NEW ZEALAND
TE ARA TIKA O TE HAUORA HAPORI
MEDICAL JOURNAL

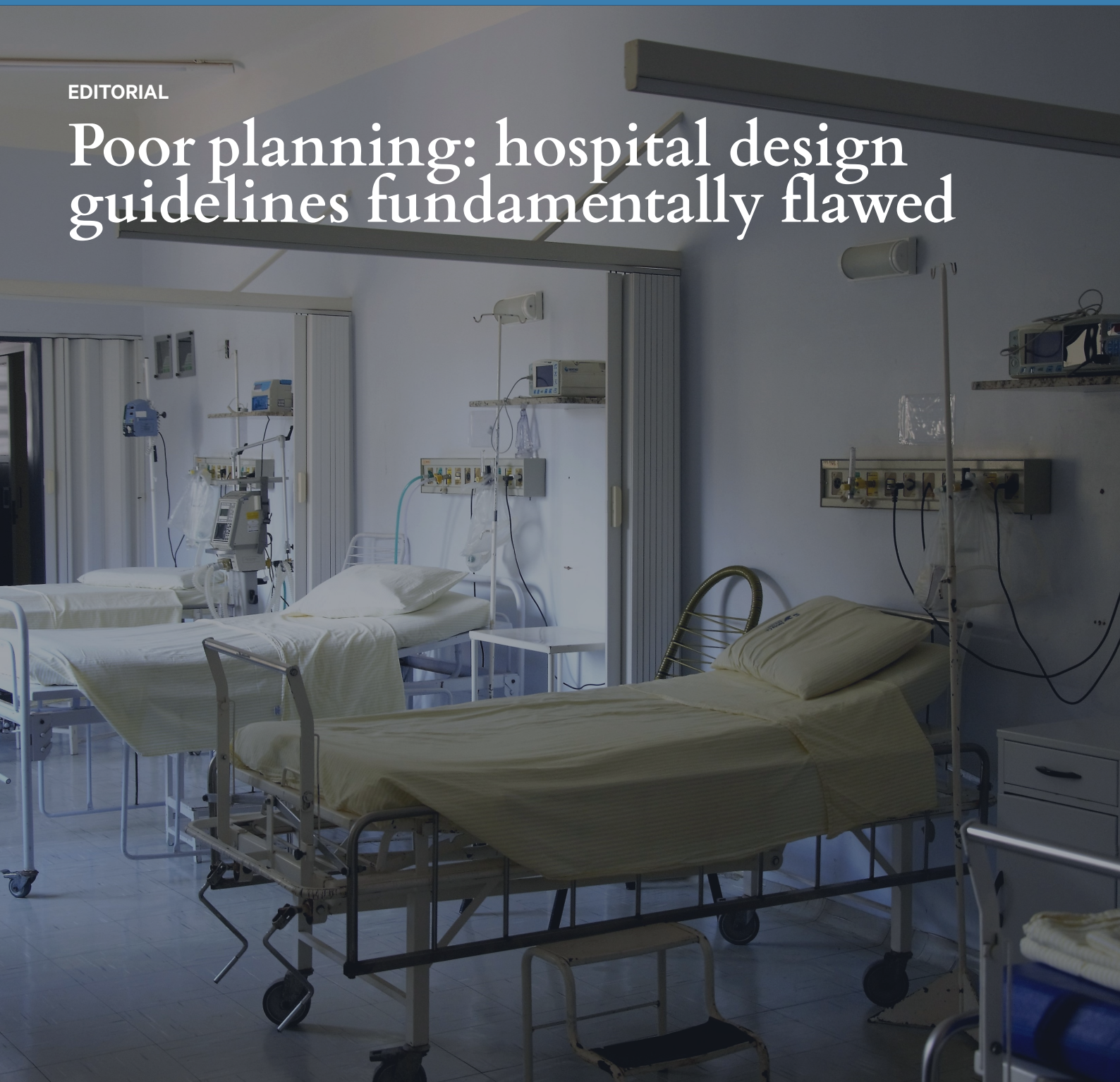
PUBLISHED BY:
PMA PASIFIKA MEDICAL ASSOCIATION Group

Vol. 138 | No. 1612 | 28 March 2025

IN THIS ISSUE:

EDITORIAL

Poor planning: hospital design guidelines fundamentally flawed



NEW ZEALAND
TE ARA TIKA O TE HAUORA HAPORI
MEDICAL JOURNAL

PMA PASIFIKA MEDICAL ASSOCIATION Group

Publication information

published by the Pasifika Medical Association Group

The *New Zealand Medical Journal* (*NZMJ*) is the principal scientific journal for the medical profession in New Zealand. The *Journal* has become a fundamental resource for providing research and written pieces from the health and medical industry.

The *NZMJ*'s first edition was published in 1887.
It was a key asset of the New Zealand Medical Association (NZMA) up until July 2022.

It is owned by the Pasifika Medical Association Group (PMAG).

The PMAG was formed in 1996 by a group of Pasifika health professionals who identified a need for an association with the purpose of "providing opportunities to enable Pasifika peoples to reach their aspirations".

ISSN (digital): 1175-8716

Editorial Board

NEW ZEALAND
TE ARA TIKA O TE HAUORA HAPORI
MEDICAL JOURNAL

PMA PASIFIKA MEDICAL ASSOCIATION Group

Publication information

published by the Pasifika Medical Association Group

Further information

ISSN (digital): 1175-8716
Publication frequency: bimonthy
Pubication medium: digital only

To contribute to the *NZMJ*, first read:
nzmj.org.nz/contribute

Other enquiries to

PMA Group
7a Pacific Rise
Auckland 1060
New Zealand

To subscribe to the *NZMJ*, email:

nzmj@pmagroup.co.nz

Full access is available to individual subscribers and does not incur a fee. Institutional subscription is available at the rates below.

All access to the *NZMJ* is by login and password, but IP access is available to institutes.

Further information is available on the *NZMJ* website:
http://www.nzmj.org.nz

If you are a member or a subscriber and have not yet received your login and password, or wish to receive email alerts, please email: nzmj@pmagroup.co.nz

Subscription rates for 2025

Individual		Institute	
New Zealand	Free	New Zealand	$680
International	Free	International	$700

New Zealand rate includes GST. No GST is included in the international rate.

Contents

Editorial

Articles

Viewpoint

Clinical correspondence

Letter

100 years ago in the *NZMJ*

Erratum

Summaries

Poor planning: hospital design guidelines fundamentally flawed

Cindy Towns, Michelle Balm

New Zealand hospital design needs to mandate single rooms. Shared rooms cannot meet basic infection control requirements or effectively manage the medical needs of the ageing population. Shared rooms also render patient rights and privacy law farcical. International research demonstrates that hospitals built with single rooms provide better care that is cost effective.

Referral patterns to the Southern Cochlear Implant Programme for adult cochlear implant candidates: a retrospective review

Calum Pears, Robin Willink, Alice Stringer, Phillip Bird, Jill Mustard

Access to cochlear implantation in New Zealand is limited by funding. Previously, there was demonstrated to be less even access to the service based on where patients lived and their socio-economic status. Interventions have been made to the service to address these, and this study suggests a more even distribution of referral to the programme since these changes have been made.

Patterns and experiences of smoking, electronic cigarettes (vapes) and heated tobacco use among people who smoke or who recently quit

Janine Nip, Jane Zhang, James Stanley, Andrew Waa, Jude Ball, El-Shadan Tautolo, Thomas K Agar, Anne C K Quah, Geoffrey T Fong, Richard Edwards

We analysed data from a survey of over 1,200 New Zealanders that was conducted in 2020 and 2021. Among people who smoked, over 75% responded that they regretted having started smoking and over 70% responded that they intend to quit in the future. Over 85% reported being addicted to smoking and over 85% stated that they had tried to quit smoking in the past. A quarter of people who smoked were vaping daily. A third of people who recently quit smoking were vaping daily. These findings highlight the importance of implementing effective and equitable smokefree measures to prevent people from starting to smoke and to support people to stop smoking.

Unapproved medicine use by paramedics in New Zealand: a comparative analysis with Australian and United Kingdom frameworks

Dylan A Mordaunt

This study looks at why New Zealand's current rules make it hard for paramedics to quickly use medicines that haven't been officially approved. By comparing the New Zealand system with those in Australia and the United Kingdom, the paper shows that other countries allow more flexible and faster use of these medicines, which can save lives. The research finds that excessive paperwork and restrictive legislation could interfere with critical care, particularly in areas where help is far away. It calls for changes to empower paramedics to act decisively while keeping patients safe.

Sexual identity and utilisation of primary healthcare services: findings from the New Zealand Health Survey

Sonja J Ellis, Jintana Jankhotkaew, Stephen Neville, Jeffery Adams

Using data from the New Zealand Health Survey (NZHS), this paper compares lesbian, gay and bisexual people and heterosexual people on engagement with, and experiences of, general practitioner (GP) services. Notable differences were observed in the percentage of GP and nurse utilisation across sexual identity groups. The findings of the study showed that both bisexual females and gay/bisexual males were much more likely to report poorer levels of trust in GPs and experience poorer explanations from doctors about health conditions. The findings of the study indicate that lesbian, gay and bisexual people have a poorer experience of GP services than do their heterosexual counterparts. These findings indicate the need for GPs and nurses to better understand the ways in which the health needs of lesbian, gay and bisexual people differ from those of heterosexuals to facilitate the provision of culturally appropriate care.

Identifying multiple sclerosis in linked administrative health data in Aotearoa New Zealand

Natalia Boven, Deborah F Mason, Barry J Milne, Annemarei Ranta, Andrew Sporle, Lisa Underwood, Julie Winter-Smith, Vanessa Selak

This study used anonymised linked health data to identify people likely to have multiple sclerosis, 4,860 of whom were resident in June 2022. The characteristics of this cohort were broadly similar to previous research. The estimated prevalence of multiple sclerosis was greater than prior research at 96.6 per 100,000 people, as was the estimated prevalence for Māori. Multiple sclerosis was more common among women and people living in more Southern regions. There was some indication that Māori and Pacific peoples living in more deprived areas faced barriers to diagnosis.

The burden of yersiniosis in New Zealand, 2022

Peter Cressey, Beverley Horn, Brent Gilpin, Lucia Rivas

Disease results in a burden to society that depends on the duration and severity of the illness. Yersiniosis is an infectious disease caused by the bacteria. The rate of yersiniosis has been increasing in New Zealand in recent years. A study of yersiniosis in New Zealand gathered information on the characteristics of the disease, enabling estimation of the burden of disease. The burden is predominantly due to the long duration of the primary gastroenteritis that appears to be longer than for other similar diseases, such as campylobacteriosis and salmonellosis. Two other conditions can occur after the gastroenteritis: reactive arthritis (joint pain) and erythema nodosum (painful lumps). While these were observed with some New Zealand yersiniosis cases, they were not major contributors to the societal burden.

Case studies of health-impaired prime ministers in Aotearoa New Zealand

John Horrocks, George Thomson, Nick Wilson

There is growing international concern around impaired leaders, especially in a world of heightened geopolitical instability. In this Aotearoa New Zealand study we consider brief case studies of four former New Zealand prime ministers whose poor health impaired their decision making. Two of them died in office—Michael Joseph Savage and Norman Kirk—while a third, Joseph Ward, died shortly after his resignation from his position. The fourth, Robert Muldoon, drank heavily at critical times during his prime ministership. We suggest that further New Zealand research on health-impaired leaders is justified and discuss possible system improvements that can help to recognise when leaders become incapable or even need, if possible, to be removed from any position of authority.

Accidental foveal burn from 755nm Alexandrite cosmetic laser

James Steven Lewis, James C Y Leong

A beauty therapist lost central vision in one eye after accidentally looking into a powerful cosmetic laser used for hair removal while cleaning it. The laser burned the most important part of her retina, causing permanent damage. Despite treatment, her vision did not improve, and she remains at risk for further complications. This case highlights the serious dangers of cosmetic lasers and the need for better safety training and regulations to prevent similar injuries.

Poor planning: hospital design guidelines fundamentally flawed

Cindy Towns, Michelle Balm

Internationally, there has been a move to single occupancy hospital rooms. France adopted single rooms for new construction 20 years ago, while British, Dutch and Norwegian hospitals are moving towards single occupancy designs.[1] In the United States (US), single occupancy rooms have been a minimum standard for new builds since 2006, and in Canada, design initiatives have single rooms as a cornerstone feature.[2,3]

In contrast are Australia and New Zealand design guidelines. The Australasian Health Facility Guidelines (AusHFG) provide design guidance for hospitals in Australasia.[4] AusHFG reports that their work is informed by evidence, clinical experts and consumers and provides a best-practice approach. Despite these claims, the guidelines do not provide recommendations on the proportion of single rooms, leaving it to local jurisdictions to determine the optimal ratio of single to multi-bed rooms. To date, Health New Zealand – Te Whatu Ora have aligned with AusHFG and not made recommendations outside of what is included in the published guide. New Zealand public hospitals have only a small proportion of total beds as single rooms, with the majority provided in multi-bed rooms.

Shared rooms compromise clinical standards, breach patient rights and privacy law and undermine cultural safety.[5] Given the life span of hospitals, there is no sound financial argument in their favour. Effective infection prevention and control is significantly more challenging with multi-occupancy design. Potential infection sources in a shared environment include surfaces, equipment, air and water. Standard precautions mitigate these risks somewhat but cannot protect from exposure to contaminated air or water. Strong evidence demonstrates that single rooms decrease transmission of SARS-CoV-2 in hospitals and resistant bacteria in the intensive care unit (ICU) setting.[5,6] Meta-analysis confirms a reduction in hospital-acquired infections (HAI).[7] This evidence is reflected in guidelines for the control of respiratory and gastrointestinal viruses, *Clostridium difficile* and multi-drug resistant organisms, which advise admission to single rooms.[8] New Zealand practitioners are frequently unable to meet these basic standards due to poor design. In addition, infection control competes with other patient needs for the limited number of single rooms, putting patients and whānau at risk and creating tension between clinical and operational teams.

Important considerations for our healthcare facilities are the clinical needs of an ageing population. By 2028, 1 million people will be over 65 and 200,000 will be over 85.[9] Delirium and dementia, already high prevalence conditions, will continue to rise, and pose sizeable challenges for our poorly designed public hospitals. Delirium, an acute confusional state, is associated with increased length of stay (LOS), infections, poor post-discharge function, higher need for residential care, cognitive decline and death.[5] A quarter of adult inpatients already struggle with delirium, and fundamental to its management are single rooms.[10] Local and international guidelines emphasise the need for control of light, noise and sleep—factors that are impossible to control in shared rooms with disruption from toileting, nursing care, patient deterioration and transfers.[5]

People with dementia currently number 70,000, but by 2050 this will increase to 170,000.[11] Over 80% of these patients will develop the behavioural and psychological features of dementia (BPSD), which include hallucinations, delusions, sleep disturbance, depression, inappropriate sexual behaviour and aggression.[12] Management guidelines again highlight the need for single rooms, but due to poor design, bed shortages and a lack of protective policies, these patients are frequently cohorted in shared spaces.[13] Hospitals continue to place men and women in the same room despite the threat this poses to women, a practice prohibited in the National Health Service (NHS) since 2010.[14,15]

Healthcare organisations have a duty of care to provide a safe environment for patients and staff.[5,15] No person should have to share a room with a patient who is agitated, aggressive or sexually inappropriate. Given the high rates of delirium and dementia, this is far from assured in our hospitals. Review of the many patient complaints and staff incident reports would attest

to the risks posed to patients in shared rooms.

Patient rights are not just about personal security. The Health and Disability Code of Rights (The Code) stipulates rights to privacy and dignity, while the Health Information Privacy Code (HIPC) provides the legal framework for keeping health information private. Hospital patients often have conditions that compromise these rights.[5] Incontinence, diarrhoea and vomiting are common. Sensory, cognitive or physical impairments also undermine patients' ability to manage their own privacy. Bodily exposure is common, and in shared rooms intimate bodily functions are performed next to strangers who can hear, smell and sometimes see what is occurring. Sensitive conversations disclosing private medical information can also be heard.

The Code not only outlines patient rights but also the duties of providers to uphold them. Health authorities admit that they cannot meet the privacy requirements of the Code or HIPC within shared rooms, so the question must be asked as to why Health New Zealand – Te Whatu Ora is allowed to continue to design and build hospitals that cannot uphold basic rights.[5]

Culturally safe care is a requirement for practice in New Zealand but cannot be provided in shared spaces. Research highlights the role inappropriate design has in poor healthcare experiences for Māori.[16] Participants highlighted rooms that could not accommodate whānau and the lack of dignity innate to having sensitive conversations in shared spaces. Having family present overnight is also desirable in many Pacific cultures and is an advantage for non-English speaking patients.[17] Limited space within shared rooms creates a source of tension and distress as visitors increase noise and disruption and further undermines the right to privacy for other patients.

Proponents of multi-occupancy rooms cite cost as a factor in their arguments; however, this is flawed. Single occupancy design may cost more initially, but this will be easily recouped over time. US research predicted only a 5.3% increase, with costs expected to be recouped within a year, while United Kingdom (UK) research predicted a similar small 5% increase.[18,19] Some research also demonstrated that 100% single occupancy can be achieved with the same space as a 50% single room allocation when other space saving features are used.[20] Cost gains with single rooms will be accrued with better care of high prevalence conditions (e.g., infection, delirium and dementia) reducing LOS. Patient transfers (i.e., when a patient develops a presentation change not amenable to a shared space) and reduced drug errors will also reduce cost and improve patient flow.[5] Evidence shows that 85 single patient rooms can achieve the same capacity as 100 beds in a multi-bed environment.[1] A 2023 *BMJ* review concluded that there was no economic benefit to multi-occupancy rooms, a conclusion rendered without including gains in delirium and dementia management.[21]

Although some have raised concerns about falls and pressure injuries for patients in single rooms, research demonstrates no clear difference between single and multi-occupancy designs.[5,21] Similarly, arguments that state that some patients "prefer company" fail to accurately reflect research that overwhelmingly favours the privacy and dignity of single rooms.[15,22] Such arguments also fail to recognise the non-equivalence between preferences and rights.

Pleasingly, a recent meeting and correspondence with members of the National Health Facility Planning – Infrastructure and Investment Group for Health New Zealand – Te Whatu Ora indicates that design teams will now recommend some patient areas be designed with 100% single rooms (email Health New Zealand – Te Whatu Ora, December 2024). However, these are currently limited to paediatrics, obstetrics and gynaecology and mental health. It is not clear why adult medical wards housing infectious disease—and where delirium, dementia and disability are highly prevalent—are not currently included in these recommendations.

New Zealand hospitals must meet basic clinical, ethical and medico-legal standards of care. The life of a hospital building exceeds 40 years and, consequently, so will their design errors.[23] Health facilities guidelines and design briefs must consider infection control, the needs of an ageing population and the privacy and dignity of all patients. New Zealand hospitals need to follow international best practice and move to 100% single rooms for new builds and major renovations.

COMPETING INTERESTS
The authors declare no conflicts of interests or financial disclosures.

AUTHOR INFORMATION
Cindy Towns: General Physician, Department of General Medicine, Wellington Hospital; Geriatrician, Older Adult Service, Te Whatu Ora Capital, Coast and Hutt Valley; Clinical Ethics Advisor, Te Whatu Ora Capital, Coast and Hutt Valley; Senior Lecturer, Department of Medicine, University of Otago, Wellington.
Michelle Balm: Infectious Diseases Specialist, Infection Services, Te Whatu Ora Capital, Coast and Hutt Valley, Wellington, New Zealand; Clinical Microbiologist, Awanui Labs, Wellington Hospital.

CORRESPONDING AUTHOR
Dr Cindy Towns, PhD MBChB FRACP: Department of General Medicine, Wellington Hospital, Riddiford Street, Newtown, Wellington 6021, New Zealand. E: Cindy.Towns@ccdhb.org.nz

URL
https://nzmj.org.nz/journal/vol-138-no-1612/poor-planning-hospital-design-guidelines-fundamentally-flawed

REFERENCES
1. Detsky ME, Etchells E. Single-patient rooms for safe patient-centered hospitals. JAMA. 2008;300(8):954-6. doi: 10.1001/jama.300.8.954.
2. The Facility Guidelines Institute. 2006 Guidelines for Design and Construction of Health Care Facilities [Internet]. Washington, DC (US): The Facility Guidelines Institute, The American Institute of Architects Academy of Architecture for Health, US Department of Health and Human Services; 2006 [cited 2024 Feb 15]. Available from: https://www.fgiguidelines.org/wp-content/uploads/2016/07/2006guidelines.pdf
3. Ward of the 21st century [Internet]. CA: University of Calgary and Alberta Health; 2024 [cited 2024 Feb 24]. Available from: https://www.w21c.org
4. Australasian Health Infrastructure Alliance. Australasian Health Facility Guidelines [Internet]. Sydney (AU): Australasian Health Infrastructure Alliance; 2015 [cited 2025 Mar 19]. Available from: https://aushfg-prod-com-au.s3.amazonaws.com/Part%20A%20Whole_6_0.pdf
5. Towns C, Kelly M, Ballantyne A. Infection, ageing and patient rights: Time for single-occupancy hospital rooms. Aust N Z J Public Health. 2024;48(6):100198. doi: 10.1016/j.anzjph.2024.100198.
6. Cooper BS, Evans S, Jafari Y, et al. The burden and dynamics of hospital-acquired SARS-CoV-2 in England. Nature. 2023;623(7985):132-8. doi: 10.1038/s41586-023-06634-z.
7. Halaby T, Al Naiemi N, Beishuizen B, et al. Impact of single room design on the spread of multi-drug resistant bacteria in an intensive care unit. Antimicrob Resist Infect Control. 2017;6:117. doi: 10.1186/s13756-017-0275-z.
8. US Centers for Disease Control and Prevention. 2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings [Internet]. US: Centers for Disease Control and Prevention; 2024 [cited 2024 Feb 22]. Available from: https://www.cdc.gov/infectioncontrol/guidelines/isolation/index.html
9. Stats NZ. One million people aged 65+ by 2028 [Internet]. Wellington (NZ): Stats NZ; 2022 [cited 2024 Feb 16]. Available from: https://www.stats.govt.nz/news/one-million-people-aged-65-by-2028/
10. Gibb K, Seeley A, Quinn T, et al. The consistent burden in published estimates of delirium occurrence in medical inpatients over four decades: a systematic review and meta-analysis study. Age Ageing. 2020;49(3):352-60. doi: 10.1093/ageing/afaa040.
11. Alzheimers New Zealand. Facts and figures [Internet]. NZ: Alzheimers New Zealand; 2024 [cited 2024 Feb 16]. Available from: https://alzheimers.org.nz/explore/facts-and-figures/
12. Abraha I, Rimland JM, Trotta FM, et al. Systematic review of systematic reviews of non-pharmacological interventions to treat behavioural disturbances in older patients with dementia. The SENATOR-OnTop series. BMJ Open. 2017;7(3):e012759. Erratum in: BMJ Open. 2017;7(7):e012759corr1. doi: 10.1136/bmjopen-2016-012759corr1.
13. Towns C, Hodgetts K, Shirtcliffe P, et al. General Medicine wards and the mental health crisis: invisible and unsafe. Under Review. Intern Med J. 2024.
14. Towns CR, Rowley N, Woods L. Mixed gender accommodation: prevalence, trend over time and vulnerability of older adults. Intern Med J. 2022;52(3):474-8. doi: 10.1111/imj.15712.
15. Towns C, Ballantyne A. Blowing the whistle on mixed gender hospital rooms in Australia and New Zealand: a human rights issue. J Med Ethics. 2024;50(8):513-6. doi: 10.1136/jme-2023-109080.
16. Edmonds M, Shankar S, Elia TI, et al. Māori experiences and perspectives of hospital treatment in the context of acute care. N Z Med J. 2024;137(1601):63-73. doi: 10.26635/6965.6397.

17. Wylie E, Duthie V, Tautai Fakataha Team. Adult Medical Services, Cultural Experience Project [Internet]. Auckland (NZ): Auckland District Health Board; 2021 [cited 2025 Mar 19]. Available from: https://static1.squarespace.com/static/5c18088d372b967f56ac2bc2/t/617b666beabcf12c272faf0a/1635477109790/AMS+Pacific+Report.pdf
18. Maben J, Griffiths P, Penfold C, et al. One size fits all? Mixed methods evaluation of the impact of 100% single-room accommodation on staff and patient experience, safety and costs. BMJ Qual Saf. 2016;25(4):241-56. doi: 10.1136/bmjqs-2015-004265.
19. Ulrich RS. Essay: evidence-based health-care architecture. Lancet. 2006;368:S38-9. doi: 10.1016/S0140-6736(06)69921-2.
20. NHS Estates. Ward layouts with Single Rooms and Space for Flexibility. London (UK): The Stationary Office; 2005. (amended 2013).
21. Bertuzzi A, Martin A, Clarke N, et al. Clinical, humanistic and economic outcomes, including experiencing of patient safety events, associated with admitting patients to single rooms compared with shared accommodation for acute hospital admissions: a systematic review and narrative synthesis. BMJ Open. 2023;13(5):e068932. doi: 10.1136/bmjopen-2022-068932.
22. Walker D. Challenging the culture of caring of 100 years: the evidence behind single-room provision in hospitals. Future Hosp J. 2016;3(1):30-32. doi: 10.7861/futurehosp.3-1-30.
23. Hill R. $47b bill for new hospitals and repairs over next decade - Health NZ. Radio New Zealand [Internet]. 2024 Aug 14 [cited 2024 Jan 24]. Available from: https://www.rnz.co.nz/news/national/525079/47b-bill-for-new-hospitals-and-repairs-over-next-decade-health-nz

Referral patterns to the Southern Cochlear Implant Programme for adult cochlear implant candidates: a retrospective review

Calum Pears, Robin Willink, Alice Stringer, Phillip Bird, Jill Mustard

ABSTRACT

AIM: The aim was to determine whether changes made to the Southern Cochlear Implant Programme (SCIP) following a previous audit in 2014[1] have affected referral patterns, and to identify ongoing areas of potential need that may inform future service provision and organisational policy. The primary objective was to assess whether changes in referral patterns (specifically distance to referral centre, ethnicity) occurred following interventions in SCIP service provision. The secondary objective was to evaluate the distribution of socio-economic deprivation for referrals to SCIP.

METHODS: A retrospective review of all adult patients referred for consideration of cochlear implantation to the SCIP was conducted between 1 December 2014 and 1 December 2022. Distances to nearest SCIP referral centre were calculated based on patients' regions of domicile. This was modelled with linear regression to assess the relationship between incidence of referrals and distance to nearest SCIP centre. Along with demographic data, this was compared to the 2014 audit and baseline New Zealand population demographics from the 2018 New Zealand Census.

RESULTS: In total, 793 individual patient referrals were identified and included. An improvement in referrals relative to distance to SCIP centre was demonstrated, along with a more even distribution of referrals across socio-economic groups. Assessment of ethnicity data was limited by the amount of unrecorded data.

CONCLUSION: Publicly funded cochlear implantation is currently a limited resource in New Zealand. Findings from this audit help assess both current and past service provisions, providing insights to guide future service developments. Interventions targeted at improving access to SCIP for those more geographically isolated from the service appear to be effective. These interventions, along with ongoing collection, audit and reporting of demographic data including ethnicity, should continue and help inform future service planning.

Cochlear implantation has been proven to be a successful option for adults with severe to profound hearing loss in whom hearing aid amplification is no longer beneficial.[2] The benefits include cost effectiveness, reduction of dementia progression and reduced rates of depression and anxiety.[3,4,5] Internationally, there are well-recognised inequities in access to cochlear implantation and outcomes across different social groups. Documented factors that determine access include physical distance to a cochlear implant centre, socio-economic status, race and increasing age.[6,7,8]

The Southern Cochlear Implant Programme (SCIP) was established in 2003 to facilitate cochlear implantation and hearing rehabilitation for the South Island and lower North Island of New Zealand. SCIP is an organisation that provides a multidisciplinary team service for assessment of cochlear implant eligibility, prioritisation of publicly funded implantation, implantation surgery, rehabilitation or habitation and patient support. Referrals can be made by otolaryngologists, audiologists or "advisors on deaf children". The assessment process involves audiological and medical assessments for implantation candidacy, as well as assessing the social and functional impact the individual's hearing disability is causing them.

An audit conducted between 1 December 2014 and 1 December 2022[1] assessed referral patterns across this region. Key findings included a discrepancy in referrals based on the geographical location, with a higher proportion of referrals from providers closer to Christchurch, where the programme was physically based. Additionally, Māori and Pacific patients were under-represented in referrals compared to general population demographics, suggesting a potential unmet need in these population groups.

Since 2014, changes have been implemented

to attempt to address these geographical and ethnic discrepancies in referrals, aiming to improve access to the service. In 2015, SCIP opened an assessment and rehabilitation clinic in Wellington, the lower North Island (Figure 1), to reduce travel barriers for potential patients. Outreach clinics based in rural centres were also established, along with in-service education sessions and online seminars to improve awareness among audiologists (referrers) in the SCIP catchment areas. In addition to these changes, there has been wider political and media exposure of cochlear implantation and an increase in public funding. The aim of this second audit was to assess the effects of these changes on referral patterns to further inform future service provision.

Hypothesis

The study hypothesises that the change made to the SCIP service delivery and provision would impact the referral patterns between the two audits, showing an improved incidence of referrals relative to distance to referral centre. Secondly, the demographic distribution of referrals in the more recent audit is hypothesised to be more reflective of the overall demographics in New Zealand, in particular ethnicity and relative socio-economic deprivation.

Methods

A retrospective review of consecutive patients 18 years and older and referred to SCIP between 1 December 2014 and 1 December 2022 was conducted. Deidentified patient data were collected from the SCIP patient database to identify all referrals over the audit period and create a dataset. This dataset was placed alongside 2018 New Zealand Census data and compared with the dataset from the 2014 audit, which included patients referred between 1 March 2003 and 30 November 2014. The census data were used to give a baseline reference for the New Zealand population distribution of age, gender, ethnicity and domicile.

Primary objective:

- To evaluate 2014–2022 referral demographics, specifically distance to SCIP centre and ethnicity, and to compare these to 2003–2014 referral demographics.

Figure 1: Locations of SCIP clinics in Wellington and Christchurch, as well as region of service highlighted in green. Outreach clinics are intermittently based in provincial towns throughout the region of service.

Secondary objective:

- To evaluate the distribution of socio-economic deprivation for referrals to SCIP between 2014 to 2022.

The dataset of SCIP referrals included date of birth (age at referral calculated based on this), gender, ethnicity and domicile location. The distance to the nearest SCIP clinic was taken to be the distance from the domicile council region calculated using the Google Maps™ mapping tool in a standardised fashion. The distance to the Christchurch SCIP clinic alone was also calculated to allow comparison to the previous audit. Distance to outreach clinic was not calculated, as these clinics were variable in their frequency and location during the audit period. The 2014 audit was conducted prior to the opening of the Wellington SCIP clinic. Patients were geographically grouped by their domicile council district for the other statistical analysis. New Zealand Index of Deprivation (NZDep) 2018 score[9] was extrapolated from patients' addresses. The NZDep2018 score is an established index of relative deprivation within the New Zealand population. It geographically divides areas based on address into even deciles across New Zealand, with a score of 10 indicating the most deprived.

Statistical analysis

The incidence of referral (number of referrals per person per year) was estimated for each of the geographic districts using the baseline adult population of their district as the denominator. The incidence was calculated by dividing the number of referrals per person by the total number of years of audit duration. The relationship between incidence and distance to the nearest SCIP centre (Christchurch or Wellington) was modelled using linear regression. Although data analysis had been completed in the previous audit and the classification into council districts had changed since then, conducting our analysis on the relevant figures from the previous audit as well as on our dataset allowed direct comparison between the two datasets. 95% confidence intervals were placed on two regression slopes to draw a conclusion about whether there had been an improvement between the two time periods.

The proportions of patients in the audit sample for different ethnic groups and different NZDep2018 scores were calculated. These were compared with proportions in the New Zealand population to assess relative representation in the audit dataset. Regional–specific demographic data were not available for sub-analysis comparison.

Ethical considerations

The study proposal was submitted through the Health and Disability Ethics Committees (HDEC) and noted to be outside of scope and did not require HDEC approval.

Results

There were 793 individual patient referrals between 2014 and 2022. (The 2014 audit covering the period 2003–2014 had included 709 patients.) The demographic distribution of these referrals is described in Table 1. Ethnicity data were unspecified in 27.6% of referrals for the current audit and 19.7% of the 2014 audit. Calculation of percentages for ethnicity and NZDep2018 score was performed with and without excluding the referrals with missing data. Sub-analysis of referral patterns for each individual year of the audit period was not specifically analysed as it was thought that case numbers would not be enough on a yearly basis to allow for significant statistical analysis.

Geographic analysis

Comparing the incidence of referrals vs distance to nearest SCIP clinic, a change is noted between the 2003–2014 period and the current audit period (Figure 2).

With the data from the 2014 audit, we obtain a point estimate of slope of −0.0037 per kilometre, with the *upper* limit of a 95% confidence interval being −0.0024 per kilometre. In the current audit, the point estimate of slope is −0.0008 per kilometre and the *lower* limit of a 95% confidence interval is −0.0029. The two confidence intervals for the slopes do not overlap, so there is strong informal evidence that there is a more even distribution of referrals in the current audit period in terms of distance relative to patient domicile. Distribution of scatter plot varies more widely in the current audit. This included a larger number of distance variables due to measuring distance relative to council district rather than using district health board as the prior audit had. Thus, the variation in scatter distribution is thought to be most likely a reflection of this change.

Ethnicity analysis

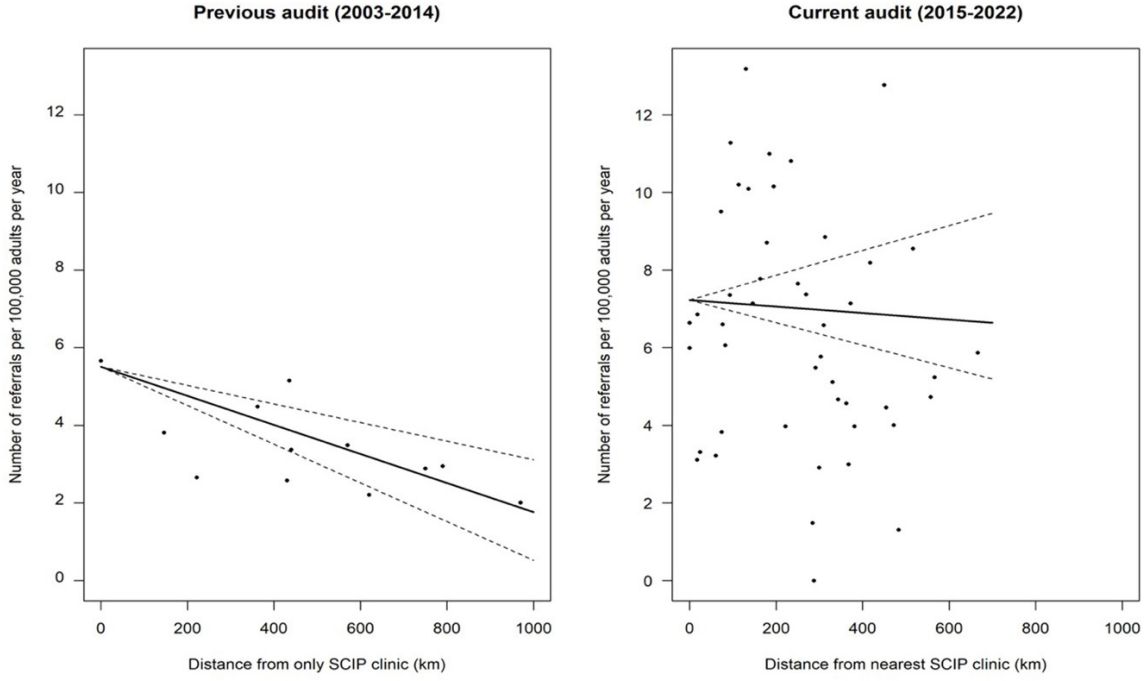
In the current audit, the proportion of Māori

Table 1: Demographic distribution of referrals.

Demographics	Referrals 2003–2014 (709)	Referrals 2014–2022 (793)	Percentage (%) 2003–2014*	Percentage (%) 2014–2022*	NZ population percentage (%) 2018 Census
Gender					
Male	357	475	50.3	59.9	49.4
Female	352	312	49.7	39.2	50.6
Unspecified	0	6	0	0.01	
Ethnicity					
NZ European	517	517	72.9 (90.9)	65.2 (90.2)	70.2
Māori	31	52	4.4 (5.4)	6.6 (9.1)	16.5
Pacific peoples	9	3	1.3 (1.6)	0.3 (0.5)	8.1
Asian	12	2	1.7 (2.1)	0.2 (0.4)	
Unspecified	140	219	19.7	27.6	
NZDep2018 Score					
1	84	84	11.8	10.6 (11.2)	
2	65	69	9.1	8.7 (9.2)	
3	46	84	6.5	10.6 (11.2)	
4	81	71	11.4	9.0 (9.5)	
5	68	71	9.6	9.0 (9.5)	
6	85	72	11.9	9.1 (9.7)	
7	98	82	13.8	10.3 (11.0)	
8	77	77	10.8	9.7 (10.3)	
9	71	82	10.0	10.3 (11.0)	
10	34	54	4.8	6.8 (7.2)	
Unspecified	0	47	0	5.9	

*Percentage excluding unspecified data is presented in brackets.

Figure 2: Incidence of referrals (number of referrals per 100,000 adult population per year) versus distance to the SCIP clinic (in kilometre) for different geographical districts. The solid lines give estimates of linear relationships obtained by standard regression methods. The slopes of the dashed lines indicate 95% confidence limits on the slopes of the underlying relationships (the intercepts of the dashed lines do not have statistical meaning).



among referrals with known ethnicity was 9.1% (52/574) with a 95% confidence interval of 7–12%. In the 2014 audit, 5.4% (31/569) of the referrals with known ethnicity were Māori. These proportions lie below the proportion of Māori in the population, which is 16.5%. This may suggest that Māori are continuing to be referred at a reduced rate from non-Māori. However, due to the large proportion of unspecified ethnicity data (27.6% in the current audit and 19.7% in 2014) this cannot be confirmed. Additionally, due to under-reporting of ethnicity data, meaningful statistical analysis of ethnic differences in referral patterns could not be undertaken. Delayed, late and reduced referral rates for Māori for ear health issues have also been reported in the literature previously.[10,11] Pacific peoples made up 0.5% of referrals, with Asians making up 0.4% of referrals where data were recorded. While not statistically significant (due to the large proportion of unspecified ethnicity data), both of these ethnicities are likely under-represented compared to baseline New Zealand population.

