<0.05$. MRSA and ESBL-*E. coli* infection incidence rates for 2013 were obtained from the national survey (one month) of all public and private laboratories performed by the Institute of Environmental Science and Research Limited (ESR).[11,12] Isolates from a clinical site were considered to represent infection. Isolates from presumed screening sites (nasal and groin for MRSA; rectal for ESBL-*E. coli*) were excluded to remove bias due to differences in active surveillance practices between DHBs.

Demographic data for each DHB population, including the proportion aged <5 years and ≥65 years; the proportion reporting European, Māori, Pacific and Asian ethnicities; and the proportion who were overseas born new arrivals in New Zealand (<1 year), was obtained from New Zealand census 2013 data.[13] Population socioeconomic deprivation, as assessed by the proportion of each DHB population living in the most deprived NZdep2013 index quintile, was obtained from the New Zealand Index of Deprivation Atlas.[14] The NZdep2013 index is a relative measure of socioeconomic deprivation that is assigned to small geographical units nationwide. It is made up of census 2013 variables covering communication; income; employment; qualifications; home ownership; support; living space and transport.[15] DHB-level household crowding data, as assessed by the proportion of each DHB population living in crowded conditions (as per Canadian National Occupancy Standard) in 2013, was obtained from a Ministry of Health publication: *Analysis of Household Crowding based on Census 2013 data*.[16] DHB population community antimicrobial usage in defined daily doses (DDD) per 1,000 persons per day (DID) was obtained from the ESR Antimicrobial Consumption Report.[17] Population variable data from two pairs of geographically adjacent DHBs (Canterbury and South Canterbury; Capital and Coast and Hutt Valley) were merged as MRSA and ESBL-*E. coli* infection rates from these respective pairs were not differentiated in the 2013 ESR surveys.

Results

The incidence rate of MRSA and ESBL-*E. coli* infection across the 18 DHB populations is illustrated in Figure 1. Co-correlation between the evaluated population-level variables, which affect interpretation of the results for MRSA and ESBL-*E. coli* given below, is demonstrated in Table 1.

Figure 1: Incidence rate (per 100,000 per month) of MRSA and ESBL-*E. coli* infection across DHB populations.



The incidence of MRSA infection had a very strong positive correlation with the proportion of the population living in crowded housing conditions (Figure 2, Table 2). It also had a strong positive correlation with the proportion of the population aged <5 years; living in the most socioeconomically deprived NZdep2013 quintile; and with community antimicrobial use (Figure 2, Table 2). It had a moderate positive correlation with proportion of the population reporting Māori ethnicity and Pacific ethnicity (Figure 2, Table 2). MRSA infection had a strong negative correlation with the proportion of the population reporting European ethnicity (Figure 2, Table 2).

Table 1: Pairwise correlation between DHB population variables.

	Age <5 years	Age ˜ 65 years	European ethnicity	M°ori e thnicity	Pacific ethnicity	Asian ethnicity	Overseas born new arrivals in NZ	Socioeconomic deprivation	Household crowding	Community antimicrobial use
Age <5 years	-	NS	-0.69	0.66	NS	NS	NS	0.60	0.67	0.53
Age ˛ 65 years	NS	-	0.67	NS	-0.66	-0.70	-0.69	NS	-0.57	NS
European ethnicity	-0.69	0.67	-	NS	-0.85	-0.53	NS	-0.50	-0.98	-0.87
M˝ori ethnicity	0.66	NS	NS	-	NS	NS	-0.74	0.79	NS	NS
Pacific ethnicity	NS	-0.66	-0.85	NS	-	0.69	NS	NS	0.84	0.74
Asian ethnicity	NS	-0.70	-0.53	NS	0.69	-	0.86	NS	0.48	0.61
Overseas born new arrivals in NZ	NS	-0.69	NS	-0.74	NS	0.86	-	-0.50	NS	NS
Socioeconomic deprivation	0.60	NS	-0.50	0.79	NS	NS	0.50	-	0.57	0.48
Household crowding	0.67	-0.57	-0.98	NS	0.84	0.48	NS	0.57	-	0.85
Community antimicrobial use	0.53	NS	-0.87	NS	0.74	0.61	NS	0.48	0.85	-

Note: r_s values are given in the table when there was a significant ($p<0.05$) correlation between the two given population variables. NS, not significant.

Table 2: DHB population variables and association with incidence of MRSA and ESBL-*E. coli* infection.

	MRSA		ESBL-*E. coli*	
	Correlation coe° icient (95% CI)	p-value	Correlation coe° icient (95% CI)	p-value
Age <5 years	0.75 (0.42 to 0.90)	<0.01	0.47 (-0.01 to 0.77)	0.05
Age ≥65 years	-0.35 (-0.71 to 0.15)	0.15	-0.73 (-0.90 to -0.39)	<0.01
European ethnicity	-0.87 (-0.95 to -0.67)	<0.01	-0.79 (-0.92 to -0.50)	<0.01
Māori ethnicity	0.60 (0.17 to 0.84)	<0.01	-0.01 (-0.49 to 0.47)	0.97
Pacific ethnicity	0.61 (0.19 to 0.84)	<0.01	0.66 (0.27 to 0.87)	<0.01
Asian ethnicity	0.24 (-0.27 to 0.64)	0.35	0.57 (0.12 to 0.82)	0.01
Overseas born new arrivals (<1 year) in NZ	-0.12 (-0.57 to 0.38)	0.63	0.48 (0.002 to 0.78)	0.04
Living in most socioeconomically deprived quintile	0.76 (0.44 to 0.91)	<0.01	0.17 (-0.34 to 0.60)	0.50
Living in crowded housing	0.90 (0.74 to 0.96)	<0.01	0.77 (0.46 to 0.91)	<0.01
Community antimicrobial use	0.76 (0.44 to 0.91)	<0.01	0.64 (0.24 to 0.86)	<0.01

CI, confidence interval.

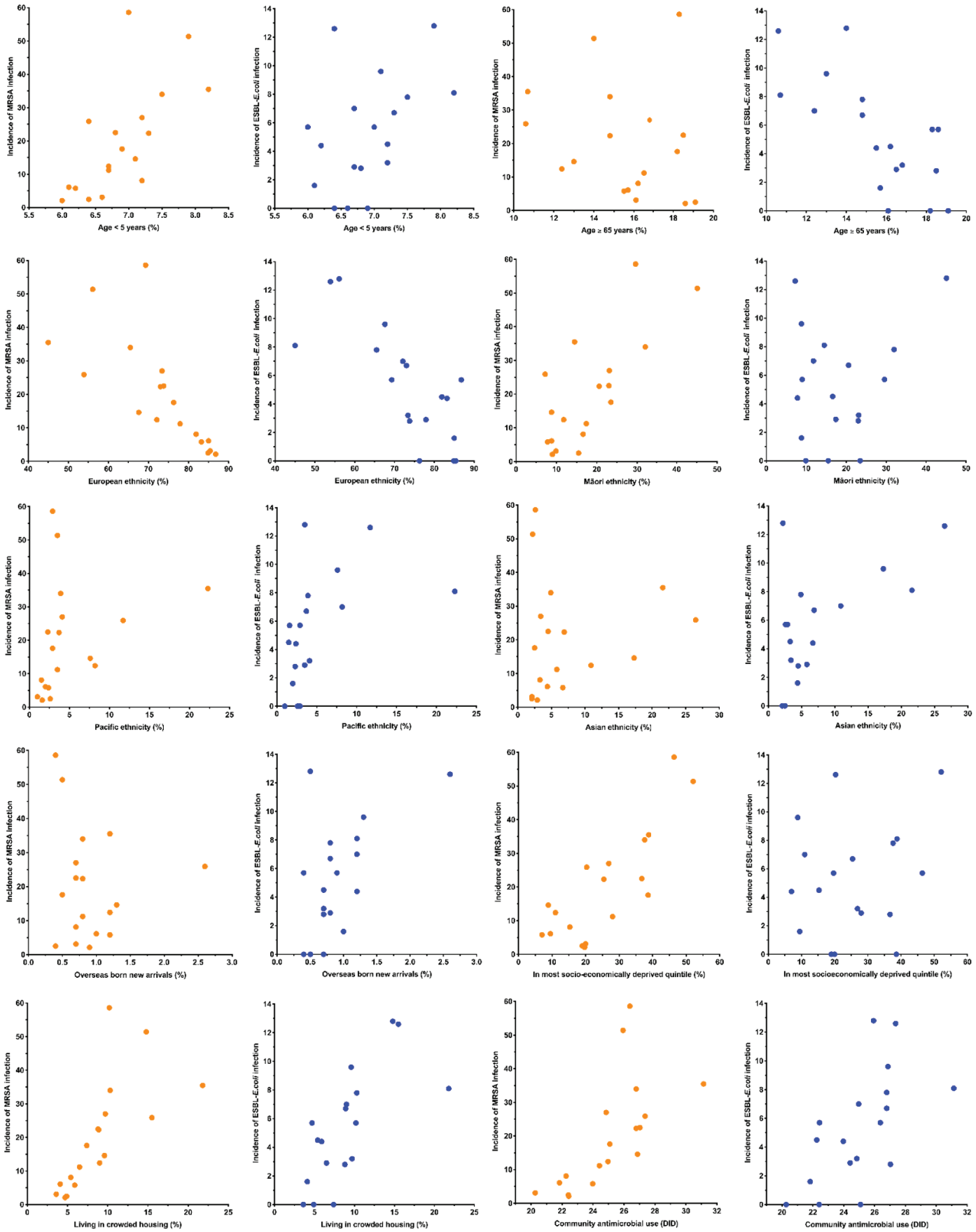
The incidence of ESBL-*E. coli* infection had a strong positive correlation with the proportion of the population living in crowded housing conditions (Figure 2, Table 2). It also had a moderate positive correlation with the proportion of the population reporting Asian ethnicity; reporting Pacific ethnicity; who were overseas born new arrivals; and with community antimicrobial use (Figure 2, Table 2). ESBL-*E. coli* infection had a strong negative correlation with the proportion of the population aged ≥65 years and the proportion reporting European ethnicity (Figure 2, Table 2).

