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Regulation of physician associates in Aotearoa New Zealand

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Lisa deWolfe, Shelly Collins

Physician associates and their healthcare teams that work in Aotearoa New Zealand await regulation that will offer a cost-effective, sustainable workforce solution. Regulation for this profession improves patient safety, reduces risk and allows the profession a full scope of practice, including prescribing rights that can only follow regulation. Regulation is a major determinant as to whether the profession can become a workforce multiplier like it has in many other countries.

Review of the Health and Disability Commissioner Act and Code—your chance to have your say

Frank Frizelle

The Code of Health and Disability Service Consumers' Rights and the *Health and Disability Commissioner Act* are at present being reviewed as required every 5 years by the *Act*, and submissions close on 31 July 2024. There has been much made of the tension between the Health and Disability Commissioner (HDC) and the healthcare providers in the media of late—here is an opportunity to have your say about the HDC *Act* and Code.

Outcome measures for Māori with non-traumatic dental presentations: a retrospective observational study and Kaupapa Māori approach examining emergency department inequities

Sam Cameron-Dunn, Calum Fisher, Tania Huria, Andrew McCombie, Angela Forbes, Laura R Joyce

We investigated characteristics of patients presenting to the Christchurch Emergency Department (ED) and followed them through all the steps of waiting in ED, being seen by a doctor and either being admitted to the hospital or discharging. We then compared this experience between ethnicities to see if there were overall differences in who was presenting to ED and how they were being provided care in the hospital. NZ European patients were less likely to present with non-traumatic dental problems, such as toothache, than Māori and Pacific peoples. NZ Europeans were older, lived in areas of lower deprivation and were less likely to be admitted to hospital—a marker of severity of disease—than Māori. These findings highlight failures in dental care for Māori patients in Aotearoa New Zealand, specifically barriers to accessing primary oral healthcare and a paucity of Kaupapa Māori initiatives. Further action and accountability are required to provide high-quality, equitable care for Māori.

Update and projections for New Zealand's ophthalmology workforce

Chuen Yen Hong, Michael Merriman, Graham Wilson, Sheng Chiong Hong

New Zealand has not had a comprehensive review of eye care workforce availability since 2010. Globally, the demand for eye care is increasing faster than the rate at which ophthalmologists are being trained. The article aimed to update and project the growth of ophthalmologists in New Zealand. Results from the study showed that in order to meet the demand of an increasing and aging population, and the Royal Australian and New Zealand College of Ophthalmologists' goal of 40 ophthalmologists per million population, we need to increase the number of ophthalmologists training positions from the current 5-year average of 6.6 to 11 new trainees annually.

Characteristics of low, moderate and high severity trauma hospitalisations in a health region of Aotearoa New Zealand—10-year review

Grant Christey, Ishani Soysa, Alastair Smith

New Zealand has a higher burden of disease than other high-income countries, as measured by the number of disability-adjusted life years (DALY). Falls, road traffic crashes and self-harm are among the top 10 causes of DALY. However, there is limited information available about the incidence of injuries based on their severity and the cost of hospital care. Equitable use of resources for the prevention and treatment of injuries depends on the use of reliable and representative information on incidence rates and risks across ethnicities and demographic groups in the New Zealand context. This research aims to describe the incidence and characteristics of injuries that result in hospital admission in the Te Manawa Taki Region of New Zealand. The study also assesses the associations between injury severity and the cause of injury, length of hospital stays and cost.

Nitrous oxide myelopathy: a case series

Shilpan G Patel, Tony Zhang, Bernard Liem, Frederick Sundram, Richard H Roxburgh, P Alan Barber

Nitrous oxide is sold as a dairy-cream whipping agent; however, it is also inhaled recreationally as a drug of abuse. Inhaling this drug depletes active vitamin B12 in the body, which leads to nerve and spinal cord damage. This can lead to impairment with walking, sensation and balance. Patients can recover from this condition; however, a quarter of our patients were left needing assistance with basic activities of daily living 3 months after their diagnosis and treatment due to slow recovery.

Addressing closed and limited enrolments in general practices in Aotearoa New Zealand: a mixed-methods study

Nisa Mohan, Maite Irurzun-Lopez, Megan Pledger, Mona Jeffreys, Jacqueline Cumming

In this study, researchers talked to experts and professionals working in general practices to understand why some GPs cannot take new patients. They found a few main reasons: not enough doctors and nurses, not enough money to cover the costs, staff having too much work, problems because of COVID-19 and worries about how good the care is if they take on too many patients. To fix this, they suggested hiring more doctors from other countries, training more medical students and giving them more experiences in general practice, making sure GPs and nurses get paid as much as those in hospitals, and changing how the government gives money to general practices based on patient needs.

Use of medications for migraine in Aotearoa New Zealand

Fiona Imlach, Sue Garrett

This study reports on a survey of 530 people with migraine that asked about use of medications to both treat and prevent migraine attacks in the last month. Participants were also asked about previous use of medications, reasons for stopping them and reasons for or against use of new migraine medications. International guidelines provide a clear consensus about best-practice migraine treatment, giving limits on the number of days a month that acute treatments can be safely taken, recommending against use of opioids and outlining when preventive medication is indicated. However, around a quarter of survey respondents were not taking acute medication in line with these guidelines and close to half of those eligible for preventive medication were not taking it, often because these medications did not work or had significant side effects. There is a clear unmet need for more effective and safer migraine treatments, but most new medications are not available in New Zealand. For medications that are available, respondents identified cost, lack of knowledge and awareness as barriers to their use. Improved access to treatments is needed to give people with migraine better options to manage their disease, reduce the impact and burden of migraine disease and enable health professionals to offer best-practice treatment.

ANZACS-QI Heart Failure Registry: a new approach using age-stratified sampling of hospital discharges to guide quality improvement (ANZACS-QI 79)

Daniel ZL Chan, Robert N Doughty, Mayanna Lund, Aleisha Easton, Katrina K Poppe, Daman Kaur, Lia Sinclair, Julie Chirnside, Catherine Malone, Helen McGrinder, Andy McLachlan, Jo Scott, Jennifer Roberts, Cara Wasywich, Gerry Devlin, Matire Harwood, Sue Wells, Wil Harrison, Andrew J Kerr

Heart failure is a common health problem in New Zealand and carries a high risk of hospitalisation and death. Effective treatments are available; however, studies have shown that they are under-utilised. The ANZACS-QI Heart Failure Registry is a database of routinely collected healthcare information from patients admitted to hospital with heart failure. This data will be used to inform strategies to improve the care of patients with heart failure in New Zealand.

Cribriform adenocarcinoma of the minor salivary glands: case report and literature review

Maria van Kuijk, Harsha De Silva, Ling Chan, Guangzhao Guan

Cribriform adenocarcinoma is a rare type of cancer that affects the salivary glands, classified as a low-risk malignancy by the World Health Organization. It represents less than 1% of all salivary gland tumours. This cancer occurs equally in men and women and is more common among African and African American individuals. Typically, it is found on the tongue but can also appear on the palate, tonsils, maxillary sinus/nasal area and the area behind the molars. The document reports an unusual case of cribriform adenocarcinoma in the minor salivary glands of the left retromolar trigone and reviews current research on its characteristics and frequency.

Regulation of physician associates in Aotearoa New Zealand mitigates a medical practitioner workforce crisis and leads to stronger, diversified healthcare teams

Lisa deWolfe, Shelly Collins

Physician associates (PAs) were introduced in Aotearoa New Zealand in 2010. In 2013, PAs began to fill the demand for healthcare practitioners during a predicted doctor shortage in Aotearoa New Zealand. Approximately 11 years later the shortage is being called a health crisis.[1,2] There are healthcare worker shortages in many countries and predictions reveal this trajectory will not diminish soon. Estimates from the World Health Organization state there will be a global shortage of 10 million healthcare workers by 2030, mostly in low- and low–middle-income countries.[3] These shortages and forecasted deficiencies have caught the attention of several countries.

If Aotearoa New Zealand wants to change its trajectory and deliver positive change to the healthcare system, strategic insight and a timely action plan are necessary. Like many countries during the pandemic, our country was tested and stressed with border closings, and an even greater workforce shortage emerged. The economic impact cannot be erased. A step in this timely action plan and a means of expanding the role of medical service delivery is to fill a portion of the workforce gap with the PA profession. The profession was built on doctor shortages in the United States in the late 1960s and it has continued to expand globally. An impressive catalogue of medical workforce studies identifies the PA as a highly trained, cost-effective and patient-satisfying addition to the workforce. Globally, there are over 170,000 physician assistants/associates and 366 training programmes.[4] This article looks at what the profession offers Aotearoa New Zealand amid a health workforce crisis. The views and information expressed in this report are gathered from two PA workforce demonstration pilots,[5] combined with research and input from workforce strategists, employers, stakeholders and doctors.

A formalised strategic plan to support doctor shortages began in 2018 with the New Zealand Physician Associate Society (NZPAS) and a few PAs who worked in Aotearoa New Zealand at that time. Expanding the profession with rural placement was a priority. Within 5 years of this initiative, a 10-fold increase in PA employment was realised.[6] With nearly 50 PAs in the country, many have become residents of Aotearoa New Zealand.[6] These PAs are employed in general practices, urgent care, dermatology clinics and an emergency department.[6] However, regulation of the profession is necessary and to delay this will prevent this highly skilled practitioner from becoming a workforce multiplier, as it has been in other countries.

PAs are healthcare professionals trained under the medical model, and they practise medicine with medical practitioner supervision. They offer a unique and flexible role within the healthcare team. Trained in health sciences, along with partaking in clinical rotations, their skill set aligns closely with their supervising doctor(s). The scope of practice and professional autonomy of PAs varies slightly internationally due to different healthcare systems, regulatory frameworks and professional standards.[7,8] The range of medical tasks the PA performs daily includes physical examination, diagnosing and treating illnesses, ordering and interpreting medical tests, assisting in surgery, writing prescriptions and providing preventive healthcare services. All tasks are undertaken within a framework of delegated practice, with the PA located with a doctor on-site or contactable to a doctor at a distance.[4] The role is flexible and offers crossover into a range of medical specialties. A PA's scope can move from general practice to a specialty, like orthopaedics or psychology. Those

working in primary care cover general practice, paediatrics and women's health, and work in clinics alongside general practitioners. Due to their unregulated status here, PAs cannot prescribe and everything they do is under the supervising doctor's registration.[6]

The specialty PA becomes an expert in their chosen area of medicine and can offer relief in under-served areas and areas with critical shortages. Settings can include prisons, in- and outpatient hospital departments, dermatology, geriatrics, nephrology, surgery, orthopaedics, gastroenterology, urology, occupational health and telehealth. This flexibility marks the role as an addition to current teams and not a replacement.[9] However, lack of regulation stymies what PAs can offer within Health New Zealand – Te Whatu Ora, the public system.[10] Currently, PAs cannot work in hospitals and most specialty practices until the profession is regulated. Private clinics with some government funding do hire PAs because there are not enough doctors in the country and the profession has proven its worth as a role that is able to support shortages.

Employers, staff and doctors working with Aotearoa New Zealand PAs wholeheartedly support regulation.[6] A central policy that ensures public safety and provides a full scope of practice for the profession is considered essential.[7,8,11] Research that compares the work of PAs and that of doctors assures that if quality of care is maintained, patients trust PAs, and access to and the cost of care improve without compromising safety.[6,12]

One of the strongest arguments that has been made by supporters is that PA regulation will protect the public. Medical practitioners looking after the healthcare of individuals face unwanted liability when they supervise unregulated professionals.[6] There is a voluntary register for PAs set by NZPAS. However, with the growing numbers of PAs it is unclear what percentage of qualified and practising PAs are on this register. The possibility of a growing group of advanced healthcare providers practising medicine in Aotearoa New Zealand without a national regulatory authority is risky. In addition, concerned parties have questioned the PA profession's capability and education. Regulation would address this by ensuring that all registrants are competent and fit to practise in New Zealand, with education, professional conduct and practising standards set by the regulatory authority.[6] A full scope includes prescribing authority rights and ordering testing and imaging under their registration.

The PA profession has expanded internationally and is meeting healthcare demands in over 18 countries with 25 more countries using alternative names for similar roles. The model and international training is becoming more standardised, and regulation is on the increase, most recently progressing in the United Kingdom and Canada.[11] PAs are practice-focussed, train within the medical model and have relatively shorter training than doctors. As a result, they can adapt to a broad range of clinical settings and clinical specialties.[7] They do not seek to practise independently of doctors. Hospitals found that they could substitute about 50–75% of a doctor's work with one PA. One of the advantages of having PAs working in house officer positions is the continuity of service they offer. They are not rotated as junior medical staff are, and they are trained for a specific role and stay with it. They offer an added teacher for nurses and junior doctors and are invaluable in hospital wards and emergency departments that often get overwhelmed.[12]

As of May 2024, there were 43 PAs practising in Aotearoa New Zealand across 29 clinics in both the North and South Islands, with four more PAs awaiting visas and seven more clinics actively recruiting a PA. There has been a 100% satisfaction rate for clinics who employed a PA, with 11 of the 29 clinics who have hired a PA choosing to hire a second or even third PA.[6] Several clinics await their first PA hires this year. PAs have been shown to decrease burnout and increase job satisfaction among physician teammates.[6,12] PAs already play a crucial and expanding role in providing quality healthcare services to hundreds of thousands of New Zealanders a year, particularly in underserved communities. Quick expansion can help further in the public system and within specialty practices facing workforce shortages. To address existing risk and to make them sustainable and fully integrated into these communities, a centralised regulatory authority is necessary and will provide consistent standards of practice and patient safety.[7] However, a few members of some of the medical colleges and the Medical Council of New Zealand propose various concerns that regulation can wait, risk can be ignored and regulation is not essential at this time. Unfortunately, these influential individuals are not considering important factors that are essential in terms of supporting their colleagues and the public. Small numbers may seem like a strong argument but for doctors, nurse practitioners

and clinic staff working under stress in crisis conditions this is no small matter. They want regulation and prescribing rights for the PAs they are working alongside.[6] As PAs are relatively new to Aotearoa New Zealand, the country's inexperience of the PA role is understandable. Realisation that this profession is high risk needs to be clear and the following obstacles accepted as accurate and significant. These obstacles have not been resolved and stakeholders understand there has not been success on these important issues. Indemnity insurance and Accident Compensation Corporation coverage is not set. Prescribing rights and a full scope, which constitute the PA role only, follow regulation. In New Zealand it has been established that no domestic training programme can begin without regulation due to the profession's partial scope, vulnerability of standards and namesake.[6] PA training often sits alongside medical schools and allows shared coursework, professors and cost. Medical schools have expressed interest for a training programme after regulation is secured.[6] Professions need domestic training programmes that allow access to homegrown workers. Aotearoa New Zealand specifically needs individuals from small rural communities, including Māori and Pacific individuals, to train in a tertiary programme and return quickly to the communities to provide high-standard medical care. Policymakers, risk management systems and the *Health and Disability Commissioner Act* have long set rules and responsibilities for doctors and many medical professionals to abide by many standards of care under regulation. The PA application for regulation has progressed through all the standardised steps the Ministry of Health regulatory body requires, up to and including the health minister review and support.[6] When the choice for the regulatory body is set, regulation for PAs awaits the final step that will anticipatingly be an enthusiastic and astute supportive vote from Parliament to become law—thus offering the public a regulated, safe, full-scope PA profession to further assist healthcare teams and support a struggling workforce.

COMPETING INTERESTS
Nil.

AUTHOR INFORMATION
Lisa deWolfe: Physician Associate, Emeritus, Past President, New Zealand Physician Associate Society.
Shelly Collins: Physician Associate, President, New Zealand Physician Associate Society.

CORRESPONDING AUTHOR
Lisa deWolfe: Physician Associate, Emeritus, Past President, New Zealand Physician Associate Society.
E: Fitzydew08@gmail.com

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Review of the Health and Disability Commissioner Act and Code—your chance to have your say

Frank Frizelle

Most healthcare providers have had dealings with the office of the Health and Disability Commissioner (HDC) at some point. Recent articles in the lay media have drawn attention to the stress in the relationship that exists between the HDC and healthcare providers.[1,2] The Code of Health and Disability Services Consumers' Rights (the Code) and the *Health and Disability Commissioner Act*[3,4] are at present being reviewed as required every 5 years by the *Act*, and submissions close on 31 July 2024.

The office of the HDC was set up following the enacting of the *Health and Disability Commissioner Act* in October 1994. The *Act* established the HDC, with the role of promoting and protecting the rights of health and disability services consumers, and facilitating the fair, simple, speedy and efficient resolution of complaints. The *Act* was passed to implement the recommendations of Judge Cartwright in her 1988 *Report of the Cervical Cancer Inquiry*. Judge Cartwright stated that there was a strong need for the establishment of a Commissioner as an independent complaints resolution and educational body, and for a Code of patients' right.[5] The first Commissioner, Robyn Stent, was appointed in December 1994. The Code was made regulation in 1996 and applies to all providers of health and disability services.

Every provider is subject to the duties in the Code. Every provider must take action to inform people of their rights and enable them to exercise their rights. A provider is not in breach of the Code if he/she/it has taken reasonable actions considering the circumstances to give effect to the rights, and comply with the duties, in the Code. However, the onus is on the provider to prove that reasonable actions were taken.

The Code sets out 10 rights:[4]

1. The right to be treated with respect.
2. The right to freedom from discrimination, coercion, harassment and exploitation.
3. The right to dignity and independence.
4. The right to services of an appropriate standard.
5. The right to effective communication.
6. The right to be fully informed.
7. The right to make an informed choice and give informed consent.
8. The right to support.
9. Rights in respect of teaching or research.
10. The right to complain.

The complaint mechanisms under the *Health and Disability Commissioner Act* have become the primary vehicle for dealing with complaints about the quality of health and disability services in New Zealand. Most complaints are dealt with in a timely manner and without the need for a full investigation; the complaints that do require full investigations that can take 3 years and are anything but timely.

The findings, however, of some of the HDC investigations have major impacts on healthcare provision in New Zealand. The 1998 Stent Report,[6] which made 112 recommendations and altered the managerial approach to healthcare that had evolved under the free market approach of the time, established the power of the HDC. Subsequent incisive investigations such as the recent report on oncological care in the Southern district, where the HDC found (among other things) that Te Whatu Ora Southern failed to recognise and respond to the clinical risk created by the lack of capacity within the Southern Blood and Cancer Service (SBCS), and that this was due to poor overall clinical governance systems, including inadequacies in quality measures and indicators, and poor relationships between clinicians and executive management have also helped to establish what is expected of healthcare providers.[7] The HDC has, over the years, repeatedly stressed issues around informed consent, and its decisions have helped re-model minority rights in healthcare; however, most importantly, it has given

patients a voice in healthcare provision.

The volume of work the HDC has to deal with is considerable and increasing rapidly. In the 2022/2023 HDC Annual Report, the commissioners stated that during 2022/2023, the HDC received 3,353 complaints, up 36%. Despite these pressures, the HDC succeeded in closing 6,028 complaints—clearing a lot of backlog.[8] With this increasing workload, resourcing has been an issue, especially with the reported NZ$3 million budget cuts.[9]

Submissions for the review of the *Act* and Code close on 31 July 2024. The portal for information is on the HDC website; though is hard to find and is part of 10 revolving sections in the right upper part of the HDC website—alternatively, it can be found under the "Your Rights" section of the pull-down menu.[10] These areas contain information on how to make a submission.

The portal states "*We want to know how you think we can make the Act and the Code better. You will be able to answer questions on five topics:*

- *Supporting better and equitable complaint resolution;*
- *Making the Act and the Code more effective for, and responsive to the needs of, Māori;*
- *Making the Act and the Code work better for tāngata whaikaha | disabled people;*
- *Considering options for a right of appeal of HDC decisions; and*
- *Minor and technical improvements.*"[10]

The feedback will aid the HDC to make recommendations to the minister of health to improve the *Act* and the Code. Or, as Machiavelli states in *The Prince*, "*He ought to question them upon everything, and listen to their opinions, and afterwards form his own conclusions.*"[11] These recommendations are due by 20 December 2024, and the minister of health must present a copy of the report to Parliament within 12 working days of receiving it. Publishing recommendations just prior to Christmas is often a way of burying them, and how 12 working days works when the report is realised on 20 December will be interesting.

As healthcare providers, if you want to comment on the HDC *Act* or Code, now is the opportunity, so either express your opinion or live with the outcome of those who do.

COMPETING INTERESTS
Frank Frizelle is the Editor-in-Chief of the *New Zealand Medical Journal*.

CORRESPONDING AUTHOR INFORMATION
Frank Frizelle: Editor-in-Chief NZMJ; Professor of Surgery; Department of Surgery, University of Otago Christchurch, New Zealand.
E: Frank.Frizelle@cdhb.health.nz

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Outcome measures for Māori with non-traumatic dental presentations: a retrospective observational study and Kaupapa Māori approach examining emergency department inequities

Sam Cameron-Dunn, Calum Fisher, Tania Huria, Andrew McCombie, Angela Forbes, Laura R Joyce

ABSTRACT

AIM: To assess the equity of care of patients with non-traumatic dental presentations (NTDP) to Christchurch Emergency Department (ED) in Aotearoa New Zealand.

METHODS: This retrospective observational study reviews NTDP to Christchurch ED over a 2-year period (2018–2020). ED and hospital outcomes were compared for Māori, Pacific peoples and NZ Europeans. Results are interpreted utilising Te Ao Māori principles and discussed referencing a Kaupapa Māori framework.

RESULTS: There were a total of 2,034 NTDPs, with Māori (27.0%) and Pacific peoples (6.9%) being over-represented compared to local population estimates (9.4% and 3.2% respectively). Māori experienced shorter wait times (45 minutes, 95% CI 22–86) compared to NZ Europeans (56 minutes, 95% CI 24–97) and Pacific peoples (54 minutes, 95% CI 23–97). Māori had the highest age-standardised incidence of admission, but shorter hospital length of stay (0.9 days, IQR 0.4–2.3) compared to Pacific peoples (3.8 days, IQR 1.8–3.9) and NZ Europeans (2.0 days, IQR 1.0–3.7).

CONCLUSION: This is the first paper to employ a Kaupapa Māori approach examining NTDP patients presenting to the ED. While outcome measures were largely positive, differences in demographic variables indicate upstream failures, specifically barriers to accessing primary oral healthcare and a paucity of Kaupapa Māori initiatives. Further action and accountability are required to provide high-quality, equitable care for Māori.

In Aotearoa New Zealand, Māori experience higher unmet dental need, lower access to primary dental care and increased dependence on acute dental care.[1–3] Oral health inequities lead individuals to utilise emergency departments (EDs) for toothaches, dental abscesses and other conditions termed non-traumatic dental presentations (NTDP). Of NTDP, Māori are disproportionately over-represented compared to non-Māori.[3–5] Despite nearly 3 decades of healthcare professionals working towards oral health equity, Māori continue to face persistent adverse oral health outcomes, violating rights enshrined in Te Tiriti o Waitangi.[2,6] The Manatū Hauora – Ministry of Health Māori Action Plan, *Whakamaua*, strategically addresses these issues, emphasising the auditing of acute inpatient services as a crucial indicator of healthcare system equity.[7]

Systemic bias and structural racism are underlying causes of ethnic health inequities that contribute to individuals utilising acute services to access healthcare in Aotearoa New Zealand.[8] Unfortunately, EDs are complex environments operating under time and resource constraints that pose challenges to delivering high-quality and equitable care to diverse populations. Clinicians are susceptible to unconscious biases, such as racial bias and stereotyping, which can be heightened in this environment due to factors such as overcrowding, variability of patient acuity and flow, and cognitive load.[9] Despite high ED utilisation by Māori, few studies have examined ethnic disparities in emergency care in Aotearoa New Zealand. A study by Curtis et al. demonstrated that, despite some positive ED process measures, non-Māori received faster triage, had lower mortality within 10 days of departure and lower rates of repeat presentations compared to Māori attending ED.[10] Another study by Prisk et al. found that non-Māori were more

likely to receive investigations, go to observation areas and were less likely to be discharged or self-discharge than Māori.[11]

The Australasian College for Emergency Medicine (ACEM) has recently released *Te Rautaki Manaaki Mana* to promote equity for Māori within EDs in Aotearoa.[12] The strategy aims to guide clinicians in achieving health equity in EDs by advocating for research that is relevant, safe and responsive to Māori, and incorporates Kaupapa Māori values and methodologies. Kaupapa Māori methodology includes rangatiratanga (Māori research leadership), acknowledgement of mātauranga Māori (Māori knowledge and worldview), positioning Māori at the centre of research objectives and adopting a structural determinants approach to address issues of power, racism and privilege.[13] Several frameworks exist for researchers to utilise to promote equitable research practices.[2,13,14] Failing to embrace research methods that acknowledge the adverse impacts of colonisation perpetuates health inequities.[13]

The present study aims to assess the equity of care received by patients with NTDP at Christchurch ED by comparing demographic variables and outcomes measures between Māori and non-Māori. The study employs a Kaupapa Māori approach and framework to describe findings.

Tikanga (methods)

Positionality statement

This study recognises Te Ao Māori principles and Māori-centred analysis frameworks reflected in: rangatiratanga (Māori research leadership), undertaking Māori:non-Māori comparisons, maximisation of statistical power to quantitatively examine Māori:non-Māori inequities, and use of conceptual frameworks that enhance the reporting of Indigenous health research.[13,14] Our discussion is presented through a Kaupapa Māori framework previously utilised to explore oral health in Aotearoa New Zealand through the following criteria: whakapapa (lineage), whakakotahitanga (unity), whakawhānuitanga (diversity), whakawhanaungatanga (relationships), whakapakari (capacity building), rangatiratanga (leadership) and māramatanga (enlightenment).[2]

The first author SC-D is Māori (Ngāi Tahu), and this research involves TH (Ngāi Tahu and Ngāti Mutunga o Wharekauri), a senior Māori academic with expertise in Kaupapa Māori research methods. SC-D confirmed authorship with TH and built in a feedback mechanism that ensured that the research remained focussed on Kaupapa principles such as Māori advancement. The remaining authors are non-Indigenous authors with clinical and statistical expertise who have been involved in previous studies incorporating Kaupapa Māori approaches. The authors are academically and clinically interested by this topic for the following reasons: SC-D/TH are Kaupapa Māori researchers who share a vested interest in equitable health outcomes for Māori, and CF/LJ/AM (Pākehā, Tangata Tiriti) are dedicated to reducing inequities in oral health and ED care.

Study design

A retrospective observational study was conducted assessing NTDP presenting to Christchurch Hospital ED over a 2-year period between 1 January 2019 and 31 December 2020.

Setting

Christchurch Hospital is a tertiary-level hospital located in Canterbury, Aotearoa New Zealand, serving a population of approximately 580,000. The hospital's ED is the primary acute referral centre in the region, with over 100,000 presentations annually.[15] Patients with NTDP are solely managed by medical doctors and ED staff, unless they have significant facial swelling or systemic concern requiring acute referral to the Oral and Maxillofacial Service (OMS).

In Aotearoa New Zealand, publicly funded health and disability services are available to those who meet the eligibility criteria, and basic oral health services are provided for free until the age of 18. Thereafter, most primary dental care for adults is limited and primarily through private, user-pays dental services. The hospital-based dental service provides limited non-acute services during working hours, such as "relief-of-pain" services (e.g., simple extractions) for New Zealanders on incomes under an income threshold, and these services must be booked in advance.

Participants

Patients with arrival complaints or discharge diagnoses of "toothache", "dental pain", "facial swelling" or "dental abscess" were included. Patients were excluded if presentations were not related to NTDP, patients left before being seen by a doctor, or were missing documentation.

Data collection

Data were extracted from Christchurch Hospital's electronic medical record system. Demographics

and outcome variables were collected, including New Zealand Index of Deprivation (NZDep)[16] (area-based measure of socio-economic deprivation from 1–10, 1 being the least deprived), triage code (1–5, 1 being the most urgent), ED length of stay (hours), time to be seen by doctor (minutes), admission to hospital from ED (admitted or discharged) and hospital length of stay if admitted (days).

Data analysis

Data underwent descriptive statistical analysis with IBM SPSS Statistics (Version 28.0). The normality of the continuous variables was assessed by inspecting histograms and performing Shapiro–Wilk tests. Non-parametric tests (Kruskal–Wallace) were used for continuous variables or Fisher's tests for any cell with zero in it. Data not normally distributed were presented with median and interquartile range (IQR).

Non-standard output groupings were used in our results, implementing a super-aggregate level 0 grouping method when stratifying ethnicity. Ethnicity was prioritised as Māori, NZ European, Pacific peoples and Other ethnicities to maximise statistical power. Māori ethnicity is used as the reference category instead of NZ European.

Raw- and age-standardised incidence rates per 100,000 were calculated for Māori, Pacific peoples, NZ European and all other ethnicities. The age distribution of the 2001 Census Māori population data was used as the index for standardising these ethnic groups as per the Manatū Hauora – Ministry of Health recommendations for age standardisation.[17,18] Age-standardised incidences and standard errors were calculated using the method published by Bray and Ferlay.[19] In controlling data for NZDep, for discrete data, binary logistic regression was used, and for continuous, a general linear model was used, with Māori as the reference group. A univariate coefficient and p-value was reported, as well as a multivariate coefficient controlling for deprivation.

Ethics

Ethical approval under the Minimal Risk Health Research University of Otago Human Ethics Application (HD21/032) was granted. In addition to ethical approval (RO#22070), locality authorisation and Māori consultation (#220429) were undertaken. The project was consequently approved by both the hospital and the regional University of Otago Māori Health Advancement Review Panel.

Whakarite (results)

Over the 2-year study period, there were a total of 2,034 presentations, which included 550 (27.0%) Māori, 1,211 (59.5%) NZ Europeans, 141 (6.9%) Pacific peoples and 132 (6.5%) Other ethnicities.

Discrete data is shown in Table 1. Compared to the Census data, NZ European (59.5% vs 82.43%) and Other (6.5% vs 13.7%) ethnicities were under-represented compared to Māori (27.0% vs 9.4%) and Pacific peoples (6.9% vs 3.2%). Among the patients studied, there was a similar percentage

Table 1: Discrete data related to non-traumatic dental presentations.

	Māori	NZ European	Pacific peoples	Other
Regional (CDHB) census data 2018*	9.4%	82.43%	3.2%	13.7%
Number of presentations (%)	550 (27.0%)	1,211 (59.5%)	141 (6.9%)	132 (6.5%)
Female sex (%)**	278 (50.5)	518 (42.8%)	73 (51.8%)	56 (42.4%)
Male sex (%)	272 (49.5%)	693 (57.2%)	68 (48.2%)	76 (57.6%)
Number of admissions (%)	33 (32.0%)	57 (55.3%)	5 (4.9%)	9 (8.7%)

*>100% total due to ability to record more than one ethnicity.

**Binary sex categorisation is recorded in the electronic medical record at time of data collection and may not be reflective of gender.

Figure 1: Presentations by deprivation (NZDep) and ethnicity.