Socio-economic analysis

The socio-economic data based on NZDep2018 scores calculated from home address show a relatively even distribution across the decile range, except for the most deprived areas with an NZDep2018 score of 10 making up 7.2% of referrals, after excluding referrals without a known address. Five-point-nine percent of referrals had no physical address recorded and thus NZDep2018 scores for these referrals remain unspecified. On the basis that NZDep2018 divides the national population into even deciles and the geographical area admitting a referral to SCIP is representative of the nation, the expected percentage of baseline NZDep2018 scores would be close to 10% for each decile.

Gender analysis

Assessment of gender was not a specific primary or secondary objective during the study design process. There was, however, an unexpected gender imbalance in referrals during the audit period. The proportion of men among referrals with known gender was 475/787 (60.4%) with a 95% confidence interval of 57–64%. Thus, even though this analysis is formally *post hoc*, there is evidence that men are being referred at a higher rate than women.

Discussion

The benefits of having access to sound and functional hearing are well evidenced. Hearing loss remains one of the most modifiable mid-life risk factors for dementia,[12] and adequate management of hearing loss can improve depression and anxiety.[3,4,5] Cochlear implantation is more cost effective when compared with other high-cost implantable medical devices, such as pacemakers and defibrillators.[13] Additionally, they are cost beneficial from an overall societal perspective.[5]

There is evidence in the literature that geographical location of services is a barrier to provision of healthcare.[14] This study demonstrates that changes to the SCIP have been successful in improving access to cochlear implant assessment for those who are geographically distant to its primary office. Since the opening of a second referral centre and the provision of rural outreach clinics and education sessions, there has been an improvement in the rate of referrals relative to geographical distance to referral centre. True causation between the above interventions and the changes in referrals, however, cannot be proven with this study design.

A limitation exists in the consistency of the data for the analysis relating to Figure 2 (labelled above, comparing incidence of referrals versus distance to SCIP during both audit periods). The 2014 dataset used district health board domiciles while the more recent dataset utilised regions of domicile due to the disestablishment of district health boards. However, the mean point difference of 55 kilometres may suggest that some of the improvements noted for geography of referrals between the audits may not be due to addition of the new referral centre alone. The changes made over this period coincided with increased political awareness of the effects of hearing loss and increased public funding of cochlear implantation.

Unfortunately, there was limited recording of ethnicity in this study. Reporting of ethnicity data is not required to be included in referrals to SCIP; it is recorded at the time of patient assessment if the referral criteria is met. More than one-quarter of the ethnicity data were unrecorded in the referrals assessed in this study, many of which were related to referrals without ethnicity data that did not subsequently get assessed for cochlear implantation. As such, it is difficult to assess any trend with regards to ethnicity of patients being referred to SCIP. The 2014 audit noted that Māori and Pacific peoples were under-represented in referrals to the SCIP clinic. It remains likely that this is an ongoing issue, which needs to be a continued focus for service development and data collection.

There are limitations in using the 2018 New Zealand Census data as a comparison for demographic data in New Zealand. Stats NZ reports 73% of people in the 2018 Census dataset with Māori descent filled out an individual form during the 2018 Census compared with an 83.3% overall response rate.[15] This increases the chance of statistical error and makes drawing accurate conclusions from this study more challenging.

The Deafness Notification Database[16] has repeatedly demonstrated that lower socio-economic status is associated with hearing loss (not remediable by grommets) in children in New Zealand. Internationally, lower socio-economic status is linked to poorer hearing health outcomes.[17–19] To the authors' knowledge, no studies have been able to sufficiently explain this phenomenon or to determine whether this association persists into adulthood or affects eligibility for cochlear implantation in the New Zealand setting. This study has demonstrated a relatively even distribution of referrals for assessment according to socio-economic status. However, it is possible that this does not reflect the distribution of hearing loss in our population, because people who are more deprived may be over-represented in the hearing-impaired population. Further research is required but should not delay efforts to make hearing assistance more accessible to those more deprived.

The tentative finding of higher referrals for males noted in the more recent audit may be due to a variety of factors, including a potentially higher proportion of males with workplace noise exposure history.[20,21]

Conclusion

With targeted efforts to improve access to the SCIP service, some of the geographic barriers have improved. There is likely persisting inequity in referrals to SCIP for non-NZ European ethnicities. Given cochlear implants are an expensive and limited resource in the public health system, we need to ensure that efforts are made to identify those who will benefit most. Ongoing development and expansion of the service should consider targeting these potential areas of discrepancy in service provision, the goal being to ensure equitable access to the service across the southern region of New Zealand served by SCIP.

COMPETING INTERESTS
AS provides surgical services for the Southern Cochlear Implant Programme.
PB is a Trustee of the Southern Charitable Hearing Trust, which governs the Southern Cochlear Implant Programme.

AUTHOR INFORMATION
Dr Calum Pears: Otolaryngology Registrar, Health New Zealand – Te Whatu Ora Southern, Dunedin, New Zealand.
Dr Robin Willink: Senior Research Fellow/ Biostatistician, Biostatistical Group, University of Otago, Wellington, New Zealand.
Dr Alice Stringer: Otolaryngologist, Health New Zealand – Te Whatu Ora Capital, Coast and Hutt Valley, Wellington, New Zealand.
Dr Phillip Bird: Otolaryngologist, Health New Zealand – Te Whatu Waitaha Canterbury, Christchurch, New Zealand.
Jill Mustard: Clinical Manager, Southern Cochlear Implant Programme, Christchurch, New Zealand.

CORRESPONDING AUTHOR
Dr Calum Pears: c/o ENT department, Dunedin Hospital, Great King Street, Dunedin 9016, New Zealand.
E: Calum.Pears@southerndhb.govt.nz

URL
https://nzmj.org.nz/journal/vol-138-no-1612/referral-patterns-to-the-southern-cochlear-implant-programme-for-adult-cochlear-implant-candidates-a-retrospective-review

REFERENCES
1. Stanley-Wishart B, Guidera A, Gathecole B, et al. Adult Referrals to the Southern Cochlear Implant Programme. Proceedings of the New Zealand Society Otolaryngology Head and Neck Surgery 68th Annual General and Scientific Meeting; 2015 Oct 20-23; Nelson, New Zealand; 2015.
2. Boisvert I, Reis M, Au A, et al. Cochlear implantation outcomes in adults: A scoping review. PLoS One. 2020;15 (5):e0232421. doi: 10.1371/journal.pone.0232421.
3. Guitar K, Giles E, Raymond B, Welch D. Health effects of cochlear implants. N Z Med J. 2013;126(1375):9-26.
4. Sarant J, Harris D, Busby, et al. The Effect of Cochlear Implants on Cognitive Function in Older Adults: Initial Baseline and 18-Month Follow Up Results for a Prospective International Longitudinal Study. Front Neurosci. 2019;13:789. doi: 10.3389/fnins.2019.00789.
5. Neve OM, Boerman JA, van den Hout WB, et al. Cost-benefit Analysis of Cochlear Implants: A Societal Perspective. Ear Hear. 2021;42(5):1338-1350. doi: 10.1097/AUD.0000000000001021.
6. Schuh M, Bush ML. Defining Disparities in Cochlear Implantation through the Social Determinants of Health. Semin Hear. 2021;42(4):321-330. doi: 10.1055/s-0041-1739282.
7. Tolisano AM, Schauwecker N, Baumgart B, et al. Identifying Disadvantaged Groups for Cochlear Implantation: Demographics from a Large Cochlear Implant Program. Ann Otol Rhinol Laryngol. 2020;129(4):347-354. doi: 10.1177/0003489419888232.
8. Williams L. Untreated severe-to-profound hearing loss and the cochlear implant situation: how policy and practice are disabling New Zealand society. N Z Med J. 2019;132(1505):73-78.
9. Atkinson J, Salmond C, Crampton P. NZDep2018 Index of Deprivation [Internet]. Wellington, New Zealand; University of Otago; 2020 Dec [cited 2024 Jul 1]. Available from: https://www.otago.ac.nz/__data/assets/pdf_file/0020/326711/nzdep2018-index-of-deprivation-research-report-final-dec-2020-823833.pdf
10. McLaren H, Kim R, MacFater W, et al. Factors affecting clinic attendance for children referred with middle ear conditions. ANZ J Surg. 2022;92(12):3264-3267. doi: 10.1111/ans.18140.
11. Manuel AR, Smith J, Lowe T, O'Beirne GA. Kaupapa Māori development of te reo Māori assessments and culturally responsive hearing healthcare in Te Waipounamu: findings from wānanga. J R Soc N Z. 2024:1-17. doi: 10.1080/03036758.2024.2418999.
12. Livingston G, Huntley J, Liu K, et al. Dementia prevention, intervention, and care: 2024 report of the Lancet standing Commission. Lancet. 2024;404(10452):572-628. doi: 10.1016/S0140-6736(24)01296-0.
13. Pindrop. Economics of Cochlear Implantation [Internet]. New Zealand; 2015 [cited 2024 Jul 1]. Available from: https://www.pindrop.org.nz/articles/economics-of-cochlear-implantation
14. Lilley R, de Graaf B, Kool B, et al. Geographical and population disparities in timely access to prehospital and advanced level emergency care in New Zealand: a cross-sectional study. BMJ Open. 2019;9(7):e026026. doi: 10.1136/bmjopen-2018-026026.
15. Stats NZ. 2018 Census: Interim coverage rates, collection response rates, and data sources [Internet]. Stats NZ; 2018 [cited 2024 Jul 1]. Available from: https://www.stats.govt.nz/reports/2018-census-interim-coverage-rates-

collection-response-rates-and-data-sources
16. Digby JE, Purdy SC, Kelly AS. Deafness Notification Report (2022) Hearing loss (not remediable by grommets) in New Zealanders under the age of 19. Auckland, New Zealand: Enable New Zealand; 2022 Dec [cited 2024 Jul 1]. Available from: https://audiology.org.nz/assets/Uploads/DND/Deafness-Notification-Database-2022-Report.pdf
17. Chadha S, Kamenov K, Cieza A. The world report on hearing, 2021. Bull World Health Organ. 2021;99(4):242-242A. doi: 10.2471/BLT.21.285643.
18. Zhang Y, Xu M, Zhang J, et al. Risk factors for chronic and recurrent otitis media-a meta-analysis. PLoS One. 2014;9(1):e86397. doi: 10.1371/journal.pone.0086397.
19. Acuin J. Chronic suppurative otitis media: Burden of Illness and Management Options [Internet]. Geneva, Switzerland: World Health Organization; 2004 [cited 2024 Jul 1]. Available from: https://iris.who.int/bitstream/handle/10665/42941/9241591587.pdf?sequence=1&isAllowed=y
20. Greville A. Hearing Impaired and deaf people in New Zealand; population numbers and characteristics [Internet]. Greville Consulting; 2001 [cited 2024 Jul 1]. Available from: https://www.oticon.org.nz/pdf/hearingimpaireddeafpeoplenz.pdf
21. Greville A. Hearing Impaired and deaf people in New Zealand: an update on population numbers and characteristics [Internet]. Greville Consulting; 2005 [cited 2024 Jul 1]. Available from: https://www.oticon.org.nz/pdf/hearingimpaireddeafpeoplenzmar05a.pdf

Patterns and experiences of smoking, electronic cigarettes (vapes) and heated tobacco use among people who smoke or who recently quit

Janine Nip, Jane Zhang, James Stanley, Andrew Waa, Jude Ball, El-Shadan Tautolo, Thomas K Agar, Anne C K Quah, Geoffrey T Fong, Richard Edwards

ABSTRACT

AIM: The aim of this study is to understand patterns and experiences of smoking and electronic cigarette use, as well as related attitudes and behaviours among adults in Aotearoa New Zealand who smoke or recently stopped smoking.

METHODS: We analysed data from the Evidence for Achieving Smokefree Aotearoa Equitably/International Tobacco Control New Zealand Survey (N=1,230), conducted between November 2020 and February 2021.

RESULTS: Among people who smoked, 77.5% (95% confidence interval [CI] 74.0–80.8%) reported regretting having started smoking, 73.6% (95% CI 69.5–77.4) intended to quit, 87.3% (95% CI 84.1–89.9) reported being addicted to smoking and 86.3% (95% CI 83.3–88.8) had tried to quit smoking in the past. Among people who smoked, 24.8% (95% CI 21.3–28.6) used electronic cigarettes (ECs) daily and 4.6% (95% CI 3.3–6.6) used heated tobacco products (HTPs) daily. Among people who had recently stopped smoking, 33.4% (95% CI 25.6–42.2) used ECs daily and less than 1% used HTPs daily.

CONCLUSION: High levels of regret for starting smoking, addiction and intent to quit smoking highlight the importance of implementing effective and equitable smokefree measures to prevent people from starting to smoke and to support people to stop smoking.

Following advocacy by Māori leaders to aim to achieve a tobacco "endgame", the Aotearoa New Zealand government set the Smokefree Aotearoa goal in 2011. The goal aimed to reduce daily smoking prevalence and the availability of smoked tobacco products to minimal levels for all population groups by 2025.[1] However, over the following decade, largely business-as-usual policy changes took place, including a ban on point-of-sale displays of tobacco products, plain packaging, annual above-inflation increases in tobacco taxation and media campaigns. While important, these measures fell short of the changes required to achieve rapid and equitable reductions in smoking prevalence. Smoking is still the leading cause of preventable death in Aotearoa New Zealand[2,3] and significant inequities remain: in 2022/2023, 6.8% of New Zealanders smoked daily, but rates were substantially higher for Māori (17.1%) and people living in the most deprived neighbourhoods (10.7%).[4]

In December 2021, the New Zealand Government introduced the Smokefree Aotearoa 2025 Action Plan, which included three endgame policies to reduce smoking prevalence profoundly, rapidly and equitably by: 1) greatly reducing the number of outlets where cigarettes can be sold, 2) decreasing nicotine in cigarettes to very low non-addictive levels (VLNCs), and 3) implementing a "smokefree generation" by disallowing the sale of tobacco products to people born after 2008. These measures were passed into law in January 2023 as part of the *Smokefree Environments and Regulated Products (Smoked Tobacco) Amendment Act* (*SERPA Act*).[5]

However, following a change of government in September 2023, the three *SERPA* endgame measures were repealed in February 2024, before implementation could occur. This is despite modelling studies strongly suggesting the measures would have had a substantial impact on smoking prevalence, including for Māori.[6,7] In March 2024, new regulations introduced by the previous Government for electronic cigarettes (ECs, also known as "vapes") were implemented. These aimed to reduce youth EC use and included a nicotine concentration limit on e-liquids and limits on flavour names. There has also been a change to the regulation of heated tobacco products (HTPs), which are devices that heat tobacco (rather

than burn it), allowing nicotine to be absorbed from the resulting aerosol. In July 2024, the new Government halved excise tax on HTPs, claiming this would support people to quit smoking. This was contrary to recommendations of the World Health Organization[8] and a Cochrane review that found minimal evidence that HTPs support smoking cessation.[9]

We analysed data from a nationally representative sample of adults who smoke or who recently stopped smoking in the 2020–2021 EASE (Evidence for Achieving Smokefree Aotearoa Equitably) International Tobacco Control New Zealand (ITC NZ) Survey to understand patterns of tobacco and nicotine product use, attempts to stop smoking and key attitudes and beliefs associated with the likelihood of continued smoking vs cessation, including desire to quit smoking, perceived addiction and regret over starting smoking, which have been shown to be related to intentions to quit smoking.[10] We conducted these analyses prior to the 2024 changes to regulations on ECs and HTPs, providing baseline data on cigarette smoking, EC use and HTP use, as well as factors relating to product use. We also examined whether product use and the factors relating to product use varied by equity dimensions, including ethnicity and financial hardship.

Methods

Study design, sampling and recruitment

This cross-sectional analysis examined data from Wave 3 of the EASE/ITC NZ Survey, a combined prospective cohort and repeat cross-sectional study of people who currently smoke (combustible tobacco) or recently stopped smoking. Wave 3 was conducted online from 8 November to 24 December 2020 and 1–27 February 2021.

Recruitment was via an invitation to participants in the previous survey wave (Wave 2 in 2018), and a replenishment sample of participants was recruited through an online survey panel and through social media to boost recruitment among Māori, Pacific peoples and people aged 18–24. This included targeted paid social media advertisements and invitations distributed through Pacific and Māori networks such as the University of Otago Pacific Centre Facebook page and local/community Facebook groups in Porirua and South Auckland (areas with large Māori and Pacific populations).

People from Wave 2 of the survey were eligible to take part in Wave 3 if they lived in Aotearoa New Zealand, were at least 18 years of age and either: i) currently smoked, or ii) had recently stopped smoking and quit for fewer than 5 years. Replenishment participants were eligible to take part if they were at least 18 years of age and either: i) currently smoked at least monthly, or ii) had recently stopped smoking and had previously smoked at least monthly, had smoked at least 100 cigarettes in their lifetime and stopped smoking within the past 24 months.

To achieve adequate statistical precision and explanatory power for priority groups, we aimed to recruit equal numbers of Māori, Pacific and non-Māori, non-Pacific participants, and to have at least 25% of the sample aged 18–24. Details of the sampling and survey methods are available on the ITC website.[11]

Data collection and measures

Socio-demographic measures included ethnicity, age and gender. Smoking status was combined with intention to quit to create four categories: "smokes daily not intending to quit", "smokes daily intending to quit", "smokes less than daily" or "recently stopped smoking". Survey questions on smoking status and financial hardship are in the Table 1 legend.

Study outcomes included: 1) the types of cigarettes smoked among people who smoke (including factory-made [tailor-made] and roll-your-own [RYO]), 2) use of ECs and HTPs among people who smoke and people who quit smoking, and 3) among people that smoked: perceived addiction to smoking, regret for starting to smoke, previous quit attempts and plans to quit in the future. Wording of the questions used to obtain these outcomes is in the table legends.

Participants who refused to answer or answered "don't know" were excluded from the relevant analyses.

Data analysis

Weighted prevalence estimates are reported as percentages with 95% confidence intervals (95% CI) for the key outcomes. When comparing subgroups, marginally standardised percentages and absolute differences (with 95% CIs) are presented that adjust for key covariates: smoking status and quit intention, prioritised ethnicity, gender, age group and financial hardship.[12]

Data were analysed in R 4.1 (R Institute, Vienna, Austria),[13] with raked weight calculations drawing on gender, age group, region and prioritised ethnicity, calibrated based on population estimates

for people who smoke and recently stopped smoking from the New Zealand Health Survey (NZHS) (2018–2019 and 2019–2020, combined) to represent this population. Marginal standardisation and differences for multinomial outcomes (more than two levels) were conducted in Stata 17 (Statacorp, College Station, TX).

To ensure complete representation of Pacific participants, prevalence of outcomes by ethnicity are presented using total ethnicity, classified as Māori (including people who also identified as Pacific), Pacific (including people who also identified as Māori), or non-Māori, non-Pacific (exclusive of the other two groups). Marginal differences for Māori and for Pacific are presented compared to the exclusive non-Māori, non-Pacific category, but total ethnicity estimates for Māori and Pacific should be compared with caution as these groups are not mutually exclusive. Prioritised ethnicity[14] was only used for weighting and for marginal standardisation adjustment, with participants classified as Māori (including people who also identified as Pacific), Pacific (excluding people who also identified as Māori), or non-Māori, non-Pacific.

Marginal estimates for Pacific total ethnicity are estimated from a separate model and marginal standardisation step (using the same covariates), and so the absolute marginal differences (relative to non-Māori, non-Pacific) presented in the tables may not perfectly match the differences between the marginal proportions reported in the Pacific and non-Māori, non-Pacific rows.

Marginally adjusted estimates and differences are not reported for participants indicating "other" for their gender, as there was an insufficient number to allow for their inclusion as a category in the multivariable models (n=18).

Ethics

Approval was obtained prior to participant recruitment from the University of Otago Human Ethics Committee (20/020) and University of Waterloo Office Research Ethics Board (REB#42549).

Results

Participants

A total of 1,230 participants were included, of whom 80.7% were currently smoking and 19.3% recently stopped smoking (Table 1).

Tobacco product use

Among people who smoke, 39.6% (95% CI 35.7–43.6) only smoked factory-made cigarettes, 22.0% (95% CI 18.8–25.5) only smoked RYO cigarettes and 38.4% (95% CI 34.5–42.5) smoked both.

People who smoked daily and intended to quit were less likely to only smoke RYO than people who smoked daily and did not plan to quit (absolute marginal difference [AMD] −13.9% [95% CI −23.7–−4.0]). People who smoked less than daily were less likely to smoke RYO and more likely to smoke factory-made than people who smoked daily and did not intend to quit (AMD −16.5% [95% CI −27.8–−5.2] and 18.9% [95% CI 7.0–30.7], respectively).

Smoking both RYO and factory-made cigarettes was less common for Māori compared to non-Māori, non-Pacific (AMD −16.0% [95% CI −24.3–−7.7]), less common in women compared to men (AMD −10.1% [95% CI −18.0–−2.1]) and more common in those experiencing financial hardship compared to those who do not (AMD 10.5% [95% CI 1.9–19.2]). Smoking factory-made cigarettes only was more common for Māori compared to non-Māori, non-Pacific (AMD 11.3% [95% CI 2.5–20.0]). Further details are available in Appendix Table 1.

Other nicotine and tobacco product use

As outlined in Table 2, a quarter of people who smoked also used ECs daily (24.8%, 95% CI 21.3–28.6). Among people who had stopped smoking, a third used ECs daily (33.4%, 95% CI 25.6–42.2).

Daily EC use was more common in people who smoked daily and intended to quit and in people who smoked less than daily, compared with people who smoked daily not intending to quit. Among people who smoked, daily EC use was less prevalent among Māori compared to non-Māori, non-Pacific, among people aged 45 and older compared with younger age groups and in women compared with men.

Among people who had recently stopped smoking, daily EC use was more common in Māori and Pacific peoples compared to non-Māori, non-Pacific; however, this did not reach statistical significance for Māori.

ECs were used at least monthly by 41.6% (95% CI 37.6–45.6) of people who smoke and 39.7% (95% CI 31.5–48.6) of people who recently stopped smoking. Further detail is available in Appendix Table 2.

About one in 20 of those who smoke also used HTPs daily (4.6%, 95% CI 3.3–6.6). There were no substantial differences in prevalence of daily HTP use by age, ethnicity, gender or financial hardship. Two out of 235 people who had stopped smoking

Table 1: Participant characteristics.

Characteristic	N (%) unless otherwise stated
Age (years)	
Mean (SD)	38.0 (14.8)
18–24	326 (26.5%)
25–44	528 (42.9%)
≥45	376 (30.6%)
Gender	
Man	442 (35.9%)
Woman	770 (62.6%)
Other	18 (1.5%)
Ethnicity*	
Māori	492 (40.0%)
Pacific	238 (19.3%)
Non-Māori, non-Pacific	546 (44.4%)
Smoking status^	
People who smoke daily	700 (56.9%)
• with no intent to quit	182 (14.8%)
• with intent to quit	474 (38.5%)
• no response for intent to quit#	44 (3.6%)
People who smoke less than daily	292 (23.7%)
• with no intent to quit	28 (2.3%)
• with intent to quit	234 (19.0%)
• no response for intent to quit#	30 (2.4%)
People who have recently stopped smoking	238 (19.3%)
Heaviness of smoking in people who smoke (people who smoke daily only)	
Smokes ≤20 cigarettes per day	540 (77.1%)
Smokes >20 cigarettes per day	141 (20.1%)
No response on amount smoked#	19 (2.7%)

Table 1 (continued): Participant characteristics.

Evidence of financial hardship**	
Yes	345 (28.0%)
No	847 (68.9%)
No response on financial hardship#	38 (3.1%)

N=1,230. All figures are unweighted.
SD = standard deviation.
*Ethnicity reported as total ethnicity; some participants identified as both Māori and Pacific (n=46 [3.7%]), resulting in percentages adding to over 100%.
^"Daily smoker, wanting to quit" is defined as a person who smoked daily and selected one of the following options when asked "Are you planning to quit smoking?": "within the next month", "between 1–6 months from now" or "sometime in the future, beyond 6 months".
#This includes participants who refused to answer, answered "don't know" or had missing data for this question.
**Financial hardship is defined as answering "yes" to the following question: "In the last 30 days, because of a shortage of money, were you unable to pay any important bills on time, such as electricity, telephone or rent bills?"

Table 2: Daily electronic cigarette use in people who smoke and people who recently stopped smoking.

	n/N	**Weighted percentage (95% CI)**	**Marginally standardised percentage (95% CI)**	**Absolute marginal difference (95% CI)**
People who smoke: use of electronic cigarettes daily				
Total	252/992	24.8 (21.3–28.6)		
Smoking status:				
Smokes daily not intending to quit	26/182	10.3 (6.2–16.8)	11.7 (7.0–18.9)	Reference
Smokes daily intending to quit	93/474	22.9 (18.2–28.3)	23.7 (18.8–29.4)	**12.1 (4.0–20.2)**
Smokes less than daily	130/292	43.9 (36.1–52.0)	42.0 (33.8–50.7)	**30.3 (19.5–41.2)**
Total ethnicity:				
Māori	95/408	20.4 (16.2–25.4)	21.8 (17.0–27.4)	**−7.8 (−15.3–−0.2)**
Pacific	49/197	24.3 (17.5–32.9)	24.3 (17.4–33.0)	−5.2 (−14.6–4.1)
Non-Māori, non-Pacific	120/427	27.2 (22.0–33.2)	29.6 (24.3–35.4)	Reference
Age group:				
18–24	94/263	37.0 (30.0–44.7)	32.3 (25.6–39.9)	**14.2 (4.7–23.7)**
25–44	120/436	28.8 (23.4–34.8)	31.1 (25.3–37.5)	**12.9 (4.4–21.5)**
≥45	38/293	15.3 (10.4–22.1)	18.2 (12.9–24.9)	Reference
Gender:				
Man	117/369	28.8 (23.3–35.1)	30.0 (24.4–36.3)	Reference
Woman	133/621	20.0 (16.4–24.0)	22.2 (18.3–26.6)	**−7.8 (−15.1–−0.5)**

Table 2 (continued): Daily electronic cigarette use in people who smoke and people who recently stopped smoking.

Evidence of financial hardship:				
No	164/669	24.9 (20.6–29.7)	25.8 (21.7–30.4)	Reference
Yes	82/292	26.6 (20.7–33.5)	28.3 (21.9–35.6)	2.4 (−5.3–10.2)
People who stopped smoking: use of electronic cigarettes daily				
Total	92/238	33.4 (25.6–42.2)		
Total ethnicity:				
Māori	36/84	40.0 (25.7–56.2)	44.6 (29.2–61.1)	17.3 (−1.8–36.4)
Pacific	17/41	51.6 (30.9–71.7)	55.9 (34.7–75.1)	**28.9 (5.4–52.4)**
Non-Māori, non-Pacific	42/119	28.4 (19.6–39.1)	27.3 (18.9–37.6)	Reference
Age group:				
18–24	20/63	29.4 (17.9–44.3)	29.9 (17.0–47.0)	0.6 (−20.3–21.4)
25–44	43/92	42.5 (27.9–58.6)	40.9 (27.8–55.4)	11.5 (−7.5–30.6)
≥45	29/83	27.6 (17.2–41.1)	29.3 (18.3–43.4)	Reference
Gender:				
Man	26/78	31.8 (20.3–46.1)	34.3 (23.0–47.6)	Reference
Woman	66/159	35.4 (26.5–45.6)	33.1 (24.4–43.2)	−1.1 (−16.8–14.5)
Evidence of financial hardship:				
No	67/178	31.6 (23.3–41.3)	32.8 (24.6–42.3)	Reference
Yes	24/53	41.4 (23.5–62.0)	36.9 (22.5–54.0)	4.0 (−13.8–21.9)

Values in bold indicate statistically significantly absolute marginal differences compared with the reference value.
Total ethnicity data are presented for Māori and Pacific. Some participants identified as both Māori and Pacific (see Table 1); comparisons for these two groups are made to an exclusive non-Māori, non-Pacific group.
Note that those with a non-binary gender do not have results reported (group too small for reasonable inference).
See Table 1 for the definition of financial hardship.
Participants who refused to answer or answered "don't know" were excluded from the relevant analyses.
Marginally standardised percentages and absolute differences adjust for: smoking status and quit intention, prioritised ethnicity, gender, age group and financial hardship.

used HTPs daily (0.6%); due to small numbers no further analyses could be conducted by subgroup. HTPs were used at least monthly by 10.2% of people who smoke (95% CI 8.1–12.7) and 1.7% of people who stopped smoking (95% CI 0.6–4.3). Further detail is available in Appendix Table 3.

Regret and addiction

As outlined in Table 3, most people who smoke reported being addicted to smoking (87.3%, 95% CI 84.1–89.9) and most reported that they regretted starting to smoke (77.5%, 95% CI 74.0–80.8). People who smoked less than daily were less likely to report being addicted to smoking. People who smoked daily and did not intend to quit were less likely to report that they regret having started smoking, compared with people who smoked daily and intended to quit and people who smoked less than daily.

Māori were more likely to report being addicted

Table 3: Prevalence of addiction, regret, previous failed quit attempts and plans to quit in the future in people who smoke.

	n/N	Weighted percentage (95% CI)	Marginally standardised percentage (95% CI)	Absolute marginal difference (95% CI)
People who smoke: report being addicted* to smoking				
Total	854/974	87.3 (84.1–89.9)		
Smoking status:				
Smokes daily not intending to quit	170/177	95.9 (90.8–98.2)	95.7 (90.5–98.1)	Reference
Smokes daily intending to quit	455/473	96.7 (94.3–98.1)	96.4 (93.8–97.9)	0.8 (−3.2–4.7)
Smokes less than daily	188/281	61.5 (53.1–69.2)	63.0 (55.1–70.3)	**−32.6 (−41.3–−4.0)**
People who smoke: regret having started smoking**				
Total	747/964	77.5 (74.0–80.8)		
Smoking status:				
Smokes daily not intending to quit	110/170	64.9 (55.2–73.4)	60.0 (50.2–69.1)	Reference
Smokes daily intending to quit	395/468	84.4 (79.5–88.3)	86.0 (81.5–89.6)	**26.0 (15.7–36.3)**
Smokes less than daily	212/285	74.4 (67.1–80.6)	76.3 (69.2–82.2)	**16.3 (4.4–28.2)**
People who smoke: previously tried to quit smoking^				
Total	834/972	86.3 (83.3–88.8)		
Smoking status:				
Smokes daily not intending to quit	121/180	69.4 (60.3–77.2)	66.4 (57.5–74.3)	Reference
Smokes daily intending to quit	434/469	92.5 (88.8–95.1)	92.3 (88.4–95.0)	**25.9 (16.8–34.9)**
Smokes less than daily	245/281	90.0 (85.2–93.3)	92.0 (88.2–94.7)	**25.6 (16.5–34.8)**
People who smoke: previously tried to quit smoking in the past 12 months^^				
Total	546/988	51.5 (47.4–55.6)		
Smoking status:				
Smokes daily not intending to quit	35/182	14.2 (9.5–20.6)	15.9 (10.7–22.9)	Reference
Smokes daily intending to quit	280/472	56.3 (50.5–61.9)	56.1 (50.0–62.0)	**40.2 (31.6–48.9)**

Table 3 (continued): Prevalence of addiction, regret, previous failed quit attempts and plans to quit in the future in people who smoke.

Smokes less than daily	209/290	72.2 (65.0–78.5)	71.4 (63.7–78.0)	**55.5 (45.7–65.3)**
People who smoke: plan to quit smoking in the future#				
Total	708/918	73.6 (69.5–77.4)		
Smoking status:				
Smokes daily	474/656	68.4 (63.5–73.0)	68.5 (63.7–72.9)	Reference
Smokes less than daily	234/262	88.8 (82.8–92.9)	87.4 (80.5–92.1)	**18.9 (11.6–26.1)**

Values in bold indicate statistically significantly absolute marginal differences compared with the reference value.
See Table 1 for the definition of financial hardship.
*Participants who reported being "yes—somewhat addicted" or "yes—very addicted" when asked "Do you consider yourself addicted to cigarettes?" were classified as addicted to smoking.
**Participants who answered that they "agree" or "strongly agree" with "If you had a chance to live your life again, you would not have started smoking cigarettes" were classified as regretting having started to smoke.
^This was classified as answering "yes" to the question "Have you ever tried to quit smoking cigarettes?"
^^This was classified as answering "yes" to the question "Have you tried to stop smoking in the last 12 months?"
#This was classified as answering "within the next month", "between 1–6 months from now", or "sometime in the future, beyond 6 months" after the question "Are you planning to quit smoking..."
Participants who refused to answer or answered "don't know" were excluded from the relevant analyses.
Marginally standardised percentages and absolute differences adjust for: smoking status and quit intention, prioritised ethnicity, gender, age group and financial hardship.

to smoking than non-Māori, non-Pacific.

Pacific people were less likely to report regret for having started smoking compared to non-Māori, non-Pacific. People aged 18–24 were also less likely to report regret compared with people aged 45 and older. For detailed information see Appendix Table 4.

Previous quit attempts and intent to quit

As outlined in Table 3, most participants that smoked tried but had not been able to quit smoking in the past (86.3%, 95% CI 83.3–88.8). Most also planned to quit in the future (73.6%, 95% CI 69.5–77.4). Of those who smoked, about half had tried and failed to quit smoking in the past 12 months (51.5%, 95% CI 47.4–55.6). People who smoked daily and intended to quit and people who smoked less than daily were more likely to report that they had previously tried to quit smoking compared with people who did not intend to quit.

People with evidence for financial hardship were more likely to report a previous quit attempt and report that they planned to quit smoking in the future compared with people without evidence of financial hardship. For detailed information see Appendix Table 5–6.

Discussion

The data in this study from people who smoke or who recently stopped smoking provide a baseline prior to the 2024 changes to cigarette, EC and HTP policies and regulations and provide important evidence to inform the development and implementation of effective and equitable public health policy.

RYO tobacco use in Aotearoa New Zealand is common; ITC data dating back to 2007/2008 demonstrated over half of the participants who smoked were regularly using RYO tobacco.[15] The results from the current survey are much higher than in many other countries,[16] and particularly high among people who smoked daily and did not intend to quit, Māori, young people and people experiencing financial hardship. This demonstrates the importance of considering the impacts of public health measures on the use of both factory-made and RYO products. For example, mass media campaigns should include representation of both types of products to ensure their relevance to all people who smoke.

In line with international findings,[10,17,18] we found that a high proportion of participants who smoked regretted having started smoking, and did not want to continue smoking (intent to quit

and history of attempts to quit). These findings were consistent across demographic groups and strengthen the case for implementing policy measures to prevent the initiation of smoking and support people to stop smoking, such as the *SERPA* endgame measures.[7] Further evidence in support of these measures comes from findings from the EASE/ITC NZ study that found substantial support for them among people who smoke or who recently stopped smoking.[19]

A quarter of people who smoke and one-third of people who recently stopped smoking used ECs daily—a much higher prevalence than in the general adult population (9.4%, in the 2020/2021 NZHS for people aged 15+).[4] Rates of daily EC use were much higher than in previous waves of the EASE/ITC NZ Survey (4.9% in people who smoke and 21.0% in people who recently stopped smoking [2016/2017, Wave 1]; 7.9% in people who smoke and 22.6% in people who recently stopped [2018, Wave 2]).[20]

The high prevalence of EC use in people who recently stopped smoking suggests they are used to help people stop smoking and may help prevent relapse back to smoking. This is consistent with overall population trends in Aotearoa New Zealand of substantial increases in prevalence of EC use concurrent with recent rapid reductions in smoking prevalence (NZHS data: daily smoking prevalence reduced from 14.5% in 2015/2016 to 6.8% in 2022/2023, while daily EC use increased from 0.9% to 9.7% in the same period).[4] It also aligns with a recent Cochrane review that demonstrated "high certainty" evidence that ECs with nicotine increase smoking quit rates compared to nicotine replacement therapy, but less certainty compared to behavioural support.[21]

However, the high prevalence of EC use in people who smoke could also suggest long-term dual use of both tobacco and ECs.[22,23] We found 11.7% of people who smoked and did not intend to quit smoking used ECs daily, suggesting that ECs may be used by some people who smoke as an additional source of nicotine (e.g., in places where smoking is not allowed) rather than as stop smoking aids.[21,24]

Any positive impacts of ECs on stopping smoking need to be balanced by the rapidly increasing levels of EC use among young people.[25] Care is needed in developing regulatory frameworks that protect young people from becoming addicted to ECs and enable their use as smoking cessation aids.

HTP use was far less common than EC use, suggesting they were not substantially contributing to smoking cessation. Given these products are likely more hazardous than ECs, with little evidence that they are effective for smoking cessation,[9] there is a case for stronger regulation of these products than for ECs. The data from this study will provide an important baseline for evaluating the decision by the New Zealand Government to reduce excise tax on HTPs from July 2024.

A key strength of this study is that it provides results that are directly relevant to intervention and policy development in Aotearoa New Zealand. We were able to recruit 40% Māori participants, and the sample is sufficiently large enough to provide relatively precise estimates of tobacco and alternative product use, as well as related attitudes and behaviours. Additionally, data are weighted to the NZHS sample (a nationally representative population survey), so the findings should be representative of the population of New Zealanders who smoke or recently quit smoking. Where the sample size allowed, we were able to evaluate differences by smoking status and intent to quit smoking, ethnicity, age, gender and evidence of financial hardship.

One limitation is that the target for the recruitment of Pacific participants (a third of participants) was not reached, meaning that results for this group are less precise than for Māori and non-Māori, non-Pacific participants. We are actively investigating ways to increase Pacific recruitment for subsequent survey waves.

We do not make a causal interpretation of the associations with ethnicity that we found: estimates by ethnic group describe differential patterning of opinions/behaviours for these groups, with the marginal estimation reporting differences adjusted for demographic covariates (as listed in the Methods). Differences by ethnicity are likely to represent the outcome of multiple contextual factors, such as historical experiences of colonisation, racism and structural disadvantage, rather than being due to ethnicity itself.

Patterning of outcomes by other variables (e.g., by age group) derive from the same models, and so while estimates are technically "adjusted" for differential profile by ethnicity, we again do not assume that the adjustment role for ethnicity within these models represents a causal mechanism, but rather most likely reflects the impact of other variables that are associated with outcomes and that are differentially distributed by ethnicity.