Discussion

Variation in the incidence of antimicrobial resistant pathogen infection is almost certainly caused by multiple factors that promote selective pressure, increase transmission and increase risk of clinical infection.[7] In this study we examined the relationship between population-level exposures and the incidence of MRSA and ESBL-*E. coli* infection among New Zealand DHB populations.

Community antimicrobial use and the proportion of the population living in crowded housing were both strongly to very strongly correlated with MRSA and ESBL-*E. coli* infection. These variables were also strongly co-correlated (r_s=0.85); consistent with a recent study in the Counties-Manukau DHB population that demonstrated household crowding was associated with higher rates of antimicrobial prescribing.[18] This co-correlation may be confounding one or other of the variables' association with MRSA and ESBL-*E. coli* infection. Nonetheless, the largely clonal nature of MRSA and ESBL-*E. coli*, means it is plausible that community antimicrobial use may contribute to a higher incidence of infection by rendering people more vulnerable to colonisation and infection in the event of subsequent exposure.[19] It is known that community antimicrobial use in New Zealand is high compared to other high-income countries.[17,20] Household crowding and antimicrobial use could be part of the same causal pathway (ie, crowded households have more infections and thus require more antimicrobials). However, as these organisms are known to spread between household members, it is likely that crowding also has a more direct effect by promoting transmission of ESBL-*E. coli* and MRSA when one or more household member is colonised.[21,22]

Figure 2: DHB population variables versus incidence of MRSA and ESBL-*E. coli* infection (per 100,000 per month).



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Population levels of socioeconomic deprivation had a strong positive correlation with MRSA infection. This relationship may be affected by moderate co-correlation between socioeconomic deprivation and household crowding (r_s=0.57) and community antimicrobial use (r_s=0.48). Socioeconomic deprivation has been associated with higher levels of antimicrobial use in New Zealand, although not in all regions.[20,23] Nonetheless, a direct contribution of deprivation to higher incidences of MRSA infection is considered probable as living in an area of greater socioeconomic deprivation is an established risk factor for MRSA infection and all cause infectious disease morbidity in New Zealand.[24–26]

The proportion of the population reporting Māori ethnicity and Pacific ethnicity had moderate positive correlations with MRSA infection. MRSA isolation rates have previously been reported to be higher among Māori and Pacific peoples than New Zealand Europeans or Asians.[24] These observations are likely to be explained in part by co-correlation with socioeconomic deprivation (Māori), household crowding (Pacific) and antimicrobial use (Pacific). The proportion of the population reporting Asian ethnicity, Pacific ethnicity and overseas-born new arrivals, had moderate positive correlations with the incidence of ESBL-*E. coli* infection. Co-correlation with each other and confounding by other positively associated variables (Table 1) are possible explanations for these associations. Asian ethnicity has however been previously associated with an individual risk of ESBL-*E. coli* infection in New Zealand and is presumed to reflect initial acquisition in highly endemic regions of Asia.[27] It is possible that despite established ESBL-*E. coli* endemicity in New Zealand that ongoing importation may still contribute to variation in infection rates between DHBs. European ethnicity had a strong negative correlation with MRSA and ESBL-*E. coli* infection. This seems likely to largely reflect the summation of a number of negative correlations between European ethnicity and positively associated population variables (Table 1).

The proportion of the population aged <5 years had a strong positive correlation with MRSA infection. This relationship may be affected by co-correlation of age <5 with household crowding, socioeconomic deprivation and antimicrobial use. However, a direct causal relationship is considered a possibility as high rates of MRSA infection are well documented among New Zealand pre-school aged children.[24,25] Age ≥65 years was negatively correlated with ESBL-*E. coli* infection rates (despite older age typically considered an individual risk factor for infection). This may be explained by the negative correlation of age ≥65 years with other positively associated variables (Table 1).

This study has a number of limitations. The ecological design precludes causal relationships from being definitively established. Secondly, the limited number of data points available resulted in wide confidence intervals and prevented adjustment for confounding due to co-correlation between variables. Thirdly, inherent limitations in the source data used may have affected our findings. Finally, the results are of uncertain generalisability to settings outside of New Zealand. Our findings require further research to explore the causative relationships, utilising, for instance, population-level data amenable to multivariate analysis, or individual level analysis inclusive of both individual and population-level exposures.

Despite the limitations, our findings provide insight into the potential contribution of population-level exposures to variation in the incidence of MRSA and ESBL-*E. coli* infection between populations within New Zealand (an MRSA/ESBL-*E. coli* endemic high-income country). The differences observed between MRSA and ESBL-*E. coli* suggest that a single set of generic interventions may have a differential impact on different AMR-associated organisms. Moreover, several MRSA and ESBL-*E. coli* infection associated exposures are in principle modifiable. It may be that policy measures to reduce rates of household crowding and socioeconomic deprivation could present potentially novel approaches to reducing AMR. Similarly, reducing community antimicrobial use in the population at large may help reduce MRSA and ESBL-*E. coli* infections. As New Zealand and other countries devise and implement national AMR response plans, these findings highlight directions for future research and potentially novel opportunities to reduce the burden of AMR.

Competing interests:
Nil.

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The role and functions of community health councils in New Zealand's health system: a document analysis

Gagan Gurung, Sarah Derrett, Robin Gauld

ABSTRACT

BACKGROUND: Community/consumer health councils (CHCs) are a relatively new phenomenon in New Zealand. CHCs are usually established within district health boards (DHBs) to help address gaps in community engagement in the health sector. Little is known about the establishment, structure, roles and functioning of these councils.

AIM: To undertake a literature review, including grey literature, related to the structure, roles and functioning of CHCs in New Zealand.

METHOD: A document analysis of the New Zealand-focused website materials and newspaper articles related to CHCs was conducted. Data were analysed thematically using a qualitative content analysis approach.

RESULTS: The search identified 251 relevant web sources and 118 newspaper articles. The main role of the CHCs appeared to be to advise and make recommendations to their respective DHBs (and DHB governance and management structures) about health service planning, delivery and policy. All CHCs discussed in the identified sources comprised different demographic backgrounds and expertise. Although the CHCs were mainly engaged in information sharing and consultation, their influence on DHB decision-making could not be determined from the sources.

CONCLUSION: This is the first study of CHCs throughout New Zealand investigating their roles, structure and type of engagement. As the concept is evolving and more CHCs are being established, this information may be useful for future CHCs. With increasing longevity of CHCs in New Zealand, future studies could usefully investigate CHCs' potential to represent the health interests of their local communities, and their influence on DHB decision-making.