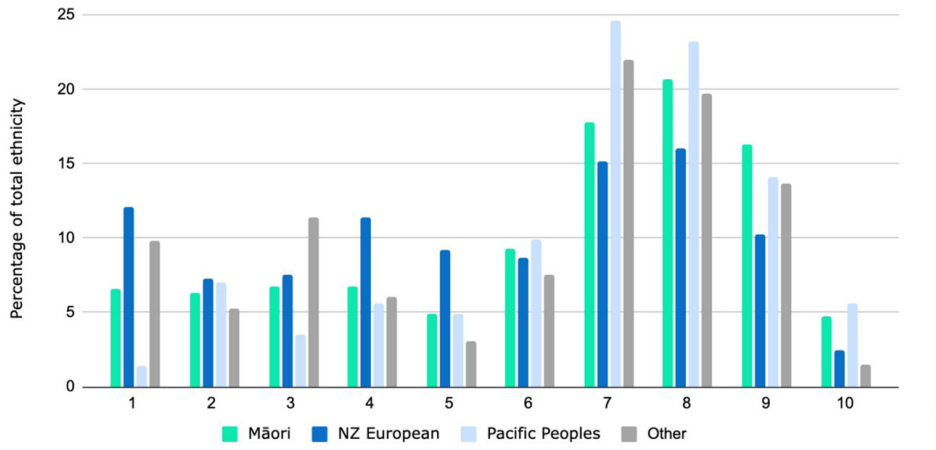


Table 2: Continuous data related to non-traumatic dental presentations.

	Māori	NZ European	Pacific peoples	Other	p-value*
Median NZDEP 1–10 (IQR)	7 (4–8)	6 (3–8)	7 (6–8)	7 (3–8)	<.001
Median age (IQR)	28 (23–34)	32 (25–45)	32 (23–42)	35 (25–48)	<.001
Median triage score 1–5 (IQR)	4 (3–4)	4 (3–4)	4 (4–4)	4 (3–4)	.065
Median time until seen by ED doctor (mins) (IQR)	45 (22–86)	56 (24–97)	54 (23–97)	73 (30–123)	<.001
Median ED length of stay (mins) (IQR)	142 (94–201)	141 (85–203)	132 (91–195)	130 (85–207)	.664
Median hospital length of stay (days) (IQR)	0.9 (0.4–2.3)	2.0 (1.0–3.7)	3.8 (1.8–3.9)	1.4 (0.8–3.6)	.003

Interquartile range = IQR. *Independent samples Kruskal–Wallis test.

between male and female Māori and Pacific peoples, while males were over-represented in NZ European ethnicities (57.2%) and Other ethnicities (57.6%). During the study period, a total of 103 admissions were recorded for NTDP, which included 33 (31.1%) Māori, 5 (5%) Pacific peoples, 57 (55.3%) NZ European and 9 (64%) Other ethnicities.

The NZDep distribution by ethnicity is shown in Figure 1. The distribution of NZDep was negatively skewed for all ethnic groups, with a median of 6 (IQR 4–8) and mode of 8. Most presentations were NZDep 7 and 8 (35%). The median NZDep score was less deprived for NZ European ethnicities (6, IQR 3–8) compared to Māori (7, IQR 4–8) and Pacific peoples (7, IQR 6–8).

Continuous data are shown in Table 2, where medians are favoured in each variable due to non-symmetrical value distributions. The median age of presentation is older for Pacific peoples (32), NZ European (32) and Other ethnicities (35) compared to the median age for Māori (28). A higher proportion of Pacific peoples (IQR 23–42), NZ European (IQR 25–45) and Other ethnicities (IQR 25–48) were older compared to Māori patients (IQR 23–34). The median triage score for Māori patients (4, IQR 3–4) was the same as the median triage for NZ European ethnicities (4, IQR 3–4) and Other ethnicities. Pacific peoples were triaged with lower urgency than both groups (4, IQR 4–4).

On average, Māori patients were seen by an ED doctor the fastest (45 minutes, CI 22–86), 11 minutes faster than NZ European ethnicities (56 minutes, CI 24–97), 9 minutes faster than Pacific peoples (54 minutes, CI 23–97) and 28 minutes faster than Other ethnicities (73 minutes, 30–123). There was no significant difference in the median

Figure 2: Incidence of presentations per 100,000 population—age-standardised incidence (Māori 2001).

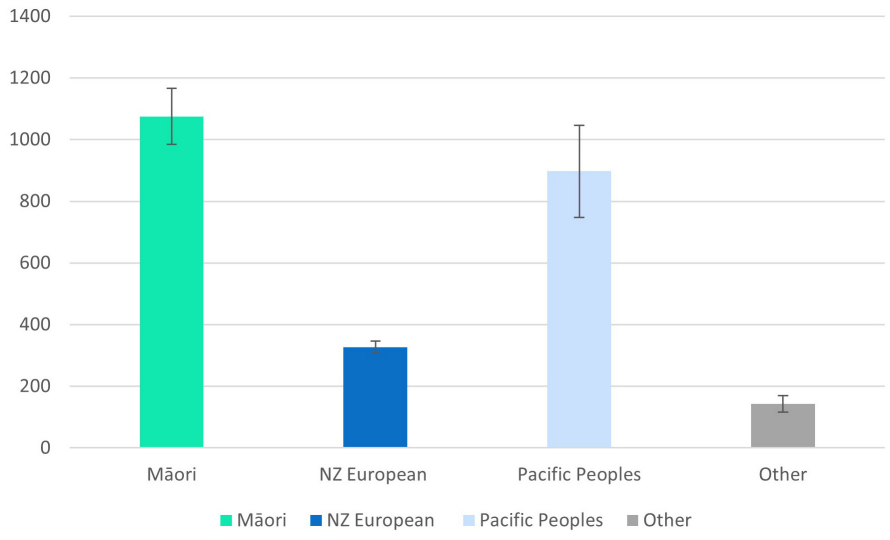
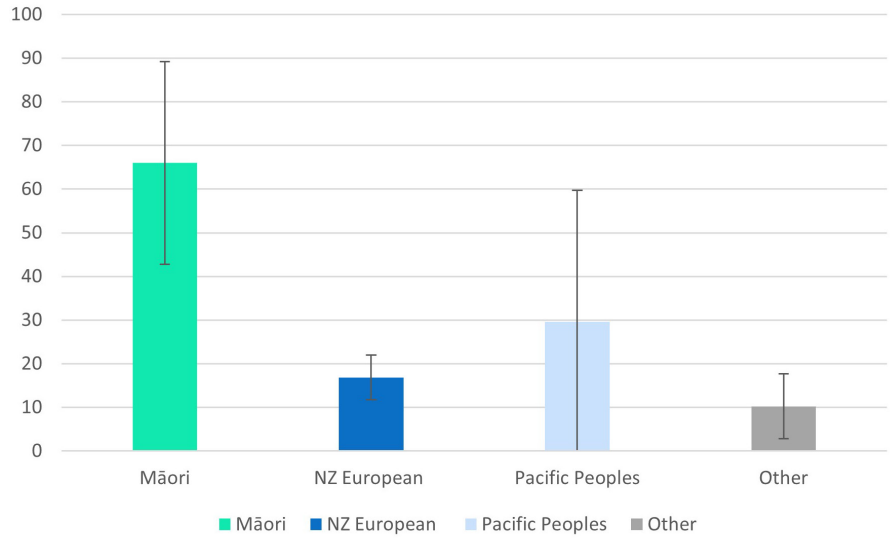


Figure 3: Incidence of admissions per 100,000 population—age-standardised incidence (Māori 2001).



ED length of stay across all groups (p=0.664). Of patients admitted, the median hospital length of stay in days was longer for Pacific peoples (3.8, IQR 1.8–3.9), NZ European (2.0, IQR 1.0–3.7) and Other ethnicities (1.4, 0.8–3.6) compared to Māori admissions (0.9, IQR 0.4–2.3).

Incidence of presentations per 100,000 population is presented in Figure 2. Where Māori were used as the reference population, NZ European (difference = 793.8, 95% CI=700.6–887.0) and Other (difference = 916.4, 95% CI=821.6–1011.3) had a lower incidence than Māori. The difference in incidence between Pacific peoples and Māori was not significant (difference = 105.3, 95% CI=-69.6–280.3).

Incidence of admissions per 100,000 population is presented in Figure 3. NZ European (difference = 49.5, 95% CI=25.8–73.3) and Other (difference = 51.5, 95% CI=27.1–75.9) had a lower incidence than Māori. The difference between Pacific peoples and Māori was not significant (difference = 28.6, 95% CI=-9.5–66.7).

Discrete and continuous outcome measures were controlled for NZDep (see Appendix) and found differences between ethnicities were not driven by deprivation.

Whakawhiti kōrero (discussion)

This study investigates the equity of care received by patients with NTDP at Christchurch ED by comparing demographic variables and outcomes measures between Māori and non-Māori.

Whakapapa (lineage)

The recognition of the past, where Māori have come from, have been and are going

This study found patient demographics and pre-admission variables were consistent with previous research on ED presentations for NTDP in Aotearoa New Zealand, with Māori being over-represented and of a younger median age.[3–5] These findings have not changed since they were reported in the New Zealand Oral Health Survey a decade ago.[1]

Of presentations, Māori with NTDP were over three times more likely to present and over three times more likely to be admitted. However, following admission, NZ Europeans had a longer length of stay compared to Māori. While this difference in hospital length of stay could suggest that Māori patients present with lower severity of illness, a recent audit by Graham et al. suggests that Māori are referred to Christchurch Oral and Maxillofacial services at a rate almost four times higher than NZ Europeans, and there is no difference in the level of care required.[20] Compared to a similar study conducted in 2008–2009, these referral rates may suggest an increasing utilisation of hospital services and worsening of oral health inequity for Māori in this region.[21] Another possibility is that Māori are discharged earlier, which may align with previous evidence that Māori do not receive adequate healthcare at initial presentation.[4,10] This study did not investigate repeat presentation or re-admission of patients; however, further investigation is required to understand this relationship.

Whakakotahitanga (unity)

A holistic approach to health improvement that is culturally valid, and which maximises coordination within the health sector and provides more effective services for Māori

It is important to acknowledge that health professional bias and institutional racism exist within acute care in hospitals and health systems in Aotearoa New Zealand to consider approaches to coordinate and improve health equity.[10] NTDP are particularly susceptible to experience bias, given this group is most likely to present outside of regular working hours when clinicians may be fatigued.[5,22] In this study, some ED process measures for NTDP at this centre favoured Māori: Māori patients were triaged similarly and seen faster compared to other ethnicities. Shorter wait times for Māori aligns with the recently reported ED outcomes by Curtis et al., yet contrasts with other studies reporting ethnic bias in triage allocation favouring non-Māori.[9,10] This is encouraging given prolonged wait times have generally led to negative perceptions of acute care for Māori patients, who may question why they were not being seen and whether they made the right decision to seek care.[23]

Whakawhānuitanga (diversity)

Recognising and catering for the diverse needs and aspirations of Māori individuals and collectives

The NZDep is an area-based measure of socio-economic deprivation in Aotearoa New Zealand.[16] At Christchurch ED, most patients presenting with NTDP had deprivation indices of 7 or 8 (35%), contrasting with Waikato, where the highest proportion exhibits indices 9 or 10, indicating the highest deprivation.[4] This divergence may stem partly from regional variations in

service provision. For instance, Christchurch Hospital's dental service offers subsidised relief-of-pain services to individuals eligible for a Community Services Card (CSC), redirecting those of highest deprivation from ED usage. Cost is by far the most prohibitive barrier to dental care, leading to deferral of primary care attendance and increased utilisation of ED services.[8,24] This stresses the importance of tailoring future interventions to regional data, acknowledging that different iwi, hapū and whānau may require different delivery approaches of oral health services.

These findings may suggest there exists a portion of patients presenting within index levels 7–8 that sit above the threshold for a CSC but may experience "in-work poverty", for which Māori and Pacific peoples are most at risk.[25] According to Smith et al., patients with low income, but above eligibility for a CSC and emergency care subsidy offered by Work and Income New Zealand (WINZ), face the greatest difficulty in accessing care.[5] This gap in care is reflected in a qualitative study of Māori with type 2 diabetes, with participants feeling "penalised" for being employed when trying to access oral healthcare.[24]

Whakawhanaungatanga (relationships)

The recognition of the many branches and associations, interactions and relations within and without Te Ao Māori

Māori oral health inequities arise from systemic failures in the provision of dental care. These failures are consequences of historical denial of Māori partnership and participation in the design of oral health policy and inequities in the social determinants of health.[6] Despite public funding for dental care until age 18, inequities in childhood caries are already evident by age 5.[6] Across all age groups, Māori adults have been shown to experience a poorer quality of life due to their oral health.[6] Furthermore, recent analysis indicates that the uneven distribution of dental practices in Canterbury disproportionately affects utilisation of dental services, posing the greatest oral health risk to Māori adolescents.[26]

Limited access to affordable and culturally responsive primary oral healthcare has led to a disproportionate dependence of Māori on sporadic or acute care.[27] Historically, due to limited WINZ grants, emergency dental care has often prioritised tooth extraction as the most viable solution, with EDs being inadequately equipped for treatments beyond symptomatic relief.[5] This approach has continued to disadvantage Māori, perpetuating generational edentulism.[5,24] While the recently increased WINZ funding for low-income adults may increase access to additional relief-of-pain services, it does not encompass preventative care such as routine dental examinations. This increase does not address the need for improved access to primary oral healthcare for Māori.[28]

Whakapakari (capacity building)

The recognition of the need for Māori institutions to continually grow and develop for the benefit of all

The recent partnership of the Dental Council New Zealand and Te Ao Mārama – The Māori Dental Association has led to the development of the National Māori Oral Health Equity Action Plan.[29] It demonstrates a commitment to a united oral health system, where all members must be held accountable for equity improvements for Māori. Future health policy must consider the Ministry of Health Māori Action Plan, *Whakamaua*, recognising oral health as integral to achieving holistic care for Māori.

Rangatiratanga (leadership)

Māori control over their own health improvement

Our findings reaffirm that oral health inequities disproportionately affect Māori. A restructure of the oral health system around Kaupapa Māori-focussed initiatives is needed, rather than increasing funding into historical structures that have under-served Māori.[30] The abolition of Te Aka Whai Ora—the Māori Health Authority—fails to demonstrate our health systems' support for the coordination of Kaupapa Māori services and rangatiratanga through a "by Māori, for Māori" approach. Future oral health services must prioritise Māori–Crown partnerships to meet obligations enshrined in Te Tiriti o Waitangi and facilitate Māori decision-making throughout the health and disability system's leadership and governance arrangements.[7]

Māramatanga (enlightenment)

The increase in knowledge and the application of that knowledge for a beneficial outcome

Although this study found some positive process markers for NTDP exist in the Christchurch ED, addressing inequitable oral health outcomes for Māori requires significant upstream change. These results may differ from other regions, and

regular auditing of ethnic inequities within acute health services is crucial to achieve equity for Māori across Aotearoa New Zealand. Applications at regional and national levels should acknowledge that the final step of Kaupapa Māori research is transformational change. At a national level, development of frameworks such as *Te Rautaki Manaaki Mana* promote culturally safe and responsive healthcare for Māori in emergency care.[12]

Whaikaha (strengths)

This is the first study to investigate acute care outcomes related to NTDP for Māori patients utilising a Kaupapa Māori approach. This approach recognises that being Māori is not a risk factor for health disparities, but rather an indicator of an increased exposure to the impacts of colonisation and racism.[13] Utilising a Kaupapa Māori approach is crucial to shifting the Western-dominated academic discourse on Hauora Māori.

Ngoi koretanga (limitations)

While NTDP are common hospital presentations, service provision varies by region. Before the establishment of Te Whatu Ora – Health New Zealand, district health boards had autonomy to provide relief-of-pain services, as seen in Canterbury. Regions lacking such services may have greater unmet dental needs and NTDP incidence. Furthermore, regional differences in ethnic composition may impact the generalisability of these findings. This study is retrospective in nature and the accuracy of data relies on self-identified ethnic and ED documentation. The electronic medical system utilised for data extraction only collects binary sex categorisation, and therefore this study fails to acknowledge the presentations of gender-diverse individuals. It also fails to capture important factors that may add to understanding NTDP, such as: patient experiences, reasons for attending ED over primary care and ED attendees who left before being seen.

Te whakamutunga (conclusion)

This study identifies inequitable presentation of Māori to Christchurch ED with NTDP. While ED outcomes measures were largely positive, differences in demographic variables indicate persisting upstream failures, specifically barriers to accessing primary oral healthcare and a paucity of Kaupapa Māori-focussed initiatives. Further action and accountability are required to reorient our oral health services to provide high-quality, equitable care for Māori.

COMPETING INTERESTS
Nil.

AUTHOR INFORMATION
Mr Sam Cameron-Dunn: Medical Student, Māori/Indigenous Health Institute (MIHI), University of Otago, Christchurch, New Zealand; Department of Surgery and Critical Care, University of Otago, Christchurch, New Zealand.
Dr Calum Fisher: House Officer; MBChB BDS(Hons) MRACDS(PDS), Department of Surgery and Critical Care, University of Otago, Christchurch, New Zealand.
Dr Tania Huria: Senior Lecturer, Associate Dean Māori, Associate Dean Student Affairs; BA(Cant) BNS(Chch Poly IT) MPH(Otago) RCpN, Māori/Indigenous Health Institute (MIHI), University of Otago, Christchurch, New Zealand.
Dr Andrew McCombie: Research Officer and Data Analyst (Te Whatu Ora – Health New Zealand); BSc BA(Hons) PhD(Otago), Department of Surgery and Critical Care, University of Otago, Christchurch, New Zealand; Department of Surgery, Te Whatu Ora – Waitaha Canterbury, Christchurch, New Zealand.
Mrs Angela Forbes: MPH, PhD candidate, Department of Medicine, University of Otago, Christchurch, New Zealand.
Dr Laura R Joyce: Emergency Medicine Specialist; FACEM AFRACMA MBChB BMedSc(Hons) MMedEd CCPU, Department of Surgery and Critical Care, University of Otago, Christchurch, New Zealand; Emergency Department, Te Whatu Ora – Waitaha Canterbury, Christchurch, New Zealand.

CORRESPONDING AUTHOR
Dr Laura Joyce: Department of Surgery and Critical Care, University of Otago, Christchurch, 2 Riccarton Avenue, Christchurch 8011, New Zealand. Ph: 03 364 0270. E: laura.joyce@otago.ac.nz

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Appendix

Appendix Table 1: Controlled for New Zealand Index of Deprivation (supplementary).

	Māori (ref) n=551 (27.1%)	**Statistical test**	**Pacific peoples n=142 (7.0%)**	**Univariate coefficient**	**Controlled for deprivation**	**Other n=1,344 (66.0%)**	**Univariate coefficient**	**Controlled for deprivation**
Male sex	273 (50.5%)	Binary logistic	69 (48.6%)	0.96 (p=0.83)	0.95 (p=0.78)	768 (57.1%)	**1.36 (p=0.003)**	**1.40 (p=0.001)**
Hospital admissions (odds ratio, 95% CI)	1	Binary logistic	0.6 (0.3–1.6)	0.6 (p=0.30)	0.6 (p=0.31)	0.9 (0.6–1.3)	0.8 (p=0.42)	0.8 (p=0.31)
Median age (IQR)	28 (23–34)	General linear model	32 (23–42)	**3.8 (p=0.006)**	**3.9 (p=0.005)**	32 (25–45)	**6.4 (p<0.001)**	**6.3 (p<0.001)**
Median triage score (IQR) †	4 (3–4)	General linear model	4 (4–4)	**0.14 (p=0.01)**	**0.13 (p=0.02)**	4 (3–4)	**0.04 (p 0.22)**	**0.05 (p=0.09)**
Median time until seen by ED doctor (mins) (IQR)	45.2 (22–86)	General linear model	53.8 (23–96)	5.7 (p=0.30)	5.6 (p=0.31)	57.6 (25–98)	**9.2 (p=0.002)**	**9.5 (p=0.002)**
Median ED length of stay (mins) (IQR)	160.7 (94–201)	General linear model	154.8 (92–192)	-0.01 (p=0.567)	-0.10 (p=0.55)	159.0 (85–203)	-0.03 (p=0.759)	0.02 (p=0.80)
Median hospital length of stay (days) (IQR)	0.9 (0.4–2.3)	General linear model	3.8 (1.8–4.0)	**1.7 (p=0.04)**	1.7 (p=0.05)	2.0 (0.9–3.7)	**1.2 (p=0.003)**	**1.2 (p=0.002)**

Update and projections for New Zealand's ophthalmology workforce

Chuen Yen Hong, Michael Merriman, Graham Wilson, Sheng Chiong Hong

ABSTRACT

AIM: The aim of this study was to update and project the growth of ophthalmologists in New Zealand. This will help decision makers better understand the current ophthalmologist workforce and make appropriate resource allocations.

METHOD: Supply and demographics of ophthalmologists in New Zealand were obtained from the Medical Council of New Zealand, Health Workforce New Zealand and Health New Zealand – Te Whatu Ora. Ophthalmology trainee numbers were extracted from the annual reports of the Royal Australian and New Zealand College of Ophthalmologists (RANZCO). New Zealand population statistics were extracted from the Stats NZ database. A simulation model was developed to project the growth of ophthalmologists from 2024 to 2050.

RESULTS: In March 2023, there were 175 practising ophthalmologists in New Zealand. Overall, there were 34.0 ophthalmologists per million population, with 201.4 ophthalmologists per million for those aged ≥65 years. To maintain the current ratio, an additional 20 practising ophthalmologists are needed by 2050.

CONCLUSION: The ratio of ophthalmologists per million population aged ≥65 years is projected to drop by 1.5% annually. To meet the demand of an increasing and ageing population, and RANZCO's goal of 40 ophthalmologists per million population, there needs to be an increase in ophthalmologist training positions from the current 5-year average of 6.6 to 11 new trainees annually, and a more effective distribution of the ophthalmologist workforce.

The eye health workforce plays a positive role in improving the quality of life of those with vision impairment. Timely detection and consistent follow-up are pertinent to ensure optimal treatment and delay preventable progression of eye conditions. Unfortunately, the demand for eye care is increasing faster than the rate at which ophthalmologists are being trained. In the last two decades, the prevalence of blindness has dropped from 4.8% to 3.1%, and 90 million people world-wide have had their vision impairment treated or prevented.[1] However, with population growth and ageing, by 2050 the global prevalence of vision impairment and blindness are projected to double.[2] Vision impairment is known to negatively impact both physical and mental health, with known associations such as increased falls in older people,[3–7] employment barriers,[8–11] social isolation,[12] loss of independence,[12] depression[13,14] and mortality.[15]

The last assessment of global Human Resources for Eye Health found that the global population of ophthalmologists was growing at less than half the rate of the population over age 60.[16] There is a need for an assessment of the future needs for New Zealand's ophthalmologist workforce. In New Zealand, the population aged 65 and above is projected to rise by 64% between 2023 and 2050, to make up one quarter of the population.

New Zealand has not had a comprehensive review of eye care workforce availability since the Eye Health Workforce Service Review in 2010.[17] The World Health Organization's eye care situation analysis tool (ECSAT) was developed to summarise the current eye health situation and identify areas of eye care services that need strengthening. Workforce and infrastructure are one of the six major health system blocks in ECSAT. Results from ECSAT Aotearoa 2022 found that although there only needs to be minor strengthening in this area, there are still workforce shortages in ophthalmology (particularly outside urban centres), ongoing dependence on internationally trained ophthalmologists and limited vocational training opportunities.[18] This paper aims to assess the current workforce and project the demand and supply of ophthalmologists for New Zealand up to 2050.

Methods

The number of all active practising ophthalmologists (as of 7 March 2023) in New Zealand was obtained from the Medical Council of New Zealand's (MCNZ) register of doctors. The locations of ophthalmologists were determined

Figure 1: Simulation model for projection of ophthalmologist workforce.

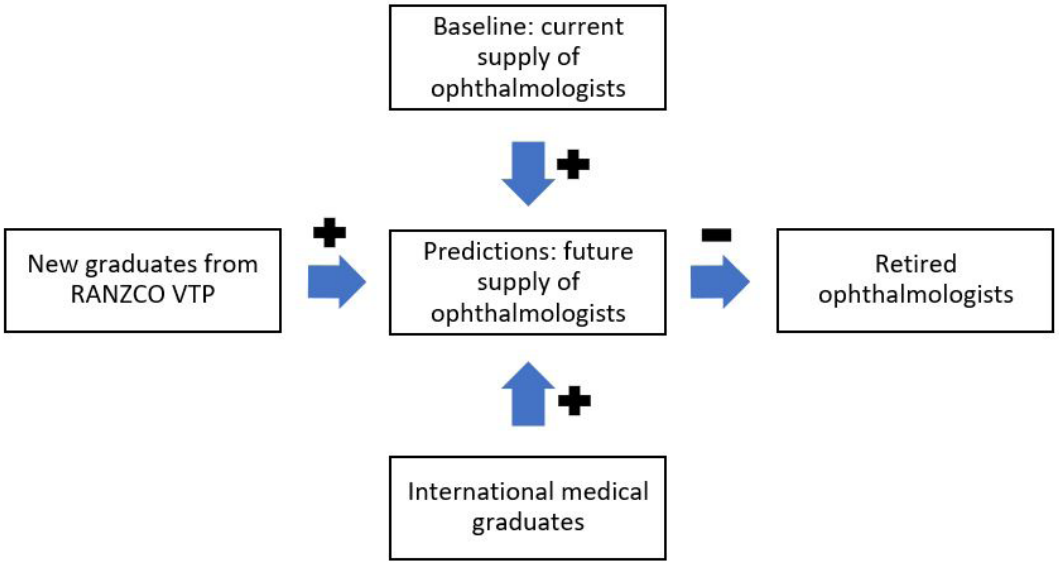
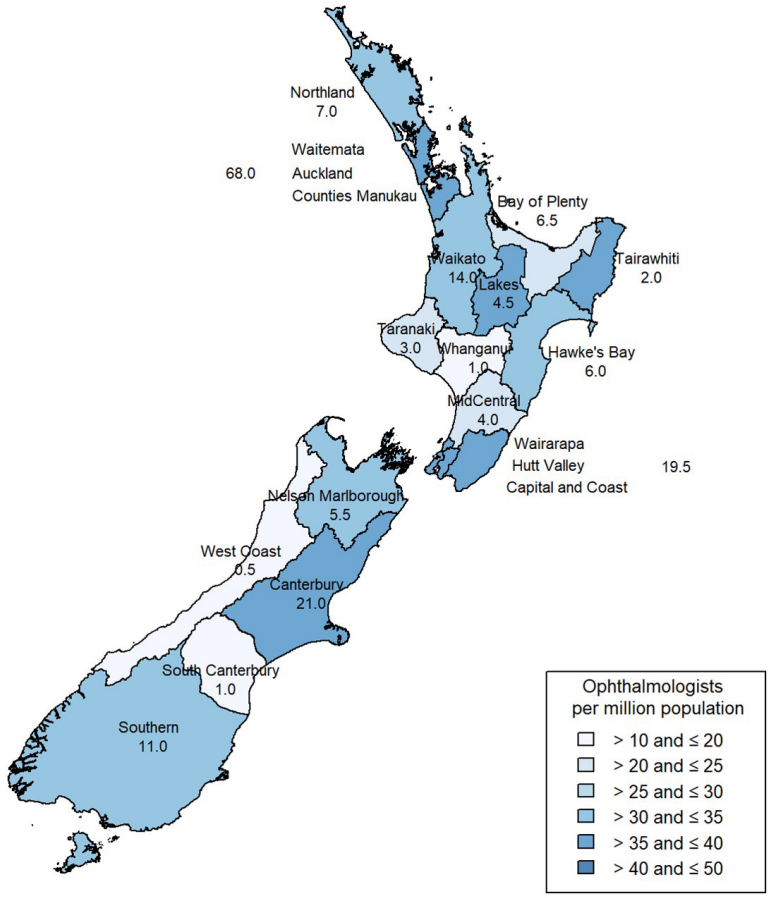


Figure 2: Geographic distribution of ophthalmologists per million population across regional divisions of Health New Zealand—darker shades correspond to higher density. The number of ophthalmologists for each region is labelled on the map.



using registered location on MCNZ and by searching publicly available information on the internet. Ophthalmologists who were not practising in New Zealand were excluded. Ophthalmologists practising in more than one region were assumed to spend equal time in each region. The collated list was then circulated to all ophthalmology departments in Health New Zealand for confirmation. Demographic data, ophthalmology training body and full-time equivalent (FTE) (including distribution across public and private sectors) were provided by the Analytics and Intelligence section of Health New Zealand – Te Whatu Ora. New Zealand population statistics were extracted from the Stats NZ database.[19]

The growth of ophthalmologists was projected with the following simulation model (see Figure 1), with 2022 as the baseline year. Data sources for key variables and their assumptions are summarised in Table 1.

Table 1: Model parameters and assumptions.

Variable	Data source	Assumptions
Current workforce in baseline year (2023)	The number of ophthalmologists reported by the MCNZ in their annual report	NA
The number of new New Zealand-trained graduates from RANZCO VTP	The number of new trainees to the RANZCO VTP programme (2010–2023) was extracted from the annual reports of RANZCO and recorded as the number of new graduates 5 years later	All trainees completed their 5-year VTP (100% pass rate at the end of the VTP) with no time taken off for non-training purposes (e.g., research, part-time, maternity leave) Assumed to follow *Normal (6.29, 1.07)* distribution The mean and standard deviation of the number of new graduates are 6.29 and 1.07 respectively
The retention rate of new graduates from RANZCO VTP, New Zealand[a]	HWNZ	Estimated to be 80% by HWNZ Retention rate estimated at 71% in survey[20] Assumed to follow *Uniform (0.7, 0.8)* distribution
The number of vocationally registered international medical graduates	The number of vocationally registered internationally trained ophthalmologists reported by the MCNZ in their annual medical workforce report (2010–2023)	Assumed to follow *Normal (2.71, 2.27)* distribution. The mean and standard deviation of the number of new internationally trained doctors are 2.71 and 2.27 respectively
The retention rate of internationally trained ophthalmologists[a]	HWNZ	Estimated to be 87% by HWNZ Retention rate estimated to be 71% in survey[20] Assumed to be *Uniform (0.7, 0.9)*
The number of retired ophthalmologists		Assumed to be between 2–5% of previous year's workforce[20] *Uniform (0.02, 0.05)*

[a] Retention defined as vocational registration in New Zealand after 1 year.
Abbreviations: MCNZ = Medical Council New Zealand; NA = not applicable; RANZCO = Royal Australian and New Zealand College of Ophthalmologists; VTP = vocational training programme; HWNZ = Health Workforce New Zealand.
Distributions: normal (mean, standard deviation); uniform (minimum, maximum).

All statistical analyses were performed using RStudio (version 4.2.2).

