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Reforming Health New Zealand: confronting crisis, sustaining recovery

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Reforming Health New Zealand: confronting crisis, sustaining recovery

Lester Levy

The theoretical advantages of merging New Zealand's 20 district health boards, eight support services and elements of the Ministry of Health as a basis of the 2022 health reforms were clear—single-point accountability, integrated financial management, economies of scale and the ability to coordinate consistent care across the entire population. As is often the case with health reform, the gap between structural change and improved outcomes proved difficult to bridge and the first 2 years were marked by deteriorating financial control, widening per¬formance gaps and an erosion of local clinical governance. The missteps that characterised Health New Zealand's first 2 years carry a very important lesson, reflecting the broader truth that consol¬idating governance structures is not the same as integrating care delivery. During the 12-month term of the commissioner who replaced the Health New Zealand Board, the organisation has moved from crisis to stability, but challenges remain and there is a lot more work to do over the next 12 months.

Longitudinal trends in community antibiotic dispensing: a surveillance study of Aotearoa New Zealand from 2010 to 2019

Kirsten Fanning, Phil Hider, Ibrahim S Al-Busaidi, Jonathan Williman

This study looked at how often antibiotics were prescribed and collected from pharmacies (dispensed) in New Zealand between 2010 and 2019. It found that overall dispensing went down, especially for antibiotics that have a higher risk of bacteria becoming resistant, which compromises the effectiveness of the medication and makes infections harder to treat. However, use of one common antibiotic, cefalexin, increased. The study also showed that some groups, like Pacific peoples, young children and those in deprived areas, received more antibiotics. These results show progress in reducing antibiotic use, while also highlighting the need to monitor how antibiotics are dispensed across different groups.

Weight management services in Counties Manukau Health New Zealand – Te Whatu Ora: consumer experiences and ideal components

Tamasin Taylor, Rachel Ling, Mark McNeill, Delanie Nepia, Rinki Murphy

This study, conducted through three focus groups with 21 waitlisted metabolic bariatric surgery patients, explored their experiences with weight management and ideal service features. It revealed significant service gaps, including a lack of treatment options, prevalent weight-related stigma and unaddressed psychological issues. Participants desired more holistic and centralised weight management services, emphasising increased support from healthcare professionals, group support, and funded access to medications and surgery. Flexible programme formats, peer support and health coach support were also highly valued. Overall, the findings advocate for affordable, effective, and sustainable services that address the complex mental, social, and physical aspects of excess weight, supporting the model of care offered by the new Te Mana ki Tua service.

Trauma patient outcomes after the implementation of a trauma admitting service: a pre–post cohort study

Yuyi Feng, Tom Haig, Andrew McCombie, Dali Fan, Christopher Wakeman, Laura R. Joyce

Injury is the leading cause of death in Aotearoa New Zealand for those under the age of 35, and is

the second most common reason for hospitalisation. International studies have shown that dedicated multidisciplinary trauma team care can reduce morbidity and mortality for patients admitted to hospital after major trauma. Christchurch Hospital, the largest trauma centre in the South Island of New Zealand, established a specialist trauma admitting service in January 2022. However, resourcing limitations have undermined the potential impact of this service, with inadequate funding and resource for specialist trauma surgeons/resident medical officers/trauma nurses, and restricted operating hours. The introduction of this minimally resourced service has not demonstrated any improvement in outcomes for major trauma patients.

Examining ethnic and geographic disparities in end-of-life care pathways and community specialist palliative care engagement: insights from the Waikato Region

Rebecca J. Stevenson, Lana Ferguson

A Waikato audit of end-of-life care has found that while Māori and Pākehā/NZ Europeans were referred to the community specialist palliative care service at similar times, true equity goes deeper—meaning we need to address the cultural, social and systemic barriers Māori face before they even see a specialist and ensure care meets their needs. The study revealed most patients were referred for specialist palliative care only about 3 months before death, far behind best-practice recommendations that suggest a year of support; achieving this would require much greater government investment in services and workforce. In an unexpected finding, rural patients in the Waikato were sent for community specialist palliative care earlier and received more medical support than their urban peers, challenging the usual picture of rural health disadvantage. However, people in aged residential care (ARC), like rest homes, received much less specialist doctor input than those living at home, highlighting a significant gap for a growing older population. Despite these challenges, the service managed to make initial contact quickly—usually within a day by phone and within a week face-to-face—even though the region covers a vast geographic area; however, exploring how to ensure ongoing support is delivered equitably across different groups remains an important area for future research.

Recommendations for the use of functional medical imaging in the management of cancer of the cervix in New Zealand: a rapid review

Shouzhuang Feng, Sibusiso Mdletshe

In New Zealand, cervical cancer is the third most common gynaecological (female reproductive system) cancer, with Māori and Pacific women being at a greater risk due to health disparities (preventable differences in health outcomes). Utilising functional imaging scans (imaging methods that detect or measure aspects like blood flow, metabolism, regional chemical composition, absorption in the tissue), such as magnetic resonance imaging and positron emission tomography combined with computed tomography, can help doctors find, treat and track the treatment response of cervical cancer more accurately, which is more likely to result in better outcomes for affected patients. New tools, such as artificial intelligence software, can also help doctors improve cancer detection and staging accuracy, as well as reduce their workload. However, New Zealand currently does not have any clear guidelines on the use of these functional scans for cervical cancer, and this article suggests creating standardised guidelines to help ensure that all women get the best care possible.

Updated hepatitis C modelling in Aotearoa New Zealand: a lower burden, but clearer elimination targets

Michael Walsh, David Monnelly, Karen Bartholomew, Ed Gane

New modelling shows that far fewer people in New Zealand have hepatitis C than we thought—around 18,000 rather than 50,000—but many still don't know they have it. If left untreated, hepatitis C can lead to serious liver damage. Although we have excellent treatments that can cure the virus, not enough

people are being treated each year to meet our elimination goals. Community clinics and outreach vans have helped reach some of the most affected groups, but a wider approach is now needed. This could include offering one-off testing to all adults to find people who don't yet know they're infected. With a renewed push, New Zealand can still eliminate hepatitis C as a public health threat.

Blood cancers and Māori: a perspective on current evidence and next steps

Sydney Clough, Myra Ruka, Matthew Wheeler, James Stanley, Virginia C. Signal, Jonathan Koea, Jason K. Gurney

Blood cancers are significant in Māori populations. We still don't have a strong understanding of the causes of blood cancer, but we do know enough to prevent some of these cancers through public health action, particularly around infectious diseases. Improvements in treatment options over time means that survival from these cancers has improved overall. However, these gains are not equally shared, and Māori are less likely to survive all forms of blood cancer. To improve survival for Māori, and close gaps in survival between Māori and non-Māori, we need to improve access to early diagnosis and best treatment for Māori with these cancers.

Granulomatous heart: unmasking tubercular constrictive pericarditis

Jeco Jacob Kuttykandathil, Subhash Surya Venkata Sri Palakurthi, Gauri Malavalli Girish, Arfath Ahmed, Chakrapani Mahabala, Rakshatha Nayak, Vipul K Rathan

Tuberculous pericarditis is a rare but often dangerous consequence of tuberculosis, which is difficult to identify as its symptoms are seen in other common illnesses, in turn leading to a high risk of death and serious health problems. It causes stiffening of the heart lining and/or fluid build-up around the heart, which can cause life-threatening pressure on the heart. Special tests, like imaging of the heart and analysis of the fluid around the heart, are required to make a diagnosis, and treatment includes medications to fight tuberculosis, along with steroids. In some cases, excess fluid may have to be drained, or surgery may be necessary to relieve the pressure on the heart. Early identification of the illness and immediate treatment are crucial for recovery and reducing complications.

Laparoscopic cholecystectomy after endoscopic gallbladder drainage: a case report

Fraser Welsh, Bernadette Goodwin, Frank Weilert, Christopher Tse, Jasen Ly

In the past, patients with an inflamed gallbladder who are not well enough for surgery have been treated with a drain through the skin into the gallbladder. Internal drainage into the duodenum with a special drain placed via endoscope is an emerging alternative option but can make subsequent gallbladder surgery difficult. We report on an approach which allowed successful keyhole gallbladder surgery in a patient who had undergone internal (endoscopic) gallbladder drainage while he was temporarily not well enough for emergency gallbladder surgery.

Manaaki Mamao—to care from a distance: evaluating a telehealth service for Māori and Pacific peoples with hypertension

Tiffany Neary, Kwan-Lyn Lim, Vola Betham, Nick Coley, Sarah E. Maessen

Manaaki Mamao is a six-month telehealth programme by Hato Hone St John designed to reduce health inequities for Māori and Pacific peoples, starting with managing high blood pressure (BP). Clinicians provide personalised care, education, medication support, and monitor readings, escalating to a doctor when needed. It offers an effective option for patients not achieving BP control in primary care, with strong engagement leading to significant improvements. Trust, respect, and a culturally inclusive approach are key to the programme's success.

Reforming Health New Zealand: confronting crisis, sustaining recovery

Lester Levy, formerly Commissioner and currently Chair of Health New Zealand

A health system under strain

By the early 2020s, New Zealand's public health system faced deep-seated and widely acknowledged problems. Long before the COVID-19 pandemic, performance on key indicators—from emergency department waits to access to elective surgery—had been declining. These trends reflected structural fragmentation, variable local governance, outdated infrastructure and the absence of a coherent national delivery model.

The 2022 health reforms sought to address these failings by replacing 20 district health boards (DHBs) with a single entity: Health New Zealand – Te Whatu Ora. The ambition was to design a nationally planned, regionally supported and locally delivered system that could reduce unwarranted variation, improve equity and make better use of resources. Eight shared service agencies and key Ministry of Health functions were also integrated into the new organisation. The theoretical advantages were clear: single-point accountability, integrated financial management, economies of scale and the ability to coordinate care across the entire population.

Yet, as is often the case with health reform, the gap between structural change and improved outcomes proved difficult to bridge. The first 2 years of Health New Zealand were marked by deteriorating financial control, widening performance gaps and an erosion of local clinical governance. Centralisation, rather than delivering streamlined decision making, weakened links to frontline knowledge and accountability.

By mid-2024, the organisation was facing a cash crisis, growing deficits and mounting political and public concern that the reforms were failing to deliver. The Government responded by taking its strongest governance intervention—replacing the board with a commissioner.

The commissioner's mandate

The commissioner's appointment in July 2024 acknowledged that incremental course corrections would not suffice. The remit was explicit: arrest the financial decline, stabilise service performance and lay the groundwork for a sustainable turnaround.

Functionally, a commissioner has the powers of a board but operates more like an executive chair, enabling rapid interaction with the chief executive and senior management. Three deputy commissioners were appointed with focussed remits: financial control, clinical engagement and workplace safety. This structure compressed decision-making timelines and enabled sharper, faster responses.

Diagnosing the causes of underperformance

Independent reviews commissioned during this period provided a clear, if sobering, diagnosis.

Financial deterioration was attributed to multiple factors:

- Loss of district-level financial oversight after centralisation
- Weaknesses in budgeting and savings plans
- Ineffective financial reporting systems and information flows
- Organisational restructuring that reduced institutional capability
- Delayed responses to issues and emerging risks

This was not simply an accounting failure—it was a loss of control over the levers that determine financial sustainability.

On quality and safety, New Zealand's performance was broadly in line with comparable countries, but long waits for assessment and treatment emerged as the largest source of preventable harm. The patients in greatest jeopardy were those waiting in emergency departments, for first specialist assessments, for diagnostics and for elective surgery.

The review of workplace safety found progress in managing risks but noted that responses were

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often reactive rather than preventive, limiting consistency and resilience.

Tellingly, a review of innovation concluded that while world-class healthcare innovators existed within New Zealand, the system lacked the mechanisms to scale their work or to adopt proven global solutions.

Turning the corner

Over the following 12 months, the commissioners adopted a markedly different governance rhythm. Seventy-three formal commissioner meetings were held in a year—compared with the 11 or 12 typical of a board. This intensity allowed faster governance decisions, enabling the executive to move with urgency.

Financial recovery was a central achievement. Between July 2024 and May 2025, the monthly deficit fell by 85%, and by the end of the financial year the organisation was within budget. The projected depletion of cash reserves within 12 months was averted, with the year-end balance at NZ$1.054 billion. The organisation is now on a credible path to break even by 2026/2027.

Service performance also began to improve. Emergency department length of stay metrics reached their best levels in almost 3 years despite a 4% rise in attendances. Cancer treatment timeliness improved to 90% within 31 days, the first time this had been achieved since 2021. Childhood immunisation at 24 months reached 82%—the highest since Health New Zealand's inception.

Waiting lists, which had reached record highs in early 2025, were reduced by over 8,000 patients each for elective surgery and first specialist assessments. The number of patients waiting longer than 4 months for treatment fell by 15.5%, and those waiting for a first specialist appointment by 26.4%.

An internally funded elective surgery boost between February and June 2025 delivered an additional 10,579 cases through partnerships with private providers. This was accompanied by investment in primary care—notably an enhanced capitation initiative and government-funded programmes to strengthen urgent care, 24/7 digital access and workforce development.

Productivity trends showed encouraging signs. The long-run decline in hospital productivity, evident since at least 2012, was arrested, with May 2025 recording the highest levels since 2021.

Why the early reforms faltered

The structural weaknesses that undermined Health New Zealand's first 2 years hold important lessons for health reform globally. Centralisation removed layers of local governance without replacing them with effective regional or clinical leadership structures. In doing so, it severed feedback loops between those delivering care and those setting priorities.

Clinical governance was diluted, and decision making became slower and less aligned with patient needs. National enabling services—finance, IT, workforce planning—became disconnected from the realities of local service delivery. Without robust systems, financial and operational oversight degraded, and pre-existing weaknesses in infrastructure and models of care persisted.

These missteps reflect a broader truth: consolidating governance structures is not the same as integrating care delivery. Structural reform must be accompanied by robust mechanisms for local accountability, clinical engagement and transparent performance monitoring.

The road ahead: sustaining the gains

The commissioner's 2-year turnaround plan is only half complete. The next 12 months must consolidate financial control, deepen performance improvements and—crucially—move towards the model that was envisaged in 2022 but never realised.

Devolution is central to this vision. Decision-making authority and budgets should move progressively from the national centre to regional, district and unit levels, enabling services to respond to local needs while remaining aligned with national priorities. With devolved authority must come clear accountability for outcomes, supported by governance frameworks that allow regions and districts to influence national policy.

Clinical leadership and engagement will be equally important. This means embedding clinicians at every level of governance, strengthening clinical networks, aligning service planning with frontline expertise and fostering a culture where quality and safety are paramount. The clinical senate and an expanded clinical innovation network can help ensure that decision making is informed by both best evidence and local context.

Culture change will underpin all else. Leadership can set direction and allocate resources, but sustainable improvement depends on the day-to-day decisions of clinicians, managers and support staff. Every operational choice—from workforce planning to service redesign—must be viewed through the lens of patient benefit.

Lessons for health system reform

Health New Zealand's experience underscores several broader principles relevant to health systems worldwide:

1. **Structural reform is a means, not an end.** Organisational mergers do not automatically produce integration, efficiency or improved outcomes. Without parallel investment in governance capability, clinical engagement and system intelligence, centralisation can impair performance.
2. **Financial stability is a prerequisite for reform.** Service innovation and performance improvement are difficult to sustain in the context of fiscal crisis. Restoring financial discipline provides the platform for longer-term change.
3. **Local accountability matters.** National bodies must remain connected to frontline realities. Devolution, when paired with robust oversight, can align national goals with local responsiveness.
4. **Culture drives performance.** Systems that engage clinicians as partners, value innovation and align decision making with patient benefit are more likely to achieve lasting improvement.

Cautious optimism

Health New Zealand has moved from crisis to stability, but it is not yet a high-performing health system. The gains of the past year—in financial control, service access and operational efficiency—are still fresh. The test for the coming year will be to embed these improvements while advancing towards a devolved, clinically led model.

With an experienced clinician as chief executive, strong clinical representation on the board and a workforce committed to patient care, the potential is real. The challenge is to maintain discipline, avoid distraction and deliver a system that is nationally coordinated, locally responsive and unrelentingly focussed on patient benefit.

COMPETING INTERESTS
LL reports the following roles:
Chair, Health New Zealand 24 July 2025 to present.
Commissioner, Health New Zealand 24 July 2024 to 23 July 2025.
Chair, Health New Zealand 1 June 2024 to 23 July 2024.
Chair, Health Research Council 1 January 2016 to present.
Crown Monitor, Canterbury District Health Board 2019 to 2022.
Ministerial Advisory Group Member 2017 to 2019.
Chair, Waitematā District Health Board 2009 to 2018.
Chair, Auckland District Health Board 2010 to 2018.
Chair, Counties Manukau District Health Board 2016 to 2018.

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Longitudinal trends in community antibiotic dispensing: a surveillance study of Aotearoa New Zealand from 2010 to 2019

Kirsten Fanning, Phil Hider, Ibrahim S Al-Busaidi, Jonathan Williman

ABSTRACT

AIM: We aimed to investigate community systemic antibiotic dispensing in New Zealand across 2010–2019.

METHODS: This longitudinal study utilised dispensing data from the National Pharmaceutical Collection and population data from the Health New Zealand – Te Whatu Ora populations web tool. Dispensing rates were measured as the number of defined daily doses/1,000 inhabitants per day (DIDs) and courses dispensed/1,000 inhabitants/year. Dispensing data were stratified by antibiotic group, AWaRe (Access, Watch, Reserve) categories, district health board (DHB) region and patient characteristics.

RESULTS: Between January 1 2010 and December 31 2019, community systemic antibiotic dispensing in New Zealand declined, with courses dispensed dropping from 930 to 782 (average annual change [AAC] −1.9%) and DID from 20.9 to 19.6 (AAC −0.75%). Watch antibiotics decreased by 8% in courses dispensed/1,000 inhabitants/year, with quinolones showing the largest proportional reduction (−37 courses dispensed/1,000 inhabitants/year; AAC −13.4%). Conversely, first-generation cephalosporins increased significantly (+45 courses dispensed/1,000 inhabitants/year; AAC +56%), primarily due to cefalexin. Ethnic differences persisted, with Pacific people consistently exhibiting the highest dispensing rates. Most DHB regions experienced an overall decline in dispensing during this period.

CONCLUSIONS: The study identified encouraging trends in antibiotic dispensing, reflecting New Zealand's antimicrobial stewardship initiatives, but also highlighted the rise in cefalexin and ongoing variations that require further investigation.

Antibiotics play a critical role in healthcare by providing essential treatment and prevention of bacterial infections, ranging from common ailments to life-threatening illnesses. However, the effectiveness of antibiotics is increasingly threatened by the emergence of antimicrobial resistance (AMR).[1,2] AMR now ranks among the top 10 global health threats, with an estimated 1.27 million deaths worldwide in 2019.[2] Future projections suggest a marked rise in AMR-related deaths, potentially reaching 10 million annually by 2050, accompanied by substantial increases in healthcare costs exceeding US$1 trillion.[2]

Excessive use of antibiotics can lead to the emergence of resistant bacteria. Human consumption in the community is a significant driver of high antibiotic use.[3] This is particularly evident in high-income countries (HICs), where community consumption accounts for 85–95% of all antibiotic use.[3] There is limited development of new antibiotics by the pharmaceutical industry; hence, re-evaluating and reducing antibiotic use is critical to mitigating the progression of AMR and its associated consequences.[1]

Encouragingly, over the last decade, there have been signs of decreased community antibiotic dispensing in countries such as New Zealand, Australia, Canada, the United Kingdom (UK), Denmark and Sweden.[4–11] Despite this reduction, New Zealand still exhibits comparatively high dispensing rates. In 2018, the number of defined daily doses per 1,000 inhabitants per day (DIDs) in New Zealand (22.5 DIDs) exceeded those in UK (18.7 DIDs), Denmark (15.5 DIDs), Sweden (12.4 DIDs), Netherlands (9.7 DIDs) and Australia (22.4 DIDs). However, it remained lower than those in Spain (26.2 DIDs) and Greece (34.1 DIDs).[9,10]

One factor contributing to New Zealand's comparatively high antibiotic dispensing rates could be the higher burden of infectious diseases among certain groups. Māori and Pacific people experience disproportionately high hospitalisation rates for certain infectious diseases, particularly acute rheumatic fever, which is almost exclusively seen in Māori and Pacific children.[12]

Prescribing practices may also be contributing to the high dispensing rates in New Zealand. For instance, during 2014–2015, a 26% increase in

antibiotic dispensing for upper respiratory tract infections during winter may suggest a tendency to prescribe antibiotics for viral cases, which are not effectively treated with these medications.[6]

Given these potential contributing factors, it is essential to analyse recent trends in community-based antibiotic dispensing within New Zealand to gain a comprehensive understanding of current practices. Such understanding is crucial for promoting more judicious use of antibiotics in healthcare and ensuring that existing frameworks are responsive to the unique health needs of New Zealand's diverse population.

This study aims to describe the trends in community antibiotic dispensing in New Zealand from 2010 to 2019, with a focus on examining the demographic and geographic patterns associated with this usage.

Methods

Study design and data collection

This was a longitudinal study using national, community-based, systemic antibiotic dispensing data from 2010 to 2019. Dispensing and demographic data were obtained from the National Pharmaceutical Collection (NPC). The NPC contains records of all subsidised drugs dispensed by community pharmacies across New Zealand since 1992.[13] Antibiotics dispensed to hospital inpatients, patients without subsidises and by practitioner supply orders (PSO) were excluded.

Collected data included the type of antibacterial agent, the quantity and the dosage dispensed. Antibiotics were classified under the Anatomical Therapeutic Chemical (ATC) system, specifically under the J01 category for antibacterial agents intended for systemic use (see Appendix 1).[14] The dataset also included details of the district health board (DHB) region where the antibiotics were dispensed, as well as patient demographic characteristics. These comprised age groups (<5 years, 5–9 years, 10–19 years, 20–59 years and 60+ years), sex (male or female), prioritised ethnicity (Māori, Pacific people, Asian, and "Other") and socio-economic deprivation measured by the New Zealand Index of Deprivation (NZDep) quintiles. NZDep13 was used for the years 2010–2016, while NZDep18 was used for the years 2017–2019. Population estimates were obtained from the Health New Zealand – Te Whatu Ora population web tool, which provides detailed demographic information for New Zealand, including breakdowns by DHB, age, prioritised ethnicity and deprivation quintiles.[15]

Derived variables

Antibiotic dispensing was assessed using two measures: i) the number of dispensed courses per 1,000 inhabitants per year, and ii) the number of DIDs per 1,000 inhabitants per day. The DID represents the average daily dosage for a 70kg adult as defined by the World Health Organization (WHO).[16] However, because the DID calculation is based on adult weight, it does not accurately estimate paediatric dosage.[14] Therefore, for the age group analysis, only the number of dispensed courses per 1,000 inhabitants per year was considered.

In addition to these measures, antibiotic categories were further classified according to the AWaRe (Access, Watch, and Reserve) tool introduced by the WHO in 2018.[17] This tool monitors antimicrobial stewardship (AMS) efforts by grouping commonly used antibiotics based on their spectrum and resistance potential. The *Access* group includes narrow-spectrum antibiotics recommended as first-choice agents, while the *Watch* group comprises broader-spectrum antibiotics associated with higher-resistance risks.[17] The *Reserve* group is reserved for infections involving suspected multi-drug–resistant organisms and is recommended as a last resort.[17] WHO guidelines suggest that at least 60% of national antibiotic usage should come from the Access category.[17] Building on this, the UK set a more ambitious target in its 2024 AMR action plan, aiming to increase Access category usage to 70% by 2029.[18]

Data analysis

Data was grouped by year, age group, sex, prioritised ethnicity and deprivation quintiles before calculating the number of dispensed courses per 1,000 inhabitants per year and DIDs. For sex, prioritised ethnicity and deprivation quintiles, the dispensed courses per 1,000 inhabitants per year were age-standardised using the direct method and the World Standard (WHO 2000–2025) as the reference population.[16]

Changes over time in overall dispensing patterns were examined by presenting the data in figures and tables and calculating the average annual change (AAC) between the first and last study years (2010 and 2019). Additionally, stratified analyses were conducted according to ATC groupings and WHO AWaRe classification (see Appendix 1), DHB regions and patient characteristics including age group, sex, prioritised ethnicity and deprivation. All analyses were conducted using R (Version

2023.06.02).

Ethical considerations

Māori consultation was conducted, and ethical approval for this study was granted by the University of Otago Human Ethics Committee (Reference: HD23/061).

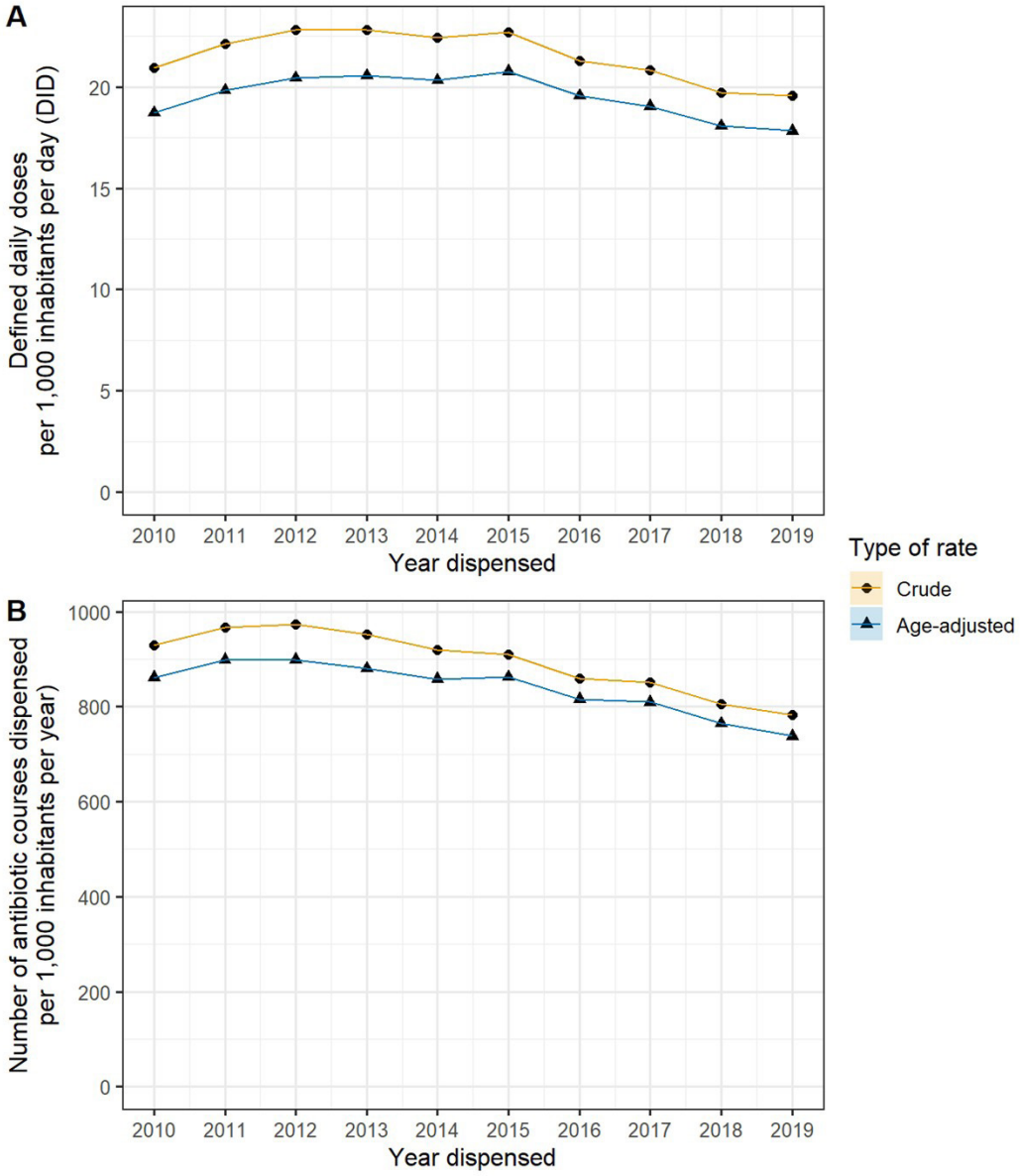
Results

In 2010, 4,045,177 systemic antibiotic courses were dispensed to at least 1,796,538 individuals. By 2019, this had decreased to 3,894,786 courses dispensed to 1,926,149 people. A small number (3.3%) of courses could not be linked to specific people and were missing demographic data. The proportion of courses not linked to specific people decreased steadily between 2010 (5.5%) and 2019 (1.2%).

Overall antibiotic dispensing

Between 2010 and 2019, there was an overall decline in community-based antibiotic dispensing per person. The courses dispensed/1,000 inhabitants/year fell from 930 in 2010 to 782 in 2019, indicating an AAC of −1.9%. The DID decreased modestly from 20.9 to 19.6, with an AAC of −0.75% (see Figure 1 and Appendix 2).

Figure 1: Community systemic antibiotic dispensing between 2010 and 2019 by defined daily doses per 1,000 inhabitants per day (DIDs) (a), and antibiotic courses dispensed per 1,000 population per year (b).