Data were collected in 2020 and 2021, so the findings represent views and experiences prior to the introduction and repeal of the *SERPA*

endgame measures. We plan to evaluate data from subsequent waves of the EASE/ITC NZ Survey as new policies are implemented. A limitation of this analysis for investigating the impacts of ECs on smoking cessation is that the direction of causation of associations are uncertain due to its cross-sectional nature. We plan to explore the relationship between use of ECs and subsequent smoking patterns (including cessation and relapse) through longitudinal analysis of EASE/ITC NZ data.

Overall, these findings demonstrate the need for further interventions and policies to equitably encourage and support people who smoke to stop smoking. Risk-proportionate regulatory frameworks for smoked tobacco products, ECs and HTPs are needed, including policy measures that promote smoking cessation, minimise youth uptake of all nicotine and tobacco products and discourage long-term dual use of tobacco products and ECs.

COMPETING INTERESTS

This research was funded by the New Zealand Health Research Council (19/641) with additional support from the Canadian Institutes of Health Research (FDN-148477) and the Ontario Institute for Cancer Research (IA-004). Additional support is provided to TA, ACKQ and GTF by the United States National Institute of Health (P01 CA200512) .

RE currently receives funding from the Health Research Council, University of Otago and United States National Institutes of Health and has also worked on previous projects funded by the New Zealand Cancer Society, Royal Society, Ministry of Health, University of Queensland and NIH. RE has received payments for deputy editor services to Society of Research on Nicotine and Tobacco. RE is or has been a member of Expert Advisory Group, Asthma and Respiratory Foundation (2013–2022); member of Smokefree Expert Advisory Group, Health Coalition Aotearoa (2019–present); member of National Tobacco Control Advocacy Service Advisory Group, Hapai Te Hauora Māori Public Health (2016–present); member of NZ Cancer Society's National Scientific Advisory Committee (2020–2023); chair of Public Health Communication Centre Expert Advisory Board (2021–2024).

GTF has been an expert witness or consultant for governments defending their country's policies or regulations in litigation. Additional support to GTF is provided by a Senior Investigator Grant from the Ontario Institute for Cancer Research (IA-004).

JN has received funding from the Health Research Council for other research projects and has also worked on projects funded by the University of Otago, the Ministry of Health, the National Health and Medical Research Council (NHMRC) and the New Zealand Cancer Society.

JS has received funding from the Health Research Council, University of Otago and Lotteries Foundation.

AW currently receives funding from the Health Research Council and in the past has received funding from the University of Otago, Heart Foundation, Cancer Society and Ministry of Business, Innovation and Employment. AW has a leadership/fiduciary role in Hapai te Hauora/ National Smokefree Advisory Service Advisory Group. AW is a senior journal editor for Nicotine and Tobacco Research Journal.

JB currently receives funding from the Health Research Council for this and other projects and in the past has received funding from the Royal Society of New Zealand, Health Promotion Agency, NIB foundation, Cancer Society and the Ministry of Business, Innovation and Employment. JB is secretary of Public Health Association, Wellington Branch; member of Smokefree Expert Advisory Group, Health Coalition Aotearoa; and member of Tuturu development rōpu, NZ Drug Foundation.

All other authors have no conflicts of interest to declare. None of the authors have ever received funding from the tobacco or vaping industries or their associates.

AUTHOR INFORMATION

Dr Janine Nip: Research Fellow, Department of Public Health, University of Otago Wellington, Wellington, New Zealand.

Jane Zhang: Research Fellow, Department of Public Health, University of Otago Wellington, Wellington, New Zealand.

Professor James Stanley: Professor, Department of Public Health, University of Otago Wellington, Wellington, New Zealand.

Associate Professor Andrew Waa: Associate Professor, Department of Public Health, University of Otago Wellington, Wellington, New Zealand.

Dr Jude Ball: Senior Research Fellow, Department of Public Health, University of Otago Wellington, Wellington, New Zealand.

Professor El-Shadan Tautolo: Professor, Centre for Pacific Health & Development Research, Auckland University of Technology, Auckland, New Zealand.

Thomas K Agar: Research Associate, Department of Psychology, University of Waterloo, Waterloo, Ontario, Canada.

Dr Anne C K Quah: ITC Managing Director and Senior Research Scientist, Department of Psychology, University of Waterloo, Waterloo, Ontario, Canada.

Professor Geoffrey T Fong: University Professor, Department of Psychology and School of Public Health Sciences, University of Waterloo, Waterloo, Ontario, Canada; Senior Investigator, Ontario Institute for Cancer Research, Toronto, Ontario, Canada.

Professor Richard Edwards: Professor, Department of Public Health, University of Otago Wellington, Wellington, New Zealand.

CORRESPONDING AUTHOR

Dr Janine Nip: University of Otago, PO Box 7343, Newtown, Wellington 6242, New Zealand. Ph: +64 21 1724343 E: Janine.nip@otago.ac.nz

URL

https://nzmj.org.nz/journal/vol-138-no-1612/patterns-and-experiences-of-smoking-electronic-cigarettes-vapes-and-heated-tobacco-use-among-people-who-smoke-or-who-recently-qu

REFERENCES

1. Ministry of Health – Manatū Hauora. Smokefree Aotearoa 2025 Action Plan - Auahi Kore Aotearoa

Mahere Rautaki 2025 [Internet]. 2021 [cited 2025 Mar 4]. Available from: https://aspireaotearoa.org.nz/sites/default/files/2024-09/hp7801_-_smoke_free_action_plan_v15_web.pdf
2. Ministry of Health – Manatū Hauora. Health Loss in New Zealand 1990-2013: A report from the New Zealand Burden of Diseases, Injuries and Risk Factors Study, 1990-2013 [Internet]. 2016 [cited 2025 Mar 4]. Available from: https://www.health.govt.nz/publications/health-loss-in-new-zealand-1990-2013
3. Walsh M, Wright K. Ethnic inequities in life expectancy attributable to smoking. N Z Med J. 2020 Feb 7;133(1509):28-38.
4. Ministry of Health – Manatū Hauora. New Zealand Health Survey: Annual Data Explorer 2022/2023 [Internet]. 2024 [cited 2025 Mar 4]. Available from: https://minhealthnz.shinyapps.io/nz-health-survey-2023-24-annual-data-explorer/_w_9e74a56b/#!/home
5. *Smokefree Environments and Regulated Products (Smoked Tobacco) Amendment Bill 2022* (NZ).
6. Wilson N, Hoek J, Nghiem N, et al. Modelling the impacts of tobacco denicotinisation on achieving the Smokefree 2025 goal in Aotearoa New Zealand. N Z Med J. 2022 Jan 21;135(1548):65-76.
7. Ait Ouakrim D, Wilson T, Waa A, et al. Tobacco endgame intervention impacts on health gains and Māori:non-Māori health inequity: a simulation study of the Aotearoa/New Zealand Tobacco Action Plan. Tob Control. 2024 Nov 10;33(e2):e173-e184. doi: 10.1136/tc-2022-057655.
8. World Health Organization. Heated Tobacco Products Information Sheet, 2nd Edition [Internet]. 2020 [cited 2024 Oct 7]. Available from: https://iris.who.int/bitstream/handle/10665/331297/WHO-HEP-HPR-2020.2-eng.pdf
9. Tattan-Birch H, Hartmann-Boyce J, Kock L, et al. Heated tobacco products for smoking cessation and reducing smoking prevalence. Cochrane Database Syst Rev. 2022 Jan 6;1(1):CD013790. doi: 10.1002/14651858.CD013790.pub2.
10. Fong GT, Hammond D, Laux FL, et al. The near-universal experience of regret among smokers in four countries: findings from the International Tobacco Control Policy Evaluation Survey. Nicotine Tob Res. 2004 Dec;6 Suppl 3:S341-51. doi: 10.1080/14622200412331320743.
11. International Tobacco Control Policy Evaluation Project. Technical Reports [Internet]. [cited 2024 Oct 7]. Available from: https://itcproject.org/methods/technical-reports/?country=new-zealand
12. Muller CJ, MacLehose RF. Estimating predicted probabilities from logistic regression: different methods correspond to different target populations. Int J Epidemiol. 2014 Jun;43(3):962-70. doi: 10.1093/ije/dyu029.
13. Lumley T. Survey: analysis of complex survey samples. R package version 4.0. 2020.
14. McLeod M, Harris R, Taipapaki Curtis E, Loring B. Considerations for Māori Data Analyses: A report for Te Aka Whai Ora [Internet]. 2023 [cited 2024 Nov 15]. Available from: https://www.tewhatuora.govt.nz/assets/Publications/Maori-health/Ethnicity-analysis-report-Sept-2023.pdf
15. Young D, Wilson N, Borland R, et al. Prevalence, correlates of, and reasons for using roll-your-own tobacco in a high RYO use country: findings from the ITC New Zealand survey. Nicotine Tob Res. 2010 Nov;12(11):1089-98. doi: 10.1093/ntr/ntq155.
16. Filippidis FT, Driezen P, Kyriakos CN, et al. Transitions from and to roll-your-own tobacco, perceptions and health beliefs among smokers: findings from the EUREST-PLUS ITC Europe Surveys. Eur J Public Health. 2020 Jul 1;30(Suppl_3):iii18-iii25. doi: 10.1093/eurpub/ckz214.
17. Sansone N, Fong GT, Lee WB, et al. Comparing the experience of regret and its predictors among smokers in four Asian countries: findings from the ITC surveys in Thailand, South Korea, Malaysia, and China. Nicotine Tob Res. 2013 Oct;15(10):1663-72. doi: 10.1093/ntr/ntt032.
18. Lee WB, Fong GT, Zanna MP, et al. Regret and rationalization among smokers in Thailand and Malaysia: findings from the International Tobacco Control Southeast Asia Survey. Health Psychol. 2009 Jul;28(4):457-64. doi: 10.1037/a0014669.
19. Edwards R, Johnson E, Stanley J, et al. Support for New Zealand's Smokefree 2025 goal and key measures to achieve it: findings from the ITC New Zealand Survey. Aust N Z J Public Health. 2021 Dec;45(6):554-561. doi: 10.1111/1753-6405.13129.
20. Edwards R, Stanley J, Waa AM, et al. Patterns of Use of Vaping Products Among Smokers: Findings from the 2016-2018 International Tobacco Control (ITC) New Zealand Surveys. Int J Environ Res Public Health. 2020 Sep 11;17(18):6629. doi: 10.3390/ijerph17186629.
21. Hartmann-Boyce J, Lindson N, Butler AR, et al. Electronic cigarettes for smoking cessation. Cochrane Database Syst Rev. 2022 Nov 17;11(11):CD010216. doi: 10.1002/14651858.CD010216.pub7. Update in: Cochrane Database Syst Rev. 2024 Jan 8;1(1):CD010216. doi: 10.1002/14651858.CD010216.pub8.
22. Nguyen N, Koester KA, Kim M, et al. "I'm both smoking and vaping": a longitudinal qualitative study of US young adults who tried to quit smoking

cigarettes by using electronic cigarettes. Tob Control. 2024 Sep 25;33(5):596-602. doi: 10.1136/tc-2022-057804.
23. Notley C, Ward E, Dawkins L, Holland R. User pathways of e-cigarette use to support long term tobacco smoking relapse prevention: a qualitative analysis. Addiction. 2021 Mar;116(3):596-605. doi: 10.1111/add.15226.
24. Burrowes KS, Fuge C, Murray T, et al. An evaluation of a New Zealand "vape to quit smoking" programme. N Z Med J. 2022 Sep 2;135(1561):45-55. doi: 10.26635/6965.5545.
25. Nip J, Hoek J, Waa A. Vaping prevalence and trends: key findings in the 2022/23 NZ Health Survey [Internet]. Public Health Communications Centre Aotearoa; 2023 [cited 2025 Mar 4]. Available from: https://www.phcc.org.nz/briefing/vaping-prevalence-and-trends-key-findings-202223-nz-health-survey

Appendix

Appendix Table 1: Smoking patterns among people who smoke.

	n/N	Weighted percentage (95% CI)	Marginally standardised percentage (95% CI)	Absolute marginal difference (95% CI)
Total number and percentage of participants that smoke				
Tailor-made and roll your own cigarettes*	386/986	38.4 (34.5–42.5)		
Tailor-made cigarettes only*	388/986	39.6 (35.7–43.6)		
Roll-your-own cigarettes only*	212/986	22.0 (18.8–25.5)		
Smoking status				
Smokes daily not intending to quit:				
Tailor-made and roll-your-own cigarettes	70/181	31.4 (23.9–40.1)	35.2 (27.0–43.3)	Reference
Tailor-made cigarettes only	57/181	34.0 (25.3–43.9)	31.3 (23.1–39.5)	
Roll-your-own cigarettes only	54/181	34.6 (25.9–44.5)	33.5 (24.6–42.5)	
Smokes daily intending to quit				
Tailor-made and roll-your-own cigarettes	196/473	45.0 (39.3–50.8)	42.7 (37.0–48.5)	7.5 (−2.7–17.7)
Tailor-made cigarettes only	178/473	35.7 (30.5–41.2)	37.6 (32.0–43.2)	6.3 (−3.7–16.4)
Roll-your-own cigarettes only	99/473	19.4 (15.5–23.9)	19.7 (15.4–23.9)	**−13.9 (−23.7–−4.0)**
Smokes less than daily				
Tailor-made and roll-your-own cigarettes	108/288	34.4 (27.0–42.6)	32.9 (24.9–40.8)	−2.4 (−14.3–9.6)
Tailor-made cigarettes only	134/288	49.5 (41.6–57.4)	50.1 (42.2–58.1)	**18.9 (7.0–30.7)**
Roll-your-own cigarettes only	46/288	16.1 (11.4–22.3)	17.0 (10.9–23.1)	**−16.5 (−27.8–−5.2)**
Total ethnicity				
Māori:				
Tailor-made and roll-your-own cigarettes	192/407	47.0 (41.3–52.8)	44.9 (38.6–50.6)	**11.3 (2.5–20.0)**
Tailor-made cigarettes only	119/407	27.7 (22.9–33.0)	28.8 (23.0–34.5)	**−16.0 (−24.3–−7.7)**

Appendix Table 1 (continued): Smoking patterns among people who smoke.

Roll-your-own cigarettes only	96/407	25.3 (20.6–30.7)	26.3 (20.3–32.2)	4.7 (−2.8–12.2)
Pacific:				
Tailor-made and roll-your-own cigarettes	83/196	47.1 (38.3–56.2)	42.8 (33.8–51.7)	9.1 (−1.6–19.8)
Tailor-made cigarettes only	82/196	36.6 (28.7–45.3)	39.2 (30.5–47.8)	−5.5 (−16.1–5.0)
Roll-your-own cigarettes only	31/196	16.3 (10.6–24.3)	18.0 (10.5–25.5)	−3.6 (−12.3–5.2)
Non-Māori, non-Pacific:				
Tailor-made and roll-your-own cigarettes	131/423	31.5 (25.9–37.6)	33.7 (27.9–39.4)	Reference
Tailor-made cigarettes only	200/423	46.4 (40.3–52.5)	44.7 (38.9–50.6)	
Roll-your-own cigarettes only	92/423	22.2 (17.6–27.6)	21.6 (17.0–26.1)	
Age group				
18–24:				
Tailor-made and roll-your-own cigarettes	123/261	43.5 (36.2–51.1)	41.2 (33.7–48.8)	6.4 (−4.1–16.9)
Tailor-made cigarettes only	89 /261	37.9 (30.7–45.7)	34.1 (26.5–41.7)	−9.8 (−20.3–0.7)
Roll-your-own cigarettes only	49/261	18.6 (13.4–25.3)	24.7 (16.8–32.5)	3.4 (−6.7–13.6)
25–44:				
Tailor-made and roll-your-own cigarettes	173/432	43.3 (37.2–49.5)	40.1 (34.1–46.1)	5.2 (−3.8–14.3)
Tailor-made cigarettes only	163/432	36.1 (30.4–42.1)	37.2 (31.4–43.0)	−6.7 (−15.9–2.4)
Roll-your-own cigarettes only	96/432	20.7 (16.5–25.6)	22.7 (17.8–27.5)	1.5 (−5.9–8.8)
≥45:				
Tailor-made and roll-your-own cigarettes	90/293	31.2 (25.0–38.1)	34.9 (28.0–41.7)	Reference
Tailor-made cigarettes only	136/293	44.1 (37.2–51.2)	43.9 (37.0–50.9)	
Roll-your-own cigarettes only	67/293	24.8 (19.1–31.5)	21.2 (15.6–26.8)	
Gender				
Man:				
Tailor-made and roll-your-own cigarettes	153/368	42.5 (36.4–49.0)	43.1 (36.7–49.5)	Reference

Appendix Table 1 (continued): Smoking patterns among people who smoke.

Tailor-made cigarettes only	146/368	38.7 (32.7–45.1)	37.3 (31.3–43.4)	
Roll-your-own cigarettes only	69/368	18.8 (14.5–24.0)	19.6 (14.6–24.6)	
Woman:				
Tailor-made and roll-your-own cigarettes	232/616	33.7 (29.4–38.2)	33.0 (28.6–37.5)	**−10.1 (−18.0–−2.1)**
Tailor-made cigarettes only	241/616	40.6 (35.9–45.4)	41.9 (36.9–46.9)	4.5 (−3.5–12.5)
Roll-your-own cigarettes only	143/616	25.8 (21.5–30.5)	25.1 (20.5–29.7)	5.5 (−1.3–12.4)
Evidence of financial hardship				
No:				
Tailor-made and roll-your-own cigarettes	233/665	33.9 (29.3–38.8)	35.4 (30.9–40.0)	Reference
Tailor-made cigarettes only	283/665	42.6 (37.8–47.6)	41.0 (36.4–45.6)	
Roll-your-own cigarettes only	149/665	23.5 (19.5–27.9)	23.6 (19.5–27.6)	
Yes:				
Tailor-made and roll-your-own cigarettes	139/291	49.5 (42.3–56.8)	46.0 (38.5–53.5)	**10.5 (1.9–19.2)**
Tailor-made cigarettes only	93/291	32.1 (25.7–39.2)	35.2 (28.0–42.5)	−5.8 (-14.1–2.6)
Roll-your-own cigarettes only	59/291	18.4 (13.9–24.0)	18.8 (13.3–24.2)	−4.8 (−11.5–1.9)

Values in bold indicate statistically significantly absolute marginal differences compared with the reference value.
Total ethnicity data are presented for Māori and Pacific. Some participants identified as both Māori and Pacific (see Table 1); comparisons for these two groups are made to an exclusive non-Māori, non-Pacific group.
Note that those with a non-binary gender do not have results reported (group too small for reasonable inference).
See Table 1 for the definition of financial hardship.
*Classifications were made by asking "Do you smoke …?" and offering the answer options of: "tailor-made cigarettes only", "roll-your-own cigarettes only" and "both".
Participants who refused to answer or answered "don't know" for this outcome were excluded.
Marginally standardised percentages and absolute differences adjust for: smoking status and quit intention, prioritised ethnicity, gender, age group and financial hardship.

Appendix Table 2: Current electronic cigarette use in people who smoke and people who recently stopped smoking.

	n/N	Weighted percentage (95% CI)	Marginally standardised percentage (95% CI)	Absolute marginal difference (95% CI)
People who smoke: use electronic cigarettes at least monthly				
Total	449/992	41.6 (37.6–45.6)		
Smoking status:				
Smokes daily not intending to quit	42/182	18.3 (12.5–25.9)	21.9 (15.6–29.8)	Reference
Smokes daily intending to quit	192/474	40.1 (34.6–45.9)	40.8 (35.2–46.7)	**19.0 (9.7–28.2)**
Smokes less than daily	201/292	65.9 (58.3–72.7)	63.6 (55.1–71.3)	**41.7 (30.4–53.0)**
Total ethnicity:				
Māori	182/408	37.9 (32.6–43.5)	38.1 (32.5–43.9)	**−10.9 (−18.6–−3.2)**
Pacific	80/197	38.7 (30.4–47.7)	34.6 (27.0–43.1)	**−14.4 (−24.0–−4.8)**
Non-Māori, non-Pacific	207/427	44.5 (38.5–50.6)	49.0 (43.3–54.7)	Reference
Age group:				
18–24	155/263	58.0 (50.4–65.3)	49.9 (41.7–58.1)	**17.8 (7.1–28.6)**
25–44	212/436	48.6 (42.6–54.7)	50.0 (44.0–56.0)	**18.0 (9.2–26.8)**
≥45	82/293	27.2 (21.3–34.1)	32.1 (25.8–39.0)	Reference
Gender:				
Man	200/369	47.6 (41.3–53.9)	47.8 (41.7–54.0)	Reference
Woman	247/621	34.6 (30.3–39.1)	37.6 (33.2–42.3)	**−10.2 (−17.5–−2.9)**
Evidence of financial hardship:				
No	290/669	41.1 (36.3–46.1)	41.8 (37.2–46.5)	Reference
Yes	148/292	45.9 (38.9–53.2)	46.9 (39.8–54.1)	5.1 (−2.9–13.2)
People who quit smoking: use electronic cigarettes at least monthly				
Total	109/238	39.7 (31.5–48.6)		
Total ethnicity:				
Māori	45/84	52.2 (36.8–67.2)	58.7 (42.2–73.5)	**25.8 (6.4–45.1)**
Pacific	18/41	54.4 (33.7–73.7)	56.4 (35.0–75.6)	23.7 (−0.6–47.9)
Non-Māori, non-Pacific	49/119	34.0 (24.3–45.1)	33.0 (23.7–43.8)	Reference
Age group:				
18–24	29/63	45.8 (31.3–61.0)	49.7 (31.9–67.5)	20.1 (−3.5–43.6)
25–44	48/92	48.0 (32.7–63.6)	46.6 (32.4–61.3)	17.0 (−2.7–36.7)

Appendix Table 2 (continued): Current electronic cigarette use in people who smoke and people who recently stopped smoking.

≥45	32/83	29.3 (18.6–42.9)	29.6 (18.8–43.3)	Reference
Gender:				
Man	32/78	38.8 (26.4–52.9)	41.4 (29.2–54.8)	Reference
Woman	77/159	40.9 (31.2–51.4)	38.6 (29.4–48.7)	−2.8 (−19.0–13.3)
Evidence of financial hardship:				
No	78/178	37.2 (28.2–47.1)	38.9 (30.0–48.6)	Reference
Yes	30/53	51.0 (32.0–69.7)	44.5 (28.2–62.0)	5.6 (−13.9–25.1)

Current use is defined as use at least monthly.
Values in bold indicate statistically significantly absolute marginal differences compared with the reference value.
Total ethnicity data are presented for Māori and Pacific. Some participants identified as both Māori and Pacific (see Table 1); comparisons for these two groups are made to an exclusive non-Māori, non-Pacific group.
Note that those with a non-binary gender do not have results reported (group too small for reasonable inference).
See Table 1 for the definition of financial hardship.
Participants who refused to answer or answered "don't know" were excluded from the relevant analyses.
Marginally standardised percentages and absolute differences adjust for: smoking status and quit intention, prioritised ethnicity, gender, age group and financial hardship.

Appendix Table 3: Daily heated tobacco product use in people who recently stopped smoking, current heated tobacco product use in people who smoke and current heated tobacco use in people who recently stopped smoking.

	n/N	Weighted percentage (95% CI)	Marginally standardised percentage (95% CI)	Absolute marginal difference (95% CI)
People who smoke: use heated tobacco products daily				
Total	54/975	4.6 (3.3–6.6)		
Smoking status:				
Smokes daily not intending to quit	15/175	4.5 (2.4–8.3)	5.0 (2.7–9.2)	Reference
Smokes daily intending to quit	26/468	5.0 (3.0–8.1)	4.8 (2.9–7.7)	−0.3 (−4.1–3.6)
Smokes less than daily	10/289	3.2 (1.4–7.0)	3.6 (1.6–7.9)	−1.5 (−5.9–3.0)
Total ethnicity:				
Māori	30/401	5.6 (3.5–8.8)	4.9 (2.8–8.4)	0.0 (−4.2–4.1)
Pacific	8/194	5.4 (2.2–12.9)	3.0 (1.0–8.5)	−1.9 (−6.5–2.6)
Non-Māori, non-Pacific	19/420	3.8 (2.2–6.5)	4.9 (2.8–8.6)	Reference
Age group:				
18–24	7/262	1.9 (0.8–4.4)	2.0 (0.8–4.9)	−1.0 (−4.4–2.5)
25–44	39/426	7.4 (4.8–11.1)	6.8 (4.3–10.6)	3.8 (−0.5–8.2)
≥45	8/287	2.8 (1.3–6.0)	2.9 (1.2–7.1)	Reference
Gender:				
Man	35/363	6.1 (3.9–9.5)	5.8 (3.6–9.0)	Reference
Woman	18/610	2.9 (1.6–5.0)	3.1 (1.7–5.4)	−2.7 (−5.8–0.5)
Evidence of financial hardship:				
No	22/660	3.8 (2.3–6.2)	3.5 (2.1–5.7)	Reference
Yes	31/285	7.6 (4.8–11.9)	7.6 (4.5–12.6)	4.1 (−0.2–8.5)
People who smoke: current use of heated tobacco products				
Total	116/975	10.2 (8.1–12.7)		
Smoking status:				
Smokes daily not intending to quit	24/175	8.3 (4.9–13.6)	9.7 (6.0–15.5)	Reference
Smokes daily intending to quit	60/468	11.4 (8.4–15.2)	10.3 (7.5–14.1)	0.6 (−5.0–6.2)

Appendix Table 3 (continued): Daily heated tobacco product use in people who recently stopped smoking, current heated tobacco product use in people who smoke and current heated tobacco use in people who recently stopped smoking.

Smokes less than daily	28/289	9.4 (5.8–15.0)	9.7 (5.9–15.4)	−0.1 (−6.8–6.7)
Total ethnicity:				
Māori	63/401	13.1 (9.7–17.5)	12.2 (8.6–17.0)	1.3 (−4.6–7.2)
Pacific	13/194	9.2 (4.7–17.2)	4.6 (1.9–10.7)	**−6.3 (−12.1–−0.5)**
Non-Māori, non-Pacific	43/420	8.7 (6.1–12.2)	10.9 (7.6–15.3)	Reference
Age group:				
18–24	13/262	4.8 (2.5–8.9)	4.4 (2.3–8.5)	−1.5 (−6.3–3.3)
25–44	88/426	17.0 (13.0–21.8)	15.4 (11.5–20.4)	**9.5 (3.5–15.5)**
≥45	15/287	4.9 (2.8–8.5)	5.9 (3.2–10.7)	Reference
Gender:				
Man	78/363	14.2 (10.7–18.6)	13.3 (10.0–17.5)	Reference
Woman	37/610	5.5 (3.7–7.9)	6.0 (4.1–8.8)	**−7.3 (−11.7–−2.9)**
Evidence of financial hardship:				
No	59/660	8.8 (6.5–11.9)	8.8 (6.5–11.9)	Reference
Yes	54/285	13.7 (9.8–18.7)	13.4 (9.4–18.8)	4.6 (−0.7–9.9)
People who stopped smoking: current use of heated tobacco products				
Total	5/235	1.7 (0.6–4.3)		
Total ethnicity:				
Māori	2/84	3.1 (0.7–13.2)	2.9 (0.7–11.6)	1.6 (−2.8–6.0)
Pacific	1/41	2.5 (0.3–17.0)	1.6 (0.2–12.0)	0.3 (−3.7–4.4)
Non-Māori, non-Pacific	2/116	1.0 (0.2–4.7)	1.3 (0.3–5.9)	Reference
Age group:				
18–24	2/62	4.0 (1.0–15.4)	3.6 (0.9–13.3)	3.0 (−2.2–8.2)
25–44	2/90	1.6 (0.3–7.6)	1.5 (0.4–5.8)	0.9 (−1.4–3.3)
≥45	1/83	0.4 (0.1–3.2)	0.6 (0.1–4.4)	Reference
Gender:				
Man	1/77	0.9 (0.1–6.4)	1.0 (0.2–5.9)	Reference
Woman	4/157	2.6 (0.9–7.4)	2.5 (0.9–6.7)	1.5 (−1.3–4.3)

Appendix Table 3 (continued): Daily heated tobacco product use in people who recently stopped smoking, current heated tobacco product use in people who smoke and current heated tobacco use in people who recently stopped smoking.

Evidence of financial hardship:				
No	2/175	1.1 (0.3–4.2)	1.2 (0.3–5.2)	Reference
Yes	3/53	4.0 (1.0–14.3)	2.8 (0.6–12.1)	1.5 (−3.4–6.5)

Current use is defined as use at least monthly.
Values in bold indicate statistically significantly absolute marginal differences compared with the reference value.
Note that those with a non-binary gender do not have results reported (group too small for reasonable inference).
Total ethnicity data are presented for Māori and Pacific. Some participants identified as both Māori and Pacific (see Table 1); comparisons for these two groups are made to an exclusive non-Māori, non-Pacific group.
See Table 1 for the definition of financial hardship.
Participants who refused to answer or answered "don't know" were excluded from the relevant analyses.
Marginally standardised percentages and absolute differences adjust for: smoking status and quit intention, prioritised ethnicity, gender, age group and financial hardship.

Appendix Table 4: Prevalence of addiction and regret in people who smoke, by ethnicity, age, gender and evidence of financial hardship.

	n/N	Weighted percentage (95% CI)	Marginally standardised percentage (95% CI)	Absolute marginal difference (95% CI)
People who smoke: report being addicted* to smoking				
Total	854/974	87.3 (84.1–89.9)		
Total ethnicity:				
Māori	370/403	93.3 (90.2–95.4)	90.9 (86.6–93.8)	**5.2 (0.6–9.8)**
Pacific	162/194	84.4 (77.2–89.7)	83.5 (76.4–88.8)	−2.1 (−8.8–4.5)
Non-Māori, non-Pacific	355/417	85.2 (80.0–89.3)	85.7 (81.7–88.9)	Reference
Age group:				
18–24	202/257	76.5 (69.0–82.7)	84.6 (79.1–88.8)	−1.2 (−7.9–5.5)
25–44	389/429	90.1 (86.1–93.1)	88.1 (83.6–91.5)	2.3 (−3.6–8.2)
≥45	263/288	88.6 (82.0–93.0)	85.8 (80.2–90.0)	Reference
Gender:				
Man	306/361	84.5 (79.0–88.7)	84.7 (80.3–88.2)	Reference
Woman	546/611	90.6 (87.5–92.9)	88.9 (85.4–91.7)	4.3 (−0.2–8.8)
Evidence of financial hardship:				
No	573/660	86.4 (82.3–89.7)	86.6 (83.1–89.4)	Reference
Yes	255/285	88.8 (83.3–92.7)	86.1 (80.5–90.3)	−0.5 (−5.6–4.7)
People who smoke: regret having started smoking**				
Total	747/964	77.5 (74.0–80.8)		
Total ethnicity:				
Māori	311/400	75.0 (69.5–79.8)	74.9 (69.0–80.0)	−6.9 (−14.1–0.3)
Pacific	140/193	69.9 (60.7–77.8)	70.4 (60.5–78.7)	**−11.4 (−21.6–−1.1)**
Non-Māori, non-Pacific	325/411	81.1 (75.8–85.4)	81.8 (76.7–86.0)	Reference
Age group:				
18–24	172/257	66.5 (59.1–73.2)	67.9 (59.9–75.0)	**−14.9 (−24.2–−5.7)**
25–44	337/426	76.8 (71.0–81.8)	77.4 (71.1–82.6)	−5.5 (−13.2–2.2)
≥45	238/281	82.8 (76.8–87.5)	82.8 (77.1–87.4)	Reference
Gender:				
Man	272/355	75.5 (69.7–80.6)	76.1 (70.3–81.0)	Reference
Woman	474/607	79.9 (75.7–83.5)	80.2 (75.8–84.0)	4.1 (−2.5–10.7)

Appendix Table 4 (continued): Prevalence of addiction and regret in people who smoke, by ethnicity, age, gender and evidence of financial hardship.

Evidence of financial hardship:				
No	495/645	78.5 (74.2–82.3)	77.4 (73.0–81.3)	Reference
Yes	233/288	77.7 (70.5–83.5)	79.3 (72.6–84.8)	1.9 (−5.2–9.1)

Values in bold indicate statistically significantly absolute marginal differences compared with the reference value.
Total ethnicity data are presented for Māori and Pacific. Some participants identified as both Māori and Pacific (see Table 1); comparisons for these two groups are made to an exclusive non-Māori, non-Pacific group.
Note that those with a non-binary gender do not have results reported (group too small for reasonable inference).
See Table 1 for the definition of financial hardship.
*Participants who reported being "yes—somewhat addicted" or "yes—very addicted" when asked "Do you consider yourself addicted to cigarettes?" were classified as addicted to smoking.
**Participants who answered that they "agree" or "strongly agree" with "If you had a chance to live your life again, you would not have started smoking cigarettes" were classified as regretting having started to smoke.
Participants who refused to answer or answered "don't know" were excluded from the relevant analyses.
Marginally standardised percentages and absolute differences adjust for: smoking status and quit intention, prioritised ethnicity, gender, age group and financial hardship.

Appendix Table 5: Prevalence of failed quit attempts in the past 12 months,* in people who smoke by ethnicity, age, gender and evidence of financial hardship.

	n/N	Weighted percentage (95% CI)	Marginally standardised percentage (95% CI)	Absolute marginal difference (95% CI)
Total	546/988	51.5 (47.4–55.6)		
Total ethnicity				
Māori	239/406	54.4 (48.6–60.1)	52.7 (46.5–58.7)	2.4 (−5.6–10.4)
Pacific	115/196	55.0 (46.0–63.8)	53.4 (44.7–61.9)	3.1 (−7.1–13.4)
Non-Māori, non-Pacific	218/426	49.1 (43.0–55.3)	50.2 (44.6–55.9)	Reference
Age group				
18–24	190/263	75.2 (68.4–80.9)	64.0 (55.4–71.7)	**19.2 (8.5–29.9)**
25–44	232/432	54.4 (48.3–60.3)	52.3 (46.4–58.1)	7.5 (−1.2–16.3)
≥45	124/293	38.8 (32.2–45.8)	44.7 (38.1–51.6)	Reference
Gender				
Man	202/369	52.4 (46.1–58.7)	51.7 (45.7–57.6)	Reference
Woman	343/617	50.4 (45.6–55.3)	50.8 (46.1–55.6)	−0.8 (−8.0–6.3)
Evidence of financial hardship				
No	353/667	49.3 (44.4–54.3)	49.5 (44.8–54.1)	Reference
Yes	178/290	58.7 (51.3–65.7)	56.1 (49.0–63.0)	6.7 (−1.2–14.6)

Values in bold indicate statistically significantly absolute marginal differences compared with the reference value.
Total ethnicity data are presented for Māori and Pacific. Some participants identified as both Māori and Pacific (see Table 1); comparisons for these two groups are made to an exclusive non-Māori, non-Pacific group.
Note that those with a non-binary gender do not have results reported (group too small for reasonable inference).
See Table 1 for the definition of financial hardship.
*This was classified as answering "yes" to the question "Have you tried to stop smoking in the last 12 months?"
Participants who refused to answer or answered "don't know" were excluded from the relevant analyses.
Marginally standardised percentages and absolute differences adjust for: smoking status and quit intention, prioritised ethnicity, gender, age group and financial hardship.

Appendix Table 6: Prevalence of previous failed quit attempts and plans to quit in people who smoke, by ethnicity, age, gender and evidence of financial hardship.

	n/N	Weighted percentage (95% CI)	Marginally standardised percentage (95% CI)	Absolute marginal difference (95% CI)
People who smoke: previously tried to quit smoking^				
Total	834/972	86.3 (83.3–88.8)		
Total ethnicity:				
Māori	354/400	89.0 (85.0–92.0)	89.9 (85.7–92.9)	4.7 (−0.8–10.2)
Pacific	161/196	84.1 (76.6–89.4)	86.4 (79.1–91.5)	1.3 (−6.2–8.8)
Non-Māori, non-Pacific	350/416	85.3 (80.6–89.0)	85.1 (80.4–88.9)	Reference
Age group:				
18–24	225/262	86.7 (80.9–90.9)	82.3 (74.5–88.0)	−6.6 (−14.5–1.4)
25–44	360/424	86.1 (81.4–89.7)	85.7 (80.5–89.7)	−3.1 (−9.3–3.0)
≥45	249/286	86.4 (80.9–90.5)	88.8 (84.0–92.3)	Reference
Gender:				
Man	303/364	85.4 (80.7–89.1)	86.3 (81.7–89.9)	Reference
Woman	530/606	87.4 (83.6–90.4)	87.1 (83.1–90.3)	0.9 (−4.4–6.1)
Evidence of financial hardship:				
No	555/656	85.0 (81.2–88.2)	85.3 (81.6–88.4)	Reference
Yes	256/286	91.1 (86.3–94.3)	90.7 (85.3–94.2)	**5.4 (0.1–10.7)**
People who smoke: plan to quit smoking in the future^^				
Total	708/918	73.6 (69.5–77.4)		
Total ethnicity:				
Māori	296/381	76.9 (71.5–81.5)	70.9 (66.0–75.4)	−2.9 (−6.1–0.4)
Pacific	144/185	75.3 (66.3–82.6)	72.3 (67.1–76.9)	−1.5 (−4.9–1.9)
Non-Māori, non-Pacific	294/390	70.7 (64.3–76.4)	73.8 (69.5–77.6)	Reference
Age group:				
18–24	210/243	84.8 (78.0–89.8)	73.3 (68.8–77.3)	1.4 (−2.1–4.9)
25–44	319/406	78.9 (73.5–83.5)	73.8 (69.5–77.7)	1.9 (−1.3–5.1)
≥45	179/269	63.5 (55.9–70.5)	71.9 (66.9–76.3)	Reference
Gender:				
Man	250/341	71.5 (65.1–77.2)	72.3 (67.9–76.3)	Reference

Appendix Table 6 (continued): Prevalence of previous failed quit attempts and plans to quit in people who smoke, by ethnicity, age, gender and evidence of financial hardship.

Woman	457/576	76.0 (71.0–80.4)	74.4 (70.2–78.1)	2.1 (−0.1–4.3)
Evidence of financial hardship:				
No	464/619	70.6 (65.5–75.3)	72.6 (68.4–76.5)	Reference
Yes	223/276	80.2 (73.4–85.6)	75.1 (70.9–78.8)	**2.5 (0.7–4.2)**

Values in bold indicate statistically significantly absolute marginal differences compared with the reference value.
Total ethnicity data are presented for Māori and Pacific. Some participants identified as both Māori and Pacific (see Table 1); comparisons for these two groups are made to an exclusive non-Māori, non-Pacific group.
Note that those with a non-binary gender do not have results reported (group too small for reasonable inference).
See Table 1 for the definition of financial hardship.
^This was classified as answering "yes" to the question "Have you ever tried to quit smoking cigarettes?"
^^This was classified as answering "within the next month", "between 1–6 months from now", or "sometime in the future, beyond 6 months" after the question "Are you planning to quit smoking..."
Participants who refused to answer or answered "don't know" were excluded from the relevant analyses.
Marginally standardised percentages and absolute differences adjust for: smoking status and quit intention, prioritised ethnicity, gender, age group and financial hardship.