Results

Current workforce in New Zealand

There are currently 184 ophthalmologists registered with MCNZ (including provisionally registered ophthalmologists working in specialist medical officer roles), of whom 175 are actively practising and 9 are either practising overseas or not currently practising in New Zealand (and were thus excluded from the analyses). The geographic districts of Health New Zealand – Te Whatu Ora were used to define locations of practice. For those working across different regional divisions, the time spent working in each region was assumed to be split equally. Overall, there were 34 ophthalmologists per million population in New Zealand. The highest density was in the Auckland Region (Te Toka Tumai Auckland, Waitematā and Counties Manukau districts were combined for this review) at 39.5 ophthalmologists per million population. Whanganui, West Coast and South Canterbury districts had the lowest density in the country, with less than 20 ophthalmologists per million population. Most regions had between 30–40 ophthalmologists per million population. Figure 2 gives the geographic distribution of practising ophthalmologists across New Zealand.

There was a total of 188.7 FTEs for ophthalmology across New Zealand, based on the MCNZ workforce data as of March 2023. This was collated from the compulsory annual survey at re-registration. Of the 175 ophthalmologists, 47.4% worked within the public sector, 48.9% in the private sector and the remainder were within academic or government departments. Almost three quarters (72.7%) of New Zealand's vocationally registered ophthalmologists had completed their training with the Royal Australian and New Zealand College of Ophthalmologists (RANZCO) and 64.8% were graduates from New Zealand medical schools. Less than half (40.3%) of vocationally registered ophthalmologists were below 50 years of age. Just over one quarter of the workforce was female (27.3%). There was under-representation of Māori (2.3%) and Pacific (1.7%) ophthalmologists relative to the New Zealand population of Māori (17.3%) and Pacific people (8.9%).

Figure 3 shows the number of ophthalmologists by year in New Zealand, by specialist training body and whether they were graduates of a New Zealand medical school. Since 2010, on average the ophthalmic specialist population grew by 2.8% annually. Over the same time, the population aged ≥65 years grew by an average of 3.4% annually. This same trend is seen globally, with the ageing population growing at a faster rate than that of ophthalmologists.[21]

Projected workforce

Projections from our simulation model show that by 2050, with the assumptions set out in Table 1, New Zealand will be served by 189 (95% prediction interval 184–194) ophthalmologists. To maintain the current ratio of 33.98 ophthalmologists per million population, an additional 20 ophthalmologists would be needed. RANZCO's Vision 2030 set a goal of 40 ophthalmologists per million population.[22] To meet this target, New Zealand will require an additional 48 ophthalmologists in 2040 and 57 in 2050. If there are no changes in retention and retirement rates, New Zealand would need to increase the annual number of vocational training programme (VTP) trainees from the current 5-year average of 6.6 to 8 to maintain the current ophthalmologist ratio, and to 11 to meet the goal of 40 ophthalmologists per million population (Figure 4). The scenario where a trainee takes 6 years to complete training was also considered and simulation results showed that an additional 2 ophthalmologists are needed by 2050 to meet current and projected ophthalmologist ratios, i.e., 22 and 59 ophthalmologists respectively.

The outlook for the population aged ≥65 years was also projected (Figure 5) as 62.1% of services within ophthalmology are devoted to those in this age group.[16] For this cohort, the number of ophthalmologists per million population aged ≥65 years has been decreasing from 220 in 2010 to 202 in 2023. Assuming similar trends, in 2050 the ratio of ophthalmologists per million population aged ≥65 years is predicted to be 133. The mean annual percentage increase in the predicted number of ophthalmologists from 2024 to 2050 is 0.27%, which is 7 times less than the median predicted annual 1.8% population growth for this age group.

The New Zealand female ophthalmologist workforce has increased from an average of 18% in 2010 to 27% in 2023. The Medical Deans Australia and New Zealand publishes yearly reports on commencing and graduating medical students. Data from the yearly reports showed that the proportion of female students has fluctuated around 55% over the past 15 years, with an overall

Figure 3: Trends of New Zealand ophthalmologist workforce (2010–2023).

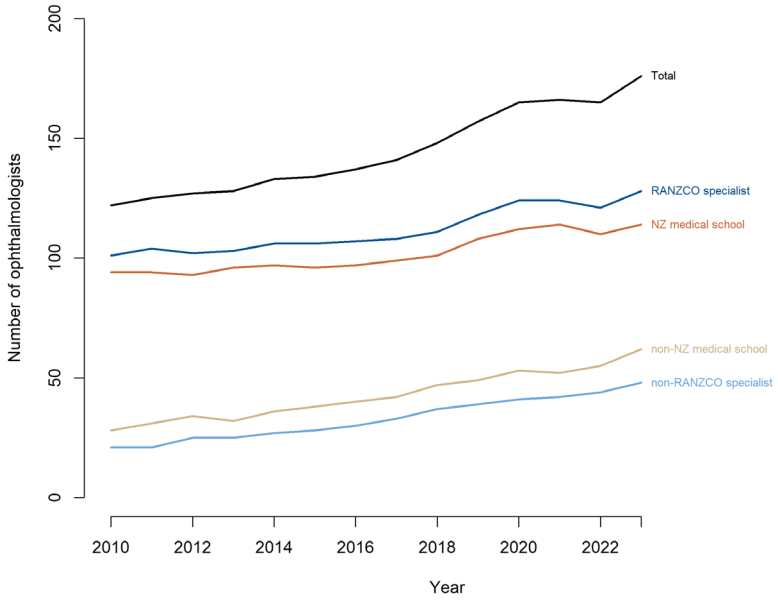
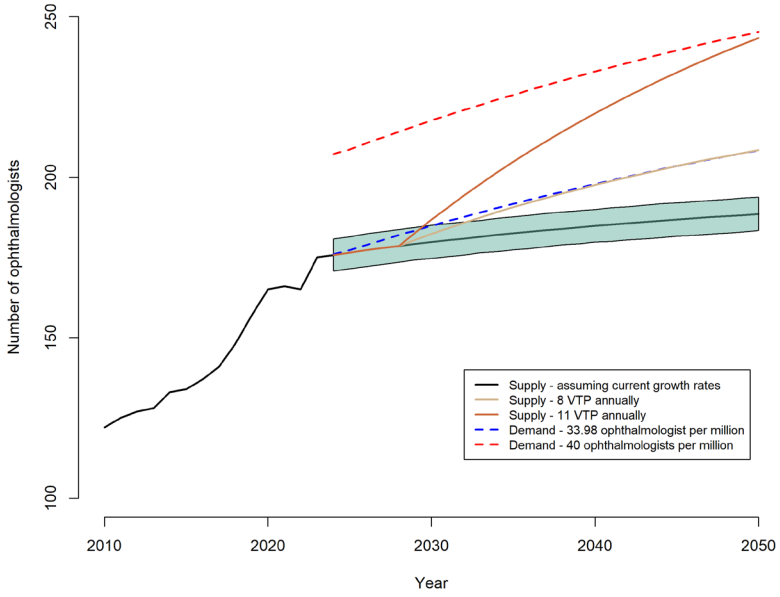


Figure 4: New Zealand ophthalmologists: projected supply and demand.



increasing trend, but has remained under 60%. A non-linear asymptotic regression model was fitted to the percentage of female ophthalmologists and used to project the female workforce in 2050, assuming an asymptote of 60%. This projection and associated prediction interval are shown in Figure 6. Projection to 2050 showed that by 2050, 37.9% (95% prediction interval 34.8–40.6%) of the ophthalmologist workforce in New Zealand will be female.

As data from the Analytics and Intelligence section of Health New Zealand – Te Whatu Ora were available only from the year 2020, we combined this with data published by MCNZ in

Figure 5: Number of ophthalmologists per million population aged ≥65 years.

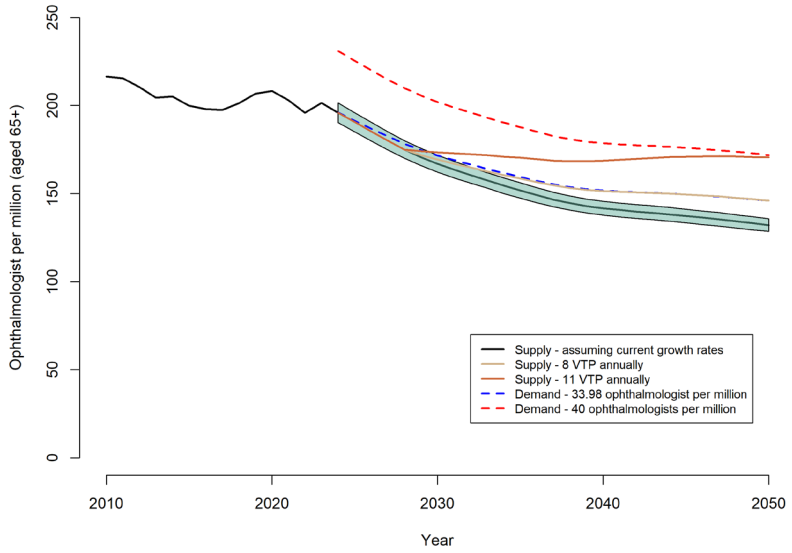
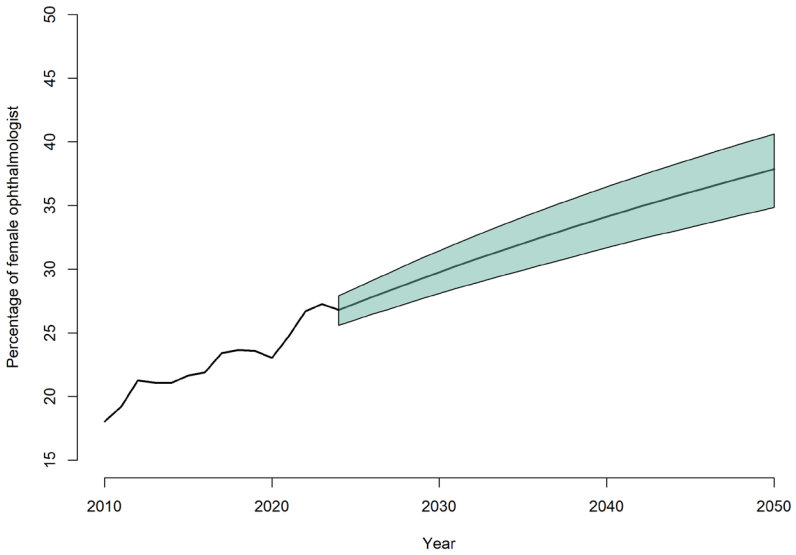
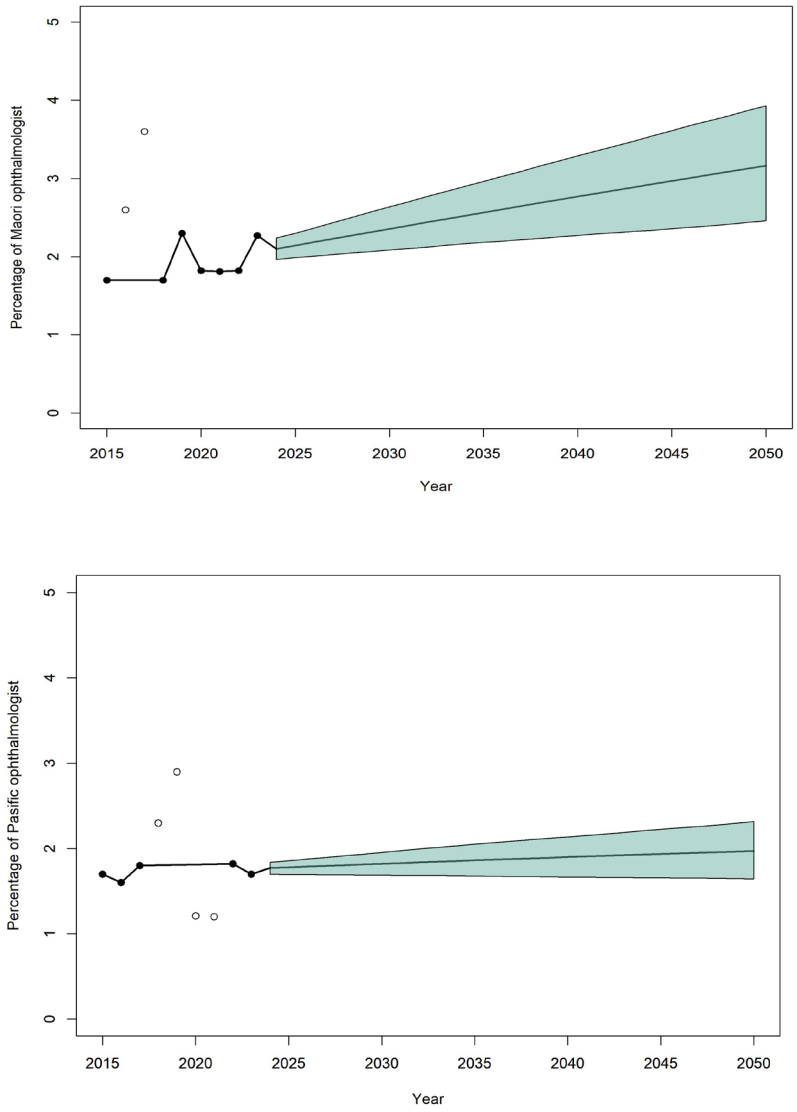


Figure 6: Projected percentage of the female ophthalmologist workforce.



their annual New Zealand Medical Workforce report to project the percentage of Māori and Pacific ophthalmologists. The projections and associated prediction intervals are shown in Figure 7. The percentages of Pacific ophthalmologists from 2018 to 2021, and from 2016 to 2017 for Māori ophthalmologists, were omitted when fitting the non-linear least squares models. We set asymptotes of 20% and 7% in our non-linear models for the percentage of Māori and Pacific ophthalmologists, respectively. This is with reference to the annual reports of commencing medical students and graduating medical school graduates in New Zealand over the last 10 years. By 2050, the percentages of Māori and Pacific ophthalmologists are estimated to be 3.2% (95% prediction interval 2.5–3.9%) and 2.0% (95% prediction interval: 1.6–2.3%) respectively. This represents 6 Māori and 4 Pacific ophthalmologists by 2050 assuming current growth trends. This is

Figure 7: Projected percentage of the Māori and Pacific ophthalmologist workforce.



a significant under-representation considering Stats NZ's projection that by 2043, 21% and 11% of New Zealand's population will be Māori and Pacific respectively.

Discussion

An updated inventory of the ophthalmologist workforce helps with healthcare resource planning and delivery by providing an overview of the current number and distribution of ophthalmologists in New Zealand and the projected gap in workforce. New Zealand's ophthalmologist density of 34 ophthalmologists per million population is one of the lowest when compared to other high-income countries. The International Council of Ophthalmology survey in 2015 reported ophthalmologist density in other high-income countries such as Japan, Singapore, Switzerland, Sweden, Australia, the United Kingdom and the United States ranged from 40 to 114 ophthalmologists per million population.[16] The recommended ratio proposed by RANZCO of 40 ophthalmologists and 7.7 trainees per million population may be applicable in New Zealand. However, changes in practice over the next decades including new technologies, treatments and shared-care models may change this target.

The number of new trainees in New Zealand has

increased from the 5-year average of 5.6 in 2015 to 6.6 in 2023. Results from our simulation model are conservative estimates given the assumptions that all trainees completed their training within 5 years with a 100% passing rate. The actual number of new fellows graduating from a VTP is expected to be less than this, as shown in our sensitivity analysis—if it takes 6 years to complete a VTP, the gap is further widened. A survey carried out in 2008 estimated an average of 4.5 new ophthalmologists per year.[20] Increasing the number of training positions would be a solution to address the supply issue; however, this is dependent on national health funding for eye healthcare.

Māori and Pacific people continue to be under-represented within the ophthalmologist workforce. There is an overall increasing trend; however, at the current growth rate, the workforce will be far from achieving proportions representative of the national population demographics by 2050. RANZCO New Zealand's Te Tiriti o Waitangi and Pasifika Eye Health Action plans have committed to expand the Māori and Pacific eye care workforce. Strengthening existing mentoring programmes and enhancing ophthalmology exposure to Māori and Pacific medical students may encourage more to choose ophthalmology as a career. If New Zealand continues to rely on internationally trained ophthalmologists to fill workforce gaps, achieving a representative workforce will prove exceedingly challenging. By improving the pipeline for New Zealand medical students to train in ophthalmology and ensuring locally trained ophthalmologists are retained, this will also lead to a more equitable increase in Māori and Pasifika ophthalmologists.

There are several limitations to our model. The ideal proportion of ophthalmologists per population for those older than age 65 years is unknown and will be influenced by many variables including individual productivity, healthcare system efficiency and the distribution of care with other eye care providers. Our assumptions for new RANZCO VTP graduates do not consider trainees who take time off during training, embark on several fellowship programmes or delay their entry into practice. Any increase in the number of years to complete training will only widen the gap between the actual and ideal numbers of ophthalmologists. There are limited historic data on the actual number of Māori and Pacific ophthalmologists, limiting the reliability of our predictions; however, it is evident that these demographics are under-represented in the workforce.

Furthermore, technological innovation,[23] advances in healthcare services delivery—for example, the increasing use of both synchronous and asynchronous teleophthalmology[24]—and the up-skilling and scope expansion of other eye care professionals may help relieve demand on the ophthalmologist workforce.[25] New Zealand has seen positive outcomes with the introduction of nurse-led clinics for intravitreal injections and macular review, with an increased volume of patients seen within a centre even when the ophthalmologist workforce remained stable.[26] Rational and safe division of labour between ophthalmologists, clinical nurse specialists and optometrists is crucial to ensure that the provision of care for the population does not come at the expense of quality care.

Continued attention is imperative to ensure that the New Zealand ophthalmic workforce is representative of the community it serves, particularly with respect to geographic distribution, gender and ethnicity. The gap between the ophthalmology workforce and the numbers needed in New Zealand is increasing, especially with an ageing population. The ratio of ophthalmologists to total population is projected to drop by 9.8% in 2050 to 30.6 ophthalmologists per million population if no initiatives are taken to train and retain our ophthalmologist workforce. Immediately increasing the number of training positions to 11 annually will ensure that New Zealand achieves RANZCO's target of 40 ophthalmologists per million population by 2050.

COMPETING INTERESTS
None.

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AUTHOR INFORMATION
Chuen Yen Hong: Postgraduate Year 1 House Officer, Te Whatu Ora Southern, Dunedin, New Zealand.
Michael Merriman: Honorary Lecturer; Ophthalmologist, Waikato Public Hospital, Hamilton, New Zealand.
Graham Wilson: Honorary Clinical Associate Professor; Ophthalmologist, Mātai Medical Research Institute/ Hauora Tairawhiti, Gisborne, New Zealand.
Sheng Chiong Hong: Ophthalmologist, oDocs Eye Care, Dunedin, New Zealand.

CORRESPONDING AUTHOR
Chuen Yen Hong: Postgraduate Year 1 House Officer, Te Whatu Ora Southern, Dunedin, New Zealand.
Ph: +6421 2091230
E: ChuenYen.Hong@southerndhb.govt.nz

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Characteristics of low, moderate and high severity trauma hospitalisations in a health region of Aotearoa New Zealand—10-year review

Grant Christey, Ishani Soysa, Alastair Smith

ABSTRACT

AIM: To describe the incidence, characteristics, outcomes and hospital costs of patients admitted to hospital following trauma in a health region in Aotearoa New Zealand over a 10-year period.

METHODS: A retrospective, observational study used data from the Te Manawa Taki (TMT) regional trauma registry to identify patients of all ages and injury severities that were admitted to hospital following injuries from 2013 to 2022, inclusive. This study reports on incidence of injuries with regard to age, gender, ethnicity, injury severity score (ISS), injury characteristics and direct cost to TMT facilities.

RESULTS: Searches identified 60,753 trauma events leading to patient admission to hospitals in the TMT region. Of these, 81.9% were low-severity trauma, 10.2% were moderate-severity trauma and 7.9% were high-severity trauma. There were statistically significant relationships between gender, ethnicity and ISS category. Males were more likely to be hospitalised for any traumatic injuries. High-severity trauma is dominated by road traffic injuries and low-severity trauma is dominated by falls. Advanced age was associated with higher injury severity. The direct cost of trauma care to TMT hospitals increased by 122% during the 10-year period.

CONCLUSIONS: The study has identified the incidence, demographic features, severity, costs and outcomes for trauma patients admitted to hospitals in the TMT region of Aotearoa New Zealand over a continuous 10-year period. The volumes and costs of injury represent a significant burden on the health system, individuals and communities. Detailed understanding of the causes and costs of injuries of all severities will inform prevention activities, clinical quality improvement and health service planning.

Trauma is a significant public health concern and a major cause of death and disability across the globe[1,2] and in Aotearoa New Zealand.[3] Road traffic injuries are the leading cause of death for children and young adults aged 5–29 years and one of the major contributors to increasing disability.[4] Aotearoa New Zealand has a relatively high burden of disease (as measured in Disability-Adjusted Life Years [DALY]) compared to an average of other high-income countries[5] and road injuries, falls and self-harm were among the top 10 causes of DALY.[4] Over 50,000 people are hospitalised annually due to injury, with an estimated economic cost of NZ$10.2 billion per year in Aotearoa New Zealand.[6] In the 2016 injury-related health loss report, the Aotearoa New Zealand Ministry of Health (MoH) stated that an estimated 8% of total health loss from all causes was due to injuries.[7] The 2021/2022 annual report of the New Zealand Major Trauma Registry (NZMTR) shows that transport was the most common mechanism of severe trauma presentations and was responsible for 48% of all severe trauma presentations nationally.[8] However, limited information is available about the incidence of injuries and its potential to cause death and disability.[9] Equitable use of resources for the prevention and treatment of injuries depends on the use of reliable and representative information on incidence rates and risks across ethnicities and demographic groups in the Aotearoa New Zealand context.

The Te Manawa Taki Trauma System (TMTTS) was established in 2010 to coordinate improvements in the quality of trauma care delivery within the Te Manawa Taki/Midland health region of Aotearoa New Zealand and served a population of 1,007,405, 28% of whom identify as Māori.[10,11] The Te Manawa Taki Trauma Registry (TMTTR) has been operating continuously since 2012, capturing comprehensive patient data across all age groups and injury severities, including time and date stamping of transfer of patients to and between six hospital facilities (Waikato, Tauranga, Whakatāne, Rotorua, Taranaki and Tairāwhiti Hospitals). This dataset is unique

in Aotearoa New Zealand, and over 6,000 trauma patients are admitted to hospitals in the region annually.[12] It captures interventions and inpatient costs to allow detailed clinical outcomes and process evaluation. The TMTTR now holds over 90,000 Te Manawa Taki (TMT) trauma patient admission records. These data provide a reliable platform for evidence-based system analysis and population-based studies. Continuous monitoring and performance feedback enable improvements to service delivery and patient outcomes.[11] The TMT health region has broad demographic characteristics for age groups, ethnicities and rurality that are representative of Aotearoa New Zealand as a whole.[13,14]

The aim of this research is to describe the incidence and characteristics of injuries resulting in admission to hospitals in the TMT region of Aotearoa New Zealand. Additionally, this study assesses associations between injury severity and cause of injury, length of hospital stays and cost. To our knowledge, this is the first study examining the characteristics of patients of all age groups and severities admitted to hospitals in a health region of Aotearoa New Zealand following trauma over a prolonged period (10 years).

Methods

A retrospective analysis of high-, moderate- and low-severity trauma data from the TMTTR identified patients of all ages admitted to TMT hospitals with an injury during the 10-year period from 1 January 2013 to 31 December 2022. Consistent with trauma registries internationally, patients were excluded if they sustained insufficiency or periprosthetic fractures, exertional injuries, hanging/drowning/asphyxiation without evidence of external force, poisoning, ingested foreign body, injury as a direct result of pre-existing medical conditions or late effects of injury, or the injury occurred more than 7 days prior to admission.[15] Demographic and injury event information in the trauma registry was collected from prehospital records, hospital systems and, where required, directly from patients. The cause and place of injury were classified by the International Classification of Disease (ICD-10-AM).[16] The Abbreviated Injury Score (AIS), which is an anatomical scoring system used to grade the severity of individual injury on a scale of 1 (minor) to 6 (unsurvivable injury), is used by the registry to quantify injury patterns and severity.[17] The TMTTR employs AIS Version 2008 for all diagnoses and for this review, trauma severity was split into high (ISS [injury severity score] >12),[18] moderate (ISS 9–12) and low (ISS 1–8) severity trauma. ISS groups of low, moderate and severe were chosen to show variation in the characteristics of patients in the transition from the comparatively large "non-major" trauma group to "major" as defined in the NZMTR.[19]

The variables of interest included: patient demographic characteristics; injury event information; type, intent, cause and place of injuries; patient length of stay (LOS); outcomes; and direct cost to TMT hospitals. Multiple ethnicities were managed using prioritised ethnicity. The National Health Index (NHI) was used, together with admission date and times, as unique keys to extract trauma-specific admission costings from each of the five district hospital costing systems. All costs are direct hospital costs prepared in accordance with the requirements and guidelines of the Common Costing Standards.[20] Life-stage groups were children (0–14 years), working age (15–64 years) and older persons (65+ years). Intent of injury is consistent with ICD-10-AM[16] and is categorised as unintentional, inflicted by others or self-inflicted. The mean LOS was calculated at an event level. This means that the LOS from admission date–time to discharge date–time during each hospital admission was summed at a patient-level prior to the calculation of global means. Annual incidence per 100,000 population was calculated by incorporating annual population projections for the TMT region provided by the MoH to Health New Zealand – Te Whatu Ora Waikato (district health board [DHB] population projections 2018 update). Case fatality rate was calculated as the proportion of trauma patients who died while in hospital, including within the emergency department as a result of their injury, and excluding "medical deaths" not resulting directly from their injuries such as hospital-acquired infections (e.g., pneumonia, sepsis). Data were extracted from the TMTTR using DI Writer/Collector™. All statistical analyses were performed using RStudio 2023.06.0.[21] Population-adjusted incidence rate ratio (aIRR) and associated p-values were calculated using negative binomial regression using population (at study midpoint) as offset, and, using log link, all aIRR calculations were performed in RStudio using the "MASS" package.[22]

Ethical approval was deemed out of scope by the New Zealand Health and Disability Ethics Committee (HDEC) and research approval

was provided under the locality authorisation process by the Health New Zealand – Te Whatu Ora Waikato Research Office (RD023079).

Results

From 1 January 2013 to 31 December 2022, 60,753 trauma patients were admitted to hospitals within the TMT region. Of these, 4,781 (7.9%) were high-severity trauma (ISS >12), 6,203 (10.2%) were moderate-severity trauma (ISS 9–12) and 49,769 (81.9%) were low-severity trauma (ISS 1–8). The demographic characteristics of these patients are shown in Table 1. Males were more likely to be hospitalised for any traumatic injuries than females.

There were 537 deaths in hospital following trauma events, including all "medical" deaths primarily due to medical causes rather than the injuries sustained, and this reduced to 430 when medical deaths were excluded. The global case fatality rate (CFR) for all trauma events was 0.71% (n=430 [died] vs n=60,323 [survived]). High-severity trauma events had a CFR of 6.92% (n=331 [died] vs n=4,450 [survived]) compared to a CFR of 0.84% (n=52 [died] vs n=6,151 [survived]) in moderate and CFR of 0.09% (n=47 [died] vs. n=49,722 [survived]) in low-severity trauma. Table 2 represents how CFRs varied by severity over the 10 years. CFRs are somewhat similar for all severities over the period but noticed a slight drop in 2019 for severe trauma.

Table 1: Trauma patient admissions to Te Manawa Taki hospitals by injury severity score (ISS) band, 2013–2022.

Demographic	ISS band			Total
	>12 (High)	9–12 (Moderate)	1–8 (Low)	
Total events, n (%)	4,781 (7.9)	6,203 (10.2)	49,769 (81.9)	60,753 (100)
Total admissions, n (%)	6,005 (8.5)	7,300 (10.3)	57,605 (81.2)	70,910 (100)
Gender, n (column %)				
Female	1,362 (28.5)	2,191 (35.3)	19,154 (38.5)	22,707 (37.4)
Male	3,419 (71.5)	4,012 (64.7)	30,615 (61.5)	38,046 (62.6)
Ethnicity, n (column %)				
European	2,980 (62.3)	4,189 (67.5)	31,252 (62.8)	38,421 (63.2)
Māori	1,479 (30.9)	1,637 (26.4)	14,899 (29.9)	18,015 (29.7)
Pacific	75 (1.6)	103 (1.7)	1,233 (2.5)	1,411 (2.3)
Other	238 (5.0)	266 (4.3)	2,287 (4.6)	2,791 (4.6)
Not stated	9 (0.2)	8 (0.1)	98 (0.2)	115 (0.2)
Age, mean years (SD)	45.9 (±23)	45.5 (±26)	36.7 (±25)	38.3 (±25)
Died, n (%)	373 (69.5)	74 (13.8)	90 (16.8)	537 (100)
Non-medical deaths, n (%)	331 (77.0)	52 (12.1)	47 (10.9)	430 (100)
Case fatality rate (%) (excludes medical deaths)	6.92	0.84	0.09	0.71

Table 2: Annual case fatality rate (CFR) by ISS band (excludes medical deaths).

	Year (ED arrival)									
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
ISS >12										
Died	20	25	32	30	28	39	29	36	40	52
Events	307	372	391	404	443	489	550	615	568	655
CFR (%)	6.5	6.7	8.2	7.4	6.3	8.0	5.3	5.9	7.0	7.9
ISS 9–12										
Died	5	1	1	2	2	2	5	10	14	10
Events	458	470	559	623	564	619	684	733	716	780
CFR (%)	1.1	0.2	0.2	0.3	0.4	0.3	0.7	1.4	2.0	1.3
ISS 1–8										
Died	8	4	2	3	2	2	6	1	11	8
Events	4,362	4,672	4,980	4,844	5,227	5,014	5,335	5,334	5,280	4,745
CFR (%)	0.2	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.2	0.2
All ISS										
Died	33	30	35	35	32	43	40	47	65	70
Events	5,127	5,514	5,930	5,871	6,234	6,122	6,569	6,682	6564	6180
CFR (%)	0.6	0.5	0.6	0.6	0.5	0.7	0.6	0.7	1.0	1.1

ED = emergency department; CFR = case fatality rate; ISS = injury severity score.

Table 3 represents the population-adjusted IRR for gender and ethnicity. The incident rates are higher for males than females and show statistically significant relationships between gender and having a low, moderate or severe injury score. The population-adjusted incidence rates for Māori are higher than the non-Māori group for low and severe injury scores and show a significant relationship in the ISS 1–8 and ISS >12 bands. Incidence rates of moderate trauma are similar for Māori and non-Māori.

The annual incidence of severe and moderate trauma increased steadily during 2013 to 2022, while the incidence of low severity has been variable over the study period (Figure 1). The incidence of severe trauma almost doubled from 35 per 100,000 population (95% confidence interval [CI] 24–48 per 100,000 population) in 2013 to 67 per 100,000 population (95% CI 51–83 per 100,000 population) during 2022. Moderate-severity trauma has also increased from an incidence of 53 per 100,000 population (95% CI 39–68 per 100,000 population) during 2013 to 80 per 100,000 population (95% CI 62–97 per 100,000 population) during 2022. The overlap of 95% CI in the incidence of the moderate and severe groups as in Figure 1 suggests that this change over the period is not significant. On the other hand, non-overlaps of CI for low-severity trauma incidence suggest a significant difference between low-severity trauma incidences with the other two groups.