Over the study period, both measures initially increased before showing a subsequent decline. The number of courses dispensed/1,000 inhabitants/year rose by 44 from 2010 to 2012, then decreased by 191 from 2013 to 2019. Similarly, the DID increased by 1.9 from 2010 to 2012, and remained elevated until 2015 before dropping by 3.1 between 2015 and 2019 (see Appendix 2).

Antibiotic dispensing per antibiotic group

The largest reductions in the number of courses dispensed/1,000 inhabitants/year were observed in relation to penicillin with beta-lactamase inhibitors (−63 courses dispensed/1,000 inhabitants/year; AAC −4.6%), quinolones (−37 courses dispensed/1,000 inhabitants/year; AAC −13%) and macrolides/lincosamides (−30 courses dispensed/1,000 inhabitants/year; AAC −3.4%) (see Appendix 3). Quinolones were associated with the largest proportional decrease, with an approximately 3.5-fold reduction in courses dispensed/1,000 inhabitants between 2010 and 2019.

Some antibiotic groups exhibited an increase in dispensing over the study period. First-generation cephalosporins increased the most (+45 courses dispensed/1,000 inhabitants/year; AAC +56%), largely driven by cefalexin. There were also small increases in nitrofuran derivatives (+8.3 courses dispensed/1,000 inhabitants/year; +5.5 DIDs) and Other antibiotics (+0.8 courses dispensed/1,000 inhabitants/year; AAC +12%) (see Appendix 3).

Antibiotic dispensing per WHO AWaRe group

The proportion of antibiotics in the Access category rose from 81% to 86% when measured by DIDs and from 78% to 86% when assessed by the number of courses dispensed/1,000 inhabitants/year (see Figure 2 and Appendix 4). Conversely, in the Watch category, there was a decrease in DIDs from 19% to 13%, with a parallel decline from 22% to 14% in the number of courses dispensed/1,000 inhabitants/year (see Figure 2 and Appendix 4).

Antibiotic dispensing per DHB

Between 2010 and 2019, notable discrepancies were observed among DHBs in relation to the absolute changes in both DIDs and courses dispensed/1,000 inhabitants/year for systemic antibiotics in the community.

The majority of DHBs experienced a decline in DIDs during this period. This ranged from a substantial decrease in Tairāwhiti (−4.2 DIDs) to a small reduction in the West Coast (−0.6 DIDs). Conversely, two DHBs had an increase in DIDs: Taranaki (+0.6 DID) and Southern (+0.1 DID) (see Appendix 5a and Appendix 5b).

All DHBs showed a decline in the annual number of systemic antibiotic courses dispensed per 1,000 inhabitants per year. Bay of Plenty experienced the most significant reduction (−255 courses dispensed/1,000 inhabitants/year), while Taranaki exhibited the smallest decrease (−68 courses dispensed/1,000 inhabitants/year) (see Appendix 5a and Appendix 5b).

Antibiotic dispensing by patient characteristics

The number of courses dispensed/1,000 inhabitants/year declined across all age groups. Notably, children under 5 years old had a substantial reduction, with the dispensing rate decreasing by approximately a third from 2010 to 2019 (see Figure 3 and Appendix 6).

Over the study period, females consistently exhibited a higher dispensing rate compared with males, regardless of whether it was measured by the number of courses dispensed/1,000 inhabitants/year or DIDs (see Appendix 6a and Appendix 6b).

Ethnic differences persisted throughout the study years, with Pacific people consistently having the highest dispensing rates and people of Asian ethnicity having the lowest, both in terms of DIDs and the courses dispensed/1,000 inhabitants/year (see Figure 4 and Appendix 6).

The most deprived quintile (quintile 5) consistently had the highest dispensing rates between 2010 and 2019, regardless of whether it was measured by the number of courses dispensed/1,000 inhabitants/year or DIDs (see Figure 5 and Appendix 6).

Discussion

Community systemic antibiotic dispensing per inhabitant in New Zealand decreased between 2010 and 2019. The number of courses dispensed/1,000 inhabitants/year decreased by 148 courses (16% decrease), while the number of DIDs declined by a smaller amount (1.3 DIDs, 6.2% decrease). There was also a notable decrease in the proportion of antibiotics dispensed from the WHO Watch category, particularly a significant drop in quinolones. Conversely, cefalexin showed a marked increase in proportional usage. Significant variation in dispensing rates was observed among ethnic groups, with Pacific people exhibiting the

Figure 2: Percentage of community systemic antibiotic dispensing by the World Health Organization AWaRe groups in Aotearoa New Zealand during 2010-2019.

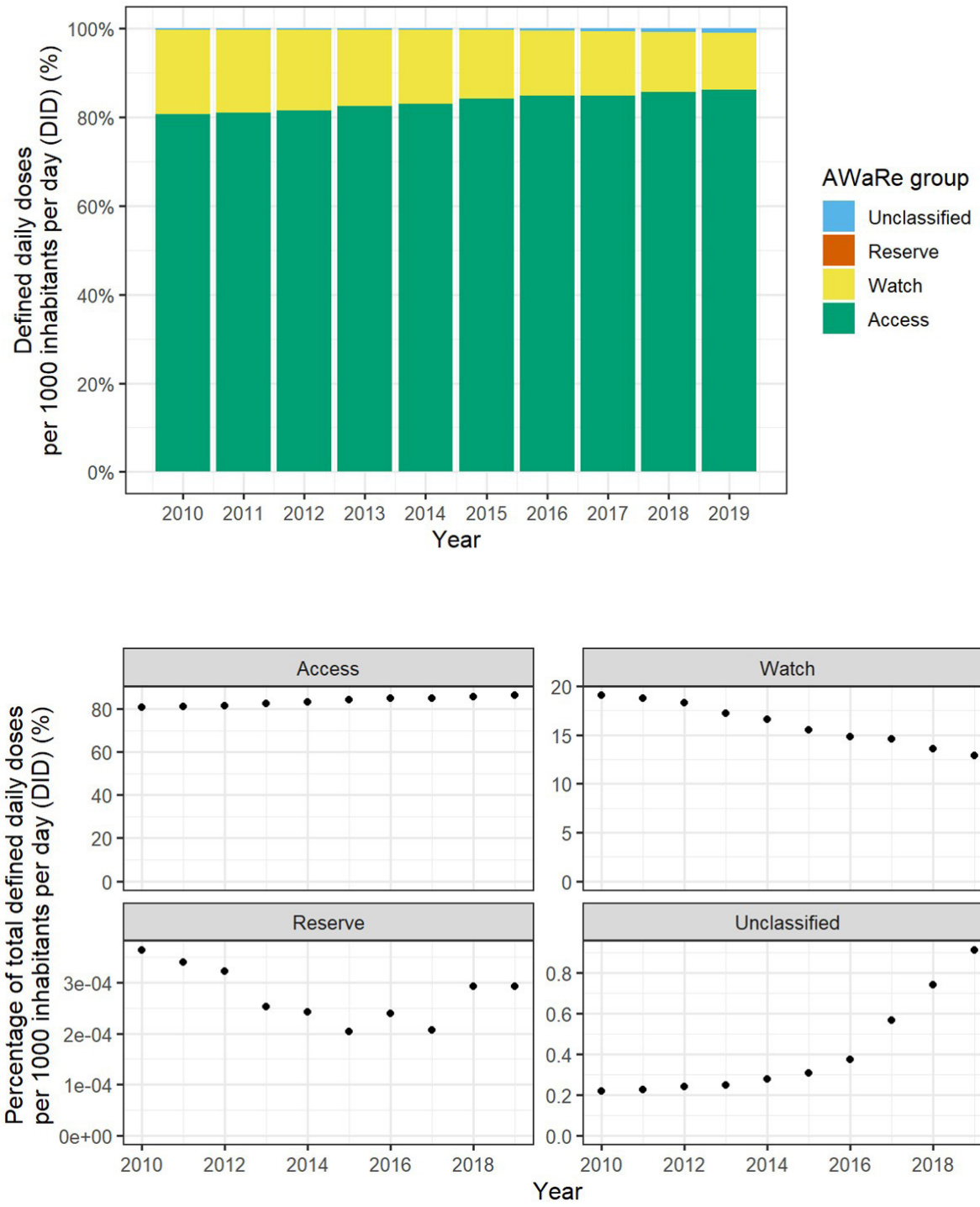
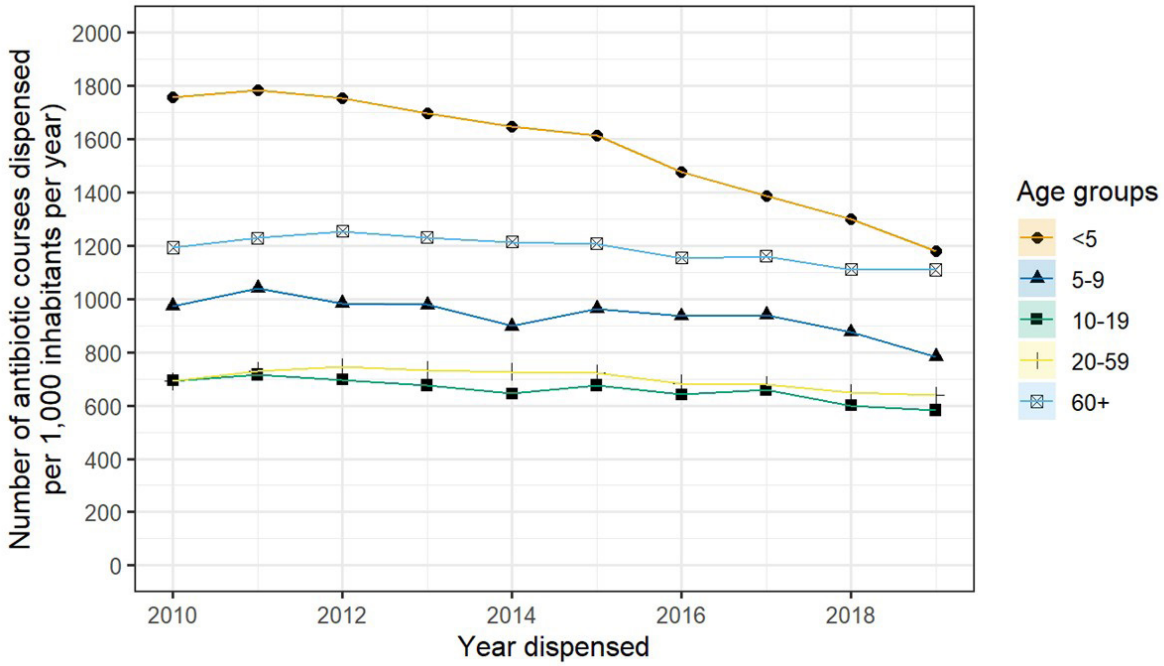


Figure 3: The number of systemic antibiotic courses dispensed per 1,000 inhabitants per year in the Aotearoa New Zealand community between 2010 and 2019 by age group.



highest age-adjusted dispensing rates. Additionally, individuals in the most deprived quintile had the highest rates of antibiotic dispensing, based on the age-adjusted courses dispensed rate. Furthermore, both the young and elderly consistently showed higher rates of antibiotic dispensing.

The observed decline in antibiotic consumption in New Zealand during the second half of the past decade parallels similar trends in other HICs, including the UK, Canada, Australia and the European Union.[9–11] This trend may reflect concerted international efforts to enhance AMS. A significant milestone in this global initiative was the launch of the WHO's global action plan on AMR in 2015, which was adopted by 79% of member countries—including New Zealand—who implemented their own national action plans (NAPs) by 2017.[19]

New Zealand's NAP embodies a "one-health" approach, incorporating initiatives across human, animal and agricultural sectors.[20] In 2015, the New Zealand Veterinary Association set an ambitious goal to eliminate the necessity of using antibiotics for maintaining animal health by 2030.[21] Since then, significant progress has been made, with a reported 42% decrease in antibiotic sales in the animal and agricultural sectors from 2017 to 2022.[21]

In human health, multiple efforts are underway. The Institute of Environmental Science and Research (ESR) is responsible for national AMR surveillance of human pathogens, monitoring ongoing trends and the potential emergence of new AMR threats.[20] Numerous initiatives aimed at promoting responsible antibiotic use include national programmes (such as the AMR group and DHB-based AMR teams), comprehensive guidelines (both national, like the Best Practice Advocacy Centre *Antibiotic Guide* and the New Zealand Formulary, and regional, such as HealthPathways), targeted interventions and campaigns, such as the 2019 Antibiotic Amnesty.[21–26]

During this same period (2011–2017), New Zealand implemented the Rheumatic Fever Prevention Programme—a national initiative that aimed to improve access to antibiotics, particularly penicillin, for high-risk populations through school-based sore throat services and public health campaigns.[27] Eleven DHBs in the North Island participated, reflecting a substantial investment in improving accessibility in regions with the highest incidence of rheumatic fever.[27] While this programme likely increased antibiotic use in targeted communities, the fact that a national decline in dispensing was still observed is encouraging, suggesting that reductions occurred despite efforts to expand access in specific areas.

These human health initiatives have likely

Figure 4: Age-standardised rates of community systemic antibiotic dispensing between 2010 and 2019 by ethnicity measured by defined daily doses per 1,000 inhabitants per day (DIDs) (a), and antibiotic courses dispensed per 1,000 population per year (b).

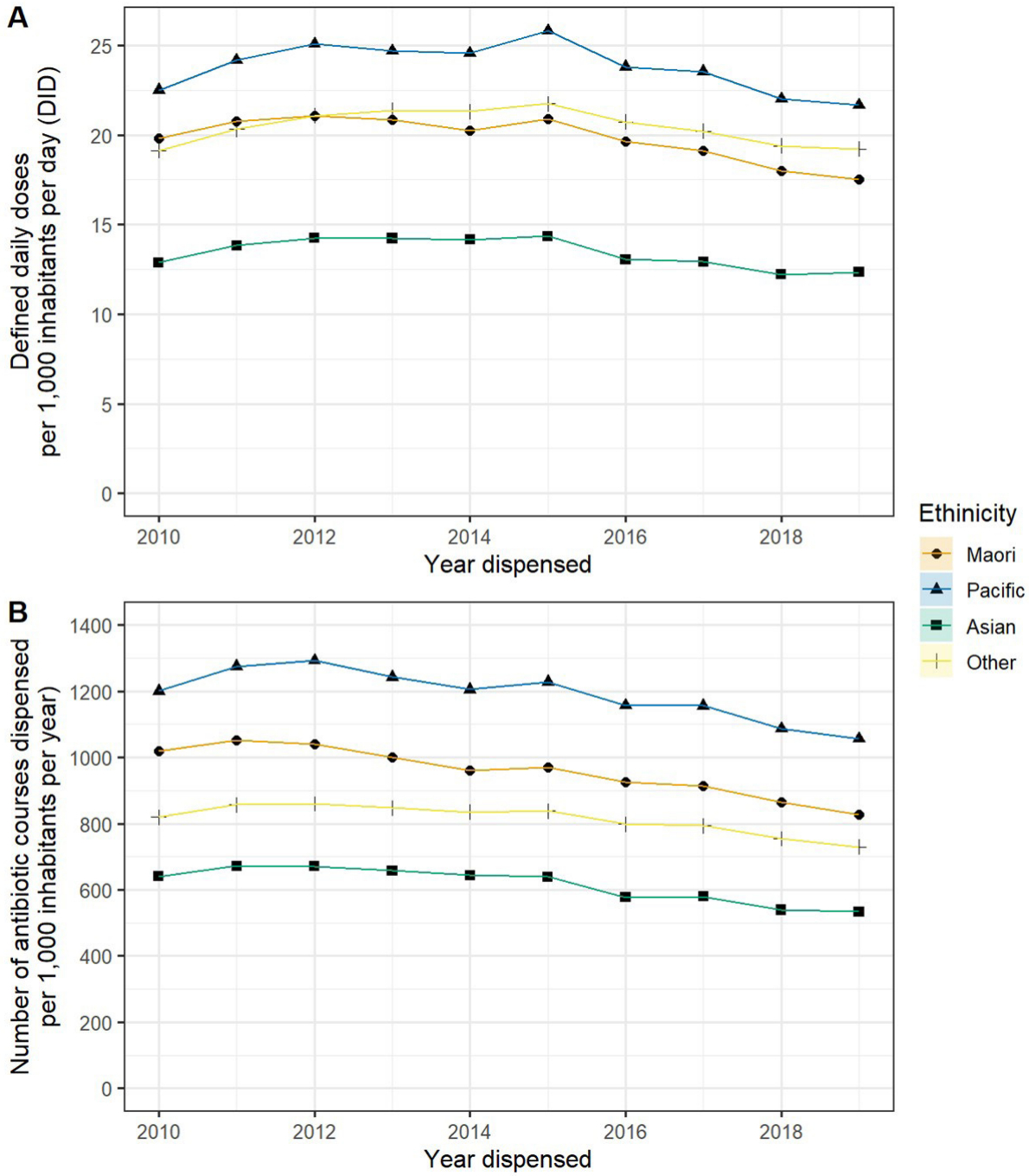
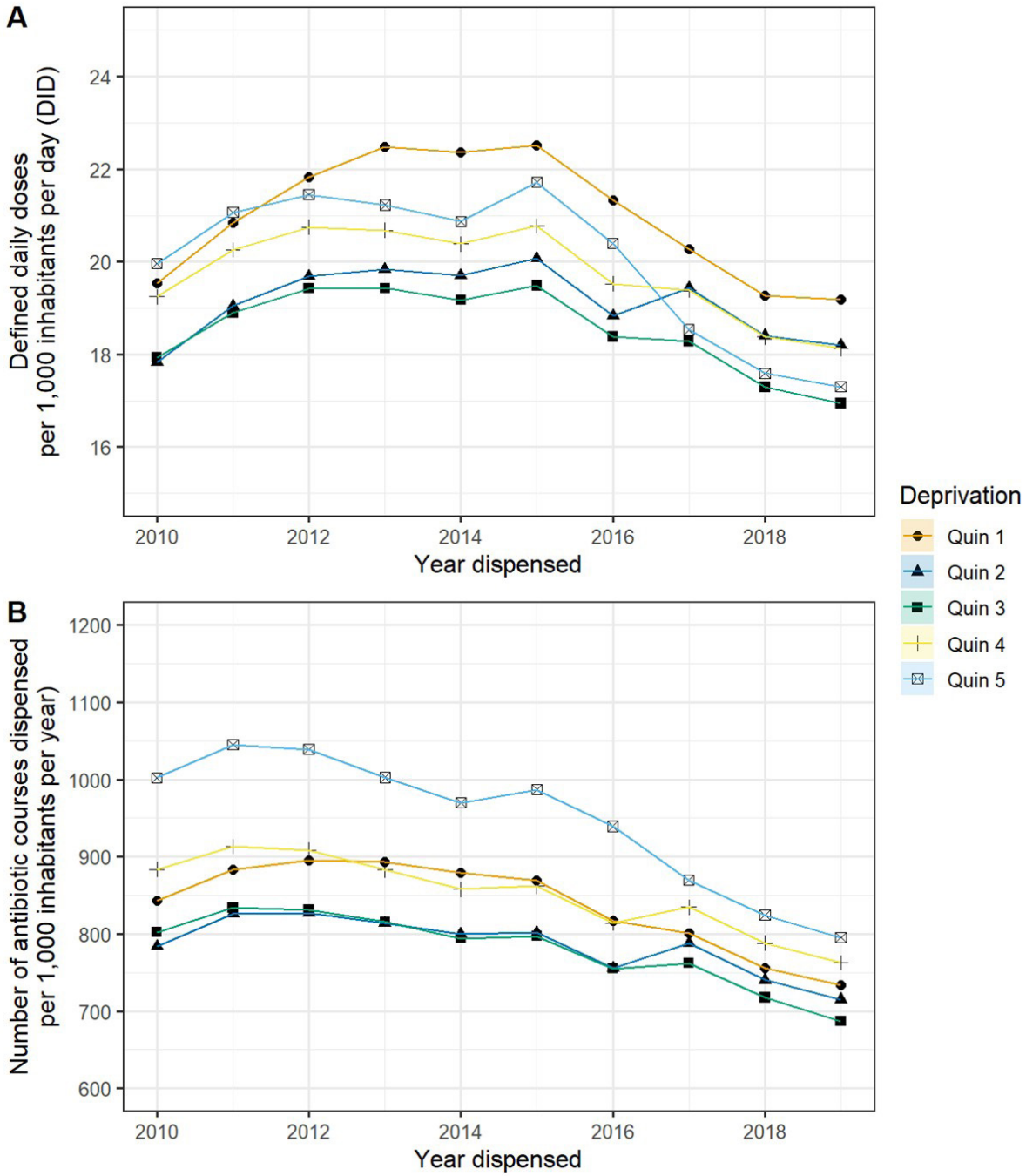


Figure 5: Age-standardised rates of community systemic antibiotic dispensing between 2010 and 2019 by New Zealand Deprivation (NZDep) quintiles (quintile 1 = least deprived, quintile 5 = most deprived). Measured by the number of defined daily doses per 1000 population per day (DIDs) (a), and the number of antibiotic courses dispensed per 1,000 inhabitants per year (b).



(a) y axis range is 16–24 DIDs and (b) y axis range is 600–1200 courses dispensed per 1,000 inhabitants per year.

contributed to the observed decrease in community antibiotic dispensing, especially for antibiotics with a greater risk of resistance, such as those in the Watch category. Recent guideline revisions for quinolones strongly discourage prescribing these antibiotics and impose several prescribing restrictions.[28] Ciprofloxacin now requires endorsement from a specialist before use, and midstream urine test results do not include sensitivity to ciprofloxacin unless the microbe is resistant to first- and second-line antibiotics.[28] Quinolone prescribing has reduced by one-third, suggesting that ongoing initiatives such as these may be changing prescribing practices.

By contrast, first-generation cephalosporins have seen a significant proportional increase in both the number of courses dispensed/1,000 inhabitants/year and DIDs, driven primarily by the rising use of cefalexin. Similar patterns have been observed in Australia over the past decade.[10] Cefalexin is commonly prescribed for various indications, including skin and soft tissue infections and urinary tract infections.[23] Until national guidelines were revised in 2019, cefalexin was also recommended for the treatment of recurrent group A streptococcal sore throats, which may partly account for its increased use during the study period.[29] Given that cefalexin is a broad-spectrum antibiotic, a more detailed understanding of the factors contributing to its increased use in New Zealand is warranted. Further research is currently underway to investigate this trend.

There was marked variation in dispensing rates related to ethnicity, with the highest rates observed among Pacific people, while the "Other" ethnic group had the second highest dispensing rates per 1,000 inhabitants per year. Although ethnicity is associated with differing infectious burdens, drawing definitive conclusions about disparities in healthcare access from the data remains challenging.[13]

During the COVID-19 pandemic, Duffy et al. observed that reducing antibiotic dispensing across all ethnic groups did not lead to an increase in specific sentinel infections, suggesting that healthcare needs could still be fulfilled with lower antibiotic use.[30] However, this study coincided with a period of reduced infectious burden due to COVID-19 interventions.[6] To gain deeper insights into the relationship between antibiotic dispensing and healthcare outcomes outside of COVID-19 contexts, looking at the relationship between antibiotic dispensing and hospitalisation rates using the National Minimum Dataset (NMD) would be highly useful.[31] This approach would contribute to a balanced assessment, monitoring both lowering dispensing targets while simultaneously assessing whether healthcare needs were being met.

Implications for research, policy and practice

This study shows a reduction in community antibiotic dispensing per inhabitants across a period (2010–2019), but the large proportional rise in cefalexin use warrants further investigation to understand its causes and implications for New Zealand's AMS.

Implementing an ongoing surveillance programme for community antibiotic dispensing in New Zealand, similar to those in Australia, Canada, the UK and the European Union/European Economic Area, could be a promising strategy for enhancing AMS in the future.[9–11] These countries collect and report dispensing data every 1–2 years, offering valuable insights into dispensing patterns.[9–11] A similar programme, managed by Health New Zealand – Te Whatu Ora, could be a publicly accessible resource that complements existing strategies such as prescribing guidelines and Antimicrobial Awareness Week.[21–26]

A unified surveillance system would strengthen existing AMR efforts led by ESR and provide clinicians with regular feedback to refine their prescribing practices.[21] By capturing detailed data on antibiotic use—including recipients, types and geographic trends—this programme could drive evidence-based AMS initiatives and enable local stakeholders to measure their progress more effectively. Furthermore, integrating dispensing data with hospitalisation trends from the NMD could offer a more comprehensive view of antibiotic use and healthcare needs.[31] Ultimately, this system would serve as a supportive tool, bolstering both existing and future AMS interventions and guiding more appropriate prescribing practices across New Zealand.

Strengths and limitations

This study is the first nationwide analysis in New Zealand to use the AWaRe classification system for investigating community antibiotic dispensing, highlighting AMS efforts over time. Study strengths include dual outcome measures and a thorough analysis of community antibiotic trends. By examining data across antibiotic groups, geographical regions and patient characteristics, the study identifies demographic variations and provides insights for future AMS strategies.

Additionally, the updated DDD Index (Defined Daily Dose Index) enhances the accuracy of DID calculations and, in turn, improves interpretation of New Zealand's dispensing patterns and international comparability.[14]

However, the study is not without limitations. Primarily, it is limited to observations of the quantity and distribution of antibiotics dispensed, without providing underlying information about the clinical conditions that lead to the dispensing. Thus, the study cannot comment on whether the observed changes are due to appropriate or inappropriate prescribing. Additionally, the study fails to account for all community antibiotic dispensing, particularly from PSOs. In addition to PSOs, unsubsidised antibiotics with a prescription from a practitioner and pharmacist-supplied antibiotics (e.g., trimethoprim) were not included in this dataset.[5] Finally, the use of DDD may not accurately reflect paediatric antibiotic usage patterns.

Conclusions

There has been a small decline in community antibiotic dispensing per inhabitant in New Zealand from 2010 to 2019, aligning with global trends. These findings are encouraging, particularly due to the overall reduction in the Watch group of antibiotics, indicating progress in AMS efforts.

Study results underscore persistent variation in dispensing across demographic groups. It remains uncertain whether the dispensing trends reflect healthcare needs and represent appropriate prescribing.

Further research is needed to investigate the factors contributing to the observed prescribing variations and the increase in cefalexin usage. Establishing a national surveillance framework that also utilises NMD data for bacterial infections would provide valuable insights.

COMPETING INTERESTS
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REFERENCES
1. Nahrgang S, Nolte E, Rechel B. Antimicrobial resistance. In: Rechel B, Maresso A, Sagan A, et al., editors. The role of public health organizations in addressing public health problems in Europe: The case of obesity, alcohol and antimicrobial resistance [Internet]. Copenhagen (Denmark): European Observatory on Health Systems and Policies; 2018. (Health Policy Series, No. 51.) 4. Available from: https://www.ncbi.nlm.nih.gov/books/NBK536193/
2. World Health Organization. Global Antimicrobial Resistance and Use Surveillance System (GLASS) [Internet]. Geneva: World Health Organization; 2022 [cited 2024 Apr 20]. Available from: https://www.who.int/initiatives/glass
3. Duffy E, Ritchie S, Metcalfe S, et al. Antibacterials dispensed in the community comprise 85%–95% of total human antibacterial consumption. J Clin Pharm Ther. 2018 Feb;43(1): 59-64. doi: 10.1111/jcpt.12610.
4. Thomas M, Tomlin A, Duffy E, Tilyard M. Reduced community antibiotic dispensing in New Zealand during 2015-2018: marked variation in relation to primary health organisation. N Z Med J. 2020 Jul;133(1518): 33-42.
5. Hagedoorn NN, Al-Busaidi I, Bridgford P, et al. Longitudinal trends in community antibiotic consumption in the Waitaha Canterbury Region of Aotearoa New Zealand over 10 Years (2012-2021): an observational study. N Z Med J. 2023 Mar;136(1571): 49-64. doi: 10.26635/6965.5999.
6. Whyler N, Tomlin A, Tilyard M, Thomas M. Ethnic disparities in community antibacterial dispensing in New Zealand, 2015. N Z Med J. 2018 Aug;131(1480):50-60.
7. Williamson DA, Roos R, Verrall A, et al. Trends, demographics and disparities in outpatient antibiotic consumption in New Zealand: a national study. J Antimicrob Chemother. 2016 Dec;71(12):3593-3598. doi: 10.1093/jac/dkw345.
8. Health & Quality Safety Commission. Atlas of Healthcare Variation: Methodology | Community use of antibiotics [Internet]. Health & Quality Safety Commission; 2020 [cited 2023 Dec 15]. Available from: https://www.hqsc.govt.nz/assets/Our-data/Publications-resources/Antibiotic_Methodology_Jun_2020.pdf
9. Robertson J, Vlahović-Palčevski V, Iwamoto K, et al. Variations in the Consumption of Antimicrobial Medicines in the European Region, 2014–2018: Findings and Implications from ESAC-Net and WHO Europe. Front Pharmacol. 2021 Jun;12:639207. doi: 10.3389/fphar.2021.639207. Erratum in: Front Pharmacol. 2021 Sep 30;12:765748. doi: 10.3389/fphar.2021.765748.
10. Australian Commission on Safety and Quality in Health Care. AURA 2021: Fourth Australian report on antimicrobial use and resistance in human health [Internet]. Sydney: Australian Commission on Safety and Quality in Health Care; 2021 [cited 2023 Dec 15]. Available from: https://www.safetyandquality.gov.au/sites/default/files/2021-09/aura_2021_-_report_-_final_accessible_pdf_-_for_web_publication.pdf
11. Public Health Agency of Canada. Canadian Antimicrobial Resistance Surveillance System Report 2022 [Internet]. Ottawa: Public Health Agency of Canada; 2022 [cited 2023 Dec 15]. Available from: https://www.canada.ca/en/public-health/services/publications/drugs-health-products/canadian-antimicrobial-resistance-surveillance-system-report-2022.html
12. Baker MG, Barnard LT, Kvalsvig A, et al. Increasing incidence of serious infectious diseases and inequalities in New Zealand: a national epidemiological study. Lancet. 2012 Mar;379(9821):1112-9. doi: 10.1016/s0140-6736(11)61780-7.
13. Health New Zealand – Te Whatu Ora.