The broader community can bring unique and valuable perspectives to the health system.[1] There has been an increasing focus globally on community engagement in health,[2] and there is a growing body of evidence to support the relationship between community engagement and improved health outcomes.[1] In New Zealand, community engagement in health has a long tradition.[1,3] Much of the earlier experience in New Zealand came from the disability and mental health sectors.[1]

A fundamental document underpinning engagement in New Zealand is Te Tiriti o Waitangi (Treaty of Waitangi) signed by Māori chiefs and representatives of the British Crown in 1840 (although since its signing, full and genuine recognition of Te Tiriti has been, and is still being, called for in our health system by Māori leaders and others).[4–7] More recently, other government documents have articulated the importance of community engagement, including The New Zealand Health Strategy 2000,[8] The New Zealand Disability Strategy[9] and the Primary Health Care Strategy 2001.[10] In New Zealand, the health sector is required to involve patients (sometimes referred to as consumers). Efforts in engaging the community have been devolved to the local level,[3] and engagement initiatives include mainly elected members of district

health boards (DHBs), DHB requirements to consult with their communities, establishment of advisory committees, and collecting and reporting patient feedback to the healthcare system, usually through patient surveys.[11,12] It has been argued that community engagement in the general health sector lags behind the disability and mental health sectors.[3]

The concept of a community health council (CHC; also referred to as a consumer health council) is a relatively new phenomenon in New Zealand. Health consumer councils exist elsewhere, but their scope and contexts may differ from New Zealand's. In the UK, community health councils were established as statutory bodies in 1974 to represent the interests of the public in local health services.[13] The concept of participation has been described as being rooted into two ideological streams—consumerism and citizenship.[14,15] The private sector notion of markets underpins the consumerist approach and its emphasis is on the rights of consumers to access, preferences, information and complaints in relation to a specific service.[14,15] On the other hand, the citizenship approach is related to people in their capacities as citizens with their rights to use public services and duties to participate collectively in society.[15] Although contested, CHCs tend to be placed within the citizenship approach.[15,16]

In New Zealand, CHCs were formed to help address gaps in community engagement in the health sector. They are usually established within DHBs to advise the executive and clinical teams in their regions, and to develop partnership and communication pathways with their communities. Yet little is known about the establishment, structure, roles and functioning of these councils.

The purpose of this study was to undertake a literature review, including grey literature, related to the structure, roles and functioning of the CHCs in New Zealand. Furthermore, healthcare has been a priority concern of the New Zealand public in opinion polls, with the New Zealand media giving close attention to the events in the health system.[17] Hence, this study also aims to report how the New Zealand media has covered aspects of CHCs.

Methods

A document analysis was conducted for this study.[18] Eligible documents included minutes of meetings, terms of reference, organisational or institutional reports, plans and strategies, webpages and newspaper articles (including media releases) related to CHCs in New Zealand. We undertook an initial search of all sources available electronically up to 19 February 2017. The search was subsequently updated to 13 November 2019. We conducted manual searches of websites of DHBs, CHCs, the Ministry of Health and the Health Quality and Safety Commission (HQSC) to find minutes of meetings, terms of reference and annual reports related to CHCs.

In the case of newspapers, we conducted an electronic search. Two news databases, Newztext and Factiva, which index New Zealand newspapers were chosen. Simple keywords search ("consumer health council*" OR "health consumer council*" OR "district health board health consumer council*" OR "district health board consumer council*" OR "community health council*" OR "consumer council*") were performed to identify relevant news stories about CHCs in New Zealand. As noted, the date limit applied to search was up to 13 November 2019. The keywords could be anywhere in the full-text article.

Data were analysed thematically using a qualitative content analysis approach.[19] In both newspaper and website items, we coded items for one of the following categories: history of CHC, rationale/purpose, roles, meetings, representation in CHC and consultation/engagement. Within these broad categories, sub-categories (themes) were developed inductively.

Results

Manual searches of websites of DHBs, CHCs, Ministry of Health and HQSC identified 251 documents including: minutes of 134 meetings, 10 terms of reference, one annual report to CHCs and 16 webpages with background information. The manual searches of these documents provided information about rationale and purpose, functions and roles, structure and representation of CHCs,

types of engagement, issues raised by CHCs and influence in decision making.

The media search identified 799 articles (Newztext—549, Factiva—250); 441 after duplicate articles were removed. Each news story was then checked by one member of the research team (GG) against broader inclusion criteria related to the CHC. The final 118 articles relating to a CHC had been reported by 25 newspapers. The articles included information about CHC formation, structure and representation, rationale and purpose of CHCs, and the function and roles of CHCs. Of the 118 stories, 48 were from the period 1996 to 2002 covering old CHCs formed under the Area Health Board Act 1983 (which ceased to operate when the Act was abolished). Among the older CHCs, most of the stories related to the Nelson CHC and the Wairarapa CHC. The remaining 70 news stories from 23 newspapers were about CHCs formed in New Zealand covering the period 2007–2019 (Table 1).

Table 1: Number of media reports of CHC activity according to year of publication (2007–2019) and publishing newspaper.

Newspaper	2007	2008	2013	2014	2015	2016	2017	2018	2019	Total
Otago Daily Times						1	5	1	3	10
Stuff						1				1
Hawkes Bay Today			4	1	3	1	2			11
The Press	1	1								2
Nelson Mail						1				1
Scoop Independent News		1		1	5	6	1	4	1	19
Northern Advocate					2					2
Waikato Times						1				1
Manawatu Standard						1	1	1		3
Radio New Zealand Newswire					1					1
Whanganui Chronicle						1				1
Bay News								1		1
Kati Kati Advertiser								1		1
Bay of Plenty Times								1		1
Te Puke Times								1		1
Weekender Rotorua								1		1
Te Awamutu Courier								1		1
The Timaru Herald							1	1		2
Horowhenua Chronicle							2	2		4
Dannevirke News							1			1
The Northern Advocate Saturday							1			1
Southland Times							3			3
New Zealand Doctor									1	1
TOTAL	1	2	4	2	11	13	17	15	5	70

Table 2: Community health councils and their date of establishment.

SN	Council's name	Establishment
1	Canterbury DHB Consumer Council	2008
2	Hawke's Bay Health Consumer Council	2013
3	Northland Health Consumer Council	2014
4	West Coast DHB Consumer Council	2014
5	Taranaki DHB Consumer Council (Interim)	2014
6	Counties Manukau DHB Consumer Council	2015
7	Southern Community Health Council (for the Southern DHB and WellSouth Primary Health Network)	2016
8	Whanganui DHB Consumer Representative Group	2016
9	Wairarapa DHB Consumer Council	2017
10	Mid Central DHB Consumer Council	2017
11	Nelson Marlborough Health Consumer Council	2017
12	Capital & Coast DHB Citizens Health Council	2016
13	Waikato DHB Consumer Council	2018
14	South Canterbury DHB Consumer Council	2018
15	Bay of Plenty Health Consumer Council	2018
16	Hutt Valley DHB Consumer Council	2019
17	Waitematā DHB Consumer Council	2019

CHC developmental history

According to the media articles, CHCs existed during the era of area health boards (1980s–1993), but most of these earlier CHCs appear to have been abolished by early 2000.[20–23] The lack of other supporting documentary evidence means that available information about their developmental history, role and functions is scant. These earlier CHCs were set up to liaise between the public and government-funded health services, and to meet the needs of communities that had particular cultural or geographic needs.[21] Apparently, the selection of these CHC members was through voting at public meetings.[24] The Nelson Mail reported that members of the Nelson CHC were elected at a public meeting at which approximately 50 people turned up to vote.[24] With successive government changes and health sector reforms and cuts to resourcing, CHCs were abolished.[20–23] In 1998, The Dominion and The Nelson Mail reported that the funding would be cut and that (the then) Health Funding Authority had decided to adopt a national approach to community consultation rather than continuing with the decentralised approach with regionally elected community health boards (councils).[20,21]

Nelson and Wairarapa CHCs were reported most frequently in newspapers and appeared to have been active in organising public meetings on health issues, such as funding cuts, hospital cuts and quality of care concerns. An article published in the Dominion Post in 2002 showed the Wairarapa CHC was among the few which remained active prior to finally being abolished.[21] The analysis of newspapers and website data found that the first of the more recent wave CHCs was established by Canterbury DHB in 2008. By 2019, 17 of the 20 DHBs in the country had established CHCs or were in the process of developing one (Table 2). All CHCs were directly related, and accountable to, their respective DHB. One CHC, the Southern Community Health

Council, was also directly related to their regional Primary Health Organisation (PHO). Two other DHBs had initiated community representatives onto their clinical governance committee, or community and public health committees, with the intent of facilitating community input in a similar manner to the 17 other CHCs. We were unable to locate information on the remaining DHB.