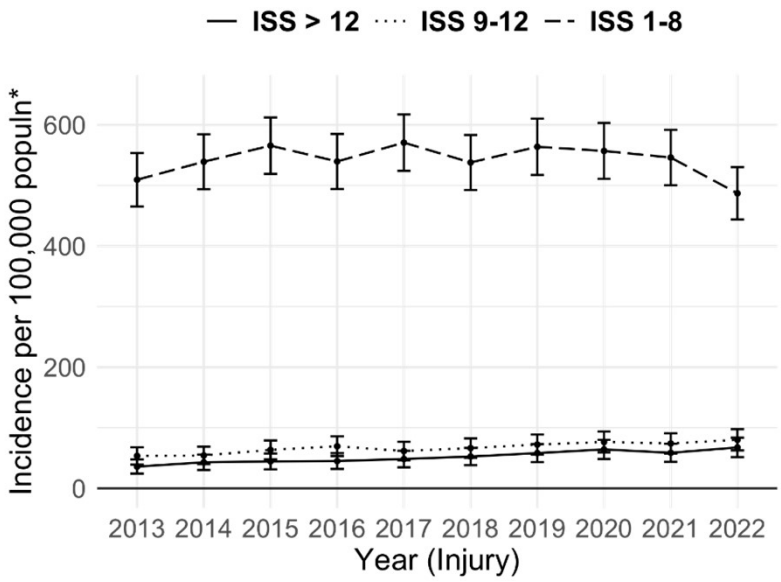
The proportion of high-severity trauma admissions increased from 6.6% of all

Table 3: Population-adjusted incidence rate ratio by demographic and ISS band.

ISS band	Demographic	Average annualised events	Population*	aIRR	(95% CI)	P-value
Gender						
>12	Female	131	457,425 (50.9%)	Reference		
	Male	333	440,130 (49.1%)	2.64	2.16–3.24	<.001
9–12	Female	215	457,425 (50.9%)	Reference		
	Male	394	440,130 (49.1%)	1.90	1.61–2.25	<.001
1–8	Female	1,877	457,425 (50.9%)	Reference		
	Male	6,034	440,130 (49.1%)	1.67	1.58–1.78	<.001
Ethnicity						
>12	Non-Māori	323	667,045 (74.3%)	Reference		
	Māori	141	230,510 (25.7%)	1.26	1.03–1.54	<.05
9–12	Non-Māori	449	667,045 (74.3%)	Reference		
	Māori	160	230,510 (25.7%)	1.03	0.86–1.23	NS
1–8	Non-Māori	3,448	667,045 (74.3%)	Reference		
	Māori	1,463	230,510 (25.7%)	1.23	1.16–1.31	<.001

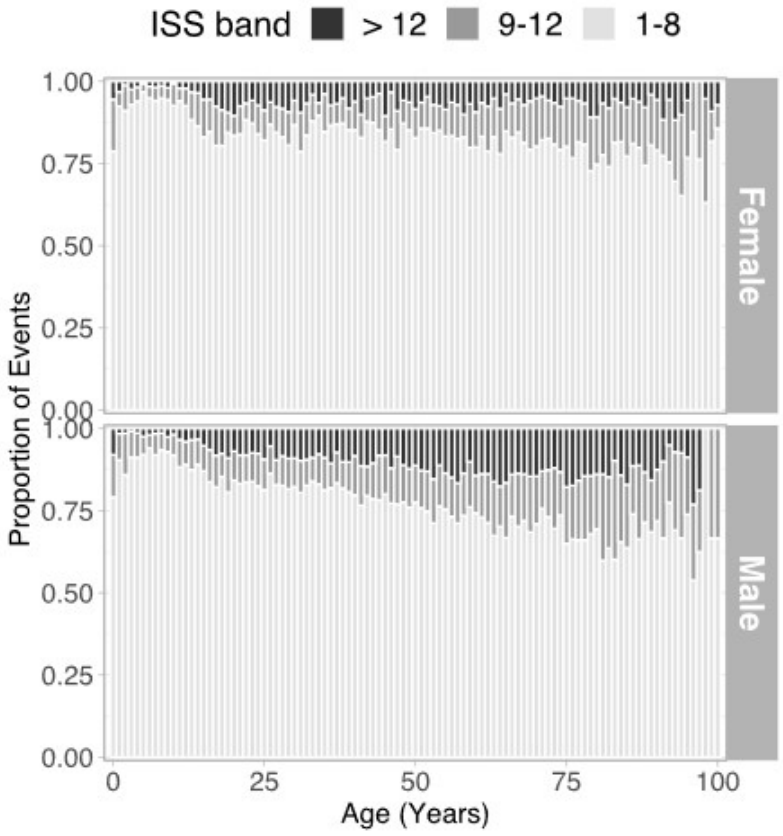
*Midland (TMT) Region population at midpoint 2018.
ISS = injury severity score; aIRR = ppopulation-adjusted incidence rate ratio; CI = confidence interval; NS = not significant.

Figure 1: Annual incidence of trauma per 100,000 population 2013–2022; bars—95% confidence intervals.



*Te Manawa Taki Region population standardised.

Figure 2: Trauma patient admissions to Te Manawa Taki hospitals by age (years), gender and severity, 2013–2022.



admissions during 2013 to 11.2% during 2022. Moderate-trauma admissions also increased slightly from 9.0% of admissions during 2013 to 12.7% during 2022. The proportion of low-severity trauma decreased from 84.3% during 2013 to 76.1% during 2022.

The mean ages of hospitalised cases were 45.9 years, 45.5 years and 36.7 years for severe, moderate and low severity, respectively (Table 1). The proportion of moderate and severe trauma combined increased markedly from 14 years onwards (Figure 2). Adults aged 50 and over had an increase in the proportion of moderate severity, while 75.9% were admitted with low severity. Paediatric trauma, with the exception of infants aged 0–1 year, was also dominated by low-severity trauma. Irrespective of the age group, the proportion of low-severity trauma among females was higher than their counterparts. In contrast to that, the proportion of moderate trauma of males was higher than females. Hospitalisations of females aged 75 years or older were higher than males.

Across all ages, Māori accounted for 29.73% (n=18,015) of all trauma events; however, this was highly skewed towards the ≤9 and 15–29 age groups and represented 52.2% of their total presentation.

When high-, moderate- and low-severity hospitalisations were compared, the proportions of trauma events by both primary injury type and injury intent were similar (Table 4). There were slightly more penetrating injuries among severe trauma compared to moderate- and low-severity cases. There were proportionately more self-inflicted injuries among those with high severity compared to both low and moderate. Low-severity hospitalisations had a higher proportion of burn injuries compared to high and moderate cases.

Table 4: Primary injury type and injury intent by high-, moderate- and low-severity trauma admissions to Te Manawa Taki hospitals, 2013–2022.

ISS	Primary injury type, events (%)			Total
	Blunt	Penetrating	Burn	
>12	4,541 (95.0)	157 (3.3)	83 (1.7)	4,781 (100)
9–12	5,982 (96.4)	154 (2.5)	67 (1.1)	6,203 (100)
1–8	46,870 (94.2)	1,394 (2.8)	1,505 (3.0)	49,769 (100)
Total	57,393 (94.5)	1,705 (2.8)	1,655 (2.7)	60,753 (100)
ISS	**Injury intent,* events (%)**			
	Unintentional	**By other**	**Self-inflicted**	**Total**
>12	4,304 (90.5)	363 (7.6)	88 (1.9)	4,755 (100)
9–12	5,708 (92.5)	406 (6.6)	57 (0.9)	6,172 (100)
1–8	46,560 (93.7)	2,717 (5.5)	393 (0.8)	49,670 (100)
Total	56,573 (93.4)	3,486 (5.8)	538 (0.9)	60,597 (100)

*Excludes 156 injury intent unknown/undetermined (ISS >12 = 26; ISS 9–12 = 31; ISS 1–8 = 99).
ISS = injury severity score.

Table 5: High-, moderate- and low-severity trauma admissions by top five causes of injury, Te Manawa Taki hospitals, 2013–2022.

ISS	Cause of injury,* events (%)					Total
	Road traffic crash	Fall	Motorcycle	Assault	Pedal cycle	
>12	1,441 (37.4)	1,062 (27.7)	660 (17.2)	359 (9.4)	317 (8.3)	3,839 (100)
9–12	947 (19.1)	2,557 (51.6)	582 (11.8)	397 (8.0)	469 (9.5)	4,952 (100)
1–8	3,409 (10.9)	20,068 (64.3)	2,641 (8.4)	2,647 (8.5)	2,495 (8.0)	31,233 (100)
Total	5,797 (14.5)	23,687 (27.7)	3,856 (9.6)	3,403 (8.5)	3,281 (8.2)	40,024 (100)

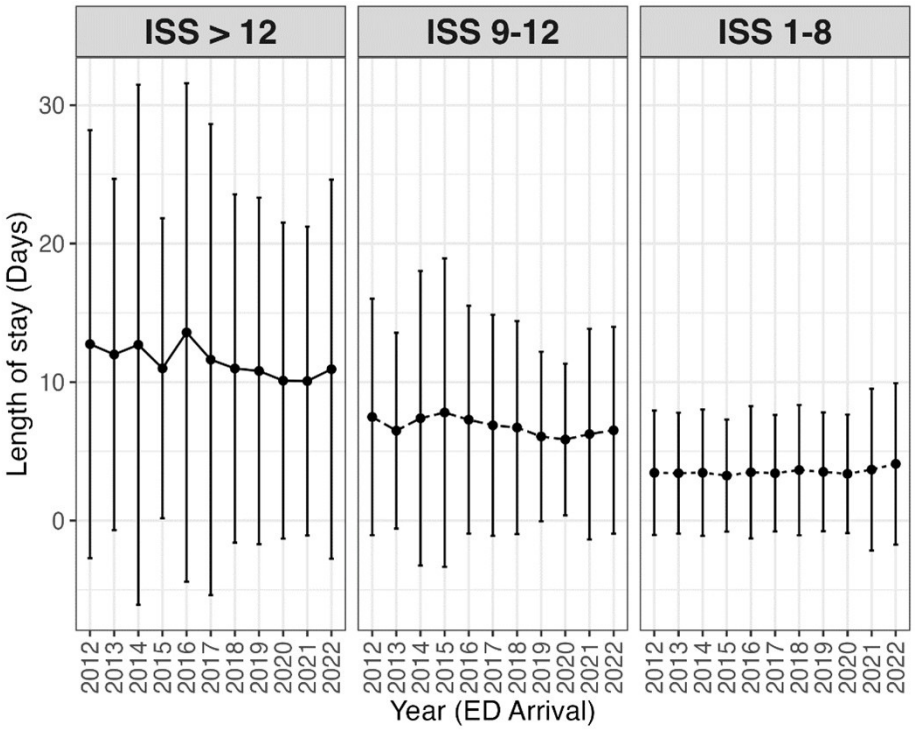
*Cause of injury ordered by decreasing volume for high-severity trauma ISS >12.
ISS = injury severity score.

Table 6: High-, moderate- and low-severity trauma by five most common places of injury, Te Manawa Taki hospital admissions, 2013–2022.

ISS	Place of injury,* events (%)					Total
	Street and highway	Home	Sports and athletics area	Farm	Beach/forest/ countryside	
>12	2,179 (51.5)	957 (22.6)	520 (12.3)	340 (8.0)	239 (5.6)	4,235 (100)
9–12	1,642 (31.7)	2,062 (39.8)	722 (13.9)	457 (8.8)	299 (5.8)	5,182 (100)
1–8	7,240 (18.7)	20,553 (53.1)	5,561 (14.4)	3,283 (8.5)	2,087 (5.4)	38,724 (100)
Total	11,061 (23.0)	23,572 (49.0)	6,803 (14.1)	4,080 (8.5)	2,625 (5.5)	48,141 (100)

*Place of injury ordered by decreasing volume for high-severity trauma ISS >12.
ISS = injury severity score.

Figure 3: Annual mean length of hospital stay in Te Manawa Taki hospitals by injury severity score (ISS) band, 2013–2022.



The most common cause of injury among all-severity hospitalisations was falls (n=23,687) while the most common cause for severe trauma was road traffic crash (n=1,441), accounting for 37.4% of the top five causes of injury (Table 5). The top five causes cover 66% of all events. Falls were the most common cause of injury among both moderate- and low-severity trauma admissions.

The most common place of injury among all-severity hospitalisations was home (n=23,572), and street and highway for severe trauma (Table 6). The home was the most common place of injury among both moderate- and low-severity trauma admissions. Most falls (52%) occurred at home.

From 2013 to 2022, 70,910 admissions to TMT hospitals resulted in a combined 271,155 days of in-hospital care. An average LOS for high-severity trauma patients of 11.2 days resulted in a combined 53,761 days in the hospital. A mean 3.5-day LOS across 57,605 low-severity admissions resulted in a combined 175,978 days in hospital (81%). During 2013, all-trauma admissions involved a total of 21,588 days of in-hospital trauma care. This grew annually to 31,680 days of in-hospital trauma care during 2022, an increase of 137% over 2013.

The average LOS in TMT hospitals across 2013–2022 for high-severity admissions was 12.2 days (standard deviation [SD] ±13.9). This does not include any time spent in a hospital outside the TMT region following an outward transfer and is thus likely to be a slight under-estimate. The mean LOS for moderate- and low-severity admissions was 7.7 days (SD ±7.9) and 4.5 days (SD ±4.7) respectively. The annual mean LOS for low-severity trauma patients varied little from 2013 to 2022 while mean LOS was slightly more variable for moderate- and high-severity trauma admissions (Figure 3).

From 2013 to 2022, the total direct cost to TMT in-hospital trauma care cost was approximately NZ$599.13 million. Of this, high-severity trauma cost approximately NZ$142.27 million (23.8%) while moderate- and low-severity cost approximately NZ$86.08 million (14.4%) and NZ$370.06 million (61.8%) respectively. Direct in-hospital costs increased 122% from approximately NZ$37.44 million during 2013 to approximately NZ$83.27 million during 2022 (based on 97% of patients cost). While the proportion and incidence of low-severity trauma have decreased over time, the annual cost of their in-hospital care has continued to grow.

Discussion

This is the first study to report the descriptive epidemiology of low-, moderate- and high-severity trauma patients admitted to hospitals across all ages within a health region in Aotearoa New Zealand over a 10-year period. Considering the need to reduce the significant biopsychosocial and economic impacts of traumatic injuries, identifying at-risk populations and risk factors allows us to understand patterns of trauma in more detail, and will support targeted strategies for injury prevention.

The study includes 60,753 trauma patients who were admitted to TMT hospitals over a 10-year period, during which time the incidence of admissions of high-severity trauma grew steadily, possibly owing to an increase in transport-related events.[23] Study results also demonstrate that differences in trauma rates exist in TMT region by gender, ethnicity and age. Males showed higher incident rates than females in all severities, ranging from an aIRR of 1.67 for low-severity trauma up to an aIRR of 2.6 for high-severity trauma. Hence, males were hospitalised 2.6 times more than females due to severe trauma. This is consistent with data from the annual report (2021/2022) of the New Zealand Major Trauma Registry & National Trauma Network.[8] Either this may possibly reflect a tendency to exhibit high-risk behaviour, or differences in work-related activities between genders, as well as other factors. However, across all age groups, the proportion of low-severity females was higher than their counterparts. This may possibly reflect the differences in activities between genders, as well as other factors. The results also show that actual hospitalisations of females aged 75 years or over were higher than males. This may possibly reflect a greater proportion of females surviving into older age.

Study findings indicate that age has an important relationship with severity. The proportion of moderate- and high-severity trauma increases steadily with advancing age from 14 years. These findings are consistent with the systematic review of Montoya et al.[9] This steady increase suggests that consideration should be given to commencing prevention initiatives at an earlier age than has traditionally been the case. Paediatric trauma except for infants ≤1 years is primarily low severity, with approximately 92% of cases being ISS 1–8. However, paediatric trauma was dominated by low-severity trauma. The age group analysis also shows an increase in the proportion of moderate trauma among adults aged

50 years and over. One possible explanation may be that falls, which are very common among older adults, contribute significantly to this trend.[3,24] As a result, older adults are more likely to have worse outcomes than younger age groups.[3,9,24,25]

The study results show that though the Māori accounted for less than a third of all trauma events, this was highly skewed towards the ≤9 and 15–29 age groups and represented 52.2% of their total representation. This may be due to the younger age structure of the Māori ethnicity. Results show statistically significant relationships between ethnicity and severity. The population-adjusted incidence rates for Māori are higher than the non-Māori group for low and severe injury scores. This is in line with the literature, which showed that Māori experienced higher major trauma rates than non-Māori.[8,9]

The proportions of primary injury types within each high-, moderate- and low-severity band were relatively similar, with only slightly more penetrating injuries among high-severity trauma patients. High-severity trauma is dominated by road traffic crash injuries while low-severity trauma is dominated by falls. These results are in line with the international studies discussed in Montoya et al.'s review.[9] It is also noted that most falls occurred at home. This aligns with previous work suggesting structural hazards for falls are common in Aotearoa New Zealand homes.[3,26]

The results demonstrate that the sum of total in-hospital LOS increased by 137% during the study period, but the mean hospital LOS varied slightly, suggesting increasing trauma admission volume was the main driver of the increasing sum of total hospital LOS. The study results also show that the direct cost of trauma care to TMT hospitals increased by 122%, which might be attributable to an increase in trauma admissions.

The study is unique in that it utilises a continuously collected dataset that represents low-, moderate- and high-severity trauma patients hospitalised across all ages within a health region in Aotearoa New Zealand, including estimates of hospital cost. The TMT region is also representative of Aotearoa New Zealand as a whole in terms of demography; therefore, the findings may be applicable in some degree to Aotearoa New Zealand as a whole. The study findings need to be considered in light of some limitations. This study includes hospitalised patients and does not represent a population sample of all traumatic injuries because it does not include non-admitted persons, nor pre-hospital deaths from injuries. Another limitation is that ethnicity data obtained from the registry and national collections can differ from how a patient identifies, potentially leading to mis-classification bias that can under-estimate incidence rate of Māori.[27]

Conclusion

During the 10-year period reviewed, the incidence of admissions of high-severity trauma in the TMT region grew steadily and varied by gender, age and ethnicity. Males and adult age groups predominate in traumatic hospitalisations resulting in significant cost and public health burden. The significant relationships between gender, ethnicity and injury severity may suggest that some groups are more at risk of severe trauma events. The population-adjusted incidence rates for Māori and non-Māori (despite similar incidence rates for moderate injuries) are very concerning. The current work will be used to direct and support in-depth analysis of at-risk groups to improve services and help reduce this significant and potentially preventable burden on the health system, patients and the community.

COMPETING INTERESTS
The authors declare no competing interests.

AUTHOR INFORMATION
Grant Christey: Clinical Director, Te Manawa Taki Trauma System, Te Whatu Ora – Waikato, Hamilton, Aotearoa New Zealand; The University of Auckland, Waikato Clinical School, Hamilton, Aotearoa New Zealand.
Ishani Soysa: Research Manager, Te Manawa Taki Trauma Research Centre, Te Whatu Ora – Waikato, Hamilton, Aotearoa New Zealand.
Alastair Smith: Biostatistician, Te Manawa Taki Trauma System, Te Whatu Ora – Waikato, Hamilton, Aotearoa New Zealand.

CORRESPONDING AUTHOR
A/Prof Grant Christey: Clinical Director, Midland Trauma Research Centre, Meade Clinical Centre, Waikato Hospital, Hamilton; Waikato Clinical School, The University of Auckland, Auckland.
E: grant.christey@waikatodhb.health.nz

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Nitrous oxide myelopathy: a case series

Shilpan G Patel, Tony Zhang, Bernard Liem, Frederick Sundram, Richard H Roxburgh, P Alan Barber

ABSTRACT

AIMS: To describe the clinical features and outcomes of patients with myelopathy and neuropathy due to recreationally inhaled nitrous oxide.

METHODS: We identified patients presenting with nitrous oxide-associated myelopathy from an electronic database of all discharges in a large tertiary hospital between 2016 and 2023. Demographics, clinical features and the results of investigations were recorded. The primary outcome was modified Rankin Scale score (mRS) at least 3 months after hospital discharge where available.

RESULTS: There were 12 patients identified, six women, mean (SD) age 27.5 (5.1) years, range 19–47 years. The most common symptoms were numbness, weakness and mental state changes. Four patients used large amounts of inhaled nitrous oxide and also took over-the-counter vitamin B12 supplements. The median (range) hospital length of stay was 8.5 (2–56) days. Functional independence at last assessment (median [range] of 3 [1–34] months after discharge) was achieved in nine of the patients, with three requiring ongoing support for activities of daily living (mRS ≥3).

CONCLUSION: Nitrous oxide abuse and its neurological complications are an important public health issue. Clinicians should be aware that some patients who use large amounts of nitrous oxide may self-supplement vitamin B12.

The use of nitrous oxide (N_2O) for anaesthesia has been established for over 100 years. It is also sold as a dairy-cream whipping agent in 8g canisters which, for recreational purposes, are dispensed into balloons that are then inhaled. The consequent feelings of euphoria have led to it becoming a drug of abuse. Lifetime prevalence of recreational N_2O has been reported as high as 38% in the United Kingdom and 29% in the United States,[1] with 17% of young people admitting to using it in the 2014–2016 Global Survey.[2] There are concerns that the prevalence of N_2O abuse has been increasing.[3,4]

N_2O use has been associated with adverse effects, including neuropathy and myelopathy.[4] In the Global Survey, 3% of regular users reported permanent sensory symptoms.[2] The proposed mechanism of neurological damage is N_2O inactivation of vitamin B12 resulting in a functional deficiency of vitamin B12. This affects cellular structures such as myelin, which are dependent on B12-mediated cellular pathways.[4,5] Low serum vitamin B12 indicates that a patient may be at risk for this deficiency. Importantly, it is the elevated serum methylmalonic acid (MMA) level that confirms the diagnosis of a functional B12 deficiency. MMA accumulates in the body when vitamin B12 is inactivated and unable to facilitate the conversion of methylmalonyl-CoA to succinyl-CoA in the Krebs cycle.[5]

We present a case series of patients admitted to a tertiary hospital with N_2O-associated myelopathy. We aim to describe the demographic and clinical features of these patients and outcome on follow-up.

Methods

Patients admitted to our institution with N_2O myelopathy from 2016 to 2023 were identified from an electronic hospital discharge database. Our hospital provides neurology care for a regional population of 1.7 million people. Clinical data, investigation results and outcome data from community physiotherapy and occupational therapy assessments were extracted retrospectively. The dose of N_2O was determined from the self-reported number of cannisters inhaled, with the highest number of cannisters used in a single day in the month prior to presentation defined as the peak daily use. Patients were contacted either by telephone or seen in person after discharge and had a structured interview to assess ongoing symptoms and dependence using the modified Rankin Scale (mRS). The mRS is a 7-point scale, with 0 normal and 6 dead, with the primary outcome measure of functional independence defined as mRS 0, 1 or 2.[6] An attempt was made to follow-up patients for at least 3 months or until asymptomatic; one patient was lost to follow-up before 3 months. We present the results

Table 1: Summary of cases.

#	Patient details and age range	Clinical presentation	Serum B12 (N: 170–800pmol/L) MMA (N: <0.4umol/L)	MRI spine location of T2/ FLAIR hyperintense lesions	Peak daily N_2O canister use in month prior to presentation	Length of hospital stay (days)	Follow-up duration (months)	Modified Rankin Scale at follow-up
1	26–30y Alcoholic gastritis.	LL weakness and paraesthesia	B12 = 125 MMA = 1.14	Cervical cord	10	7	1	4
2	31–35y	Cognitive impairment, auditory hallucinations, sensory ataxia	B12 = 115 MMA not done	Entire spinal cord	50	20	12	0
3	46–50y	Paraesthesia and sensory ataxia	B12 = 247 MMA = 0.93	Not done	Regular use, quantity not disclosed	3	34	0
4	21–25y PCOS on metformin	Apathy, sensory ataxia, quadriparesis, urinary retention	B12 = 117 MMA = 1.14	Cervical cord	Single session of 200 canisters	56	7	4
5	21–25y	Sensory ataxia	B12 = 91 MMA = 7.30	Cervical and thoracic cord	40	6	6	0
6	41–45y Taking oral B12 replacement Alcohol dependence	Low mood, sensory ataxia	B12 = 115 MMA not done	Cervical cord	100	15	3	0

Table 1 (continued): Summary of cases.

#	Patient details and age range	Clinical presentation	Serum B12 (N: 170–800pmol/L) MMA (N: <0.4umol/L)	MRI spine location of T2/ FLAIR hyperintense lesions	Peak daily N_2O canister use in month prior to presentation	Length of hospital stay (days)	Follow-up duration (months)	Modified Rankin Scale at follow-up
7	26–30y	Paraesthesias, Lhermitte's and gait impairment	B12 = 98 MMA not done	Cervical and thoracic cord	Regular use, quantity not disclosed	10	4	3
8	16–20y Taking multi B vitamin supplements	Gait impairment, numbness, paraesthesia and sensory ataxia	B12 = 168 MMA = 3.26	Cervical cord	200	4	3	2
9	21–25y	Poor concentration, LL numbness and weakness	B12 = 142 MMA = 2.75	Not done	100	7	3	2
10	21–25y Taking oral B12 supplements and B12 injection	LL weakness, sensory ataxia, distal numbness and low mood	B12 >1,470 MMA = 1.69	Cervical and lumbar cord	720	26	3	2
11	16–20y Taking oral B12 replacement	LL weakness, sensory ataxia, distal numbness and low mood	B12 = 379 MMA = 0.47	Entire spinal cord	360	19	3	2
12	26–30y	UL parasthesiae	B12 = 234 MMA = 1.16	Entire spinal cord	100	2	3	0

LL = lower limb; UL= upper limb; MMA = methylmalonic acid; PCOS = polycystic ovarian syndrome.

of the last assessment for each patient.

The study had approval from a regional ethics committee (Ref AH26091). Patient 8 provided informed written consent for their MRI images to be published.

Patients were involved in the conduct of this research. They were asked during follow-up which measures of function were most important to them, and this helped to inform our outcome measures.

Results

There were 12 patients (six women, mean [SD] age 27.5 [5.1] years, range 19–47 years) with N_2O-induced myelopathy identified (Table 1). Of the 12 patients, five had Chinese, four European and three Polynesian ethnic backgrounds. All 12 patients presented with spinal posterior column involvement (impaired light touch, vibration and joint position sensation in the lower limbs), and 11 patients had a sensory ataxia. Pain and temperature sensation was impaired in three patients. Numbness conformed to a glove-and-stocking distribution. Five patients reported lower limb weakness, one of whom also had upper limb weakness. Five patients reported changes in mental state, including three with poor concentration, one with impaired cognition confirmed on cognitive testing and one who presented with psychosis. The median (range) hospital length of stay was 8.5 (2–56) days. The most severely affected person (patient 4) presented with quadriparesis, had risk factors for a vitamin B12 deficiency and had used 200 canisters of N_2O in a single day for the first time in their lifetime.

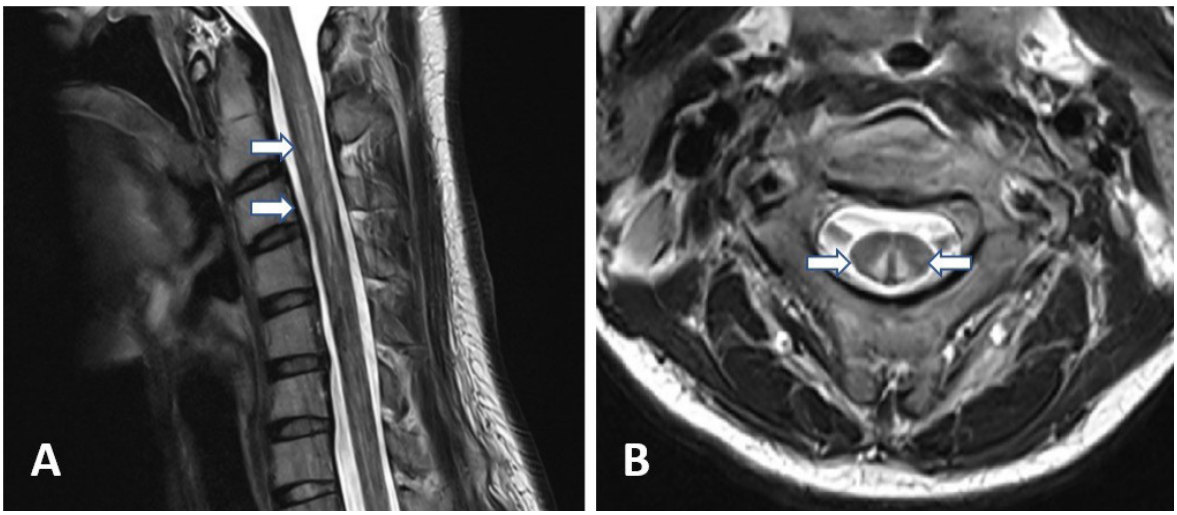
All patients had laboratory evidence of low serum vitamin B12 or elevated MMA. Four patients had been self-supplementing vitamin B12 prior to presentation. Ten patients had MRI of the spine, and all had T2 FLAIR hyperintense lesions in the dorsal columns of the cervical cord. Two also had involvement of the thoracic cord, one the cervical and lumbar cord, and three had involvement of the whole spinal cord (Figure 1).

Use of N_2O varied between patients with the median (range) use of 100 (10–720) N_2O canisters per day in the month prior to presentation. We were unable to determine a relationship between N_2O peak usage and severity of clinical presentation, which was complicated by two factors. Firstly, four patients had been self-supplementing vitamin B12. Secondly, two patients had other risk factors for vitamin B12 deficiency; one with alcoholic gastritis, and another with polycystic ovarian syndrome being treated with metformin and a calorie-restricted diet.

All patients were offered counselling support and ceased N_2O use. All were treated with at least 2 weeks of vitamin B12 at a dose of 1mg intramuscularly on alternate days, and rehabilitation where this was required.

Eleven patients were followed-up after discharge for at least 3 months (median [range],

Figure 1: Magnetic resonance imaging (1.5T) of the cervical spine: A) sagittal T2 demonstrating signal hyperintensities predominantly in the upper cervical cord; B) corresponding axial T2 demonstrating signal hyperintensities affecting the dorsal columns.



3 [1–34] months). Functional independence (mRS <3) was achieved at last assessment in nine of the patients, with three requiring ongoing support for activities of daily living at last follow-up (however, one of these three patients was lost to follow-up at 1 month after discharge). Mental state changes resolved rapidly within 1 to 2 weeks following treatment. Weakness resolved within the first 2 to 4 weeks following treatment. Sensory ataxia often improved within the first 3 to 6 months following treatment.