Pharmaceutical Collection [Internet]. Wellington: Health New Zealand – Te Whatu Ora; 2023 [cited 2023 Jul 10]. Available from: https://www.tewhatuora.govt.nz/our-health-system/data-and-statistics/nz-health-statistics/national-collections-and-surveys/collections/pharmaceutical-collection
14. Norwegian Institute of Public Health. Definition and general considerations [Internet]. Oslo: Norwegian Institute of Public Health; 2018 [cited [2023 Oct 24]. Available from: https://atcddd.fhi.no/ddd/definition_and_general_considera/
15. Health New Zealand – Te Whatu Ora. Populations web tool [Internet]. Wellington Health New Zealand – Te Whatu Ora; 2023 [cited 2023 Jul 12]. Available from: https://tewhatuora.shinyapps.io/populations-web-tool/
16. Ahmad O, Boschi-Pinot C, Lopez AD, et al. Age standardization of rates: a new WHO standard [Internet]. Geneva: World Health Organization; 2001 [cited 2024 Jan 21]. Available from: https://cdn.who.int/media/docs/default-source/gho-documents/global-health-estimates/gpe_discussion_paper_series_paper31_2001_age_standardization_rates.pdf
17. World Health Organization. 2021 AWaRe classification [Internet]. World Health Organization; 2021 [cited 2023 Aug 20]. Available from: https://www.who.int/publications/i/item/2021-aware-classification
18. Government Department of Health and Social Care, Scottish Government, Welsh Government, Department for Environment, Food & Rural Affairs, Department of Health (Northern Ireland), Department of Agriculture, Environment and Rural Affairs (Northern Ireland). Confronting antimicrobial resistance 2024 to 2029 [Internet]. London; 2024 May 8 [cited 2025 May 23]. Available from: https://www.gov.uk/government/publications/uk-5-year-action-plan-for-antimicrobial-resistance-2024-to-2029/confronting-antimicrobial-resistance-2024-to-2029
19. Patel J, Harant A, Fernandes G, et al. Measuring the global response to antimicrobial resistance, 2020-21: a systematic governance analysis of 114 countries. Lancet Infect Dis. 2023 Jun;23(6):706-718. doi: 10.1016/S1473-3099(22)00796-4.
20. Ministry of Health – Manatū Hauora, Ministry for Primary Industries – Manatū Ahu Matua. New Zealand Antimicrobial Resistance Action Plan [Internet]. Wellington: Ministry of Health; 2017 [cited 2024 Feb 13]. Available from: https://www.health.govt.nz/system/files/2017-08/new-zealand-antimicrobial-resistance-action-plan.pdf
21. Thomas M. Improving community antibiotic prescribing to keep antibiotics working in Aotearoa New Zealand. N Z Med J. 2024;137(1592):90-99. doi: 10.26635/6965.6389.
22. Gardiner SJ. Antimicrobial stewardship in human healthcare in Aotearoa New Zealand: urgent call for national leadership and coordinated efforts to preserve antimicrobial effectiveness. N Z Med J. 2021;134(1544):113-28.
23. Best Practice Advocacy Centre New Zealand. bpac^{NZ} Primary Care Antibiotic Guide. Best Practice Advocacy Centre New Zealand; 2023 [cited 2024 Feb 29]. Available from: https://bpac.org.nz/antibiotics/guide.aspx
24. New Zealand Formulary. The New Zealand Formulary [Internet]. New Zealand Formulary; 2024 [cited 2024 Feb 29]. Available from: https://nzformulary.org
25. HealthPathways Community. Welcome to the HealthPathways Community [Internet]. HealthPathways; 2024 [cited 2024 Feb 29]. Available from: https://www.healthpathwayscommunity.org
26. Pharmaceutical Society of New Zealand Incorporated. Antimicrobial stewardship [Internet]. Pharmaceutical Society of New Zealand Incorporated; 2024 [cited 2024 Feb 29]. Available from: https://www.psnz.org.nz/practicesupport/antimicrobial
27. Best Practice Advocacy Centre New Zealand. Limiting the use of quinolone antibiotics [Internet]. Best Practice Advocacy Centre New Zealand; 2021 [cited 2024 Feb 10]. Available from: https://bpac.org.nz/2021/quinolone.aspx
28. Bennett J, Anderson A, Atkinson J, et al. Trends in penicillin dispensing during an acute rheumatic fever prevention programme. N Z Med J. 2023 Dec 1;136(1586):84-93. doi:10.26635/6965.6285.
29. New Zealand Heart Foundation. Summary of key changes in the Group A Streptococcal Sore Throat Management Guideline: 2019 Update. Auckland: New Zealand Heart Foundation; 2019 [cited 2025 May 15]. Available from: https://assets.heartfoundation.org.nz/documents/shop/heart-healthcare/non-stock-resources/summary-of-changes-to-gas-sore-throat-guideline-2019.pdf
30. Duffy E, Thomas M, Hills T, Ritchie S. The impacts of New Zealand's COVID-19 epidemic response on community antibiotic use and hospitalisation for pneumonia, peritonsillar abscess and rheumatic fever. Lancet Reg Health West Pac. 2021;12:100162. doi: 10.1016/j.lanwpc.2021.100162.
31. Health New Zealand – Te Whatu Ora. National Minimum Dataset (hospital events) [Internet]. Wellington: Health New Zealand – Te Whatu Ora; 2024 [cited 2024 August 20]. Available from: https://www.tewhatuora.govt.nz/for-health-professionals/data-and-statistics/nz-health-statistics/national-collections-and-surveys/collections/national-minimum-dataset-hospital-events

Appendices

Appendix 1: Anatomic therapeutic chemical and AWaRe classification for funded systemic antibiotics.

ATC group	Antibiotic agent	AWaRe classification
J01A: tetracyclines	Doxycycline, minocycline, tetracycline	Access
J01C: penicillins		
J01CA: penicillins with extended spectrum	Amoxicillin	Access
J01CE: β-lactamase-sensitive penicillins	Phenoxymethylpenicillin, benzyl-penicillin, benzathine penicillin, procaine penicillin	Access
J01CF: β-lactamase-resistant penicillins	Flucloxacillin	Access
J01CR: combinations of penicillins with β-lactamase inhibitors	Amoxicillin and clavulanic acid	Access
J01D: cephalosporins		
J01DB: first-generation cephalosporins	Cefalexin, cefazolin	Access
J01DC: second-generation cephalosporins	Cefaclor, cefuroxime	Watch
J01DD: third-generation cephalosporins	Ceftriaxone	Watch
J01E: sulfonamides and trimethoprim	Trimethoprim, trimethoprim and sulfamethoxazole	Access
J01F: Macrolides and lincosamides		
J01FA: macrolides	Azithromycin, clarithromycin, erythromycin, roxithromycin	Watch
J01FF: lincosamides	Clindamycin	Access
J01M: quinolones	Ciprofloxacin, moxifloxacin, norfloxacin	Watch
J01X: other antibacterials		
J01XA: glycopeptides	Vancomycin	Watch

Appendix 1 (continued): Anatomic therapeutic chemical and AWaRe classification for funded systemic antibiotics.

J01XE: nitrofuran derivatives	Metronidazole, ornidazole,	Access
J01XE: nitrofuran derivatives	Nitrofurantoin	Access
J01XX: other	Colistin, gentamicin, methenamine, tobramycin, vancomycin	Reserve, Access, Unclassified, Access Watch, Watch

Appendix 2: The defined daily doses per 1,000 inhabitants per day (DIDs) and number of antibiotic courses per 1,000 inhabitants per year in the Aotearoa New Zealand community from 2010 to 2019. Presented alongside the average annual change (AAC) between 2010 and 2019.

	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**AAC (%)**
DIDs	20.4	21.6	22.3	22.4	22.3	22.8	21.4	21.0	20.0	19.9	−0.27
Number of antibiotic courses per 1,000 inhabitants per year	867	906	914	897	879	879	834	830	787	767	−1.7

Appendix 3: Systemic antibiotic dispensing rates in the Aotearoa New Zealand community for 2010 and 2019 by antibiotic group. Rates are presented as defined daily doses per 1,000 inhabitants per day (DIDs) and number of antibiotic courses per 1,000 inhabitants per year in the Aotearoa New Zealand community for 2010 and 2019. Presented alongside the average annual change (AAC) between 2010 and 2019.

Antibiotic group	DID				Number of antibiotic courses per 1,000 inhabitants per year			
	2010	2019	Delta: 2010–2019	AAC (%)	2010	2019	Delta: 2010–2019	AAC (%)
J01A: tetracyclines								
Tetracyclines	5.6	6.0	+0.4	−3.2	57	56	−1	−1.7
J01C: penicillins								
Penicillin with extended spectrum	3.2	4.1	+0.9	−3.0	210	222	+12	−3.8
Beta-lactamase sensitive penicillins	0.5	0.3	−0.2	−4.3	28	15	−13	−6.5
Beta-lactamase resistant penicillins	1.8	1.7	−0.1	−0.7	106	89	−17	−2.5
Penicillin with beta-lactamase inhibitors	3.2	2.3	−0.9	−8.5	165	115	−50	−5.0
J01D: cephalosporins								
First-generation cephalosporins	0.0	0.6	+0.6	+19.2	1	45	+45	+30.0
Second-generation cephalosporins	0.8	0.4	−0.4	−16.9	42	19	−23	−10.3

Appendix 3 (continued): Systemic antibiotic dispensing rates in the Aotearoa New Zealand community for 2010 and 2019 by antibiotic group. Rates are presented as defined daily doses per 1,000 inhabitants per day (DIDs) and number of antibiotic courses per 1,000 inhabitants per year in the Aotearoa New Zealand community for 2010 and 2019. Presented alongside the average annual change (AAC) between 2010 and 2019.

Antibiotic group	DID				Number of antibiotic courses per 1,000 inhabitants per year			
	2010	2019	Delta: 2010–2019	AAC (%)	2010	2019	Delta: 2010–2019	AAC (%)
Third-generation cephalosporins	0.00	0.00	0	0	0	0	0	0.0
J01E: sulfonamides and trimethoprim								
Sulfonamides and trimethoprim	1.6	1.5	−0.1	−2.6	67	61	−6	−2.5
J01F: macrolides and lincosamides								
Macrolides/ lincosamide	2.3	1.8	−0.5	−6.2	105	80	−25	−4.2
J01M: quinolones								
Quinolones	0.1	0.3	+0.2	−10.3	49	14	−35	−14.4
J01X: other antibacterials								
Imidazole derivatives	0.2	0.3	+0.1	−1.8	24	29	+5	−2.0
Nitrofuran derivatives	0.4	0.5	+0.1	−0.6	13	22	+9	+2.7
Other	0.1	0.2	+0.1	+26.6	1	2	+1	+13.0

All standard errors (SE) were minuscule (SE <0.0001); therefore, level of precision for results is how it is presented.

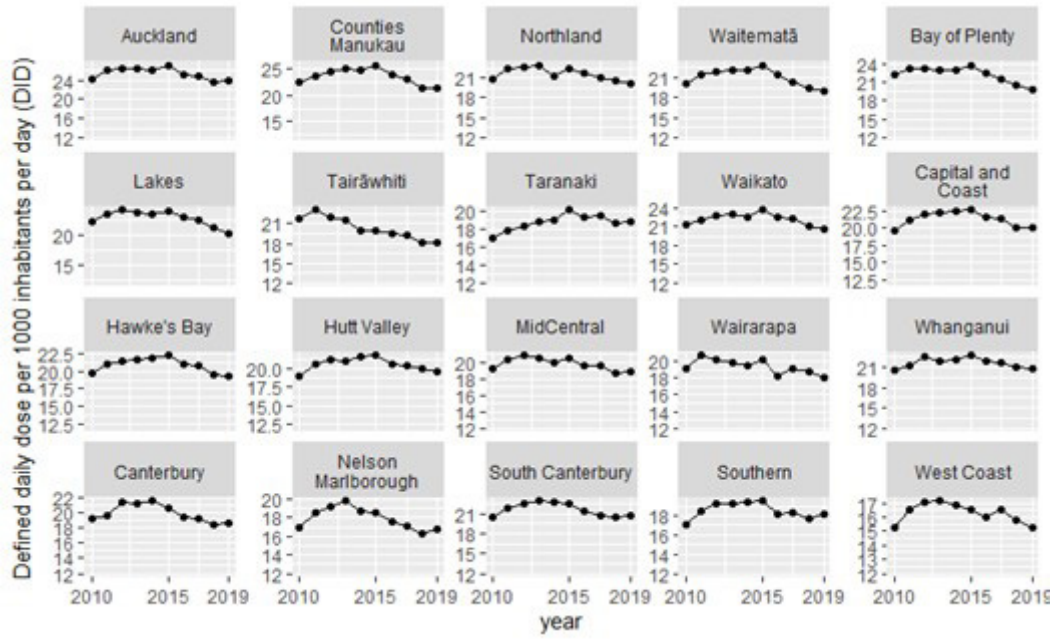
Appendix 4: Proportion of total community systemic antibiotic dispensing attributed to each World Health Organization AWaRe group in Aotearoa New Zealand for 2010 and 2019, with absolute change (delta: 2019–2010) and average annual change (AAC).

	DID				Number of antibiotic courses per 1,000 inhabitants per year			
AWaRe group	**2010**	**2019**	**Delta: 2019–2010**	**AAC (%)**	**2010**	**2019**	**Delta: 2019–2010**	**AAC (%)**
Access	81	87	+7	1.0	78	86	+8	1.0
Watch	19	13	−6	−1.3	22	14	−8	−18
Reserve	0.0	0.0	0	0.0	0.0	0.0	0	0.0
Unclassified	0.2	0.9	+0.7	18	0.0	0.2	+0.2	18

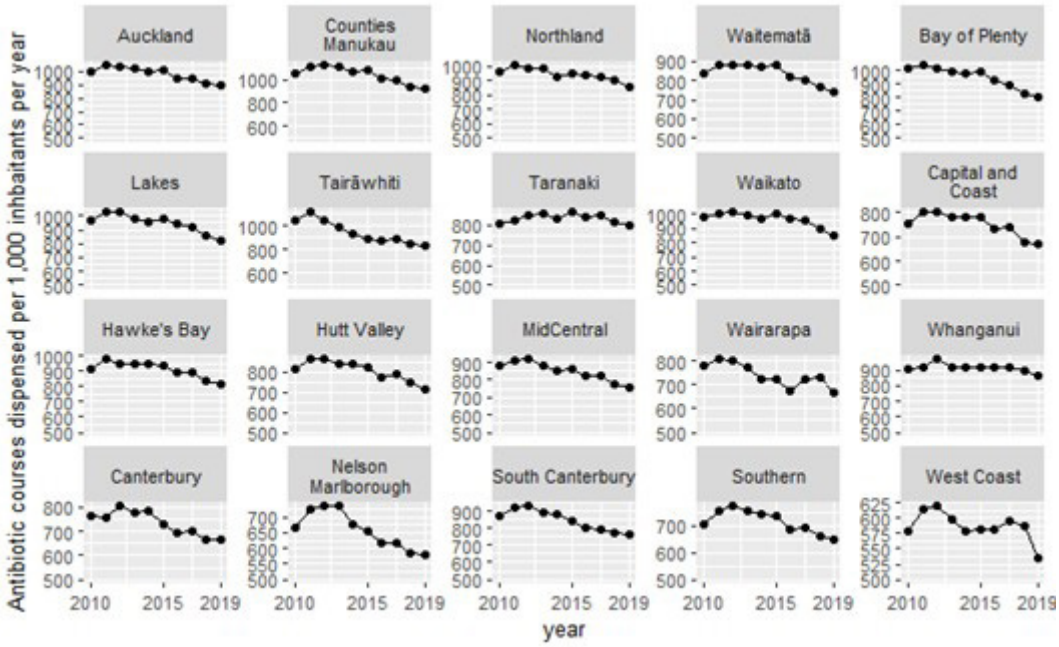
Values represent the proportion (%) of total community systemic antibiotic dispensing attributed to each AWaRe group, calculated separately for defined daily doses per 1,000 inhabitants per day (DIDs) and antibiotic courses per 1,000 inhabitants per year.

Appendix 5a: Rates of in-community systemic antibiotic dispensing between 2010 and 2019 for each district health board (DHB) region by defined daily doses per 1,000 inhabitants per day (DIDs) (a), and antibiotic courses dispensed per 1,000 population per year (b).

(a)



(b)



Graph (a) y axis limit is 10 DIDs and Graph (b) y axis limit is 500 courses dispensed per 1,000 inhabitants per year.

Appendix 5b: Systemic antibiotic dispensing rates in the Aotearoa New Zealand community by district health board (DHB) region between 2010 and 2019. Rates presented as defined daily doses per 1,000 inhabitants per day (DIDs) and number of antibiotics courses dispensed per 1,000 inhabitants per year alongside the average annual change (AAC).

	DID				Number of courses dispensed per 1,000 inhabitants per year			
DHBs	**2010**	**2019**	**Delta: 2019–2010**	**AAC (%)**	**2010**	**2019**	**Delta: 2019–2010**	**AAC (%)**
Northern Region								
Auckland	24.1	23.9	−0.2	−0.7	972	665	−307	−1.6
Counties Manukau	22.4	21.2	−0.8	−1.0	1,031	899	−132	−2.1
Northland	20.9	20.1	−0.8	−0.9	959	853	−106	−1.3
Waitematā	20.0	19.1	−0.9	−1.0	816	724	−92	−1.7
Midland Region								
Bay of Plenty	22.2	19.9	−2.3	−1.4	999	798	−201	−2.6
Lakes	22.1	20.3	−1.8	−1.2	966	817	−149	+2.0
Tairāwhiti	21.7	18.1	−3.6	−2.5	1,037	831	−206	−3.1
Taranaki	17.0	18.8	−1.8	+1.0	802	797	−5	−0.2
Waikato	21.4	20.5	−0.9	−0.5	963	844	−119	−1.4
Central Region								
Capital and Coast	19.7	20.0	+0.3	−0.4	746	664	−82	−1.7
Hawke's Bay	19.7	19.4	−0.3	−0.6	910	812	−98	−1.6
Hutt Valley	18.9	19.6	+0.7	−0.2	804	712	−92	−1.7

Appendix 5b (continued): Systemic antibiotic dispensing rates in the Aotearoa New Zealand community by district health board (DHB) region between 2010 and 2019. Rates presented as defined daily doses per 1,000 inhabitants per day (DIDs) and number of antibiotics courses dispensed per 1,000 inhabitants per year alongside the average annual change (AAC).

	DID				Number of courses dispensed per 1,000 inhabitants per year			
DHBs	**2010**	**2019**	**Delta: 2019–2010**	**AAC (%)**	**2010**	**2019**	**Delta: 2019–2010**	**AAC (%)**
MidCentral	19.2	18.8	−0.4	−0.7	874	754	−120	−1.9
Wairarapa	19.1	18.0	−1.1	−1.1	781	661	−120	−1.9
Whanganui	20.5	20.9	+0.4	0	905	859	−46	−0.6
South Island Region								
Canterbury	19.2	18.6	−0.6	−1.0	750	656	−94	−2.0
Nelson Marlborough	17.0	16.7	−0.3	−1.2	662	577	−105	−2.5
South Canterbury	20.6	20.6	0.0	−0.7	866	762	−104	−2.1
Southern	17.0	18.1	+1.1	−0.1	697	647	−50	−1.5
West Coast	15.2	15.2	0.0	−0.4	577	534	−43	−0.8

All standard errors (SE) were minuscule (SE <0.0001); therefore, level of precision for results is how it is presented.

Appendix 6a: Systemic antibiotic dispensing rates in the Aotearoa New Zealand community by patient characteristics. Rates presented as defined daily doses per 1,000 inhabitants per day (DIDs) and number of antibiotics courses dispensed per 1,000 inhabitants per year and the average annual change (AAC).

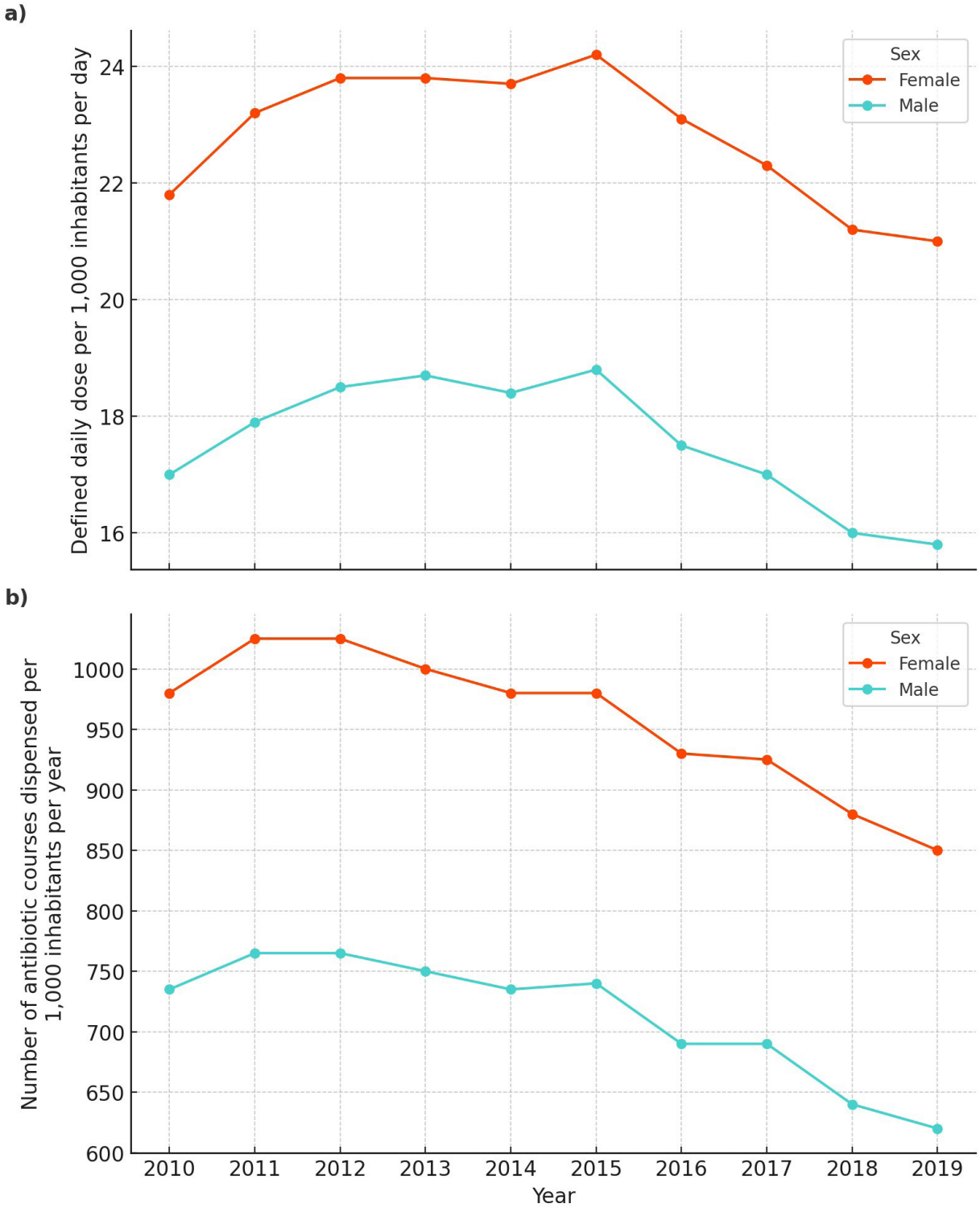
	DID				Number of antibiotic courses per 1,000 inhabitants per year			
Patient characteristics	**2010**	**2019**	**Delta: 2019–2010**	**AAC (%)**	**2010**	**2019**	**Delta: 2019–2010**	**AAC (%)**
Age								
>5					1,758	1,179	−579	−1.8
5–9					975	785	−190	−1.8
10–19					695	584	−111	−1.8
20–59					692	641	−51	−1.8
60+					1,200	1,117	−83	−1.8
Sex								
Females	21.8	21.1	−0.7	−1.0	981	851	−130	−1.6
Males	17.0	15.9	−1.1	−1.0	732	625	−107	−1.6
Ethnicity								
Māori	28.1	28.5	+0.4	−0.5	1,322	1,228	−94	−1.4
Pacific people	34.7	34.6	−0.1	−0.3	1,674	1,555	−119	−1.0
Asian	20.4	20.3	−0.1	−0.6	918	838	−80	−1.3
Other	30.9	32.7	+1.8	0	1,278	1,208	−70	−0.7
Deprivation quintile								
1	30.2	30.1	−0.1	−0.6	1,371	1,235	−136	−1.3
2	29.0	31.4	+2.4	0	1,184	1,169	−15	−0.3

Appendix 6a (continued): Systemic antibiotic dispensing rates in the Aotearoa New Zealand community by patient characteristics. Rates presented as defined daily doses per 1,000 inhabitants per day (DIDs) and number of antibiotics courses dispensed per 1,000 inhabitants per year and the average annual change (AAC).

	DID				Number of antibiotic courses per 1,000 inhabitants per year			
Patient characteristics	**2010**	**2019**	**Delta: 2019–2010**	**AAC (%)**	**2010**	**2019**	**Delta: 2019–2010**	**AAC (%)**
3	30.8	30.5	−0.3	−0.5	1,273	1,165	−108	−1.1
4	31.7	28.9	−2.8	−1.8	1,343	1,123	−220	−2.4
5	39.0	33.2	−5.8	−2.2	1,672	1,322	−350	−2.9

All standard errors (SE) were minuscule (SE <0.0001); therefore, level of precision for results is how it is presented.

Appendix 6b: Age-standardised rates of community systemic antibiotic dispensing between 2010 and 2019 by sex and measured in defined daily doses per 1,000 inhabitants per day (DIDs) (a), and antibiotic courses dispensed per 1,000 population per year (b).



Weight management services in Counties Manukau Health New Zealand – Te Whatu Ora: consumer experiences and ideal components

Tamasin Taylor, Rachel Ling, Mark McNeill, Delanie Nepia, Rinki Murphy

ABSTRACT

AIM: To understand consumers' past experiences with weight management services and explore their conceptions of the ideal weight management programme.

METHODS: Three focus groups (*n*=21) were conducted between November and December 2023, with participants who were waitlisted for metabolic bariatric surgery at Counties Manukau Health New Zealand – Te Whatu Ora. Past experiences with weight management services and ideal features were explored using reflexive thematic analysis. A ranking exercise of 18 potential features in an ideal weight management service was also conducted. Sessions followed Kaupapa Māori principles.

RESULTS: Three main themes centred around service gaps. These were: lack of treatment options and support, weight-related stigma and shame, and psychological issues. Ideal weight management services themes were: increased support from healthcare professionals, group support, funded weight loss medications and metabolic bariatric surgery, a centre for weight management, and flexible programme formats and lengths. In addition to weight loss medications, the top ranked features were peer-support and health coach support.

CONCLUSION: Participants perceived a general lack of weight management services that are affordable, effective or sustainable and able to address the prevalent underlying mental, social or physical issues associated with excess weight. Participants desired a more holistic, centralised service. This study's findings support the initial model of care by Te Mana ki Tua, a recently initiated specialist weight management service based in Mangere, Counties Manukau.

Obesity rates are likely to increase over the coming decades. This presents increased demands on publicly funded weight management services across Aotearoa New Zealand to adapt and expand. Nationwide, it is estimated that 33% of adults are classified as obese[1] and Type 2 Diabetes (T2D) is expected to increase by 70–90% over the next 20 years. The estimated cost is expected to reach NZ$2.1 billion.[2] There are clinical guidelines for the identification and management of unhealthy weight in adults, which includes bariatric surgery, obesity medications, meal replacement (MR) and other dietary approaches along with lifestyle modification.[3] However, current provision of funded weight management services are limited to variable community resources for healthy lifestyle support and a small allocation of publicly funded metabolic bariatric surgery (MBS) at a few major hospitals.[4–5]

While MBS usually provides long-term weight loss maintenance,[6] obesity medications may need to be taken consistently for weight loss to be maintained.[7–9] Several clinical guidelines have endorsed the use of MR programmes given their superior results compared to food-based caloric restriction.[10] There are, however, no funded medications for obesity indication in Aotearoa New Zealand at the present time and only limited use of structured MR programmes.