Rationale and purpose

The document review found the main reason behind the initiation of the recent wave of CHCs was to address the existing gaps in community engagement in the health system and to become more patient-focused in decision making. The gaps included a lack of a systematic way for patient and public engagement, lack of mechanisms which cover all areas of health rather than focusing on specific interests such as mental health only, and lack of public accountability of DHB boards (which are comprised of both democratically elected representatives and government appointees) and other advisory boards, and the selection of some DHB board members by the Ministry of Health.[25–28] In one district, it was reported that:

"The move comes after some commentators and district health board candidates criticised boards for their lack of public accountability and the high number of members appointed by the Ministry of Health."[26]

Elsewhere, a DHB Chief Executive Officer (CEO) suggested:

"'Ensuring we hear the perspectives of patients and consumers is not new', comments Southern DHB Interim CEO Chris Fleming, who points to existing systems including consumer advocates in mental health services, community representatives in regional networks, patient feedback surveys and the In Your Shoes listening sessions undertaken as part of the DHB's Southern Future programme. However, he says, 'there have been gaps, and we have not always been systematic about how we should seek and make best use of the perspectives patients bring'."[25]

In another district, it was reported that, despite the representation of consumers in the DHB advisory committees, they were not happy with the way they were involved:

"Prior to the Hawke's Bay Health Consumer Council, consumers were represented across several statutory advisory committees such as a Community Public Health Advisory Committee, the Hospital Advisory Committee and Disability Services Advisory Committee.

'Our consumer representatives on those committees were generally pretty frustrated with the way things were', Norton [Graeme Norton, ex-chairperson Hawke's Bay Health Consumer Council] said.

'The problem was that they only met once a quarter for half a day and mostly it was consumer members catching up on the last three months of reports from the system as to what was happening or had happened, most of which the majority of other members around the table already knew because they were either board members or clinical members', he said."[28]

The purpose of forming a CHC was to act as a bridge between the community and DHB by representing the voice of the community in strengthening district health services planning, design and delivery, working collaboratively with the DHB:

- To have a direct, practical input of consumers into DHB plans.[26,29]
- To develop communication pathways by receiving, considering and disseminating information from and to the DHB and communities.[30]
- To develop an effective partnership between the DHB (governance and management team) and community by providing a strong and viable voice for the community and consumers/patients as a collective perspective in health services planning, design and delivery.[30–34]
- To enhance consumer experience and service integration across the sector, promote equity and ensure that services are organised around the needs of people.[30,33]
- To ensure patient perspectives are embedded across health service[25] and contribute to patient and family/whānau-centred care by working with patients and whānau to co-design care, facilities and strategies.[35]

- To engage people earlier with the health system and encourage them to take responsibility to actively self-manage their own treatment and care.[36]
- To create strong links between communities and district and national health systems.[37]
- To act as vehicle for consumers to participate in improving health outcomes.[38]
- To ensure a focus on improving health equity for populations (Māori, people living in rural communities and people living with disabilities).[39]

Governance of CHCs

Governance includes sub-themes such as the structure of CHCs, their representation, roles and functions, meeting processes and functional relationships and influence.

Structure and representation

Information about structure was only available for 16 of the 17 CHCs. Analysis of the eight CHC structures showed that the number of members in the council ranged from 5–16, with a mean 10.8. The media and other document analysis showed that selection processes involved nomination following open advertisement through DHB websites or media/newspapers, emails to local community groups, or advertisements requested via specific groups, and sending calls for expressions of interest from suitable consumer organisations and non-government organisations. The appointment of members was generally made by CEOs or the chair of the DHB selection panel after consultation with local consumer and community groups.[30,33,40–45]

Different criteria for representation included having a demographic balance that reflects the DHB population, age, gender, disability, social economic status, people to have a particular interest, understanding and knowledge in selected areas (eg, mental health, alcohol and other drugs, long-term conditions, disability, Māori health, women's health and primary health), potential to bring skills, perspectives and ability to enhance work of the CHC. Although appointed to reflect a patient or population voice in particular areas of interest, members do not tend to be regarded as representatives of any specific organisation or community.[30,33,40–43,46–48] Furthermore, it has been emphasised that council members need to bring a broader perspective not limited to an individual personal experience of the health system:

"More than 80 applications were received for the Community Health Council, which was advertised in October. Representatives were chosen by a selection panel comprised of independent community leaders, Iwi Governance, University of Otago and Southern DHB."[44]

"'While Council members will need personal experiences of the health system, they should not be focused on a single issue. Instead, we want them to advocate for all patients, whānau and their communities, and ensure the processes across the health system for hearing the voices we need to hear are strong' [Quote from Sarah Derrett, establishment chair of the Southern health system's CHC]."[25]

The review of meeting minutes revealed that CHC members were also co-opted into other committees and governance mechanisms such as the Hand Hygiene Governance Group, HQSC Consumer Network, Mental Health panel, Clinical Governance Board and the Ministry of Health Long Term Conditions Advisory Council.

Roles of CHC

The analysis of the news media articles and website documents found that the role of CHCs encompassed fostering patient and public engagement in the health system, and advising DHBs and their governance, management and clinical teams on health services planning, delivery and policy. In a few CHCs, roles went beyond DHB hospital boundaries to encompass the wider local health system (ie, to include advising primary health organisations) and national health systems.[25,33,34,45] The roles of the CHC in different DHBs included the following functions:

- Advising the DHB on policy, planning, implementation and evaluation of services.
- Working with DHBs to improve the quality of patient journeys.[32,33]
- Communicating with the community and specific interest groups.[25,46]
- Promoting and facilitating patient and public participation across the DHB.[49]

- Advising on health system and services, and also the development of health service priorities and strategies.[25]
- Helping ensure appropriate consultation occurred while developing DHB reports, plans or services.[25,46]
- Collecting and using feedback from service users.[25]
- Contributing to the design or redesign of services.[32]

Many councils also specified the functions which were out of the scope, including:[30,33,40–42,46]

- Providing clinical evaluation of health services.
- Discussing or reviewing issues that are (or should be) processed as formal complaints, for which full and robust processes exist.
- Being involved in DHB contracting processes.

Meetings

Most CHC meetings were held monthly, except in the case of the West Coast and Waitematā where it was bi-monthly. Payment for attending meetings varied, but was often set at the rate of other advisory groups. In some CHCs, meetings were open to the public (Hawke's Bay Clinical Council, Nelson Marlborough Health Consumer Council, and Northland Health Consumer Council); others were closed. There was a practice of publishing agendas and meeting minutes or key messages on the DHB or related websites.[33,40,41,43,50,51]The term of CHC membership varied in different DHBs ranging from 1–3 years. In some CHCs, half of the members were appointed for a year and a half, and some for two years. In all CHCs there was a provision for renewal for 1–3 terms.[33,40,41,43,50]

CHC functional relationships

Generally, CHCs had functional relationships with their communities, other consumer groups and networks, the DHB chief executive, executive management team, clinical councils and other advisory groups.[42,43] CHCs reported to, and were accountable to the CEO of their respective DHBs (and in one case a PHO).

Consultation with CHCs and influence in decision making

The review of website documents, particularly terms of reference, showed that CHCs were, variously, involved in policy and governance with authority to give advice and make recommendations to DHB management, without direct decision-making power.[30,33,40–42,45] In some cases (Northland Health Consumer Council, Nelson Marlborough Health Consumer Council, Southern health system's CHC), the level of influence of the CHC was specifically mentioned to be equivalent to the Clinical Council and Iwi Health Board.[30,33]Analysis of meeting minutes showed that CHCs did discuss aspects of DHB governance. Information and updates by DHBs and the Ministry of Health on a range of issues related to plans, policy, care and services of DHBs were shared with CHCs. DHBs and the Ministry of Health also involved CHCs in consultation on a range of issues (Table 3). Examples of issues discussed in CHC meetings for included: accessibility and availability of services (availability of drugs, changes in provision of services, DHB facility development, funding issues and transportation), information and education (different tools and forms for patients, leaflets and newsletters and websites), quality improvement (hand hygiene, patient surveys, patient files, credentialing, complaints processes and privacy concerns on electronic health records); planning and policy development (smoking policy, partners in care policy, New Zealand Health Strategy, visiting policy, DHB annual plans and disability action plans).[52–54]

Recent newspaper articles also highlighted the positive influence of CHCs in DHB decision-making in a number of areas, for example: the development of a primary and community care strategy; hospital rebuilding; improvement of feedback; complaints and resolution system; development of a new pain service; improvement of renal health services; improvement of the emergency department service; installation of proper signage in the day patients' wing; and undertaking of a disability services stock take.[55–58]

Table 3: Consultation with CHC by DHBs and the Ministry of Health.