Unapproved medicine use by paramedics in New Zealand: a comparative analysis with Australian and United Kingdom frameworks

Dylan A Mordaunt

ABSTRACT

AIM: To evaluate the regulation of unapproved medicines and its impact on paramedic practice in out-of-hospital settings by comparing regulatory frameworks in New Zealand, the United Kingdom (UK) and Australia. The objective was to propose actionable policy recommendations to improve New Zealand's current regulatory approach.

METHODS: A comparative analysis was conducted using theoretical frameworks including regulatory theory, public health law, institutionalism, comparative policy analysis and health crisis management. A technical comparison was also undertaken. Data were collected from legislative texts, policy documents and secondary sources. The analysis focussed on prescribing and administration authority, administrative requirements, flexibility in emergency situations and the impact on patient care.

RESULTS: Section 29 of the New Zealand *Medicines Act 1981* imposes comprehensive reporting requirements and restricts unapproved medicine use to registered medical practitioners, hindering timely interventions by paramedics. The administrative burden and lack of flexibility in emergency situations compromise patient care. In contrast, the UK's *Human Medicines Regulations 2012* and Australia's *Therapeutic Goods Act 1989* provide structured and adaptable pathways. The *Therapeutic Products Act 2023* in New Zealand proposed reforms but is currently in the process of being repealed.

CONCLUSION: New Zealand's framework of Section 29 is ill-suited for pre-hospital emergency care, creating ethical and practical dilemmas for paramedics. Comparative insights reveal that more flexible legal frameworks in the UK and Australia better support paramedics' ability to provide timely care. Ethical considerations emphasise the need to balance regulatory oversight with patient care imperatives. Legislative reforms in New Zealand are urgently needed to enable the lawful administration of unapproved medicines by paramedics, reduce administrative burdens and align its framework with international best practices.

In out-of-hospital (urgent and emergency ambulance) care, paramedics are tasked with delivering life-saving interventions under intense time pressure, usually in isolation and often in challenging (austere) environments. Their ability to provide timely and effective care depends on the availability of appropriate medications. However, legal frameworks regulating medicine use can impose significant restrictions, particularly when paramedics need to administer unapproved medicines. In 2024, paramedics frequently need to administer unapproved medicines due to global supply chain disruptions.[1,2]

In New Zealand, Section 29 of the *Medicines Act 1981* mandates that only registered medical practitioners may prescribe or administer unapproved medicines, and each instance must be reported to the Ministry of Health.[3] While intended to maintain oversight, this provision creates practical challenges for paramedics, who often operate independently and under considerable time constraints. The rigid nature of Section 29 contrasts with more flexible frameworks in Australia and the United Kingdom (UK), which empower paramedics under defined emergency protocols.[4,5]

Since 2020, medicine supply chains have encountered significant disruptions due to a combination of global events and challenges.[1,2] The COVID-19 pandemic played a central role by causing widespread lockdowns, which led to reduced manufacturing output and labour shortages in production facilities worldwide.[1,2] Transportation restrictions and border closures further hindered the movement of raw materials and finished pharmaceutical products.[1,2] Additionally, the surge in demand for certain medications, personal protective equipment and vaccines strained existing supply capacities.[1] Geopolitical tensions, including trade disputes and export

controls, have also impacted the availability of medicines by affecting international collaborations and supply agreements.[6] Natural disasters and climate-related events have disrupted logistics and damaged infrastructure essential for the production and distribution of pharmaceuticals.[7] Collectively, these factors have exposed vulnerabilities in the global medicine supply chain.[2] In New Zealand, this is exacerbated further by the impact of our public payer model on the domestic medicines market and related supply chain resilience.

The realities of out-of-hospital emergency care differ substantially from clinical settings. Paramedics must make rapid decisions without the luxury of time or consultation, aiming to stabilise critically ill patients. Supply chain disruptions, manufacturing shortages and public health emergencies like the COVID-19 pandemic have underscored the importance of flexible legal provisions that allow healthcare professionals to adapt quickly.[1,2] This article examines the limitations of Section 29 in New Zealand's ambulance environment and explores potential reforms inspired by practices in Australia and the UK to enhance paramedics' ability to deliver timely and effective care. The objective was to compare unapproved medicines regulatory frameworks and to propose actionable policy recommendations to improve New Zealand's current regulatory approach.

Methods

Methodological approach

A comparative analysis was conducted to evaluate the regulatory frameworks governing the use of unapproved medicines in New Zealand, Australia and the UK. These countries were selected due to similarities between their health systems. This methodology is appropriate for exploring the nuances of different legal systems and their impact on healthcare delivery, particularly in emergency settings.[8]

This analysis is guided by five theoretical frameworks. "Regulatory theory" examines how regulations are structured and enforced to balance control and flexibility.[6] It considers the effectiveness of legal frameworks in achieving regulatory objectives without imposing unnecessary burdens on practitioners. "Public health law" evaluates the implications of laws on health outcomes, emphasising patient safety and accessibility.[9] It assesses how legal provisions impact the delivery of healthcare services and the ability of professionals to meet public health needs. "Institutionalism" focusses on the role of institutions in shaping policy and practice within the healthcare system.[10] It explores how organisational structures, norms and cultures influence the implementation of regulations. "Comparative policy analysis" assesses policy differences and their impacts across jurisdictions.[3] By comparing different legal frameworks, it identifies best practices and potential areas for reform. "Health crisis management" considers the effectiveness of regulations in responding to emergencies and crises.[11] It examines the adaptability of legal frameworks during public health emergencies, such as pandemics or natural disasters. Each framework provides a unique lens for understanding the challenges faced by paramedics when using unapproved medicines and the implications for patient care.

Data

The following primary legal texts were examined. New Zealand: *Medicines Act 1981* (Section 29) and *Medicines Regulations 1984*;[12,13] Australia: *Therapeutic Goods Act 1989* (Special Access Scheme [SAS]);[4] UK: *Human Medicines Regulations 2012* (Regulation 174).[5] These documents were sourced from official government websites and legislative archives. Additionally, the *Therapeutic Products Act 2023* in New Zealand was considered.[14] Additional data were drawn from operational protocols for paramedics, including clinical practice guidelines from ambulance services in each country.

Comparative framework

The analysis focussed on several key aspects to comprehensively evaluate the regulatory frameworks. Firstly, it examined prescribing and administration authority by investigating who is authorised to prescribe or administer unapproved medicines in each jurisdiction and how this affects paramedics' ability to act in emergencies. Secondly, the study analysed the administrative requirements by evaluating the notification and reporting obligations imposed on healthcare professionals. This aspect aimed to understand how these obligations impact paramedics' ability to deliver timely care, considering that extensive administrative processes can hinder prompt medical intervention. Thirdly, flexibility in emergency situations was assessed by considering how legal frameworks adapt to the demands of emergency medical care. The analysis

investigated how regulations accommodate the need for rapid decision making, which is essential for effective pre-hospital care where delays can have severe consequences. Lastly, the study evaluated the impact on patient care by focussing on how legal frameworks affect paramedics' ability to provide life-saving interventions. This included examining patient outcomes, and the quality of care delivered under different regulatory conditions, highlighting the practical implications of the laws on the effectiveness of emergency medical services.

Ethical analysis

Ethical considerations were explored, particularly the balance between regulatory oversight and the need for immediate decision making by paramedics. The potential consequences of delaying care or administering unapproved medicines without legal authorisation were examined within the context of patient safety, professional accountability and the ethical obligations of healthcare providers.[15]

Results

A summary of findings is outlined in Table 1.

New Zealand's Section 29: comprehensive but rigid

Section 29 of the *Medicines Act 1981* restricts the use of unapproved medicines to registered medical practitioners and requires individual case notifications to the Ministry of Health.[12] This framework presents significant challenges for paramedics. In terms of time-sensitive care, the requirement for individual notifications is impractical during emergencies where immediate action is necessary. Paramedics operate in high-pressure environments, and delays in administering treatment can have life-threatening consequences. The administrative process mandated by Section 29 does not accommodate the urgency required in emergency medical situations.

The restricted authority under Section 29 means that paramedics are not authorised to administer unapproved medicines independently, leading to delays when medical practitioners are unavailable. This limitation is particularly problematic in rural or remote areas where access to registered medical practitioners is limited. Paramedics, often the first and only responders, are hindered by legal constraints that prevent them from providing essential care promptly.

The administrative burden of reporting obligations adds to paramedics' workload, detracting from patient care. In emergency situations, paramedics must prioritise patient stabilisation and rapid decision making, making extensive documentation impractical. The requirement to report each instance of unapproved medicine use imposes an unrealistic expectation on paramedics during critical moments.

These constraints hinder paramedics' ability to provide timely interventions, forcing them to choose between delaying treatment or risking legal repercussions. As a result, patient outcomes may be adversely affected, and paramedics face ethical dilemmas in fulfilling their duty of care. The rigidity of Section 29 does not align with the practical necessities of pre-hospital emergency care.

Equity considerations for rural paramedics

Rigid frameworks like Section 29 disproportionately affect rural paramedics and residents, where healthcare access is already limited due to shortages of medical practitioners. These restrictions lead to delays in patient care and place an additional burden on paramedics in isolated areas who are unable to access support from registered medical practitioners in a timely manner. This is not only a patient care issue but also an equity issue, as rural residents are disproportionately impacted by the inability to provide timely interventions. Flexible frameworks like those in the UK and Australia mitigate these disparities by authorising paramedics to act under emergency protocols, reducing reliance on medical practitioners in rural settings.

A recent study[16] highlights the disparity in health outcomes for rural residents in New Zealand compared to urban areas, further reinforcing the need for adaptable regulations that support paramedics in these settings.

Australia: SAS

Australia's *Therapeutic Goods Act 1989* provides a more flexible approach through the SAS. Under Category A, healthcare practitioners, including paramedics, can administer unapproved medicines without prior approval for patients with life-threatening conditions, with post-event notification to the Therapeutic Goods Administration (TGA). This provision acknowledges the urgency of emergency care and reduces delays associated with obtaining prior authorisation.

The emergency flexibility of the SAS recognises the realities of pre-hospital care, enabling prompt action while maintaining accountability.[17] By allowing post-event reporting, the administrative burden does not impede immediate patient care. Paramedics can focus on delivering essential interventions without the hindrance of time-consuming documentation during emergencies.

This framework empowers paramedics to act in the best interests of their patients without being hindered by administrative processes. It strikes a balance between regulatory oversight and practical necessity, ensuring patient safety and effective care delivery. The SAS supports paramedics' professional judgement and enhances their ability to respond effectively in critical situations.

UK: Regulation 174

The UK's *Human Medicines Regulations 2012* (Regulation 174) offers a streamlined approach. Temporary authorisations permit unapproved medicines during emergencies, following a risk–benefit analysis by the secretary of state. This mechanism allows for rapid response to public health crises or when approved alternatives are unavailable, facilitating quick adaptation to emerging health needs.

The establishment of national guidelines enables paramedics to administer unapproved medicines under predefined protocols, ensuring legal support without complex approvals. This system provides clarity and confidence for paramedics to make critical decisions. It ensures that paramedics are legally protected when acting within established guidelines, promoting consistency in emergency care practices.

This framework supports paramedics in delivering timely care and enhances the overall responsiveness of the healthcare system. By maintaining regulatory oversight while allowing for flexibility in emergencies, Regulation 174 ensures that patient safety is upheld without compromising the effectiveness of emergency medical interventions.

Discussion

The incompatibility of Section 29 with pre-hospital emergency care

Section 29's rigid requirements are incompatible with the urgent nature of pre-hospital emergency care. The restrictions on paramedic authority and the administrative burdens impede timely interventions, potentially compromising patient outcomes. Paramedics are often the sole healthcare providers on the scene and need the autonomy to make immediate decisions without unnecessary legal constraints.

The restricted authority under Section 29 means that paramedics are not authorised to administer unapproved medicines independently, leading to delays when medical practitioners are unavailable. This limitation is particularly problematic in rural or remote areas where access to registered medical practitioners is limited.[18] Paramedics, often the first and only responders in these regions, are hindered by legal constraints that prevent them from providing essential care promptly. This situation exacerbates health disparities between urban and rural populations, raising equity concerns. Rural residents may face longer response times and reduced access to timely interventions, potentially leading to poorer health outcomes compared to their urban counterparts.[14,18] Addressing these legal barriers is essential not only for improving patient care but also for promoting health equity across different geographic regions.

The administrative demands of individual case notifications are impractical in emergency settings. Paramedics must focus on patient stabilisation and cannot afford to engage in time-consuming documentation during critical moments. This situation creates ethical dilemmas, forcing paramedics to choose between adhering to the law and providing optimal patient care.

Comparative insights: lessons from Australia and the UK

Australia's SAS and the UK's Regulation 174 demonstrate how legal frameworks can balance flexibility with oversight. By allowing paramedics to administer unapproved medicines with post-event reporting, these countries support timely care while ensuring accountability.[4,5] These models recognise the unique challenges of emergency medical services and provide practical solutions.

The flexibility in these frameworks empowers paramedics to act decisively, improving patient outcomes. The emphasis on post-event reporting reduces administrative burdens during emergencies without compromising regulatory control. These approaches align legal requirements with the realities of pre-hospital care.

Ethical considerations

Delaying care due to legal constraints raises significant ethical concerns. Paramedics have

an obligation to provide the best possible care, and restrictive laws like Section 29 may force them to choose between legal compliance and patient welfare.[15] This conflict can undermine professional integrity and negatively impact patient trust. Flexible frameworks in Australia and the UK better align with ethical imperatives by empowering paramedics to act swiftly in emergencies.[17] They support the ethical principle of beneficence, enabling healthcare providers to act in the patient's best interest while maintaining appropriate oversight.[17]

Regulatory theory and public health law

From a regulatory theory perspective, Section 29 represents a high-control model that may be too rigid for emergency care.[6,8] It fails to accommodate the need for flexibility in dynamic situations. The comparative analysis suggests that regulations should be adaptable to different contexts, especially in critical care environments. Public health law advocates for regulations that do not unduly hinder access to care, emphasising the need for proportionality.[9,19] Laws should protect public health without imposing unnecessary barriers to essential services. Reforming Section 29 to allow greater paramedic autonomy would align with these principles.

Institutionalism and policy implications

Institutions play a crucial role in shaping effective policies. In New Zealand, the Ministry of Health could collaborate with paramedic organisations to reform Section 29, drawing on successful models from Australia and the UK.[10] Engaging stakeholders ensures that policies are grounded in practical experience and meet the needs of those on the front lines. Implementing changes requires institutional support and a willingness to adapt existing structures. By fostering a collaborative approach, reforms can be more effectively integrated into the healthcare system, enhancing overall efficiency and responsiveness.

Health crisis management: the need for adaptable regulations

The COVID-19 pandemic highlighted the necessity for adaptable regulations. Flexible legal frameworks enable healthcare systems to respond effectively to crises, ensuring continuity of care.[11,20] Rigid laws like Section 29 hinder the ability to address unexpected challenges, potentially exacerbating public health emergencies. Adopting more flexible regulations supports resilience in the healthcare system. It allows for rapid deployment of resources and empowers healthcare professionals to act decisively when faced with novel threats.

Would the *Therapeutic Products Act 2023* have addressed these issues for New Zealand?

The *Therapeutic Products Act 2023* introduced a framework that appeared to address some of the limitations of Section 29, particularly with respect to emergency-use provisions. However, while this *Act* is in the process of being repealed, its clauses offer insight into potential future directions for New Zealand's regulatory landscape.[21] Key provisions of the *Act* include:

1. Revisions to market authorisation: The *Bill* allows certain activities involving unauthorised therapeutic products under controlled conditions.[21] In general, these were outlined in Section 9 of the *Act*. This could potentially have provided more flexibility compared to Section 29 of the *Medicines Act 1981*.
2. Emergency arrangements: Section 119 of the *Therapeutic Products Act 2023* mentions that in emergency situations, the chief executive of the Ministry of Health could make notices that allow otherwise restricted activities, which would potentially benefit emergency services like paramedics by permitting them to use unapproved medicines in urgent situations without immediate compliance hurdles. Looking at the *Therapeutic Products Bill* (which contains information not in the *Act*), the Regulations Review Committee suggested that these emergency powers should not be delegated by the Ministry of Health to the chief executive—quite a contrast to both the Australian and UK approaches.[22]
3. Special case provisions: Sections 66 and 89 discuss specific cases where health practitioners can import and supply unapproved medicines under conditions that satisfy regulatory requirements, providing more leeway than the current Section 29.

These updates appear as though they may have addressed some of the administrative and regulatory constraints that paramedics currently face

by potentially simplifying the use of unapproved medicines during emergencies and enabling a more responsive approach. However, while these changes might offer improvements, a future bill should address how common and serious scenarios would be addressed in practice, and that real-time administration without excessive delays or post-event penalties is feasible.

As a final point with regards to the *Therapeutic Products Act 2023*, it is notable that although nurse practitioners are mentioned, specialist paramedics are not, despite being a substantially similar model, and indeed the critical care paramedical nature of the role having outgrown the delegated standing orders system warrants a regulatory approach that is more fit for purpose and the actual role that paramedics play in New Zealand society.

Recommendations for New Zealand's framework

A summary of recommendations is available in Table 2. To address the challenges identified in the current regulatory approach, several key recommendations are proposed to reform New Zealand's framework concerning the use of unapproved medicines by paramedics. Firstly, expanding paramedic authority is crucial. Amending a future medicines bill to include paramedics would allow them to administer unapproved medicines under defined conditions—such as a scope of clinical practice already regulated by the *Health Practitioners Competence Assurance Act 2003* system. This change would acknowledge their expertise and critical role in emergency care, empowering them to act promptly in life-threatening situations without unnecessary legal constraints but while reasonably expecting similar public safety oversight such as occurs with medical practitioners, veterinarians, dentists and nurse practitioners.

Secondly, there is a need to simplify administrative requirements. Introducing post-event reporting would reduce administrative burdens during emergencies. By streamlining documentation processes, accountability is maintained without hindering immediate action. This approach ensures that paramedics can focus on delivering timely patient care during critical moments and means that regulatory processes do not directly hinder appropriate life-saving clinical action.

Thirdly, establishing emergency use provisions would provide clear legal support. Creating protocols for the use of unapproved medicines in emergencies, like Australia's SAS and the UK's Regulation 174, would offer consistency in practice. Clear clinical practice guidelines are already available to enable paramedics to make critical decisions confidently, but what is necessary is for them and the medical practitioners supporting them to know they are operating within a legally supported framework. Additionally, it is recommended to develop tiered training programmes to certify paramedics for administering unapproved medicines. Implementing specialised education ensures competence and safety, reinforcing professional standards and building patient trust. Such training would equip paramedics with the necessary skills and knowledge to handle unapproved medicines appropriately. In the current environment where ambulance services are privately operated under a partly publicly funded arrangement, there are not resources available for that to be organisationally supported.

Finally, fostering institutional collaboration is essential for effective policy development. Engaging stakeholders—including paramedic associations, healthcare institutions and policymakers—in the reform process ensures that new regulations meet practical needs. We often hear from public health circles the expression "the ambulance at the bottom of the cliff." This ignores the substantial growth of paramedics and ambulance services in providing not only core emergency medical services, but also a long-term expansion into primary and urgent care, and the fact that paramedics now staff the ambulance well before, at the top, half-way down and at the bottom of the cliff. That preventable acute conditions present via ambulance services does not, unfortunately, mean that an austere funding approach improves health outcomes. Collaborative efforts enhance the relevance and effectiveness of the regulations, promoting widespread acceptance and successful implementation. By adopting these recommendations, New Zealand can create a more flexible and responsive regulatory framework that empowers paramedics, maintains patient safety and aligns with international best practices. These changes would ultimately improve patient outcomes during emergencies and strengthen the healthcare system's ability to respond effectively to critical situations.

Conclusion

New Zealand's Section 29 of the *Medicines Act 1981* is not fit for purpose in pre-hospital

emergency care. The legal restrictions and administrative burdens hinder paramedics' ability to provide timely, life-saving interventions. This situation poses ethical dilemmas and potentially compromises patient outcomes.

In contrast, Australia and the UK offer flexible frameworks that empower paramedics while maintaining oversight. These models demonstrate that it is possible to balance regulatory control with practical necessity, supporting both patient safety and effective care delivery.

Urgent legal reform is needed in New Zealand to expand paramedic authority, simplify administrative processes and establish emergency use provisions. By aligning with international best practices, New Zealand can enhance paramedic autonomy, improve patient outcomes and ensure that regulatory frameworks support effective emergency responses. Such changes would prevent paramedics from facing legal risks or compromising patient care, ultimately strengthening the healthcare system's ability to respond to emergencies. Embracing flexibility and collaboration in regulatory practices is essential for meeting the evolving challenges of modern healthcare.

Table 1: Summary table of findings.

Aspect	New Zealand (*Medicines Act 1981* Section 29)	United Kingdom (*Human Medicines Regulations 2012*)	Australia (*Therapeutic Goods Act 1989*)	New Zealand (*Therapeutic Products Act 2023*)
Reporting requirements	Comprehensive and immediate reporting to the director-general required	Streamlined post-event reporting for emergency use	Embedded in health system protocols, allowing retrospective reporting	Reporting exemptions allowed in emergencies under specific declarations by the chief executive
Scope for paramedics	Limited to delegated authority with detailed oversight	Authorised to administer under National Health Service–approved protocols	Permitted under state-based authorisations through the Therapeutic Goods Administration	Provisions for emergency exemptions could enable paramedics to act more independently but remain untested for implementation
Emergency use flexibility	High control; delays real-time emergency interventions	Allows temporary use under structured guidelines	Special access schemes enable rapid response	Emergency declarations under Section 116 allow otherwise restricted activities but require ministerial oversight
Administrative burden	High: each instance requires pre-approval and detailed reporting, delaying timely interventions and increasing workload	Low: emergency-use provisions simplify administration with predefined protocols, reducing paramedics' documentation burden	Medium: reporting requirements exist but are retrospective and aligned with broader state and federal systems	Moderate: emergency declarations simplify requirements but still rely on higher-level administrative action for flexibility
Patient safety vs practicality	High emphasis on safety but may delay treatment	Balanced approach supporting rapid action and oversight	Timely intervention supports safety protocols	Emphasis on safety, but flexibility depends on activating emergency provisions, potentially limiting responsiveness
Health system integration	Less integrated: high administrative burden	Integrated into National Health Service frameworks	Integrated into broader health system with state and federal support	Improved integration promised but lacks specific inclusion of paramedics, particularly critical care roles

NB: More detailed tables are available in the Appendix.

Table 2: Summary of recommendations.

Recommendation	Justification	Expected outcome	Addressed by TPA?
Controlled authorisation	Aligns with practices in the UK and Australia	Expanded paramedic scope, timely care	Partially: TPA allowed certain activities under controlled conditions but did not explicitly expand paramedic scope
Emergency exemption amendment	Reduces delay while maintaining post-event oversight	Faster emergency response, compliance	Yes: TPA included emergency provisions for the chief executive to permit restricted activities
Tiered training and certification	Ensures safety with expanded prescribing rights	High level of trust and patient safety	Not specifically addressed: TPA did not outline training programmes for paramedics
Integrated reporting systems	Simplifies compliance without real-time delays	Efficient reporting, reduced admin burden	Partially: TPA proposed more flexible reporting requirements
Collaborative policy development	Strengthens policy through stakeholder input	Enhanced policy acceptance and effectiveness	Uncertain: TPA development may not have fully engaged all stakeholders, including paramedic associations

TPA = *Therapeutic Products Act 2023*; UK = United Kingdom.

COMPETING INTERESTS
The author is a medical practitioner (paediatrician and medical administrator) and works for an ambulance organisation in a clinical governance leadership role.

DATA
The legislation reviewed in this research is all outlined in the references and is publicly available.

CORRESPONDING AUTHOR INFORMATION
Dylan A Mordaunt: Faculty of Health, Victoria University of Wellington, New Zealand; Wellington Free Ambulance, New Zealand; College of Medicine and Public Health, Flinders University, South Australia.
E: dylan.mordaunt@vuw.ac.nz

URL
https://nzmj.org.nz/journal/vol-138-no-1612/unapproved-medicine-use-by-paramedics-in-new-zealand-a-comparative-analysis-with-australian-and-united-kingdom-frameworks

REFERENCES
1. Ivanov D. Predicting the impacts of epidemic outbreaks on global supply chains: A simulation-based analysis on the coronavirus outbreak (COVID-19/SARS-CoV-2) case. Transp Res E Logist Transp Rev. 2020;136:101922. doi: 10.1016/j.tre.2020.101922.
2. Kavanagh MM, Singh R. Democracy, Capacity, and Coercion in Pandemic Response: COVID-19 in Comparative Political Perspective. J Health Polit Policy Law. 2020;45(6):997-1012. doi: 10.1215/03616878-8641530.
3. Blank RH, Burau V, Kuhlmann E. Comparative Health Policy. 5th ed. Bloomsbury Publishing; 2017.
4. *Therapeutic Goods Act 1989* (AU).
5. *The Human Medicines Regulations 2012* (UK).
6. Baldwin R, Cave M, Lodge M. Understanding Regulation: Theory, Strategy, and Practice. Oxford University Press; 2012.
7. United Nations Office for Disaster Risk Reduction. The human cost of disasters: an overview of the last 20 years (2000-2019) [Internet]. Centre for Research on the Epidemiology of Disasters, United Nations Office for Disaster Risk Reduction; 2021 [cited 2024 Nov 11]. Available from: https://www.undrr.org/publication/human-cost-disasters-overview-last-20-years-2000-2019
8. de Cruz P. Comparative Healthcare Law. Routledge-Cavendish; 2013.
9. Gostin LO, Wiley LF. Public Health Law: Power, Duty, Restraint. University of California Press; 2016.
10. Hall PA, Taylor RCR. Political Science and the Three New Institutionalisms. Political Studies. 1996;44(5):936-57. https://doi.org/10.1111/j.1467-9248.1996.tb00343.
11. Ansell C, Boin A, Keller A. Managing Transboundary Crises: Identifying the Building Blocks of an Effective Response System. Journal of Contingencies and Crisis Management. 2010;18(4):195-207. https://doi.org/10.1111/j.1468-5973.2010.00620.x.
12. *Medicines Act 1981* (NZ).
13. *Medicines Regulations 1984* (NZ).
14. Te Tāhū Hauora – Health Quality & Safety Commission. Te kounga o te tauwhiro hauora – Window on the quality of health care [Internet]. Wellington, New Zealand: Te Tāhū Hauora – Health Quality & Safety Commission; 2021 [cited 2024 Nov 11]. Available from: https://www.hqsc.govt.nz/our-data/window-on-the-quality-of-health-care/
15. Beauchamp TL, Childress JF. Principles of Biomedical Ethics. Oxford University Press; 2001.
16. Lilley R, Davie G, Dicker B, et al. Rural and Ethnic Disparities in Out-of-hospital Care and Transport Pathways After Road Traffic Trauma in New Zealand. West J Emerg Med. 2024 Jul;25(4):602-613. doi: 10.5811/westjem.18366.
17. O'Meara P, Wingrove G, Nolan M. Clinical leadership in paramedic services: A narrative synthesis. Int J Health Gov. 2017;22(4):251-268. doi:10.1108/IJHG-03-2017-0014.
18. Ministry of Health – Manatū Hauora. Health and Independence Report 2022 – Te Pūrongo mō te Hauora me te Tū Motuhake 2022 [Internet]. Wellington, New Zealand: Ministry of Health–Manatū Hauora; 2022 [cited 2024 Nov 11]. Available from: https://www.health.govt.nz/publications/health-and-independence-report-2022
19. Gostin LO. Pandemic Influenza: public health preparedness for the next global health emergency. J Law Med Ethics. 2004;32(4):565-73. doi: 10.1111/j.1748-720x.2004.tb01962.x.
20. Legido-Quigley H, Mateos-García JT, Campos VR, et al. The resilience of the Spanish health system against the COVID-19 pandemic. Lancet Public Health. 2020;5(5):e251-e252. doi: 10.1016/S2468-2667(20)30060-8.
21. *Therapeutic Products Act 2023* (NZ).
22. *Therapeutic Products Bill 2022* (NZ).

Appendix

Appendix Table 1: Framework-based analysis of medicine regulation across jurisdictions.

Framework	United Kingdom	Australia	New Zealand
Legal pluralism	Multiple layers of regulation: *Medicines Act 1968* and *Human Medicines Regulations* blend national and international influences	Federal oversight by TGA, with integration of state regulations	Combines domestic law with global practices, evident in *Medicines Act 1981*
Regulatory theory	Strict regulation under the *Medicines Act 1968*; emergency provisions in *Human Medicines Regulations 2012*	The *Therapeutic Goods Act 1989* governs, with emergency access through TGA's Special Access Scheme	Section 29 of the *Medicines Act 1981* allows unapproved medicines with strict reporting to the director-general
Comparative legal analysis	Strong alignment with EU directives pre-Brexit; post-Brexit shifts expected	Reflects federal–state legal integration and alignment with international standards	Clear distinctions in regulations for handling unapproved medicines under Section 29
Public health law framework	Emphasises public safety and controlled access to unapproved medicines	TGA ensures public health and regulated emergency access to unapproved medicines	Focusses on emergency supply with oversight to ensure public health safety
Institutionalism	Institutions like MHRA enforce strict compliance and oversight	TGA oversees regulations and enforcement, supporting institutional adherence	Ministry of Health ensures adherence through director-general oversight
International health law framework	Historically influenced by EU, ensuring international alignment pre-Brexit	Aligned with WHO and global standards in therapeutic goods regulation	Aligned with global practices for emergency medicine use while maintaining local control
Socio-logical legal framework	Considers societal safety and controlled use of medicines in emergencies	Focusses on safe use and accessibility of emergency medicines	Emphasises oversight and societal impacts, especially in emergencies
Emergency medical systems framework	Emergency use defined in regulations for controlled temporary authorisations	Emergency and compassionate use allowed with TGA oversight	Section 29 and *Medicines Regulations 1984* specify emergency protocols
Health crisis and disaster law	Supports the use of unapproved medicines in public health emergencies	Supports rapid response with emergency amendments for unapproved drugs	Handles supply chain issues by permitting emergency use under strict reporting
Scope of practice and professional autonomy	Paramedics require NHS guidance and specific authorisations for use	State laws dictate paramedic authority for emergency medicine use	Limited prescribing authority for paramedics under delegation and protocols

Appendix Table 1 (continued): Framework-based analysis of medicine regulation across jurisdictions.

Framework	United Kingdom	Australia	New Zealand
Pharmaceutical regulation and access framework	Robust processes under *Medicines Act 1968* and *Human Medicines Regulations 2012*	TGA's framework supports regulation and controlled access to unapproved drugs	Section 29 outlines ministerial consent for unapproved medicine use
Health workforce and role delineation	Roles defined under NHS guidance; strict authorisation for paramedics	Roles defined by state regulations; paramedics need authorisation for emergency administration	Paramedic roles defined under delegated authority for emergency situations
Comparative policy analysis	Detailed regulatory approach emphasising controlled and documented use	Adaptive approach for emergency and urgent needs under TGA schemes	Specific Section 29 and emergency provisions key for handling supply issues
Health equity and access to care	Ensures equitable access to unapproved medicines in emergencies	Provisions support equity in access during medical emergencies	Ensures continuity of care during supply chain disruptions with oversight

TGA = Therapeutic Goods Administration; EU = European Union; MHRA = Medicines and Healthcare products Regulatory Agency; WHO = World Health Organization; NHS = National Health Service.

Appendix Table 2: Comparison of provisions for unapproved medicines across jurisdictions.

Jurisdiction	Regulatory framework	Ease of use in emergencies	Adequacy for paramedics
United Kingdom	*Human Medicines Regulations 2012*: temporary authorisation for emergency use	Flexible, allows paramedics to act quickly within set guidelines	Supportive, reduces on-the-spot reporting and administrative burden
Australia	*Therapeutic Goods Act 1989*: Special Access Scheme for unapproved medicines	Adaptable for pre-hospital care with state-level authorisations	Practical, balances regulation with emergency care flexibility
New Zealand	*Medicines Act 1981*: Section 29 mandates strict reporting for unapproved use	Restrictive: extensive reporting hinders timely use in emergencies	Impractical: paramedics may avoid use due to stringent reporting

Appendix Table 3: Practical options for administering unapproved medicines in New Zealand.

Option	Description	Challenges
Protocol-based pre-authorisations	Implement standing orders or pre-approved protocols under medical oversight	May require legislative changes for broader protocol acceptance
Delegated medical authority	Remote supervision by an on-call medical director for reporting responsibility	Real-time communication challenges in rural or busy environments
Emergency exemption clauses	Amend Section 29 of the *Medicines Act 1981* to allow specific emergency exemptions	Legislative amendments needed; safeguards required to prevent misuse
Streamlined reporting system	Develop digital tools for real-time or shift-end reporting	Adds administrative steps but is less burdensome than current requirements

Sexual identity and utilisation of primary healthcare services: findings from the New Zealand Health Survey

Sonja J Ellis, Jintana Jankhotkaew, Stephen Neville, Jeffery Adams

ABSTRACT

Using data extracted from the New Zealand Health Survey (NZHS), the purpose of this study was to compare lesbian, gay and bisexual people and heterosexual people on engagement with general practitioner (GP) and nursing services and patient experiences of GP services. Quantitative data spanning four waves of NZHS from the years 2017/2018 to 2020/2021 were used to undertake a comparative analysis of lesbian females, bisexual females, gay males, bisexual males and heterosexual males and females. Statistically significant differences were observed in the percentage of GP and nurse utilisation across sexual identity groups. Our analysis showed that both bisexual females and gay/bisexual males were significantly more likely to report poorer levels of trust in GPs and experience poorer explanation of doctors and health conditions. The findings of this study indicate that lesbian, gay and bisexual people have a poorer experience of GP services than do their heterosexual counterparts. These findings indicate the need for GPs and nurses to better understand the ways in which the health needs of lesbian, gay and bisexual people differ from those of heterosexuals to facilitate the provision of culturally appropriate care.

Access to primary healthcare services is paramount in achieving the best possible health outcomes.[1] Failure to engage with healthcare services may lead to unmet health needs, preventable hospitalisation and serious illness. In many instances, the prevention of serious ill health is contingent on early detection of problems to enable effective intervention. Quality of care is also important because it can be a determinant of ongoing engagement with healthcare professionals. Despite this, engagement in healthcare among lesbian, gay and bisexual (and other non-heterosexual) people is purported to be low, at least in some areas (e.g., cervical screening in lesbian and bisexual females, STI prevention in gay and bisexual males).[2–5] However, what is known more generally about rates of engagement in healthcare and interactions with health professionals among lesbian, gay and bisexual people, particularly in New Zealand, is limited.

Regular engagement with healthcare services is particularly important for marginalised populations, including lesbian, gay and bisexual people, given their elevated risk of both physical and mental health issues.[6] For example, in both lesbian/bisexual females and gay/bisexual males, the incidence of cancers is higher than for cisgender heterosexual females and males.[7] Lesbian and bisexual females are disproportionately affected by type 2 diabetes and ischaemic heart disease due to weight issues,[8,9] while stigma around gay male sexuality places gay and bisexual males at greater risk of sexual health issues.[10] Due to systemic marginalisation, lesbian, gay and bisexual people experience higher rates of mental health issues (e.g., depression, anxiety) than do heterosexuals.[11] Systemic marginalisation based on gender and/or race especially affects the mental wellbeing of lesbian, gay and bisexual people who are also from ethnic minorities and/or who are gender diverse (transgender or non-binary).[12,13]

Despite considerable social change, research with lesbian, gay and bisexual people consistently report problematic interactions with healthcare professionals. A recent systematic review of studies identified four main factors adversely impacting the healthcare experiences in this population.[14] These factors include healthcare professionals' apparent lack of knowledge of the specific health needs of this population; discomfort during interactions with lesbian, gay and bisexual patients; and the enactment of heteronormative assumptions, issues that result in culturally inappropriate care. For these reasons, healthcare professionals may fail to identify conditions specifically affecting lesbian, gay and bisexual people[15,16] and/or overlook the ways in which their health needs differ from those of heterosexuals.[17,18]

While overt prejudice is rare in healthcare settings today, the persistence of heteronormativity is a key factor in many lesbian, gay and bisexual people being reticent to engage with—or, in some cases, actively avoiding—healthcare services.[19–21]

While there are some studies that explore engagement with professionals and processes in primary healthcare in Aotearoa among lesbian, gay and bisexual people,[2,22] these have not utilised national level data. Using data collected from the New Zealand Health Survey (NZHS), the purpose of this study was to compare a) the engagement with general practitioner (GP) and nursing services, and b) patient experiences of GP services of lesbian, gay and bisexual people and heterosexual people. Rather than focussing on general experiences of healthcare—as has been the case in previous studies—this article explores experiences as defined in the NZHS; namely, levels of trust, explanations of health conditions and treatments and patient involvement in decision-making. Experiences of interactions were only explored for GPs, as the NZHS does not currently ask for this information in relation to nurses.

Method

Study design

The data analysed in this paper were extracted from the NZHS. The NZHS is a nationally representative survey that employs a multi-stage sampling method and conducts face-to-face interviews with respondents aged 15 years and older residing in Aotearoa New Zealand. We used data from the NZHS spanning four waves from the years 2017/2018 to 2020/2021, and combined all four waves of the survey, resulting in a total sample size of 46,849. The study reported here uses quantitative data to undertake a comparative analysis of lesbian/bisexual females, gay/bisexual males and heterosexual males and females. For the purposes of this article, only those identifying with the gender categories "male" or "female" were included in the analysis. The terms "male" and "female" are used throughout this article rather than "women" and "men", as this is the language used in the NZHS to ask about gender. There is currently no provision in the survey to identify as "non-binary" or with a gender other than male or female.

Sample

Prior to analysis some data cleaning was necessary to ensure the sample only included people who had responded to all relevant questions. We excluded respondents who did not provide data for the main variables of interest: utilisation of GPs (n=70), utilisation of nurse service (n=163) and sexual identity (2,501). In total, we excluded 2,689 respondents who did not report those main outcomes (i.e., GP and nurse utilisation) and/or independent variables (i.e., sexual identity). Additionally, respondents who did not respond to variables used for adjustments in the model (e.g., income, education) were excluded (n=1,537). The final sample size for the analysis of GP and nurse service utilisation was 42,623.