Previous studies indicate that general practitioners (GPs) experience a sense of disempowerment in being able to treat patients with obesity effectively due to being unable to address a range of associated barriers.[11] A study from the perspectives of patients in primary care in Waikato found health consumers believed it was not possible to receive effective weight management treatment from their GP services.[12] Social barriers, stigma associated with weight- and obesity-management, and low resource availability were cited as challenges to effective weight management treatment. This included the high cost of weight management medications

and limited access to MBS. The co-occurrence of obesity and poverty in many patients meant interventions were usually financially inaccessible. Understanding health consumers' experiences accessing suitable weight management treatments is invaluable for designing improved services.[13]

Aim

The current study explored South Auckland consumer experiences of existing weight management services to identify specific gaps in available weight management services as well as conceptions of the ideal weight management service. The study was funded by Counties Manukau Health New Zealand – Te Whatu Ora as part of a consumer co-design to inform the development of Te Mana ki Tua specialist weight management service (TMKT). This service was set up to provide intensive weight management for those with medically complex and severe obesity who were not eligible for MBS or those who could achieve remission of T2D. While this service began its group-based programme in year 1 after brief consumer consultation, further improvements were expected to be informed by this study in year 2.

Method

Three focus group sessions with patients who were on the waiting list for MBS at Counties Manukau Health New Zealand – Te Whatu Ora, along with their whānau, were conducted between November 18–December 2, 2023. Participants were selected from the list of those who had not yet been invited to the TMKT. Ethics approval was granted by the Auckland Health Ethics Research Committee (AHREC: AH26189) and Counties locality approval was obtained before study commencement. TMKT staff members made initial contact with patients about the study. All who agreed to find out more about taking part were contacted by the first author (TT) to discuss study details as part of the informed consent process. If they agreed to take part they were allocated to one of three focus group sessions based on ethnicity groups: Māori, Pacific, NZ European/Other. Sessions took place in a TMKT meeting room on Saturdays and ran for between 2 to 3 hours including a refreshment break. See Table 1 for participant recruitment eligibility.

Focus group content

The focus group sessions involved two primary activities. First, participants were encouraged to recount their past and present experiences with weight management programmes. Participants' weight management experiences and ideal service user journeys were elicited through group conversations around key questions and topic areas. Second, a ranking task was undertaken. Participants could choose to complete this task either individually, or in small groups of up to three participants. Eighteen pre-defined components of a potential weight management programme were ranked from most to least important. They also had the opportunity to suggest additional components using blank cards. This ranking exercise aimed to gather detailed insights into what health consumers considered essential elements of an effective service and to stimulate further discussion about their needs and preferences.

Table 1: Participant eligibility inclusion criteria.

Criteria	Description
Referral status	Referred for MBS and graded as low priority for surgery. Referred but not yet invited to take part in TMKT.
Ethnicity	Māori, Pacific, or New Zealand European/Other (Prioritised: Māori Pacific, then NZ European/Other).
Age	≥18 years
BMI	>30 kg/m^2

Analysis

Focus groups were digitally recorded and transcribed verbatim. A koha (gift) was given to participants in acknowledgement and contribution in accordance with professional ethical practices and tikanga Māori.[14] Thematic analysis followed an iterative reflexive thematic analysis (RTA) step process.[15] The six phases were dataset familiarisation; generation of codes; creation of initial themes; theme review and development; refining, naming, and defining themes; and writing up the findings. First, two researchers (authors TT and RL) became familiar with the content of the transcripts and began to identify reoccurring ideas and patterns. They then used NVivo (version 12) to organise sections of extracted data under initial codes based on the interview questions and semantic and latent ideas related to the research questions that emerged from the transcripts. The researchers further reflected on these codes to ensure they captured relevant features of the data, discussing any differences and nuances between the coding. Codes were defined into main- and sub-themes.

Results

The sample consisted of 21 participants (female, *n*=18) with a mean age of 41 (range 18–69) who attended three separate sessions: Māori (*n*=5), Pacific (*n*= 8), and 'Other' ethnicity (*n*=8). See Table 2 for demographic details.

Gaps in weight management experiences: main themes

1. Lack of treatment options and support

Limited options

The GP was not seen as an effective service for receiving weight management treatment. Instead, the primary care practice was primarily

Table 2: Participants ethnicity and occupations.

Characteristic	***n*=21**
Gender	
Female	18
Male	3
Ethnicity	
Māori	5
Pacific	9
Indian	4
NZ European	1
South African	1
Iraqi	1
Occupation	
Education and training	2
Self-employed	1
Manufacturing and labouring	2
Retail	3
Professional services	2
Home carer	3
Retired	1
Unemployed	4
Unknown	3

a service for medication prescriptions. "*They're just there for giving Panadol to those who are sick. They don't help big people.*" – Māori female. The groups believed there was a lack of transparency around the range of treatments available that could assist with weight loss. "*They* [GPs] *don't really tell you about some of the tools that they have that they could be talking to you about, like medicine, and the way that can help you to manage your weight loss…*" – Māori female. Participants discussed experiences of regaining weight lost once a weight management programme ended. "*My GP, she put me through the Green Prescription, so I went to those exercise programmes because I have to go twice a week, but the thing is, I'll go in, exercise, come back, eat chicken and chips.*" – "Other" ethnicity female. Discovering the results of a blood test was a trigger for one participant to engage in negative eating behaviours resulting in weight cycling. "*And he* [GP] *goes, 'oh, your levels are up this month'. So, you don't eat, and then you do this* [restrict calories]*, you're going to yo-yo effect again.*" – "Other" ethnicity male.

Although advised to exercise, many participants did not feel comfortable using a swimming pool or gym due to feeling judged about their body size. Participants reported that physical activity often resulted in substantial pain and discomfort, a situation that many trainers did not appear to understand. "*…I will never go to a* ['regular' trainer] *to help you exercise to lose weight because they've never been where you are, and they don't realise you can't do what they do.*" – "Other" ethnicity female.

Inaccessibility of metabolic bariatric surgery (MBS)

Most participants discussed being frustrated with not being able to access MBS. For some participants, referrals were turned down sometimes after more than a year. To qualify for MBS, some attempted to make their health worse, such as gaining weight or becoming diabetic through increasing sugar intake. "*I lost the weight* [to qualify for MBS]*, but there was only two kgs to the ideal weight … and the doctor just said no … and then I just got defeated and I came home, and I had a feast.*" – Pacific female. One participant who had been declined for MBS drank 1.5 litres of soft drink immediately before a routine blood test in the hope of inducing a high glucose reading suggestive of T2D.

Lack of time and money

There were practical difficulties to maintain "healthy" eating due to busy lifestyles. "*…by the time I get home, just tired… then you've got dinner to cook, and then for dinner, you just want to chuck in the oven, not stand there and cook … then so it just becomes that fast food stuff, and then yeah, it just kind of rolls, and just continues until you realise, oh s***, I just wake up feeling worse every time.*" – Māori male. Cost was a barrier to weight management for many who had tried supplements and medications. "*…for 3 months, you spend all this money on Optifast, Herbalife, and all the things that you need to do, these diets and fad things. It's not something that you can actually maintain long term.*" – "Other" ethnicity female.

2. Weight-related stigma and shame

Feelings of shame were experienced by a number of participants who tried to access weight management through their health care providers. "*…I went to get the thing* [MBS] *about my diabetes … and then she goes, 'yeah, you want to just die early … do you want to be better? Look at you,' you know, and she was saying a lot of things to run me down.*" – Pacific female. A number of participants reflected on feeling as if there was something wrong with them because they could not achieve sustained weight loss, and some believed their GPs did not understand weight was not a choice. "*It's like nobody has ever trained them* [GPs] *to say, big people are not big by their choice.*" – "Other" ethnicity female. One participant commented it may be easier for health professionals to allocate weight loss responsibility to the patient. "*It's like it's easier to blame people and say, oh, you're fat or you need to lose weight.*" – "Other" ethnicity female. Racism was also a barrier to accessing weight management. "*…they see you as a minor. Especially, I'm a* [Pacific person] *… you don't know how to speak English, and they simplify the English that they speak to us.*" – Pacific female. She found another patient with the same GP who was of NZ European ethnicity had a completely different experience with the same GP. "*I was talking to someone that she was white, and I said, 'don't go to* [names the GP]*.' She* [the other patient] *said, 'no, no, she's nice to me.' … so, I just put two and two together and I said, this must be a race thing.*" – Pacific female.

3. Psychological issues

Some participants had identified they were depressed, stressed, experienced anxiety and unresolved traumas that contributed to their weight gain and subsequent inability losing

weight; issues that were not addressed as part of weight management treatments. "*Sometimes at night when I didn't tell anyone I'll cry, and I'll crawl to the fridge and start eating and just making myself look ugly. I get stressed, emotional eating.*" – Pacific female. Some participants had come to the point in their lives where their experiences had left them fearing that any new attempts to lose weight would not work. "*…what's going to be different for me this time if that makes sense, you know what I mean? I just don't want to repeat the same cycle.*" – Māori female. Some discussed losing a certain amount of weight until reaching a 'plateau phase'. "*When we look into the mirror, it's like, oh, my God, how am I going to lose this? And then you reach a plateau where you can't lose, even though you cut down. And then I would be like, I'm not eating anything all day, and I'm still not losing.*" – "Other" ethnicity female.

Ideal weight management programme components

Four ideal weight management programme components were elicited from the focus groups. The following is a summary of the main programme components (see Table 3 for theme definitions).

Component 1: Increased support from healthcare professionals

Participants called for GPs to provide more effective weight management pathways that included access to qualified healthcare professionals for weight management and strategies that were effective. This would include weight loss medications and *Taha Hinengaro* (mental health) support to support participants who needed to address psychological factors contributing to their weight gain.

Component 2: Group support and increased government funding for weight management treatments

The findings from all three focus groups indicated that group support was an important programme component so they could connect with people going through similar weight loss journeys. The Pacific focus group indicated a preference for an all-female group as they would feel more comfortable discussing personal issues. The Māori and Pacific groups both suggested the inclusion of social media groups where they could share progress updates.

Several participants suggested the ideal programme would include a health coach who could offer guidance regarding food selection, portion control and cooking for nutritional benefits. Tailored and budget-friendly eating plans that incorporated cultural and customary foods were proposed. Also suggested were affordable and well-promoted community exercise initiatives at a gym where they could connect with a like-minded community that had available classes such as Zumba and "less jarring" exercises, for example, using stair climbers or treadmills. Relatedly, a coach with fitness expertise and who understood a client's physical limitations and who could design personalised exercise plans was proposed. Some participants in the Pacific group preferred health coaches who were from a similar cultural background.

There was a desire for funding or subsidies for weight loss medications and dietary supplements. Conversely, a few participants disagreed on including medications or supplements believing them to be ineffective. There was a general agreement across groups for a more attainable eligibility requirement for MBS including support to achieve pre-surgery weight loss goals.

Component 3: A centralised weight management centre

A centralised weight management centre that could provide wrap around services was a main component of the ideal programmes among all three groups. Patients would be referred by their GP with relevant medical records shared through the central connected system. Working together with the patient, a specialist weight management clinician would develop an individualised weight management plan and would determine other specialist needs to support the patient's weight management plan. Centralising services in one location would enhance accessibility and enable greater collaboration between different health specialists. The Māori group further suggested that supplementary retreats centred on nutrition and food gardening education would offer substantial benefits to participants undertaking the ideal weight management programme. The Pacific group preferred a community venue, such as a church that could offer exercise classes, cooking workshops, and a space for sharing vegetables.

Component 4: Programme lengths/check-up frequencies/format

There were varying ideas on programme duration and check-in frequency within the groups ranging from 3 months to as long as this was

required. A few agreed that support was a lifelong potential. Preference for either face-to-face meetings and appointments or online formats was also mixed, however, groups collectively agreed that face-to-face check-ins were crucial for accountability. On the other hand, some participants could see the benefit of having a mixture of both formats. One suggested it didn't matter what the format was as long as they were being "heard" (Table 3).

Table 3: Ideal weight management programme: main theme and subthemes.

Ideal weight management programme: main theme and subthemes	Definition
1. Increased support from healthcare professionals	
	Increased proactive support from GPs
	Referrals to other healthcare professionals to help with weight loss
	Prescribing weight loss medications and providing health advice and information
	The need for an effective weight management plan
	Offering mental health support as part of a weight management programme
	Provision of nutritional and fitness health coach/trainer support
2. Group support	
	Being part of a like-minded community of people also journeying through weight management
	The Pacific focus group preferred an all-female group
3. Increased governmental funding for weight management treatments	
	Increased funding of weight loss medication and dietary supplements
	Increased numbers of publicly funded metabolic bariatric surgeries with expanded access and shorter wait times
	Providing programmes tailored to an individual's financial budget and cultural and customary requirements
	Affordable and well-advertised community-based exercise programmes at a gym with like-minded people of a similar body type
4. Centralised weight management centre	
	Centralised weight management centre containing all relevant services
	A retreat-style weight management programme
	Nutrition, gardening workshops
	Church location
5. Flexible programme lengths/check-up frequencies	
	Ideal programme format and length was varied

Ranking task

The ranking task indicated that of 11 groups, four groups ranked having funded medications that control hunger for weight loss as the first most important of all weight management components, with six indicating this component in their top five components. This was followed by having a support group to journey with/engage in fitness and plan nutrition with (allocated by three groups in the first rank and seven times in the top five ranks overall). Having a health navigator/coach to guide them through the services/programme was ranked 10 times in the top five components. Less prioritised components were, having exercise help from a free physiotherapist/gym membership (*n*=8), kai support (e.g. food vouchers or My Food Bag delivered) (*n*=5), cooking classes run by dietitians to provide ideas on what foods to make (*n*=5), weekly group support meetings (*n*=4), and weekly check-ins with a health coach/health professional (*n*=4). (Table 4)

Table 4: Ranking task of ideal weight management components.

Ranking – Top 5 (*n*=11 groups)	**1**	**2**	**3**	**4**	**5**
Having funded medications that control hunger for weight loss	4*		1		1
Having a support group to journey with/engage in fitness and nutrition planning with	3	1		1	2
Having a navigator/health coach to help guide you through the services/programme	1	2	5		2
Psychologist	1			1	
Having kai support (e.g. food vouchers or My Food Bag delivered to you)	1	2		2	
Social support service	1		1		1
Having exercise help from a free physiotherapist/gym membership	1	1	2	2	2
Having another family member or friend doing the programme with you	1	1		1	
Having the location in a welcoming community setting		1		2	
Having cooking classes run by dietitians to provide ideas on what foods to make		1	1		3
To have weekly check ins with a health coach/health professional			1	2	1
Having relatable role models who have lost weight to talk to about how they achieved their goals			1		
To have weekly group support meetings		1	1	1	1
Having childcare provided				1	
Having transport provided to the individual and group sessions					
To have a health coach with lived experience					
Having relatable role models who have lost weight to talk to about how they achieved their goals					
To have a health coach with the same gender					
(Other ideas) Check ins from weight services		1			
(Other ideas) Funded bariatric surgery without wait list		1			
(Other ideas) Specialist/medical professional to guide/right diet for weight loss.		1			

Note: *Number of groups choosing this option and where they ranked it.

Discussion

This study revealed a general lack of weight management treatments available that were effective in the long term. There was a consensus among participants that their GPs were able to offer only limited weight management treatment options, access was very limited for MBS and weight loss medications incurred prohibitive costs. At the same time, most participants indicated a need for a centralised community location specialising in weight management services with variable programme formats and lengths. The top ranked service components were funded weight management medications, peer-group support and a health navigator or coach.

Several of the elements of the ideal weight management service identified by the participants in this study have already been incorporated into TMKT in its first year of delivery for people living with severe and medically complex obesity. TMKT provides group-based support over 12 months, offering 18 group sessions and five individual clinic appointments with the support of a multidisciplinary team including an endocrinologist, a nurse practitioner, a health psychologist, a dietitian and health coaches. The programme includes the provision of funded MR products over the first 12 weeks, followed by stepped food reintroduction that is adapted to individual preferences and contexts, and the provision of medication adjuncts.

Depending on the formulation of the MR, the induction of ketosis in the intensive phase is initially associated with improved appetite control and enables significant weight loss.[10] Part of the success of MR is due to stimulus-narrowing, intended to control the number of food-related stimuli in one's environment, typically by limiting food choices and reducing the need for people to make choices between other high-energy-dense, nutrient-poor foods. Functional brain imaging showed that in contrast to food-based caloric restriction, MR related food stimulus-narrowing activates inhibitory signalling in reward centres of the brain and reduces gut/nutrient activation that occurs in response to food cues, reducing hunger and cravings.[16]

Long-term weight maintenance after MR relies on including physical activity and ongoing food stimulus-narrowing learned during the stepped food reintroduction phase.[10] This includes selecting bulky, less processed foods that are high in protein and fibre, having regular meal intake times to avoid severe hunger and overeating at the next meal, and using MR intermittently long term.[10] Often eating is triggered by opportunities to eat at social events and by seeing tempting palatable foods or advertising.[17–18] Some people also use food to deal with negative emotions or boredom.[19] Hence, additional behavioural components for weight management support include understanding triggers for impulsive eating and planning ways of avoiding these (e.g. by going to the supermarket when feeling satiated, shopping with a meal plan list and rehearsing how to handle social pressures to eat), employing mindful eating habits, recognising triggers of emotional hunger and practicing alternative coping strategies for different emotions.[20]

The intensive weight management approach also incorporates principles from Health at Every Size (HAES), such as reducing obesity stigma, improving body image, making sustainable lifestyle changes, addressing mental health and social determinants of health which are consistent with international guidelines.[21–22] Clinical screening is used to identify people with severely disordered eating patterns such as binge-eating and bulimia, as they generally benefit more from psychological support to reduce distress before embarking on intensive weight management.

Further investigations are required to determine the feasibility of the other ideas presented by participants in our study, such as gender- or ethnicity-specific groups, competitions, retreat style delivery, opportunities to link with community providers of exercise programmes, gardening workshops and cooking programmes. One limitation of the current study is that no participants had achieved lasting weight loss through non-surgical means, and therefore, their ideas around components that may work to assist with weight loss as part of the ideal weight management service need to be taken with caution.

In conclusion, this is the first focus-group study exploring the experiences and ideal service user programmes of a diverse sample of adult health consumers living in the Counties Manukau region of Aotearoa New Zealand. Our focus-group study found that current publicly funded weight management programmes offering services that can produce effective clinical outcomes are lacking. Together, the results of the present study support the recently implemented model of care by TMKT, which encompasses a novel holistic-based weight management programme free of charge to eligible patients.

COMPETING INTERESTS
The study was funded by the Counties Manukau specialist weight management service evaluation budget.
TT received funding from Health New Zealand – Te Whatu Ora, Counties Manukau to conduct the analysis.
RL received a summer studentship from the University of Auckland.
RM is clinical head of specialist weight management service Te Mana ki Tua and has received speaking and advisory board honoraria from Eli Lilly, Novo Nordisk, Boeringer Ingelheim.

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REFERENCES
1. Obesity. Ministry of Health – Manatū Hauora. 2020. Updated 12 February 2025. Accessed July 17, 2025. https://www.health.govt.nz/strategies-initiatives/programmes-and-initiatives/obesity
2. The Economic and Social Cost of Type 2 Diabetes. Diabetes New Zealand. February 28, 2020. Accessed July 17, 2025. https://healthierlives.co.nz/wp-content/uploads/Economic-and-Social-Cost-of-Type-2-Diabetes-EXEC-SUMMARY-ONLY.pdf
3. Clinical Guidelines for Weight Management in New Zealand Adults. Ministry of Health. November 30, 2017. Accessed July 17, 2025. https://www.health.govt.nz/publications/clinical-guidelines-for-weight-management-in-new-zealand-adults
4. Murphy R, Ghafel M, Beban G, et al. Variation in public-funded bariatric surgery intervention rate by New Zealand region. Intern Med J. 2019 Mar;49(3):391-395. doi: 10.1111/imj.14226
5. Garrett M, Poppe K, Wooding A, et al. Private and Public Bariatric Surgery Trends in New Zealand 2004-2017: Demographics, Cardiovascular Comorbidity and Procedure Selection. Obes Surg. 2020 Jun;30(6):2285-2293. doi: 10.1007/s11695-020-04463-x
6. Murphy R, Plank LD, Clarke MG, et al. Effect of Banded Roux-en-Y Gastric Bypass Versus Sleeve Gastrectomy on Diabetes Remission at 5 Years Among Patients With Obesity and Type 2 Diabetes: A Blinded Randomized Clinical Trial. Diabetes Care. 2022 Jul 7;45(7):1503-1511. doi: 10.2337/dc21-2498
7. le Roux CW, Astrup A, Fujioka K, et al. 3 years of liraglutide versus placebo for type 2 diabetes risk reduction and weight management in individuals with prediabetes: a randomised, double-blind trial. Lancet. 2017 Apr 8;389(10077):1399-1409. doi: 10.1016/S0140-6736(17)30069-7. Epub 2017 Feb 23. Erratum in: Lancet. 2017 Apr 8;389(10077):1398. doi: 10.1016/S0140-6736(17)30705-5
8. Aronne LJ, Sattar N, Horn DB, et al. Continued Treatment With Tirzepatide for Maintenance of Weight Reduction in Adults With Obesity: The SURMOUNT-4 Randomized Clinical Trial. JAMA. 2024

Jan 2;331(1):38-48. doi: 10.1001/jama.2023.24945
9. Wilding JPH, Batterham RL, Davies M, et al. Weight regain and cardiometabolic effects after withdrawal of semaglutide: The STEP 1 trial extension. Diabetes Obes Metab. 2022 Aug;24(8):1553-1564. doi: 10.1111/dom.14725
10. Edwards-Hampton SA, Ard J. The latest evidence and clinical guidelines for use of meal replacements in very-low-calorie diets or low-calorie diets for the treatment of obesity. Diabetes Obes Metab. 2024 Sep;26 Suppl 4:28-38. doi: 10.1111/dom.15819
11. Claridge R, Gray L, Stubbe M, et al. General practitioner opinion of weight management interventions in New Zealand. J Prim Health Care. 2014 Sep 1;6(3):212-2
12. Norman K, Burrows L, Chepulis L, et al. Understanding weight management experiences from patient perspectives: qualitative exploration in general practice. BMC Prim Care. 2023 Feb 13;24(1):45. doi: 10.1186/s12875-023-01998-7
13. Hall AE, Bryant J, Sanson-Fisher RW, et al. Consumer input into health care: Time for a new active and comprehensive model of consumer involvement. Health Expect. 2018 Aug;21(4):707-713. doi: 10.1111/hex.12665
14. Walker S, Eketone A, Gibbs A. An exploration of kaupapa Maori research, its principles, processes and applications. Int J of Soc Res Methodol. 2006 Nov;9(4), 331–344. https://doi.org/10.1080/13645570600916049
15. Braun V, Clarke V, Hayfield N, Terry, G. Thematic Analysis. University of Auckland. n.d. Retrieved from: https://www.thematicanalysis.net/
16. Kahathuduwa CN, Davis T, O'Boyle M, et al. Effects of 3-week total meal replacement vs. typical food-based diet on human brain functional magnetic resonance imaging food-cue reactivity and functional connectivity in people with obesity. Appetite. 2018 Jan 1;120:431-441. doi: 10.1016/j.appet.2017.09.025
17. Wing RR, Phelan S. Long-term weight loss maintenance. Am J Clin Nutr. 2005 Jul;82(1 Suppl):222S-225S. doi: 10.1093/ajcn/82.1.222S
18. Stevenson RJ. The psychological basis of hunger and its dysfunctions. Nutr Rev. 2024 Oct 1;82(10):1444-1454. doi: 10.1093/nutrit/nuad092
19. Ahlich E, Rancourt D. Boredom proneness, interoception, and emotional eating. Appetite. 2022 Nov 1;178:106167. doi: 10.1016/j.appet.2022.106167
20. Frayn M, Livshits S, Knäuper B. Emotional eating and weight regulation: a qualitative study of compensatory behaviors and concerns. J Eat Disord. 2018 Sep 14;6:23. doi: 10.1186/s40337-018-0210-6
21. Bacon L, Aphramor L. Weight science: evaluating the evidence for a paradigm shift. Nutr J. 2011 Jan 24;10:9. doi: 10.1186/1475-2891-10-9. Erratum in: Nutr J. 2011;10:69
22. Elmaleh-Sachs A, Schwartz JL, Bramante CT, Nicklas JM, Gudzune KA, Jay M. Obesity Management in Adults: A Review. JAMA. 2023 Nov 28;330(20):2000-2015. doi: 10.1001/jama.2023.19897

Trauma patient outcomes after the implementation of a trauma admitting service: a pre–post cohort study

Yuyi Feng, Tom Haig, Andrew McCombie, Dali Fan, Christopher Wakeman, Laura R Joyce

ABSTRACT

AIMS: Injury is the leading cause of death for those under 35 years in New Zealand, with major trauma (Injury Severity Score >12) accounting for 2,409 cases in 2021/2022. There is evidence of improved outcomes with specialised trauma care including dedicated trauma admitting teams. Christchurch Hospital introduced a minimally resourced trauma admitting service (TAS) in January 2022. This study evaluates the impact of the implementation of a TAS on the outcomes of major trauma patients.

METHODS: A pre–post cohort study compared major trauma patient outcomes at Christchurch Hospital 1 year before and after TAS implementation.

RESULTS: The study included 773 patients—356 pre-TAS and 417 post-TAS. Patient characteristics were similar across both cohorts. No significant differences were found between pre- and post-TAS groups in hospital LOS (7 vs 8 days, p=0.558), in-hospital mortality (6% vs 7%, p=0.774), 30-day mortality (6% vs 7%, p=0.764) or tertiary survey completion (60% vs 60%, p=0.853).

CONCLUSION: The introduction of the TAS at Christchurch Hospital did not yield objective improvements in major trauma outcomes. Limitations in coverage and staffing may have impacted effectiveness, highlighting the need for better resources and larger studies for further analysis.

Injury is the leading cause of death in New Zealand for those under the age of 35, and is the second most common reason for hospitalisation.[1] Trauma is a significant contributor to morbidity, with the World Health Organization (WHO) estimating that approximately 973 Disability-Adjusted Life Years were lost per 100,000 individuals worldwide in 2019 due to trauma.[2] This also imposes a substantial financial burden on the New Zealand healthcare system, amounting to an estimated average cost of NZ$341 million per year for major trauma alone.[3] In the 2021/2022 period, the country recorded 2,409 major trauma cases, with the South Island Region reporting an incidence rate of 51 cases per 100,000 people.[4]

Dedicated trauma assessment teams typically comprise of a multidisciplinary group of healthcare professionals from emergency medicine, general surgery, anaesthetics and nursing staff.[5,6] Upon the presentation of a trauma patient, the trauma team is activated based on predetermined protocols (i.e., physiological criteria, injury pattern or injury mechanism).[7] There is strong evidence that dedicated multi-professional trauma team care reduces mortality and morbidity.[8,9] Although most hospitals have a multidisciplinary trauma assessment team that responds to the arrival of trauma patients in the emergency department (ED), only two out of the seven tertiary hospitals in the country provide ongoing inpatient trauma-specific care through dedicated trauma admission teams.[4]

Christchurch Hospital is the largest trauma centre in the South Island of New Zealand; however, it has lacked a dedicated trauma admitting service (TAS) until recent years. Traditionally, major trauma patients are admitted to one of a number of on-call surgical teams. In January 2022, a TAS was introduced at Christchurch Hospital, designed to provide coordinated and specialised inpatient trauma management. International studies have shown that such services can lead to improved outcomes, including reduced mortality.[10,11]

However, several resourcing limitations may undermine the potential impact of this service. The Christchurch TAS was launched without adequate funding, resulting in significant staffing shortfalls including limited trauma surgeon involvement (fewer than 4 hours per week), no dedicated house officer and restricted operational hours (Monday to Friday only). This has meant that patients admitted over weekends are initially managed by on-call teams before being transferred to the TAS, introducing delays and potential inconsistencies in care. In addition, a lack of trauma specialist

nursing and administrative support, as well as gaps in data management infrastructure, further constrained the service's capacity.

This study seeks to evaluate the impact of the implementation of a minimally resourced TAS on outcomes for patients with major trauma. By assessing the effectiveness of the TAS, the study aims to inform the optimisation of trauma care services across New Zealand, ultimately improving patient outcomes and reducing the burden of trauma-related morbidity and mortality.

Methods

Study design

This was an observational pre–post cohort study comparing patient outcomes before and after the implementation of the Christchurch Hospital TAS. The STROBE guidelines for reporting observational studies have been adhered to.[12]

Setting

Christchurch Hospital is a tertiary-level hospital located in Canterbury, New Zealand, serving a population of over 600,000. The hospital's ED is the primary acute referral centre in the region, with over 130,000 presentations annually.[13] It is the sole major acute referral centre in the region, with over 400–450 major trauma presentations per year.[13] Major spinal trauma and major burns from approximately the lower two-thirds of New Zealand are also transported directly to Christchurch Hospital.

Christchurch Hospital uses a trauma team activation system based on both physiological and mechanism of injury parameters.[13] Once the patient has been resuscitated and assessed, the decision to be admitted to the hospital is made by the trauma assessment team. Before 10 January 2022, patients would be admitted under the care of the team of best fit for their injury pattern (such as isolated chest injuries to cardiothoracic, severe head trauma to neurosurgery and multiply injured patients to the general surgical team). Christchurch Hospital introduced a TAS on January 10 2022. This service includes weekday cover of a dedicated general surgical trauma consultant, a trauma surgical registrar and a trauma clinical nurse specialist, aiming to enhance the care provided to trauma patients in the hospital. The TAS operates Monday to Friday with care handed over to on-call general surgical teams over the weekend. Patients admitted during the weekend are initially managed by the on-call surgical team and care is transferred back to the TAS on Monday. Trauma surgeon coverage of the TAS is limited to fewer than 4 hours per week.