Discussion

This case series highlights the dangers of inhaled N_2O, with patients presenting with cognitive, psychiatric and neurological impairment. Most patients were using large quantities of N_2O on a regular basis; the two patients who had used smaller quantities had risk factors for vitamin B12 deficiency. All of the patients had clinical and imaging involvement of the spinal dorsal columns consistent with previous reports,[7–9] and three had imaging changes extending down the whole spinal cord. Seven of the patients continued to have symptoms at their last follow-up assessment and three required ongoing support for activities of daily living. The prevalent recreational use of N_2O underscores the need to improve education and restrict access to this drug.

Knowledge about the risks of N_2O use has been reported as being poor among the general population.[4] However, four of our cohort who were using large quantities of N_2O with a peak daily use of more than 100 canisters per day were aware of the potential dangers and were taking over-the-counter vitamin B12. It suggests that patients who self-supplement vitamin B12 may tolerate very large quantities of N_2O before experiencing symptoms. We have not seen this described previously. Importantly, such supplementation was not sufficient to prevent their developing myelopathy and may falsely reassure patients and clinicians. These patients require a harm reduction approach to management with addiction counselling and psychological support. In patients who continue to use N_2O, vitamin B12 supplementation may be indicated as part of a harm reduction strategy.

There are limited reports on recovery following treatment of N_2O myelopathy, with assessments limited to 2 months or less.[4,7,10–12] Our patients were followed for a median of 3 months after hospital discharge. Mental state changes, weakness and sensory symptoms improved within the first 6 months of follow-up.

Where possible, we recommend public health interventions to discourage people from using N_2O recreationally. However, N_2O remains accessible to the general public, where large quantities can be purchased legally online. Restricting sales from commercial vendors, including limiting the number of cannisters sold to only those required for non-recreational day-to-day use, and the provision of education about the potential adverse effects of N_2O may help reduce harm.

This report has a number of limitations. This is a single- centre report and there are likely other presentations to hospitals outside of our district that have not been captured. Additionally, some patients may not have had their condition accurately documented in their electronic clinical record. We were not able to identify patients with milder symptoms who did not present to hospital.

Recreational nitrous oxide abuse can cause a myelopathy and cognitive changes, leading to young people presenting with significant psychiatric and neurological disturbance with incomplete recovery. This case series highlights the importance of early identification, prompt treatment and support from addiction and psychological services to discontinue N_2O use to improve long-term outcomes. Clinicians should be aware that some young people may self-supplement vitamin B12; however, this did not prevent presentation with myelopathy.

COMPETING INTERESTS
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AUTHOR INFORMATION
Shilpan G Patel, MBChB: Department of Neurology, Auckland City Hospital, New Zealand.
Tony Zhang, MBChB: Department of Neurology, Auckland City Hospital, New Zealand.
Bernard Liem, MBChB: Department of Neurology, Auckland City Hospital, New Zealand.
Frederick Sundram, PhD FRCPsych: Department of Psychological Medicine, The University of Auckland, New Zealand.
Richard H Roxburgh, PhD FRACP: Department of Neurology, Auckland City Hospital, New Zealand; Department of Medicine, The University of Auckland, New Zealand.
P Alan Barber, PhD FRACP: Department of Neurology, Auckland City Hospital, New Zealand; Department of Medicine, The University of Auckland, New Zealand.

CORRESPONDING AUTHOR
P Alan Barber: Department of Neurology, Auckland City Hospital, New Zealand. Ph: +649 367 0000
E: ABarber@adhb.govt.nz

URL
https://nzmj.org.nz/journal/vol-137-no-1599/nitrous-oxide-myelopathy-a-case-series

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Addressing closed and limited enrolments in general practices in Aotearoa New Zealand: a mixed-methods study

Nisa Mohan, Maite Irurzun-Lopez, Megan Pledger, Mona Jeffreys, Jacqueline Cumming

ABSTRACT

AIM: To ascertain the reasons for and impacts of closed books in general practices in Aotearoa New Zealand and report recommendations for mitigation.

METHOD: A mixed-methods approach was used. A first round of interviews with experts in the primary care sector was conducted, followed by a survey across general practices and, finally, a second round of interviews. Data reported here are qualitative data from the interviews and open-ended questions in the survey. Qualitative data were analysed using a general inductive approach.

RESULTS: The key reasons for not enrolling new patients included workforce shortages, high workloads and staff burnout, funding issues, concerns about quality of care and insufficient physical space. These were exacerbated during the COVID-19 pandemic. The impacts included no access or delayed access to primary care, worsening health conditions, undiagnosed or untreated diseases and less or no access to preventive care. Recommendations included recruiting more staff including administrative staff, resolving the pay disparity between general practice and hospital staff, having a longer placement period for students in general practice, utilising a multidisciplinary workforce and revising the funding formula.

CONCLUSION: There is an urgent need to resolve key issues so that general practices can accept all who wish to enrol.

In Aotearoa New Zealand, primary care (PC) is delivered principally in community-based general practices by general practitioners (GPs), practice nurses, nurse practitioners and other healthcare professionals, both from the regulated professions (such as pharmacists) and non-regulated professions (such as health coaches).[1] There are approximately 5,600 GPs and around 1,000 general practices in Aotearoa New Zealand, providing about 14 million consultations every year.[2]

Patient enrolment with a general practice is fundamental to the funding of PC, as practices are largely funded by the government, based on the numbers and characteristics of their enrolled populations.[3,4] Enrolling with a general practice also has many benefits for patients, such as reduced consultation fees (resulting from higher government subsidies), centralisation and management of patient data and of recalls for preventive care, and GPs taking responsibility for prescription, referrals to specialised care and subsequent follow-ups.[3]

PC providers serve as the entry point to the broader healthcare system in Aotearoa New Zealand. Consequently, limited access to PC translates into challenges in obtaining referred services such as prescriptions, diagnostic tests and specialist consultations. A robust PC system is seen as the path for the effectiveness, equity and efficiency of the overall healthcare system.[5] Amidst a growing burden of non-communicable diseases, PC is central for both preventive measures, as well as coordinating the long-term management of chronic conditions. Additionally, PC plays a crucial role in executing key public health tasks, exemplified by its response to the COVID-19 pandemic.[5]

However, general practices in Aotearoa New Zealand are increasingly having to limit or cease enrolments of new patients, with the latter being known as "closed books." Closed books have been reported in the media for some time.[6] In 2017, it was estimated that 10% of general practices were closed to new enrolments, rising slightly to 11% in 2018.[7,8] We have more recently estimated that 27% of practices had closed books in 2022, and 79% of practices were closed to new enrolees at some point between January 2019 to August 2022.[9] Previous research identified workforce shortages as a key reason for closed books,[10]

Aotearoa New Zealand being highly dependent on overseas-trained staff, with around 50% of doctors working in Aotearoa New Zealand trained in other countries[10,11] and 27% of nursing staff having also trained overseas.[12] The long-term emigration of medical professionals to Australia continually contributes to workforce shortages in Aotearoa New Zealand.[11]

While previous studies have quantified the problem, few have looked at the issue in depth.[7,8,13] This study aimed to explore the reasons and impacts of closed books based on the perceptions of primary care experts and general practice healthcare professionals, and to elicit recommendations for improvement.

Methods

This research was a part of a larger study about the challenges of closed books for PC access, health outcomes and equity in Aotearoa New Zealand.[9] The larger study used a mix of qualitative interviews and quantitative and qualitative survey methods. This article focusses primarily on qualitative data from interviews and open-ended questions in the survey.

A first round of interviews was conducted with informants to better understand the key issues relating to closed books and to refine the survey questions. A survey of general practice healthcare professionals was then launched. It included the recommendations that informants gave to end the problems of closed books in order to gauge the level of support for these recommendations among general practice health professionals. Subsequently, after analysing the preliminary survey findings, a second round of interviews took place, focussing on clarifying emerging issues from the survey and further exploring recommendations.

Participation in this study was voluntary. A participant information sheet and consent form were sent to all potential interviewees. Interviewees received a brief introduction about the study before their interview. An interview guide was used to structure the interviews, allowing data gathering through a consistent set of questions, as well as the ability to explore new insights as they emerged. The interviews were conducted either virtually via Zoom or face-to-face, according to the preference of the interviewee and feasibility. Interviews were recorded for data analysis with interviewees' consent; they were not transcribed, but notes were taken while the audio recordings were played back repeatedly. The audio recordings were named according to de-identified participant numbers and stored in a password-protected computer, with attention to protecting interviewees' privacy and data confidentiality.

We used a mix of inductive and deductive approaches. The first round of interviews was analysed using a general inductive approach. This approach aimed to develop categories for a model or framework that can highlight the most important key themes arising from the data.[14] These themes were then organised, categorised and combined to give meaningful explanations relating to the research questions. The analysis of survey data reported here primarily followed a deductive approach, where pre-defined options (based on informants' responses) were given to respondents to react to. The second round of interviews used a mix of inductive and deductive approaches to expand on key emerging issues from the survey, as well as explore ways forward.

The survey was primarily advertised to practice managers and GPs through newsletters of the Royal New Zealand College of General Practitioners (RNZCGP) and the Practice Managers and Administrators Association of New Zealand. The survey was administered through Qualtrics.[15] The key questions in the survey touched on whether the practice had closed books, the reasons for closed books and its impacts, and recommendations to resolve the issue. The 227 survey respondents comprised practice managers (n=119), GPs (n=85), practice owners (n=52), administration staff (n=10) and other management staff (n=10), with some having multiple roles.[9] Further details about the survey, including a copy of the questionnaire, are available elsewhere.[11]

The Victoria University of Wellington Human Ethics Committee provided ethical approval for the study (Number: 0000030193).

Results

Altogether, 17 key informants in the PC sector were purposively selected and interviewed for the study: nine GPs, four practice mangers, two academic PC researchers, one nurse practitioner and one staff member of RNZCGP. GPs or practice managers from four practices with a high proportion of Māori users were intentionally included in the study. Māori have higher health needs, under-utilisation of healthcare and lower rates of enrolments with PC compared to other groups.[3]

We delineate below the key findings across

three topics: a) reasons for closed books, exploring the causes leading to limiting new enrolments, b) impact of closed books, focussing on the effects and consequences observed, and c) recommendations in moving forward, discussing proposed measures and strategies to address the challenges identified.

Reasons for closed books

1. Workforce shortages: Interviewees most frequently cited staff shortages as the reason for practices closing their books to new patients. They mentioned that a shortage of GPs or nurses compelled practices to stop taking new patients.

> *"We closed our books because one GP resigned, and we couldn't recruit one." – Interviewee 4*

> *"Recruitment and staff retention, especially GPs and nurses, has been the key issue. Almost no job applicants, and those few that do, have multiple offers to pick between because there are so many vacancies around." – Survey respondent*

Interviewees and survey respondents pointed to a variety of factors contributing to the workforce shortages, including:

1.1 Retiring GPs: The growing proportion of GPs who are approaching retirement age exacerbates staff shortages. Staff shortages are worse in rural areas; one interviewee noted that there were no replacements for retiring GPs from high-needs practices in their rural location. Another pointed to the particular problems of recruiting in rural areas, including the trouble obtaining suitable employment for GPs' partners and locating schools of choice for children.

> *"Thirty percent of the GPs are going to retire in [soon]. That's adding to the problem." – Interviewee 2*

1.2 Difficulty in recruiting overseas-trained staff: Interviewees commented that Aotearoa New Zealand relies heavily on medical staff trained abroad. The recruitment of medical staff was limited between 2020 and 2022 because of COVID-related border restrictions.

> *"[Staff shortage] seems to be worsened during the last couple of years from 2019. I think that's a direct consequence of the GP workforce issues we are having. Certainly, it's been exacerbated by the borders being closed." – Interviewee 1*

1.3 Pay inequity compared to secondary and tertiary care: Pay inequity in PC compared to secondary and tertiary care came up as another reason for staff shortages in PHC. Hospital staff receive a higher salary than PC staff, which makes more professionals attracted to specialised care.

> *"The pay equity stuff is really significant, a nurse working in a hospital earns an average NZ$20,000 more than a nurse practitioner." – Interviewee 1*

1.4 Fewer medical students choosing general practice as a career: During medical training, students get less exposure to general practice compared to secondary care, and medical students are thought to frequently regard general practice as a less appealing option than hospital medicine due to its lower remuneration.

> *"We are expecting our medical students to go into something they don't have exposure to." – Interviewee 3*

> *"Medical students are choosing specialities: better pay and status." – Interviewee 14*

2. Under-funding of general practices: Another major reason provided for closed books was insufficient funding for general practices. General practices are partially funded through capitation formula based on the number of people enrolled and their characteristics. As the capitation funding model is generally not seen to adequately account for the complexity of conditions that patients have, there is a perception that high-needs patients are being passed along.

> *"Funding per patient does not reflect the workload that is required. It is problematic especially for high-needs patients." – Interviewee 2*

> *"We take all comers whether high needs or not. Other local practices seem to refuse high-needs patients, so we get more than our fair share." – Survey respondents*

3. High workloads and staff burnout: The pressure of under-funding and staff shortages

causes a higher workload among existing staff, resulting in staff burnout in general practice. Professional staff reported having to increasingly conduct administrative tasks in addition to clinical work, further leading to higher workloads and burnout among staff. Higher levels of patient concerns, and staff sickness during the COVID-19 pandemic period, also added to the workload.

> *"The pressure and stress of under-funding and insufficient workforce are causing existing staff to resign, which further worsens stress on existing staff." – Survey respondent*

> *"General practices are asked to take on more and more work, including work that was previously performed in hospitals. The paperwork has also increased. So, there is more work but a seriously declining number of healthcare workers (most particularly, GPs) to carry out this work." – Survey respondent*

4. Impacts of COVID-19: The COVID-19 pandemic was seen to have both direct and indirect impacts on the PC sector. The workload of general practices increased as the number of sick patients increased, along with an increase in patient demand, and with the added precautions needed to treat COVID-19 patients. The pandemic also resulted in staff shortages due to staff or family sickness. The border closure enforced during the COVID-19 pandemic had an impact on workforce shortages in Aotearoa New Zealand due to the reliance on overseas-trained medical professionals and the inability of new health professionals to enter the country.[16]

> *"[Our] high-needs practice was hit hard with COVID-19, both staff and patients, and [we were] required to support patients 7 days per week, with up to 40% of staff away at any given time." – Survey respondent*

5. Concerns about quality of care: High ratios of patients to staff can increase waiting times, cause delays in patient care and decrease quality of care and patient satisfaction. PC staff worry about the quality of care they can offer when there is more demand for healthcare than can be managed. Therefore, general practices may choose to limit or close the number of new patient enrolments to manage the workload and thereby retain quality of care. They may choose to do this despite the revenue new enrolees would bring to the practice.

> *"From a business point of view, there is a disincentive to close your book but at some point, patient care has [to] take priority over financial benefit." – Survey respondent*

6. Insufficient physical space: Insufficient physical space was another reason given for closing books to new enrolments. Respondents noted that there may not be sufficient rooms for examination and treatment, and in some practices, patients' waiting areas are also limited. One interviewee mentioned that in some general practices, staff are working in shifts to occupy the working spaces available to them. Interviewees noted the need for plans to extend or upgrade the existing space to meet demand.

> *"We are limited in terms of funding, staff and space to accommodate patients in our waiting areas, and consultation rooms." – Interviewee 8*

Impacts of closed books

Study respondents noted that all three dimensions of PC—preventative care, acute care and chronic care—are affected by closed books. When people cannot get an appointment when needed, they are forced to seek care at after-hour services or hospital emergency departments. After-hours services are expensive, while free hospital emergency departments can get over-loaded and people can face long waiting times. People may also choose not to access care at all, which can lead to delays in treatment and diagnosis. Consequently, people's health may worsen. They may also not be able to access preventive care such as cancer and cardiovascular disease screening, and continuity of care may be lost if they are not enrolled. The increasing prevalence of closed books may also affect care for those who can get a general practice visit by putting pressure on the ability of practices to maintain clinical standards of care and continuity of care.

> *"Patients need someone who knows their health needs. These kind of relationships and trust in medical staff will be compromised because of*

discontinuity of care." – Interviewee 4

The impacts of closed books can also compound; when one general practice closes or closes enrolments, it increases the burden on other practices. It can also induce gridlock when multiple patients, across different localities, do not want to relinquish enrolment in one place because they cannot enrol in their new location, as well as issues of excessive travel or problems of managing distant patients via telehealth.

"[We have] patients trying to enrol from outside our community because they have been unable to enrol in their hometown—these are people who are one and a half hours from our practice." – Survey respondent

Recommendations

To address the workforce challenges, interviewees and survey respondents proposed several strategies. Recommended actions included: to recruit more staff, establish pay equity between primary and secondary care staff, increase the number of places at medical schools, include longer placements in general practice for medical students, relax immigration rules to ease overseas staff recruitment and increase remuneration in PC to attract and retain staff.

Recruiting more staff from overseas was seen as a short-term solution. It was argued that there is not enough GP training in Aotearoa New Zealand to meet current and future needs. Increasing the number of places for medical training in Aotearoa New Zealand was seen as a long-term solution that could lead to an increase in the number of medical students choosing general practice as a career. It was also felt that there was a need to make general practice more attractive to new graduates and that the medical curriculum needed to be reorientated to increase its focus on PC, including having more student placements in the community, especially in rural areas.

"We rely on overseas-trained doctors; the immigration department needs to make the rules more relaxed to let more medical professionals come and work here." – Interviewee 4

"Please encourage the New Zealand government to create incentives for people training as a GP and also incentives to bring more doctors to New Zealand from overseas." – Survey respondent

Recommendations to manage the workload of staff were to recruit multi-disciplinary team members in general practices, recruit more nurse practitioners and appoint more administrative staff to support the work of existing staff.

"There should be an understanding about the workload of GPs and nurses." – Interviewee 6

"Rearrangement of paperwork management so doctors can see more patients." – Interviewee 5

More funding and revision of the capitation formula were repeatedly suggested by most of the interviewees as key means of reducing general practices closing their books. Some general practices were also seen to need funding for expanding or building new spaces and facilities for patient care. Finally, it was felt that the government needs to better understand the problems and, in particular, the workload of general practice staff.

"More space, improved funding to pay GPs and nurses, improved communication from the Ministry of Health in advance of changes." – Survey respondent

The main recommendations compiled from the first-round interviewees were put to respondents in the survey to assess respondents' agreement with key recommendations. Table 1 reports the proportion of survey respondents who agreed with each recommendation, listing recommendations from those with the highest to those with less support. Overwhelmingly, survey respondents wanted more funding for PC and pay equity with other sectors. Other recommendations with high levels of agreement revolved around staffing, specifically the ability to attract and retain staff, and improved training pipelines.

Discussion

The results of this mixed-methods study show that the key reasons for not enrolling new patients included workforce shortages, under-funding, high workloads and staff burnout, the desire to preserve quality of care and having insufficient physical space. The results suggest that the situation

Table 1: The survey respondents' responses to "What would you recommend to the Ministry of Health and new authorities to address closed or limited enrolments?".

	N	%
Provide more funding for primary care	194	95
Support pay equity for primary care nurses compared to hospital nurses	186	91
Support pay equity for GPs	183	89
Recruit more overseas-trained GPs	175	85
Increase the number of trainee nurses/nurse practitioners	166	81
Increase the number of GP training practices	165	80
Make the registration pathways simple for overseas-trained doctors	161	79
Recruit more nurse/nurse practitioners in practices	159	78
Place more medical students in primary care	159	78
Increase the number of medical students	158	77
Employ more staff to support admin work of GPs	148	72
Re-orient the curriculum for medical students	144	70
Provide more government investment in building/resource	143	70
Provide more software support to do admin work of GPs and practices	130	63
Increase the number of health improvement practitioners	107	52
Provide more telehealth support and infrastructure	100	49
Other	31	15
Missing	22	

has worsened due to the impacts of the COVID-19 pandemic, resulting from higher demand for services for COVID-19, staff getting sick and border restrictions preventing the inflow of medical workforce, adding to the already existing shortage of GPs and nurses. The interviews highlighted a critical shortfall in the capacity of Aotearoa New Zealand's general practice workforce to meet the demands of PC.

Other studies have reported similar findings. A RNZCGP survey conducted in 2021 showed that about 31% of the informants reported being burned out.[1] Staff shortages have also been previously recognised as an issue in the PC sector and are expected to worsen due to the increasing number of GPs approaching retirement age: approximately 31% of GPs are planning to retire in 5 years and half of the current GP workforce will have retired in 10 years.[17]

A shortage of GPs also affects other countries. In Australia, the New South Wales Rural Doctors Network found that 40% of GPs in rural areas are planning to leave their career in 5 years and 70% of rural general practices in New South Wales are trying to recruit staff.[18] Equally, findings from a 2022 Commonwealth Fund survey, conducted among physicians, showed that at least half of the physicians aged 55 and older in most of the countries surveyed would stop seeing patients and leave the PC workforce within 3 years.[19]

Healthcare workers migrate internationally for better working conditions and better pay. To

confront these challenges, New South Wales is planning to recruit 10,000 nurses and has put up AU$4.5 billion for the move.[20] Experts in the Aotearoa New Zealand healthcare sector fear that many New Zealand nurses will be attracted to Australia from an already over-stretched workforce.[20] Te Whatu Ora – Health New Zealand started an immigration service in October 2022 to offer overseas-trained healthcare professionals immigration advice for free, a one-way airfare, moving costs and temporary accommodation. GPs were the key group for recruitment.[21]

Besides the short-term strategy of recruiting international medical professionals, those participating in this research demonstrated a consensus about the need for training and recruiting more medical students for general practice, to meet its demands in a sustainable manner. To address this, the RNZCGP has recommended an increase in the annual number of medical students from 200 to 300 each year.[17] While the Labour Government committed to 50 new placements in the 2023 budget, the National Party, in the run-up to the 2023 election, promised a further 50 new places in 2025, as well as opening a medical school at the University of Waikato by 2030, although the National–ACT coalition agreement required a cost–benefit analysis for the latter before making a final decision.[22,23] If these plans were to come to fruition, it would mean 759 medical graduates in 2030, up from 539 graduates in 2023.[22]

Extended placements of medical students in general practices, especially in rural areas, was a recommendation from the study participants. A study conducted in Australia found that placement of medical students in extended short-term training in rural areas was associated with a higher proportion of students selecting to work in regional and rural areas.[24,25] Similar evidence was also found in the United Kingdom, which suggests that more immersive and longer placements in community care make medical students more likely to select general practice as a career.[26] However, general practices already working at capacity may feel the need to close their books, even if temporarily, if they have to take on more medical students requiring longer placements.

Another key recommendation from the research was for more and immediate government funding, especially for high-needs practices and to resolve pay disparities between general practice and hospital staff. The proportion of government health funding allocated to PC is notably low, estimated as about 14% on average across 22 OECD countries (2016), and in the case of Aotearoa New Zealand, about 6% of Vote Health going to general practices.[27,28] The way in which the money is allocated could also be improved, adjusting capitation payments to reflect the complexity of providing care for high-needs populations.[29] A study of the capitation formula commissioned by the Department of the Prime Minister and Cabinet in 2022 reported that a 9% rise in funding was required for general practices to maintain their current operations.[30] Following this analysis, Te Whatu Ora – Health New Zealand offered a 5% increase in funding for PC from 1 July 2023, but general practice organisations rejected it, arguing that they required at least a 14% raise.[31] In April 2023, the previous Labour Government announced an NZ$44 million fund for PC services, particularly for Māori and Pacific populations, an additional NZ$4.9 million for workforce training and NZ$37 million for high-needs populations' practices, to address funding inadequacies.[32]

Key strengths of this study included collecting data from key experts in the PC sector, combining in-depth interviews with quantitative and qualitative data from a survey, and timing interviews in two rounds to maximise information available, in particular integrating survey findings. Limitations of the study included the small sample size and the self-selection of survey respondents. It would be useful in future research to look at the service user perspective by interviewing patients who were not able to enrol.

In summary, the challenges facing the Aotearoa New Zealand PC sector are both multifaceted and pressing, exacerbated by the COVID-19 pandemic and an ageing workforce. The study illuminates the critical issues of workforce shortages, under-funding and systemic inefficiencies that imperil the accessibility and quality of care. While initiatives have begun to address these challenges, they remain insufficient to meet the escalating demands. The study participants' recommendations, including the re-evaluation of funding models and the expansion of medical education, suggest steps to move forward. Failure to act promptly risks not only the exacerbation of closed books in general practices, but also the erosion of the healthcare system's overall efficacy. We hope that this study will encourage debate and accelerate actions for the necessary improvements in general practice care in Aotearoa New Zealand.

COMPETING INTERESTS
None.

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AUTHOR INFORMATION
Nisa Mohan: Te Hikuwai Rangahau Hauora | Health Services Research Centre, Te Wāhanga Tātai Hauora | Wellington Faculty of Health, Te Herenga Waka—Victoria University of Wellington.
Maite Irurzun-Lopez: Te Hikuwai Rangahau Hauora | Health Services Research Centre, Te Wāhanga Tātai Hauora | Wellington Faculty of Health, Te Herenga Waka—Victoria University of Wellington.
Megan Pledger: Te Hikuwai Rangahau Hauora | Health Services Research Centre, Te Wāhanga Tātai Hauora | Wellington Faculty of Health, Te Herenga Waka—Victoria University of Wellington.
Mona Jeffreys: Te Hikuwai Rangahau Hauora | Health Services Research Centre, Te Wāhanga Tātai Hauora | Wellington Faculty of Health, Te Herenga Waka—Victoria University of Wellington.
Jacqueline Cumming: Te Hikuwai Rangahau Hauora | Health Services Research Centre, Te Wāhanga Tātai Hauora | Wellington Faculty of Health, Te Herenga Waka—Victoria University of Wellington.

CORRESPONDING AUTHOR
Megan Pledger: Te Hikuwai Rangahau Hauora | Health Services Research Centre, Te Wāhanga Tātai Hauora | Wellington Faculty of Health, Te Herenga Waka—Victoria University of Wellington. Old Government Building, Pipitea Campus, Bunny Street, Wellington 6011, New Zealand. E: megan.pledger@vuw.ac.nz

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Use of medications for migraine in Aotearoa New Zealand

Fiona Imlach, Sue Garrett

ABSTRACT

AIM: To document and assess acute and preventive medication use in people with migraine disease in Aotearoa New Zealand.

METHODS: Online survey of people with migraine in Aotearoa New Zealand (n=530), run from 22 August to 7 October 2022, including questions on current and previous acute and preventive medication use, reasons for medication discontinuation and use of new migraine medications.

RESULTS: Most respondents had used simple analgesics for acute treatment; 55% were currently using a triptan; 27% were currently using an opioid. Overall, 27% of survey respondents had over-used at least one acute medication in the last month. Half of respondents were taking at least one preventive medication but only 57% of those eligible for preventive treatment were currently taking it. In those who had previously tried preventives, side effects and lack of efficacy were common reasons for stopping. Cost, lack of knowledge and awareness were the main barriers to use of new migraine medications.

CONCLUSION: Many people with migraine in Aotearoa New Zealand are not receiving optimal treatment, which increases the burden and cost of migraine disease. More effective and tolerable acute and preventive medications are needed that are affordable and available in Aotearoa New Zealand. Greater awareness of best practice prescribing is also needed.

Despite being a common and disabling condition, with a global prevalence of 14%, migraine disease is often inappropriately or under-treated.[1] This is due to a combination of low consultation rates for headache (for reasons including cost, system barriers or not prioritising getting help for headache),[2] failure among health professionals to accurately diagnose migraine and poor delivery of evidence-based migraine treatment.[3–5]

There are two elements to migraine treatment: management of acute attacks and instigation of a preventive medication. Appropriate management of migraine attacks is important not only to ameliorate the pain and disability of the attack but also because inadequate treatment may contribute to the development of chronic migraine (headache on 15 days or more a month for at least 3 months).[6]

Over-the-counter medication such as non-steroidal anti-inflammatory drugs (NSAIDs) and prescription-only triptans are first-line treatments for migraine attacks. Triptans were developed in the 1990s specifically to treat migraine and are recommended for moderate to severe headache or when NSAIDs are ineffective.[1] Of the seven triptans used globally, two (sumatriptan and rizatriptan) are currently available in Aotearoa New Zealand. International surveys report that only between 6–23% of people with migraine are currently using a triptan,[3,7] and although this is higher in people with chronic migraine,[8] it suggests that under-utilisation of triptans is widespread.[3] However, NSAIDs and triptans do not work or are not suitable for all people with migraine.[9] NSAIDs have gastrointestinal and cardiovascular side effects and triptans may be contraindicated in as many as a fifth of people.[9,10]

Opioids (e.g., codeine, tramadol, oxycodone) are not recommended for migraine attacks because they are not as effective as first-line options, have significant side effects, a risk of addiction and are associated with an increased risk of chronic migraine and medication overuse headache (MOH).[11] MOH is a chronic secondary headache that develops in people with migraine (or another primary headache disorder) who have headache for 15 days or more a month and have used (for at least 3 months):

- Simple analgesics on ≥15 days a month (including paracetamol, NSAIDs, combination analgesics and caffeine).
- Opioids or triptans on ≥10 days a month.[12]

Hence, inappropriate management of migraine attacks includes not only under-use of migraine-specific triptans where indicated, but over-use of triptans and analgesics, and any use of opioids.[9]

The second element of migraine management, prevention, is recommended for those with frequent and/or disabling headache. The goals of preventive treatment are to reduce frequency and severity of attacks, reduce disability, improve response to acute treatments and prevent or treat MOH.[13] However, preventive medications for migraine are often under-used.[4] For example, a large United States (US) study of people with migraine calculated that 40% were eligible for preventive treatment but only 17% were currently using it.[3] This is often due to the poor tolerability/adverse effects and relatively poor efficacy of these medications.[9,14,15]

Despite affecting an estimated 642,000 people in Aotearoa New Zealand and causing significant impacts on work, life and physical and mental health,[16] there are no published data on acute or preventive medication use in people with migraine in Aotearoa New Zealand, nor any published data on whether migraine management in Aotearoa New Zealand adheres to evidence-based recommendations. We undertook a survey of people with migraine to explore:

- Current and previous use of acute and preventive migraine medications.
- Under-use and misuse of medications, including risk of acute medication overuse.
- Need for new types of migraine medication, specifically the monoclonal antibodies developed to treat migraine by targeting calcitonin gene-related peptide (CGRP).

Methods

The online *Migraine in Aotearoa New Zealand Survey* ran from 22 August to 7 October 2022, via SurveyMonkey. Recruitment was through website and/or social media platforms of Migraine Foundation Aotearoa New Zealand (MFANZ), Healthify, Neurological Foundation and New Zealand Pain Society, via media articles and through personal networks of MFANZ co-founders.

The survey was piloted by six individuals, five with migraine disease. Responses were anonymous and informed consent was assumed by initiation of the survey (information about the survey was provided on the landing page). Ethical approval was granted by the University of Otago Human Ethics Committee (D23/156).

Respondents were asked about acute medications taken for migraine: paracetamol, NSAIDs, triptans, opioids, anti-emetics and caffeine, with response options of currently use, previously used—stopped because of side effects, previously used—stopped because it didn't work, previously used—stopped for another reason, never used—would like to try, never used—don't want to try. Respondents were asked on how many days in the last month they had used paracetamol, NSAIDs, triptans or opioids and were classified as at risk of medication over-use if used 15 days or more a month (for paracetamol and NSAIDs) or 10 days or more a month (for opioids and triptans).