Additionally, we conducted an analysis of patient experiences with GP services. In the NZHS, the assessment was limited to individuals who had visited a GP within the past 3 months, thereby focussing the analysis on this specific group (n=21,363). Respondents who did not provide answers to questions regarding their patient experience of GP services were excluded from the analysis (n=2,182). The total sample size for the analysis of experiences in GP services was 19,181.

Independent variables and dependent variables

Sexual identity

Sexual identity was self-defined and derived from responses to the survey question "Which of the following options best describes how you think of yourself?" The response options included heterosexual or straight, gay or lesbian, bisexual, other (not further defined), don't know and choose not to answer. To enable a comparative analysis, we grouped individuals into the sexual identity categories "heterosexual females", "lesbian", "bisexual females", "heterosexual males", "gay" and "bisexual males". Those who responded to either question with "don't know" or "choose not to answer" or "other" were excluded from the analysis.

GP utilisation and experiences

We analysed the main outcome variables that were consistent across all four waves of the survey, which included the utilisation of GP services and patient experiences in GP services.

For GP utilisation, respondents were asked, "In the past 12 months, have you seen a GP or been visited by a GP about your own health? By health, I mean your mental health and emotional health as well as physical health." Response options included yes, no, don't know and refused.

Concerning patient experiences in GP services,

respondents were queried about their experience if their last visit to a GP was within the last 3 months. There were three primary outcome variables related to patient experience in GP services: levels of trust, explanations of health conditions and treatments, and patient involvement in decision-making. Levels of trust in the GP were determined by asking respondents, "Did you have confidence and trust in the GP you saw or talked to?" Response options included yes, to some extent and no, not at all. Experiences regarding medical doctors explaining health conditions and treatments were assessed with the question, "Still thinking about your last visit or talk with a GP, how good was the doctor at explaining your health conditions and treatments in a way that you could understand?" Response options included very good, good, neither good nor bad, poor and very poor. The involvement of patients in decision-making about healthcare and treatment was evaluated by asking, "How good was the doctor at involving you in decisions about your care, such as discussing different treatment options?" The response options were the same as those mentioned for the second patient experience explained earlier.

Nurse utilisation

The nurse utilisation was measured using following question, "In the past 12 months, have you seen or talked to a nurse at a GP clinic or medical centre, about your own health?" Response options included yes, no, don't know and refused. There was no question related to patient experience regarding nurse utilisation.

Analyses

Statistical analyses were undertaken using Stata version 11. Analyses comprised both univariate and multivariate calculations. Descriptive statistics were used to identify the percentage utilisation for both GPs and nurses. A Chi-squared test was utilised for a univariate analysis to examine differences in the percentage of GP utilisation and nurse utilisation across different sexual identities. For investigating the association between GP utilisation and nurse utilisation and sexual identity, we employed multiple logistic regression. The model was adjusted for potential confounding variables (e.g., demographic variables, socio-economic indicators, etc.). For examining the association between patient experience and sexual identity, we utilised ordered logistic regression. While acknowledging potential violations of assumptions of proportional odds assumptions, the large sample size supports the practicality of using ordered logistic regression.[23] Additionally, to account for errors stemming from the study design, we applied weight analysis in all our analyses. We analysed based on complete case analysis because missing data is less than 10%; therefore, it might not have a large effect on the findings.[24,25]

We also adjusted for key confounding factors that were consistently assessed in all survey waves. These factors encompassed demographic variables, socio-economic indicators, the presence of health insurance, health condition and the survey year. Demographic variables consisted of age groups and ethnicity. Socio-economic status was evaluated based on household incomes over the past 12 months, highest educational attainment (categorised as no formal education, secondary, undergraduate, postgraduate and other) and employment status (categorised as not paid and looking for a job, not paid due to retirement and other groups). Health conditions took into account the presence of chronic diseases.

We also adjusted for gender and sexual identity in the model; however, the model was simplified due to the overlap in categories between gender and sexual identity with the primary sexual identity variable. As a result, we excluded both gender and sexual identity from the model and instead included the main sexual identity variable, which integrates both dimensions.

Results

Association between sexual identity and GP utilisation and nurse utilisation

The overall percentage of GP utilisation among the samples was 80%, while nurse utilisation was 54%. Upon exploring the percentage of GP utilisation across different sexual identities, we observed that bisexual females had the highest percentage (84%), followed by heterosexual females (83%), and the lowest percentage was found among bisexual males (70%). The distribution was similar for nurse utilisation. Statistically significant differences were observed in the percentage of GP and nurse utilisation across sexual identity groups (see Table 1).

After adjusting for potential confounders, lesbian and bisexual females were more likely to utilise GP services compared to heterosexual females. For example, bisexual females were 1.81 times more likely to utilise GPs than heterosexual

Table 1: Distribution of GP and nurse utilisation across sexual identities.

Sexual identity	GP utilisation n (%)	Nurse utilisation n (%)
Overall samples	34,044 (79.9)	23,081 (54.2)
Heterosexual females	19,670 (82.9)*	13,841 (58.3)*
Lesbian females	205 (81.7)	130 (51.8)
Bisexual females	477 (84.3)	345 (61.0)
Heterosexual males	13,368 (75.8)	8,558 (48.5)
Gay males	200 (76.9)	132 (50.8)
Bisexual males	124 (70.1)	75 (42.4)

*Chi-squared test; p-value <0.05.
GP = general practitioner.

Table 2: Association between GP utilisation, nurse utilisation and sexual identity using multiple logistic regression (n=42,623).

Variables	GP utilisation OR (95% CI)	Nurse utilisation OR (95% CI)
Sexual identity (ref. heterosexual females)		
Lesbian females	1.07 (1.05, 1.09)*	1.01 (1.00, 1.03)
Bisexual females	1.81 (1.79, 1.83)*	1.74 (1.73, 1.76)*
Heterosexual males	0.57 (0.57, 0.57)*	0.64 (0.64, 0.64)*
Gay males	0.83 (0.81, 0.84)*	1.03 (1.01, 1.04)*
Bisexual males	0.57 (0.56, 0.58)*	0.79 (0.78, 0.80)*
Age group (ref. 15–24 years)		
25–34	1.12 (1.11, 1.12)*	1.12 (1.12, 1.13)*
35–44	1.09 (1.08, 1.09)*	1.13 (1.13, 1.14)*
45–54	1.39 (1.39, 1.40)*	1.32 (1.32, 1.33)*
55–64	1.89 (1.88, 1.90)*	1.59 (1.58, 1.59)*
65–74	2.89 (2.87, 2.90)*	3.16 (3.15, 3.18)*
75+	5.08 (5.03, 5.12)*	3.25 (3.23, 3.27)*
Household income (ref. NZ$1–20,000)		
>NZ$20,000–30,000	1.10 (1.09, 1.11)*	0.87 (0.87, 0.88)*
>NZ$30,000–50,000	1.05 (1.04, 1.06)*	0.96 (0.95, 0.97)*
>NZ$50,000–70,000	1.01 (1.00, 1.02)*	0.91 (0.91, 0.92)*

Table 2 (continued): Association between GP utilisation, nurse utilisation and sexual identity using multiple logistic regression (n=42,623).

>NZ$70,000–100,000	1.10 (1.09, 1.11)*	0.92 (0.91, 0.92)*
More than NZ$100,000	1.11 (1.10, 1.12)*	0.86 (0.85, 0.86)*
Do not know	0.90 (0.90, 0.91)*	0.81 (0.81, 0.82)*
Highest education attainment (ref. no education)		
Secondary	1.03 (1.03,1.04)*	1.12 (1.11, 1.12)*
Undergraduate level	1.08 (1.08, 1.09)*	1.14 (1.13, 1.14)*
Postgraduate level	1.14 (1.14, 1.15)*	1.09 (1.09, 1.10)*
Other (e.g., degrees from overseas)	1.03 (1.02, 1.03)	1.22 (1.21, 1.22)*
Employment status (ref. in paid)		
Not paid (looking for job)	1.05 (1.04, 1.05)*	1.00 (0.99, 1.00)
Not paid (e.g., retirement)	1.06 (1.06, 1.06)*	0.99 (0.99, 1.00)*
Māori (ref. New Zealand European)		
Māori	0.88 (0.88, 0.88)*	1.11 (1.10, 1.11)*
Pacific peoples	0.89 (0.88, 0.90)*	1.37 (1.36, 1.37)*
Chinese	0.62 (0.62, 0.63)*	0.67 (0.66, 0.67)*
Indian	1.07 (1.06, 1.08)*	1.23 (1.22, 1.23)*
Others	0.85 (0.85, 0.86)*	0.93 (0.93, 0.93)*
Insurance (ref. do not have vs have)	0.81 (0.80, 0.81)*	0.91 (0.91, 0.91)*
Chronic diseases (ref. no vs yes)	2.15 (2.15, 2.16)*	1.69 (1.68, 1.69)*
Year (ref. 2017/2018)		
2018/2019	1.01 (1.01, 1.01)*	1.06 (1.05, 1.06)*
2019/2020	1.06 (1.06, 1.06)*	1.00 (1.00, 1.01)
2020/2021	0.78 (0.78, 0.78)*	0.91 (0.91, 0.91)*

*p-value <0.05.
GP = general practitioner.

females (OR:1.81; 95% CI:1.79, 1.83; p-value <0.05). However, heterosexual males and gay/bisexual males were less likely to utilise GP services. For example, bisexual males were approximately 43% less likely to utilise GP services compared to heterosexual females (OR:0.57; 95% CI:0.56, 0.58; p-value <0.05). This is similar to nurse utilisation, except for gay males. Gay males were 1.03 times more likely to utilise nurses than heterosexual females (OR:1.03; 95% CI:1.01, 1.04; p-value <0.05) (see Table 2).

Association between sexual identity and patient experience in GP services

To identify associations, a total of 19,181 samples were included in the analysis, comprising 11,278

heterosexual females, 118 lesbian females, 296 bisexual females, 7,311 heterosexual males, 116 gay males and 62 bisexual males.

Level of trust

After adjusting for potential confounders, we observed that bisexual females as well as gay males were more likely to report poorer scores of trust in GPs compared to heterosexual females. For example, bisexual females were 1.32 times more likely to report poorer scores of trust in GPs compared to heterosexual females (OR:1.32; 95% CI:1.30, 1.34; p-value <0.05). However, we found that heterosexual males and lesbian females were less likely to report poorer scores of trust in GP services compared to heterosexual females. For example, lesbian females were 7% less likely to report poorer scores of trust compared to heterosexual females (OR:0.93; 95% CI:0.91, 0.96; p-value <0.05) (see Table 3).

Table 3: Association between levels of trust in GPs and sexual identity using ordered logistic regression (n=19,181).

Variables	Level of trust OR (95% CI)	Level of explanation of doctors on health conditions and treatment OR (95% CI)	Level of involvement in decision making on healthcare OR (95% CI)
Sexual identity (ref. heterosexual females)			
Lesbian females	0.93 (0.91, 0.96)*	1.10 (1.07, 1.12)*	1.28 (1.25, 1.30)*
Bisexual females	1.32 (1.30, 1.34)*	1.50 (1.49, 1.52)*	1.37 (1.36, 1.39)*
Heterosexual males	0.94 (0.93, 0.94)*	1.12 (1.12, 1.13)*	1.18 (1.18, 1.19)*
Gay males	1.66 (1.63, 1.70)*	1.01 (0.99, 1.03)	1.26 (1.24, 1.28)*
Bisexual males	1.02 (0.99, 1.05)	1.11 (1.08, 1.14)*	0.87 (0.85, 0.89)*
Age group (ref. 15–24 years)			
25–34	1.15 (1.14, 1.16)*	0.94 (0.94, 0.95)*	1.16 (1.15, 1.17)*
35–44	0.94 (0.93, 0.95)*	0.80 (0.80, 0.81)*	0.87 (0.87, 0.88)*
45–54	0.88 (0.88, 0.89)*	0.65 (0.65, 0.66)*	0.74 (0.74, 0.75)*
55–64	0.72 (0.71, 0.73)*	0.58 (0.57, 0.58)*	0.64 (0.64, 0.64)*
65–74	0.57 (0.56, 0.57)*	0.43 (0.43, 0.43)*	0.53 (0.53, 0.54)*
75+	0.40 (0.40, 0.40)*	0.40 (0.40, 0.40)*	0.52 (0.52, 0.53)*
Household income (ref. NZ$1–20,000)			
>NZ$20,000–30,000	0.84 (0.83, 0.86)*	0.85 (0.84, 0.86)*	0.80 (0.79, 0.80)*
>NZ$30,000–50,000	0.79 (0.78, 0.79)*	0.81 (0.80, 0.82)*	0.72 (0.71, 0.73)*
>NZ$50,000–70,000	0.65 (0.64, 0.66)*	0.75 (0.74, 0.76)*	0.69 (0.68, 0.70)*
>NZ$70,000–100,000	0.73 (0.72, 0.74)*	0.76 (0.75, 0.76)*	0.74 (0.73, 0.75)*
More than NZ$100,000	0.61 (0.61, 0.62)*	0.67 (0.66, 0.67)*	0.66 (0.66, 0.67)*
Do not know	0.70 (0.69, 0.70)*	0.79 (0.78, 0.80)*	0.74 (0.73, 0.74)*

Table 3 (continued): Association between levels of trust in GPs and sexual identity using ordered logistic regression (n=19,181).

Highest education attainment (ref. no education)			
Secondary	1.27 (1.26, 1.28)*	0.99 (0.98, 0.99)*	0.98 (0.97, 0.98)*
Tertiary	1.24 (1.23, 1.25)*	0.94 (0.93, 0.94)*	0.96 (0.95, 0.96)*
Higher education	1.24 (1.23, 1.25)*	0.87 (0.86, 0.88)*	0.86 (0.85, 0.87)*
Other (e.g., degrees from overseas)	1.09 (1.07, 1.10)*	0.82 (0.81, 0.83)*	0.86 (0.85, 0.86)*
Employment status (ref. in paid)			
Not paid (looking for job)	1.12 (1.11, 1.13)*	0.95 (0.94, 0.96)*	0.96 (0.95, 0.97)*
Not paid (e.g., retirement)	1.04 (1.03, 1.04)*	1.01 (1.01, 1.02)*	1.01 (1.00, 1.01)*
Māori (ref. New Zealand European)			
Māori	1.08 (1.07, 1.09)*	1.04 (1.03, 1.04)*	1.05 (1.04, 1.05)*
Pacific peoples	1.24 (1.23, 1.25)*	1.23 (1.22, 1.24)*	1.22 (1.21, 1.23)*
Chinese	1.50 (1.48, 1.52)*	1.37 (1.35, 1.38)*	1.15 (1.14, 1.16)*
Indian	0.92 (0.90, 0.93)*	1.24 (1.23, 1.25)*	1.29 (1.28, 1.30)*
Others	0.99 (0.99, 1.00)	1.11 (1.10, 1.11)*	1.09 (1.08, 1.09)*
Insurance (ref. do not have vs have)	1.20 (1.20, 1.21)*	1.16 (1.16, 1.17)*	1.15 (1.14, 1.15)*
Chronic diseases (ref. no vs yes)	1.06 (1.05, 1.06)*	0.98 (0.98, 0.99)*	0.98 (0.98, 0.99)*
Year (ref. 2017/2018)			
2018/2019	1.14 (1.14, 1.15)*	1.00 (0.99, 1.00)	0.99 (0.99, 1.00)*
2019/2020	1.12 (1.11, 1.12)*	0.99 (0.99, 1.00)*	0.92 (0.92, 0.93)*
2020/2021	1.26 (1.26, 1.27)*	0.96 (0.95, 0.96)*	0.93 (0.92, 0.93)*
Cut-off 1	1.64 (1.63, 1.66)	0.31 (0.30, 0.33)	0.21 (0.20, 0.23)
Cut-off 2	3.53 (3.52, 3.55)	2.01 (2.00, 2.03)	1.83 (1.82, 1.84)
Cut-off 3		3.06 (3.05, 3.08)	2.89 (2.88, 2.91)
Cut-off 4		4.15 (4.13, 4.16)	3.98 (3.96, 3.99)

*p-value <0.05.

Patient experiences in explanation of doctors on health conditions and treatment

After adjusting for potential confounders, we observed that all sexual identities were more likely to experience poorer scores of explanations from doctors regarding health conditions and treatment compared to heterosexual females. For instance, bisexual females were 1.50 times more likely to experience poorer scores of explanations compared to heterosexual females (OR: 1.50; 95% CI: 1.49–1.52; p-value <0.05). However, the association for gay males was not significant (see Table 3).

Level of involvement in decision making on healthcare

After adjusting for potential confounders, we observed that all sexual identities, except bisexual males, were more likely to experience lower levels of involvement in decision making on health compared to the heterosexual females. For instance, lesbian females were 1.28 times more likely to report lower levels of involvement in decision making on health (OR: 1.28; 95% CI: 1.25–1.30; p-value <0.05). However, bisexual males were 13% less likely to report lower levels of involvement in decision making on health (OR: 0.87; 95% CI: 0.85–0.89; p-value <0.05) (see Table 3).

Discussion

The purpose of this study was to explore levels of engagement and experiences of interactions with GPs (and nurses) among lesbian, gay and bisexual people compared to heterosexual people. In relation to the utilisation of GPs and nurses, lesbian and bisexual females were more likely to use GP or nurse services than heterosexual females. However, both heterosexual and gay/bisexual males were less likely to utilise GPs and nurse services compared to heterosexual females. Gay males and lesbian females were more likely to report poorer experiences in the explanation of health conditions and treatments, and more likely to report lower levels of involvement in decision making about their healthcare. Bisexual males and females were more likely to experience lower levels of trust in GPs compared to heterosexual females.

It is surprising that lesbian/bisexual females were more likely to use GPs and nurses than were heterosexual females given lower rates of engagement in cervical screening in this population.[2] However, this might suggest that lower engagement in healthcare among lesbian/bisexual females is restricted to gynaecological services and that this population is less reticent about engaging with health professionals over other concerns. It is also possible that, due to health disparities, lesbian and bisexual females experience serious illness at higher rates, necessitating more frequent engagement with health professionals. Additionally, studies on the health of lesbian and bisexual females typically include people who identify as transgender or gender diverse, whereas this study does not. Given that transgender and gender diverse people are reported to experience substantive challenges in accessing healthcare and therefore may actively avoid engagement, these findings may reflect the nature of the study sample.

In relation to men, the results of this study are consistent with a long-standing concern about men being much less likely to access healthcare than women. Men's engagement with healthcare services is impacted by factors such as structural barriers (e.g., general practices appearing unwelcoming), internal barriers (e.g., masculinity and stoicism) and a lack of understanding of the role of healthcare providers (e.g., overlooking role of prevention).[26] Many gay and bisexual men also very carefully manage their healthcare encounters,[17] including not disclosing their sexuality to their healthcare providers.[27,28] Such disclosures could be due to past or expected experiences of discomfort, negative attitudes and judgement and heteronormative assumptions demonstrated by healthcare professionals.[14] Additionally, some gay and bisexual men dismiss links between sexuality and health[29] and only feel it is relevant for doctors to know about sexuality if a consultation is about sexual behaviours.[17,22]

Consistent with previous research,[14–18] the findings of this study indicate that lesbian, gay and bisexual people have a poorer experience of GP services than do their heterosexual counterparts. This was evident across all three indicators asked about in the NZHS (trust of GPs, the explanation of health conditions and treatments and in decision making about healthcare options). While these indicators differ from those asked about in other studies, they may be attributable to factors such as GP discomfort during interactions with lesbian, gay and bisexual patients and knowledge gaps that may make conveying information in culturally appropriate ways more challenging. Without recognition of the ways in which the health needs of lesbian, gay and bisexual people differ from those of heterosexuals, it is difficult for GPs to provide appropriate multi-dimensional healthcare. Too often the onus is put on patients to disclose their sexuality and/or educate healthcare professionals about the ways in which their healthcare needs differ from those of heterosexuals.

Policy and practice implications

The findings of this study point to the need for GPs and nurses to be better educated about the specific health needs of lesbian, gay and bisexual people, in tandem with how to exercise culturally competent practice in respect of this population.

To do this, health professionals need to work in ways that create trust, leading to better provider–patient relationships. Rather than treating lesbian, gay and bisexual people as "special cases", this could be best accomplished through engagement that approaches all patients as if they may be sexually diverse rather than assuming heterosexuality. To upskill health practitioners in this, it is necessary to make LGBTQIA+ affirmative awareness training part of the in-service training of GPs and nurses.

Strengths and limitations

This study is based on national representative samples and pooled data from four waves of the NZHS. However, despite this study using the most robust data available for the health of lesbian, gay and bisexual populations in New Zealand, a potential limitation relates to the collection of information about the sexuality of respondents. Lesbian, gay and bisexual people have been found to be under-represented in population surveys,[30] and it is not possible to know how comfortable respondents in the survey were in identifying they were gay, lesbian or bisexual, or how accurate the responses were. This concern is pertinent given there is current concern among officials about people's willingness to answer questions about sexuality in government surveys.[17] In addition, the data collection processes assume a binary conceptualisation of gender (i.e., male or female), with no recognition of other ways of accounting for gender identities/expressions and the subsequent implications for sexual identities/labels.[18] Therefore, it is possible some people with a non-male or non-female gender identity may not have taken part or have been forced to use a label they were not comfortable with. There is also the possibility of a social-desirability bias, in that participants may have been more inclined to provide more desirable responses to questions about patient experience.

Our analysis was based on secondary data, which resulted in small sample sizes for certain groups, such as bisexual males. Consequently, interpretations regarding these groups should be made with caution. Moreover, the validity of the ordinal scales, specifically levels of trust, explanations of health conditions and treatments and patient involvement in decision making, was not assessed in this study, due to reliance on secondary data. The utilisation of GPs and nurses may be affected by COVID-19; however, in our study we did not consider this issue.

COMPETING INTERESTS
None to declare.
This research was funded by a Massey University Research Fund grant.

ACKNOWLEDGEMENTS
Access to the data used in this study was provided by Stats NZ under conditions designed to keep individual information secure in accordance with requirements of the *Statistics Act 1975*. The opinions presented are those of the authors and do not necessarily represent an official view of Stats NZ.

AUTHOR INFORMATION
Sonja J Ellis: Associate Professor Human Development, School of Education, The University of Waikato, Hamilton, New Zealand.
Jintana Jankhotkaew: PhD candidate, Researcher, SHORE & Whāriki Research Centre, Massey University, New Zealand; International Health Policy Program, Ministry of Public Health, Nonthaburi, Mueang, Thailand.
Stephen Neville: Professor, Head of Discipline – Nursing, School of Health, University of the Sunshine Coast, Queensland, Australia.
Jeffery Adams: Postgraduate Health Sciences Lecturer, SHORE & Whāriki Research Centre, Massey University, Auckland, New Zealand; School of Health and Sport Science, Eastern Institute of Technology, Auckland, New Zealand.

CORRESPONDING AUTHOR
Dr Sonja J Ellis: Te Kura toi Tangata | School of Education, The University of Waikato, Private Bag 3105, Hamilton 3240, New Zealand. E: sonja.ellis@waikato.ac.nz

URL
https://nzmj.org.nz/journal/vol-138-no-1612/sexual-identity-and-utilisation-of-primary-healthcare-services-findings-from-the-new-zealand-health-survey

REFERENCES
1. Shiu C, Kim HJ, Fredriksen-Goldsen K. Health care engagement among LGBT older adults: The role of depression diagnosis and symptomatology. Gerontologist. 2017;57(suppl 1):S105-14. doi: 10.1093/geront/gnw186.
2. Ellis SJ. Are women-who-have-sex-with-women an 'at-risk' group for cervical cancer? An exploratory study of women in Aotearoa New Zealand. Sex Health. 2024;21(1):NULL. doi: 10.1071/SH23145.
3. Williams AD, Bleicher RJ, Ciocca RM. Breast cancer risk, screening, and prevalence among sexual minority women: an analysis of the National Health Interview Survey. LGBT Health. 2020;7(2):109-18. doi: 10.1089/lgbt.2019.0274.
4. Newcomb ME, Moran K, Li DH, Mustanski B. Demographic, regional, and political influences on the sexual health care experiences of adolescent sexual minority men. LGBT Health. 2020;7(1):28-36. doi: 10.1089/lgbt.2019.0122. Epub 2019 Nov 21.
5. Furukawa NW, Maksut JL, Zlotorzynska M, et al. Sexuality disclosure in U.S. gay, bisexual, and other men who have sex with men: Impact on healthcare-related stigmas and HIV pre-exposure prophylaxis. Am J Prev Med. 2020;59(2):e79-e87. doi: 10.1016/j.amepre.2020.02.010.
6. Medina-Martínez J, Saus-Ortega C, Sánchez-Lorent MM et al. Health inequities in LGBT people and nursing interventions to reduce them: A systematic review. Int J Environ Res Public Health. 2021;18(22):11801. doi: 10.3390/ijerph182211801.
7. Tundealao S, Sajja A, Titiloye T, et al. Prevalence of self-reported cancer based on sexual orientation in the United States: a comparative analysis between lesbian, bisexual, gay, and heterosexual individuals. Cancer Causes Control. 2023;34(11):1027-35. doi: 10.1007/s10552-023-01749-0.
8. Simenson AJ, Corey S, Markovic N, Kinsky S. Disparities in chronic health outcomes and health behaviors between lesbian and heterosexual adult women in Pittsburgh: a longitudinal study. J Womens Health (Larchmt). 2020;29(8):1059-67. doi: 10.1089/jwh.2019.8052.
9. Stevens SD. Obesity in sexual and gender minority populations: prevalence and correlates. Curr Obes Rep. 2023;12(2):175-82. doi: 10.1007/s13679-023-00499-z.
10. Martín-Sánchez M, Case R, Fairley C, et al. Trends and differences in sexual practices and sexually transmitted infections in men who have sex with men only (MSMO) and men who have sex with men and women (MSMW): a repeated cross-sectional study in Melbourne, Australia. BMJ Open. 2020;10(11):e037608. doi: 10.1136/bmjopen-2020-037608.
11. Wittgens C, Fischer MM, Buspavanich P, et al. Mental health in people with minority sexual orientations: A meta-analysis of population-based studies. Acta Psychiatr Scand. 2022;145(4):357-72. doi: 10.1111/acps.13405.
12. Tan KKH, Ellis SJ, Schmidt JM, et al. Mental health inequities among transgender people in Aotearoa New Zealand: Findings from the Counting Ourselves Survey. Int J Environ Res Public Health. 2020;17(8):2862. doi: 10.3390/ijerph17082862.
13. Fox KR, Choukas-Bradley S, Salk RH, et al. Mental

health among sexual and gender minority adolescents: Examining interactions with race and ethnicity. J Consult Clin Psychol. 2020;88(5):402-15. doi: 10.1037/ccp0000486.
14. McNeill SG, McAteer J, Jepson R. Interactions between health professionals and lesbian, gay and bisexual patients in healthcare settings: a systematic review. J Homosex. 2023;70(2):250-76. doi: 10.1080/00918369.2021.1945338.
15. LaVaccare S, Diamant AL, Friedman J, et al. Healthcare experiences of underrepresented lesbian and bisexual women: a focus group qualitative study. Health Equity. 2018;2(1):131-38. doi: 10.1089/heq.2017.0041. Erratum in: Health Equity. 2018;2(1):233. doi: 10.1089/heq.2017.0041.correx.
16. Thomas C, Dwyer A, Batchelor J, Van Niekerk LA. qualitative exploration of gynaecological healthcare experiences of lesbian, gay, bisexual, transgender, queer people assigned female at birth. Aust N Z J Obstet Gynaecol. 2024;64(1):55-62. doi: 10.1111/ajo.13741.
17. Adams J, McCreanor T, Braun V. Doctoring New Zealand's gay men. N Z Med J. 2008;121(1287):11-20.
18. Munson S, Cook C. Lesbian and bisexual women's sexual healthcare experiences. J Clin Nurs. 2016;25(23-24):3497-3510. doi: 10.1111/jocn.13364.
19. Albuquerque GA, da Silva Quirino G, dos Santos Figueiredo FW, et al. Sexual diversity and homophobia in health care services: perceptions of homosexual and bisexual population in the cross-cultural theory. Open J Nurs. 2016;6(6):470-482. doi: 10.4236/ojn.2016.66049.
20. Manzer D, O'Sullivan L, Doucet S. Culturally competent care of LGBT patients: The NP experience. Int J Adv Nurs Educ Res. 2019;4(3):53-68. doi: 10.21742/IJANER.2019.4.3.09.
21. Villemure SE, Astle K, Phan T, Wilby KJ. A scoping review of the minority stress processes experienced by sexual and gender minority individuals in pharmacy settings: implications for health care avoidance. J Am Pharm Assoc. 2023;63(1):32-38. doi: 10.1016/j.japh.2022.10.011.
22. Adams J, McCreanor T, Braun V. Gay men's explanations of health and how to improve it. Qual Health Res. 2013;23(7):887-99. doi: 10.1177/1049732313484196.
23. Liu A, He H, Tu XM, Tang W. On testing proportional odds assumptions for proportional odds models. Gen Psychiatr. 2023;36(3):e101048. doi: 10.1136/gpsych-2023-101048.
24. Bennett DA. How can I deal with missing data in my study? Aust N Z J Public Health. 2001;25(5):464-69.
25. Dong Y, Peng CY. Principled missing data methods for researchers. SpringerPlus. 2013;2(1):1-17. doi: 10.1186/2193-1801-2-222.
26. Mursa R, Patterson C, Halcomb E. Men's help-seeking and engagement with general practice: An integrative review. J Adv Nurs. 2022;78(7):1938-53. doi: 10.1111/jan.15240.
27. Neville S, Henrickson M. Perceptions of lesbian, gay and bisexual people of primary healthcare services. J Adv Nurs. 2006;55(4):407-15. doi: 10.1111/j.1365-2648.2006.03944.x.
28. Ludlam AH, Saxton PJ, Dickson NP, Hughes AJ. General practitioner awareness of sexual orientation among a community and internet sample of gay and bisexual men in New Zealand. J Prim Health Care. 2015;7(3):204-12.
29. Adams J, Braun V, McCreanor T. Gay men talking about health: Are sexuality and health interlinked? Am J Mens Health. 2012;6(3):182-93. doi: 10.1177/1557988311421980.
30. Van Kampen SC, Lee W, Fornaseiro M, Husk K. The proportion of the population in England that self-identifies as lesbian, gay or bisexual: Producing modelled estimates based on national social surveys. BMC Res Notes. 2017;10(1):594. doi: 10.1186/s13104-017-2921-1.

Identifying multiple sclerosis in linked administrative health data in Aotearoa New Zealand

Natalia Boven, Deborah F Mason, Barry J Milne, Annemarei Ranta, Andrew Sporle, Lisa Underwood, Julie Winter-Smith, Vanessa Selak

ABSTRACT

AIM: The 2006 New Zealand national multiple sclerosis (MS) prevalence study (NZMSPS) provided invaluable information about the prevalence of MS in Aotearoa and characteristics of people with this debilitating condition. This study aimed to update the NZMSPS by identifying people with MS using linked administrative health records.

METHODS: Cases of MS were identified from hospitalisation, pharmaceutical dispensing, needs assessments for older adults and disability support records between January 1988 and June 2022. MS prevalence was estimated, and characteristics described and compared by sub-groups.

RESULTS: A total of 7,890 people (73% female) with MS were identified across the study period. The estimated crude national prevalence of MS in 2022 was 96.6 per 100,000 (72.4 in 2006). MS prevalence exhibited a strong latitudinal gradient. Estimated age-adjusted prevalence was highest for Europeans (124.7 per 100,000), followed by Middle Eastern/Latin American/African (MELAA) (85.5), Māori (41.8), Asian (16.8) and Pacific peoples (11.1) ethnic groups.

CONCLUSION: Characteristics of MS cases were broadly similar to previous research, excepting a greater estimated prevalence among Māori, and a lower relative estimated prevalence for Auckland than surrounding regions. Linked administrative health data can be used to identify people with MS in Aotearoa, providing a mechanism for further research.

Multiple sclerosis (MS) is a chronic, inflammatory demyelinating disease of the central nervous system.[1] MS causes a range of neurological symptoms, including spasticity, optic neuritis, sensory disturbances, weakness, motor coordination impairment and cognitive dysfunction, as well as profound fatigue.[1]

The New Zealand national MS prevalence study (NZMSPS) identified 2,917 people with definite MS who were resident in Aotearoa on census day 2006, yielding an estimated prevalence of 72.4 per 100,000.[2,3] This was an estimated 96.7% of diagnosed cases.[2,3] Other studies of people with MS in Aotearoa have used online cohorts,[4] or older regional cohorts.[5]

For the NZMSPS, various organisations holding data about MS, including consultant neurologists, Multiple Sclerosis New Zealand (MSNZ), the Ministry of Health – Manatū Hauora and district health boards, contacted people living with MS and invited them to participate on behalf of researchers.[3] The study was also advertised publicly.[3] Consenting participants completed questionnaires and shared their medical records, which were assessed by a study neurologist.[3] Once established, this cohort has been used to understand mortality,[6] disability profiles,[7] the relationship between receipt of disease-modifying therapies and disability[8] and clinical features and geographic distributions of Māori and non-Māori living with MS.[9]

The Integrated Data Infrastructure (IDI) contains de-identified linked-administrative, census and survey data for an "ever resident" population of Aotearoa, and is accessible for research in the public interest.[10] Information is available across many domains of life, including (but not limited to) health, education, work and family composition.[10] The IDI allows for a wide range of research, including cross-sectional and longitudinal analyses, research about small populations, intervention analyses and examination of the social determinants of health.[10]

Previous research has characterised a range of medical conditions in the IDI, including autism and mental health conditions,[11] attention-deficit/hyperactivity disorder,[12] sudden unexpected deaths among infants[13] and chronic conditions.[14] To our knowledge, there has been little research characterising chronic autoimmune conditions

like MS in the IDI. Identifying such conditions may be challenging, as the IDI does not contain diagnostic codes from primary care or outpatient settings,[15] and it is likely that such disorders are commonly diagnosed in these settings.

Research aims

This study aims to:

1. Use health service data in the IDI to identify a cohort of individuals likely to have been diagnosed with MS.
2. Compare the characteristics of the identified cohort to previous studies, including the NZMSPS.

Methods

The Integrated Data Infrastructure (IDI)

The IDI is a large research database developed and managed by Stats NZ containing de-identified linked-administrative, census and survey data.[10] Records in the IDI are linked probabilistically to a central "spine" of people who have been ever-resident in Aotearoa.[10] In accordance with Stats NZ confidentiality requirements, all counts in this paper have been random rounded to base 3, and some small categories have been combined or could not be presented.

Data sources for identifying MS cases

Individuals likely to have been diagnosed with MS were identified based on service use in the following areas:

- publicly funded hospitalisations (January 1988–June 2022)
- privately funded hospitalisations (January 2001–December 2020)
- interRAI needs assessments of older adults (July 2014–June 2022)
- disability assessments through national disability support services (Socrates) (January 1998–June 2022)
- pharmaceutical dispensings (January 2006–June 2022).

Hospital discharges with the ICD-9 code 340 or the ICD-10 code G35 recorded as the primary or secondary diagnosis were used to identify people with MS from both publicly funded and privately funded hospitalisations. The disability support service and interRAI data contain specific flags for MS. Pharmaceutical dispensings of the eight funded disease-modifying therapies (DMTs)—interferon beta-1-alpha, interferon beta-1-beta, glatiramer acetate, teriflunomide, dimethyl fumarate, fingolimod, natalizumab and ocrelizumab—were taken as evidence of MS.[16]

Cohort characteristics

The following characteristics were compared between the IDI MS cohort and prior studies: gender, self-identified ethnic distribution, Māori descent (ancestry), regional distribution and functional limitations.[2,5,7,9,17] We also report on age of first record of MS and distribution by area deprivation using the 2018 New Zealand Index of Deprivation (NZDep2018).[18]

Demographic data were sourced from the personal details table, which contains information on gender, birth year and ethnicity for all individuals in the IDI.[19] Ethnic group information is source-ranked, with more reliable data sources prioritised.[19] Everyone was counted in every level 1 ethnic group with which they identify—Māori, Pacific peoples, Asian, Middle Eastern/Latin American/African (MELAA) and European.

Data on Māori descent, region and usual residence were sourced from the administrative population census (APC), with geographical data measured at 30 June 2022.[20] Māori descent data in the APC is sourced from birth records.[20] Area deprivation was classified by linking small area information (meshblocks) with NZDep2018 scores. Functional limitations were measured using the Washington Group Short Set in the 2018 census.[21]

Comparisons were made for three different cohorts, i) the overall cohort of people classified with MS at any point, whether or not they subsequently moved overseas or died ("overall cohort"), ii) those resident and classified with MS by 30 June 2022 ("resident in June 2022"), and iii) those resident and classified with MS by 30 June 2018 ("resident in June 2018"; functional limitations only).

There was no missing data for age, gender, ethnicity, region or area deprivation for the relevant MS cohorts. Māori descent was unknown for 19% (1,515/7,890) of the overall MS cohort. Of those resident in June 2018, 12–13% (516–549/4,278) were missing data for individual functional limitation domains.

Crude prevalence

Crude prevalence rates for the total resident population (N=5,029,095) and population subgroups were calculated using estimates from the

June 2022 APC.[20] No age restrictions were applied as children can be (rarely) affected by MS.

Age standardisation

Direct standardisation to the total resident population in June 2022[20] was used to allow for comparisons across groups with different age structures. Age-adjusted rates are presented by gender and ethnic group, for those of Māori descent and by region. Age-specific rates were calculated for the following age groups: <40, 40–49, 50–59 and 60+ years. Due to small counts, those aged 40–59 were combined to calculate the age-adjusted rate for Pacific peoples, so this rate may not be directly comparable.

Area deprivation trends

Binary logistic regression was used to estimate associations between NZDep2018 decile and MS records for the resident population in June 2022. Analyses were stratified by ethnic group and Māori descent. Models controlled for age and gender. Under 1% (38,313/5,024,235) of people without a record of MS were excluded due to missing NZDep2018, having implausible ages (>110), or not being classified as male or female.

Software

SAS Enterprise Guide 8.3 was used for data management. Tabulations were conducted in Microsoft Excel. R was used to conduct regression analyses and create figures.

Results

Identification of MS cases

Counts of people with MS classified from each data source for the overall cohort and for those resident in June 2022 are summarised in Table 1. Overall, 7,890 people were identified with service use with MS recorded or indicated, of which 4,860 were classified as resident in June 2022. Some people with MS were identified from more than one data source.