Participants

Major trauma cases are classified according to the National Trauma Network definition, which includes those patients with an Injury Severity Score (ISS) greater than 12.[14] Exclusion criteria include hangings, drownings and poisonings, as well as trauma patients discharged directly from the ED and those with delayed admissions exceeding 7 days post-injury. Those that died before admission were not included in this study. Major trauma patients admitted under medical specialty teams, patients <16 years old and those with incomplete information were also excluded from the study.

Variables

The data collection period was 12 months pre- and 12 months post-commencement of the service, with the pre-TAS cohort including 10 January 2021 to 9 January 2022, and the post-TAS cohort including 10 January 2022 to 9 January 2023. Patients meeting major trauma criteria were included in this study. These participants were identified from the Christchurch Trauma Registry. Patients under the age of 16 and those with incorrect or invalid National Health Index (NHI) numbers were excluded. The remaining patients' NHIs were used to retrieve data from Health Connect South (the regional electronic health record system) and Cortex (the electronic clinical notes platform).

Demographic information was extracted from Health Connect South. ISS were obtained directly from the Christchurch Trauma Registry. Ethnicity data were coded using the standard New Zealand Ministry of Health ethnicity classification system. The outcome measures included ED length of stay (LOS), total hospital LOS, in-hospital mortality, 30-day mortality and completion rates of tertiary survey.

Statistical methods

RStudio was used for analyses. Firstly, pre-TAS and post-TAS major trauma patients were compared in terms of ISS, sex, age and ethnicity using the summaryM function within Hmisc.[15] Median times for LOS, in-hospital mortality and 30-day mortality were also compared. Rates of tertiary survey were calculated by specialty.

Ethical approval

The University of Otago Ethics Committee (H24/0101) and the Health New Zealand – Te Whatu Ora Waitaha Canterbury (RO#22049) approved the study.

Results

A total of 870 major trauma patients attended during the study period. Of these, 47 records were excluded due to age under 16 years old, or based on trauma registry criteria. The remaining 823 records were screened, with a further 12 exclusions due to incorrect NHI numbers and incomplete information. Additionally, 38 major trauma patients admitted under medical specialties were excluded, as most were frail, elderly and multimorbid, with no further surgical specialty input. These patients were primarily managed with supportive or palliative care. This resulted in a study population comprising 773 patients, of which 356 attended during the 1-year pre-TAS implementation period, and 417 during the 1-year post-TAS implementation period.

The demographic and injury characteristics of the study sample are presented in Table 1. The median ISS was slightly higher in the post-TAS group (17, interquartile range [IQR] 14–25) compared with the pre-TAS group (17, IQR 14–22), with a statistically significant difference (p=0.04). The median age was similar in both groups (54 years vs 52 years, p=0.39). The proportion of male patients was also comparable between groups (70% vs 72%, p=0.49). Ethnicity distribution was similar between groups (p=0.1) with European patients comprising the majority in both groups (83% vs 77%), followed by NZ Māori (11% vs 16%).

Patient outcomes in the pre-TAS and post-TAS groups were largely comparable, with no differences observed in mortality and LOS measures (Table 2). The median ED LOS was similar in the pre- and post-TAS groups (4.98 hours vs 5.12 hours, p=0.25), as was the proportion of patients with documented tertiary surveys (60.6% vs 67.4%, p=0.05). Median hospital LOS remained unchanged between groups, with a median LOS of 8 days (IQR 4–13) in both cohorts (p=0.85): in-hospital (4.7% vs 5.0%, p=0.75) and 30-day

Figure 1: Study inclusion flow chart.

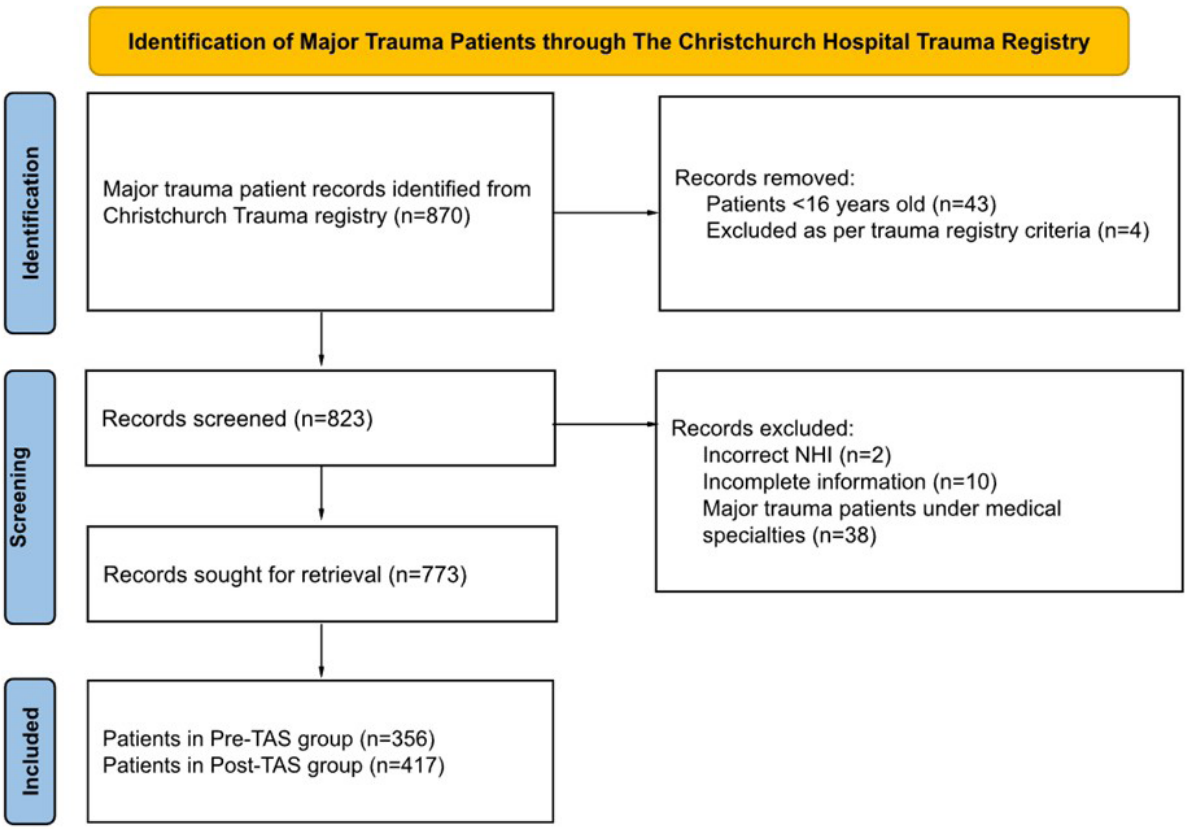

Table 1: Characteristics of pre-TAS and post-TAS patients.

	Pre-TAS (n=356)	Post-TAS (n=417)	P-value
Median ISS (IQR)	17 (14–22)	17 (14–25)	0.04
Median age, years (IQR)	52 (33–68)	54 (33–70)	0.39
Sex, male n(%)	249 (70%)	301 (72%)	0.49
Ethnicity n(%)			
European	295 (83%)	322 (77%)	0.1*
NZ Māori	39 (11%)	66 (16%)	
Pacific peoples	8 (2%)	4 (1%)	
Asian	12 (3%)	21 (5%)	
Other	2 (1%)	4 (1%)	

TAS = trauma admitting service; ISS = Injury Severity Score; IQR = interquartile range.
*Chi-squared test for goodness of fit.

Table 2: Clinical outcomes of pre-TAS and post-TAS groups.

	Pre-TAS (n=356)	Post-TAS (n=417)	P-value
Median ED LOS, hours (IQR)	4.98 (3.00–6.88)	5.12 (3.45–7.16)	0.25
Median hospital LOS, days (IQR)	8 (4–13)	8 (4–13)	0.85
In-hospital mortality n(%)	17 (4.7%)	22 (5.0%)	0.75
30-day mortality n(%)	21 (5.7%)	25 (5.7%)	0.96

TAS = trauma admitting service; ED = emergency department; LOS = length of stay; IQR = interquartile range.

Table 3: Tertiary survey documentation by specialty pre-TAS compared with post-TAS.

	Pre-TAS (n=356)	Post-TAS (n=417)	P-value
Trauma n(%)	N/A	120/127 (94.5%)	N/A
General surgery n(%)	48/61 (78.7%)	6/10 (60.0%)	0.20
Orthopaedics n(%)	89/148 (60.1%)	84/132 (63.6%)	0.55
Neurosurgery n(%)	30/71 (42.2%)	40/82 (48.8%)	0.42
Cardiothoracics n(%)	45/63 (71.4%)	26/55 (47.3%)	0.007
Sub-specialties* n(%)	4/13 (30.8%)	5/11 (45.4%)	0.46

TAS = trauma admitting service.
Sub-specialties: ear, nose and throat, maxillofacial, vascular, plastic surgery, urology.

mortality (5.7% vs 5.7%, p=0.96).

The rate of tertiary survey documentation was similar across specialties before and after the implementation of TAS, with the exception of cardiothoracics with a decrease from 71.4% (45/63) to 47.3% (26/55). Tertiary survey documentation rates in the trauma service were 94.5% (post-TAS only) (Table 3).

Discussion

Before the introduction of the TAS at Christchurch Hospital, trauma patients were typically admitted under the acute general surgical team and subsequently distributed across various surgical teams. Delivering specialised and coordinated trauma care was challenging due to the lack of a dedicated inpatient trauma team. The provision of specialised multidisciplinary trauma care aims to minimise the time from injury to critical interventions and optimise the coordination of care between multiple specialties, as these patients often have complex, multifaceted issues.[6]

Having a dedicated TAS provides continuity for the patient and staff trained in trauma care. It also allows the team to focus on trauma patients without the demands of other specialty patients. The benefits of a dedicated trauma service are well established in the literature. Ursic et al. found that the introduction of a TAS in Australia was associated with a reduction in hospital LOS and lower mortality rates among severely injured patients.[10] Similarly, a study by Cornwell et al. demonstrated that the implementation of a full-time trauma service, including a dedicated trauma admitting unit, trended towards lower overall mortality rates.[11] However, it is worth noting that much of the available literature examining the effectiveness of trauma inpatient admission services is over a decade old, and there is a lack of recent studies evaluating their impact in modern hospital systems.

The Christchurch TAS was designed with similar principles in mind; however, our study did not demonstrate significant improvements in measurable outcomes. Several resourcing limitations of the TAS may have prevented this service from demonstrating measurable improvement in patient outcomes. The TAS was implemented in Christchurch Hospital with inadequate funding, leading to insufficient staffing. Notably, there are critical deficiencies in trauma surgeon and junior medical staff cover, trauma specialist nursing resource and dedicated resource for data management and administration. The New Zealand National Trauma Network (NZ-NTN) recommends that hospitals receiving more than 150 major trauma patients per annum are staffed with a nurse practitioner and admin support, which Christchurch does not have. The NZ-NTN recommends a trauma nursing ratio of full-time equivalent to caseload of 1:75, however, in 2021/2022 this ratio was 1:99 in Christchurch (in: personal communication, June 2025). The Royal Australasian College of Surgeons recommends trauma clinical nurse specialist cover 7 days a week, which again is not fully covered in Christchurch.

One major limitation was the restricted operational hours of the TAS, which ran only from Monday to Friday. As a result, trauma patients admitted over the weekend were initially managed by the on-call surgical teams before being handed over to the TAS on Monday, potentially leading to delays or inconsistencies in tertiary survey completion. Additionally, trauma surgeon involvement was limited to fewer than 4 hours per week, and there was no dedicated house officer to support the service, resulting in variable coverage and service delivery. Due to staffing issues there were some dates when the TAS was not in effect, which could dilute the observed effect of the intervention. An example of this is when there was a lack of registrar cover, and so the entire service was closed over the Christmas and New Year period in 2023/2024. These resource limitations have likely contributed to inconsistencies in overall patient management, potentially diluting the effect of the TAS.

Another limitation was the quality and completeness of documentation, particularly in the early phases of the TAS implementation. Inconsistent or missing data—especially around tertiary surveys, injury documentation and timelines—may have affected the accuracy of outcome measurements and masked potential areas of improvement. Reliable data collection is essential in trauma audits and quality assurance, and the absence of robust data capture mechanisms limits the ability to draw definitive conclusions.

The partially funded operational model has struggled to achieve key performance indicators associated with trauma care. Adequate support requires funding for trauma nursing staff, registrar continuity, administrative support and dedicated data analysis to ensure accurate capture and review of trauma outcomes. Without investment

in these essential components, the system cannot support a consistent, high-quality trauma service, and the ability to audit and improve care is compromised.

These limitations underscore the need for better resourcing and a more integrated continuous trauma service to fully realise the benefits of dedicated inpatient trauma care. This aligns with findings from Havermans et al., which demonstrated that optimising in-hospital infrastructure, including the introduction of 24/7 trauma service coverage, was associated with reduced LOS, fewer complications and lower mortality rates.[16] Their study highlights how around-the-clock availability of trained trauma personnel contributes to earlier interventions, better continuity and streamlined decision making. In contrast, the lack of full-time, senior trauma coverage in our setting may have contributed to the absence of improvement in objective outcomes.

This study did not assess important patient-focussed qualitative aspects such as patient satisfaction, quality of care, coordination between teams or communication with patients and their whānau—factors that may contribute significantly to overall patient experience and recovery. It also did not assess longer-term outcomes such as time to return to work and time under Accident Compensation Corporation cover. Future discussions should focus on advocating for increased funding to fully support the trauma service, including hiring additional staff and developing robust administrative capabilities. Continuous assessment of both qualitative and quantitative outcomes will be essential to understand the full impact of the trauma service and inform ongoing improvements in trauma care delivery.

Conclusions

Dedicated multidisciplinary trauma inpatient teams have been shown to improve outcomes for patients with major trauma. This review of the implementation of the minimally resourced Christchurch TAS did not show such improvements; however, addressing resource constraints, increasing trauma surgeon availability and ensuring consistent coverage—including weekend admissions—could enhance the effectiveness of the service and lead to measurable improvements in patient outcomes. The experience from the trauma service introduction suggests that adequate funding and staffing are crucial for achieving operational success and optimising trauma care.

COMPETING INTERESTS
Dr Wakeman is the clinical lead of the trauma admitting service at Christchurch Hospital.

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REFERENCES:
1. Curtis K, Caldwell E, Delprado A, Munroe B. Traumatic injury in Australia and New Zealand. Australas Emerg Nurs J. 2012 Feb;15(1):45-54. doi: 10.1016/j.aenj.2011.12.001.
2. World Health Organization. Global health estimates: Leading causes of DALYs [Internet]. [cited 2025 Mar 12]. Available from: https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/global-health-estimates-leading-causes-of-dalys
3. Gabbe BJ, Isles S, McBride P, Civil I. Disability-Adjusted Life Years and cost of health loss of hospitalised major trauma patients in New Zealand. N Z Med J. 2022 Oct 7;135(1563):62-69. doi: 10.26635/6965.5878.
4. New Zealand Trauma Registry & National Trauma Network. Annual Report 2021/22 [Internet]. [cited 2025 Mar 12]. Available from: https://www.majortrauma.nz/assets/Annual-reports/NZMT/NZMT2021-2022.pdf
5. Tiel Groenestege-Kreb D, van Maarseveen O, Leenen L. Trauma team. Br J Anaesth. 2014 Aug 1;113(2):258-265. doi: 10.1093/bja/aeu236.
6. Georgiou A, Lockey DJ. The performance and assessment of hospital trauma teams. Scand J Trauma Resusc Emerg Med. 2010 Dec 13;18:66. doi: 10.1186/1757-7241-18-66.
7. Verhoeff K, Saybel R, Fawcett V, et al. A quality-improvement approach to effective trauma team activation. Can J Surg. 2019 Oct;62(5):305-314. doi: 10.1503/cjs.000218.
8. Celso B, Tepas J, Langland-Orban B, et al. A systematic review and meta-analysis comparing outcome of severely injured patients treated in trauma centers following the establishment of trauma systems. J Trauma. 2006 Feb;60(2):371-378. doi: 10.1097/01.ta.0000197916.99629.eb.
9. Groven S, Eken T, Skaga NO, et al. Long-lasting performance improvement after formalization of a dedicated trauma service. J Trauma. 2011 Mar;70(3):569-574. doi: 10.1097/TA.0b013e31820d1a9b.
10. Ursic C, Curtis K, Zou Y, Black D. Improved trauma patient outcomes after implementation of a dedicated trauma admitting service. Injury. 2009 Jan 1;40(1):99-103. doi: 10.1016/j.injury.2008.06.034. Erratum in: Injury. 2009 Sep;40(9):1020.
11. Cornwell EE 3rd, Chang DC, Phillips J, Campbell KA. Enhanced trauma program commitment at a level I trauma center: effect on the process and outcome of care. Arch Surg. 2003 Aug 1;138(8):838-843. doi: 10.1001/archsurg.138.8.838.
12. von Elm E, Altman DG, Egger M, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. J Clin Epidemiol. 2008 Apr;61(4):344-9. doi: 10.1016/j.jclinepi.2007.11.008.
13. Nonis M, McCombie A, Wakeman C, et al. Trauma Team Activation: improved care of major trauma patients. N Z Med J. 2022 Sep 23;135(1562):78-94. doi: 10.26635/6965.5770.
14. National Trauma Network. National Minimum Data Set for trauma [Internet]. [cited 2025 Mar 14]. Available from: https://www.majortrauma.nz/nz-mtr/national-minimum-data-set-for-trauma/
15. Harrel Jr FE, Dupont C. Hmisc: Harrell Miscellaneous

[Internet]. 2025 [cited 2025 Apr 8]. Available from: https://cran.r-project.org/web/packages/Hmisc/index.html
16. Havermans RJM, de Jongh MAC, Bemelman M, et al. Trauma care before and after optimisation in a level I trauma Centre: Life-saving changes. Injury. 2019 Oct 1;50(10):1678-1683. doi: 10.1016/j.injury.2019.07.017.

Examining ethnic and geographic disparities in end-of-life care pathways and community specialist palliative care engagement: insights from the Waikato Region

Rebecca J Stevenson, Lana Ferguson

ABSTRACT

AIM: This audit aims to evaluate differences in access and care between Māori and Pākehā patients, as well as between urban, rural and aged residential care (ARC) populations.

METHOD: A regional clinical audit reviewed 511 patients referred to community specialist palliative care services in the Waikato Region from January 2021 to January 2023. Key endpoints included time from referral to death, time to first phone and face-to-face contact, and medical team engagement.

RESULTS: Referral times were equal between Māori and Pākehā, though rural patients were referred significantly earlier than urban patients, with medians of 59 and 36 days, respectively ($p<0.001$). Rural patients also had higher rates of medical team input (52%) compared with urban patients (40%), with ARC patients receiving significantly less at 8.7% ($p<001$).

CONCLUSION: While referral times were similar for Māori and Pākehā, this may overlook delays for Māori, who likely have greater specialist palliative care needs. Rural patients were referred earlier and received more medical input, reflecting both greater needs and opportunities to improve urban referrer relationships. Disparities in specialist palliative care for aged care patients merit further investigation, particularly with the projected growth of this population.

The World Health Organization defines palliative care as *"an approach that improves the quality of life of patients—adults and children—and their families who are facing problems associated with life-threatening illness."*[1] Generalist or primary palliative care can assist with advanced care planning, basic symptom management and provision of treatment that aligns with patient goals of care.[2] However, at some point in their illness trajectory, patients with life-limiting or life-threatening conditions may need input from specialist palliative care services (SPCS) and this input may be continuous or episodic in nature, depending on the need of the patient and their whānau.[1,2] Specialist palliative care (SPC) extends the role of generalist palliative care by offering comprehensive, multidisciplinary support that is specifically adapted to the needs of patients and their whānau. SPC emphasises expert management of complex symptoms and provides essential psychosocial and emotional care. A recent systematic review by Iupati et al.[3] provided evidence that when SPC is delivered in the community, it can enhance patients' quality of life and ease their symptom burden, while also helping to decrease reliance on hospital and emergency services for a range of conditions, not just cancer. Most studies focussed on in-person care provided at home, available either continuously or as needed. Additionally, qualitative research highlighted in this review showed that coordinated care, practical assistance, after-hours support and effective management of medical crises are key elements that improve the experiences of patients and their families. Authors noted that despite these benefits, there is limited research involving children or minority groups, suggesting a need for future studies to address these gaps and to explore how generalist and SPC services can best work together to improve patient and whānau outcomes.[3]

While SPC should be universally accessible, in Aotearoa New Zealand there exists a concerning disparity to appropriate and timely access to SPC, particularly for Māori.[4–6] This inequity is further exacerbated by the disproportionate impact of

non-communicable chronic disease on Māori, which has resulted in inequitable distribution of life-limiting, non-malignant conditions such as end-stage organ failure.[4] For example, deaths secondary to advanced diabetes complications and organ failure are significantly higher among Māori, with mortality rates 700% greater than non-Māori.[4]

Several studies have evaluated the challenges surrounding palliative care accessibility for Māori, employing qualitative methodologies seeking the perceived experience of Māori.[7–11] Delayed referral is a consistent barrier identified in the literature, where the consequences of such may have significant ramifications on the end-of-life (EOL) experience for both the patient and their whānau.[7–10]

Early access to SPC for patients with life-limiting or life-threatening illness results in improved patient and whānau outcomes inclusive of, but not limited to, enhanced quality of life through reduced symptom burden, reduced psychosocial suffering and enhanced caregiver satisfaction.[2] A study from the United States of America corroborates this, where surveyed bereaved family members were asked if they perceived referral to SPCS to be "early", "on-time" or "late".[12] Late referral, as perceived by families, was associated with a poorer experience at EOL and heightened distress.[12] It is therefore possible to infer that if Māori are referred late to SPCS then Māori also experience these negative outcomes disproportionately.

Geographical location can also contribute to inequitable outcomes. It is widely acknowledged that individuals residing in rural areas often face exacerbated health challenges, including higher mortality rates and increased vulnerability to adverse social determinants of health.[11,13] Rural Māori communities may be particularly susceptible to a disproportionate impact that would exacerbate existing inequities, thus locality is an important factor to consider when reviewing access to SPC for Māori.[13]

This audit seeks to explore the disparities identified in the literature by examining differences in access to care and key quantitative measures of quality of care between Māori and Pākehā patients, as well as among those from urban, rural and aged residential care (ARC) settings, within a single community SPCS.

Methods

The study was a regional clinical audit of patients referred to Hospice Waikato. Quantitative data were used to draw inferences about any difference in referral times to this SPCS between Māori and Pākehā, as well as to determine if there were differences in points of care. Two equal groups were selected: Māori and Pākehā (New Zealand European or Other European). This meant the study had equal explanatory power, which is important as it recognises Māori have equal status and findings are less likely to privilege Pākehā data, which can happen when sampling is heavily tilted in the direction of a much larger non-Māori group.[14] Pākehā rather than non-Māori was sampled because other minority ethnic groups (e.g., Pacific peoples) also experience similar inequity and face many of the same health system barriers as Māori.[15] Thus, to eliminate potential confounding bias, other minority groups were not included in a broader "non-Māori" group.

All patients referred and accepted into Hospice Waikato between January 31 2021 and January 30 2023 were eligible for inclusion in the audit. The geographical area served by this SPCS encompasses the Health New Zealand – Te Whatu Ora (HNZ) Waikato district, which has a population of over 425,000 people, 23% of whom identify as Māori, a proportion significantly higher than the national average of 16%.[16] Additionally, 41% of the Waikato population resides in rural areas. The increased Māori and rural populations in the Waikato make this regional study particularly relevant to underserved groups, providing valuable insights into SPC access and outcomes for these communities at a national level.

Referral criteria to this SPCS specifically states patients require a terminal condition with prognosis likely fewer than 12 months, have needs that are likely to require SPC input, patients have consented to referral to the service, they have New Zealand citizenship or permanent residency and they are registered with a local primary healthcare provider (general practitioner).[17] These criteria are based on international recommendations (Leeds eligibility criteria for specialist palliative care services).[18]

To provide service delivery context, Hospice Waikato provides a nine-bed inpatient unit (IPU) service for complex symptom management or complex EOL care, and an outpatient community service. SPC is delivered by an expert multidisciplinary team comprised of nursing, medical and allied health professionals. Nursing services are split into rural and urban teams, and during the audit period, two clinical nurse specialists provided input to patients in ARC (across urban and rural)

with the remainder of the nursing team being registered nurses. Medical and family services teams work across both areas. Specialist medical input flexes to patient need, with input varying from phone advice to primary care providers (or other generalist palliative care providers) through to direct patient review via outpatient clinic, telehealth virtual consultation, home visit or admission to the Hamilton-based IPU for a multimodal approach to complex symptom management, complex dying or wrap-around psychosocial support. Over the audit period there were 1.0–1.4 full-time-equivalent (FTE) medical officers/registrars working in the community team, 1.0 FTE medical officer/registrar in the IPU and up to 2.2 FTE senior medical officers across both community and inpatient service.

Stratified random sampling was used to select equal numbers of Māori and Pākehā, with a total of 500 (250 per group) aimed for. Patients were randomised through Microsoft Excel (version 2312) and data were anonymised. Patient information came from a secondary data source—electronic medical records (EMR) system PalCare. Results were analysed using statistical software package R.

Endpoints measured were time from referral received to death (days), time from referral to first nursing contact by phone (days), time from referral to first face-to-face contact (days) and specialist medical input received (yes/no). Results were compared and contrasted according to ethnicity (Māori vs Pākehā) and locality (urban vs rural vs ARC) based on home address in the EMR.

Researchers in this audit identify as New Zealand European/Pākehā and are doctors within the Hospice Waikato service with an interest in public health, particularly in relation to palliative care provision and equity.

Ethics approval

This was sought through the New Zealand Health and Disability Ethic committee. The study did not require ethics approval as it was out of scope.

Results

There were slightly more Māori patients than Pākehā (261 compared to 250). Using R, data were cleaned and duplicates were checked for, of which there were none. Non-parametric tests were used to test for statistical significance between medians as variables were not normally distributed (highly skewed).

Sample characteristics

In total, half the study sample was rural (50%), while one-third was urban and the remainder was from ARC (Table 1). Fewer ARC patients

Table 1: Categorical variables of 511 patients randomly selected by stratified sampling among patients accepted to Hospice Waikato between 31 January 2021 and 30 January 2023.

Characteristic	Total N=511	European/Pākehā N=250	Māori N=261
Patient gender			
Female	254 (50%)	115 (46%)	139 (53%)
Male	257 (50%)	135 (54%)	122 (47%)
Location			
Urban	168 (33%)	77 (31%)	91 (35%)
Rural	258 (50%)	119 (48%)	139 (53%)
Aged residential care	85 (17%)	54 (22%)	31 (12%)
Specialist medical team input			
No	280 (55%)	137 (49%)	143 (51%)
Yes	231 (45%)	113 (49%)	118 (51%)

were Māori, with 12% of the total Māori sample residing in ARC compared with 22% of Pākehā. Forty-five percent of the total sample received medical input from an SPCS doctor, and this was replicated across both Pākehā and Māori groups.

Referral times

By ethnicity

Māori were referred on average 91 days before death, compared with 88 days for Pākehā; however, there was no statistically significant difference between medians, which were 48 days and 37 days for Pākehā and Māori respectively (Table 2).

By locality

Overall, there was an average of 89 days from time of referral to death. Rural patients were referred earlier than urban patients (105 days vs 86 days) and patients in ARC were the latest to be referred at 50 days before death (Table 3). Between localities, median referral times differed at 36 days for urban, 59 days for rural and 24 days for ARC. These differences were highly statistically significant (p-value <0.001).

Contact times

By ethnicity

There was an average of 3 days between referral to first phone contact for both Māori and Pākehā (Table 4). For first face-to-face contact, there was an average of 12 days from time of referral, and only 1 day difference between Māori and Pākehā (11 and 12 days, respectively). There were no statistically significant differences between medians, which was 7 days for both groups (p-value >0.05).

Table 2: Time from referral to death (days) by ethnicity.

Characteristic	Total N=511	European/Pākehā N=250	Māori N=261	P-value[a]
Time from referral received to death (days)				
Mean (standard deviation)	89 (116)	88 (110)	91 (122)	
Median (range)	43 (0–646)	48 (1–646)	37 (0–559)	0.4
N/A (alive or discharged)	81	48	33	

[a]Wilcoxon Rank-Sum Test.

Table 3: Time from referral received to death (days) by locality.

Characteristic	Total N=511	Urban N=168	Rural N=258	ARC N=85	P-value[a]
Time from referral received to death (days)					
Mean (standard deviation)	89 (116)	86 (120)	105 (126)	50 (56)	
Median (range)	43 (0–646)	36 (0–610)	59 (1–646)	24 (1–226)	0.0005
N/A (alive or discharged)	*81*	*32*	*37*	*12*	

[a]Kruskal–Wallis test.
ARC = aged residential care.

Table 4: Data for time from referral to first contact (phone and face) by ethnicity.