Respondents were also asked about use of prescribed preventive medications (same response options as above) that are listed in international guidelines on migraine treatment, including melatonin (which is often a prescription medication) and onabotulinumtoxinA (Botox™) injections. We derived the number of oral preventive medications currently or previously used through a count of all listed medications, excluding Botox™ and CGRP monoclonal antibody injections.

We determined that respondents were "eligible" for preventive treatment if they had:

- Eight or more headache days a month, and/or
- Moderate to severe disability, as measured by the Migraine Disability Assessment Scale (MIDAS), which measures the impact of migraine on daily life through questions about limitations on work/study, household work, social/family life in the last 3 months, with a score of 21 or more indicating severe disability.[17]

We also asked whether a GP or neurologist had been seen about migraine, with response options including seen in the last 12 months.

The survey included an open-ended question about the new CGRP monoclonal antibody medications, noting that only erenumab and galcanezumab were available in Aotearoa New Zealand. Respondents were asked about their experience with these and why they would or would not try one in the future. More details about other questions in the survey are published elsewhere[16] and a copy of the questionnaire is available in the Appendix.

The final dataset included 530 respondents, after removal of duplicates (n=4) and responses completing <6% of survey questions (n=33). Only people with a positive ID-Migraine test™ (n=513), which has a sensitivity of 84% and specificity of 76%,[18] or a migraine diagnosis from a health

professional (n=17) were included.

As the survey was a convenience, self-selected sample, only descriptive and unweighted statistics were calculated, using Microsoft Excel version 2403. Missing data were excluded from analyses; respondents were able to skip individual questions, so response rates for each question varied. The qualitative data from the open-ended question were coded for themes relating to reasons for or against trying the new medication. Three main themes around barriers to uptake of these medications were identified. Quotes to illustrate the themes include the gender, age group and ethnicity of the respondent.

Results

The survey sample was predominantly female (82%) and NZ European (77%) (Table 1). Over a fifth (22%) had chronic migraine, who were more likely to report severe migraine disability and poor self-rated health than those with episodic migraine.

Acute medications

Use of acute medications for migraine is detailed in Table 2. Most people had used NSAIDs or paracetamol and around half or more currently used NSAIDs, caffeine, triptans and paracetamol.

Table 1: Characteristics of survey respondent by migraine type.

Characteristic	Migraine type					
	Chronic n=118 (22.2%)		Episodic n=412 (77.7%)		Total n=530	
Age band	N	Col %	N	Col %	N	Col %
<18 years	1	0.8	1	0.2	2	0.4
18–24 years	5	4.2	15	3.6	20	3.8
25–34 years	16	13.6	64	15.5	80	15.1
35–44 years	30	25.4	93	22.6	123	23.2
45–54 years	35	29.7	120	29.1	155	29.2
55–64 years	15	12.7	55	13.3	70	13.2
65+ years	7	5.9	24	5.8	31	5.8
Missing	9	7.6	40	9.7	49	9.2
Gender						
Female	96	81.4	337	81.8	433	81.7
Male	10	8.5	31	7.5	41	7.7
Another gender	3	2.5	5	1.2	8	1.5
Missing	9	7.6	39	9.5	48	9.1
Ethnic group						
Māori	7	5.9	32	7.8	39	7.4
Pacific peoples	0	0.0	6	1.5	6	1.1
Asian	2	1.7	21	5.1	23	4.3
NZ European/Other	99	83.9	310	75.2	409	77.2
Missing	10	8.5	43	10.4	53	10.0

Table 1 (continued): Characteristics of survey respondent by migraine type.

MIDAS disability score						
0–5 (little or no)	1	0.8	74	18.0	75	14.2
6–10 (mild)	3	2.5	74	18.0	77	14.5
11–20 (moderate)	11	9.3	105	25.5	116	21.9
>21 (severe)	103	87.3	159	38.6	262	49.4
Self-rated health						
Excellent	6	5.1	39	9.5	45	8.5
Very good	24	20.3	147	35.7	171	32.3
Good	46	39.0	145	35.2	191	36.0
Fair	22	18.6	64	15.5	86	16.2
Poor	19	16.1	17	4.1	36	6.8
Missing	1	0.8		0.0	1	0.2

Table 2: Acute and preventive migraine medication use.

	Currently use		**Never used**		**Stopped using—did not work**		**Stopped using—side effects**		**Stopped using—other reason[1]**		**Total**
	n	Row %	n	Row %	n	Row %	n	Row %	n	Row %	n
Acute medications											
NSAIDs	318	60.6%	28	5.3%	106	20.2%	40	7.6%	33	6.3%	525
Caffeine	277	55.4%	138	27.6%	51	10.2%	18	3.6%	16	3.2%	500
Paracetamol	256	48.6%	16	3.0%	241	45.7%	3	0.6%	11	2.1%	527
Anti-emetic	215	41.7%	179	34.7%	35	6.8%	18	3.5%	69	13.4%	516
Sumatriptan	170	32.9%	199	38.5%	55	10.6%	44	8.5%	49	9.5%	517
Rizatriptan	166	32.1%	188	36.4%	69	13.3%	37	7.2%	57	11.0%	517
Opioids	139	27.0%	174	33.8%	70	13.6%	56	10.9%	76	14.8%	515
Preventive medications[2]											
Antidepressants											
Amitriptyline	52	10.8%	255	53.1%	68	14.2%	91	19.0%	14	2.9%	480
Nortriptyline	41	8.8%	306	65.4%	48	10.3%	59	12.6%	14	3.0%	468
Venlafaxine	23	5.1%	375	83.5%	13	2.9%	30	6.7%	8	1.8%	449
Fluoxetine	19	4.2%	345	77.0%	17	3.8%	34	7.6%	33	7.4%	448

Table 2 (continued): Acute and preventive migraine medication use.

Antihypertensives (including beta-blockers)											
Propranolol	24	5.1%	351	74.2%	45	9.5%	45	9.5%	8	1.7%	473
Metoprolol	20	4.4%	398	87.3%	13	2.9%	20	4.4%	5	1.1%	456
Candesartan	21	4.6%	403	88.0%	23	5.0%	7	1.5%	4	0.9%	458
Nadolol	12	2.6%	400	87.1%	22	4.8%	21	4.6%	4	0.9%	459
Verapamil	5	1.1%	433	95.2%	8	1.8%	6	1.3%	3	0.7%	455
Antiepileptics											
Topiramate	24	5.0%	329	68.4%	38	7.9%	85	17.7%	5	1.0%	481
Gabapentin	17	3.7%	401	86.8%	18	3.9%	18	3.9%	8	1.7%	462
Lamotrigine	4	0.9%	435	96.0%	6	1.3%	4	0.9%	4	0.9%	453
Sodium valproate	2	0.4%	411	89.7%	18	3.9%	23	5.0%	4	0.9%	458
Other											
Melatonin	34	7.3%	349	74.9%	50	10.7%	10	2.1%	23	4.9%	466
BotoxTM	20	4.1%	424	87.6%	30	6.2%	1	0.2%	9	1.9%	484
Erenumab	15	3.2%	449	94.5%	7	1.5%	2	0.4%	2	0.4%	475
Pizotifen	7	1.5%	406	84.9%	36	7.5%	20	4.2%	9	1.9%	478

[1]Stopped using for a reason other than that it did not work or had side effects (reason not specified).
[2]Preventive medications currently or previously used by five or fewer respondents are not presented (galcanezumab and lisinopril). Other medications that respondents reported (that were not listed in the survey) included citalopram, sertraline, paroxetine, mirtazapine, duloxetine, cilazapril, quinapril, amlodipine, perindopril, lacosamide, pregabalin, clonidine, clonazepam.

Almost half had stopped using paracetamol because it did not work. Fifty-five percent were currently using one or both of the triptans, 23% had never used either of the triptans and 22% had previously used one or both of the triptans but had stopped for some reason. For each individual triptan, the most common reason for stopping was that they did not work.

Over a quarter of respondents were currently using opioids and only a third had never used them for migraine attacks (9% said they would like to try opioids). Of the 139 survey respondents who were currently using opioids for migraine, 36 had previously used a triptan but stopped, 30 had never used a triptan and the remainder were concurrently using a triptan.

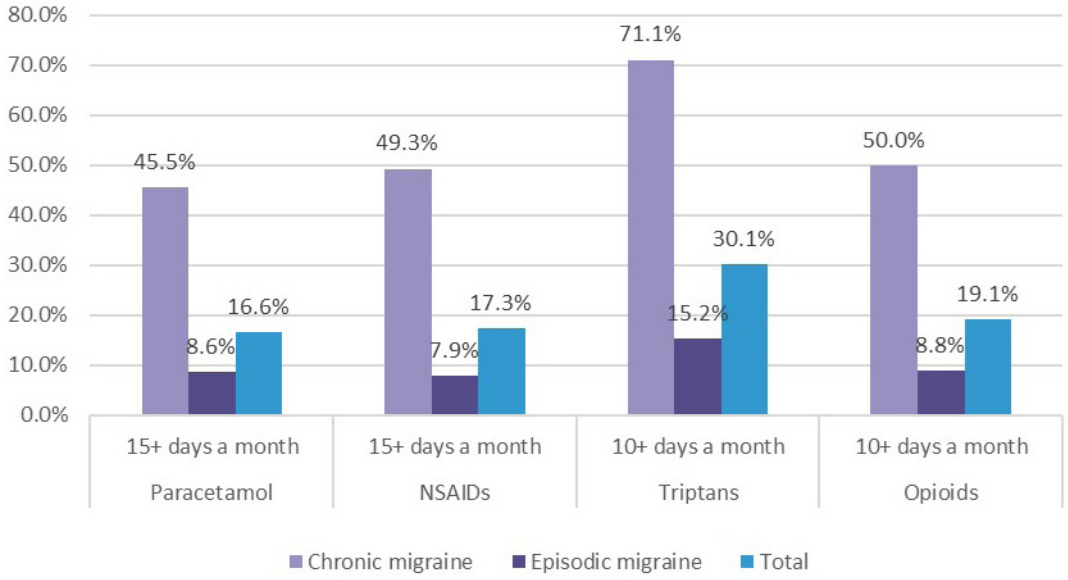
Risk of medication over-use

Overall, 27% of survey respondents had over-used at least one acute medication in the last month (i.e., paracetamol or NSAIDs on 15 days or more, triptan or opioids on 10 days or more). This was higher in people with chronic migraine (70%) than episodic migraine (15%). By medication type, triptans were most commonly over-used, with 30% of those currently using triptans taking more than the recommended amount in the last month (Figure 1). Nearly one fifth of those currently using opioids were taking more than recommended. All the rates of over-use were much higher in those with chronic migraine than episodic migraine.

Preventive medications

A total of 496 respondents answered questions on migraine preventive medication. Half of these respondents (n=249) were currently taking at least one preventive. The most commonly used class of preventive was antidepressants, currently taken by 28% of survey respondents (36% previously used). Antihypertensives, including beta-blockers,

Figure 1: Acute medication over-use in the last month in those with chronic and episodic migraine.[1]



[1]Five missing responses for frequency of NSAID use among current users; three missing responses for opioids; two missing responses for paracetamol.

were the next most commonly used medication, currently taken by 17% of respondents (25% previously used). Only 8% of survey respondents were currently taking an antiepileptic for migraine prevention but 30% had previously taken one.

The most common currently used medications were amitriptyline, nortriptyline, melatonin, venlafaxine, propranolol and topiramate, each taken by 5% or more of respondents (Table 2). For all medications, a much higher proportion of respondents had previously tried and stopped the medication, because of lack of efficacy, side effects or another reason, than were currently using it. Side effects were most notable for amitriptyline, topiramate, fluoxetine, propranolol, nadolol, pizotifen and sodium valproate, where those who stopped due to side effects were nearly or more than double the proportion of those currently using them.

Current preventive medication use was higher in people with chronic migraine (72%) than episodic migraine (44%). Only 5% of those with chronic migraine had not previously used any preventives compared with 30% of those with episodic migraine. People with chronic migraine had previously used an average of four oral preventive medications. Of those who had previously used any preventives, 12% had tried seven or more.

Under-use of preventives

Nearly three quarters (74%, n=393) of all survey respondents were "eligible" for preventive medication, according to our stringent criteria of 8 headache days or more a month and/or presence of moderate–severe migraine disability. Of these, 369 respondents provided information about preventive medication use. Only 57% of people "eligible" for preventive treatment were currently taking it, while nearly two thirds (64%) of those **not** currently taking a preventive were "eligible" for one. Over a quarter (28%) of people with chronic migraine were not receiving preventive treatment.

Consultation with a health professional provides an opportunity for preventive treatment to be reviewed and instigated. In those who were "eligible" for preventive treatment, a higher proportion of people currently taking a preventive (compared with those not taking a preventive) had seen a neurologist (28% compared with 11%) and a GP (89% compared with 71%) about migraine in the last 12 months.

New treatments

There were 435 responses to the open-ended question about CGRP monoclonal antibodies. Many respondents reported that their migraine

attacks were so severe or poorly controlled they "would try anything" to reduce the impact of migraine attacks on their lives. The new medications represented hope for those who had found little relief from other preventives or had experienced intolerable side effects.

> *"I would love to try Emgality [galcanezumab]. I get horrible side effects from the propranolol … I have awful exercise tolerance due to my low blood pressure and everyday activities can be difficult. I have not reacted well or had benefit from other prevention medications so am stuck with this." – 18–24 years, Female, Māori*

Respondents identified three main barriers to use of the new medications. The prohibitive cost (up to NZ$325 a month for Emgality), uncertainty about effectiveness and side effects, and lack of awareness of their existence, in both patients and doctors.

All three of these barriers may need to be addressed for new medications to be accessible:

> *"I … would try one in the future if I knew enough about it, if it was publicly funded and my doctor discussed it with me." – 25–34 years, Female, Asian*

Discussion

This survey of people with migraine in Aotearoa New Zealand reveals several areas where best practice in migraine prescribing was not being followed. For management of acute attacks, opioids were being inappropriately used in over a quarter of respondents. A similar proportion were at risk of MOH, through over-use of one or more acute treatments. Nearly a quarter had never used a triptan, which suggests a level of under-use, but may also include those with contraindications for triptan use. Over two fifths (43%) of those assessed as "eligible" for preventive medication were not currently taking a preventive, including 28% of those with chronic migraine, all of whom would benefit from effective preventive treatment.

Among people diagnosed with migraine, US research suggests that appropriate treatment is received by only 54–60%[19] and many general practitioners (GPs) are not aware of or adhere to best practice on managing migraine.[20,21] For example, a survey of GPs in the US found that only 28% were familiar with the American Academy of Neurology guidelines on preventive treatment, only a third knew that opioids can cause MOH and few recommended non-pharmacological treatments, despite these being included in evidence-based guidelines.[20] The knowledge of GPs in managing migraine in Aotearoa New Zealand is unknown and deserves additional research to establish the role of prescribers in contributing to MOH and under-use of preventive medications. Ineffective migraine treatment increases the risk of developing chronic migraine and increases healthcare utilisation and costs.[6,22,23] A stronger emphasis on the importance of avoiding opioids in the treatment of migraine is needed in Aotearoa New Zealand, for both health professionals, especially prescribers, and patients.

The prevalence of MOH in Aotearoa New Zealand is unknown. Estimates from international studies range from 0.5–2.6%,[24] with most cases associated with migraine.[25] As many as a third of people with episodic migraine and three quarters of people with chronic migraine may be at risk of MOH,[19] which is consistent with our survey results that 15% of those with episodic and 70% of those with chronic migraine had over-used medication in the last month. MOH is avoidable with appropriate migraine management and is also treatable with effective preventive medications.[26] Knowledge about MOH among the public, people with migraine and health professionals is often low,[24,25] including awareness of the risk of a person with migraine developing MOH if taking regular analgesics for another condition (e.g., back pain). Education of patients about MOH can reduce medication over-use and prevent MOH.[24]

The high use of opioids and high rates of acute medication over-use in survey respondents also highlights the need for more options to treat migraine attacks that are safe and effective. Insufficient response to triptans can occur in around 30% of people with migraine,[9] which could contribute to increased use of opioids as an alternative. In cases of initial triptan non-response, trying two or more different triptans is recommended.[9] However, only two of the seven triptans on the market are available in Aotearoa New Zealand and only one is in a formulation that bypasses the stomach, which is beneficial for people with severe nausea or vomiting during a migraine attack. New, alternative treatments are available overseas (but not in Aotearoa New Zealand), including the ditan lasmiditan, which has a similar action to triptans but without the side

effect of vasoconstriction, and has demonstrated efficacy for those in whom triptans are contraindicated or ineffective.[27] Gepants (such as rimegepant, ubrogepant and zavegepant) are small molecule CGRP receptor antagonists taken orally or as a nasal spray that have few side effects and do not appear to induce MOH, unlike triptans.[9]

The survey also highlighted issues with the use of migraine preventive medications. These were much more likely to have been used in the past, and stopped because they were ineffective or intolerable, than to be currently used. Most people who had used preventives had tried more than one—one respondent had tried 18 different medications. International research has found that among people with migraine who have ever used preventive medication, the average number used was four for people with chronic migraine and three for people with episodic migraine,[15] which was the same as in our survey. Close to half of respondents were not taking preventive medication despite frequent and disabling headaches. Many of those who were on preventive medication still had a high headache frequency, indicating that these medications were not working well. Adherence to migraine preventives has been shown to be low in many countries,[14] with one study finding that only 17–20% of people continued with a preventive at 12 months.[28]

New and more effective medications to prevent migraine attacks, that have fewer side effects, are needed to reduce migraine disability and chronification. Of the new migraine medications that target CGRP and can be used for prevention (the monoclonal antibodies and several gepants), only two monoclonal antibodies are currently available in Aotearoa New Zealand and neither are yet funded. In a recent systematic review, the CGRP medications outclassed other drugs used for migraine prevention in both safety and efficacy.[29] Early and effective preventive treatment has the potential to not only improve quality of life for people with migraine but also reduce healthcare and other costs and improve work and other functioning.[30] However, these new drugs do not work for all people with migraine, and more research into the underlying pathophysiological causes of migraine and development of additional targeted treatments is still needed.

At the time of this survey, respondents identified cost, lack of awareness about the existence of the medication and uncertainty around effectiveness and side effects as barriers to use. The latter two issues should resolve as awareness spreads across health professionals and people with migraine, but cost remains a considerable obstacle, particularly for those who are unable to work. In December 2023, three CGRP medications (galcanezumab, erenumab and atogepant) were recommended for funding at a high priority by Pharmac's Neurological Advisory Committee, and in June 2023, these were added to Pharmac's Options for Investment list.

Strengths and limitations

This was the first survey of people with migraine undertaken in Aotearoa New Zealand and provides a snapshot of medication use in this sample. However, it was a non-representative survey, delivered online, and cannot be used to estimate prevalences at a population level. Responses from Māori and Pacific peoples were low, and more research is needed to explore potential ethnic inequities in migraine management.

We asked about medication use in the last month to minimise error from recall bias and reduce respondent burden from multiple questions. Since the diagnosis of MOH requires 3 months of medication over-use, our results only identify people at risk of MOH and will likely over-estimate the true risk. We provided names of commonly used medications but recall of previous medications may have led to an under-count of these.

Our estimate of eligibility for preventive medication was based on headache frequency and migraine disability, but is a conservative estimate because prevention is often appropriate for people with fewer than 8 headache days a month (e.g., if disability is high, if acute medications are ineffective or not well tolerated, or for specific types of migraine). Hence, our results will under-estimate the true number of "eligible" people and the proportion of those who are "eligible" but not using preventive medication.

Many non-prescription and non-medication approaches to migraine management (e.g., supplements, biofeedback, neurostimulation, acupuncture, lifestyle changes) are recommended for use, often in conjunction with medication.[9] These were not included in this analysis but merit further research.

Conclusions

Many people with migraine in Aotearoa New Zealand are not receiving best practice prescribing of acute and preventive migraine medications. More awareness is needed among health professionals

and patients about the risk of MOH with acute treatments, especially opioids and triptans. There is a clear need for more effective acute and preventive medications, with fewer side effects. The lack of availability and affordability of new migraine-specific medications in Aotearoa New Zealand means that people with migraine in Aotearoa New Zealand are likely to experience higher migraine disability and lower quality of life than those in countries with a broader range of treatment options.

COMPETING INTERESTS
Nil.

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AUTHOR INFORMATION
Fiona Imlach: Co-founder Migraine Foundation Aotearoa New Zealand, Ponsonby, Auckland; Honorary Senior Research Fellow, Department of Public Health, University of Otago Wellington.
Sue Garrett: Senior Lecturer, Department of Primary Health Care and General Practice, University of Otago Wellington.

CORRESPONDING AUTHOR
Fiona Imlach: Co-founder Migraine Foundation Aotearoa New Zealand, Ponsonby, Auckland; Honorary Senior Research Fellow, Department of Public Health, University of Otago Wellington. PO Box 7343, Wellington 6242, New Zealand.
E: fiona@migrainefoundation.org.nz

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Appendix 1: Migraine in Aotearoa New Zealand survey

Migraine in Aotearoa New Zealand

Survey information

This survey is to understand the burden and impact of migraine in Aotearoa New Zealand. It includes questions about treatments you've tried, health services you've used and any issues or challenges living with migraine has on your professional and personal life.

We are seeking participants who currently live in New Zealand who have been diagnosed with migraine or have symptoms that are consistent with migraine disease. These include:

- pain on one side of the head
- pain that lasts 4 hours to 3 days if not treated
- throbbing or pulsing pain, usually moderate to severe and often worse with routine activity such as walking or climbing stairs
- sensitivity to light, sound and/or smell
- nausea and vomiting.

This survey is being run by Migraine Foundation Aotearoa New Zealand. Migraine Foundation Aotearoa New Zealand is the only registered charity in New Zealand supporting people living with migraine. Our mission is to raise awareness of the impact of migraine disease and support people living with migraine in Aotearoa New Zealand.

All responses are anonymous and remain confidential.

The survey will take around 20 minutes to complete.

Migraine identification

Do you have migraine?

These questions help identify people who have migraine disease.

1. Have you had a headache in the last 3 months?

- Yes
- No
- Don't know

2. Has a headache limited your activities for a day or more in the last 3 months? (Activities includes work, study, play or other things you need to do in the day.)

- Yes
- No
- Don't know

3. Are you nauseated or sick to your stomach when you have a headache?

- Yes
- No
- Don't know

4. Does light bother you when you have a headache?

- Yes
- No
- Don't know

Appendix 1 (continued): Migraine in Aotearoa New Zealand survey.

About your migraine disease

5. How old were you when you had your first migraine attack?

- 0–9 years
- 10–14 years
- 15–19 years
- 20–24 years
- 25–29 years
- 30–39 years
- 40–49 years
- 50–59 years
- 60 or older
- Don't know/unsure

6. How old were you when you were diagnosed with migraine by a health professional?

- 0–9 years
- 10–14 years
- 15–19 years
- 20–24 years
- 25–29 years
- 30–39 years
- 40–49 years
- 50–59 years
- 60 years or older
- Don't know/unsure
- Not diagnosed by a health professional

7. Does anyone else in your family have migraine?

- Yes
- No
- Don't know/unsure

Migraine disability assessment scale

These questions help measure the impact of headaches on your life. They are based on an international set of questions that have been tested and used in migraine drug trials.

8. On average, on how many days a month do you have a headache? (If a headache lasted more than 1 day, count each day.)

- 0–7 days per month
- 8–14 days per month
- 15–23 days per month
- >/=24 days per month
- Continuous/nearly continuous (essentially no headache-free time)
- Don't know/unsure

9. On average, how painful were these headaches on a scale of 0–10? (where 0=no pain at all, and 10=pain as bad as it can be.)

0 5 10

Appendix 1 (continued): Migraine in Aotearoa New Zealand survey.

Please answer the following questions about ALL of the headaches you have had over the last 3 months. Select zero if you did not have the activity in the last 3 months.

It can be hard to remember what happened in the last 3 months, so your best guess is fine.

10. On how many days in the last 3 months did you miss work or school because of your headaches?
11. On how many days in the last 3 months did you not do household work (such as housework, home repairs and maintenance, shopping, caring for children and relatives) because of your headaches?
12. How many days in the last 3 months was your productivity in household work reduced by half or more because of your headaches? (Do not include days you counted in question 3 where you did not do household work.)
13. On how many days in the last 3 months did you miss family, social or leisure activities because of your headaches?

The total MIDAS score can be used to define four grades of migraine-related disability with grade I for "little or no disability" (0–5); grade II for "mild disability" (6–10); grade III for "moderate disability" (11–20); and grade IV for "severe disability" (≥21).

Note: one question was missed in the survey:

How many days in the last 3 months was your productivity at work or school reduced by half or more because of your headaches? (Do not include days you counted in question 1 where you missed work or school.)

Self-rated health

14. In general, would you say your health is:

- Excellent
- Very good
- Good
- Fair
- Poor

Acute treatments

This section asks about what treatments you use when you get a migraine attack.

15. Do you or have you used paracetamol to treat your migraine attacks?

Currently use	Previously used—stopped because of side effects	Previously used—stopped because it didn't work	Previously used—stopped for another reason	Never used—would like to try	Never used—don't want to try

16. On how many days in the last month have you used paracetamol for a migraine attack?
    0 30
17. Do you or have you used non-steroidal anti-inflammatories (NSAIDs) to treat your migraine attacks?
    e.g., Aspirin, Ibuprofen (Nurofen, Brufen, Advil), diclofenac (Voltaren), naproxen (Naprosyn, Naprogesic, Noflam), celecoxib (Celebrex), meloxicam (Mobic)—including tablets that combine NSAIDs with paracetamol.

Appendix 1 (continued): Migraine in Aotearoa New Zealand survey.

Currently use	Previously used—stopped because of side effects	Previously used—stopped because it didn't work	Previously used—stopped for another reason	Never used—would like to try	Never used—don't want to try

18. On how many days in the last month have you used NSAIDs for a migraine attack?
    0 30
19. Do you or have you used sumatriptan (Imigran, Imitrex) to treat your migraine attacks?

Currently use	Previously used—stopped because of side effects	Previously used—stopped because it didn't work	Previously used—stopped for another reason	Never used—would like to try	Never used—don't want to try

20. On how many days in the last month have you used sumatriptan for a migraine attack?
    0 30
21. Do you or have you used rizatriptan (Maxalt, Rizamelt) to treat your migraine attacks?

Currently use	Previously used—stopped because of side effects	Previously used—stopped because it didn't work	Previously used—stopped for another reason	Never used—would like to try	Never used—don't want to try

22. On how many days in the last month have you used rizatriptan for a migraine attack?
    0 30
23. Do you or have you used opioids to treat your migraine attacks? e.g., tramadol (Tramal), codeine (including combined with paracetamol in Panadeine or ibuprofen in Nurofen Plus), Oxycodone.

Currently use	Previously used—stopped because of side effects	Previously used—stopped because it didn't work	Previously used—stopped for another reason	Never used—would like to try	Never used—don't want to try

24. On how many days in the last month have you used opioids for a migraine attack?
    0 30
25. Do you or have you used anti-emetics (anti-nausea medications) to treat your migraine attacks? e.g., metoclopramide (Maxolon), ondansetron, prochlorperazine (Stemetil, Buccastem)

Currently use	Previously used—stopped because of side effects	Previously used—stopped because it didn't work	Previously used—stopped for another reason	Never used—would like to try	Never used—don't want to try

26. Which of the following non-medication treatments have or do you use to treat your migraine attacks?

- Caffeine
- Occipital nerve block

Appendix 1 (continued): Migraine in Aotearoa New Zealand survey.

- Neurostimulation device e.g., TENS machine
- Ginger e.g., tablets, tea
- Other (please specify)

Currently use	Previously used—stopped because of side effects	Previously used—stopped because it didn't work	Previously used—stopped for another reason	Never used—would like to try	Never used—don't want to try

Preventive treatment

There are many medicines that can be taken to prevent migraine attacks. This section asks whether you have or would like to try preventive medicines and why you might have stopped taking them.

27. Which of the following anti-depressants have you used to prevent migraine attacks?

- Amitriptyline (Amirol)
- Nortriptyline (Norpress)
- Venlafaxine (Effexor)
- Fluoxetine (Prozac)
- Other (please specify)

Other (please specify)

Currently use	Previously used—stopped because of side effects	Previously used—stopped because it didn't work	Previously used—stopped for another reason	Never used—would like to try	Never used—don't want to try

28. Which of the following anti-epileptic medications have you used to prevent migraine attacks?

- Topiramate (Topamax)
- Sodium valproate (Epilim)
- Gabapentin (Neurontin)
- Lamotrigine (Lamictal)
- Other (please specify)

Currently use	Previously used—stopped because of side effects	Previously used—stopped because it didn't work	Previously used—stopped for another reason	Never used—would like to try	Never used—don't want to try

29. Which of the following anti-hypertensive or cardiac medications have you used to prevent migraine attacks?

- Nadolol (Corgard)
- Metoprolol (Lopressor)
- Propranolol (Inderal)
- Verapamil (Isoptin)
- Candesartan (Candesar)
- Lisinopril (Zestril)

Appendix 1 (continued): Migraine in Aotearoa New Zealand survey.

- Other (please specify)

Currently use	Previously used—stopped because of side effects	Previously used—stopped because it didn't work	Previously used—stopped for another reason	Never used—would like to try	Never used—don't want to try

30. Which of the following migraine-specific medications have you used to prevent migraine attacks?

- Pizotifen (Sandomigran)
- Erenumab (Aimovig)
- Galcanezumab (Emgality)
- Other (please specify)

Currently use	Previously used—stopped because of side effects	Previously used—stopped because it didn't work	Previously used—stopped for another reason	Never used—would like to try	Never used—don't want to try

31. Which of the following hormone treatments have you used to prevent migraine attacks?

- Melatonin
- Estrogen, with or without progesterone e.g., hormone replacement therapy, combined oral contraceptive pill
- Progesterone on its own e.g., progesterone-only oral contraceptive, depot provera, progestin implant or intrauterine device/IUD
- Testosterone
- Other (please specify)

Currently use	Previously used—stopped because of side effects	Previously used—stopped because it didn't work	Previously used—stopped for another reason	Never used—would like to try	Never used—don't want to try

32. Which of the following supplements have you used to prevent migraine attacks?

- Magnesium
- Riboflavin (vitamin B2)
- Coenzyme Q10
- Feverfew
- Ginger
- Butterbur
- Other (please specify)

Appendix 1 (continued): Migraine in Aotearoa New Zealand survey.