Most people were identified from a publicly funded hospitalisation event, with 87% (6,897/7,890) of people in the overall MS cohort identified this way. This was followed by receipt of DMTs at 33% (2,616/7,890), receipt of disability support at 25% (1,965/7,890), interRAI assessments at 12% (918/7,890) and privately funded hospitalisations at 1% (177/7,890). The distribution was broadly similar for those resident in June 2022, excepting that 49% (2,373/4,860) had received DMTs for MS.

There was a considerable degree of overlap between data sets. However, for the overall cohort, 47% (3,216/6,897) of those identified from publicly funded hospitalisations were only identified from this source. This compares to 28% (258/918) for interRAI assessments, 19% (495/2,616) for pharmaceutical records, 15% (27/177) for privately funded hospitalisations and 9% (168/1,965) for disability support services.

National prevalence

The estimated national crude prevalence of MS from this study is 96.6 per 100,000 for the resident population in June 2022.

Demographic characteristics

Table 2 presents demographic characteristics. Of the total cohort, 73% (5,766/7,890) were women, 95% (7,509/7,890) identified as European and 5% (399/7,890) identified as Māori.

Age-adjusted prevalence in June 2022 was estimated at 145.1 per 100,000 for women compared to 48.9 per 100,000 for men. Estimated

Table 1: Number of people identified as multiple sclerosis (MS) cases from each health data source for the overall cohort and those resident in June 2022.

Data set	Overall cohort N/7,890 (%)	Resident, June 2022 N/4,860 (%)
Public hospitalisations	6,897 (87)	4,149 (85)
Private hospitalisations	177 (2)	54 (1)
Socrates	1,965 (25)	1,296 (27)
InterRAI	918 (12)	435 (9)
Pharmaceuticals	2,616 (33)	2,373 (49)

Table 2: Distribution of key demographic characteristics for those with multiple sclerosis (MS) for the overall cohort and those resident in June 2022.

		Overall cohort N/7,890	Resident, June 2022 N/4,860		
Variable	**Category**	**n (%)**	**n (%)**	**Crude prevalence per 100,000**	**Age-adjusted prevalence per 100,000**
Gender	Men	2,124 (27)	1,200 (25)	47.9	48.9
	Women	5,766 (73)	3,660 (75)	145.1	142.4
Ethnic group	Māori	399 (5)	297 (6)	33.1	41.8
	Pacific peoples	63 (1)	42 (1)	9.2	11.1
	Asian	171 (2)	135 (3)	16.0	16.8
	MELAA	174 (2)	78 (2)	72.6	85.5
	European	7,509 (95)	4,617 (95)	132.4	124.7
Māori descent	Yes	396 (5)	309 (6)	36.1	48.6
	No	5,985 (76)	3,969 (82)		
	Missing/ unknown	1,515 (19)	582 (12)		

MELAA = Middle Eastern, Latin American and African.

age-adjusted prevalence was highest for Europeans (124.7 per 100,000), followed by MELAA (85.5), Māori (41.8), Asian (16.8) and Pacific peoples (11.1) ethnic groups. The age-adjusted rate of MS was slightly higher for those of Māori descent (48.6) than those with Māori ethnicity.

Age of first record

The mean (SD) age of first record was 47.4 (15.4) years for the overall cohort. Mean age of first record was similar for men at 48.6 (15.8) years and women at 46.9 (15.3) years. Across ethnic groups, mean age of first record was oldest for Europeans at 47.7 (15.3) years, followed by MELAA, Pacific peoples, Māori and Asian ethnic groups at 43.9 (16.0) years, 42.4 (18.5) years, 40.7 (14.4) years and 37.1 (14.7) years, respectively. Mean age of first record was 40.4 (14.5) years for people of Māori descent.

Regional distribution

Estimated crude and age-adjusted prevalence rates for each region are shown in Figure 1, which demonstrates a strong latitudinal gradient. Due to small counts, Gisborne and Hawke's Bay, and Nelson and Marlborough, were combined to estimate age-adjusted prevalence rates. Estimated crude and age-adjusted prevalence rates were generally similar. The highest crude prevalence rate was in Southland at 209.8 per 100,000, while the lowest crude prevalence was in Auckland at 59.5 per 100,000.

Functional limitations

Figure 2 compares the distributions of functional limitations across six domains (mobility, self-care, cognition, vision, communication and hearing) between those with a record of MS by June 2018 and the total resident population. People with MS had greater levels of functional limitations compared to people of the same age for all age groups across all domains except for hearing. Functional limitations were particularly pronounced for mobility and self-care.

For the hearing domain, the <40 and 40–49 age categories were combined, and 9% (120/1,302)

Figure 1: Crude and age-adjusted prevalence rates of multiple sclerosis (MS) per 100,000 population by region for those resident in June 2022.

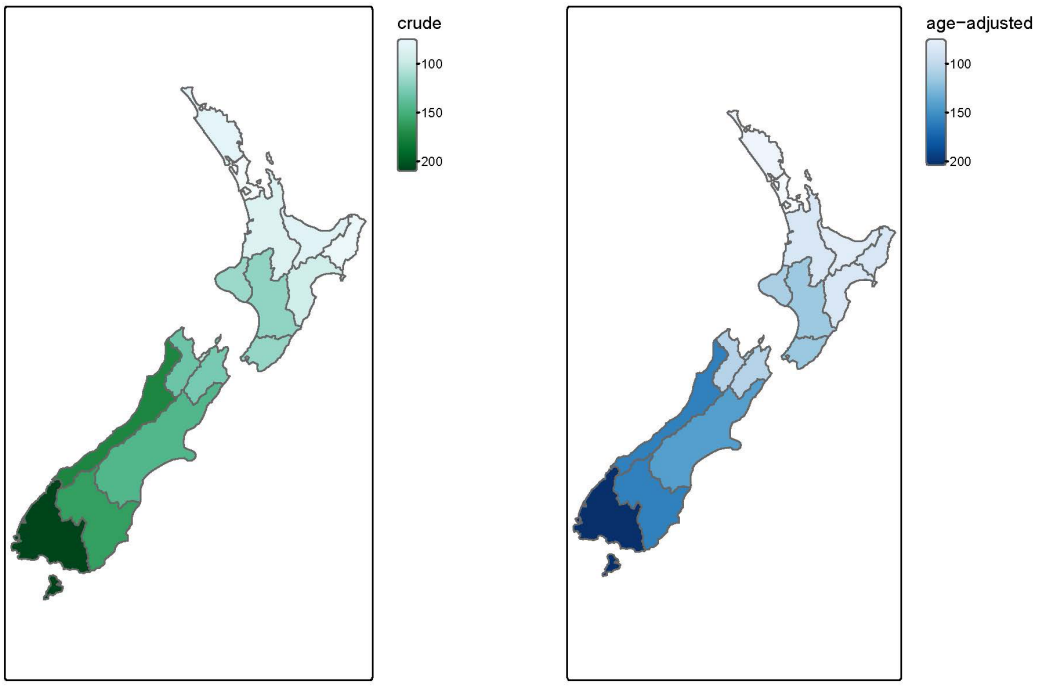


Figure 2: Functional limitations by age band for the resident multiple sclerosis (MS) cohort compared to the total Aotearoa resident population in June 2018.

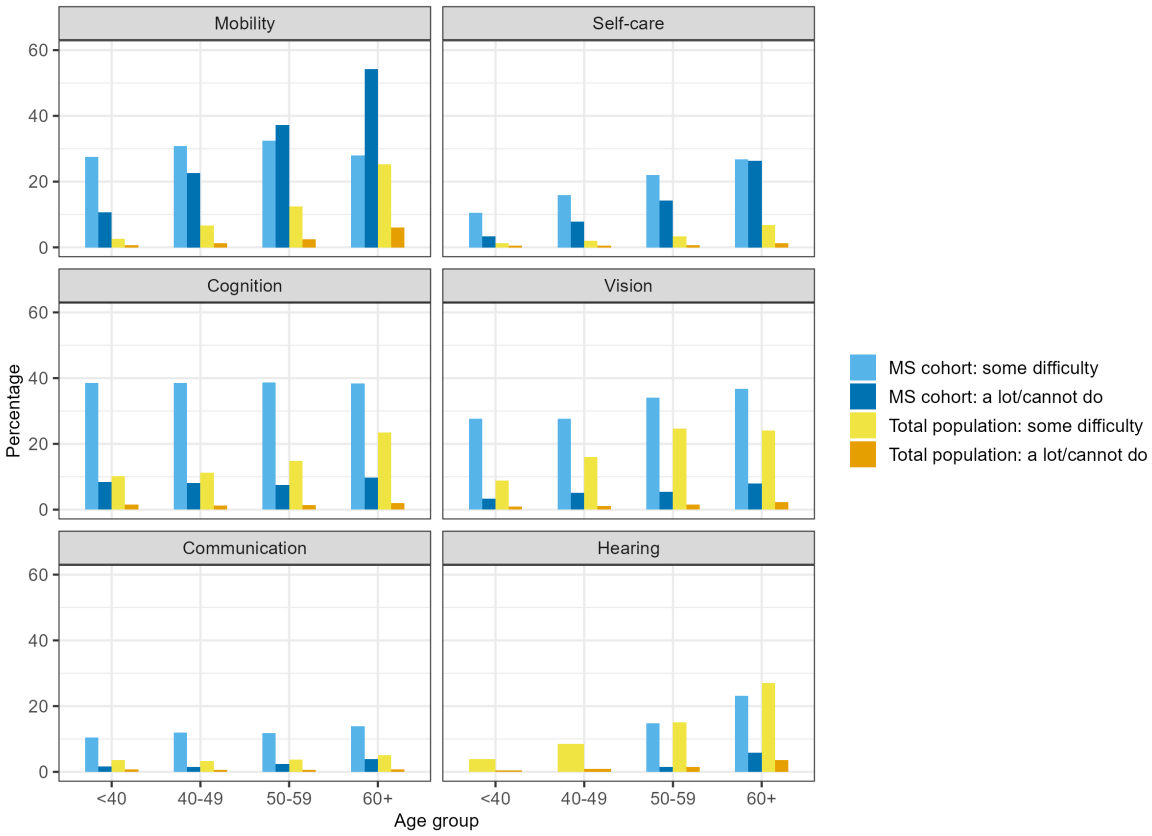
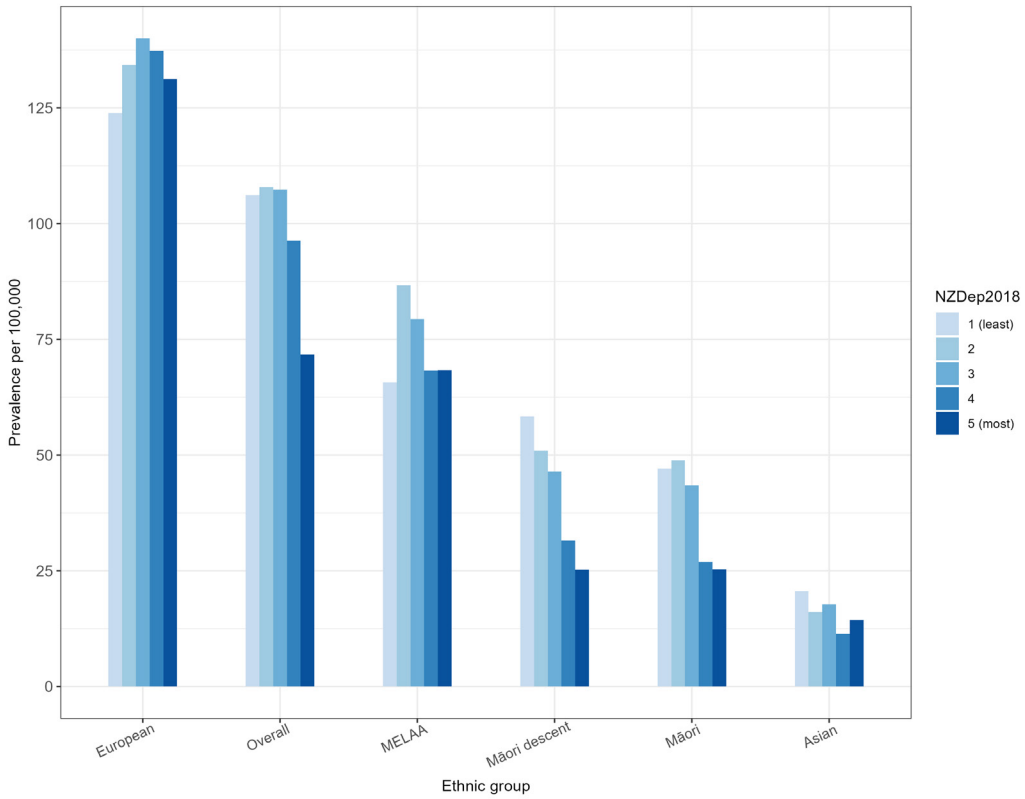


Figure 3: Crude prevalence rates of multiple sclerosis (MS) per 100,000 population by NZDep2018 quintile for those resident in June 2022 by ethnic group and Māori descent.



of those with MS reported some difficulty with hearing, while under 1% (6/1,302) reported a lot of difficulty or being unable to hear.

Area deprivation

Figure 3 shows the crude prevalence of MS per 100,000 population across area deprivation quintiles for those classified with MS and resident in June 2022 stratified by ethnic groups (excluding Pacific peoples group due to small counts). This shows a reduced prevalence of MS for the overall cohort, and for people with Māori ethnicity and Māori descent, among the most deprived quintiles. This pattern was not evident for the European ethnic group, for whom those living in the least deprived quintile had the lowest estimated prevalence.

Table 3 shows the results of logistic regression models estimating the association between area deprivation and MS records, controlling for age and sex. For the total population, the odds of having a record of MS were 0.97 (0.96, 0.98) times lower with each one decile increase in NZDep2018. Stronger associations were apparent between area deprivation and MS records for the Māori, Pacific peoples and Māori descent groups, with estimated odds ratios of 0.90 (0.87, 0.93) for both the Māori ethnicity and Māori descent groups, and 0.87 (0.80, 0.95) for the Pacific peoples ethnic group. For the European ethnic group, the odds of having a record of MS were 1.01 (1.00, 1.02) times greater given a one decile increase in NZDep2018. There was no evidence of an association between area deprivation and MS records for the Asian or MELAA ethnic groups.

Discussion

This study identified 7,890 people with MS in the IDI within the period from January 1988 to June 2022. Most people were identified from publicly funded hospital records. MS was more common in women, European and MELAA ethnic groups, and people living in more Southern regions. Estimated prevalence of MS was lower among those living in the most deprived quintiles for the overall resident population, Māori, Pacific peoples and those of Māori descent. People with MS reported greater levels of functional impairment, especially for mobility and self-care.

Table 3: Logistic regression models for having a record of multiple sclerosis (MS) by NZDep2018, controlling for age and gender, for the resident population in June 2022, and for each ethnic group and Māori descent.

Model (N)	Parameter	Odds ratio (95% CI)	t-value	p-value
Overall (N=4,985,922)	Intercept	0.00 (0.00, 0.00)	-193.2	<0.001
	NZDep2018 (decile)	0.97 (0.96, 0.98)	-5.7	<0.001
	Gender: female	2.87 (2.69, 3.07)	31.7	<0.001
	Age (1-year)	1.03 (1.03, 1.03)	68.3	<0.001
Māori (N=893,598)	Intercept	0.00 (0.00, 0.00)	-52.0	<0.001
	NZDep2018 (decile)	0.90 (0.87, 0.93)	-5.7	<0.001
	Gender: female	3.11 (2.38, 4.07)	8.3	<0.001
	Age (1-year)	1.04 (1.04, 1.04)	22.2	<0.001
Pacific peoples (N=449,169)	Intercept	0.00 (0.00, 0.00)	-22.0	<0.001
	NZDep2018 (decile)	0.87 (0.8,0 0.95)	-3.0	0.003
	Gender: female	1.86 (0.97, 3.56)	1.9	0.061
	Age (1-year)	1.03 (1.02, 1.04)	6.5	<0.001
Asian (N=829,098)	Intercept	0.00 (0.00, 0.00)	-35.2	<0.001
	NZDep2018 (decile)	0.95 (0.89, 1.01)	-1.5	0.13
	Gender: female	2.67 (1.81, 3.93)	5.0	<0.001
	Age (1-year)	1.02 (1.01, 1.03)	6.5	<0.001
MELAA (N=105,603)	Intercept	0.00 (0.00, 0.00)	-26.2	<0.001
	NZDep2018 (decile)	0.97 (0.90, 1.05)	-0.8	0.423
	Gender: female	2.63 (1.62, 4.27)	3.9	<0.001
	Age (1-year)	1.04 (1.03, 1.04)	8.7	<0.001
European (N=3,469,437)	Intercept	0.00 (0.00, 0.00)	-187.6	<0.001
	NZDep2018 (decile)	1.01 (1.00, 1.02)	2.1	0.034
	Gender: female)	2.87 (2.69, 3.07)	30.8	<0.001
	Age (1-year)	1.03 (1.03, 1.03)	60.9	<0.001
Māori descent (N=851,280)	Intercept	0.00 (0.00, 0.00)	-52.9	<0.001
	NZDep2018 (decile)	0.90 (0.87, 0.93)	-5.9	<0.001
	Gender: female	3.21 (2.46, 4.20)	8.5	<0.001
	Age (1-year)	1.04 (1.04, 1.04)	23.6	<0.001

NZDep = New Zealand Index of Deprivation; MELAA = Middle Eastern, Latin American and African.

Comparisons with the prior studies

The estimated prevalence rate of 96.6 per 100,000 is considerably higher than the estimate of 72.4 per 100,000 from the NZMSPS in 2006.[2,3] Prior research demonstrated an increase in the prevalence of MS in Aotearoa over the period 1968–2006[5] and it is possible that this represents a continuation of this trend. Increasing rates of MS have been observed in other countries.[22]

Demographic characteristics of the cohort from this study are broadly similar to previous research. The cohort was predominantly women and European, with lower prevalence rates for Māori, Pacific peoples and Asian ethnic groups, consistent with the NZMSPS.[2,9,17] While prevalence for MELAA has not previously been reported for Aotearoa, the estimated prevalence for this group was 72.6 per 100,000, higher than most other ethnic groups.

However, prevalence rates among those of Māori ethnicity and Māori descent (crude rates 33.1 per 100,000 and 36.1 per 100,000, respectively) were considerably higher than that reported in the NZMPS (15.9 per 100,000 and 20.6 per 100,000), consistent with research suggesting the prevalence of diagnosed MS may be increasing among Māori.[2,9,17]

Average age of onset in the NZMSPS was 35 years.[7] A study of MS incidence in Aotearoa in 2014 found that the average age of onset was 37.8 (26.1–49.5) years, while the average age of diagnosis was 42.4 (29.7–55.1) years (In an email from DF Mason, October 2024), indicating that a substantial delay between onset of symptoms and diagnosis is typical. The greater average age of first record in the current study (47.4 years) likely reflects delays between initial diagnosis and having an event suggestive of MS captured in the IDI. Consequently, people in the MS IDI cohort will often have lived with symptoms of MS for some time prior to their first record of MS in the IDI.

A strong latitudinal gradient was observed, with greater estimated prevalences of MS further south, as has been previously reported.[2,5,17] The latitudinal gradient may be related to greater vitamin D exposure in northern regions, which is thought to be potentially protective against MS, as well as differences in ethnic composition across Aotearoa.[2,9]

However, a lower prevalence of MS was found for Auckland compared to the surrounding regions, Northland and Waikato, opposite to the pattern observed in the NZMSPS.[2] Auckland is the largest region in Aotearoa and has a greater share of the population born overseas (42.9% at the 2023 census).[23] Evidence from Denmark, also a high-risk country for MS, shows that first generation migrants arriving from low-risk countries have a lower MS risk than those born in Denmark, but a higher risk than in their country of birth.[24] The risk of developing MS was greater for those who migrated earlier in life, while the risk for second-generation migrants was greater than for ethnic Danes.[24] This suggests a strong role for environmental factors, which may include exposure to vitamin D, tobacco, obesity and age of primary Epstein–Barr infection.[24] Differences in characteristics between those who migrate and those who do not (e.g., the "healthy-migrant effect") may also play a role.[24] Investigating whether migration influences the MS prevalence in Auckland warrants further study.

We are not aware of previous research using the Washington Group Short Set to characterise functional capacity for people living with MS. Prior research in Aotearoa using the Expanded Disability Status Scale (EDSS), a MS-specific measure of disability particularly related to mobility, found higher levels of disability with increasing age,[7] consistent with mobility-related disability in this study.

Differences in estimated prevalence by area deprivation

This study found lower prevalence rates of recorded MS among those living in the most deprived areas for the total population, for Māori and Pacific peoples and for people of Māori descent. This may represent diagnostic barriers in more deprived areas.

Evidence for an association between socio-economic position and MS risk, as well as the direction of such relationships, is conflicting.[24,25] Studies conducted in more unequal countries tend to find lower risk of MS among those with low socio-economic position, possibly reflecting underdiagnosis due to difficulties accessing and navigating healthcare.[25] Notably, some potential risk factors for MS (e.g., smoking) are socio-economically patterned.[25]

Differences in estimated prevalence across ethnic groups

Internationally, there is a perception that MS may be less common among minority ethnic groups.[25] This may create barriers to testing and diagnosis, thereby reinforcing this belief.[25] In Aotearoa, lower rates of MS among Māori have

been ascribed to lower frequency of high-risk genetic alleles relating to the human leukocyte antigens system.[26] However, using ethnic categories to understand genetic disease risk can be highly problematic, especially given their imprecise and often overlapping nature.[27] Furthermore, there are well-known access issues among Māori and Pacific peoples in the healthcare system.[12,28,29] People identifying with Māori and Pacific peoples ethnic groups are more likely to live in deprived areas,[29] and less likely to have a record of MS if living in more deprived areas. Ethnic-specific and socio-economic barriers may intersect to reduce access to MS testing and diagnosis for these groups.

Coverage errors

Twenty percent of patients assessed by two specialty clinics in California had previously been misdiagnosed with MS.[30] Given people were classified with MS based on any instance of MS recorded/indicated in the IDI, it is likely that some people re-assessed as not having MS at a later point were included in the MS cohort. By contrast, NZMPS participants who had not seen a neurologist in the previous 12 months were re-assessed by a study neurologist.[3]

It is also likely that people with MS are missing from this cohort. People with established diagnoses of MS may be missing if they have not received DMTs, disability support or interRAI needs assessments, and have not been hospitalised with MS listed as a discharge diagnosis. It is likely there are people living with MS who are undiagnosed.

Reassuringly, the characteristics of the MS IDI cohort are broadly consistent with previous research, and the number of people identified with MS is plausible. This suggests that the cohort is useful for understanding patterns, although it should not be considered an accurate count of everyone in Aotearoa with MS.

Strengths and limitations

Classifying MS in the IDI allows researchers to examine a wide range of outcomes across multiple life domains.

Several important limitations warrant mention. Firstly, it is not possible to identify the subtype of MS, even among those hospitalised, as the ICD data in the IDI does not include this information. Importantly, disease-related outcomes and DMT eligibility varies by MS subtype.[1,7,17] Other important clinical information is unavailable, such as age of onset and diagnosis, and EDSS scores.

While the IDI is useful for understanding patterns, the cohort of people with MS will include some people who do not have MS and exclude some people who do. Without access to detailed clinical information, it is difficult to determine the extent to which this is the case. We also did not include formal validation against high quality incidence data.

Conclusion

The study identified 4,860 resident people in June 2022 with health records suggestive of MS between 1988 and 2022, resulting in an estimated crude prevalence of 96.6 per 100,000. The MS cohort was broadly similar to previously research in Aotearoa, except that the estimated prevalence among Māori was greater, and the estimated prevalence for Auckland was lower than surrounding regions. Overall, this study demonstrates that the IDI appears to be a viable tool to measure and monitor MS prevalence, demographic patterns and treatment rates in Aotearoa.

COMPETING INTERESTS

NB and BM are currently receiving funding from the New Zealand Multiple Sclerosis Research Trust to extend the research presented in this paper. Multiple Sclerosis New Zealand, Multiple Sclerosis Auckland, the New Zealand Multiple Sclerosis Research Trust and Rare Disorders NZ were consulted during this project.

VS is a Board member on EQUIT3 (vaping cessation trial) DSMB, Cess@Tion (smoking cessation trial) DSMB, and is also Board member and Deputy Chair (Medical Committee) for the Auckland Medical Research Foundation.

LU is a committee member and community organiser for Tuberous Sclerosis Complex New Zealand.

DM is a medical advisor for MSNZ.

AR is a member of the ANZSO Board, Stroke Aotearoa NZ Board, WSO Board, APSO Board.

This study was funded by a Health Research Council Health Delivery Research Activation Grant (grant number 23/659/A). The funder played no role in the research.

The University of Auckland received programme grants for this manuscript from Healthier Lives – He Oranga Hauora – National Science Challenge and Heart Foundation of New Zealand.

This project was approved by the Auckland Health Research Ethics Committee on 16/08/2023, reference number AH26469.

IDI disclaimer: Access to the data used in this study was provided by Stats NZ under conditions designed to give effect to the security and confidentiality provisions of the *Data and Statistics Act 2022*. The results presented in this study are the work of the author, not Stats NZ or individual data suppliers. These results are not official statistics. They have been created for research purposes from the Integrated Data Infrastructure (IDI), which is carefully managed by Stats NZ. For more information about the IDI please visit https://www.stats.govt.nz/integrated-data/.

ACKNOWLEDGEMENTS

We would like to thank Multiple Sclerosis New Zealand, Multiple Sclerosis Auckland, the New Zealand Multiple Sclerosis Research Trust, and Rare Disorders New Zealand for sharing their time and expertise for this project. These organisations provided useful context about the state of MS healthcare in Aotearoa and the experiences of those affected by MS. We would also like to acknowledge the Health Research Council for funding this study, Stats NZ for providing access to the data and the Public Policy Institute at The University of Auckland for allowing us to use their data lab.

AUTHOR INFORMATION

Natalia Boven: Postdoctoral fellow, COMPASS Research Centre, The University of Auckland, Auckland.

Deborah F Mason: Neurologist, Department of Neurology, Christchurch Hospital, Christchurch.

Barry J Milne: Director and Associate Professor, COMPASS Research Centre, The University of Auckland, Auckland.

Annemarei Ranta: Head of Department and Professor of Neurology, Department of Medicine, University of Otago, Wellington.

Andrew Sporle: Honorary Academic, Department of Statistics, The University of Auckland, Auckland.

Lisa Underwood: Senior Research Fellow, COMPASS Research Centre, The University of Auckland, Auckland.

Julie Winter-Smith: Professional Teaching Fellow, Health Systems Department, The University of Auckland, Auckland.

Vanessa Selak: Head of Department and Associate Professor, Epidemiology and Biostatistics, The University of Auckland, Auckland.

CORRESPONDING AUTHOR

Natalia Boven: Postdoctoral fellow, COMPASS Research Centre, The University of Auckland, Private Bag 92019, Victoria Street West, Auckland 1142, New Zealand. E: natalia.boven@auckland.ac.nz

URL

https://nzmj.org.nz//journal/vol-138-no-1612/identifying-multiple-sclerosis-in-linked-administrative-health-data-in-aotearoa-new-zealand

REFERENCES

1. McGinley MP, Goldschmidt CH, Rae-Grant AD. Diagnosis and Treatment of Multiple Sclerosis: A Review. JAMA. 2021;325(8):765-79. doi: 10.1001/jama.2020.26858.
2. Taylor BV, Pearson JF, Clarke G, et al. MS prevalence in New Zealand, an ethnically and latitudinally diverse country. Mult Scler. 2010;16(12):1422-31. doi: 10.1177/1352458510379614.
3. Richardson AK, Clarke G, Sabel CE, et al. Method for identifying eligible individuals for a prevalence survey in the absence of a disease register or population register. Intern Med J. 2012;42(11):1207-12. doi: 10.1111/j.1445-5994.2012.02754.x.
4. Phyo AZZ, Jelinek GA, Brown CR, et al. Differential multiple sclerosis treatment allocation between Australia and New Zealand associated with clinical outcomes but not mood or quality of life. Mult Scler Relat Disord. 2019;30:25-32. doi: 10.1016/j.msard.2019.01.037.

5. Alla S, Pearson J, Debernard L, et al. The increasing prevalence of multiple sclerosis in New Zealand. Neuroepidemiology. 2014;42(3):154-60. doi: 10.1159/000358174.
6. Leadbetter R, MacAskill M, Myall DJ, et al. Multiple sclerosis mortality in New Zealand: a nationwide prospective study. J Neurol Neurosurg Psychiatry. 2023;94(7):511-17. doi: 10.1136/jnnp-2022-330582.
7. Alla S, Pearson JF, Taylor BV, et al. Disability profile of multiple sclerosis in New Zealand. J Clin Neurosci. 2016;28:97-101. doi: 10.1016/j.jocn.2015.09.020.
8. Claflin SB, Campbell JA, Mason DF, et al. The effect of national disease-modifying therapy subsidy policy on long-term disability outcomes in people with multiple sclerosis. Mult Scler. 2022;28(5):831-41. doi: 10.1177/13524585211035948.
9. Pearson JF, Alla S, Clarke G, et al. Multiple sclerosis in New Zealand Māori. Mult Scler. 2014;20(14):1892-5. doi: 10.1177/1352458514535130.
10. Milne BJ, Atkinson J, Blakely T, et al. Data Resource Profile: The New Zealand Integrated Data Infrastructure (IDI). Int J Epidemiol. 2019;48(3):677-77e. doi: 10.1093/ije/dyz014. Erratum in: Int J Epidemiol. 2019;48(3):1027. doi: 10.1093/ije/dyz054.
11. Bowden N, Thabrew H, Kokaua J, et al. Autism spectrum disorder/Takiwātanga: An Integrated Data Infrastructure-based approach to autism spectrum disorder research in New Zealand. Autism. 2020;24(8):2213-27. doi: 10.1177/1362361320939329.
12. D'Souza S, Bowden N, Gibb S, et al. Medication dispensing for attention-deficit/hyperactivity disorder to New Zealand youth. N Z Med J. 2020;133(1522):84-95.
13. Mitchell EA, Zhang D, Thompson JMD, et al. Maternal mental health and substance use disorders in sudden unexpected death in infancy using routinely collected health data in New Zealand, 2000-2016. Arch Dis Child. 2022;107(10):917-21. doi: 10.1136/archdischild-2021-323006.
14. Dixon S. The employment and income effects of eight chronic and acute health conditions (WP 15/15) [Internet]. Wellington (NZ): The Treasury; 2015 [cited 2021 Aug 11]. Available from: https://www.treasury.govt.nz/publications/wp/employment-and-income-effects-eight-chronic-and-acute-health-conditions-wp-15-15-html
15. Selak V, Poppe K, Chan D, et al. Identification of clinically relevant cohorts of people with heart failure from electronic health data in Aotearoa: potential, pitfalls and a plan. N Z Med J. 2022;135(1563):96-104. doi: 10.26635/6965.5881.
16. Multiple Sclerosis New Zealand. MS Treatments [Internet]. Christchurch (NZ): Multiple Sclerosis New Zealand; 2025. [cited 2024 Oct 25]. Available from: https://msnz.org.nz/ms-treatments/
17. Alla S, Mason DF. Multiple sclerosis in New Zealand. J Clin Neurosci. 2014;21(8):1288-91. doi: 10.1016/j.jocn.2013.09.009.
18. Atkinson J, Salmond C, Crampton P. NZDep2018 Index of Deprivation: Final Research Report. Wellington (NZ): University of Otago; 2020 [cited 2022 Feb 14]. Available from: https://www.otago.ac.nz/wellington/departments/publichealth/research/hirp/otago020194.html
19. Teng A, Gibb S, Sporle A. Ethnicity and the IDI [Internet]. Wellington (NZ): Virtual Health Information Network (VHIN); 2021 [cited 2024 Jul 17]. Available from: https://vhin.co.nz/guides/ethnicity-and-the-idi/
20. Stats NZ Tatauranga Aotearoa. Experimental administrative population census: Data sources, methods, and quality (second iteration) [Internet]. Wellington (NZ): Stats NZ Tatauranga Aotearoa; 2022 [cited 2024 Apr 12]. Available from: https://www.stats.govt.nz
21. Washington Group on Disability Statistics. WG Short Set on Functioning (WG-SS) [Internet]. Hyattsville, Maryland (US): Washington Group on Disability Statistics; 2022 [cited 2021 Feb 22]. Available from: https://www.washingtongroup-disability.com/question-sets/wg-short-set-on-functioning-wg-ss/
22. Walton C, King R, Rechtman L, et al. Rising prevalence of multiple sclerosis worldwide: Insights from the Atlas of MS, third edition. Mult Scler. 2020;26(14):1816-21. doi: 10.1177/1352458520970841.
23. Stats NZ Tatauranga Aotearoa. Birthplace (NZ born/overseas born) - total census usually resident population count. Aotearoa Data Explorer [Internet]. Wellington (NZ): Stats NZ Tatauranga Aotearoa; 2024 [cited 2024 Oct 10]. Available from: https://explore.data.stats.govt.nz/
24. Munk Nielsen N, Corn G, Frisch M, et al. Multiple sclerosis among first- and second-generation immigrants in Denmark: a population-based cohort study. Brain. 2019;142(6):1587-97. doi: 10.1093/brain/awz088.
25. Dobson R, Rice DR, D'hooghe M, et al. Social determinants of health in multiple sclerosis. Nat Rev Neurol. 2022;18(12):723-734. doi: 10.1038/s41582-022-00735-5.
26. Miller DH, Hornabrook RW, Dagger J, Fong R. Ethnic and HLA patterns related to multiple sclerosis in Wellington, New Zealand. J Neurol Neurosurg Psychiatry. 1986;49(1):43-6. doi: 10.1136/jnnp.49.1.43.

27. Kaplan JB. The quality of data on “race” and “ethnicity”: implications for health researchers, policy makers, and practitioners. Race Soc Probl. 2014;6:214-36. doi: 10.1007/s12552-014-9121-6.
28. Gillies TD, Tomlin AM, Dovey SM, Tilyard MW. Ethnic disparities in asthma treatment and outcomes in children aged under 15 years in New Zealand: analysis of national databases. Prim Care Respir J. 2013;22(3):312-8. doi: 10.4104/pcrj.2013.00068.
29. Tin Tin S, Elwood JM, Brown C, et al. Ethnic disparities in breast cancer survival in New Zealand: which factors contribute? BMC Cancer. 2018;18(1):58. doi: 10.1186/s12885-017-3797-0.
30. Kaisey M, Solomon AJ, Luu M, et al. Incidence of multiple sclerosis misdiagnosis in referrals to two academic centers. Mult Scler Relat Disord. 2019;30:51-56. doi: 10.1016/j.msard.2019.01.048.

The burden of yersiniosis in New Zealand, 2022

Peter Cressey, Beverley Horn, Brent Gilpin, Lucia Rivas

ABSTRACT

AIM: To estimate the burden of yersiniosis and sequelae in New Zealand, expressed as disability-adjusted life years (DALYs).

METHODS: Information on the incidence of yersiniosis was taken from the New Zealand notifiable disease database (EpiSurv). Information on the duration and subsequent sequelae (reactive arthritis, erythema nodosum) were obtained from a New Zealand case-control study. Transition factors (e.g., proportion of cases for which a specimen is requested, proportion of cases providing a specimen) were taken from the New Zealand *Acute Gastrointestinal Illness (AGI) Study*. Disability weights used to calculate DALYs were those from the 2013 *Global Burden of Disease Study*.

RESULTS: For 2022, the burden of yersiniosis in New Zealand was estimated to be 119 (95% credible interval 41.5–243) DALYs. Most of the burden (110/119 DALYs) was due to primary gastroenteritis. Rates of reactive arthritis and erythema nodosum were similar to those observed in overseas studies.

CONCLUSION: The burden of disease due to yersiniosis is predominantly due to the long duration of the gastrointestinal disease, with relatively minor contributions from sequelae.

Priority setting for infectious disease management at a national level requires risks to be expressed in a consistent manner. Metrics of disease burden have gained wide acceptance for this purpose. These metrics also facilitate the setting of targets for reductions in infectious disease incidence and the assessment of the effectiveness of specific interventions designed to reduce disease.

To measure the burden of disease any chosen metric should integrate the amount (incidence) of a particular disease and its impact (severity) and combine fatal and non-fatal outcomes. Led by the global burden of disease estimates generated by the World Health Organization (WHO),[1,2] the disability-adjusted life year (DALY) metric is gaining increasing acceptance as a measure of the burden of illness. The fundamental calculation for DALYs is: DALY=YLL+YLD (1), where YLL is the number of years of life lost due to mortality and YLD is the number of years lived with a disability, weighted with a factor between zero and one for the severity of the disability. Disability weights are a measure of health state preferences and were originally derived using a personal trade-off (PTO) approach.[3]

Several studies have used the DALY metric to estimate the burden of diseases, including yersiniosis, in New Zealand.[4–6] However, these studies have often been dependent on characteristics of diseases in other countries to assess the disease burden in New Zealand and, in many cases, it is uncertain whether these attributes are applicable to the diseases in New Zealand.

Yersiniosis is a mainly enteric disease caused primarily by infection with *Yersinia enterocolitica* (*Y. enterocolitica*) and, to a lesser extent *Y. pseudotuberculosis*. Pigs are a recognised reservoir for *Y. enterocolitica*, and transmission is believed to be predominantly through food.[7] The disease is diagnosed through the detection of the organism or its nucleic acids in faeces or blood.[8] The condition is usually self-limiting. While most cases of yersiniosis involve uncomplicated acute gastrointestinal illness, more severe outcomes have been reported for some cases, including colitis, ileitis and pseudoappendicitis.[9] Reactive arthritis[10] and erythema nodosum[11] are recognised sequelae occurring subsequent to a proportion of cases of yersiniosis.

The reported annual incidence of yersiniosis in New Zealand was reasonably stable since the condition first became notifiable in 1996, until 2013, with 330 to 546 cases notified each year.[12] However, since then the incidence has risen steadily to 1,294 in 2022 (25.3 per 100,000).[13] New Zealand now has the highest reported rate of yersiniosis in the world, with the next highest reported rates of yersiniosis being less than 10 per 100,000.[13]

A 17-month yersiniosis case-control study was conducted in two regions of New Zealand.[14] Cases

were administered a questionnaire that allowed quantification of aspects of the burden of disease, in addition to information on risk factors. Data from this study, as well as data from the only New Zealand study on the incidence of acute gastrointestinal illness,[15] now allows the estimation of the burden of yersiniosis in New Zealand for the first time, based largely on New Zealand-specific information.