Characteristic	Total N=511	European/Pākehā N=250	Māori N=261	P-value[a]
Time from referral to first phone contact (days)				
Mean (standard deviation)	3 (7)	3 (8)	3 (6)	
Median (range)	1 (0–88)	1 (0–88)	1 (0–62)	0.9
Not recorded	96	40	56	
Time from referral to first face contact (days)				
Mean (standard deviation)	12 (15)	12 (17)	11 (13)	
Median (range)	7 (0–135)	7 (0–135)	7 (0–70)	0.4
Not recorded	66	36	30	

[a]Wilcoxon Rank-Sum Test.

Table 5: Data for time from referral to first contact (phone and face) by locality.

Characteristic	Total N=511	Urban N=168	Rural N=258	ARC N=85	P-value[a]
Time from referral to first phone contact (days)					
Mean (standard deviation)	3 (7)	3 (8)	3 (5)	5 (10)	
Median (range)	1 (0–88)	1 (0–88)	1 (0–33)	1 (0–62)	0.04
Not recorded	96	21	52	23	
Time from referral to first face contact (days)					
Mean (standard deviation)	12 (15)	11 (17)	11 (12)	18 (21)	
Median (range)	7 (0–135)	6 (0–135)	7 (0–69)	8 (0–78)	0.03
Not recorded	66	14	27	25	

[a]Kruskal–Wallis test.
ARC = aged residential care.

By locality

Time from referral to initial phone contact was consistent across urban and rural cohorts, averaging 3 days, whereas patients within ARC experienced a slight delay of 5 days (Table 5). The first face-to-face interaction was comparable between urban and rural patients at 11 days, contrasting with ARC patients at 18 days. Between urban and rural, medians for first phone contact and first face-to-face contact were the same or differed only slightly, with first phone contact at 1 day and first face contact being at 6–7 days, which was statistically significant (p-value <0.05 for both).

Specialist medical input

By ethnicity

Forty-five percent of the total cohort received SPCS doctor input (Table 6). There was no statistically significant difference between Māori and Pākehā, with 51% of Māori receiving specialist medical input and 49% of Pākehā (p-value >0.9).

By locality

Of those who received medical input from SPCS doctors, 52% lived rurally while 40% were urban and nearly 9% were in ARC (Table 7). The observed 12% difference between rural and urban was highly statistically significant (p-value <0.001). ARC patients were significantly less likely to receive SPCS doctor input (8.7%).

Discussion

This audit examined equity of access and timing of SPCS between Māori and Pākehā patients and across different geographical locations in the Waikato Region. The findings provide important insights into current palliative care delivery that both align with and diverge from existing literature.

Table 6: Specialist medical input by ethnicity.

Characteristic	European/Pākehā N=250[a]	Māori N=26[a]	P-value[b]
SPCS doctor input (advice, clinic, telehealth, IPU)			>0.9
No	137 (49%)	143 (51%)	
Yes	113 (49%)	118 (51%)	

[a]n (%).
[b]Fisher's exact test.
SPCS = specialist palliative care services; IPU = inpatient unit.

Table 7: Specialist medical input by nursing team.

Characteristic	Total N=511	Urban N=168[a]	Rural N=258[a]	ARC N=85[a]	P-value[b]
SPCS doctor input (advice, clinic, telehealth, IPU)					<0.001
No	280 (55%)	76 (27%)	139 (50%)	65 (23%)	
Yes	231 (45%)	92 (40%)	119 (52%)	20 (8.7%)	

[a]n (%).
[b]Fisher's exact test.
SPCS = specialist palliative care services; IPU = inpatient unit.

Equity in referral timing and specialist medical input for Māori

Our findings showed comparable referral times to death and equivalent specialist medical input between Māori and Pākehā patients. While this suggests procedural equity within this SPCS, these results must be contextualised within the broader landscape of health inequities in Aotearoa New Zealand. Māori experience disproportionately poorer social determinants of health and reduced healthcare access compared with non-Māori,[4] leading to worse health outcomes overall and higher mortality rates, which persists when age standardised.[13] The equity observed in our study may reflect only those patients who successfully navigated referral pathways rather than population-level equity and does not negate the persistent, systemic barriers Māori face in accessing healthcare at a population level, such as financial constraints, culturally unsafe services and experiences of racism and bias.[19–21]

Recent literature emphasises that equity in palliative care for Māori requires more than just equal timing metrics. Previous research notes that Western biomedical approaches frequently fail to meet Māori cultural palliative care needs.[22] For many, particularly Māori immersed in Te Ao Māori, the process of whakawhanaungatanga (relationship building) is a vital part of culturally safe healthcare and this takes time to develop.[20] Late referrals may undermine this, potentially impacting the quality of care Māori receive once under a SPCS. The Mauri Mate framework, developed specifically for Aotearoa New Zealand's palliative care context, highlights the importance of culturally responsive care that extends beyond clinical interventions to encompass whānau support and spiritual care.[23] This framework suggests that true equity would likely require earlier referrals for Māori post-diagnosis of life-limiting illnesses to address complex needs and facilitate meaningful whakawhanaungatanga.

Impaired whanaungatanga (sense of family connection and kinship) was demonstrated to have had significant impact on Māori whānau when caregiving at EOL during the COVID-19 lockdowns in 2020–2021, which enforced strong social restrictions.[24] The development of frameworks like the aforementioned Mauri Mate represents an important step toward addressing these challenges by providing guidance for culturally appropriate EOL care for Māori that could, and should, be translatable to all palliative care scenarios.[23]

Timing of referrals to SPCS

The mean duration from referral to death of 89 days observed in our study falls significantly short of the recommended 12-month time frame specified in this SPCS referral criteria.[17] This timing discrepancy aligns with international literature, noting that while early palliative care referrals improve patient and family outcomes, such referrals are not routine in practice.[25] The 3-month average referral-to-death time frame identified in our study may limit the potential benefits of comprehensive palliative care interventions that an SPCS can provide. To deliver high-quality, holistic palliative care, additional resources would be necessary for each SPCS in Aotearoa New Zealand, particularly if the actual referral time moved closer to the 12-month time frame specified in referral criteria, as patient numbers on each service would significantly increase. This underscores the need for national and government recognition of the importance of early SPC involvement in fostering positive EOL experiences, and for adequate funding to ensure services can meet the referral criteria they have established in line with international recommendations.[18]

Recent implementation trials in Australia have specifically targeted the integration of early palliative care at key transition points in advanced illness trajectories to improve outcomes.[25] The CarePlus model has been designed to overcome common obstacles to early palliative care for cancer patients, such as inconsistent referral timing, misconceptions that palliative care is only for EOL, and limited outpatient services.[25] CarePlus introduces automatic referrals at specific points in a patient's cancer journey, determined by disease stage and agreed upon by oncology teams, and provides structured outpatient consultations, coordinated with primary care, to better address patients' physical, emotional and support needs while normalising palliative care as a routine part of cancer care. A toolkit for this model is being rolled out and evaluated in several Australian cancer centres, with the aim of improving access, care coordination and overall patient outcomes.[25] It is pertinent to note that this model is inclusive only of patients with terminal cancer and thus excludes the growing number of patients with end-stage non-malignant disease who require SPC, with Māori over-represented in this group. A more equity-centric approach would be to roll out similar interventions across other hospital-level services such as cardiology,

endocrinology (diabetes) and cardiology specialist services at tertiary hospitals.

Rural–urban disparities in palliative care access

Our finding that rural patients received earlier referrals than their urban counterparts presented an intriguing departure from established patterns of healthcare access. This contradicts broader evidence showing that rural New Zealanders experience higher mortality rates and poorer health outcomes than urban populations.[13] The University of Otago research published in 2023 demonstrated that rural mortality rates were particularly pronounced among those under 30, where rates in rural communities were nearly double those in urban centres.[13] It also highlighted that while both rural Māori and rural non-Māori have higher mortality rates than their urban counterparts, the impact is more severe for Māori, with Māori in the most rural areas experiencing an age-standardised mortality rate of 4,018 per 100,000 compared with 3,055 per 100,000 for non-Māori.[13]

The inverse relationship we observed, with rural patients receiving more timely referrals and greater specialist medical input, warrants further investigation. It may reflect successful targeted interventions in the Waikato Region or compensatory referral practices by rural primary care providers aware of access challenges. Targeted early intervention projects, such as the Poi (Palliative Outcomes Initiative) project in Auckland,[26] could act to reduce rural inequity at a national level. No formal research data could be found that have measured outcomes from Poi, but would be useful to assist other SPCS nationally. Poi is an Auckland-wide, HNZ- and Te Aka Whai Ora-funded programme led by specialist hospices to support and upskill general practitioners, practice nurses and clinical managers in primary and residential care. It enables early identification and holistic, evidence-based planning for people in their last 6–12 months of life prior to referral to a SPCS, with the goal of improving equity and access to high-quality palliative care through multidisciplinary consultation, education and collaborative care planning with patients and whānau.[26] Programmes like these, if they were available and funded nationally, would likely improve equity across all of the HNZ regions and help to address known rural disparities in health outcomes and mortality as well as improving access to timely palliative care despite postcodes.

Palliative care in ARC settings

The significant disparity in specialist medical input for ARC patients (8.7% vs 45% for community patients) reflects complex systems issues at the intersection of aged care and palliative medicine. This finding aligns with research highlighting that while increasing numbers of older New Zealanders are spending their final phase of life in ARC facilities, these settings remain primarily rehabilitation-focused rather than palliative-oriented.[27]

The SEQUAL (Supportive Education and Quality palliative care) pilot study in regional Aotearoa New Zealand found that only 42% of ARC staff had received any palliative care education, highlighting a critical gap in workforce capability.[27] Our findings complement this research, suggesting that the limited SPCS medical input for ARC patients may reflect both systems barriers and the growing role of SPCS clinical nurse specialists in bridging this gap. With Aotearoa New Zealand's aged population projected to increase from 0.79 million to 1.4 million between 2020 and 2050, addressing these disparities becomes increasingly urgent.[28] Emerging models of integrated palliative care such as the SHARE (Supportive Hospice and Aged Residential Exchange) initiative, which emphasises timely assessment and collaborative approaches to overcome access barriers, is likely to become more critical for SPCS to utilise in order to improve SPC provision to the aged care sector.[29]

Timeliness of initial contact following referral

The equitable response times for initial contact across geographical locations represents a significant service delivery achievement for this service. The median 1-day time frame for first phone contact and 6–7 days for face-to-face assessment demonstrate successful service adaption to geographical challenges with the SPCS covering a large area that spans over 21,000 kilometres.

Recent literature emphasises that successful palliative care integration requires not just prompt initial contact but sustained engagement across the illness trajectory.[25] While our study demonstrated equity in initial contact timing, further research is needed to assess whether ongoing engagement remains consistent across different populations and settings.

Implications for future research and practice

These findings highlight several priorities for future research and practice development. Qualitative exploration of whānau experiences regarding referral timing and care quality would provide valuable context to these quantitative findings. Particular attention should be paid to the role of social work and cultural support services, which were not captured in the current analysis but are critical components of holistic palliative care delivery.[22]

Strengthening relationships between SPCS, primary care providers and ARC facilities emerges as a key priority, particularly given Aotearoa New Zealand's ageing demographic profile.[28,29] The successful rural service delivery model identified in this audit warrants further investigation to identify transferable elements that might address inequities in other contexts or populations.

Limitations of the study

A limitation of this audit is the reliance on ethnicity data from HNZ or primary referrers (e.g., general practitioners), which may not always be self-identified. This retrospective study design does not allow for verification of self-identified ethnicity posthumously. Misclassification of patients' ethnicity due to assumptions made by healthcare practitioners or other factors could lead to inaccurate records, an issue that has been recognised as an area for correction by the Ministry of Health.[30] Acknowledging these potential inconsistencies, the larger sample size and equal explanatory power were employed to help mitigate this limitation. A further limitation of this is audit is the potential limited applicability of results to other SPCS throughout Aotearoa New Zealand; however, given the paucity of research in this area, this audit remains relevant in its contribution to the field.

Conclusion

This analysis of palliative care delivery in the Waikato Region reveals both strengths and opportunities for improvement. While procedural equity between Māori and Pākehā was observed, achieving substantive equity requires addressing broader systemic factors and cultural needs. The surprising finding of better rural access contradicts typical patterns and merits further investigation. Significant gaps remain in palliative care provision within ARC settings, requiring focussed attention as Aotearoa New Zealand's population ages. These findings contribute to the growing body of evidence guiding the development of equitable, accessible and culturally responsive palliative care services in Aotearoa New Zealand.

COMPETING INTERESTS
Nil.

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REFERENCES

1. World Health Organization. Palliative care [Internet]. Geneva, Switzerland: World Health Organization; 2023 [cited 2024 May 6]. Available from: https://www.who.int/europe/news-room/fact-sheets/item/palliative-care
2. van Zuilekom I, Metselaar S, Godrie F, et al. Generalist, specialist, or expert in palliative care? A cross-sectional open survey on healthcare professionals' self-description. BMC Palliat Care. 2024;23(1):120. doi: 10.1186/s12904-024-01449-9.
3. Iupati S, Stanley J, Egan R, et al. Systematic Review of Models of Effective Community Specialist Palliative Care Services for Evidence of Improved Patient-Related Outcomes, Equity, Integration, and Health Service Utilization. J Palliat Med. 2023;26(11):1562-1577. doi: 10.1089/jpm.2022.0461.
4. Robson R, Gordon P. Chapter 4: Mortality In: Robson B, Harris R, eds. Hauora: Māori Standard of Health IV. Wellington: Te Rōpū Rangahau Hauora a Eru Pōmare; 2007. pp. 33-61.
5. Simpson ML, Berryman K, Oetzel J, et al. A cultural analysis of New Zealand palliative care brochures. Health Promot Int. 2016;31(4):839-848. doi: 10.1093/heapro/dav067.
6. Shahid S, Taylor EV, Cheetham S, et al. Key features of palliative care service delivery to Indigenous peoples in Australia, New Zealand, Canada and the United States: a comprehensive review. BMC Palliat Care. 2018;17(1):72. doi: 10.1186/s12904-018-0325-1.
7. Kidd J, Black S, Blundell R, Peni T. Cultural health literacy: the experiences of Māori in palliative care. Glob Health Promot. 2018;25(4):15-23. doi: 10.1177/1757975918764111.
8. Frey R, Gott M, Raphael D, et al. "Where do I go from here"? A cultural perspective on challenges to the use of hospice services. Health Soc Care Community. 2013;21(5):519-529. doi: 10.1111/hsc.12038.
9. Slater T, Matheson A, Ellison-Loschmann L, et al. Exploring Māori cancer patients', their families', community and hospice views of hospice care. Int J Palliat Nurs. 2015;21(9):439-445. doi: 10.12968/ijpn.2015.21.9.439.
10. Moeke-Maxwell T, Collier A, Wiles J, et al. Bereaved Families' Perspectives of end-of-Life Care. Towards a Bicultural Whare Tapa Whā Older person's Palliative Care Model. J Cross Cult Gerontol. 2020;35(2):177-193. doi: 10.1007/s10823-020-09397-6.
11. World Health Organization. WHO guideline on health workforce development, attraction, recruitment and retention in rural and remote areas [Internet]. Geneva, Switzerland: World Health Organization; 2021 [cited 2024 May 19]. Available from: https://iris.who.int/bitstream/handle/10665/341139/9789240024229-eng.pdf
12. Schockett ER, Teno JM, Miller SC, Stuart B. Late referral to hospice and bereaved family member perception of quality of end-of-life care. J Pain Symptom Manage. 2005;30(5):400-407. doi: 10.1016/j.jpainsymman.2005.04.013.
13. Nixon G, Davie G, Whitehead J, et al. Comparison of urban and rural mortality rates across the lifespan in Aotearoa/New Zealand: a population-level study. J Epidemiol Community Health. 2023;77(9):571-577. doi: 10.1136/jech-2023-220337.
14. Ministry of Health – Manatū Hauora. Rural health strategy [Internet]. Wellington, New Zealand; 2023 [cited 2024 May 19]. Available from: https://www.health.govt.nz/publications/rural-health-strategy
15. Te Rōpū Rangahau Hauora a Eru Pōmare Wellington School of Medicine and Health Sciences University of Otago. Mana Whakamārama - Equal Explanatory Power: Māori and non-Māori sample size in national health surveys [Internet]. Wellington, New Zealand; 2002 [cited 2023 Oct 23]. Available from: https://www.fmhs.auckland.ac.nz/assets/fmhs/Te%20Kupenga%20Hauora%20Māori/docs/Equal_explanatory_power.pdf
16. Foliaki S, Pulu V, Denison H, et al. Pacific meets west in addressing palliative care for Pacific populations in Aotearoa/New Zealand: a qualitative study.

BMC Palliat Care. 2020;19(1):100. doi: 10.1186/s12904-020-00604-2.
17. Hospice Waikato. Referral to Hospice Waikato Information for Referrers [Internet]. [cited 2025 Jul 22]. Available from: https://www.hospicewaikato.org.nz/file/information-on-referral-to-hospice-waikato?open=true
18. Bennett M, Adam J, Alison D, et al. Leeds eligibility criteria for specialist palliative care services. Palliat Med. 2000;14(2):157-158. doi: 10.1191/026921600669491513.
19. Espiner E, Paine SJ, Weston M, Curtis E. Barriers and facilitators for Māori in accessing hospital services in Aotearoa New Zealand. N Z Med J. 2021;134(1546):47-58.
20. Curtis E, Jones R, Tipene-Leach D, et al. Why cultural safety rather than cultural competency is required to achieve health equity: a literature review and recommended definition. Int J Equity Health. 2019;18(1):174. doi: 10.1186/s12939-019-1082-3.
21. Jeffreys M, Ellison-Loschmann L, Irurzun-Lopez M, et al. Financial barriers to primary health care in Aotearoa New Zealand. Fam Pract. 2024;41(6):995-1001. doi: 10.1093/fampra/cmad096.
22. Shah S, Ameratunga S, Peiris-John R, et al. Dying well in Aotearoa New Zealand for ethnic minority communities: a time for reclamation? N Z Med J. 2024;137(1598):86-92. doi: 10.26635/6965.6534.
23. Te Kahu Pairuri o Aotearoa – Hospice New Zealand. Mauri Mate [Internet]. Hospice New Zealand; 2019 [cited 2025 May 8]. Available from: https://www.hospice.org.nz/mauri-mate
24. Moeke-Maxwell T, Robinson J, Gott M. Pōuritanga: Whānau Māori experiences of end-of-life caregiving, death and tangihanga (funeral customs) during New Zealand's COVID-19 lockdowns. J R Soc N Z. 2024;55(2):287-301. doi: 10.1080/03036758.2024.2345314.
25. Selvam D, Crawford GB, Rizvi F, et al. CarePlus: A Model to Address Barriers to Early Palliative Care in Cancer. J Pain Symptom Manag. 2024;67(5):e495-e497. doi: 10.1016/j.jpainsymman.2024.01.011.
26. Auckland's Specialist Hospices Poi Community of Care. Healthcare Professionals - About Poi [Internet]. Auckland, New Zealand: Poi; 2025 [cited 2025 May 5]. Available from: https://www.poiproject.co.nz/healthcare-professionals/
27. Rodgers V, Marshall B, Hey F, et al. Readiness for Providing Primary Palliative Care in regional Aged Residential Care: Partnering with SEQUAL Specialist Palliative Care Nurses. Nurs Prax N Z. 2017;33(3):31-40. doi: 10.36951/ngpxnz.2017.012.
28. Dale C, St John S. Long term in-home and residential care for our ageing population [Internet]. Auckland, New Zealand: The University of Auckland; 2022 [cited 2023 Jul 21]. Available from: https://www.auckland.ac.nz/assets/business/our-research/docs/economic-policy-centre/pensions-and-intergenerational-equity/PIE%20Briefing%202022-1.pdf
29. Frey R, Boyd M, Robinson J, et al. The Supportive Hospice and Aged Residential Exchange (SHARE) programme in New Zealand. Nurse Educ Pract. 2017;25:80-88. doi: 10.1016/j.nepr.2017.05.004.
30. Ministry of Health – Manatū Hauora. Ethnicity Data Protocols for the Health and Disability Sector [Internet]. Wellington, New Zealand: Ministry of Health; 2004 [cited 2023 Oct 23]. Available from: https://www.fmhs.auckland.ac.nz/assets/fmhs/faculty/tkhm/tumuaki/docs/ethnicity-data-protocols.pdf

Recommendations for the use of functional medical imaging in the management of cancer of the cervix in New Zealand: a rapid review

Shouzhuang Feng, Sibusiso Mdletshe

ABSTRACT

AIM: We aimed to review the role of functional imaging in cervical cancer to underscore its significance in the diagnosis and management of cervical cancer and in improving patient outcomes.

METHODS: This rapid literature review targeting the clinical guidelines for functional imaging in cervical cancer sourced literature from 2017 to 2023 using PubMed, Google Scholar, MEDLINE and Scopus. Keywords such as cervical cancer, cervical neoplasms, functional imaging, stag*, treatment response, monitor* and New Zealand or NZ were used with Boolean operators to maximise results. Emphasis was on English full research studies pertinent to New Zealand. The study quality of the reviewed articles was assessed using the Joanna Briggs Institute critical appraisal checklists.

RESULTS: The search yielded a total of 21 papers after all duplicates and yields that did not meet the inclusion criteria were excluded. Only one paper was found to incorporate the New Zealand context. The papers reviewed yielded results that demonstrate the important role of functional imaging in cervical cancer diagnosis, staging and treatment response monitoring. Techniques such as dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI), diffusion-weighted magnetic resonance imaging (DW-MRI), computed tomography perfusion (CTP) and positron emission tomography computed tomography (PET/CT) provide deep insights into tumour behaviour, facilitating personalised care. Integration of artificial intelligence in image analysis promises increased accuracy of these modalities.

CONCLUSION: Functional imaging could play a significant role in a unified approach in New Zealand to improve patient outcomes for cervical cancer management. Therefore, this study advocates for New Zealand's medical sector to harness functional imaging's potential in cervical cancer management.

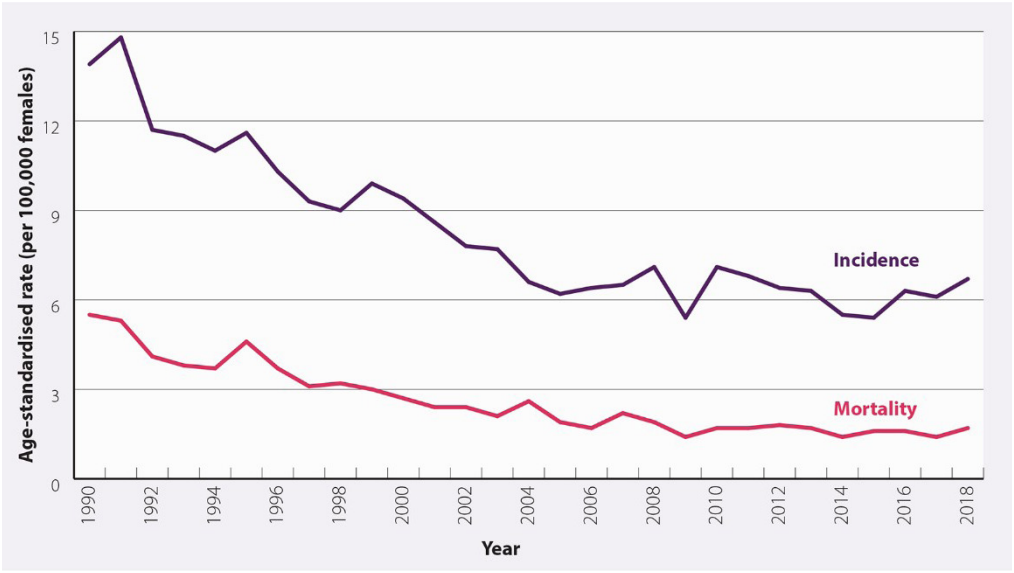
Cervical cancer is a significant health concern impacting women.[1,2] It is deemed the fourth most common cancer in women with geographic disparities, whereby low- and middle-income countries are impacted significantly more than high-income countries.[3,4] This is caused by the difference in healthcare resources, including screening programmes and vaccinations, which can significantly reduce the risk of cervical cancer.[5] In the New Zealand context, cervical cancer is reported to be the third most common gynaecological cancer.[6] Further, socio-economic deprivation has been shown to be associated with an increased incidence of cervical cancer in New Zealand.[7] However, the implementation of the human papillomavirus (HPV) immunisation and cervical screening programmes have led to the substantial decline of the age-standardised incidence rate of invasive cervical cancer for both Māori and non-Māori populations.[8] Interestingly, a pronounced disparity emerges when examining cervical cancer incidence and mortality rates among Māori and Pacific women, as they experience significantly higher rates than their European counterparts and women from other ethnicities (Figure 1).[9]

This discrepancy is potentially rooted in these population groups' challenges in accessing healthcare and their lower participation in screening programmes. Despite the free National Cervical Screening Programme, there has been no significant change in the screening coverage for the Māori and Pacific populations since 2007.[9] Further, addressing cervical cancer necessitates a comprehensive treatment strategy, meticulously formulated by considering various pivotal factors, including the disease's stage and extent, the tumour's location and size and the patient's overall health, age and future childbearing aspirations.[10]

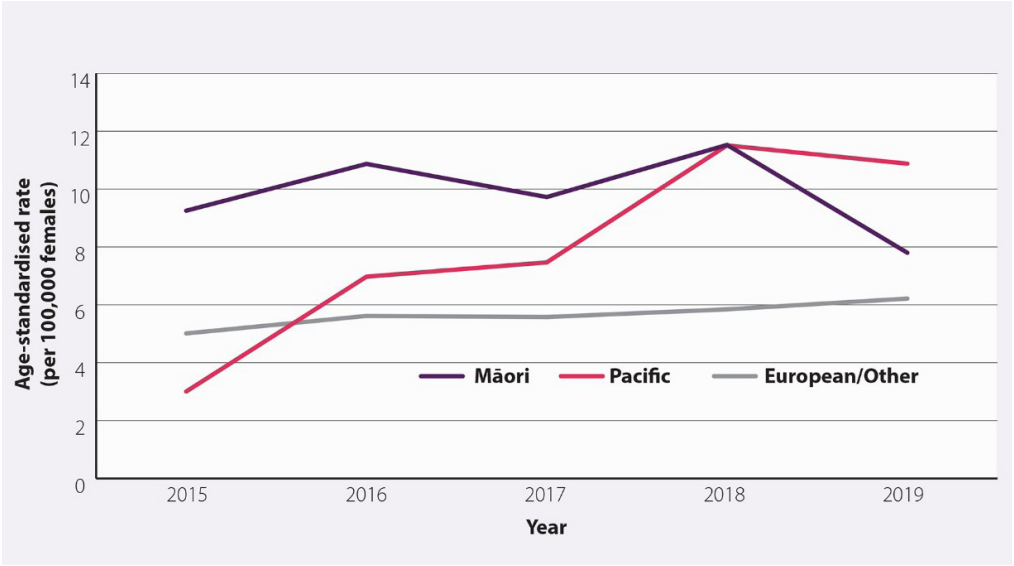
Medical imaging (MI) is quintessential in various

Figure 1: New Zealand age-standardised incidence and mortality rates (per 100,000 females) for cervical cancer (a) between 1990 and 2018, and (b) by ethnicity between 2015 and 2019.[6]

a)



b)



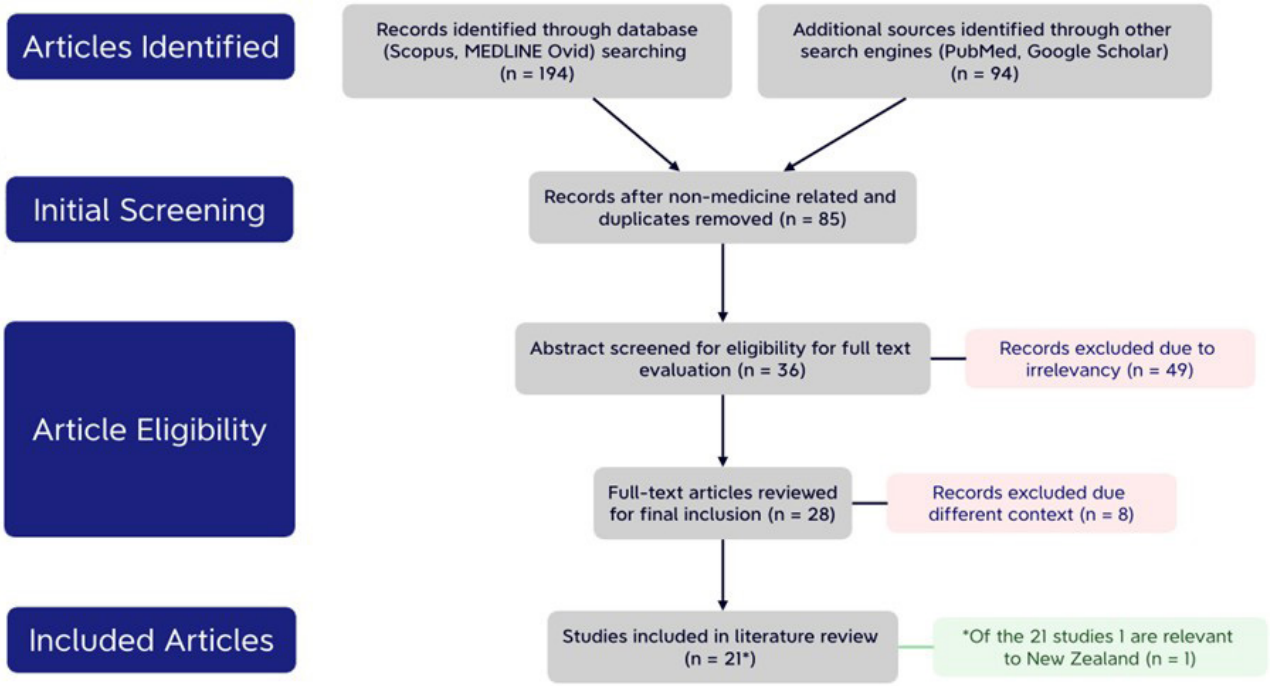
cervical cancer management phases, and guides oncologists through diagnosis, treatment and eventual monitoring, ensuring optimal patient outcomes and a better prognosis.[11] With recent advancements in MI, functional imaging and artificial intelligence (AI) integration have emerged as an asset for diagnosis, treatment monitoring and predicting patient prognosis.[12] The integration of advanced AI algorithms enhances the proficiency of functional imaging in oncological applications.[13]

In New Zealand, the current practice includes the use of magnetic resonance imaging (MRI) and positron emission tomography computed tomography (PET/CT) as part of the work up for cervical cancer management, and in some follow-up cases where there are concerns on tumour response to chemoradiotherapy. PET/CT is publicly funded for patients with locally advanced (International Federation of Gynaecology and Obstetrics [FIGO] > Stage 1A) cervical cancer,[14] which is important for staging to determine the treatment approach, as any distant metastasis would exclude the patient from curative treatment. PET/CT also helps determine the "volumes" (treatment areas) for the external beam radiotherapy, as it highlights whether any lymph nodes are involved. The MRI sequences generally used are anatomic imaging sequences and not functional sequences.