Currently use	Previously used—stopped because of side effects	Previously used—stopped because it didn't work	Previously used—stopped for another reason	Never used—would like to try	Never used—don't want to try

33. Which of the following injections have you used to prevent migraine attacks?

- Botulinum toxin A (Botox) injections
- Occipital nerve block
- Other (please specify)

Currently use	Previously used—stopped because of side effects	Previously used—stopped because it didn't work	Previously used—stopped for another reason	Never used—would like to try	Never used—don't want to try

34. Which of the following non-medication approaches have you used to prevent migraine attacks?

- Neurostimulation device e.g., TENS machine
- Meditation or mindfulness practice
- Yoga or tai chi
- Biofeedback
- Acupuncture
- Massage
- Cold therapy e.g., ice packs, cold baths
- Other (please specify)

Currently use	Previously used—stopped because of side effects	Previously used—stopped because it didn't work	Previously used—stopped for another reason	Never used—would like to try	Never used—don't want to try

35. Aimovig, Emgality, Ajovy and Vyepti are a new class of migraine prevention medication developed specifically to target migraine (calcitonin gene-related peptide or CGRP monoclonal antibodies). They have fewer side effects than most other preventive medications. Only Aimovig and Emgality are currently available in New Zealand.
If you have ever tried one of these, please tell us about your experience.
If you haven't, please tell us why you would or wouldn't try one in the future.

Healthcare use

This section asks about health professionals you have seen to help your management of migraine disease.

36. Which of the following health professionals have you seen about migraine?

- Primary care/GP
- Neurologist
- Emergency department or urgent care physician
- Osteopath

Appendix 1 (continued): Migraine in Aotearoa New Zealand survey.

- Chiropractor
- Pain specialist
- Physiotherapist
- Nutritionist/dietitian
- Occupational therapist
- Dentist
- Pharmacist
- Acupuncturist
- Naturopath
- Massage therapist
- Optician or eye specialist
- Other (please specify)

Seen in the last 12 months	Seen in the past (>12 months ago)	Never seen—would like to	Never seen—don't want to

37. How would you rate the knowledge of migraine and treatment options in the health professionals you have seen? (If you have seen more than one, rate the one you have seen most recently)

- Primary care/GP
- Neurologist
- Emergency department or urgent care physician
- Osteopath
- Chiropractor
- Pain specialist
- Physiotherapist
- Nutritionist/dietitian
- Occupational therapist
- Dentist
- Pharmacist
- Acupuncturist
- Naturopath
- Massage therapist
- Optician or eye specialist
- Other (please specify)

Excellent	Very good	Good	Fair	Poor	Not applicable/ haven't seen

38. Have you ever wanted to see a health professional for migraine but were unable to?

- Yes
- No

39. Which health professional(s) were you unable to see for migraine?
40. Why were you unable to see a health professional for migraine? (multiple responses allowed)

- It was too expensive
- Waiting time to be seen was too long
- Unable to get or was declined an appointment
- Service not available where I live
- Had no transport to get there

Appendix 1 (continued): Migraine in Aotearoa New Zealand survey.

- Difficult to take time off work
- Could not arrange childcare or care for a dependent
- Other (please specify)

41. What could be done to improve your life with migraine?

Co-morbidities

The next question is about long-term health conditions. A long-term health condition is a physical or mental illness or condition that has lasted, or is expected to last, for more than six months. The symptoms may come and go or be present all the time.

42. Which, if any, of the following long-term conditions have you been diagnosed with and currently have (in addition to migraine)? Please select all that apply

- Anxiety
- Arthritis
- Asthma
- Depression
- Epilepsy
- Fibromyalgia
- Heart disease
- Hypertension/high blood pressure
- Insomnia
- Irritable bowel syndrome
- Low back pain
- Stroke
- I do not currently have any other long-term health conditions
- Other (please specify)

Stigma

43. How often do you hide or minimise migraine symptoms for fear of being judged or misunderstood?

- Always
- Often
- Sometimes
- Rarely
- Never

44. How often do you feel judged or misunderstood because of your migraine disease by your:

- Spouse or partner
- Family
- Friends
- Workplace
- School/place of education or training
- Health professional
- Other (please specify)

Always	Often	Sometimes	Rarely	Never	Not applicable/ don't know

Appendix 1 (continued): Migraine in Aotearoa New Zealand survey.

45. Is there anything else you want to tell us about living with migraine in New Zealand?

Demographics

The final questions are about you.

46. How old are you?
47. What is your gender?

- Male
- Female
- Another gender
  Please specify

48. Which ethnic group or groups do you belong to?

- New Zealand European
- Māori
- Samoan
- Cook Island Māori
- Tongan
- Niuean
- Chinese
- Indian
- Don't know
- Refused
- Other (please specify)

49. Where do you live?

- Northland
- Auckland
- Waikato
- Bay of Plenty
- Gisborne
- Hawke's Bay
- Taranaki
- Manawatū-Whanganui
- Wellington
- Tasman
- Nelson
- Marlborough
- West Coast
- Canterbury
- Otago
- Southland
- Other (please specify)

50. What is your current employment status?

- Employed full-time
- Employed part-time
- Retired
- Student
- Stay at home carer (e.g., of children, parents)

Appendix 1 (continued): Migraine in Aotearoa New Zealand survey.

- Not employed, looking for work
- Not employed, not looking for work

51. What is the impact of migraine on your ability to work? (if you are not currently working, imagine trying to work with your current migraine condition)

- Cannot work
- Can only work part time
- Have had to choose a type of work with more flexibility
- Full-time work but less than best performance
- No work-related difficulties

52. In the last 12 months, what are all the ways that you yourself got income? Please do not count loans, including student loans

- Wages, salaries, commissions, bonuses etc, paid by an employer
- Self-employment, or business you own and work in
- Interest, dividends, rent, other investments
- Regular payments from ACC or a private work accident insurer
- NZ Superannuation or Veteran's Pension
- Other superannuation, pensions, annuities (other than NZ Superannuation, Veteran's Pension or War Pension)
- Jobseeker Support
- Sole Parent Support
- Supported Living Payment
- Student allowance
- Other government benefits, government income support payments, war pensions, or paid parental leave
- Other sources of income
- No source of income during that time
- Don't know

53. What is the total income that your household got from all sources, before tax or anything was taken out of it, in the last 12 months?

- Zero income or loss
- $1–$20,000
- $20,001–$30,000
- $30,001–$50,000
- $50,001–$70,000
- $70,001–$100,000
- $100,001 or more
- Don't know

54. Do you have health or medical insurance?

- Yes
- No
- Don't know/unsure

Have more to say?

Migraine is under-recognised in every way—in funding, research, diagnosis, treatment and understanding. Telling your story about living with migraine sheds light on this disease, reduces stigma, raises awareness and helps with advocacy.

Appendix 1 (continued): Migraine in Aotearoa New Zealand survey.

Question title

55. If you would like to find out more about telling your story, please leave your contact details and we will get in touch with you. These details will be kept separate from your survey responses and will not be shared beyond Migraine Foundation Aotearoa New Zealand.

Name
Email

Thanks for taking part in our survey!

We will use your responses to advocate for better treatment and support for people with migraine in New Zealand.

Please forward the survey on to other people you know with migraine who would like to contribute (this is the link: https://www.surveymonkey.com/r/XNSTFM5)

For more information about migraine in New Zealand, visit our website https://www.migrainefoundation.org.nz/

For questions or feedback about the survey, please email info@migrainefoundation.org.nz

ANZACS-QI Heart Failure Registry: a new approach using age-stratified sampling of hospital discharges to guide quality improvement (ANZACS-QI 79)

Daniel ZL Chan, Robert N Doughty, Mayanna Lund, Aleisha Easton, Katrina K Poppe, Daman Kaur, Lia Sinclair, Julie Chirnside, Catherine Malone, Helen McGrinder, Andy McLachlan, Jo Scott, Jennifer Roberts, Cara Wasywich, Gerry Devlin, Matire Harwood, Sue Wells, Wil Harrison, Andrew J Kerr

ABSTRACT

Heart failure is a major healthcare problem in New Zealand. The Acute Decompensated Heart Failure (ADHF) Registry was introduced in 2015, and has identified the need for quality improvement strategies to improve care of patients hospitalised with heart failure. In this paper, we describe the implementation of the revised ANZACS-QI Heart Failure Registry, which has a primary aim to support evidence-based management of and quality improvement measures for patients who are hospitalised with heart failure in New Zealand. Taking the learnings from the initial experience with the ADHF Registry, the revised ANZACS-QI Heart Failure Registry i) utilises age-stratified sampling of hospital discharge coding to identify a representative heart failure cohort, ii) utilises existing ANZACS-QI infrastructure for data-linkage to reduce the burden of manual data entry, iii) receives governance from the Heart Failure Working Group, and iv) focusses on established quality improvement indicators for heart failure management.

Heart failure affects approximately 1.6% of adults in New Zealand[1] and is associated with significant morbidity, mortality and healthcare costs. Although heart failure incidence rates were declining up to the 2000s, incidence rates have plateaued since 2013.[2] Despite advances in heart failure management, 1- and 5-year survival after first-ever heart failure hospitalisation in New Zealand remain poor at 69% and 37% respectively.[3] Significant ethnic disparities exist in heart failure outcomes in New Zealand, with Māori and Pacific peoples experiencing higher incidence rates[4] and mortality.[5]

There are effective evidence-based treatments for patients with heart failure.[6,7] Management is guided by heart failure phenotype, which is based upon left ventricular ejection fraction (LVEF): heart failure with reduced ejection fraction (HFrEF, LVEF ≤40%), heart failure with mildly reduced ejection fraction (HFmrEF, LVEF 41–49%) and heart failure with preserved ejection fraction (HFpEF, LVEF ≥50%).[6,7] A range of pharmacotherapy and devices have been shown to improve outcomes in patients with HFrEF, including angiotensin-converting enzyme inhibitors (ACEi),[8] angiotensin receptor blockers (ARB),[9] angiotensin receptor-neprilysin inhibitors (ARNI),[10] beta-blockers,[11] mineralocorticoid receptor antagonists (MRA),[12] sodium-glucose cotransporter-2 (SGLT2) inhibitors,[13] implantable cardiac defibrillators (ICD)[14] and cardiac resynchronisation therapy (CRT).[15] In contrast, these treatments have not been shown to reduce mortality and morbidity in patients with HFmrEF or HFpEF, with the recent exception of SGLT2 inhibitors.[16,17]

Despite strong clinical evidence and guideline recommendations, sub-optimal initiation and maintenance of guideline-directed medical therapy (GDMT) have been documented in heart failure.[18–20] It is important to have systems to identify these evidence–practice gaps in order to inform strategies to improve and achieve equitable outcomes for patients with cardiovascular disease in New Zealand.[21] One such system is the ANZACS-QI (Aotearoa New Zealand All Cardiology Services—Quality Improvement, formerly All New Zealand Acute Coronary Syndrome—Quality Improvement) programme,[22] which utilises a web-based system to create a clinical registry of patients with cardiac conditions.

In this paper, we describe the initial experience

with the Acute Decompensated Heart Failure (ADHF) Registry and its limitations; and describe the implementation of the revised ANZACS-QI Heart Failure Registry, which has the primary aim to support evidence-based management of and quality improvement measures for patients who are hospitalised with heart failure in New Zealand.

Acute Decompensated Heart Failure (ADHF) Registry

In December 2015, the ADHF Registry module[20] was created within the ANZACS-QI platform. This was a traditional registry that included patients hospitalised with decompensated heart failure who have had contact with local heart failure services. Site participation and patient inclusion have been voluntary.

As of August 2023, 5,739 heart failure hospitalisations from 18 district health boards have been included in the ADHF Registry. The clinical characteristics of heart failure hospitalisations included in the ADHF Registry are shown in Table 1. The mean age was 70.4 years (standard deviation [SD] 15.5 years), 3,455 (60.2%) were male, 1,450 (25.3%) were Māori and 814 (14.2%) were Pacific people. Over 75% received investigation with a NTproBNP (N-terminal pro-brain natriuretic peptide) or echocardiogram during hospitalisation. The number of registry completions decreased significantly following the COVID-19 pandemic, from an average of 1,062 per year between 2016 and 2020 to an average of 144 per year between 2021 and 2023. The patients included in the registry following the COVID-19 pandemic were older and less likely to be Māori or Pacific peoples (Table S1).

Of the 2,568 (44.7%) patients with HFrEF, 1,801 (70.1%) were discharged on an ACEi/ARB, 2,182 (85.0%) were discharged on a beta-blocker and only 979 (38.1%) were discharged on an MRA. The lower proportion of patients discharged on an ACEi/ARB may be partly explained by the introduction of subsidised sacubitril/valsartan in late 2018 and the registry form not being updated to include this new medication.

Challenges and limitations of ADHF Registry

Data collection for heart failure quality improvement poses unique challenges compared to other cardiovascular diseases that require specific attention.[3]

The key limitation of the ADHF Registry is that it was unlikely to have captured a representative cohort of hospitalised heart failure patients in New Zealand. Identification of hospitalised patients with heart failure is challenging as they are managed under a variety of settings and services, unlike patients with acute coronary syndromes, which can be reliably identified from coronary care units and cardiac catheterisation laboratories. Furthermore, there is insufficient clinician resource to include all hospitalised patients with heart failure in a registry. The patients entered into the ADHF Registry were likely a selected cohort who were engaged with heart failure services, and candidates for more intensive GDMT up-titration as suggested by the higher proportion of patients with HFrEF. Furthermore, the number of patient entries into the registry and number of participating hospital sites varied significantly over time. The lack of a representative cohort in the ADHF Registry poses limitations on interpretation of its data. It is difficult to draw any comparisons over time and between healthcare regions in order to guide quality improvement.

Secondly, the ADHF Registry long-form captured a comprehensive dataset with a relatively large number of data fields (99 variables). This may have adversely impacted the completeness and sustainability of data collection given the time constraints on clinicians for registry data entry. Several important data fields were incomplete/unknown; for example, 34% had no documented heart failure ejection fraction phenotype, 55% had unknown heart failure aetiology and 70% had unknown New York Heart Association (NYHA) symptom class (Table 1). Several key data fields, such as LVEF, are not obtainable from national datasets, and hence there is a reliance on manual data entry by clinicians.

Consequently, there has been limited reporting of data outputs and performance indicators to users and district health boards, and therefore the ADHF Registry has been unable to impact heart failure care in New Zealand.

ANZACS-QI Heart Failure Registry

The ADHF Registry has demonstrated an evidence–practice gap, with findings suggesting prescribing of ACEi/ARB and MRA on discharge could be improved for those with HFrEF, and that ethnic inequities likely exist with Māori and Pacific people being over-represented in the

Table 1: Acute Decompensated Heart Failure Registry 2016–2023.

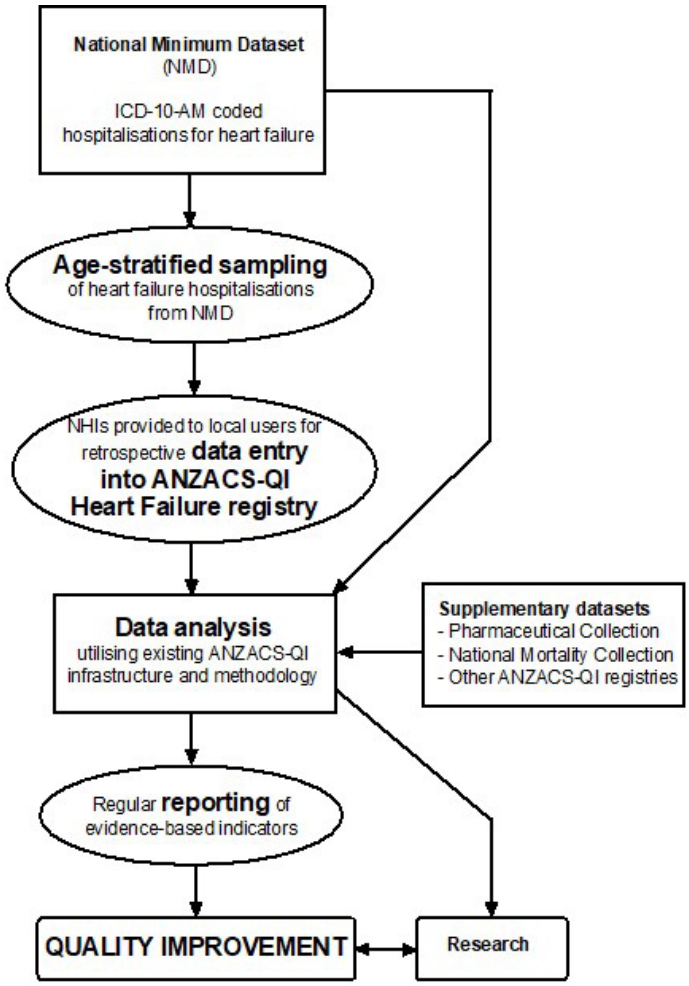
	Total **n=5,739**
Demographics	
Age, mean (SD), years	70.3 (15.5)
Age group	
<60 years	974 (17.0)
60–74 years	1,453 (25.3)
75–84 years	1,936 (33.7)
≥85 years	1,376 (24.0)
Male	3,455 (60.2)
Ethnicity	
Māori	1,450 (25.3)
Pacific	814 (14.2)
Other	3,475 (60.6)
Investigations	
NT-proBNP	4,413 (76.9)
Echocardiogram	4,348 (75.8)
Classification	
Heart failure phenotype	
HFrEF	2,568 (44.7)
HFmrEF	496 (8.6)
HFpEF	665 (11.6)
Unknown	2,010 (35.0)
Heart failure aetiology	
Ischaemic	1,007 (17.5)
Non-ischaemic	1,559 (27.2)
Unknown	3,173 (55.3)
NYHA class on discharge	
I	268 (4.7)
II	835 (14.5)
III/IV	622 (10.8)
Unknown	4,014 (69.9)
GDMT for HFrEF	
ACEi/ARB	1,801 (70.1)

Table 1 (continued): Acute Decompensated Heart Failure Registry 2016–2023.

Beta-blocker	2,182 (85.0)
MRA	979 (38.1)
Discharge information	
In-hospital death	229 (4.0)
Length of stay, median (IQR), days	5 (3 to 8)

Data available until 30 August 2023.
All values are frequency (percentage) unless otherwise specified.
Abbreviations: ACEi = angiotensin-converting enzyme inhibitor; ARB = angiotensin receptor blocker; GDMT = guideline-directed medical therapy; IQR = interquartile range; HFmrEF = heart failure with mid-range ejection fraction; HFpEF = heart failure with preserved ejection fraction; HFrEF = heart failure with reduced ejection fraction; MRA = mineralocorticoid receptor antagonist; NT-proBNP = N-terminal pro-brain natriuretic peptide; NYHA = New York Heart Association; SD = standard deviation.

Figure 1: Overview of ANZACS-QI Heart Failure Registry.



registry cohort. Ongoing data collection via a heart failure registry is needed to support evidence-based management and guide quality improvement measures in New Zealand.

Taking the learnings from the ADHF Registry, we propose a revised ANZACS-QI Heart Failure Registry that is based upon stratified sampling of hospital discharge coding, utilises the existing ANZACS-QI infrastructure, receives governance from the Heart Failure Working Group and focusses on established quality improvement indicators for heart failure management.[23,24] An overview of the registry workflow is shown in Figure 1.

Case identification and age-stratified sampling

As it is not practical to include all heart failure hospitalisations, a representative sample will be identified from the National Minimum Dataset (NMDS)[25] for each hospital district to include in the registry. The NMDS is a national collection of hospital discharge information, coded utilising the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification (ICD-10-AM). ICD-10-AM codes I50.x, I11.0, I13.0 and I13.2 in both primary and secondary diagnostic positions will be used for case identification—these codes have been shown to have high accuracy (sensitivity 90%, positive predictive value 92%) in identifying heart failure hospitalisations in the New Zealand setting.[26,27] The sampling method must i) ensure adequate representation of patient sub-groups and hospital districts, and ii) identify a large enough sample to confidently estimate the performance indicators. This needs to be balanced with resource constraints on user time for registry data entry.

The minimum sample size calculated to estimate the performance indicator of LVEF assessment is 61 for metropolitan districts (~2,500 heart failure hospitalisations/year) and 48 for non-metropolitan (~200 heart failure hospitalisations/year) with a confidence interval of 95% and a margin of error of 10%. This calculation is based upon the assumption that 80% of heart failure hospitalisations will have a LVEF assessment within 2 years. We anticipate that this sample size will be sufficient to estimate performance indicators for those with HFrEF both nationally and by individual district level, assuming that 40% of heart failure hospitalisations have HFrEF. However, the sample size will be under-powered at an individual district level to assess performance indicators by key demographic sub-groups.

Hence, we propose that each district enter a sample of 60–80 heart failure hospitalisations per year into the registry. The seven metropolitan districts (Waitematā, Te Toka Tumai Auckland, Counties Manukau, Capital Coast and Hutt Valley, Waitaha Canterbury and Southern) will contribute 80 per year, and the remaining districts 60 per year to reflect their population size and healthcare resource. The sample size has been increased to account for the small proportion of hospital discharges that are coded incorrectly for heart failure. A total of 1,340 heart failure hospitalisations would be entered into the registry annually if all districts participated, which accounts for approximately 5% of total heart failure hospitalisations nationally.

Age stratification will be applied to the sampling method to ensure that there is adequate representation of demographic sub-groups—such as younger patients and Māori and Pacific people—without increasing the sample size. Forty percent of the sample will be randomly selected from those 18–59-year-olds, 40% from 60–79-year-olds and 20% from ≥80-year-olds. We applied this stratified sampling method to a national annual cohort of heart failure admissions in 2018 (Table S2) and found that the proportion of Māori was significantly increased in the stratified sample (18.6% vs 26.0%, p<0.001), whereas the proportion of Pacific people was similar (7.7% vs 7.5%, p=0.98)

Case identification and age-stratified sampling will be done centrally by Health Intelligence, Health New Zealand – Te Whatu Ora, Counties Manukau on a quarterly basis. Heart failure hospitalisations in those aged <18 years, recurrent hospitalisations within the same 3-month period and patients admitted to a hospital outside of their domicile of residence (to allow assessment of outpatient follow-up) will be excluded from the sample. The identified sample with corresponding patient National Health Index (NHI) numbers and hospital admission and discharge dates will be made available to local users for entry into registry.

Data entry

The ANZACS-QI Heart Failure Registry will require manual data entry by clinicians as several key fields required for heart failure quality improvement, such as LVEF and presence of a left bundle branch block, are not available from routinely collected national data-

sets. We aimed to minimise the number of data fields to encourage accurate, complete and sustainable data entry, while obtaining sufficient information to assess key quality performance indicator measures,[23,24] with an emphasis on class IA guideline recommendations.[6,7] To minimise the burden of data entry, the registry will be supplemented by linkage to other national datasets using established methodology.[22] For example, the specific formulation and doses of GDMT dispensed at discharge and during outpatient follow-up are obtainable from the pharmaceutical data warehouse. The potential advantages of this approach were considered against time delays to data-linkage, which restricts timely feedback into quality improvement processes.

The revised Heart Failure Registry form (Table 2) has a total of 33 mandatory data fields for user completion, of which nine are pre-populated demographic variables. The data fields include demographic characteristics, relevant comorbidities, in-hospital investigations and classes of medications on discharge. There are an additional five variables that capture outpatient care within the 6-months post-discharge. These are only mandatory for a new diagnosis of HFrEF. The data dictionary containing full definitions of variables is available on the ANZACS-QI web platform and on request.

Local users will complete registry forms for the identified sample on a quarterly basis. This will be done retrospectively 6 months after heart failure hospitalisation, as coded hospitalisation data are usually available no earlier than 6 weeks post-discharge, and to allow for data on index hospitalisation and outpatient follow-up to be entered at the same time point. We anticipate that the local users will be healthcare teams who participate in the care of heart failure patients in their district, but who may not have been involved in the care of the patients entered in the registry.

Hospitalisations coded incorrectly as having decompensated heart failure and patients discharged from services other than cardiology or other medical specialities (e.g., surgery) will be excluded. These variables are included in the registry form and allow the form to be completed without entry of data.

Reporting

Data outputs will be analysed every 6 months using the rolling average of the previous 12 months of data. Summary reports will be generated and distributed back to local users to support quality improvement measures. The reports will contain indicator data nationally, by hospital district and for key demographic variables of age group, gender and ethnicity.

The below proposed performance indicators are adapted from established quality and performance measures for heart failure management.[6,7,23,24] The proportion of the identified sample with completed registry forms will be reported to ensure ongoing quality of the registry outputs. Inpatient care indicators will include the proportion of patients having LVEF assessment either during

Table 2: Summary of data fields in the ANZACS-QI Heart Failure Registry.

Demographics	**Age, gender, ethnic group, district of domicile**
Comorbidities	Prior heart failure, ischaemic heart disease, hypertension, diabetes, atrial fibrillation, obesity, left bundle branch block
In-hospital investigations	BNP/NT-proBNP, creatinine, echocardiogram
Medications	Prescription of medication class (diuretic, ACEi/ARB/ARNI, beta-blocker, MRA, SGLT2 inhibitor) on discharge, contraindications and other reasons for non-prescription
Outpatient follow-up	Repeat LVEF assessment, outpatient clinic visits, up-titration of GDMT, eligibility for ICD and CRT

Abbreviations: ACEi = angiotensin-converting enzyme inhibitor; ARB = angiotensin receptor blocker; ARNI = angiotensin receptor-neprilysin inhibitor; BNP = brain natriuretic peptide; CRT = cardiac resynchronisation therapy; GDMT = guideline-directed medical therapy; ICD = implantable cardiac defibrillators; LVEF = left ventricular ejection fraction; MRA = mineralocorticoid receptor antagonists; NT-proBNP = N-terminal pro-brain natriuretic peptide; SGLT2 inhibitor = sodium-glucose cotransporter-2 inhibitor.

index hospitalisation or within the past 2 years and the proportion of patients with HFrEF who were prescribed GDMT on discharge. Outpatient performance indicators will be reported for the subset of patients with a new diagnosis of HFrEF. This will include the proportion of patients who have been seen in an outpatient clinic, who have had a repeat LVEF assessment and who have been prescribed target doses of GMDT. Data from the ANZACS-QI registry can be supplemented by the Pharmaceutical Collection data warehouse to allow identification of the proportion of patients who are dispensed doses of GDMT ≥50% of target doses and who are adherent to GDMT with a proportion of days covered (PDC) of ≥0.8 at 6 months post-discharge. The pilot and initial phases of the registry will be used to inform and refine potential performance indicators with guidance and agreement from the Heart Failure Working Group of the New Zealand branch of the Cardiac Society of Australia and New Zealand (CSANZ), ANZACS-QI and the National Cardiac Clinical Network.

As the ANZACS-QI Heart Failure Registry only includes a sample of total hospitalisations, data will also be reported from the total heart failure hospitalisation cohort derived from NMDS. The crude number of heart failure hospitalisations and rate per 100,000 population per year will be reported for comparison. Outcome indicators will be reported via linkage to the Mortality Collection and will include all-cause mortality, cardiovascular-specific mortality and re-hospitalisation with heart failure at 30 days and 1 year post-discharge.

There will be scope for more exploratory analyses of the ANZACS-QI registry in a research setting. Data access proposals can be made via the existing ANZACS-QI infrastructure.

Ethics considerations and approval

ANZACS-QI has national ethics approval as part of the Vascular Risk Equity for Aotearoa New Zealand (VAREANZ) programme based at The University of Auckland. VAREANZ (previously known as "Predict", then Vascular Informatics using Epidemiology and the Web [VIEW]) was originally approved by the Northern Region Ethics Committee in 2003 (AKY/03/12/314), with subsequent approval by the National Multi-region Ethics Committee in 2007 (MEC07/19/EXP) and with annual re-approval since as part of a vascular research programme (2023 EXP 18564). Governance of the ANZACS-QI registry data is by the ANZACS-QI governance group on behalf of the New Zealand branch of the CSANZ, as described previously.[22] The Heart Failure Working Group co-chair is a member of both the CSANZ New Zealand Regional Committee and the ANZACS-QI governance group.

Under the previous ethics approvals, there is no requirement for individual patient consent to enter their data into the ANZACS-QI registry. This is on the basis that any identifiable data are used for quality improvement and that only de-identified data are linked with national datasets for quality improvement and research purposes under VAREANZ governance. Data were entered prospectively by clinician teams involved in patient care, and patient posters and information sheets are displayed in cardiology ward locations where patients are entered into the ANZACS-QI registry.

However, the ANZACS-QI Heart Failure Registry will require retrospective data entry for patients who were admitted in multiple different ward locations. It will therefore not be practical to inform patients in any meaningful way via these posters. Apart from the sampling method of identifying patients for the registry, all processes are identical to those already approved under the existing ethics approvals. An amendment to current VAREANZ ethics approval has been granted for the pilot phase of this proposed registry (2023 AM 13442).

Implementation

ANZACS-QI is a Ministry of Health-funded and National Cardiac Network-supported quality improvement programme. The implementation of the ANZACS-QI Heart Failure Registry will be overseen by a working group formed by members of the Heart Failure Working Group of the New Zealand branch of CSANZ. Processes, including those for reporting, will be aligned with ANZACS-QI governance. The Heart Failure Registry has been introduced as a pilot to the Northern Region in November 2023. Locality approval from individual sites has been obtained for pilot implementation of the registry.

Feedback will be sought from users, and identified issues with the registry will be reviewed and addressed by the governance group. Findings from the pilot study will be made available and published. Our goal will be to implement the registry nationally, with all public hospitals contributing to data collection, and outputs linked to agreed-upon key performance

indicators.

Anticipated strengths and limitations

Our proposed heart failure registry will identify a representative sample of total heart failure hospitalisations in New Zealand. This will allow for benchmarking between districts and allow comparisons over time to assess effectiveness of quality improvement strategies. The shortened registry form, focussing on key guideline recommendations, will hopefully facilitate complete and sustainable data collection. The registry utilises the existing ANZACS-QI infrastructure, and data collected will be enriched by linkage to other healthcare datasets. Scheduled reporting of evidence-based indicators will provide regular feedback to users, support clinicians in providing evidence-based heart failure management and provide data to assist with implementation of quality improvement strategies.

There are some limitations to acknowledge with this registry. First is the clinician/user time required to complete data entry, and we have minimised the data fields in the registry form and sample size to address this. Feedback from users will be sought from the pilot process, particularly from smaller hospital districts that may have less staff resource to enter a relatively larger sample. Secondly, as the registry form also captures 6 months of post-discharge care, there will be a delay in the reporting of evidence-based indicators. Linkage analyses, particularly for medication dosages, will be further delayed and how this will integrate into quality improvement processes will need to be determined in the pilot phase. Lastly, as the registry is designed to capture a representative sample of all heart failure hospitalisations, assessment of heart failure performance indicators may be inadvertently influenced by inclusion of those with end-stage heart failure or life-limiting comorbidity. Strategies to address these limitations will be developed during the pilot process.

Conclusions

The primary aim of the revised ANZACS-QI Heart Failure Registry is to support evidence-based management of and quality improvement measures for patients who are hospitalised with heart failure in New Zealand. It differs from other ANZACS-QI registries, as a representative age-stratified sample will be identified and entered into the registry retrospectively from coded heart failure hospitalisations. This registry has been implemented as a pilot to the Northern Region.