Methods

Illness outcomes included

Four outcomes for primary illness were defined in terms of acute gastrointestinal illness (AGI): AGI (do not visit a general practitioner [GP] and recover), AGI (visit a GP and recover), AGI (hospitalised and recover) and AGI (death). Hospitalised cases are considered to be a subset of cases visiting a GP, while fatal cases are considered to be a subset of hospitalised cases. Final case numbers in each category were adjusted to avoid double counting. Sequelae following AGI were defined as: reactive arthritis (ReA, subcategories of GP visit and hospitalised) and erythema nodosum (EN, no subcategories). The selected sequelae were based on the study of Rosner et al.[16]

Incidence of illness

Estimates of incidence for yersiniosis were derived using notifications for the 2022 year (1,294) as a base. It was assumed that, since the commencement of laboratory-based notification in New Zealand,[8] all isolates that tested positive for *Yersinia* spp. would result in notification. Factors for under-ascertainment of yersiniosis were taken as those for general AGI and were derived from a 2006 New Zealand study.[15] Under-ascertainment factors were determined for: 1) the proportion of cases from whom a clinical sample was requested by a GP and not provided, 2) the proportion of cases of AGI for which no clinical sample was requested by a GP, and 3) the proportion of cases of AGI who did not present to a GP.

The proportion of cases hospitalised for yersiniosis was considered to be a subset of cases who visited a GP and was derived from the case-control study.

The incidence of sequelae (ReA and EN) was derived from a subset of the case-control study that was followed up at 3 months after the primary yersiniosis. The prevalence of self-reported ReA and EN in this cohort was used to estimate the incidence of these sequelae among all yersiniosis cases presenting to a GP. As with other studies of the burden of disease from yersiniosis, sequelae were considered to only occur in more serious cases of yersiniosis, those presenting to a GP.[17]

Deaths due to yersiniosis are extremely rare, with only a single fatality reported in the New Zealand notifiable disease database during the period 2003–2022 and none reported for the index year.[13] The New Zealand case-fatality rate for the period 2003–2022 is 0.007% of notified cases. This case-fatality rate is lower than generally reported in the literature, with estimates in the range 0.03–1% of notified cases.[18–22] For the current study, it was assumed that the case fatality rate would be in the range 0.007–0.03% (uniform distribution), ranging from the New Zealand long-term mean to the bottom of the range reported internationally. As for sequelae, it was considered that fatalities would be associated with more serious cases of yersiniosis, those presenting to a GP and/or hospitalised. The very limited information on age at death for cases of yersiniosis internationally suggests they are older (50+ years).[23] This is consistent with the age of the single New Zealand fatality (55 years). Age at death for fatal cases of yersiniosis was modelled as a uniform distribution in the range 50–80 years.

Duration of illness

For primary yersiniosis, the duration of illness for cases presenting to a GP and hospitalised cases was derived from the case-control study. For a case, the duration of illness was taken as the maximum of the durations for the individual yersiniosis-related symptoms. The distribution of durations was fitted to a log-normal distribution, truncated at the minimum and maximum reported in the case-control study. The duration of illness for cases of yersiniosis not presenting to a GP was assumed to be the same as for general AGI in the New Zealand community.[15]

The case-control study did not follow cases with post-infectious sequelae to the resolution of symptoms. The duration of ReA was assumed to be the same as that resulting from other causes of AGI and was modelled as an exponential distribution with a mean of 0.608 years (222 days).[17,24,25]

Little information is available on the duration of post-infectious EN. It has been reported that EN generally resolves spontaneously in 3–4 weeks.[26] A uniform distribution between 3 and 4 weeks was used to model the duration of EN.

Table 1: Disability weights used for the estimation of the burden of yersiniosis in New Zealand, 2022.

Disease state	GBD 2013 equivalent	Disability weight (95% uncertainty interval)	Reference
AGI (do not visit GP and recover = community cases)	Diarrhoea, mild	0.074 (0.049–0.104)	27
AGI (visit GP and recover = GP cases)	Diarrhoea, moderate	0.188 (0.125–0.264)	27
AGI (hospitalised and recover = hospitalised cases)	Diarrhoea, severe	0.247 (0.164–0.348)	27
ReA (community)	Mild osteoarthritis	0.023 (0.013–0.037)	27
ReA (visit GP)	Moderate osteoarthritis	0.079 (0.054–0.11)	27
ReA (hospitalised)	Severe osteoarthritis	0.165 (0.112–0.232)	27
EN	Symptomatic other skin and subcutaneous diseases	0.011 (0.005–0.021)	27

GBD 2013 = *Global Burden of Disease Study* 2013; AGI = acute gastrointestinal illness; GP = general practitioner; ReA = reactive arthritis; EN = erythema nodosum.

Disability weights

Disability weights were based on those developed for the 2013 *Global Burden of Disease Study*[27] and are summarised in Table 1. It has been assumed that the disability associated with ReA will be similar to that due to osteoarthritis. No disability weight was found for EN, and it was assumed that this could be equated to "symptomatic other skin and subcutaneous diseases".

Burden of disease

The burden of disease due to yersiniosis in New Zealand in 2022 was estimated in terms of DALYs, as previously described.[6,28] For fatal cases, YLL was calculated from New Zealand tables of the residual life expectancy at the age of death.[29] In order to estimate the variability and uncertainty associated with DALY estimates, input variables were represented by statistical distributions (Table 2). The distributions were combined by simulation analysis using the Excel add-in @RISK (Lumivero, Denver, United States). Simulations were run for 100,000 iterations. Model outputs were presented as mean values and 95th percentile credible intervals.

Table 2: Input values and distributions for the estimation of the burden of yersiniosis in New Zealand, 2022.

Model input	Input value or distribution	Mean value (95th percentile credible interval)	Source
Gastroenteritis			
Notified cases of yersiniosis, 2022	1,294	-	13
Proportion of cases with specimen supplied on request	Beta(19,3)	0.86 (0.70–0.97)	15
Proportion of GP cases with specimen requested	Beta(261,863)	0.23 (0.21–0.26)	30

Table 2 (continued): Input values and distributions for the estimation of the burden of yersiniosis in New Zealand, 2022.

Model input	Input value or distribution	Mean value (95th percentile credible interval)	Source
Proportion of cases presenting to a GP	Beta(66,233)	0.22 (0.18–0.27)	15
Duration, community cases (days)	Custom	2.2 (2.2–2.7)	15
Proportion of cases hospitalised	Beta(27,128)	0.17 (0.12–0.24)	Current study
Duration, GP cases (days)	Log-normal(19.3,18.0), truncated (1,120)	18.8 (3.0–63.8)	Current study
Duration, hospitalised cases (days)	Log-normal(18.2,20.1), truncated (2,60)	15.7 (2.7–48.7)	Current study
Disability weight, community cases	Pert(0.04,0.74,0.12)	0.074 (0.049–0.104)	27
Disability weight, GP cases	Pert(0.105,0.189,0.305)	0.189 (0.125–0.264)	27
Disability weight, hospitalised cases	Pert(0.139,0.249,0.402)	0.249 (0.164–0.348)	27
Proportion of GP cases resulting in death	Uniform(0.00007,0.0003)	0.0002 (0.00011–0.00029)	Current study
Age at death	Uniform(50,80)	65 (51–79)	Current study
Reactive arthritis (ReA)			
Proportion of GP cases developing ReA	Beta(8,132)	0.057 (0.025–0.101)	Current study
Proportion of ReA cases requiring GP visit	Beta(10,36)	0.213 (0.109–0.339)	31
Proportion of ReA cases requiring hospitalisation	Beta(2,45)	0.043 (0.005–0.115)	31
Duration, all ReA cases (years)	Exponential(0.608)	0.608 (0.015–2.24)	24
Disability weight, community cases	Pert(0.011,0.023,0.046)	0.023 (0.013–0.037)	27
Disability weight, GP cases	Pert(0.047,0.080,0.127)	0.080 (0.054–0.110)	27
Disability weight, hospitalised cases	Pert(0.097,0.167,0.270)	0.167 (0.112–0.232)	27

Table 2 (continued): Input values and distributions for the estimation of the burden of yersiniosis in New Zealand, 2022.

Model input	Input value or distribution	Mean value (95th percentile credible interval)	Source
Erythema nodosum (EN)			
Proportion of GP cases developing EN	Beta(4,136)	0.029 (0.008–0.062)	Current study
Duration, all EN cases (days)	Uniform(21,28)	24.5 (21.2–27.8)	26
Disability weight, all cases	Pert(0.004,0.012,0.029)	0.012 (0.005–0.021)	27

GP = general practitioner; ReA = reactive arthritis; EN = erythema nodosum.

Table 3: Annual incidence and disability-adjusted life years (DALYs) for yersiniosis and sequelae in New Zealand, 2022.

Disease and disease subcategories	Incidence (cases in 2022 year)[a]	YLD[a]	YLL[a]	DALYs[a]
Gastroenteritis, mild	23,376 (16,527–32,800)	11.6 (6.6–19.0)		
Gastroenteritis, moderate	6,295 (5,188–8,012)	61.6 (8.9–216)		
Gastroenteritis, severe	225 (150–312)	2.4 (0.4–8.0)		
Gastroenteritis, fatal			34.0 (0–98.5)	
Gastroenteritis, total	**29,896 (22,328–40,562)**	**75.7 (21.5–231)**	**34.0 (0–98.5)**	**110 (33.1–233)**
ReA, mild	277 (114–514)	4.0 (0.08–17.4)		
ReA, moderate	79 (25–172)	3.9 (0.07–17.3)		
ReA, severe	16 (1–50)	1.6 (0.007–8.5)		
ReA, total	**373 (159–682)**	**9.5 (1.2–30.3)**		
EN, total	**186 (49–411)**	**0.14 0.03–0.38)**		
Total		**85.3 (28.4–242)**	**34.0 (0–98.5)**	**119 (41.5–243)**

YLD = years of life lived with disability; YLL = years of life lost; DALYs = disability-adjusted life years; ReA = reactive arthritis; EN = erythema nodosum.
[a]Figures in brackets of the 95th percentile credible interval.

Results

Illness incidence estimates and annual DALY burden of illness estimates for yersiniosis in New Zealand in 2022 are presented in Table 3. The uncertainty in the incidence and DALY estimates is shown as 95th percentile credible interval around the mean. The estimates in Table 3 are for the total amount of illness due to these diseases in New Zealand and will include illness due to transmission of the causative organisms by a variety of transmission routes.

Discussion

The burden of disease due to yersiniosis is predominantly due to the long duration of the gastrointestinal disease, with relatively minor contributions from sequelae. Preliminary data suggests that the burden of yersinosis in New Zealand is intermediate between the burdens of campylobacteriosis and listeria, and the burdens of salmonellosis and STEC (Shiga toxin *E. coli*) infection. While numbers of cases of yersiniosis reporting ReA and EN were quite low, the rates of these sequelae are consistent with rates found in other studies.

The study reported here represents the first assessment of the burden of yersiniosis in New Zealand, substantially based on New Zealand-specific data. In particular, information on the duration of the disease and the frequency of sequelae is New Zealand specific.

A range of methodological variations have been used in previous estimates of the burden of yersiniosis in New Zealand,[4,6,32,33] resulting in a range of burden estimates (54–111 DALYs). The current estimate of 119 DALYs is higher than previous New Zealand estimates, but not as proportionally higher as the substantial recent increases in the rate of notified yersiniosis in New Zealand would suggest.[13] This relatively modest increase in the DALY estimate for yersiniosis is due to changes in the disability weights applied to the various disease states. For example, the first estimate of the burden of yersiniosis in New Zealand used a disability weight for moderate gastroenteritis of 0.39.[6] Subsequent estimates used annualised disability weight, with a weight for moderate gastroenteritis of 0.015 for an incident of gastroenteritis of 10 days' duration,[4,32,33] which equates to an incident-based disability weight of 0.55. The current study used disability weights revised for the 2013 *Global Burden of Disease Study*, with a weight for moderate gastroenteritis of 0.188.[27]

While directly comparable estimates of the burden of disease due to other common enteric pathogens have not been published, work is underway, and initial findings suggest that the burden of disease due to yersiniosis is less than that due to campylobacteriosis and listeriosis, but greater than that due to salmonellosis or STEC infection.

Due to the long duration of moderate cases of yersiniosis (mean=18.5 days), these cases are a major determinant of the overall burden of disease. This extended duration has been noted in other studies. Ostroff et al.[34] reported a mean duration for a cohort of 67 cases of yersiniosis of 20 days. Rosner et al.[16] reported a median duration of illness of 10 days (n=571). While not reporting an overall duration of disease, a study of 261 Dutch cases of yersiniosis noted that 34 had diarrhoea for 2–3 months and six experienced diarrhoea for up to 1 year.[9]

Compared to some other enteric diseases, sequelae to yersiniosis contribute a relatively small proportion (<10%) to the overall burden of disease in New Zealand. In comparison, some studies have estimated that 50% or more of the disease burden due to campylobacteriosis (ReA, Guillain-Barré syndrome and inflammatory bowel disease) and Shiga toxin-producing *Escherichia coli* infection (haemolytic uraemic syndrome, end-stage renal disease) is due to sequelae.[6,24] The more modest contribution of sequelae to the disease burden for yersiniosis is due to both their relative lack of severity and non-chronic nature, with EN generally lasting no more than a few weeks, while ReA may last for a few months.

ReA and EN have been consistently identified as sequelae occurring subsequent for enteric yersiniosis.[9–11,16,34,35] In the current study, 138 cases of yersiniosis consented to re-interview after approximately 3 months, with seven cases reporting potential symptoms of ReA (5.1%, 95% confidence interval [CI] 2.1–10.2%) and three cases reporting potential symptoms of EN (2.2%, 95% CI 0.5–6.2). While the numbers of cases with self-reported sequelae were quite low, the incidence of these sequelae were generally in good agreement with other sources. A meta-analyses estimated that the proportion of yersiniosis cases that developed ReA was 3.4% (95% CI 0.8–13.7%).[35] Stolk-Engelaar and Hoogkamp-Korstanje[9] reported 15 cases of arthritis out of 261 yersiniosis cases (5.7%, 95% CI 3.3–9.3%). Hannu et al.[10] reported

four cases of ReA from 33 cases of infection with *Y. pseudotuberculosis* O:3 (12.1%, 95% CI 3.4–28.2%). Rosner et al.[16] reported symptoms of ReA in 12.4% of cases of yersiniosis and 4.8% of controls. The authors of this study concluded that this suggested a net rate of 6.6% of cases of yersiniosis with symptoms of ReA.

While less information is available on the incidence of EN subsequent to yersiniosis, Rosner et al.[16] reported EN in 3.2% of cases of yersiniosis and just 0.1% of controls, and Stolk-Engelaar and Hoogkamp-Korstanje[9] reported eight cases of EN out of 261 cases of yersiniosis (3.1%, 95% CI 1.3–6.0%).

COMPETING INTERESTS
Nil.

ACKNOWLEDGEMENTS
The authors acknowledge all the individuals that consented to participate in the case-control study and to Fiona for all her efforts with interviewing and Wendy Dallas-Katoa for assistance with the questionnaire. We are also thankful for the New Zealand Ministry of Health for the *Yersinia* surveillance and typing in New Zealand and for the use of data collected within that process. Thank you to all the multiple staff within the Public Health Services for their support for case assessment and follow-up, those within diagnostic laboratories and at ESR who conducted laboratory work (sampling, typing, DNA extractions, sequencing) and support staff that helped during the study.

AUTHOR INFORMATION
Peter Cressey: Institute of Environmental Science and Research, Christchurch, New Zealand.
Beverley Horn: Institute of Environmental Science and Research, Christchurch, New Zealand.
Brent Gilpin: Institute of Environmental Science and Research, Christchurch, New Zealand.
Lucia Rivas: Institute of Environmental Science and Research, Christchurch, New Zealand.

CORRESPONDING AUTHOR
Peter Cressey: Christchurch Science Centre, Institute of Environmental Science and Research (ESR), 27 Creyke Road, Christchurch 8041. E: peter.cressey@esr.cri.nz

URL
https://nzmj.org.nz/journal/vol-138-no-1612/the-burden-of-yersiniosis-in-new-zealand-2022

REFERENCES
1. Mathers CD, Bernard C, Iburg K, et al. Global Burden of Disease in 2002: data sources, methods and results. Report No.: GPE Discussion Paper No. 54 [Internet]. Geneva (CH): World Health Organization; 2003 [cited 2025 Mar 4]. Available from: https://citeseerx.ist.psu.edu/document?rep-id=rep1&type=pdf&doi=b1570a1c4ea8d47e1a81b7c012b054439870cc15
2. Murray CJ, Lopez AD. Global mortality, disability, and the contribution of risk factors: Global Burden of Disease Study. Lancet. 1997;349(9063):1436-42. doi: 10.1016/S0140-6736(96)07495-8.
3. Murray CJ, Acharya AK. Understanding DALYs (disability-adjusted life years). J Health Econ. 1997;16(6):703-30. doi: 10.1016/S0167-6296(97)00004-0.
4. Cressey P, Lake R, Thornley C. Risk ranking: Updated estimates of the burden of foodborne disease for New Zealand in 2013. MPI Technical Paper No. 2016/59 [Internet]. Wellington (NZ): Ministry for Primary Industries; 2014 [cited 2024 Aug 27]. Available from: https://www.mpi.govt.nz/dmsdocument/14146/direct
5. Tobias M. The burden of disease and injury in New Zealand. Report No.: Public Health Intelligence Occasional Bulletin No. 1. Wellington (NZ): Ministry of Health; 2001.
6. Lake RJ, Cressey PJ, Campbell DM, et al. Risk ranking for foodborne microbial hazards in New Zealand: burden of disease estimates. Risk Anal. 2010;30(5):743-52. doi: 10.1111/j.1539-6924.2009.01269.x.
7. Cressey PJ, Lake RJ, Thornley C, et al. Expert elicitation for estimation of the proportion foodborne for selected microbial pathogens in New Zealand. Foodborne Pathog Dis. 2019;16(8):543-9. doi: 10.1089/fpd.2018.2576.
8. Health New Zealand – Te Whatu Ora. Communicable Disease Control Manual [Internet]. Wellington (NZ): Health New Zealand – Te Whatu Ora; 2024 [cited 2024 May 16]. Available from: https://www.tewhatuora.govt.nz/for-health-professionals/clinical-guidance/communicable-disease-control-manual/
9. Stolk-Engelaar VM, Hoogkamp-Korstanje JA. Clinical presentation and diagnosis of gastrointestinal infections by *Yersinia enterocolitica* in 261 Dutch patients. Scand J Infect Dis. 1996;28(6):571-5. doi: 10.3109/00365549609037963.
10. Hannu T, Mattila L, Nuorti JP, et al. Reactive arthritis after an outbreak of *Yersinia pseudotuberculosis* O:3 infection. Ann Rheum Dis. 2003;62(9):866-9. doi: 10.1136/ard.62.9.866.
11. Jalava K, Hakkinen M, Valkonen M, et al. An outbreak of gastrointestinal illness and erythema nodosum from grated carrots contaminated with *Yersinia pseudotuberculosis*. J Infect Dis. 2006;194(9):1209-16. doi: 10.1086/508191.
12. Pattis I, Cressey P, Lopez L, et al. Annual report concerning foodborne disease in New Zealand 2017 [Internet]. Wellington (NZ): Ministry for Primary Industries; 2018 [cited 2024 Aug 27]. Available from: https://www.mpi.govt.nz/dmsdocument/35670/direct
13. Horn B, Pattis I, Cressey P, et al. Annual report concerning Foodborne Diseases in New Zealand 2022 [Internet]. Wellington (NZ): Ministry for Primary Industries; 2023 [cited 2024 Aug 27]. Available from: https://www.mpi.govt.nz/dmsdocument/58789/direct

14. Rivas L, Horn B, Armstrong B, et al. A case-control study and molecular epidemiology of yersiniosis in Aotearoa New Zealand. J Clin Microbiol. 2024;62(10):e0075424. doi: 10.1128/jcm.00754-24.
15. Adlam SB, Perera S, Lake RJ, et al. Acute gastrointestinal illness in New Zealand: A community study. Epidemiol Infect. 2011;139(2):302-8. doi: 10.1017/S0950268810000932.
16. Rosner BM, Werber D, Höhle M, Stark K. Clinical aspects and self-reported symptoms of sequelae of *Yersinia enterocolitica* infections in a population-based study, Germany 2009-2010. BMC Infect Dis. 2013;13(1):236. doi: 10.1186/1471-2334-13-236.
17. Monteiro Pires S, Jakobsen LS, Ellis-Iversen J, et al. Burden of disease estimates of seven pathogens commonly transmitted through foods in Denmark, 2017. Foodborne Pathog Dis. 2020;17(5):322-39. doi: 10.1089/fpd.2019.2705.
18. Rosner BM, Stark K, Werber D. Epidemiology of reported *Yersinia enterocolitica* infections in Germany, 2001-2008. BMC Public Health. 2010;10:337. doi: 10.1186/1471-2458-10-337.
19. Long C, Jones TF, Vugia DJ, et al. *Yersinia pseudotuberculosis* and *Y. enterocolitica* infections, FoodNet, 1996-2007. Emerg Infect Dis. 2010;16(3):566-7. doi: 10.3201/eid1603.091106.
20. EFSA/ECDC. The European Union summary report on trends and sources of zoonoses, zoonotic agents and food-borne outbreaks in 2016. EFSA J. 2017;15(12):5077. doi: 10.2903/j.efsa.2017.5077.
21. EFSA/ECDC. The European Union summary report on trends and sourcesof zoonoses, zoonotic agents and food-borne outbreaks in 2017. EFSA J. 2018;16(12):5500. doi: 10.2903/j.efsa.2018.5500.
22. EFSA/ECDC. The European Union One Health 2020 Zoonoses Report. EFSA J. 2021;19(12):e06971. doi: 10.2903/j.efsa.2021.6971.
23. Saebø A, Lassen J. Survival and causes of death among patients with *Yersinia enterocolitica* infection. A Norwegian 10-year follow-up study on 458 hospitalized patients. Scan J Infect Dis. 1992;24(5):613-7. doi: 10.3109/00365549209054647.
24. Kemmeren JM, Mangen M-JJ, van Duynhoven YTHP, Havelaar AH. Priority setting of foodborne pathogens: Disease burden and costs of selected enteric pathogens. RIVM report 330080001/2006 [Internet]. NL: RIVM; 2006 [cited 2024 Aug 27]. Available from: https://www.rivm.nl/bibliotheek/rapporten/330080001.pdf
25. Mangen M-JJ, Havelaar AH, De Wit GA. Campylobacteriosis and sequelae in the Netherlands. Estimating the disease burden and the cost-of-illness. RIVM Report 250911004/2004 [Internet]. NL: RIVM; 2004 [cited 2024 Aug 27]. Available from: http://www.rivm.nl/bibliotheek/rapporten/250911004.pdf
26. Requena L, Yus ES. Erythema nodosum. Dermatol Clin. 2008;26(4):425-38. doi: 10.1016/j.det.2008.05.014.
27. Salomon JA, Haagsma JA, Davis A, et al. Disability weights for the Global Burden of Disease 2013 study. Lancet Glob Health. 2015;3(11):e712-23. doi: 10.1016/S2214-109X(15)00069-8.
28. Havelaar AH, Haagsma JA, Mangen M-JJ, et al. Disease burden of foodborne pathogens in the Netherlands, 2009. Int J Food Microbiol. 2012;156(3):231-8. doi: 10.1016/j.ijfoodmicro.2012.03.029.
29. Stats NZ. New Zealand cohort life tables: March 2023 update [Internet]. Wellington (NZ): Statistics New Zealand Tatauranga Aotearoa; 2023 [cited 2023 Oct 20]. Available from: https://www.stats.govt.nz/information-releases/new-zealand-cohort-life-tables-march-2023-update/
30. Perera S, Adlam B. Acute gastrointestinal illness (AGI) study: General Practice survey. ESR Client Report FW0716 [Internet]. Christchurch (NZ): Institute of Environmental Science & Research Limited; 2007 [cited 2024 Aug 27]. Available from: https://www.mpi.govt.nz/dmsdocument/22321-Acute-Gastrointestinal-Illness-AGI-Study-General-practice-study
31. Hannu T, Mattila L, Rautelin H, et al. *Campylobacter*-triggered reactive arthritis: a population-based study. Rheumatology. 2002;41(3):312-8. doi: 10.1093/rheumatology/41.3.312.
32. Cressey P. Risk ranking: Updated estimates of the burden of foodborne disease for New Zealand in 2011. MPI Technical Paper No: 2012/12 [Internet]. Wellington (NZ): Ministry for Primary Industries; 2012 [cited 2024 Aug 27]. Available from: https://www.mpi.govt.nz/dmsdocument/4150/direct
33. Cressey P, Lake R. Risk ranking: DALY estimates for selected foodborne diseases in New Zealand using revised Dutch disability weights [Internet]. Christchurch (NZ): Institute of Environmental Science & Research Limited; 2009 [cited 2024 Aug 27]. Available from: https://www.mpi.govt.nz/dmsdocument/25943/direct
34. Ostroff SM, Kapperud G, Lassen J, et al. Clinical features of sporadic *Yersinia enterocolitica* infections in Norway. J Infect Dis. 1992;166(4):812-7. doi: 10.1093/infdis/166.4.812.
35. Pogreba-Brown K, Austhof E, Tang X, et al. Enteric pathogens and reactive arthritis: Systematic review and meta-analyses of pathogen-associated reactive arthritis. Foodborne Pathog Dis. 2021;18(9):627-39. doi: 10.1089/fpd.2020.2910.

Case studies of health-impaired prime ministers in Aotearoa New Zealand

John Horrocks, George Thomson, Nick Wilson

ABSTRACT

In this viewpoint we consider brief case studies of four former Aotearoa New Zealand prime ministers whose poor health impaired their decision making. Two of them died in office—Michael Joseph Savage (leader for 1935–1940) and Norman Kirk (1972–1974)—while a third, Joseph Ward (1928–1930), died shortly after his resignation from his position. The fourth, Robert Muldoon (1975–1984), drank heavily at critical times during his prime ministership. We suggest that further New Zealand research on health-impaired leaders is justified, and discuss possible system improvements that can help to recognise when leaders become incapable or even need, if possible, to be removed from any position of authority.

The last-minute withdrawal of United States (US) President Joe Biden as the Democratic candidate for the November 2024 US election has highlighted the complex risks to a country's wellbeing and security when its leader's performance is impaired by infirmity or illness. This loss of effectiveness can be particularly disruptive if it is hidden or becomes obvious only shortly before an election.[1,2] Even when allowing for the constraints imposed by domestic political institutions and the international system, leadership can matter critically, as is shown in a study by Horowitz et al., who concluded: "*Who ends up in office plays a critical role in determining when and why countries go to war*."[3]

For this viewpoint article, we used short case studies to examine four Aotearoa New Zealand prime ministers (PMs) whose health impairments were actual or potential threats to the country's good governance. The principal sources were the published biographies of these leaders. Other PMs, such as Richard Seddon (PM between 1893 and 1906), Sidney Holland (1947–1955) and Jack Marshall (1972–1972) also suffered from ill health while in office, but their incapacity did not appear to have such obvious impacts. Seddon, for example, was described by one biographer, RM Burdon, as a "*mighty feaster with little regard for moderation in eating and drinking*."[4] Despite heart problems he was energetic enough throughout his time as PM to manage a number of important ministerial portfolios as well as his prime ministerial position. It was not until after a strenuous official visit to Australia in May 1906 that his disregard for health warnings finally caught up with him. He died after a massive heart attack on the voyage back home.[5]

A further aim of this study was to identify patterns that were commonly found in the behaviour or political environment of these impaired leaders. The case study approach used here was modelled on similar work on impaired leaders in other countries.[1,6–9] We looked, for example, at whether the PM's infirmity was concealed by close associates, or "enablers". There have been at least nine US presidents for whom important health information was withheld from the public.[10] In the most recent instance of this practice, President Biden's aides attempted to mask his failing capacities by reducing the number of his press conferences, media appearances and meetings with members of Congress.[11] All these efforts were nullified during his disastrous showing in the presidential candidates' debate with Donald Trump on 27 June 2024. This was when millions of viewers saw him fumbling with his notes, losing track of his arguments and failing to challenge the many lies of his opponent. Even before this point his frequent lapses in concentration were beginning to be noticeable, while a linguist's analysis of changes in his language described it as an "unravelling", in which chunks of words resembled the pared-down forms that characterise pidgin languages.[11–13]

In the current article on impaired New Zealand PMs, the focus is largely on the impact of their physical illnesses or substance use on their functioning as PMs. Age in itself was not considered, with the possible exception of Joseph Ward, the oldest of the group at 72. When he became PM for the second time in 1928, his debility was so marked that the contrast with his intellectual vigour during his earlier term as PM supports the entry in 1930 on his death certificate that he died of "senile decay"

2025 Mar 28; 138(1612). ISSN 1175-8716
https://www.nzmj.org.nz/

as well as diabetes and thrombosis.[14]

Besides Joseph Ward (1928–1930), the other leaders chosen were Michael Joseph Savage (1935–1940), Norman Kirk (1972–1974) and Robert Muldoon (1975–1984). All of these figures were reluctant to accept limitations to their authority, despite urgings from associates who considered them no longer able to make sound decisions or too ill to carry out their work.

Joseph Ward (1856–1930)

Joseph Ward's second term as PM between 1928 and 1930 was marked by his poor and hasty decisions, frequent absences from Parliament as the result of illness and attempts by close associates to minimise the extent of his sickness and general debility. He resigned on 28 May 1930, fewer than 6 weeks before his death at the age of 74.

Ward had a long parliamentary career that included a period as Liberal Party PM between 1906 and 1911. He had been successful in business before he entered national politics, and his financial expertise was reflected by his appointment as colonial treasurer in the 1890s and later posts as finance minister in subsequent administrations. Amiable, optimistic and a key ally of PM Richard Seddon during the latter's reforming term in office from 1893 to 1906, Ward has recently been rated by a panel of historians as one of New Zealand's most capable PMs.[15]

His early successes, however, were not matched during his second term as PM 17 years later. By 1928, he was 72. After the general election in December that year the governor–general, Sir Charles Fergusson, remarked to a confidant at the Dominion Office, Avery, that he was struck by Ward's physical frailty and poor health. He feared that he might break down under the stress of office.[14]

Fergusson's assessment proved to be accurate. A visitor to Parliament in 1929, Margery Perham (an Oxford historian), described Ward as tottering into the House "*like a man in the last stages of decrepitude*."[14] His term as PM was marked by the cancellation of a number of engagements because of sickness, which was usually described as a bad cold or influenza. He was not well from early October 1929, but the reassuring bulletins from his office had to cease after 18 October, when he had a stroke. The information then given to *The Evening Post* was simply that his presence in Parliament would not be required for the remainder of the session. However this absence might have been presented, it was now obvious that Ward was very ill. At an executive council meeting on 29 October, Sir Charles Fergusson heard that Ward's heart was "*very bad … It is evidently touch and go*."[14] During the following 6 months the elderly invalid spent much of his remaining time in office convalescing at Rotorua or at his house in Heretaunga, where a photograph from January 1930 shows him in a wheelchair in his garden.

The first indication that Ward's debility was affecting his decision making had come at the opening of his election campaign in Auckland on 17 October 1928. He made a startling announcement that he would borrow £70 million in England to finance land settlement and railway development. This was not only contrary to the United Party's financial policy, but also a surprise to the Party's candidates. It was a blunder that dogged Ward throughout his term as PM. It was obvious once he took office in December 1928 that financial commitments by the previous Reform Government meant that the £70 million was an impossible goal and Ward had been out of touch with the state of the London loan market.[16]

Ward's serious error in Auckland was not only reckless, but may have been directly affected by health issues. He already had problems with his eyesight and during his speech he asked his son Vincent if the lights had failed. During the 14 minutes he continued to speak, and when the spending promise was made, he may have been having a period of confusion related to his diabetes.[14]

As PM in 1929, Ward made another over-optimistic pledge that demonstrated he was unaware of the economic conditions at home, as well as abroad. One of the first signs of the coming Great Depression was the number of men out of work. On 1 October, Ward stated that within 5 weeks the Government could provide enough jobs for all unemployed men who had registered and were capable of work.[14] The result was that the number of registered unemployed jumped within a month from nearly 2,500 to 13,000. The severity of the real unemployment situation was revealed in stories in the newspapers of men collapsing from starvation as they waited in queues to register.

Apart from these demonstrations of Ward's failing capacity to make good decisions, his declining health meant that more and more of his work had to be delegated. Important public engagements had to be passed onto ministers, and his own family were closely involved

with his support. His son Vincent was his private secretary, while his wife Eileen also took on some minor public appearances.[14] The danger of an impaired PM was demonstrated by the slow government response to the events in Western Samoa, a country administered at the time by New Zealand under a mandate from the League of Nations, when police shots killed 11 on 28 December 1929.[17] He was ill in bed at the time and his whole ministry, including senior civil servants, was absent on holiday. Instead of acting decisively, Ward thought of suppressing the bad news and it was only after a Cabinet meeting on 31 December that it was agreed to send a ship to Apia to deal with the emergency.

Michael Joseph Savage (1872–1940)

Michael Joseph Savage led the first Labour Government from 1935–1940, a period that saw progressive policies in housing, employment, health and a superannuation scheme. Yet Savage himself was constantly troubled by intestinal ailments that ultimately led to his death from colon cancer.[18] As his sickness progressed, his behaviour was marked by increasingly erratic and violent outbursts when challenged by members of the Labour caucus. Much of this discord was over policy, but also because of Savage's insistence that he alone had the right to appoint the Cabinet and his rejection of the majority vote within caucus to the contrary. His belief in his own indispensable role also meant that he deferred essential surgery in order to campaign actively during the 1938 general election.[18]

Savage's health and strength had been good throughout his life until late 1931, when agonising abdominal pains led to his admission to Auckland Hospital and a lengthy period of illness that forced him to miss the opening of Parliament in 1932.[18] Abdominal pains persisted and in August 1938, an X-ray indicated he had cancer of the colon. Savage refused medical advice to have an immediate operation and it was not until a year later that he consented to have surgery.[18] Dr David McMillan, a fellow Labour Party MP and medical practitioner, suggested that Savage's rapid recovery from this surgery showed that "*there has been no major operation, they just opened him up, saw the case is hopeless, and sewed him up again, he hasn't very many months to live*."[18]

According to Labour Party MP John A Lee, during the final months of Savage's life he became increasingly rattled by any criticism. He threatened to "get" Dr McMillan because McMillan, a Lee supporter, had said he was ill. Yet he was so sick in his final caucus meeting that Lee described him as resting his head on his hands and coming up on occasion to threaten members to take off their coats if they liked, with the implication he would fight them. When Lee was insensitive enough to tell him that he had become mentally sick as the result of physical illness, Savage said he would knock his head off.[19]

Lee was undoubtedly a highly partisan commentator, with leadership ambitions of his own.[20] The animosity between the two men exemplified the political stresses that can emerge when there is a failing leader and factions emerge between the loyalists who want the leader to remain in power and the rivals who want a change.[7] Shortly before his death, Savage wrote that the last 2 years of his life had been a "living hell".[20,21] He referred, in particular, to Lee's article "Psychopathology in Politics" published in the 6 December 1939 issue of the magazine *Tomorrow*. It hinted at Savage's mental and physical deterioration,[22] though Savage was not mentioned by name. Lee drew on his layman's reading of MacNeill Weir's *Tragedy of Ramsay MacDonald* to discuss democracies in which leaders, such as US President Woodrow Wilson, Britain's PM Ramsay MacDonald and New Zealand's Joseph Ward, had remained in office despite their obvious impairments.[23] The common features that Lee drew from this source were the leaders' sense of personal infallibility and irritation at being challenged, sycophants who flattered them and minimised any issues of poor mental or physical health and poor decision making.

In Lee's own accounts of the period, he recalled the constant reassurances from Savage's associates about their PM's health, even in a report in the Labour Party paper the *Standard* as late as 7 March 1940, which said that "*Mr Savage is not only fit and looking very fit, but in daily consultation with his Ministers*."[19] The Deputy PM Peter Fraser had said the same thing on 16 January 1940: "*The Prime Minister is again in full health and carrying out full work*."[19] Fraser also explained Savage's absences from caucus meetings as the result of a wish to avoid the scenes Lee had provoked.[22] Savage died in office on 27 March 1940. He was 68.

Norman Kirk (1923–1974)

Norman Kirk had only a brief term as PM (from 1972–1974) and died in office. He had multiple

health problems in the last 15 years of his life, including diabetes and several pulmonary embolisms, as well as what were probably a number of transient ischaemic attacks (TIAs). For example, on a visit to India in December 1973, Kirk had a likely TIA in his hotel room that left him temporarily paralysed on one side of his body and unable to speak.[24] Though he was a formidable debater and campaigner, and had proved to be an inspirational leader, his loss of energy and frequent illnesses during the last months of his life led to an impression of a loss of direction on the part of the Government.[25] His own secrecy about his poor health and his sudden death on 31 August 1974 at the age of 51 left the Labour Party little time to prepare a successor in time for the general election the following year.

During the years since Kirk first entered Parliament, he had collapsed on several occasions, once while speaking in the House and another time when he passed out in his room in Parliament. His colleagues smuggled him out of the House and took him home.[25] In 1972, only 48 hours before he was elected PM, he collapsed on the steps of an Invercargill hotel. The friend who caught him as he fell, Kevin Meates, noted that Kirk's "*breathing was very shallow and quick and he was in a bad sweat*."[25] Given his subsequent likely TIAs and death from heart failure, these collapses seem likely to have been cardiovascular events of some type.

From the first, Kirk made great efforts to keep the public from knowing about his health problems. Biographer Denis Welch suggests that it is not known how often Kirk had his "turns", given that reports of them might have given an impression of weakness.[25] Colleagues such as Bob Tizard, Warren Freer and Phil Amos were present during some such episodes, but there were also more serious occasions when doctors were involved. On 24 April 1974, while on a fishing trip at the Bay of Islands, Kirk could hardly walk for pain in his legs, was struggling to breathe and was coughing up blood. It was fewer than 2 weeks since he had spent a fortnight in hospital after a having had an operation on his legs for varicose veins. A local doctor made a quick diagnosis of "*diaphragmatic and lower right pleurisy caused by an embolism from the legs with pulmonary infarction*."[25] Kirk refused to go to hospital and said he was in the middle of important government negotiations, which could be compromised if it was known he was in hospital. He swore the doctor to secrecy, and it was eventually agreed that the official bulletin would say "flu".