However, a gap still exists in New Zealand in robust evidence to guide the best practice for the use of MI in the management of cervical cancer.[15] Further, there are no existing New Zealand guidelines about the utilisation of AI, and functional imaging in the screening, diagnosis, treatment and response monitoring of cervical cancer remains ambiguous. Given New Zealand's relatively small population size, maintaining updated national guidelines in such a specialised and rapidly evolving area can be very challenging. This lack of clear guidance underscores the importance of formulating informed recommendations and guidelines to enhance clinical practice and patient outcomes.

This rapid review aimed to describe the current practice and synthesise the relevant international evidence that may help to inform future guidelines development in New Zealand for the staging and monitoring treatment response for cervical

Figure 2: A modified PRISMA flow diagram illustrating the articles identified throughout each review stage.



cancer. The proposed guidelines are presented.

Methods

A rapid literature review was conducted to assess the current literature on the utilisation of functional imaging in the staging and treatment response in cancer of the cervix. A search was performed using the PubMed, Google Scholar, MEDLINE and Scopus databases for relevant English peer-reviewed literature published between 2017 and 2023. The search strategy included keywords such as cervical cancer, cervical neoplasms, functional imaging, stag*, treatment response, monitor* and New Zealand or NZ. Furthermore, Boolean operators such as "AND" and "OR" were implemented to maximise search results. The exclusion criteria were studies focussing on other types of cancer, conference presentations and non-English articles.

Various combinations of peer-reviewed literature were analysed, and important or valuable findings were synthesised from the included sources. Additionally, the critical appraisal tools—the Joanna Briggs Institute (JBI) checklists—were utilised to eliminate biased articles and assess the quality of the literature.[16] This assessment process involved responding with "yes", "no", "unclear" or "not applicable" to a range of queries that assessed various aspects of the study, which included the clarity of the research question, the suitability of the research methodology, the dependability of the data gathering techniques and so on.[16] Literature articles were then graded by the number of "yes" responses to gauge their overall quality, which ensured the reliability and validity of the included literature, providing a summary of the evidence on using functional imaging in cervical cancer staging and management at that time. Notably, a score of seven or higher is considered a reliable indicator of adequate methodological rigour and study quality, suggesting that the articles reviewed provide a trustworthy basis for drawing conclusions and making recommendations.[15]

Results

A total of 285 studies were initially discovered through the electronic search process. This count was reduced to 85 articles after removing non-medical papers and duplicates. After a more detailed screening, 36 of these 85 articles appeared potentially relevant to the study. At that stage, skimming and scanning methods were employed to examine the abstracts of the residual articles, and 28 articles satisfied the inclusion criteria. However, after a comprehensive text review, a further eight studies were excluded due to being from different contexts, leaving 21 studies that were included in the final review, inclusive of one article that had a New Zealand context. A modified PRISMA flow diagram, demonstrated in Figure 2, illustrates the articles obtained at each phase of the review.

The methodologies of the included articles are mainly retrospective cohort studies (n=10) and systematic reviews (n=6). Most articles were from the United States of America (n=7, 33%), three (14%) from China, two (10%) from France and the others were from various countries, including Italy, Turkey, India, Norway, Germany, Netherlands, Iran, Russia and Australia/New Zealand. The articles displayed considerable variability in sample size, study populations and data-gathering techniques. Retrospective cohort studies typically featured larger sample sizes, often reflective of the demographic makeup of their respective geographical locales. In contrast, systematic reviews amalgamated data from diverse sources, offering a more comprehensive viewpoint. Table 1 summarises the characteristics, JBI scores and key findings of all the studies that were included in the final review.

All 21 articles included in this review surpassed a JBI score of seven. Furthermore, the prospective observational studies within the review were of superior quality, each obtaining a JBI score of nine. Such elevated scores are emblematic of rigorous research frameworks, sound methodologies and dependable results.

Table 1: Literature characteristics and summaries of the 21 articles included in the results section (n=21).

Author	Title	Country	Type/ methodology	Summary of findings/conclusion	JBI score
Akhavan et al.[17]	Evaluation of Cervical Cancer Staging Based on Magnetic Resonance Imaging in Comparison with Surgical Staging	Iran	Retrospective cross-sectional study	MRI serves as an effective technique for evaluating the initial staging of cervical cancer. This approach can identify tumour invasions into the parametrium, uterus and vagina with sensitivities of 94.7%, 97.5% and 98.7%, respectively. However, the specificity of MRI is quite limited, approximately 50%, indicating challenges in accurately distinguishing mass types. MRI is not adept at detecting metastasis in the pelvic or abductor lymph nodes; post-surgical pathology remains the optimal method for such diagnoses. In the absence of MRI, a physical examination can be a dependable alternative, but its precision is closely tied to the examiner's expertise and is generally less accurate than MRI.	8
Bowen et al.[18]	Tumor radiomic heterogeneity: Multiparametric functional imaging to characterise variability and predict response following cervical cancer radiation therapy	United States of America	Prospective observational study	The paper underscores the imperative for effective techniques to measure tumour diversity, aiming to provide early guidance for tailored therapeutic approaches. The research endeavoured to technically scrutinise the temporal shifts in tumour diversity patterns observed in DCE-MRI, DW-MRI, and ^{18}F-FDG PET/CT and their correlation with radiation therapy outcomes in cervical cancer. The study encompassed 21 cervical cancer patients with IB2-IVA FIGO staging classification, undergoing definitive external beam radiation therapy and brachytherapy. Findings revealed that tumour diversity exhibited variations across patients, imaging modalities and observational moments. Radiomic evaluations of evolving tumour diversity hold promise in refining treatment personalisation and bolstering prognostic estimations.	9
Dappa et al.[19]	The value of advanced MRI techniques in the assessment of cervical cancer: a review	Germany	Systematic review	Traditional MRI holds a central position in cervical cancer diagnosis, demonstrating commendable outcomes in gauging tumour spread and PI. Emerging methodologies, including DCE-MRI, DW-MRI and intravoxel incoherent motion, appear promising for visualising cervical tumours and quantitatively exploring tumour biology and its surrounding environment. Incorporating DW-MRI enhances the precision in identifying tumour progression and pinpointing lymph node metastatic spread. Both DW-MRI and DCE-MRI could potentially offer a deeper understanding of tumour biology relating to histological categorisation and subtype distinction, subsequently aiding in evaluating the likelihood of tumour recurrence.	8
Devine et al.[20]	Imaging and Staging of Cervical Cancer	United States of America	Systematic review	The recent FIGO staging system advocates for the integration of imaging alongside clinical evaluations. Radiologists must be well-versed in the FIGO classification and grasp the implications of imaging results on FIGO categorisation and subsequent patient care. MRI is the preferred imaging technique for preliminary staging and subsequent monitoring of cervical cancers. Additionally, PET/CT, PET/MRI and plain CT contribute to evaluating individuals with cervical cancer.	8

Table 1 (continued): Literature characteristics and summaries of the 21 articles included in the results section (n=21).

Author	Title	Country	Type/ methodology	Summary of findings/conclusion	JBI score
Ditto et al.[21]	Diagnostic Accuracy of Magnetic Resonance Imaging in the Preoperative Staging of Cervical Cancer Patients Who Underwent Neoadjuvant Treatment: A Clinical–Surgical–Pathologic Comparison	Italy	Retrospective cohort study	Ditto et al. (2023) explore the significance of MRI in the preliminary staging and assessment of therapeutic outcomes in cervical cancer patients. MRI is recognised for identifying neighbouring structures' engagement, including the vagina, parametrium and lymphatic nodes. The research sought to contrast the diagnostic precision of MRI in staging cervical cancer between patients who received neoadjuvant therapy followed by surgical intervention and those who proceeded directly to surgery. The findings indicated that MRI's overall efficacy in the preoperative staging of cervical cancer is suboptimal, particularly for patients who underwent prior treatment. The research determined that MRI's overall accuracy stood at 46.1%, with its precision in assessing lymph node, vaginal and parametrial conditions being 79.4%, 79.4% and 65.8%, respectively.	7
Esfahani et al.[22]	PET/MRI and PET/CT Radiomics in Primary Cervical Cancer: A Pilot Study on the Correlation of Pelvic PET, MRI, and CT Derived Image Features	United States of America	Retrospective cohort study	The research conducted by Esfahani et al. (2022) offers an inaugural in-depth comparative examination of multimodal PET/MRI and PET/CT for primary cervical cancer. Preliminary findings from this study indicate the viability and prospective utility of hybrid PET/MRI radiomic attributes as non-invasive imaging indicators for staging primary cervical cancers before commencing treatment therapies. The association of these attributes with the tumour's biological characteristics and their prospective significance in forecasting metastasis necessitates further exploration in upcoming expansive prospective investigations to enhance the clinical management of cervical cancer patients.	7
Haldorsen et al.[23]	What Is the Role of Imaging at Primary Diagnostic Work-Up in Uterine Cervical Cancer?	Norway	Systematic review	For initial staging, TVUS or TRUS and MRI are vital for gauging pelvic tumours, while PET/CT or CT assesses lymphatic metastases and distant spread. Emerging imaging methods depict tumour attributes tied to clinical manifestations, enhancing risk categorisation and therapy potential. However, these new indicators must be rigorously evaluated alongside traditional biomarkers in cervical malignancies to understand their future benefits in patient care.	7

Table 1 (continued): Literature characteristics and summaries of the 21 articles included in the results section (n=21).

Author	Title	Country	Type/ methodology	Summary of findings/conclusion	JBI score
Kalash et al.[24]	Use of Functional Magnetic Resonance Imaging in Cervical Cancer Patients With Incomplete Response on Positron Emission Tomography/ Computed Tomography After Image-Based High-Dose-Rate Brachytherapy	United States of America	Retrospective cohort study	The research sought to explore the relationship between post-therapeutic PET/CT outcomes and the prognosis in cervical cancer patients, particularly when aligned with MRI-oriented planning. Additionally, the study evaluated if DW-MRI could refine the categorisation of treatment outcomes and prognostic predictions. This analysis encompassed 244 patients diagnosed with clinical stage IB1-IVA cervical cancer who underwent simultaneous chemoradiation, including high-dose–rate image-based brachytherapy from 2007 to 2016. Results indicated that 20% of participants exhibited an incomplete therapeutic response on post-treatment PET/CT. Incorporating DW-MRI proved instrumental in pinpointing patients susceptible to tenacious disease and adverse long-term results. The research proposes that DW-MRI could be instrumental for prompt assessment and rescue therapy in patients showcasing incomplete responses via PET/CT.	8
Lim et al.[25]	Patterns of practice survey for brachytherapy for cervix cancer in Australia and New Zealand	Austra-lia/New Zealand	Quantitative survey-based review	In Australia and New Zealand, brachytherapy is essential in the conclusive treatment of cervical cancer. There is a noted surge in the adoption of soft tissue imaging techniques, with a focus on validation, high instances of volumetric planning and a commitment to a specified overall treatment duration. Alternative external beam radiation techniques did not replace brachytherapy. Nonetheless, challenges persist in the deployment of image-guided brachytherapy. For applicator direction, ultrasound was employed by 86%. Both MRI and CT were utilised by 50% and 79% for planning purposes. Optimisation predominantly centred on at-risk organs (93%) and target regions (64%).	7
Lin et al.[26]	Molecular Imaging for Radiotherapy Planning and Response Assess-ment for Cervical Cancer	United States of America	Systematic review	The paper explores the clinical relevance of ^{18}F-FDG PET/CT in the context of cervical cancer radiotherapy schematics and therapeutic outcomes. ^{18}F-FDG-PET leverages the imaging contrast derived from heightened and irregular glucose metabolism, a distinctive trait of cancer. The discussion underscores the pivotal function of ^{18}F-FDG-PET in evaluating lymph node involvement and distant metastatic spread in cervical cancer. It further elaborates on its application in radiation therapy techniques, encompassing functional bone marrow–conserving intensity-modulated radiation therapy. The commentary provides an in-depth analysis of contemporary studies advocating for ^{18}F-FDG-PET's role in shaping treatment strategies, orchestrating treatment designs and gauging therapeutic responses in cervical cancer. The impending trajectory of molecular imaging in cervical cancer might encompass the inception of innovative PET markers to tailor treatments grounded in tumour biology.	8

Table 1 (continued): Literature characteristics and summaries of the 21 articles included in the results section (n=21).

Author	Title	Country	Type/ methodology	Summary of findings/conclusion	JBI score
Lucia et al.[27]	Prediction of outcome using pre-treatment ^{18}F-FDG PET/CT and MRI radiomics in locally advanced cervical cancer treated with chemoradiotherapy	France	Retrospective cohort study	The research endeavoured to ascertain whether radiomics attributes from ^{18}F-FDG PET/CT and MRI could enhance prognostic predictions in cervical cancer. It encompassed 102 patients diagnosed with LACC who underwent chemoradiotherapy between August 2010 and December 2016. Radiomics characteristics, including intensity, form and texture, were derived from the imaging data. Findings indicated that for LACC patients treated with chemoradiotherapy, radiomics attributes like entropy GLCM and $GLNU_{GLRLM}$ from functional imaging DW-MRI and PET, respectively, stood out as autonomous indicators of recurrence and loco-regional management, offering markedly superior prognostic capabilities compared to standard clinical metrics. The research posits that these radiomics attributes could advocate intensified treatment approaches in patients with elevated recurrence risks.	8
Mansoori et al.[28]	Multimodality Imaging of Uterine Cervical Malignancies	United States of America	Scoping review	Imaging is pivotal in devising treatment strategies and as a predictive marker in individuals with cervical cancer. MRI and PET/CT possess synergistic functions: MRI is crucial for the localised staging of the primary neoplasm, while PET/CT stands out as the optimal technique for identifying regional lymphatic and remote metastatic spread. Ultrasound is also a valuable modality in the initial phase of cervical cancer detection with its low cost and high availability.	7
Matani et al.[29]	Utilisation of functional MRI in the diagnosis and management of cervical cancer	United States of America	Systematic review	Matani et al. (2022) emphasised the pivotal role of imaging in the oversight of cervical cancer. In current practice, MRI is utilised for staging, subsequent monitoring and image-directed adaptive brachytherapy. The ongoing IQ-EMBRACE ancillary study is probing the application of functional MRI, aiding in assessing hypoxia, metabolic activity, tissue structure and haemodynamics. Additionally, the discussion extends to employing specific MRI methodologies, such as DCE-MRI and DW-MRI, in the evaluation and therapeutic approach to cervical cancer.	7
Novikov et al.[30]	SPECT-CT visualisation and biopsy of sentinel lymph nodes in patients with stage IAB–IIA cervical cancer	Russia	Retrospective data analysis study	In patients staged with IAB–IIA cervical cancer, ^{99m}Tc-phytate effectively maps sentinel lymph nodes with 92.7% efficacy, complemented by preoperative SPECT-CT imaging. A strong link exists between sentinel lymph node topography via SPECT-CT and pelvic lymph node involvement in cervical cancer: 6.5% for bilateral and 20% for unilateral sentinel lymph node positions. Unilateral sentinel lymph node mapping shows low biopsy sensitivity and high false negatives, making it unsuitable for predicting regional lymph node status in stage IAB–IIA cervical cancer. However, bilateral SPECT-CT sentinel lymph node visualisation indicates high biopsy sensitivity, advocating its routine clinical use.	7

Table 1 (continued): Literature characteristics and summaries of the 21 articles included in the results section (n=21).

Author	Title	Country	Type/ methodology	Summary of findings/conclusion	JBI score
Palaniswamy et al.[31]	^{18}F-FDG PET/CT in the evaluation of cancer cervix: Where do we stand today?	India	Retrospective cohort study	The application of ^{18}F-FDG PET/CT has demonstrated notable benefits in treating and monitoring cervical cancer patients. While conventional cervical cancer staging predominantly depended on clinical evaluations, integrating ^{18}F-FDG PET/CT delivers enhanced perspectives, particularly in discerning PI and identifying nodal/distant metastatic spread. This sophisticated imaging modality furnishes pivotal prognostic data, such as the peak standardised uptake value and metabolic tumour volume, vital for devising personalised therapeutic strategies. As a result, ^{18}F-FDG PET/CT proves indispensable for preliminary staging, is essential in tracking therapeutic outcomes and is key in evaluating potential relapses, facilitating a more enlightened approach to patient care decisions.	7
Schernberg et al.[32]	Incorporating Magnetic Resonance Imaging (MRI) Based Radiation Therapy Response Prediction into Clinical Practice for Locally Advanced Cervical Cancer Patients	France	Systematic review	Schernberg et al. (2020) investigate the significance of MRI in overseeing LACC. MRI has become a primary imaging modality to characterise the macroscopic gross tumour extent in LACC patients, predominantly through T2-weighted sequences. The discourse proposes that functional MRI might enhance target volume differentiation by focussing on physiological attributes and pinpointing radioresistant segments that might necessitate intensified dosages for effective local treatment. Additionally, the article introduces the notion of adaptive radiotherapy, a method centred on tracking shifts in target volume configurations to inform alterations in the treatment plan during radiotherapy sessions. The literature further explores the potential integration of MRI-based tumour response evaluations into routine clinical procedures during radiation treatment for LACC patients.	7
Smits et al.[33]	Can MRI Be Used as a Sole Diagnostic Modality in Determining Clinical Stage in Cervical Cancer?	Netherlands	Retrospective cohort study	In this research study, Smits et al. (2023) discovered that MRI's diagnostic accuracy, specifically its sensitivity and specificity for detecting early-stage conditions, was comparable to that of examination under anaesthesia (EUA) in patients undergoing surgery. Subsequent analyses indicated that factors such as early-stage disease, premenopausal status and a tumour diameter smaller than 2cm (2018 FIGO stage IBI) contributed to the heightened congruence between MRI and EUA (98%). Thus, subsequent research should concentrate on pinpointing suitable patient demographics and examining MRI as the primary diagnostic method by analysing treatment and survival outcomes.	7

Table 1 (continued): Literature characteristics and summaries of the 21 articles included in the results section (n=21).

Author	Title	Country	Type/ methodology	Summary of findings/conclusion	JBI score
Vojtíšek et al.[34]	Prediction of treatment response in patients with locally advanced cervical cancer using midtreatment PET/MRI during concurrent chemoradiotherapy	Turkey	Retrospective cohort study	Vojtíšek et al. (2021) verified that by applying mid-treatment PET/MRI they could identify parameters that can predict non-complete metabolic remission. Specifically, the parameters include mid-MTV-S, followed by mid-MTV, mid-tumour dimensions, mid-TLG-S, mid-TLG, and change in SUV max. Additionally, the findings indicate a strong interdependence among all these parameters, making the simultaneous consideration in decision making unnecessary. Depending on the mid-treatment PET/MRI results, cervical cancer patients could be administered more intensive local and possibly concurrent systemic treatments.	7
Yue et al.[35]	Imaging features of the whole uterus volume CT perfusion and influence factors of blood supply: A primary study in patients with cervical squamous carcinoma	China	Prospective review study	CT perfusion is a valuable instrument for examining the dimensions of cervical squamous carcinoma tumours. The perfusion parameters exhibit consistent measurement reliability. The vascular provision to cervical squamous carcinoma surpasses the typical uterine structure, and age plays a pivotal role in influencing the vascular dynamics of cervical malignancies.	9
Zhang et al.[36]	Contrast-Enhanced Ultrasonography for Transabdominal and Transrectal Ultrasound in Staging Cervical Cancer: A Reliability Study	China	Retrospective cohort study	Transrectal ultrasonography is combined with CEUS. It aligns well with pathological findings in the staging of cervical cancer, comparable to MRI with an ICC of 0.796 and 0.785, respectively. This pairing might offer superior visualisation of diminutive masses. Transabdominal CEUS can serve as a backup secondary method if a patient declines an intracavitary ultrasound assessment.	7

Table 1 (continued): Literature characteristics and summaries of the 21 articles included in the results section (n=21).

Author	Title	Country	Type/ methodology	Summary of findings/conclusion	JBI score
Zhu et al.[37]	CT, MRI, and PET imaging features in cervical cancer staging and lymph node metastasis	China	Retrospective cohort study	Zhu et al. (2021) suggested that modalities such as MRI, PET/CT, CT and PET/MRI are proficient techniques for determining stages of cervical cancer and lymphatic metastases. Notably, PET/MRI exhibits superior sensitivity, specificity and precision, making it instrumental in directing clinical evaluations and therapeutic interventions.	7

JBI = Joanna Briggs Institute; MRI = magnetic resonance imaging; DCE-MRI = dynamic contrast-enhanced magnetic resonance imaging; DW-MRI = diffusion-weighted magnetic resonance imaging; ^{18}F-FDG PET/CT = fluorodeoxyglucose positron emission tomography computed tomography; IB2-IVA FIGO/; IB1-IVA = IB2-IVA FIGO staging system; PI = parametrial invasion; PET/MRI = positron emission tomography magnetic resonance imaging; CT = computed tomography; TVUS = transvaginal ultrasound; TRUS = transrectal ultrasound; LACC = locally advanced cervical cancer; GLCM = grey-level co-occurrence matrix; GLNUGLRLM = grey-level non-uniformity derived from a grey-level run length matrix; SPECT-CT = single photon emission computed tomography; mid-MTV-S = metabolic tumour volume-sum at mid-treatment; mid-MTV = metabolic tumour volume measured at mid-treatment; mid-TLG-S = total lesion glycolysis-sum at mid-treatment; mid-TLG = total lesion glycolysis measured at mid-treatment; SUV = standard uptake value; CEUS = contrast-enhanced ultrasound; ICC = intraclass correlation coefficient.

Discussion

Functional imaging has become an indispensable tool in cervical cancer care, offering insights into the anatomical presence of tumours and their metabolic activities and blood flow dynamics during the staging process of cervical cancer.[29] The various imaging modalities and their usefulness are summarised below, and their use could be for initial planning and then surveillance.

MRI

Initial planning

The National Cancer Comprehensive Network (NCCN) recommends that the primary staging of cervical cancer should include an abdominal/pelvic computed tomography (CT) and a whole-body PET/CT scan to define the patient's nodal status.[23] However, MRI plays a vital role in staging cervical cancer due to its superior resolution on soft tissue contrast when compared to CT, making it the preferred imaging technique for accessing the primary tumour with up to 95% or higher accuracy.[19] Therefore, the NCCN recommends a pelvic MRI for initial staging, which assesses the tumour's extent and metastasis while providing a guideline on radiation therapy treatments such as brachytherapy.[20,25]

The following functional MRI imaging techniques have several advantages for initial planning:

- Dynamic contrast-enhanced MRI (DCE-MRI) and diffusion-weighted MRI (DW-MRI) achieve the same accuracy, positive predictive value, sensitivity and specificity of 97%, 97%, 100% and 50%, respectively, for detecting cervical cancer.[38]
  - DCE-MRI allows evaluation of tissue perfusion, blood volume and vascular permeability, allowing assessment of tumour angiogenesis and its aggressiveness.[18,19]
  - DCE-MRI can predict the likelihood of recurrence and survival rates by indirectly measuring the tumour's hypoxia by assessing the physiology of the tumour with low-molecular-weight contrast media.[18,29]

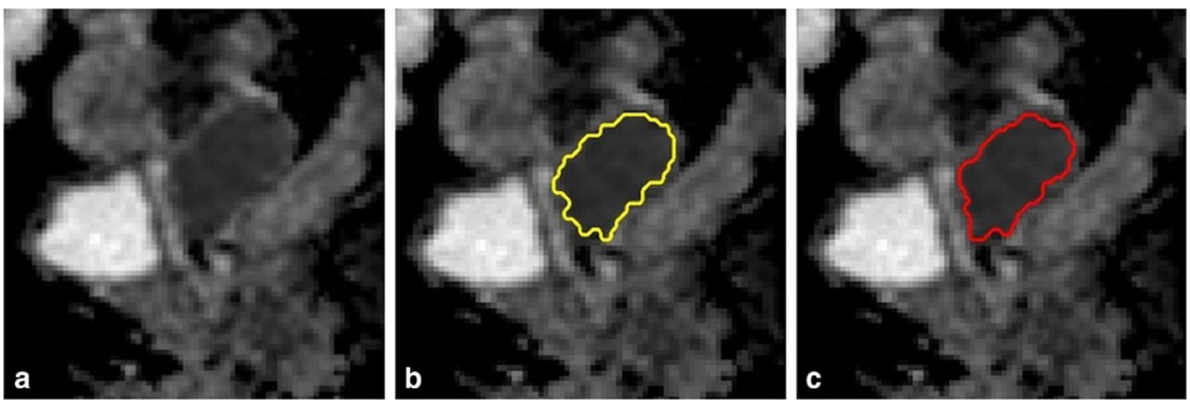
Notably, the incorporation of AI into MRI for diagnosing, staging and managing cervical cancer is advancing rapidly, showing promising outcomes. Al algorithms based on deep learning, often used in tandem with U-Net or wireless networks, can perform intricate MRI image segmentation, which minimises diagnostic time and mitigates potential human errors, thereby increasing the overall accuracy of cervical cancer diagnosis (Figure 3).