Consultation issues	Examples of issues
DHB level policy, plan and strategy	Health literacy strategic review, consumer engagement principles and frameworks, obesity strategic plan, youth health strategy, disability strategic plan, DHB annual plan, complaint management manual, visitor policy, health and social care network, Alcohol strategy, Best start healthy eating, Working together for Tamariki.
National policy and strategy	National health strategy, National organisational healthy food and drink policy.
Booklet/pamphlet development/survey forms	Complaints pamphlets, a CPR booklet, pamphlets related to reducing the risk of falls in the hospital, a falls brochure, patient stories leaflets, patient survey questions, and patient assessment forms.
Website/social media	Wifi booklet, health website, social media policy
Care/services	Acute care plan in PHO, end-of-life care, co-design partnership care programme, quality account, hand hygiene month (campaign), access to health service for rural communities, virtual health.
Physical facilities	Use of CCTV in the Acute Services Building Theatre, a Go Well Travel Plan, Bilingual Signage, bus services and car park facilities.

Discussion

Main findings of the study

The current CHC concept in New Zealand has been building since the first of the 'new style' CHCs formed in Canterbury DHB in 2008. The rationale for forming a CHC was usually reported as needing to address the existing gaps in consumer engagement in the governance and policy level of the health system. The main role of the councils appeared to be to advise and make recommendations to concerned DHBs' governance and management structure about health services planning, delivery and policy.

The study found few stories relating to CHCs reported by newspapers. Stories covering the modern CHCs were still infrequent but, in recent years, the number of reports has increased (nationally there was an average four newspaper stories per CHC for 2007–2019 period, with the actual range being 1–18 for the individual CHCs). Southern CHC (for the Southern DHB and WellSouth Primary Health Network), Hawke's Bay Health CHC and Mid Central DHB CHC were among those whose stories were most frequently covered by newspapers. Most of the newspapers covered stories of a particular CHC in the region, but Scoop Independent News covered stories of nine different CHCs. Regarding the type of stories covered by newspapers, these were mostly related to establishment, rationale and purpose of the CHCs. However, stories also covered the influence of CHCs in improving health services. In the case of website content, these incorporated issues covered by the newspaper plus the type of issues discussed by CHCs and feedback provided by CHCs.

The number of members in the council ranged from 5–16 representing different population demographic characteristics and expertise. The appointment of members was generally made by CEOs, or the chair of a DHB selection panel, after consultation with local consumer and community groups. While the present study showed that councils in New Zealand tried to ensure representation of people from different demographic backgrounds and expertise, it is too early to comment on whether they adequately represent socio-demographic features and interests of the local communities. Elsewhere, studies reported that representatives may not adequately represent the views of an entire population which limits the potential for divergent groups to be represented in the decision-making process.[59–61] Representing the entire population can be unrealistic, especially when there are no specific communication channels to connect the

representatives with communities they are supposed to be representing. Hence, an alternative is to simply focus on the personal perspectives of health service users in order to illustrate shared experience—captured in the notion of 'experiential participation'.[61–63]

There are different theoretical models of engagement, most of which specify levels and degree of engagement.[64–66] Charles and DeMaio, following Arnstein,[65,66] describe a multi-dimensional framework based on decision-making domains, role perspectives and levels of engagement in healthcare decisions.[65] The first dimension refers to types of healthcare decision-making contexts or domains, ranging from 'treatment' to 'service delivery' to 'broad macro- or system-level decision-making contexts'. The second dimension focuses on two alternative role perspectives participants can adopt in healthcare decision-making: as 'user of health services' or with a 'public policy perspective'. The third dimension depicts 'level of participation' in healthcare decision-making.

This New Zealand study found that CHCs were involved in a range of issues related to service delivery, DHB governance and planning and policy development. Hence, regarding 'decision-making domains', CHCs were involved in 'service delivery' and in 'broad macro- or system-level decision-making contexts'. In the case of 'role perspectives', while not easy to define, CHCs' roles appear more inclined towards a 'public policy perspective'. In the case of the level of engagement, it appears that CHCs were mainly engaged in 'consultation', and have no direct decision-making powers in DHB governance and policy levels. However, it is beyond the scope of this study to explore to what extent the CHC's advice actually influenced the decision-making of DHBs. This is an important issue to consider because other mechanisms, such as elected community members sitting on DHB boards (albeit serving a different governance role in contrast to CHCs), and public consultations, have been identified as not producing strong positive results in relation to genuine and effective public participation.[11,67] An interim report from the New Zealand Health and Disability System Review that is currently underway noted that although elected community members in DHBs prompted a cultural change towards openness and improvement in community engagement, there was no evidence that there was a direct impact of elected members.[12] Other studies have suggested that electoral mechanisms provided a limited role in promoting participation, indicating a need for complementary participatory channels to increase participation.[12,67] Since CHCs were set-up to address participatory gaps in the health system, it will be important to investigate over time what value CHCs really add to community engagement in the New Zealand health system, especially in relation to addressing the needs and values of their communities in health services.

The CHC scope of participation was limited to their region, and usually to healthcare and services within the scope of DHBs, with occasional consultation from the Ministry of Health. In one instance during this study's review period, a CHC (Southern health system's CHC) was established with clear relationships to both a DHB (the Southern DHB) and a PHO (the WellSouth Primary Health Network). It would be interesting to examine the effect of such cross-sectoral CHCs, and also to understand the impact of CHC engagement and influence on broader national health policy agenda and priorities.

Regarding the two ideological streams of participation discussed previously, it seems that the CHCs had both elements of consumerism and citizenship.[15,16] The present CHCs appear to be representing the interests of individual patients, families /whānau, specific health groups and larger geographic communities. Furthermore, it seems the focus of the membership was not to represent a single specific interest, but on appointing CHC members who could bring broader community perspectives to health services. Although the word 'consumer' (rather than 'community') has been chosen to name most of the CHCs, in practice all CHCs had a clear community/population orientation.

Despite wide acceptance of patient and public involvement in shaping healthcare, internationally, evidence of the effectiveness of specific mechanisms in health service planning and delivery and healthcare policy is limited.[68–70] Furthermore, participation strategies can be directed towards achieving intrinsic goals (engagement for the democratic process, accountability,

empowerment, etc) or can be focused on achieving instrumental goals (engagement for health outcomes). The goal of a community participation strategy can also influence which outcomes or impacts are sought (and achieved).[68] This review found the influence of New Zealand CHCs in their local health systems to be advisory, with no direct operational role in health service design and delivery. It now seems important to consider whether (and exactly how) new engagement structures such as CHCs contribute to achieving genuinely improved health systems for New Zealanders—or if they are located towards the tokenistic 'consultation' end of engagement as has been found in the UK.[13]

What is already known on this topic?

There was limited published literature related to CHCs. Earlier work in CHCs came from the UK where CHCs were the main statutory body in the UK's National Health Service to represent the public interest in local health services until this abolishment in 2001. CHCs in the UK were the most dominant form of user involvement.[15] Although the membership reflects a range of political and organisational interests, CHCs in the UK had been criticised for not being representative of a wide range of concerns and interest in local communities.[15,71]

In the UK, CHC influence on decision making, especially service development and health improvement priorities, was considered to be fairly limited.[13]

What this study adds

This is the first study of CHCs in New Zealand which investigated their roles, structure and engagement levels and types. As the concept is evolving and more CHCs are being established in New Zealand, this information may be useful for future CHCs in New Zealand and elsewhere. CHCs were mainly engaged in information sharing and consultation, their influence on DHB decision-making is, as yet, not empirically understood.

Limitations of the study

This study used document analysis to develop the arguments in this article. This certainly has limitations related to the comprehensiveness of the data. For example, the types and levels of engagement are not likely to be comprehensively ascertained based on newspaper and website sources alone. However, the use of the different types of documents, such as media sources and websites, helped to complement and triangulate the findings. Furthermore, although we conducted a primary source update by manually searching websites in November 2019, we could not include all CHC meeting minutes in the analysis for this period. Instead, we purposively selected the most recent minutes, especially of the CHCs whose reports were not included in the initial search to 2017. This study is intended to provide a starting point for investigation into CHCs in New Zealand, and points to the merits of more comprehensive and in-depth research on their role and impact. This could involve collecting quantitative and qualitative data on CHC member and community experiences, knowledge and viewpoints around the role and activities of CHCs, as well as analysis of CHC impact on health services delivery and outcome.