Kirk's associates helped him keep his health problems from public knowledge, but there is little sense that this was to advance their own ambitions or that there was truth in Kirk's fears that enemies might act against him while he was convalescent. He had expressed these fears before having surgery on his varicose veins in April 1974, and also in the week before he died at the age of 51.[25] Even towards the end of his life, when he was starting to lose the thread at cabinet meetings and appeared less frequently in the House, Deputy PM Hugh Watt was willing to cover for him. After Kirk went home to bed on 19 August after a cabinet meeting, Watt explained that he had a nasty type of flu that was going around.[25]

By now Kirk was only a few days away from death and Dr Tom O'Donnell thought that his heart was enlarged by 50%, only a third of one lung was working and his liver was enlarged due to heart failure.[25] Yet Kirk insisted no one was to know how sick he was, not even his own children. This wish to keep his poor health a secret and his fears of plots against him appear to be an expression of the hubris that only he was fit to lead the country. Welch, in the most recent biography of Kirk, suggests on the other hand that it was more the result of a "*fear of being seen to be weak or vulnerable. In the final analysis, his compassionate sense of humanity did not extend to himself*."[25]

Robert Muldoon (1921–1992)

Robert Muldoon, the notoriously abrasive but powerful National Party politician, was PM between the years 1975 and 1984. During his final years in office he was increasingly at odds with a number of his younger parliamentary colleagues, so much so that there had been talk of replacing him as PM, and at one stage in 1980 there was a majority in caucus for a leadership change.[26] Some of these differences were prompted by his autocratic style of management, his stubborn belief in the correctness of his own actions as minister of finance, a preference for cronies such as his confidant and drinking companion Colin McLachlan[26,27] and defensiveness about younger people of ability within the National Party, such as the economist Don Brash.[27]

Muldoon's behaviour was also impacted by excessive alcohol use. For example, during a late-night session on 4 November 1976, Muldoon, described as "liquored up" by Social Credit MP Bruce Beetham, accused Labour MP Colin Moyle

of being "*picked up by the police for homosexual activity*."[27] This accusation and its messy aftermath, which included a commission of inquiry, ultimately resulted in Moyle's resignation before the end of the year.

Muldoon's drinking was also to contribute to the demise of his own political future in 1984, when he called a snap election. On the evening of 13 June, he had a tense meeting with MP Marilyn Waring, concerned that her opposition to the Government's policies for women and support for a nuclear-free bill was weakening the National Party's position in Parliament. In an interview with Muldoon's biographer, Barry Gustafson, Waring recalled that Muldoon was pouring himself brandies during a foul-mouthed harangue.[27] Immediately afterwards Muldoon called for a meeting of available caucus members to endorse the decision he then made to call for an early election. This done, he went to Government House, where he asked for a dissolution of Parliament, and on his return he announced that the election date would be in a month's time, on 14 July. It was then 1am and the effects of further drinks throughout the evening meant that he was slurring his words and appeared drunk to the viewers who saw him on television as he answered questions. His insistence that he could then drive himself home was only foiled by the action of Government Whip Don McKinnon, who had arranged for someone to go to the Beehive garage to let down a tyre on his car. His decision to call the snap election was against the wishes of his party leaders, Sue Wood and Barrie Leay.[26]

Muldoon was also on three medications at the time, for diabetes, hypertension and a muscle relaxant for chronic back pain.[27] In the 1980s, the commonly used oral diabetes medications (e.g., sulphonylureas) could increase the risk of hypoglycaemia if used with excessive alcohol.[28] A typical feature of hypoglycaemia is confusion, and so it is possible that this could have added to the impact of his heavy alcohol intake on this occasion.

The Labour Party won a conclusive victory in the election (described by a wit as the "schnapps election"). One result of Muldoon's impulsive decision to hold an early election was a potential constitutional crisis. He was unwilling at first to carry out a request by the incoming Labour Government to devalue the currency, although there had already been a run on the currency after the announcement of the election. Uncertainty about his intentions in the 2 days immediately following the election meant that key individuals such as the Governor-General, Sir David Beattie, and the head of the PM's Department, Gerald Hensley, had to consider whether Muldoon might have to be dismissed if he should refuse to follow Labour's wishes and no longer had the confidence of the National cabinet and caucus. Trading in the New Zealand currency was suspended on the Monday and the situation was not sorted until the following morning, when Muldoon finally wrote to the incoming PM, David Lange, to say that he agreed to devalue.

The personal cost to Muldoon of this chaotic period was an overwhelming caucus vote on 29 November 1984 to replace him with Jim McLay as National Party leader.[27] Only a week earlier he had claimed that not "*one of the declared candidates is as capable of turning the* [Labour] *Government out as I am*." After receiving a humiliating five votes in support at the caucus meeting, his response at the following press conference was to rail at the party officials who had lobbied for his removal. This undignified exit contrasted with a more mellow mood when he delivered his valedictory speech at Parliament in late 1991. He even told a good joke against himself.

In his later years he experienced numerous health challenges apart from his diabetes, including an operation for bowel cancer in 1986. He continued to be an active constituency MP until his resignation in 1991, took part in international economic conferences and hosted a weekly 3-hour radio talkback show. He remained enormously popular among supporters of the National Party.

Discussion

All of these four selected New Zealand PMs showed important health impairments—with two dying in office (Savage and Kirk) and one (Ward) dying shortly after leaving office. For Muldoon, the health impairment was more a matter of heavy alcohol use. Furthermore, all four displayed one or more features of failing political leadership:

1. *Hubris*: The four PMs in these case studies demonstrated a belief that no colleagues were as well equipped as them to solve the country's problems: a sense of hubris that former British politician David Owen has described as an "occupational hazard" for heads of government.[6]
2. *Secrecy and denial*: The need for secrecy about an impairment, or denial that it was

serious, was a strong feature of the first three of these PMs.
3. *Enablers*: All of these PMs were protected at times by political associates who helped conceal the degree to which their poor health or heavy drinking impaired their capacity to govern.
4. *Poor decisions*: Ward's failure to act during a crisis in Samoa, Savage's defiance of the wishes of the majority of his caucus, Kirk's diminished energy and concentration during the last months of his prime ministership and Muldoon's drunken behaviour at the time he called a snap election were all evidence of an impaired capacity to make good decisions.
5. *Absence from office*: This was particularly so in the cases of Ward, Savage and Kirk.

The consistency of these patterns among the four New Zealand PMs studied here suggests that it would be valuable for researchers to explore health-impairment among other previous New Zealand politicians, as well as how more of the findings from other countries about impaired leaders might relate to situations in New Zealand. Apart from alerting the public and media to risks of this type, research could also examine measures that might be applied in this country for safeguarding its democratic system against the risks of having such a leader. One such possible step would be to require independent medical assessments both before and during office.[6] Tensions between privacy of health information and protection of government decision making need to be resolved, but it could reduce the chance that a country might have political leaders with diminished understanding of their own limitations.[1] Such independent medical assessments may be preferable to having arbitrary upper age limits, which are used in some democratic jurisdictions and are favoured in some surveys of the US public.[29] However, such upper age limits can be seen as ageist and risk potentially excluding an elderly but competent leader from office.[29]

Additional options that are already used in other jurisdictions and could be considered for the New Zealand context include term limits for the prime ministership and recall systems (where voters can petition for a politician to be recalled). Maintaining a strong media with investigative journalists can also help expose failing leaders and attempts by enablers to hide impairments.

In conclusion, we have briefly provided case studies of four former New Zealand PMs. We have argued that all had significant health-related impairments while they were leaders, and that there are grounds for linking these impairments to poor decision making in each case. While further New Zealand research on health-impaired PMs appears justified, we also suggest further consideration of possible system improvements that can help remove such leaders from office, when this is appropriate.

COMPETING INTERESTS
Nil.

AUTHOR INFORMATION
Dr John Horrocks: Independent Researcher, Wellington, Aotearoa New Zealand.
Honorary Associate Professor George Thomson: Department of Public Health, University of Otago, Wellington, Aotearoa New Zealand.
Professor Nick Wilson: Department of Public Health, Wellington, Aotearoa New Zealand.

CORRESPONDING AUTHOR
Nick Wilson: Department of Public Health, Wellington, Aotearoa New Zealand. E: Nick.Wilson@otago.ac.nz

URL
https://nzmj.org.nz//journal/vol-138-no-1612/case-studies-of-health-impaired-prime-ministers-in-aotearoa-new-zealand

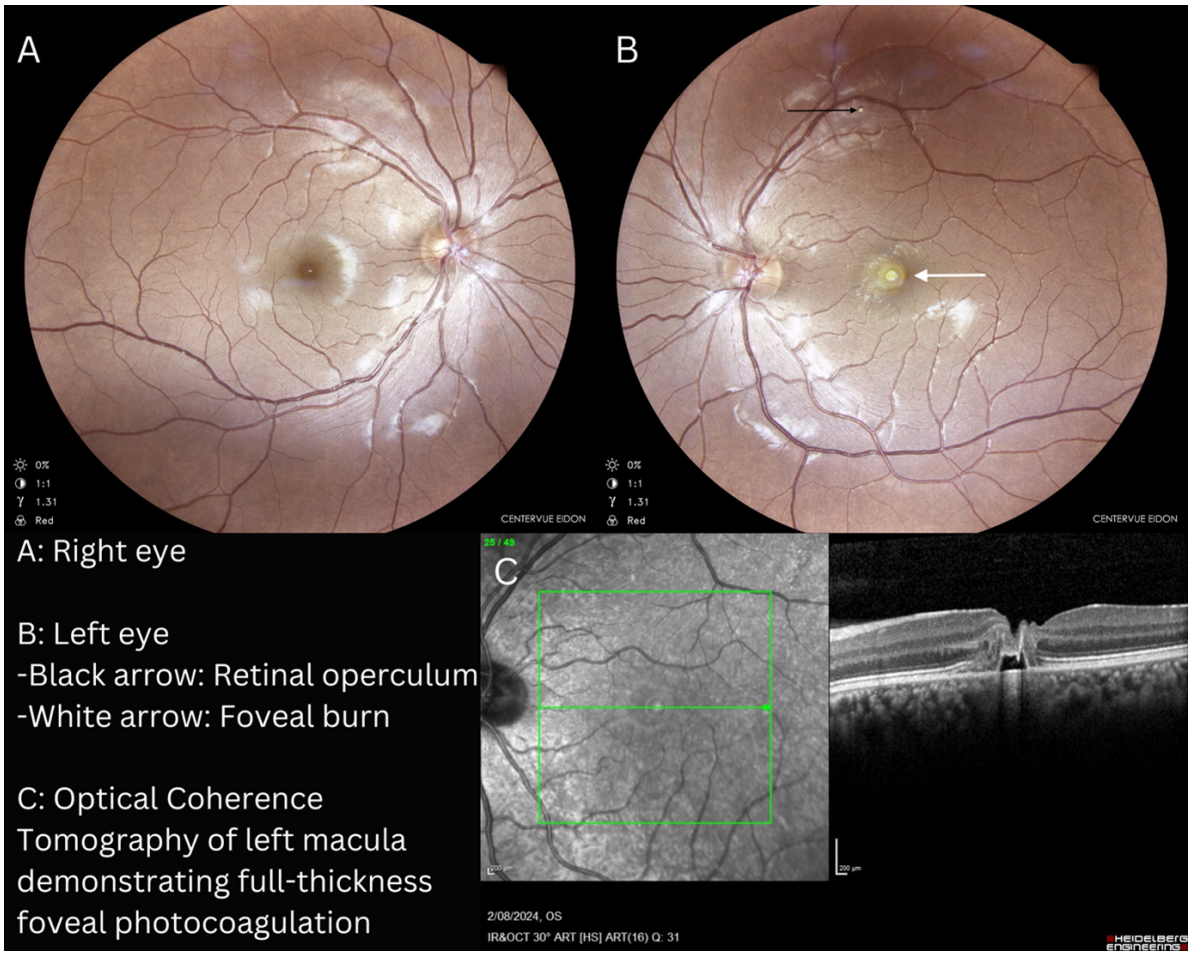
REFERENCES
1. Barr J, Pappas TN. Stricken Before Election: Presidential Health Crises From 1880 to 2020. Ann Surg Open. 2022;3(1):e126. doi: 10.1097/AS9.0000000000000126.
2. Rogers K, Entous A, Haberman M, et al. How Biden's Inner Circle Protected a Faltering President [Internet]. New York Times; 2025 Jan 17 [cited 2024 Nov 27]. Available from: https://www.nytimes.com/2025/01/17/us/politics/biden-age.html?smid=nytcore-ios-share&referringSource=articleShare
3. Horowitz MC, Stam AC, Ellis CM. Why Leaders Fight. Cambridge University Press; 2015.
4. Burdon RM. Seddon, Richard John (1845-1906). In: Owen AH, editor. An Encyclopaedia of New Zealand, Vol 3. Wellington, New Zealand: Government Printer: 1966. p. 216-219.
5. Brooking T. Richard Seddon: King of God's Own. Penguin eBooks; 2014.
6. Owen D. In Sickness and in Power: Illness in Heads of Government, Military and Business Leaders Since 1900. Methuen; 2016.
7. Post JM, Robins RS. When Illness Strikes the Leader: The Dilemma of the Captive King. Yale University Press; 1995.
8. Ghaemi N. A First-Rate Madness: Uncovering the Links Between Leadership and Mental Illness. Penguin; 2012.
9. Bumgarner JR. The Health of the Presidents: The 41 United States Presidents Through 1993 from a Physician's Point of View. McFarland; 1994.
10. Leonhardt D, Philbrick IP. Presidential Medical Secrets [Internet]. New York Times; 2024 Jul 11 [cited 2024 Nov 27]. Available: https://www.nytimes.com/2024/07/11/briefing/president-biden-age-election.html?smid=nytcore-ios-share&referringSource=articleShare
11. Tait R. White House efforts to shield Biden's missteps are unravelling [Internet]. Guardian; 2024 Jul 4 [cited 2024 Nov 27]. Available from: https://www.theguardian.com/us-news/article/2024/jul/03/biden-white-house-missteps
12. Baker P, Sanger D, Kanno-Youngs Z, et al. Biden's Lapses Are Said to Be Increasingly Common and Worrisome. New York Times; 2024 Nov 6 [cited 2024 Nov 27]. Available from: https://www.nytimes.com/2024/07/02/us/politics/biden-lapses.html
13. McWhorter J. What a Linguist Hears When Biden Speaks [Internet]. New York Times; 2024 Jul 11 [cited 2024 Nov 27]. Available from: https://www.nytimes.com/2024/07/11/opinion/biden-speaking-linguist.html?searchResultPosition=1
14. Bassett M. Sir Joseph Ward: A Political Biography. Auckland University Press; 2013.
15. Frykberg E. 'Prime Movers' [Internet, paywalled]. Listener; 2024 Nov 16:16-21. Available from: https://www.zinio.com/nz/publications/new-zealand-listener/2942/issues/632746
16. The Borrowing Problem. Otago Daily Times. 1928 Dec 15 (Issue 20592):14.
17. New Zealand History. New Zealand in Samoa: Black Saturday [Internet]. Manatū Taonga – Ministry for Culture and Heritage; 2024 Oct 3 [cited 2024 Nov 27]. Available from: https://nzhistory.govt.nz/politics/samoa/black-saturday
18. Gustafson B. From the Cradle to the Grave: A biography of Michael Joseph Savage. Auckland, New Zealand: Reed Methuen; 1986.
19. Lee JA. I Fight for New Zealand. Auckland Service Printery; 1940.
20. Olssen E. John A. Lee. Dunedin, New Zealand: Otago University Press; 1977.
21. Brown B. The Rise of New Zealand Labour: A History of the New Zealand Labour Party. Wellington, New Zealand: Price Milburn; 1962.
22. Lee JA. Simple on a Soapbox. London: Collins; 1964.
23. Weir L. The Tragedy of Ramsay Macdonald [Internet]. Internet Archive, Secker and Warburg; 1938 [cited 2024 Nov 27]. Available from: https://archive.org/details/in.ernet.dli.2015.176512/mode/2up
24. Grant D. The Mighty Totara: The Life and Times of Norman Kirk. Random House New Zealand; 2014.
25. Welch D. We Need To Talk About Norman: New Zealand's lost leader. Quentin Wilson Publishing; 2023.

26. Templeton H. All Honourable Men: Inside the Muldoon Cabinet, 1975-1984. Auckland University Press; 1995.
27. Gustafson B. His Way: a biography of Robert Muldoon. Auckland University Press; 2013.
28. Pietraszek A, Gregersen S, Hermansen K. Alcohol and type 2 diabetes. A review. Nutr Metab Cardiovasc Dis. 2010;20(5):366-75. doi: 10.1016/j.numecd.2010.05.001.
29. Mirani L. The debate around age limits for politicians will get louder in 2025 [Internet]. The Economist 2024 Nov 20 [cited 2024 Nov 27]. Available from: https://www.economist.com/the-world-ahead/2024/11/20/the-debate-around-age-limits-for-politicians-will-get-louder-in-2025.

Accidental foveal burn from 755nm Alexandrite cosmetic laser

James Steven Lewis, James C Y Leong

Figure 1: Left foveal burn from accidental 755nm Alexandrite laser exposure.



A 33-year-old beauty therapist presented to the emergency department with painless loss of central vision in her left eye just hours after the accidental activation of a 755nm Alexandrite cosmetic laser during instrument cleaning. The incident occurred when the therapist inadvertently depressed the foot pedal that activates the laser while holding the scope up to her eye for cleaning, resulting in direct retinal exposure.

Examination of the right eye was normal, while the left eye exhibited counting-fingers vision, mild conjunctival injection and anterior uveitis with a focal foveal burn and retinal operculum. Optical coherence tomography confirmed full-thickness retinal photocoagulation and macular oedema.

The patient was treated with topical corticosteroid for uveitis and ascorbic acid to promote fibroblast activity. While one case report suggests that vitamin C may aid recovery in similar injuries, its efficacy in this context remains unproven and warrants further study.[1]

Although the uveitis resolved after 1 week, her vision did not improve, and prognosis for recovery is poor, with risks of secondary macular neovascularisation requiring long-term monitoring and

possible intravitreal anti-vascular endothelial growth factor (VEGF) injections.

Subthreshold laser treatment has been proposed as a means to improve central vision and minimise scar enlargement over time, though its utility in this setting is experimental and should be approached with caution pending robust evidence.[2]

Currently, the treatment of retinal burns primarily relies on anecdotal evidence and case reports, as no randomised controlled trials have been conducted in this area. The variability in presentations and outcomes makes it challenging to establish standardised treatment protocols. Management typically focusses on mitigating inflammation and secondary complications while monitoring for long-term sequelae.[1]

This case underscores the dangers of Alexandrite lasers, which can penetrate even closed eyelids and harm ocular structures.[3]

These lasers are commonly used for hair removal and other dermatologic treatments, delivering energy at a wavelength of 755nm designed to selectively target melanin.[4] Despite regulatory guidelines requiring safety interlocks and protective eyewear, this incident highlights the potential for severe injury from inadvertent activation. Infrared lasers in this spectrum pose additional risks as they do not trigger protective ocular reflexes like the Bell's reflex.[5]

While Alexandrite lasers typically include safety features such as interlocks and automatic shut-off mechanisms, these alone cannot prevent all incidents. This case underscores the equal importance of operator training and adherence to safety protocols. Manufacturers and operators share responsibility for preventing such injuries, with manufacturers providing robust safety features and operators ensuring appropriate use.[6,7]

In New Zealand, the regulatory framework for cosmetic lasers does not fall under the *Radiation Safety Act 2016*, which primarily covers ionising radiation. Instead, oversight is provided by local government bylaws and industry standards, such as the Auckland Council's Code of Practice for pulsed light and laser treatments and guidelines from the New Zealand Association of Registered Beauty Professionals. These frameworks emphasise operator training, equipment maintenance and adherence to safety protocols, but vary in enforcement across settings.[7,8]

This incident highlights the critical role of operator training and adherence to established safety practices. Public awareness and education on laser safety are crucial to preventing similar injuries.[8]

COMPETING INTERESTS
Nil.

AUTHOR INFORMATION
Dr James Steven Lewis: Registrar, Ophthalmology, Te Whatu Ora Capital, Coast and Hutt Valley, Wellington.
Dr James C Y Leong: Consultant Ophthalmologist (Medical Retina), Te Whatu Ora Capital, Coast and Hutt Valley, Wellington.

CORRESPONDING AUTHOR
Dr James Steven Lewis: Registrar, Ophthalmology, Te Whatu Ora Capital, Coast and Hutt Valley, Wellington.
E: James.Lewis@ccdhb.org.nz

URL
https://nzmj.org.nz/journal/vol-138-no-1612/accidental-foveal-burn-from-755nm-alexandrite-cosmetic-laser

REFERENCES
1. Shum JW, Iu LP, Cheung DN, Wong IY. A Case of Accidental Ocular Injury from Cosmetic Laser Burn. Retin Cases Brief Rep. 2016;10(2):115-20. doi: 10.1097/ICB.0000000000000181.
2. Scholz P, Altay L, Fauser S. A Review of Subthreshold Micropulse Laser for Treatment of Macular Disorders. Adv Ther. 2017;34(7):1528-55. doi: 10.1007/s12325-017-0559-y.
3. Huang A, Phillips A, Adar T, Hui A. Ocular Injury in Cosmetic Laser Treatments of the Face. J Clin Aesthet Dermatol. 2018;11(2):15-18.
4. Anderson RR, Parrish JA. Selective Photothermolysis: Precise Microsurgery by Selective Absorption of Pulsed Radiation. Science. 1983;220(4596):524-27. doi: 10.1126/science.6836297.
5. Francis IC, Loughhead JA. Bell's Phenomenon: A Study of 508 Patients. Aust J Ophthalmol. 1984;12(1):15-21.
6. ANSI. ANSI Z136.1-2022 American National Standard for Safe Use of Lasers [Internet]. Washington, DC (US): Laser Institute of America; 2020 [cited 2025 Jan 1]. Available from: https://webstore.ansi.org/standards/lia/ansiz1362022
7. The New Zealand Association of Registered Beauty Professionals. Health, Hygiene and Safety Standards for Registered Beauty Professionals [Internet]. Auckland (NZ): The New Zealand Association of Registered Beauty Professionals Inc; 2022 [cited 2025 Jan 1]. Available from: https://www.beautynz.org.nz/files/5616/7018/9591/Health_Hygiene_and_Safety_Standards_for_Registered_Beauty_Prodessionals_November_2022.pdf
8. Te Kaunihera o Tāmaki Makaurau Auckland Council. Pulsed Light and Laser Treatment Code of Practice [Internet]. Auckland (NZ): Te Kaunihera o Tāmaki Makaurau; 2024 [cited 2025 Jan 1]. Available from: https://www.aucklandcouncil.govt.nz/licences-regulations/business-licences/health-beauty-businesses/health-beauty-businesses-codes-of-practice/Pages/pulsed-light-and-laser-treatment-code-of-practice.aspx

Re: Discrepancies between two D-dimer assays and impact on clinical decisions; a retrospective analysis of samples tested in community- and hospital-based laboratories in Auckland

Christine Dahler, John V Mitsios

The recent publication by Adriaansen et al. 2024[1] aimed to compare two D-dimer assays in a real-world setting by evaluating systematic bias and heterophilic interference and assessing their potential impact on patient management. The study concluded that INNOVANCE® D-Dimer assay (INNOVANCE assay) yielded higher values and was more susceptible to interference from heterophile antibodies compared to the STA®-Liatest® D-Di Plus assay (Liatest assay). Adriaansen et al. also noted concern about clinician mistrust due to discordant results between laboratories.

While this publication reports on the experience and practice of a community laboratory and hospital, we aim to raise methodological concerns with the study that challenge several of the authors' conclusions, including: 1) the systemic bias of the study, 2) missing data addressing the heterophilic interference of the D-dimer assay, and 3) missing clinical outcomes, especially in patients with discordant results.

With respect to systemic bias, it should be noted that only patients who initially tested positive with the INNOVANCE assay were referred to the hospital, where a second blood draw was performed for retesting using the Liatest assay; the reverse, however, was not evaluated. Blood draws at different times (up to 24 hours in the Adriaansen et al. study) and sites could lead to a significant bias in results because of D-dimer's half-life of 8 hours,[2] the effects of pre-analytical variables on D-dimer testing[2] and different clinical presentation of the patient from first to second blood draw (i.e., clinical pretest probability [PTP]).

Selective exclusion of samples from the study also has the potential to bias the comparison. Of the 818 samples collected for the study, 86 samples (10.5% of all samples collected) were excluded as they were above Liatest's analytical measuring interval (AMI) of 4,000µg/L fibrinogen equivalent units (FEU). This same criterion, however, was not applied for samples above the INNOVANCE AMI of 4,400µg/L FEU. An additional 44 samples (6% of all samples collected) were excluded because they demonstrated highly discordant results. For a symmetrical method comparison, sample pairs spanning the AMI for both assays should be used.

Another limitation of the manuscript is the authors' assumption regarding the cause of the highly discordant results. In the study, 44 samples gave results more than threefold higher with the INNOVANCE assay than with Liatest. After excluding high Liatest results, the authors concluded that the INNOVANCE assay likely suffered from heterophilic interference. The conclusion that the INNOVANCE assay is affected by heterophilic interference appears to be speculative, as there was no direct investigation (e.g., dilutional linearity, pretreatment with heterophilic blocking tube) or empirical data presented in the study to confirm this hypothesis. Heterophilic antibodies are known to cause interference in some immunoassays, but conclusively attributing assay performance issues to this interference without appropriate supporting evidence is premature.

To draw robust conclusions regarding suitability of D-dimer assays for clinical use, it is essential to consider the patient's PTP (i.e., Wells score or other relevant measures) and the clinical outcome. This is particularly important when assessing the 193 discordant sample pairs. However, the authors do not provide details on the number of patients who underwent additional investigation (such as

imaging) or on the final clinical determination, which complicates the ability to make definitive conclusions about assay performance. Additionally, an evaluation of a potential dependency between the patient's condition, D-dimer results and the timing of blood draw could be helpful. Laboratory test results other than D-dimer could also help in better understanding the observed discrepancies between the D-dimer assays, especially considering two-thirds of the study were carried out during the COVID-19 pandemic. For instance, elevated C-reactive protein (CRP) can indicate an inflammatory response, which could result in elevated D-dimer levels.[3,4] Furthermore, the patient's renal status could also play a role, as D-dimer is mainly cleared by the kidneys.[2]

Adriaansen et al. highlight the lack of standardisation across D-dimer assays. The heterogeneity of the D-dimer antigen, the heterogenous designs of different D-dimer assays[5] and the lack of standardisation[6] leads to known inherent variability between D-dimer assays. While we agree that a lack of standardisation may prevent the ability to interchangeably use D-dimer results from different assays, it is important to remember that D-dimer is not used in isolation but is interpreted along with clinical history and presentation (e.g., clinical PTP) and other diagnostic testing which, as noted above, are parameters not provided in the study.

Due to the study design, biased exclusion of samples and the lack of clinical correlation, the ability to draw conclusions about the clinical performance of the two D-dimer assays used in this study is limited. It is certainly premature to conclude that one assay is more prone to heterophilic antibody interference in the absence of any supporting data. The findings presented by Adriaansen et al. should also be considered in context of other studies that have found comparable results between both the INNOVANCE and Liatest assay (i.e., negative predictive value, sensitivity and specificity or correlation),[7–10] as well as proficiency data that have shown that the INNOVANCE and Liatest generate comparable results.[6]

COMPETING INTERESTS
CD and JM are employees of Siemens Healthineers.

AUTHOR INFORMATION
Christine Dahler: Hemostasis Global Marketing Manager, Siemens Healthcare Diagnostics Products GmbH, Marburg, Germany.
John V Mitsios: Medical Affairs Medical Sciences Partner, Siemens Healthcare Diagnostics Inc, Tarrytown, NY, USA.

CORRESPONDING AUTHOR
Christine Dahler: Siemens Healthcare Diagnostics Products GmbH, Emil-von-Behring-Str. 76, D-35041 Marburg, Germany. Ph: +49 (172) 4358473. E: christine.dahler@siemens-healthineers.com

URL
https://nzmj.org.nz/journal/vol-138-no-1612/re-discrepancies-between-two-d-dimer-assays-and-impact-on-clinical-decisions-a-retrospective-analysis-of-samples-tested-in-commu

REFERENCES
1. Adriaansen MJ, Morison IM, Perry HE. Discrepancies between two D-dimer assays and impact on clinical decisions; a retrospective analysis of samples tested in community- and hospital-based laboratories in Auckland. N Z Med J. 2024;137(1589):12-9. doi: 10.26635/6965.6302.
2. Favresse J, Lippi G, Roy PM, et al. D-dimer: Preanalytical, analytical, postanalytical variables, and clinical applications. Crit Rev Clin Lab Sci. 2018;55(8):548-77. doi: 10.1080/10408363.2018.1529734.
3. Crop MJ, Siemes C, Berendes P, et al. Influence of C-reactive protein levels and age on the value of D-dimer in diagnosing pulmonary embolism. Eur J Haematol. 2014;92(2):147-55. doi: 10.1111/ejh.12218.
4. Meisinger C, Kirchberger I, Warm TD, et al. Elevated plasma D-Dimer concentrations in adults after an outpatient-treated COVID-19 infection. Viruses. 2022;14(11):2441. doi: 10.3390/v14112441.
5. Dempfle CE, Zips S, Ergül H, Heene DL; FACT study group. The fibrin assay comparison trial (FACT): correlation of soluble fibrin assays with D-dimer. Thromb Haemost. 2001;86(5):1204-9.
6. Elbaz C, Hollestelle MJ, Meijer P, et al. D-dimer—An International Assessment of the Quality of Laboratory Testing: Implications for D-dimer Use in the Real World. Semin Thromb Hemost. 2024;8(1):102335. doi: 10.1055/s-0044-1791700.
7. Park SJ, Chi HS, Chun SH, et al. Evaluation of performance including influence by interfering substances of the Innovance D-dimer assay on the Sysmex coagulation analyzer. Ann Clin Lab Sci. 2011;41(1):20-4.
8. Hamer HM, Stroobants AK, Bavalia R, et al. Diagnostic accuracy of four different D-dimer assays: A post-hoc analysis of the YEARS study. Thromb Res. 2021;201:18-22. doi: 10.1016/j.thromres.2021.02.003.
9. Robert-Ebadi H, Combescure C, Bulla O, et al. Comparison of different D-dimer assays to exclude pulmonary embolism using the age-adjusted D-dimer cutoff: a secondary analysis of the ADJUST-PE study. Paper presented at: International Society on Thrombosis and Haemostasis (ISTH) 2024; 2024 Jun 22-26; Bangkok, Thailand.
10. Tonne B, Pedersen MH, Fronas SG, et al. Evaluation of the diagnostic performance of three D-dimer assays in patients with suspected deep vein thrombosis: STA-Liatest D-Di plus, Tina-quant D-dimer Gen. 2, and INNOVANCE D-dimer. Thromb Upd. 2023;13:100147. doi: 10.1016/j.tru.2023.100147.

Laryngeal Phthisis.

NZMJ, 1925

By WOLFF FREUDENTHAL, M.D., *New York*
(*Read by Mr. George E. O. Fenwick, F.R.C.S., of Auckland.*)

Continued from 14 March 2025.

2) Stop the cough. By that I do not mean cough of pulmonary origin, but cough which results as a reflex action from the nose and throat. Take for example atrophic rhinitis. Most of the patients suffering from this affliction have wide nasal passages, and yet they feel that they cannot get any air through them. The reason for this is that the mucous membrane of the nose is dried out, or covered with scabs and crusts. The air spaces are large enough but the air itself cannot be "assimilated." I might compare this condition to that of a patient suffering from cholera. He is craving for water, but no sooner drinks it than it leaves the system again without being absorbed. So it is with the inhaled air in atrophic rhinitis. Observations in the University Clinic at Kiel fully corroborated the results of my own experiments on this subject. In many patients the characteristic hacking cough, described in all text-books as a premonitory or incipient stage of tuberculosis, has its source in the pharynx, being caused by the dry secretion of atrophic rhinitis getting down into this region from the nose; or you may simply find post-nasal catarrh. If one treats this nasopharyngeal catarrh according to the customary methods, one will be sure to eliminate the cough originating in the above manner. In this way we have accomplished a great deal already, for here is a chance of arresting the disease in the beginning. *Principiis obsta* is an old rule which should be followed. On the other hand, one will benefit the patient by restoring the nasal mucosa to a normal condition, so that the inhaled air can be warmed and moistened and thus rendered fit for breathing purposes.

But it is in the pharynx that the most frequent source of a cough is found, and one that can be easily removed in the majority of cases by regular topical application. We find here post-nasal catarrh, with its sticky, tenacious secretion, often originating in the accessory sinuses, and also granulations and diseased tonsils. In catarrhal cases mild applications several times a time week will positively remove the cough. These are the typical cases, where you find that characteristic hacking cough, and with but a few slight rales over the lungs. Nobody could ever convince me that these few rales have any connection with the cough. Morphine will do great harm at this stage, but rational treatment of the pharynx will eliminate the great danger of a permanent cough.

Another prominent source of the cough is in the larynx. In that organ the aberrations from the normal are so numerous that they cannot all be enumerated here. We see a general hyperæmia, injection, injection of certain portions of the larynx, massive infiltrations of the cords, interarytenoid outgrowths, œdematous perichronditis of the arytenoids or the epiglottis, ulcerations on any part of the larynx, etc. The last-mentioned will be discussed in the next paragraph. All the others, from a simple laryngitis to the most complicated forms of laryngeal tuberculosis, can at least be relieved by regular, painstaking and untiring efforts on the part of the attending laryngologist and his assistants. The latter are mentioned because in a hospital or sanatorium much can be done by simple applications that any young man on the staff can easily master. The visiting physician, as a rule, has no time for such daily or thrice-weekly work. Formerly the infiltrations of the vocal cords and ventricular bands were removed by operative means (Krause's and Heryng's double curette, etc.). In those days I operated frequently, sometimes with a good result, but more often without any benefit or even a detrimental effect. (Subsequent or immediate pulmonary hæmorrhage, flaring up of quiescent areas, etc.). Nowadays I remove such infiltrations only when they are large enough to cause a stenosis, or a cough that cannot be got rid of by any other means. I prefer to do such operations under suspension laryngoscopy, provided there are no cavities in the lungs, or any other condition that might bring on a hæmorrhage. Simple infiltrations that cause no irritation are best left alone. The hoarseness caused by them improves spontaneously when the patient gets better. If it should persist, nevertheless, there is plenty of time to operate afterwards.

(3) Remove the dysphagia. Unless a stenosis is present or imminent, it is comparatively easy to treat an early case of laryngeal phthisis, but the

sufferings of the patient and our own troubles commence as soon as the tissues break down and ulceration sets in. Then in many instances dysphagia develops and no end of other difficulties. These pitiable people to whom even the swallowing of their saliva, or the mere thought of the ingestion of food causes a shudder, suffer really the tortures of Tantalus, since, in spite of a good appetite and a bounteous table, they are unable to eat, and prefer rather to experience hunger and thirst.

It is a source of satisfaction that just here the greatest advance has been made, but there are still many questions to be settled. First of all there is need of greater progress in the treatment of the pulmonary affection. That part of our therapy has not advanced satisfactorily. Many a case has been observed by me in which the larynx improved steadily under proper treatment, while at the same time the lungs steadily became worse. But let us return to the ulcerative processes in the larynx, and ask how are they best treated? As far back as January, 1899, in a paper read before the New York Academy of Medicine, I advocated orthoform as the main drug to be used because it is analgesic and non-poisonous. It is not an anæsthetic like cocaine, which is an advantage, but it produces analgesia, *i.e.*, freedom from pain lasting from an hour or so to three or four days and more. It has no toxic effect and may be used even several times a day. (I speak only of its application to the denuded mucous membrane and do not recommend its use on the skin.)

In the above-mentioned paper (1899) I said that whoever does not try orthoform in these cases, after everything else has failed, does an injustice to his patients. Now, after so many years I can only add: Whoever has tried orthoform in some desperate cases and has witnessed the gratitude of the patients after they were enabled to take some nourishment, will never give it up again. Of course, orthoform has only a local effect, and does not cure any pulmonary complication or general toxæmia. I have used an emulsion, to which lately was added the ethyl esters of chaulmoogra oil (chaulmestrol). My formula for this emulsion now is:—Orthoform, 6.00; menthol, 1.0 to 6.0; formaldehyde, 5.0; aquae ad., 60.0; m.f. emulsio. This emulsion is injected by means of an ordinary laryngeal syringe so that it forms a coating over the ulcerated area, which previously has been cleansed. It is not the quantity of the emulsion used that counts, but the amount that adheres to the surface and is absorbed.

Erratum

URL: https://nzmj.org.nz/journal/vol-138-no-1609/establishing-a-new-zealand-brain-tumour-registry-understanding-clinical-registry-formation-in-new-zealand

Establishing a New Zealand brain tumour registry: understanding clinical registry formation in New Zealand

Holly Wilson, Caroline Woon, Chris Tse, Jayne Sheridan, Lee-Ann Creagh, Sandar Tin Tin, George Laking, Makarena Dudley, Melissa James, Fouzia Ziad, Catherine Han, Thomas I-H Park

First published in: *2025 Feb 14; 138 (1609).*

On 28 March 2025, two authors who significantly contributed to the manuscript (previously left out by mistake) were added and acknowledged on pages 98 and 107. Detailed contributions are below:

Dr Clinton Turner is a consultant pathologist and a key committee member of our brain tumour registry project, from which this manuscript had been incepted. He provided intellectual input into the research and writing of the manuscript, and he also contributed to the final writing of the manuscript.

Prof Mike Dragunow is the co-director of the neurosurgery research unit (working with patient brain tumour samples) at the Centre for Brain Research and provided support and guidance for this project, as well as contributing to the writing of the manuscript.

Amendments to the author list on page 98:

Holly Wilson, Caroline Woon, Chris Tse, Jayne Sheridan, Lee-Ann Creagh, Sandar Tin Tin, George Laking, Makarena Dudley, **Mike Dragunow, Clinton Turner**, Melissa James, Fouzia Ziad, Catherine Han, Thomas I-H Park

Amendments to the author information section on page 107:

Mike Dragunow: The Centre for Brain Research, The University of Auckland; Department of Pharmacology, Faculty of Medical and Health Sciences, The University of Auckland.

Clinton Turner: Department of Anatomical Pathology, LabPlus, Auckland City Hospital; The Centre for Brain Research, The University of Auckland; New Zealand Aotearoa Neuro-Oncology Society.