COMPETING INTERESTS
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AUTHOR INFORMATION
Daniel ZL Chan: Department of Cardiology, Health New Zealand – Te Whatu Ora Te Tai Tokerau, Whangārei, New Zealand.
Robert N Doughty: Department of Medicine, The University of Auckland, Auckland, New Zealand; Greenlane Cardiovascular Service, Health New Zealand – Te Whatu Ora Te Toka Tumai Auckland, Auckland, New Zealand.
Mayanna Lund: Department of Cardiology, Health New Zealand – Te Whatu Ora Counties Manukau, Auckland, New Zealand.
Aleisha Easton: Department of Cardiology, Health New Zealand – Te Whatu Ora Counties Manukau, Auckland, New Zealand.
Katrina K Poppe: Department of Medicine, The University of Auckland, Auckland, New Zealand.
Daman Kaur: Department of Cardiology, Health New Zealand – Te Whatu Ora Te Matau a Māui Hawkes Bay, Hastings, New Zealand.
Lia Sinclair: Cardiology Service, Health New Zealand – Te Whatu Ora Te Pae Hauora o Ruahine o Tararua MidCentral, Palmerston North, New Zealand.
Julie Chirnside: Cardio-respiratory Integrated Services, Health New Zealand – Te Whatu Ora Waitaha Canterbury, Christchurch, New Zealand.
Catherine Malone: Cardio-respiratory Integrated Services, Health New Zealand – Te Whatu Ora Waitaha Canterbury, Christchurch, New Zealand.
Helen McGrinder: Greenlane Cardiovascular Service, Health New Zealand – Te Whatu Ora Te Toka Tumai Auckland, Auckland, New Zealand.
Andy McLachlan: Department of Cardiology, Health New Zealand – Te Whatu Ora Counties Manukau, Auckland, New Zealand.
Jo Scott: Cardio-respiratory Integrated Services, Health New Zealand – Te Whatu Ora Waitaha Canterbury, Christchurch, New Zealand.
Jennifer Roberts: Cardiology Outpatients, Health New Zealand – Te Whatu Ora Capital, Coast and Hutt Valley, Wellington, New Zealand; Te Kura Tapuhi Hauora, Te Herenga Waka – Victoria University of Wellington, Wellington, New Zealand.
Cara Wasywich: Greenlane Cardiovascular Service, Health New Zealand – Te Whatu Ora Te Toka Tumai Auckland, Auckland, New Zealand.
Gerry Devlin: Gisborne Hospital, Health New Zealand – Te Whatu Ora Tairāwhiti, Gisborne, New Zealand.
Matire Harwood: Faculty of Medical and Health Sciences, The University of Auckland, Auckland, New Zealand.
Sue Wells: Department of General Practice and Primary Healthcare, The University of Auckland, Auckland, New Zealand.
Wil Harrison: Department of Cardiology, Health New Zealand – Te Whatu Ora Counties Manukau, Auckland, New Zealand.
Andrew J Kerr: Department of Medicine, The University of Auckland, Auckland, New Zealand; Department of Cardiology, Health New Zealand – Te Whatu Ora Counties Manukau, Auckland, New Zealand.

CORRESPONDING AUTHOR
Daniel ZL Chan: Department of Cardiology, Private Bag 9742, Whangārei 0148, New Zealand. Ph: +64-09-430-4100 E: Daniel.Chan@northlanddhb.org.nz

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Appendix

Table S1: Demographic and clinical characteristics pre- and post-COVID pandemic.

	Pre-COVID (2016–2020) n=5,308	**Post-COVID (2021–2023) n=431**	**P-value***
Mean (± SD) registry entries per year	1,062±326	144±74	0.002
Demographics			
Age, median (IQR), years	73 (60–82)	77 (66–85)	<0.001
Age group			
<60 years	908 (17.1)	66 (15.3)	0.63
60–74 years	1,343 (25.3)	110 (25.5)	
≥75 years	3,057 (57.6)	260 (60.3)	
Male	3,195 (60.2)	260 (60.3)	>0.99
Ethnicity			
Māori	1,385 (26.1)	65 (15.1)	<0.001
Pacific	790 (14.9)	24 (5.6)	
Other	3,133 (59.0)	342 (79.4)	
Investigations			
NT-proBNP	4,020 (75.7)	393 (91.2)	<0.001
Echocardiogram	4,083 (76.9)	265 (61.5)	<0.001
Classification			
Heart failure phenotype			
HFrEF	2,386 (45.0)	182 (42.2)	0.07
HFmrEF	469 (8.8)	27 (6.3)	
HFpEF	616 (11.6)	49 (11.4)	
Unknown	1,837 (34.6)	173 (40.1)	
Heart failure aetiology			
Ischaemic	973 (18.3)	34 (7.9)	<0.001
Non-ischaemic	1,503 (28.3)	56 (13.0)	
Unknown	2,342 (44.1)	312 (72.4)	
NYHA class on discharge			
I	259 (4.9)	9 (2.1)	0.008
II	758 (14.3)	77 (17.9)	
III/IV	571 (10.8)	51 (11.8)	
Unknown	3,720 (70.1)	294 (68.2)	

Table S1: Demographic and clinical characteristics pre- and post-COVID pandemic.

GDMT for HFrEF			
ACEi/ARB	1,702 (71.3)	99 (54.4)	<0.001
Beta-blocker	2,026 (84.9)	156 (85.7)	0.83
MRA	914 (38.3)	65 (42.2)	0.53
Discharge information			
In-hospital death	209 (3.9)	20 (4.6)	0.44
Length of stay, median (IQR), days	5 (3–9)	4 (3–9)	0.29

All values are frequency (percentage) unless otherwise specified.
*Categorical data were compared using Fisher's exact test and continuous data were compared using Welch's *t*-Test or Mann–Whitney test as appropriate.
Abbreviations: ACEi = angiotensin-converting enzyme inhibitor; ARB = angiotensin receptor blocker; GDMT = guideline-directed medical therapy; IQR = interquartile range; HFmrEF = heart failure with mid-range ejection fraction; HFpEF = heart failure with preserved ejection fraction; HFrEF = heart failure with reduced ejection fraction; MRA = mineralocorticoid receptor antagonist; NT-proBNP = N-terminal pro-brain natriuretic peptide; NYHA = New York Heart Association; SD = standard deviation.

Table S2: Stratified sample using proposed methodology on heart failure admissions in 2018.

	Total hospitalisations n=24,098	Percent	Stratified sample n=1,340	Percent	P-value
Diagnostic position					
Primary	10,219	42.4	543	40.5	0.19
Secondary	13,879	57.6	797	59.5	
Age group					
20–49	1,471	6.1	199	14.9	<.001
50–59	2,092	8.7	309	23.1	<.001
60–69	3,725	15.5	197	14.7	0.48
70–79	6,134	25.5	339	25.3	0.92
80–84	3,891	16.2	104	7.8	<.001
≥85	6,785	28.2	192	14.3	<.001
Gender					
Male	10,848	45.0	558	41.6	0.017
Female	13,250	55.0	782	58.4	
Ethnicity					
Māori	4,470	18.6	348	26.0	<.001
Pacific	1,848	7.7	101	7.5	0.98
Indian	512	2.1	25	1.9	0.58
Chinese	265	1.1	13	1.0	0.75
Other Asian	146	0.6	6	0.5	0.57
European/Other	16,857	70.0	847	63.2	<.001
District health board					
Auckland	2,339	9.7	80	6.0	
Bay of Plenty	1,271	5.3	60	4.5	
Canterbury	2,731	11.3	80	6.0	
Capital Coast	1,336	5.5	80	6.0	
Counties Manukau	2,505	10.4	80	6.0	
Hawke's Bay	1,087	4.5	60	4.5	
Hutt Valley	776	3.2	60	4.5	
Lakes	670	2.8	60	4.5	

MidCentral	1,070	4.4	60	4.5	
Nelson Marlborough	189	0.8	60	4.5	
Northland	909	3.8	60	4.5	
South Canterbury	286	1.2	60	4.5	
Southern	1,815	7.5	80	6.0	
Tairāwhiti	206	0.9	60	4.5	
Taranaki	706	2.9	60	4.5	
Waikato	2,721	11.3	80	6.0	
Wairarapa	185	0.8	60	4.5	
Waitematā	2,548	10.6	80	6.0	
West Coast	240	1.0	60	4.5	
Whanganui	508	2.1	60	4.5	

Cribriform adenocarcinoma of the minor salivary glands: case report and literature review

Maria van Kuijk, Harsha De Silva, Ling Chan, Guangzhao Guan

Cribriform adenocarcinoma is a rare salivary basal cell adenocarcinoma, first recognised as a separate identity from the polymorphous low-grade adenocarcinoma in 1999 by Michal et al.[1] It represents less than 1% of salivary gland tumours and is defined as low-grade malignancy according to the World Health Organization histopathological classification of carcinomas of the salivary glands.[2] This neoplasm affects males and females equally and is more common in African and African-American individuals.[3] The location of the primary tumour is often the tongue or the palate. These tumours may metastasise to the cervical lymph nodes. Despite this, the overall prognosis for patients is favourable.[4]

The cribriform adenocarcinoma has a lobulated infiltrative growth pattern. Microscopically, the tumour is non-encapsulated, typically with no cyst formation or presence of eosinophilic colloid material. Mitotic figures are uncommon, and cellular atypia is usually mild. The cribriform adenocarcinoma has characteristic pale overlapping nuclei arranged in a cribriform, solid or papillary pattern with a fibrous background stroma.[5] They stain positive for cytokeratin markers (AE1-3, CK7, CK8, CK18, Cam 5.2), smooth muscle actin and S-100 protein calponin and vimentin. They return a negative stain for thyroglobulin and TTF-1.[6]

Case report

A 79-year-old male presented to the urgent care unit, Faculty of Dentistry, University of Otago, requesting the replacement of a broken filling. His past medical history included a cerebrovascular accident (stroke), heart murmur and rheumatic fever, the latter diagnosed at the age of 10 years. He was taking atorvastatin (10mg OD), aspirin (100mg OD) and pantoprazole (10mg OD). He was a non-smoker and did not report consuming alcohol regularly. He had no known drug allergies but reported adverse reactions to amitriptyline, nortriptyline, gabapentin and codeine. He was afebrile on presentation and had no palpable cervical lymphadenopathy. Intra-oral examination revealed an incidental finding of a 2.5cm x 2.5cm mass near tooth 38 in the left retromolar trigone (Figure 1). The lesion appeared dark red–purple and was ulcerated, soft and non-tender to palpation. He was unaware of this lesion and had not experienced any pain or discomfort in the area. Clinical differential diagnosis was between a lymphoma or primary salivary gland neoplasm. An initial biopsy of the lesion under local anaesthetic in the dental chair revealed histopathological findings suggesting an unencapsulated infiltrative tumour with bland cytology. However, no definitive diagnosis was reached due to insufficient tissue from the initial biopsy. Computerised tomography (CT) revealed an expansile mass with the displacement of adjacent structures, including blood vessels located inferiorly (Figure 2). The mandibular cortex remained intact and unaffected. No metastases or lymphadenopathy were reported. The CT findings suggested a benign appearance of the lesion indicative of a possible haemangioma with the differential diagnosis of a nerve sheath tumour or, less likely, a paraganglioma.

An immediate referral was made to the multidisciplinary head and neck oncology service of the Dunedin Hospital, where a surgical excision was performed under general anaesthetic. The histopathological report showed eosinophilic columnar cells arranged in cribriform, tubular and micro-cribriform arrangements and scattered glomeruloid bodies. Peripheral hyperchromatic palisaded tumour cells were present in a collaganised background stroma. There was no evidence of lymphovascular, perineural or adjacent tissue invasion. A positive response to S100 and CK7 staining and variable response for glial fibrillary acidic protein and focal membranous positivity for CD117 was evident. Histopathological findings of

the excised specimen were consistent with a diagnosis of cribriform adenocarcinoma of minor salivary gland origin (Figure 3). Surgical excision margins were reportedly tumour-free; thus, no adjunctive therapy was used. Twelve months after the surgery, the patient remains stable with no evidence of primary recurrence or metastases. The patient will be regularly reviewed and monitored for potential recurrent disease in the multidisciplinary head and neck cancer service's outpatient clinic for at least 5 years.

Discussion

There is much debate about whether cribriform adenocarcinoma is distinct from polymorphous low-grade adenocarcinoma. The current 5th edition of the World Health Organization Classification of Head and Neck Tumours identifies it as a distinct subtype of polymorphous adenocarcinoma.[2,7] There is a recognition of different characteristics, including the typical location of the primary tumour, cytology, architecture, early nodal metastases and local behaviour. We found only 149 cases reported in published literature since Michal et al. (1999) first described the cribriform adenocarcinoma as a separate entity.[1,3–6,8–39]

The commonest primary site is the tongue, and only four cases have been reported previously for the retromolar region.[8,10,20,26] Recurrence rates reported are low at 8.8% for local recurrence following treatment, but long-term follow-up of cases is not well documented in the literature.[31]

In total, 149 reported cases of cribriform adenocarcinoma have been previously described in the literature (Table 1).[1,3–6,8–39] Gender data for the 149 cases showed 62 (59.62%) were females and 42 (40.38%) were males. The location of the primary tumour was described in 107 cases. The most common site affected was the tongue (n=47, 42.93%), followed by the palate (n=30, 28.04%), the tonsil (n=6, 5.61%), the maxillary sinus/nasal region (n=5, 4.67%), retromolar regions (n=5, 4.67%), buccal mucosa (n=4, 3.74%), parotid gland (n=4, 3.74%), upper lip (n=2, 1.87%) and one tumour (n=1, 0.93%) each was found in the submandibular region, gingiva, epiglottis and floor of the mouth. Of the 107 cases describing location, 42 (39.25%) had lymph node metastases at diagnosis. Fourteen cases (13.08%) reported tumour recurrence during follow-up in local, regional or distant regions. One case involved partial resection of the tumour due to patient factors. One individual died due to cribriform adenocarcinoma metastases. Initially, the cribriform adenocarcinoma was thought to only occur at the base of the tongue. However, this has since been disproved.[5,6,10] De Luca et al. described the location of cribriform adenocarcinoma affecting the tongue, which comprised nearly 60% of cases.[31] Other sites included the palate (19.6%), tonsil (7.1%), buccal (3.6%), reticular mucosa (3.6%), lip (3.6%), retromolar pad (1.7%) and floor of the mouth (1.7%).[31] The literature review in this case report found 42.93% of cases reportedly arose in the tongue, while 28.04% occurred on the palate. De Luca et al. found cribriform adenocarcinoma to have a high risk of lymph node metastases (71.7% of cases reported), whereas this study found it to be lower at 39.25%.[31]

The 5th edition of the World Health Organization Classification of Head and Neck Tumours has incorporated molecular data and cytological findings in most sections.[7] Fine needle aspiration (FNA) has been recognised as important in these tumours' initial diagnostic workup. However, the FNAs and even core needle biopsies can fail to produce diagnostic specimens, especially lacking architectural information and assessment of the tumour's interface with surrounding tissues. Diagnosing low-grade malignancies from benign tumours can be difficult with FNA and core needle biopsies.

The polymorphous adenocarcinoma typically contains a single tumour cell type arranged in trabeculae or tubules, swirling or concentrically wrapped around nerves or vasculature.[16] In contrast, the cribriform adenocarcinoma has a multinodular growth pattern, separated by fibrous septae forming a cribriform and microcystic architecture. The low-grade polymorphous adenocarcinoma has a heterogenous histological and molecular profile. Translocations in genes PRKD1, PRKD2 and PRKD3 (protein kinase D) have been identified in about 80% of cases of cribriform adenocarcinoma.[27] Whether the cribriform adenocarcinoma remains a distinct subtype or becomes a separate entity in future classifications is unknown.[27] Both low-grade polymorphous adenocarcinoma and cribriform adenocarcinoma are associated with the activation of PRKD1, but via different mechanisms.[4] Surgical excision is the recommended first-line therapy with lateral neck dissection of involved lymph nodes yielding successful results. Adjunctive radiotherapy was performed on nearly 50% of cases. Evidence suggests that cribriform

adenocarcinoma is sensitive to radiation therapy.[31] Chemotherapy is uncommon, and no regime has been validated for cribriform adenocarcinoma.[31]

Conclusion

This case report outlines the identification of the rare cribriform adenocarcinoma of the minor salivary glands located in an uncommon site, emphasising the need to be vigilant to recognise incidental pathology when performing clinical examination. Further, it endorses the value of complete surgical resection for establishing a definitive histopathological diagnosis.

Table 1: Reported cases of cribriform adenocarcinoma in literature (n=149).

Year	No. of patient	Gender	Age	Site	Recurrence	Author
1999	8	4 M, 4 F	25–70	Tongue with cervical lymph node metastasis	2–6-year follow-up, no evidence of recurrence	Michal et al. [1]
2004	1	F	65	Base of the tongue	No relapse	Prasad et al. [9]
2010	1	F	72	Base of tongue with neck metastases	None at 3 years	Coček et al. [3]
2011	23	9 F, 10 M, 4 N/A	25–85	Tongue, palate, retromolar mucosa, tonsils, upper lip with metastases	12 tumour-free; 1 recurrence	Skalova et al. [10]
2011	1	F	73	Base of tongue with neck metastases	Yes—2 relapses, then tumour-free	Borowski-Borowy et al. [11]
2012	5	2 M, 3 F	21–72	Tongue, floor of mouth with lymph node metastases	Follow-up period 4–45 months; 3 patients no recurrence; 2 patients developed lymph node metastases	Laco et al. [6]
2013	1	F	59	Tongue	N/A	Mevio et al. [12]
2013	1	M	64	Tongue	No recurrence at 43 months	Advenier et al. [13]
2014	2	Both F	56	Base of tongue with cervical metastases; base of tongue	6–8 months with no recurrence	Gailey et al. [14]
2014	1	M	66	Tongue	N/A autopsy case, not cause of death	Urano et al. [15]
2014	21	N/A	N/A	N/A	N/A	Weinreb et al. [16]
2015	1	F	62	Left tonsillar pillar with lymph node metastases	No recurrences at 3 months	Worrall et al. [5]
2015	1	F	13	Left palate with cervical metastases	N/A	Takhar et al. [17]

Table 1 (continued): Reported cases of cribriform adenocarcinoma in literature (n=149).

Year	No. of patient	Gender	Age	Site	Recurrence	Author
2015	1	F	39	Epiglottis	No recurrence at 26 months	Brierley et al. [18]
2016	1	F	55	Tongue	No recurrence at 10 months	Madhura et al. [19]
2016	1	M	76	Base of tongue with bilateral cervical metastases	No recurrence at 10 months, died 10 months due to other causes	Majewska et al. [37]
2017	1	M	78	Palate	Developed regional metastases after 2 years, died due to metastases at the 5-year mark	Mariano et al. [38]
2017	11	5 M, 6 F	32–83	Palate, upper lip, buccal mucosa, retromolar pad	N/A	Wiley et al. [20]
2016	21	14 F, 7 M	N/A	Tongue, buccal mucosa, palate, parotid, sinonasal, non-specified; 2 with nodal metastasis	Followed-up 10–217 months; includes 13 with no evidence of disease, 2 local recurrence, 1 regional recurrence, 2 distant metastasis	Xu et al. [21]
2017	1	F	70	Tonsil with lymph node metastases	No recurrence at 6 months	Pagano & Dennis [22]
2017	1	F	70	Maxillary sinus	N/A	Narayanappa et al. [23]
2018	1	M	63	Tongue	N/A	Lahiri et al. [24]
2019	1	M	26	Palate	3-month recurrence in cervical lymph nodes; no evidence of recurrence at 15 months	Kakkar et al. [25]
2019	14	5 M, 9 F	N/A	Hard palate, retromolar trigone, gingiva, base of tongue, soft palate, parotid gland; cases with cervical lymph node metastasis	3 patients had recurrence at 232 months, 160 months and 105 months	Mimica et al. [26]

Table 1 (continued): Reported cases of cribriform adenocarcinoma in literature (n=149).

Year	No. of patient	Gender	Age	Site	Recurrence	Author
2020	1	F	73	Tongue	Partial resection of tumour due to patients age and comorbidities	Xu et al. [39]
2020	1	F	48	Buccal mucosa	N/A	Laharwani et al. [28]
2020	1	M	47	Submandibular region with cervical metastases	No recurrence at follow-up—no time frame given	Garajei et al. [29]
2021	1	F	29	Left palate with nodal metastasis	No recurrence at 18 months	Appukutty et al. [30]
2021	1	M	83	Tongue with cervical metastasis	No recurrence at 3 years	De Luca et al. [31]
2021	1	M	39	Parotid gland	Lost to follow-up	Jassim et al. [32]
2021	3	N/A	N/A	N/A	N/A	Cunha et al. [33]
2021	5	N/A	N/A	N/A	N/A	Rooper et al. [34]
2022	1	F	76	Tonsil with cervical metastases	No recurrence at 21 months	Kuczkiewicz-Siemio et al. [35]
2022	12	N/A	N/A	N/A	N/A	Clausen et al. [36]
2023	1	F	58	Retromolar trigone	N/A	de Jager et al. [8]

Figure 1: Clinical photograph of the tumor.

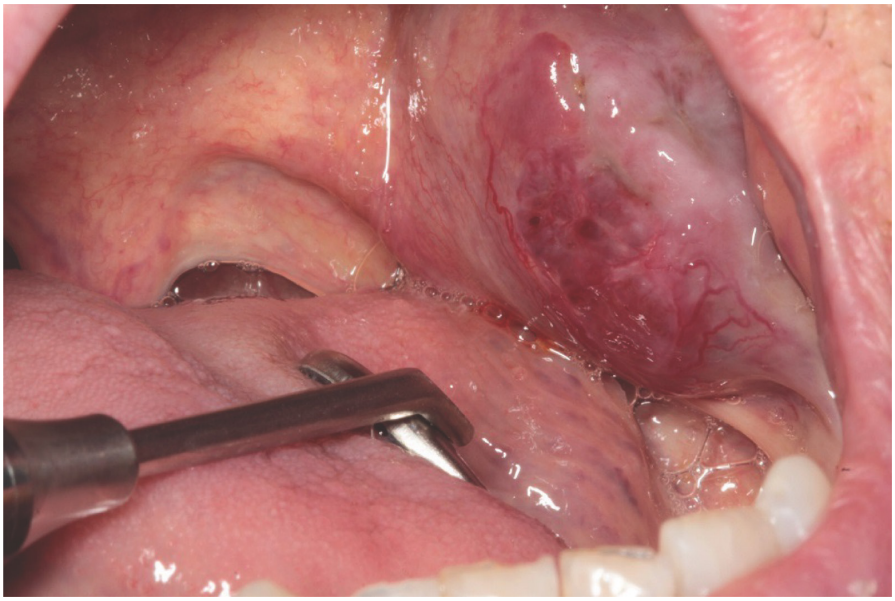


Figure 2: Images of the computerised tomography in the sagittal, coronal and axial planes, which show the cribriform adenocarcinoma in the left retromolar region.

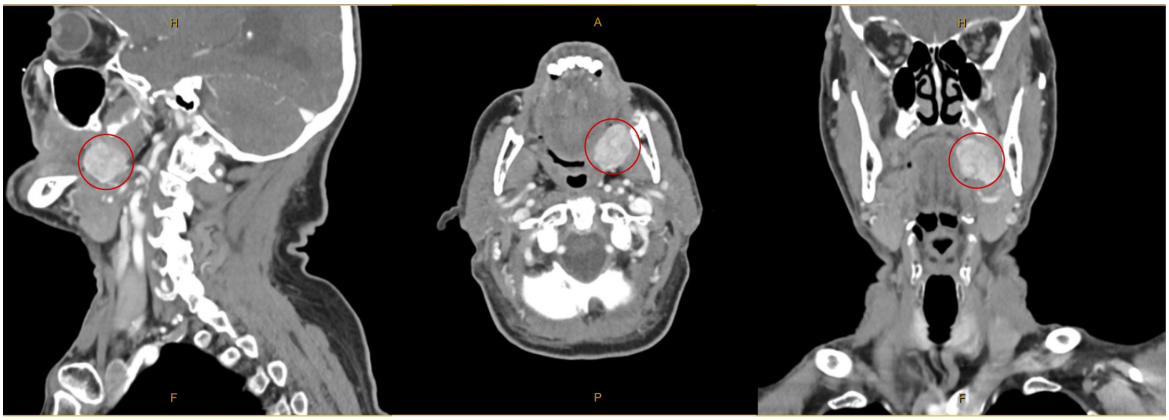
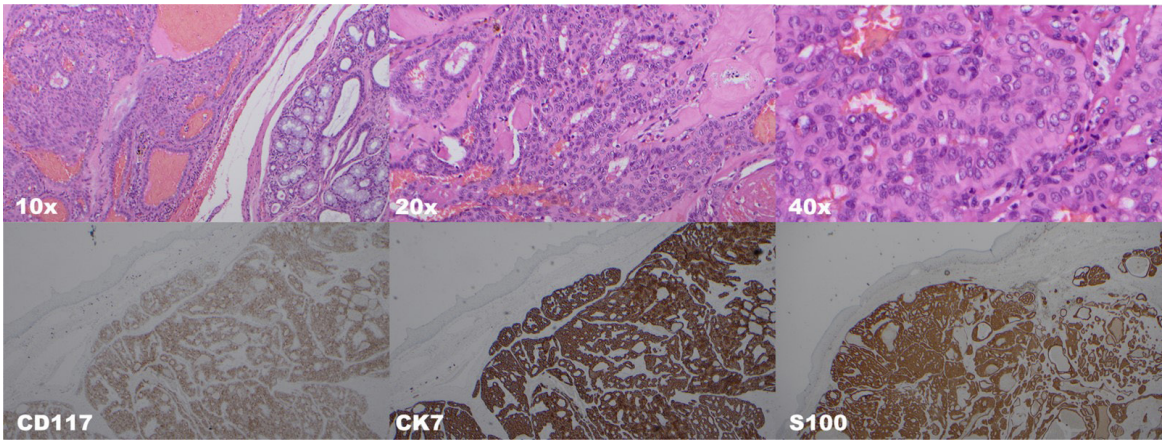


Figure 3: Histopathology images of the cribriform adenocarcinoma.



COMPETING INTERESTS
The authors have no conflict of interest to declare.

AUTHOR INFORMATION
Maria van Kuijk: Department of Oral Diagnostic and Surgical Sciences, University of Otago.
Harsha De Silva: Department of Oral Diagnostic and Surgical Sciences, University of Otago.
Ling Chan: Department of Pathology, Southern Community Laboratories Ltd.
Guangzhao Guan: Department of Oral Diagnostic and Surgical Sciences, University of Otago.

CORRESPONDING AUTHOR
Guangzhao Guan, BDS, MBChB, DClinDent: Department of Oral Diagnostic and Surgical Sciences, Faculty of Dentistry, University of Otago, Dunedin, New Zealand. E: simon.guan@otago.ac.nz

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The Dietetic Factor in Disease

NZMJ, 1924

A paper read at the Otago Division of the British Medical Association in April, 1924, *by* STUART MOORE, B.A., M.D., M.R.C.P., *Lecturer on Clinical Medicine, Otago Medical School.*

Most diseases to-day are regarded as due to bacteria and other living causes. We have studied these so intently, and know so much about them, that we naturally regard them as the most important causes of disease. I would remind you that it is claimed that there is really no such thing as a cause—phenomena which result are due to constellations of earlier conditions. We should remember this, even while we continue for convenience sake to speak of causes. Medical men are asking to-day which is the more important—the soil or the seed? Certain it is that if we are to study the beginnings of disease we must study the soil, for the study of disease merely from the viewpoint of living causes cannot bring us to a period earlier than the moment of infection. The importance of the soil, however, is well known. Witness racial and individual immunity, and the manner in which healthy dogs and certain men, tend to be immune even to vermin. Witness also the wide-spread distribution of pathogenic germs, etc., within and without the bodies of the healthy.

The drift of medical opinion is to study the soil. In this, which is more important, heredity or environment? Man has been subjected to a process of natural selection through biological ages, and should therefore, in the absence of sudden and violent changes in environment, be fitted by heredity to hold his own. Therefore, though both health and disease result from the interaction of heredity and environment, we should study environment, and, particularly, we should ask what, if any, are the sudden and violent modifications of environment to which man has recently been subjected? The answer to this question is "civilisation".

Civilisation and social organisation have been described by *Spencer* as super-organic evolution. In social evolution we see development from the simple to the complex at work. The same thing can be seen in the development of the mind of the individual, for civilisation is not hereditary. (Nevertheless it must be admitted that the greatest hope of proving the possibility of acquired characteristics being hereditary lies in a study of the mind.) Each one of us is born into the world at a stage of civilisation which is lower than that of any savage tribe to-day, and each one of us has to acquire during his own life-time the civilisation into which he is born, and which is developing around him. It is here we have the growing point of organic evolution. Lower in the scale of development the organism has very largely lost its plasticity and primitiveness and become rigid through specialisation. Our civilisation is a recent thing, for I would remind you that civilisations have waxed and waned on this world. We have had a succession of biological experiments made, and this succession of experiments has been rendered possible only through the fact that civilisation is not hereditary. The acquirement of civilisation by the individual is a delicate and complex process, and many of us suffer as a result from some degree of neurosis. So common is this that it is said that no one is perfectly sane.

Modern civilisation—the development of the industrial era—has exposed us to sedentary occupations, to fatigue, poisonous exhalations, overcrowding, monotony of employment, etc., but, in addition, we have experienced what is probably the most violent, sudden and unnatural modification of diet to which man has ever been subjected in the course of his evolution.

I would suggest the following list of the more important causes of disease in order of merit:—(1) Dietetic error (and errors in dress); (2) educational errors, and emotional stress and strain; (3) poisons of industry; (4) errors in exercise, of deficiency, of excess, fatigue; (5) erros in ventilation, lighting, climate; (6) heredity; while (7) vice, and (8) filth determine exposure to infection.

One and two are specially related, for dietetic errors can cause neurosis, and neurosis often causes dietetic error. It is perhaps a question which of these two results of civilisation is the more important. Heredity is rendered more important than it would otherwise be by the interference of civilisation with natural selection both by preserving the unfit, and destroying the fit.

The thesis I would lay before you for consideration to-night is that the most important factor in the preparation of the soil for disease, and in the production of disease is dietetic error.

Erratum

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Prevalence of urinary incontinence in New Zealand women from the cross-sectional Sexual and Reproductive Health module of the New Zealand Health Survey 2014/2015

Mark Weatherall, Jean Hay-Smith, Don Wilson

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On Friday 19 July 2024, two corrections were applied to this manuscript to ensure consistency with methodology:

- Following feedback from the Ministry of Health, on page 61 the sentence reading, "Weaknesses of the data are that it did not include those in very old age ranges or those living in residential care, that the question assessing continence was based on an older questionnaire and may not have the good measurement properties of contemporary questionnaires, and that BMI was by self-report" should read, "Weaknesses of the data are that it did not include those in very old age ranges or those living **in hospital-level or dementia care-level residential care, and** that the question assessing continence was based on an older questionnaire and may not have the good measurement properties of contemporary questionnaires." In the methodology document for the Health Survey, BMI was based on actual measurements of weight and height, so that this comment does not apply as a weakness.