Conclusion

The concept of CHCs in New Zealand is a recent phenomenon, and the rationale behind establishing CHCs was to address the existing gaps in community engagement in the health system. The main role of the councils appeared to be to advise and make recommendations to concerned DHBs, and their governance and management structures, about health services planning, delivery and policy. Representing different demographic backgrounds and expertise, CHCs were involved in service delivery as well as policy and governance areas. Although they were mainly engaged in information sharing and consultation, their influence in DHBs' decision-making is not known. In a broader sense, it is important to consider how new engagement structures, such as CHCs, contributes in improving the health system and health outcomes for New Zealanders, rather than merely becoming another type of (possibly tokenistic) engagement. With increasing longevity of CHCs in New Zealand, future studies could usefully investigate CHC potential to represent the interest of local communities and their influence on DHB decision-making related to service delivery, governance and policymaking.

Competing interests:
Professor Sarah Derrett was the establishment chair for the Southern health system's Community Health Council (Dec 2016–January 2019). Professor Robin Gauld was Independent Chair of Alliance South from 2013–2017, which strongly supported the establishment of Southern Community Health Council.

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Vaccine safety

Stewart Reid

ABSTRACT

The purpose of this article is to offer evidence that vaccine safety is taken very seriously and various examples to support this premise are described. The article covers adverse event reporting following vaccination, the difference between events which occur after vaccination and events which are caused by vaccination, the comprehensive safety monitoring required when vaccines are first introduced, international vaccine withdrawals because of safety concerns and some vaccine changes in New Zealand where safety was an important consideration. Finally, recent developments in vaccine safety monitoring are outlined. It is hoped that this will be a useful resource for those involved in the complex issue of counteracting vaccine hesitancy.

WHO has listed vaccine hesitancy as one of the 10 threats to global health in 2019,[1] and it is of considerable significance in this country. According to the New Zealand Immunisation Handbook, if parents are concerned about vaccinating their children, their concerns are most often about vaccine safety.[2] I submit that there are two key issues relating to vaccine safety which require significant public airing. Firstly, while adverse event reporting following vaccination is of great importance, the difference between adverse events following vaccination and adverse events caused by vaccination requires considerable emphasis. Secondly, the importance with which vaccine safety is regarded by authorities must be prominently publicised. Evidence to support these premises is presented.

Adverse event reporting

Adverse event reporting following vaccination is essential and, for example, an important instance occurred in the MeNZB vaccination programme. The safety monitoring system was set up to detect specific adverse events following immunisation with a catch-all category allowing unanticipated events to be detected.[3] A cluster of cases of Henoch-Schönlein Purpura, an unanticipated event, occurred early in the programme and this cluster led to a detailed investigation which demonstrated that this was simply a random occurrence not related to the vaccine.[3] This illustrates the importance of adverse event reporting as it allows the detection of 'signals', which may indicate that there is a significant vaccine risk. The signal can only be confirmed or refuted as a vaccine reaction by detailed epidemiologic investigation.

Events caused by vaccination

The relationship between adverse events following vaccination and events caused by vaccination was elegantly demonstrated by Peltola and Heinonen in a large, carefully controlled study of adverse events following MMR vaccination.[4] It is generally reported that a fever of 39.4°C or more occurs in 5–15% of children 6–12 days after immunisation and generally lasts one to two days.[5] Rash occurs in approximately 5% of children at the same interval post-vaccination.[5] However, the majority of these events are not caused by MMR immunisation.

In their double-blind, placebo-controlled crossover study on 581 pairs of twins, twin A received MMR and twin B placebo on day one. On day 21 twin B received MMR while twin A received placebo. Both twins were followed up for 42 days with a symptom diary. The study demonstrated that MMR does cause fever >39.5^{0}C, but only in 1.4% recipients 7–12 days following vaccination. Irritability and rash were also more common after MMR but respiratory and gastro-intestinal (GI) symptoms less frequent. They demonstrated that the majority of adverse events following immunisation are not caused by the vaccination but occur coincidentally. This has been called the healthy vaccinee effect.

Children frequently get infections[6] and are usually vaccinated when they are well. A proportion of children will coincidentally suffer infections after vaccination. Parents either intentionally or more likely subconsciously tend to observe their children more closely than usual after vaccination and report minor symptoms which they attribute to the vaccination. Wakefield et al publicised an apparent link between GI symptoms and autism and, in eight of their total of twelve patients, to MMR vaccination in a now withdrawn Lancet article.[7] Interestingly, the article did not refer to the Peltola and Heinonen study which demonstrated a reduction in GI symptoms following MMR vaccination and for the record MMR vaccine has subsequently been shown not to cause autism.[8]

Adverse event reporting following vaccination is of great importance but it cannot be used as evidence of events caused by vaccination without careful further scientific study.

Importance of vaccine safety

Vaccine safety is taken very seriously by health authorities and there have been numerous examples of this. Most recently in New Zealand, the introduction of the MeNZB vaccination was only possible with a comprehensive safety monitoring programme which was described by the Independent Safety Monitoring Board (ISMB), who independently assessed all safety data, as an "outstanding programme of sensitive and objective safety monitoring".[9] The MeNZB vaccine, which was unique to New Zealand, was to be offered to over a million individuals aged 0–19 years in a three-dose regimen with safety and efficacy data available from only 1,068 subjects.[10] That amount of data may be acceptable to provide evidence of efficacy, but it is a very small dataset with regard to evidence of safety. To enable provisional licensure, a comprehensive safety monitoring programme was instituted. This involved establishing a national immunisation register, which used each individual's unique national health index number so that receipt and timing of vaccine doses could be ascertained. Four methods of data collection in addition to the standard passive reporting system were established; hospital-based rare event reporting, hospital-based reporting of all events within seven days of receipt of vaccination, reporting of all deaths within three months of receipt of any vaccine dose and an intensive vaccine monitoring system run by the Centre for Adverse Reaction Monitoring (CARM).[3] The rollout of the vaccine was staggered and progress from one area to the next occurred only after the assessment and approval of an agreed quantity of safety data by the ISMB.

Vaccine withdrawals

In the last 30 years there have been a number of vaccine withdrawals internationally and I offer three examples of these withdrawals. In New Zealand in the last 20 years there have been two changes of vaccine administered in the Childhood Immunisation Schedule, which were made predominately because of safety considerations.

The Nasalflu vaccine developed by Berna Biotech in Switzerland containing *Escherichia coli* heat-labile toxin as an adjuvant was available and administered during the 2000–2001 influenza season. During the pre-licensure studies on 1,218 volunteers no serious adverse events were reported. During the seven months of its use the Swiss passive reporting system received 46 reports of Bell's Palsy. Berna Biotech ceased distribution and invited the University of Zurich to investigate whether the vaccine had caused an increase in the incidence of Bell's palsy. Using matched case-control and case series analysis methodologies, the study concluded that a significantly increased risk of Bell's Palsy was present for vaccine recipients when compared to controls. The adjusted odds ratio was 84 (95% CI 20.1–351.9) with the most likely onset 31–60 days after vaccination. The vaccine is no longer in clinical use, but the signal was detected by standard passive case reporting and studied by careful scientific assessment.[11]

The first rotavirus vaccine to be licensed was RotaShield®, which was licensed for distribution in the US in 1998. Intussusception had been noted in prelicensure trials as a possible adverse effect but there was no statistically significant difference in the incidence between the vaccine and placebo groups.[12] Intussusception occurs in approximately one young child in every 10,000 regardless of vaccination history.[13] After introduction of the vaccine, intensive

surveillance for intussusception occurred and was reported at a rate of approximately 1/10,000 children vaccinated with the majority of these cases occurring in the week after receipt of the first dose of rotavirus vaccine.[13] As a result, the manufacturer voluntarily withdrew RotaShield® from the market.[13] Subsequent rotavirus vaccines were studied in large safety studies involving 60,000–70,000 subjects to exclude the possibility of a similar rate of intussusception. After marketing, the rate of vaccine-associated intussusception has been very carefully studied and shown to occur at a rate of 1–2/100,000 vaccinees,[14] usually after the first dose.

MMR vaccine containing the Urabe Mumps strain was withdrawn in the UK in 1992 following an observation of an increased risk of aseptic meningitis 15–35 days after receipt of the vaccine. It had been previously thought that the rate of aseptic meningitis following receipt of the Urabe strain vaccine was 1/100,000 doses. However, following careful surveillance including hospital- and laboratory-identified cases in the Nottingham region it was ascertained that the rate of aseptic meningitis was 1/10,000–1/15,000 doses. Further, there was a risk of admission to hospital for febrile convulsion, relating to the Urabe strain, 15–35 days after administration of the vaccine at the rate of 1/1,500 doses. This risk led to the withdrawal of the Urabe strain from the vaccine produced by Glaxo-Smith-Kline and its replacement by the alternative Jeryl Lynn strain, which does not cause aseptic meningitis.[15]

New Zealand vaccine safety decisions

In New Zealand in August 2000 the pertussis vaccine administered changed from whole cell pertussis vaccine to the acellular pertussis vaccine. The main reason for the change was that the acellular vaccine is much less reactogenic than the whole cell vaccine, and data available at the time suggested the efficacy was similar. It also resulted in a huge reduction of antigens administered; whole cell vaccines contain approximately 3,000 antigens while the acellular vaccines in use in New Zealand contain only three antigens.[16]

In 2002 the preferred polio vaccine changed from oral (live) polio vaccine (OPV) to inactivated polio vaccine (IPV). This was because in countries with high OPV coverage, cases of polio related to the vaccine strain occurred at the approximate rate of 1/750,000 first doses administered. These cases occurred because the live attenuated vaccine strain present in OPV establishes infection in the vaccinated person and can rarely revert to the original neurovirulent form and cause clinical polio. In contrast, this reversion to neurovirulence cannot occur with the inactivated injected vaccine.[16] In these two examples of changes to the New Zealand Childhood Immunisation Schedule, an increase in vaccine safety was the key deciding factor.

Developments in vaccine safety monitoring

Currently in New Zealand there is only the standard passive monitoring system but, as all vaccines used in New Zealand are widely used internationally, we benefit from the vast amount of safety data that is generated in systems such as VAERS (Vaccine Adverse Event Reporting System) in the US and Eudra Vigilance in the EU. However, there is a move towards more active monitoring such as that used in Australia where vaccinees or their parents/caregivers can directly report adverse events.[17] During the MeNZB campaign an active system was in use in which the clinical records for a six-week period following receipt of any vaccine, from a representative sample of GPs, were sent to CARM.[18] Should this system be resurrected either continuously or at least for several months before and after any change to the childhood vaccination schedule? The Uppsala Monitoring centre has recently reported that it is looking at modernising vaccine surveillance to better detect rare adverse events.[19] It is suggested that new data analysis approaches may allow improved monitoring of vaccine safety, particularly for hard to diagnose illnesses such as postural orthostatic tachycardia syndrome. It is also proposed that it may be possible to identify biomarkers which may indicate individuals at higher risk of suffering adverse events.

Conclusion

Vaccines are not perfect, but their imperfections are taken very seriously. As can be seen from the above examples, vaccine safety is considered extremely carefully, and all vaccines are subject to safety surveillance starting with the prelicensure trials. After marketing the reporting of adverse events after vaccination is essential to detect signals of events which may be related to vaccination, but the causal relationship with a vaccine can only be determined by further study. As shown by Peltola and Heinonen,[4] many events occurring after vaccination are coincidental. However, when events are related to vaccination, even at a relatively low frequency, vaccines are withdrawn from use. The monitoring systems are subject to review and improvement. Vaccine safety is taken very seriously.

Competing interests:
Dr Reid reports personal fees from GSK, personal fees from Ministry of Health NZ outside the submitted work.

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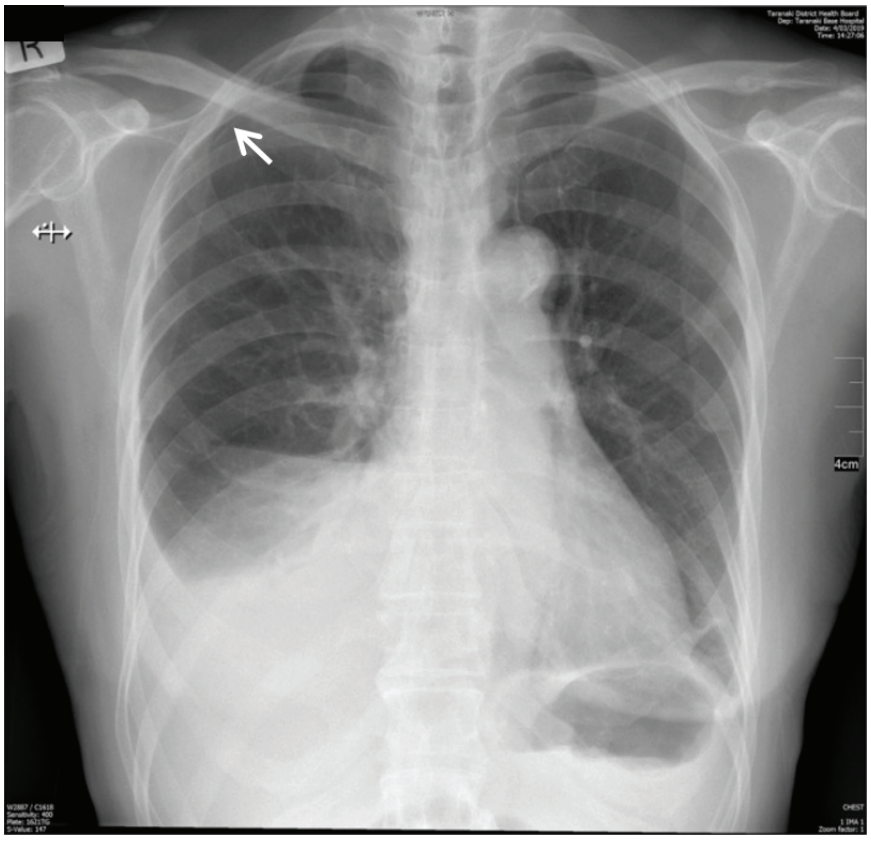
Empyema following laparoscopic appendicectomy—was peritoneal lavage to blame?

Jasmin King, Glenn Farrant

A 67-year-old Taiwanese female presented to ED with a history and examination typical of appendicitis. An abdominal CT demonstrated acute uncomplicated appendicitis, and she proceeded to laparoscopic appendicectomy. Intraoperative findings consisted of a swollen appendiceal tip, a friable base but no necrosis or perforation was present. Due to concern regarding a microperforation or microbiological contamination from the friable appendiceal stump, the abdominal cavity was thoroughly washed until returning clear fluid; a total of 2L was used. Histology results later confirmed acute appendicitis and peri-appendicitis.

On post-operative day 1, the patient developed right-sided pleuritic chest pain and decreased air entry to the right upper lobe. A CXR indicated a small right pneumothorax and pleural effusion (Figure 1); this was reconfirmed on CT.

Figure 1: Post-operative day 1 chest x-ray showing right-sided pneumothorax and pleural effusion. (Pneumothorax difficult to visualise, indicated by arrow).



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IV augmentin was commenced and a diagnostic thoracocentesis performed, draining 400ml of haemoserous fluid. Fluid analysis showed an exudate by Light's criteria, high WBC (111,729x10^6/L) and occasional G+ cocci on microscopy. Culture of the fluid grew *Escherichia coli;* a sample of the aspirate in blood culture bottles also grew *Streptococcus anginosus* after one day. These findings are consistent with a diagnosis of empyema, with pneumothorax likely arising secondary to this.

Serial CXRs over following days showed worsening of the effusion size and a CRP rise to 280, thus thoracocentesis was repeated on day 6 with <50ml of exudative fluid drained. No organisms were visualised or grown.

On day 6 the patient developed febrile episodes, a rise in the WBC/CRP and recurrence of pleuritic chest pain. Blood cultures were negative. A third thoracocentesis was performed on day 10. Clinically, septations were present and only 100ml of exudative, bloodstained and fibrinous fluid was obtained. A drain was kept in-situ for 72 hours to ensure resolution. Biochemical and clinical improvement was noted with cessation of fevers, normalisation of WBC and down-trending of CRP.

On day 13 the patient was discharged home on oral augmentin but subsequently represented with fevers. Empyema was re-demonstrated on CXR and chest CT but WBC remained normal, CRP low (54) and blood cultures negative. Thus, a conservative approach of IV augmentin was adopted. The patient remained clinically well with down-trending inflammatory markers and was finally discharged on post-operative day 17.

Discussion

Laparoscopic appendicectomy is usually a straightforward operation. Common complications are bleeding, wound infection or abscess formation.[1] Empyema is much rarer, with few published case reports.[2–4] We believe this is the first documented case of empyema post-laparoscopic appendicectomy in the absence of either perforation or subphrenic abscess.

We believe a congenital right-sided diaphragmatic defect was present, which allowed passage of intra-abdominal wash fluid into the pleural space. Contributory factors included microbiological contamination of the wash fluid from appendix amputation and the patient's head-down positioning.

No patent diaphragmatic foramina or subphrenic abscesses were visualised on CT, although foramina could not be definitively ruled out without thoracoscopy. The mechanism of the pneumothorax was presumably secondary to empyema, with mainstays of treatment being thoracocentesis/drainage and antibiotics.

At present, many surgeons utilise peritoneal lavage with discretion, the rationale being "the solution to pollution is dilution". However, there has been a lack of conclusive evidence regarding its efficacy. Most recently, two meta-analyses from 2018[5] and 2019[6] indicate no demonstrable benefit of peritoneal lavage in preventing intra-abdominal abscess, wound infections or reducing length of stay. It is important to note there is significant heterogeneity between results of included studies, thus the quality of the evidence is still only moderate.

Though our case occurred due to a combination of factors (including the likely presence of an unknown pre-existing anatomical abnormality), it should still serve as a reminder that interventions with no proven benefit may be associated with complications. Thus, we suggest that usage of peritoneal lavage be wholly avoided, or at least minimised to cases where significant peritoneal contamination has occurred. Furthermore, technique should minimise contamination of the peritoneal cavity beyond the affected area—usually achieved by using small aliquots of irrigation and appropriate patient positioning.[7] Hopefully, future studies will provide a definitive answer regarding whether peritoneal lavage provides any clinical benefit, or if it should firmly relegated to a practice of the past.

Competing interests:
Nil.

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Adolescent cannabis use continues its downward trend, New Zealand 2012–2018

Jude Ball, Niveditha Gurram, Greg Martin

A recent research article in the *NZMJ* showed that cannabis use declined in secondary students (13 to 18 years old) between 2001 and 2012, with particularly strong declines among Māori and students at low-decile schools.[1] The article provided data and commentary relevant to current cannabis law reform debates, but left trends since 2012 unexamined. This research letter provides an update on adolescent cannabis use trends for the 2012–2018 period using a nationally representative survey of Year 10 students (Youth Insights Survey) administered by the Health Promotion Agency/Te Hiringa Hauora (HPA).

Methods

The Youth Insights Survey (YIS) formed part of the New Zealand Youth Tobacco Monitor, and has included a question on cannabis use since 2012. It is a nationally representative self-report survey of Year 10 students (predominantly 14 to 15 year olds) conducted in schools every two years.

A two-stage cluster sampling design is used, where first schools are randomly selected and then classes are randomly selected within participating schools. School response rates ranged from 68% (2018) to 77% (2012), and student response rates ranged from 82% (2012) to 86% (2016). Over the 2012 to 2018 period, 11,838 students participated in the survey: 3,171 in 2012; 2,935 in 2014; 2,974 in 2016; 2,758 in 2018. Further details about the survey design, procedures and response rates are available in methodology reports produced for each survey year and available on HPA website.[2]

For the purposes of this study, analysis was restricted to 14 and 15 year olds to improve comparability between years. After this exclusion was applied, 11,445 students were included in the analysis.

Cannabis use is based on the question: 'During the last 30 days (one month), how often did you smoke marijuana (pot, grass, weed, cannabis)?' Answer options were: 'I have never smoked marijuana', 'In the past but not in the past 30 days', 'Once or twice in the past 30 days', 'Two or three times in the past 30 days', 'About once a week', 'Several times a week'.

Four categories of cannabis use were identified: never use, ever use, past month use (ie, 'once or twice in the past 30 days' or more often) and weekly use (ie, 'About once a week' or more often). Note that these categories are not mutually exclusive. Descriptive statistics were used to calculate the number and proportion in each category. The denominator included participants who did not respond to the cannabis question. Weighted proportions were calculated using delete-a-group jack-knife method and 95% confidence intervals (CI) were used to represent the sample errors for estimates. Any difference between survey years was confirmed using *p* value that was calculated using Pearson's chi-square test. Analyses were performed using STATA version 15.0.

Results

Recent trends in cannabis use among Year 10 students are presented in Table 1. Between 2012 and 2018 the proportion who had never used cannabis increased from 80% to 85%. Ever use decreased from 19% to 14% and past month use decreased from 10% to 8% over the same period. There was no statistically significant change in weekly use. It is notable that the decline appears to be slowing, with little or no change in the most recent (2016–2018) period for both 'ever use' and 'past month use'.

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Table 1: Prevalence of cannabis use in New Zealand Year 10 students (14 to 15 year olds), 2012–2018.

	2012 (N=3,017)		2014 (N=2,855)		2016 (N=2,884)		2018 (N=2,689)		Statistical significance of di ̧erence between 2012 and 2018
	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	p
Never use	2,426	79.7 (77.5–81.9)	2,336	81.2 (78.9–83.5)	2,380	82.1 (80.1–84.0)	2,281	84.7 (82.8–86.6)	<.01
Ever use	544	18.7 (16.6–20.8)	374	13.6 (11.6–15.6)	401	14.1 (12.6–15.5)	379	14.2 (12.3–16.0)	<.01
Past month use	290	9.9 (8.6–11.3)	271	9.9 (8.1–11.7)	225	7.9 (6.7–9.0)	211	7.8 (6.4–9.1)	<.05
Weekly use	117	4.1 (3.2–4.9)	96	3.7 (2.5–4.8)	79	2.9 (2.2–3.6)	92	3.3 (2.6–4.0)	ns

Discussion

The findings confirm that cannabis use in Year 10 students has continued to decline since 2012. This was predicted, since cannabis trends in this age group are strongly associated with tobacco trends, and it was already known that smoking in Year 10 students had continued to decline since 2012.[3]

In contrast, the New Zealand Health Survey (NZHS) shows that cannabis use has increased substantially among adults over the same period. Past year use increased from 9% in 2012/13 to 15% in 2018/19 overall, and from 19% to 29% among 15 to 24 year olds, the age group with the highest cannabis usage.[4]

New Zealand and international evidence suggests there are two key reasons for this discrepancy between adolescent and adult cannabis trends. Firstly, the average age at which young people are initiating risk behaviours, including cannabis use, has increased in recent years.[5–8] Secondly, normalisation of cannabis use has been counteracted by decreasing prevalence and frequency of smoking and drinking in this age group.[9,10] The evidence suggests that adolescents' willingness to try cannabis has increased, but their opportunities for doing so have decreased due to less face to face time with friends and fewer drinking and smoking occasions.[11,12]

A methodological strength of the YIS survey is the consistency of the cannabis question wording, study design and administration, providing strong comparability across years. The survey has a large sample size and a good student response rate. A limitation of the current study is that it includes only 14 and 15 year olds. Therefore trends in older secondary school students (among whom cannabis use is likely to be more prevalent) remain unknown. However, this information gap will be filled when the results of the Youth19 survey by the Adolescent Health Research Group are released in 2020.

Competing interests:
Nil.
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Fracture of both Patellae

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New Zealand soldiers playing rugby, Fontaine. Royal New Zealand Returned and Services' Association :New Zealand official negatives, World War 1914-1918. Ref: 1/2-013634-G. Alexander Turnbull Library, Wellington, New Zealand. / records/22732805

The following cage of fracture of both patellae, almost simultaneously, by muscular violence, is somewhat unusual:—

A.B., aged 28 years, solicitor, admitted 7th June, 1918. On this date he was running at football and felt his left knee crack. He experienced a sensation as if the joint were getting stiff, and was considering going off the field. Just at this moment the ball came his way. He took it and began to run, collapsing immediately in a heap, as he felt his right knee give way.

On examination, right knee showed fracture of patella and considerable separation of the fragments, with the usual effusion of blood. Left knee, contour normal, but some pain in patella. No deformity could be felt on the left side.

The skiagrams showed fractures of both patellae. Right patella wired on 13th June. The left was treated on a splint with the knee extended. Recovery uneventful, patient walking well in five weeks from his accident.

My best thanks are due to Mr. S.H. Pryor for the excellent plates and photographs of the condition.

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