Furthermore, AI can augment cervical cancer staging by assessing lymph node metastasis. The integration of AI into MRI is poised to substantially improve the diagnostic and staging accuracy of cervical cancer, increase efficiency and reduce the workload for radiologists, ultimately benefitting patient prognosis.[13,39]

Surveillance

In managing locally advanced cervical cancer (LACC), MRI, particularly through T2-weighted

Figure 3: U-Net-based deep learning model applied to diffusion-weighted magnetic resonance imaging segmentation of a 50-year-old female with cervical cancer. The hypointense area in the apparent diffusion coefficient map (a) characterises the cervical cancer mass. The region of interest was outlined manually in yellow (b). The deep learning model generated the red outline showing the predicted region of interest (c), which achieved a positive predictor value of 92%.[39]



sequences, plays a vital role. It accurately delineates the tumour size and identifies radioresistant segments that might necessitate a higher dose during radiotherapy treatment.[29,32] Functional MRI enhances target volume delineation based on physiological characteristics, and with the advent of adaptive radiotherapy, MRI facilitates the monitoring of tumour alterations, enabling real-time modifications to the treatment plan.[32] DW-MRI examines the random motion of water particles within tissues and becomes instrumental in distinguishing malignant cervical lesions from benign ones, and the apparent diffusion coefficient (ADC) value obtained from DW-MRI can assist in diagnosing local malignancy or lymph node involvement with high specificity and sensitivity while also indicating tumour cellularity and how the tumour responds to treatment.[18,29,40]

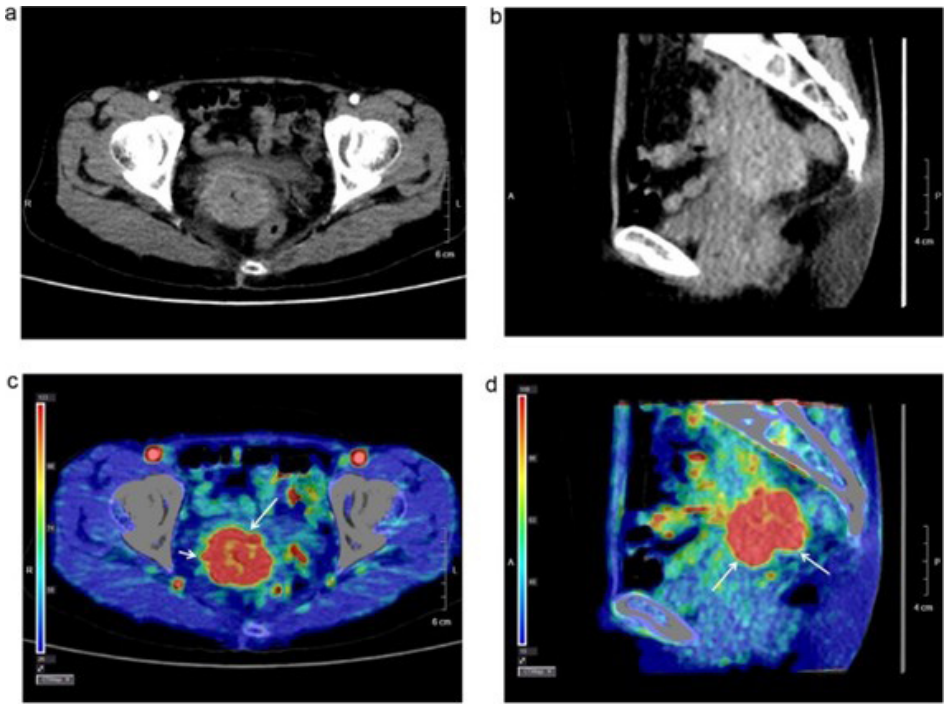
Furthermore, DW-MRI can act as a biomarker of early chemoradiation treatment response by providing functional information on soft tissue microstructures by evaluating the difference in water mobilities within the carcinoma and how it has been affected by the treatment.[27] In addition, MRI has the following advantages for cervical cancer surveillance:

- PET/MRI, also used with radiomics, can predict the mid-treatment response for patients with LACC at a sensitivity and specificity of 75% and 72%, respectively.[22,34]
- Magnetic resonance spectroscopy (MRS) offers metabolic insights since specific metabolites can suggest malignancy, and any shifts in metabolic profiles after treatment can hint at the therapy's effectiveness.[41]
- Blood oxygen level–dependent (BOLD) imaging can track changes in blood oxygenation, shedding light on tissue oxygenation and, indirectly, on tumour vascularity, thus identifying regions of hypoxia in tumours, which can be warning signs for aggressive tumours and potential resistance to specific treatments.[42]

CT

Computed tomography perfusion (CTP) stands out as a functional imaging technique when considering CT scans for cervical cancer, and offers a real-time view of how blood courses through the cervical tumour and adjacent structures by measuring blood flow and tissue permeability (Figure 4). This dynamic monitoring is particularly valuable since many aggressive tumours showcase

Figure 4: Computed tomography (CT) and computed tomography perfusion (CTP) images of a 51-year-old female with International Federation of Gynaecology and Obstetrics (FIGO) stage IIIB cervical cancer. Axial (a) and sagittal (b) plain CT grayscale images demonstrate an irregular tumour mass with ill-defined margins in the uterine region. In contrast, axial (c) and sagittal (d) CTP images of the arterial blood flow pseudo-colour maps reveal the stage IIIB cervical cancer as a region.[35]



parametrial invasion (PI) and increased vascularity due to angiogenesis.[35] Additionally, changes in the tumour's blood flow patterns, which CTP can capture, might hint at how the tumour responds to treatments like chemotherapy or radiation, often even before there is a noticeable size reduction in conventional imaging. Furthermore, CTP can dive deeper into the tumour's physiology, shedding light on factors like permeability that could influence treatment strategies and prognosis.[35]

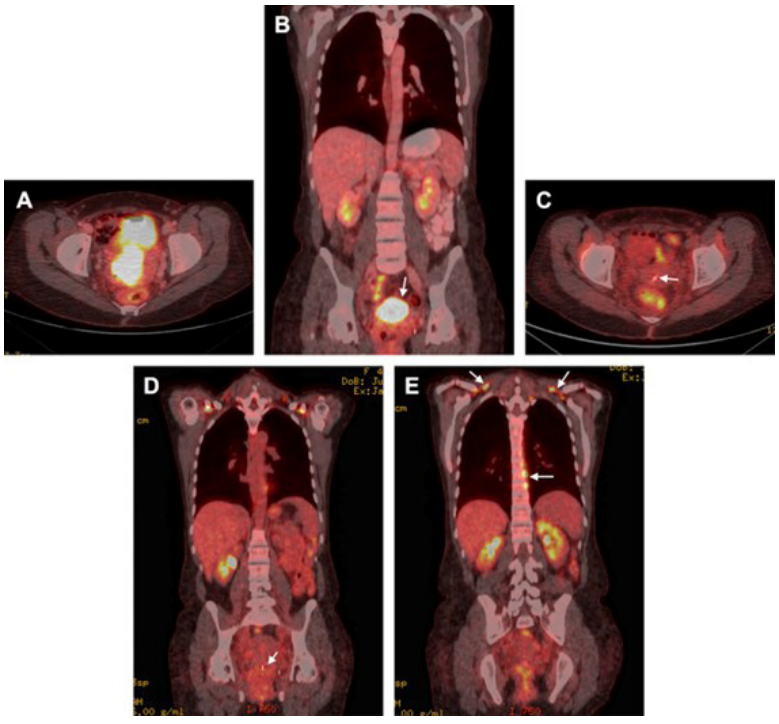
However, CTP also comes with limitations and challenges associated with the higher radiation doses and administration of iodinated contrast media. Further, CTP has a low contrast-to-noise ratio compared with MRI perfusion, resulting in misdiagnosis, especially in discrete lymph nodes. Thus, CTP images should be used in conjunction with other imaging modalities for a better tumour diagnosis and more suitable treatment.[43]

PET/CT

PET/CT can effectively detect cancer metastasis in the lymph nodes, lungs, bones and other distant metastases.[44] Moreover, PET/CT can identify metabolically active diseases in the affected lymph nodes even when they are not enlarged, which allows for more accurate staging and reduces missed diagnoses.[45] Unlike CT and traditional non-functional MRI scans, which primarily provide anatomical information, PET/CT can provide anatomic and functional information by visualising the tumour's metabolic activities, which can give more details regarding the aggressiveness of cancer.[46]

Furthermore, PET/CT can accurately monitor the treatment response by measuring the metabolic activity of the tumour post-treatment. If the metabolic activity decreases, it is indicative that the patient is responding to the treatment, which is a more sensitive indicator of treatment response when compared to imaging that primarily assesses treatment response by visualising the changes in the tumour size alone (Figure 5).[22,28] PET/CT can also be used to monitor the recurrence of the cancer post-treatment by detecting enhanced metabolic

Figure 5: Fluorodeoxyglucose positron emission tomography computed tomography (^{18}F-FDG) positron emission tomography computed tomography (PET/CT) images of a 47-year-old female demonstrating stage IIB cervical cancer before and after chemoradiation therapy. Axial pelvis (A), coronal chest abdomen and pelvis (B) demonstrate pre-treatment characteristics of the stage IIB cervical cancer mass (white arrow in B) with a significant ^{18}F-FDG uptake (hyperintense area) measured in maximum standardised uptake value (SUVmax) of 19.6. Images C–E demonstrate post-treatment (brachytherapy and external beam radiation therapy) follow-up ^{18}F-FDG PET/CT scans showing a complete anatomic and metabolic response to the chemoradiation therapy with a lower SUVmax of 3.4. In Image E, radiation fiducial markers (white arrows) were placed in the patient's chest and neck as a control to demonstrate ^{18}F-FDG uptake of the brown adipose tissues.[50]



activities in the region of the original tumour.[47] Although PET/CT lacks availability, encouragingly there is rapid growth in PET/CT scan accessibility across New Zealand in the major cities.[48] However, PET/CT has limitations as it exposes the patient to a higher radiation dose than a standard CT scan and can sometimes yield false-positive results due to infections or inflammations.[49]

Moreover, fluorodeoxyglucose positron emission tomography computed tomography (^{18}F-FDG PET/CT) can detect metabolic changes before anatomical alterations become apparent, providing early indications of treatment efficacy and clinical benefits for patients who have completed their treatment, as PET/CT identified asymptomatic recurrences in 12% of patients after 1 year of treatment.[17] Again, AI integration with ^{18}F-FDG PET/CT can also aid in cervical cancer diagnosis and prognosis prediction.[51] Consequently, ^{18}F-FDG PET/CT is valuable for initial staging and crucial for monitoring therapy response and assessing recurrence, enabling a more informed decision-making process in patient management throughout their treatment pathway, and can be used as a prognosis predictor with the integration of AI.[26,31,50]

Single photon emission computed tomography (SPECT)

Integrating SPECT with CT (SPECT/CT) captures both functional and structural data, presenting a comprehensive tool for detecting, staging and monitoring treatment response for cervical cancer. SPECT/CT can accurately identify and outline the primary tumour, assess lymph node metastases—especially with tumour-specific tracers—and detect distant metastases.[30] SPECT/CT has been shown to achieve a 92.7% efficacy in mapping cervical cancer sentinel lymph nodes (Figure 6).[30]

Regarding post-treatment, SPECT/CT is valuable for assessing tumour response by gauging tumour size and activity changes. It can also monitor activity in previously identified metastatic lymph nodes and act as a surveillance tool for potential recurrence. With its combined imaging capabilities, SPECT/CT can enhance efficiency and accuracy during radiation therapy planning, targeting tumours while sparing adjacent healthy tissues.[52] However, its limitations include spatial resolution, typically worse than PET/CT, and a heightened radiation dose from the combined procedure.[53]

Ultrasound

With advancements in ultrasound technology, certain ultrasound techniques can offer functional insights, especially when applied to cervical imaging. Doppler ultrasound, seen in Figure 7, is a widely used functional application that measures blood flow in vessels, enabling assessment of the

Figure 6: Single photon emission computed tomography (SPECT)/CT image using the ^{99m}Tc-phytate radioactive tracer of a 38-year-old female with stage IIA1 cervical cancer. Note: SPECT/CT image employing ^{99m}Tc-phytate reveals one-sided sentinel lymph node presence in the left common iliac and obturator. Histology confirmed the absence of metastases in these sentinel lymph nodes but detected them in the non-sentinel lymph nodes of the right external iliac zone. The injection site is obscured by a black oval.[30]

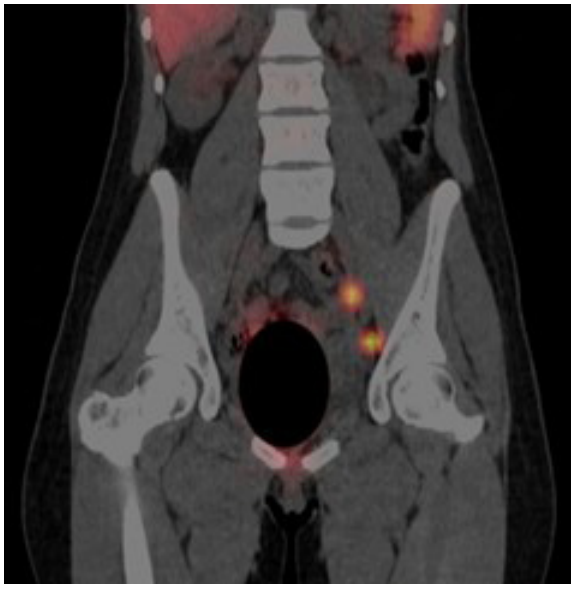
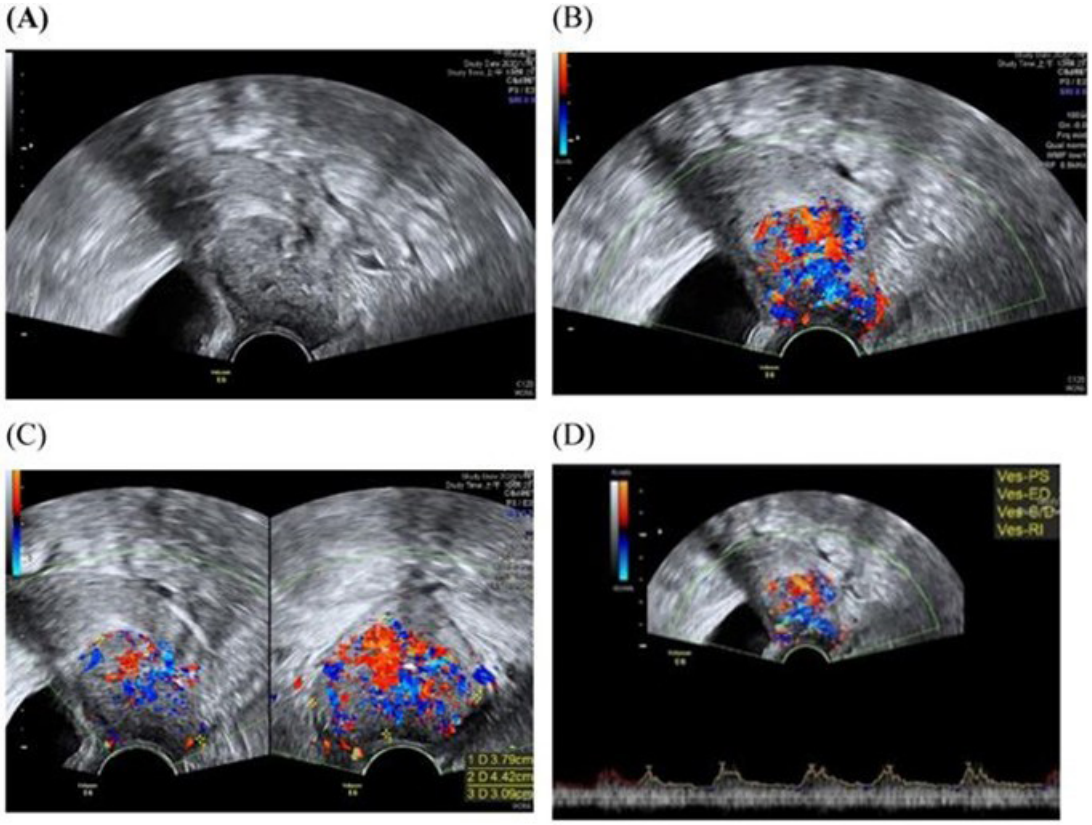


Figure 7: Longitudinal transvaginal ultrasound section images of a 68-year-old patient with cervical cancer (Hsiao et al., 2021, p. 2185). The grayscale ultrasound imaging reveals a cervical tumour (A), colour Doppler imaging indicates substantial blood circulation within the cervical neoplasm (B), additional colour Doppler imaging (C) and further colour Doppler imaging aids blood flow visualisation (D). Notably, blood flowing towards the probe is shown in red and blood travelling away from the probe is depicted in blue.[55]



vascularity of cervical lesions, which can hint at tumour aggressiveness and angiogenesis.[54,55] Colour Doppler ultrasound augments the visualisation of malignant tumours through Doppler flow imaging, yielding better image quality for more accurate cervical cancer staging and targeted biopsies. These enhancements contribute to elevating the diagnostic sensitivity (95.31%) and the positive predictive value (93.85%) of ultrasonography, thereby providing a better foundation for patient treatment planning.[56]

Additionally, elastography evaluates tissue stiffness, a useful feature since malignant cervical tumours are often stiffer than surrounding tissue, providing insight into their malignant potential. Another advancement, contrast-enhanced ultrasound (CEUS), employs microbubble contrast mediums to enhance blood flow visualisation within tissues, aiding in characterising cervical lesions and monitoring treatment responses.[57] Furthermore, transrectal contrast-enhanced ultrasonography (TR-CEUS) demonstrates good consistency with early cervical cancer staging, comparable to MRI with an intraclass correlation coefficient of 0.796 and 0.785, respectively.[57]

It is essential to recognise functional ultrasound limitations and, where appropriate, supplement it with other imaging modalities for a holistic assessment to improve patient prognosis.[54,57]

Guidelines and recommendations

The current New Zealand Gynaecological Cancer Group follow-up recommendation/guidelines and national screening programme for cervical cancer do not include MI (anatomical or functional).[6] The key recommendation from this review is that New Zealand's cervical cancer management guidelines incorporate detailed insights on the application and advantages of functional imaging across screening, diagnosis, treatment and response monitoring. Moreover, the potential enhancements offered by the

integration of AI technology merit a more thorough investigation for potential integration into these guidelines. It is proposed that the guidelines include the following imaging modalities as quintessential elements in the holistic management of women who are affected by cervical cancer:

- MRI is useful for surgical and radiation therapy planning since it delineates the tumour's extent and must, therefore, be one of the primary imaging modalities that is used for planning the best treatment opitions.[20,25,28,32]
- A spectrum of functional MRI techniques should be embedded in the standard protocol for treatment response surveillance. Additionally, evaluating the tumour's metabolic characteristics is a pivotal tool for treatment oversight.[18,24,39]
- In scenarios where functional MRI is not feasible or available, CTP emerges as a viable alternative, offering an instantaneous physiological perspective of the tumour and its adjacent structures, including blood flow and tissue permeability. However, the radiation dose of CT mandates careful consideration when using CTP.[35] Furthermore, CTP should be used with another modality, such as MRI, to enhance diagnostic accuracy.[43]
- Adopting abdominal/pelvic CT and PET/CT scans are advocated to ascertain a patient's nodal status (for initial planning and surveillance), aligning with NCCN's endorsement.[23] This is particularly pertinent for New Zealand given the recent uptick in PET/CT scan accessibility.[48]
- Doppler ultrasounds present promising avenues in cervical cancer management, particularly given their capabilities in elucidating blood flow dynamics.[54–56] Furthermore, CEUS is another efficient technique comparable with MRI in the initial assessment of early-stage cervical cancer sizing and local invasion.[57]
- While SPECT/CT used with sentinel node biopsy can enhance the efficiency and accuracy of radiation therapy planning, its poor spatial resolution and higher radiation dose necessitate careful consideration.[52,53]

It is imperative to recognise the potential financial implications and consequent accessibility challenges associated with these recommendations. These implications could have a bearing on the availability of these imaging modalities and image processing tools, thus limiting the equity. It is prudent for these guidelines to retain a degree of adaptability, enabling individual districts to calibrate their approach based on the functional imaging resources at their disposal and the incident rates of cervical cancer in their locality. However, the available resources should not lead to inequitable service provision especially when considering the aspects related to socio-economic deprivation, which are already causing higher incidence of cervical cancer in women from poor economic backgrounds. It could, therefore, be argued that the focus of the Ministry of Health should be to ensure that regions known to be socio-economically deprived are given a priority to access and use the proposed imaging resources.

Conclusion

This rapid review underscores the pivotal role of functional imaging techniques in diagnosing, staging and monitoring treatment response for cervical cancer, especially when various functional imaging techniques are used in conjunction, facilitating more precise and individualised treatment strategies. The study accentuates the irreplaceable role of functional imaging, not merely in the preliminary diagnosis and staging phases but also in tracking therapeutic efficacy, patient response and potential relapses. The review also highlights the disparities in guidelines and protocols among various New Zealand institutions. The imperative for a cohesive, research-backed approach is evident. A harmonised guideline would optimise the use of these advanced functional imaging techniques, ensuring consistent, high-quality care for patients with cervical cancer in New Zealand. Furthermore, the prospective integration of AI with functional imaging heralds an exciting frontier for future exploration.

Limitations

The expedited approach of this review may have inadvertently omitted pertinent studies due to the limited timeframe. The emphasis on published literature could also potentially introduce a publication bias, given the tendency for studies with unfavourable outcomes to remain unpublished. Lastly, it is also worth noting that the evolving nature of technological and medical advancements might result in recent developments or insights being absent from this analysis.

COMPETING INTERESTS
Nil.

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REFERENCES

1. Zhang X, Zeng Q, Cai W, Ruan W. Trends of cervical cancer at global, regional, and national level: data from the Global Burden of Disease study 2019. BMC Public Health. 2021 May 12;21(1):894. doi: 10.1186/s12889-021-10907-5.
2. Buskwofie A, David-West G, Clare CA. A Review of Cervical Cancer: Incidence and Disparities. J Natl Med Assoc. 2020 Apr 1;112(2):229-232. doi: 10.1016/j.jnma.2020.03.002.
3. Zhang S, Xu H, Zhang L, Qiao Y. Cervical cancer: Epidemiology, risk factors and screening. Chin J Cancer Res. 2020 Dec 31;32(6):720-728. doi: 10.21147/j.issn.1000-9604.2020.06.05.
4. Olpin J, Chuang L, Berek J, Gaffney D. Imaging and cancer of the cervix in low- and middle-income countries. Gynecol Oncol Rep. 2018;25:115-121. doi: 10.1016/j.gore.2018.07.001. Erratum in: Gynecol Oncol Rep. 2021 Jan 18;35:100703. doi: 10.1016/j.gore.2021.100703.
5. Vu M, Yu J, Awolude OA, Chuang L. Cervical cancer worldwide. Curr Probl Cancer. 2018 Sep;42(5):457-465. doi: 10.1016/j.currproblcancer.2018.06.003.
6. Best Practice Advocacy Centre New Zealand. Cervical cancer – early detection and referral [Internet]. 2024 [cited 2024 Apr 22]. Available from: https://bpac.org.nz/2022/cervical-cancer.aspx
7. McFadden K, McConnell D, Salmond C, et al. Socioeconomic deprivation and the incidence of cervical cancer in New Zealand: 1988-1998. N Z Med J. 2004 Nov 26;117(1206):U1172.
8. Ministry of Health. Clinical Practice Guidelines for Cervical Screening in New Zealand 2020 [Internet]. Wellington, New Zealand: Ministry of Health; 2020 [cited 2024 Apr 22]. Available from: https://www.tewhatuora.govt.nz/assets/For-the-health-sector/NSU/Publications/Clinical-Practice-Guidelines-for-Cervical-Screening-in-New-Zealand-2020-pdf-2-MB.pdf
9. Brewer N, Foliaki S, Gray M, et al. Pasifika women's knowledge and perceptions of cervical-cancer screening and the implementation of self-testing in Aotearoa New Zealand: A qualitative study. Lancet Reg Health West Pac. 2022 Nov;28:100551. doi: 10.1016/j.lanwpc.2022.100551.
10. Burmeister CA, Khan SF, Schäfer G, et al. Cervical cancer therapies: Current challenges and future perspectives. Tumour Virus Res. 2022 Apr 20;13:200238. doi: 10.1016/j.tvr.2022.200238.
11. Stieb S, McDonald B, Gronberg M, et al. Imaging for Target Delineation and Treatment Planning in Radiation Oncology: Current and Emerging Techniques. Hematol Oncol Clin North Am. 2019 Dec 1;33(6):963-975. doi: 10.1016/j.hoc.2019.08.008.
12. Ahuja AS. The impact of artificial intelligence in medicine on the future role of the physician. PeerJ. 2019 Oct 4;7:e7702. doi: 10.7717/peerj.7702.
13. Hou X, Shen G, Zhou L, et al. Artificial Intelligence in Cervical Cancer Screening and Diagnosis. Front Oncol. 2022 Mar 11;12:851367. doi: 10.3389/fonc.2022.851367.
14. Pacific Radiology. National Indications for Publicly funded PET-CT [Internet]. 2024 [cited 2024 Apr 22]. Available from: https://pacificradiology.com/assets/202408-Indications-for-Pet-CT_PRG_V2.pdf
15. New Zealand Gynaecological Cancer Group. NZGCG Follow up Recommendations for Endometrial and Cervical cancer [Internet]. 2015 [cited 2024 Apr 22]. Available from: https://www.health.govt.nz/system/files/2015-08/2015_nzgcg_follow_up_recommendations_0.pdf
16. Moola S, Munn Z, Tufanaru C, et al. Chapter 7: Systematic Reviews of Etiology and Risk. In: Aromataris E, Munn Z, editors. JBI Manual for Evidence Synthesis; 2020. doi:10.46658/JBIMES-20-08.
17. Akhavan S, Mousavi A, Sheikh Hassani S, et al. Evaluation of Cervical Cancer Staging Based on Magnetic Resonance Imaging in Comparison with Surgical Staging. Int J Cancer Manag. 2023 Apr 5;16(1):e126966. doi: 10.5812/ijcm-126966.
18. Bowen SR, WYuh WTC, Hippe DS, et al. Tumor radiomic heterogeneity: Multiparametric functional imaging to characterize variability and predict response following cervical cancer radiation

therapy. J Magn Reson Imaging. 2018;47(5):1388-1396. doi: 10.1002/jmri.25874.
19. Dappa E, Elger T, Hasenburg A, et al. The value of advanced MRI techniques in the assessment of cervical cancer: a review. Insights into Imaging. 2017 Aug 21;8(5):471-481. doi: 10.1007/s13244-017-0567-0.
20. Devine CE, Viswanathan C, Faria S, et al. Imaging and Staging of Cervical Cancer. Semin Ultrasound CT MR. 2019 Mar;40(4):280-286. doi: 10.1053/j.sult.2019.03.001.
21. Ditto A, Leone Roberti Maggiore U, Evangelisti G, et al. Diagnostic Accuracy of Magnetic Resonance Imaging in the Pre-Operative Staging of Cervical Cancer Patients Who Underwent Neoadjuvant Treatment: A Clinical–Surgical–Pathologic Comparison. Cancers (Basel). 2023 Mar 30;15(7):2061. doi: 10.3390/cancers15072061.
22. Esfahani SA, Torrado-Carvajal A, Amorim BJ, et al. Publisher Correction to: PET/MRI and PET/CT Radiomics in Primary Cervical Cancer: A Pilot Study on the Correlation of Pelvic PET, MRI, and CT Derived Image Features. Mol Imaging Biol. 2022 Nov 22;24(1):70. doi: 10.1007/s11307-021-01671-4. Erratum for: Mol Imaging Biol. 2022 Feb;24(1):60-69. doi: 10.1007/s11307-021-01658-1.
23. Haldorsen IS, Lura N, Blaakær J, et al. What Is the Role of Imaging at Primary Diagnostic Work-Up in Uterine Cervical Cancer? Curr Oncol Rep. 2019 Jul 29;21(9):77. doi: 10.1007/s11912-019-0824-0.
24. Kalash R, Glaser SM, Rangaswamy B, et al. Use of Functional Magnetic Resonance Imaging in Cervical Cancer Patients With Incomplete Response on Positron Emission Tomography/Computed Tomography After Image-Based High-Dose-Rate Brachytherapy. Int J Radiat Oncol Biol Phys. 2018 Nov;102(4):1008-1013. doi: 10.1016/j.ijrobp.2018.01.092.
25. Lim K, van Dyk S, Khaw P, et al. Patterns of practice survey for brachytherapy for cervix cancer in Australia and New Zealand. J Med Imaging Radiat Oncol. 2017 May 4;61(5):674-681. doi: 10.1111/1754-9485.12614.
26. Lin AJ, Dehdashti F, Grigsby PW. Molecular Imaging for Radiotherapy Planning and Response Assessment for Cervical Cancer. Sem Nucl Med. 2019 Nov;49(6):493-500. doi: 10.1053/j.semnuclmed.2019.06.009.
27. Lucia F, Visvikis D, Desseroit MC, et al. Prediction of outcome using pretreatment ^{18}F-FDG PET/CT and MRI radiomics in locally advanced cervical cancer treated with chemoradiotherapy. Eur J Nucl Med Mol Imaging. 2018 May;45(5):768-786. doi: 10.1007/s00259-017-3898-7.
28. Mansoori B, Khatri G, Rivera-Colón G, et al. Multimodality Imaging of Uterine Cervical Malignancies. AJR Am J Roentgenol. 2020 Aug;215(2):292-304. doi: 10.2214/AJR.19.21941.
29. Matani H, Patel AK, Horne ZD, Beriwal S. Utilization of functional MRI in the diagnosis and management of cervical cancer. Front Oncol. 2022 Nov 11;12:1030967. doi: 10.3389/fonc.2022.1030967.
30. Novikov SN, Krzhivitskii PI, Kanaev SV, et al. SPECT-CT visualization and biopsy of sentinel lymph nodes in patients with stage IAB–IIA cervical cancer. Ann Nucl Med. 2020 Jul 15;34(10):781-786. doi: 10.1007/s12149-020-01503-5.
31. Palaniswamy SS, Borde CR, Subramanyam P. ^{18}F-FDG PET/CT in the evaluation of cancer cervix: Where do we stand today? Nucl Med Commun. 2018 Jul;39(7):583-592. doi: 10.1097/MNM.0000000000000851.
32. Schernberg A, Kumar T, Achkar S, et al. Incorporating Magnetic Resonance Imaging (MRI) Based Radiation Therapy Response Prediction into Clinical Practice for Locally Advanced Cervical Cancer Patients. Semin Radiat Oncol. 2020 Oct 1;30(4):291-299. doi: 10.1016/j.semradonc.2020.05.007.
33. Smits A, Steins M, van Koeverden S, et al. Can MRI Be Used as a Sole Diagnostic Modality in Determining Clinical Stage in Cervical Cancer? Oncologist. 2023;28(1):e19-e25. doi: 10.1093/oncolo/oyac210.
34. Vojtíšek R, Baxa J, Kovářová P, et al. Prediction of treatment response in patients with locally advanced cervical cancer using midtreatment PET/MRI during concurrent chemoradiotherapy. Strahlenther Onkol. 2021;197(6):494-504. doi: 10.1007/s00066-020-01740-7.
35. Yue D, Tong DR, Fei Fei W, et al. Imaging Features of the Whole Uterus Volume CT Perfusion and Influence Factors of Blood Supply: A Primary Study in Patients with Cervical Squamous Carcinoma. Acad Radiol. 2019;26(8):e216-e223. doi: 10.1016/j.acra.2018.07.015.
36. Zhang J, Xiang JD, Jia C, et al. Contrast-Enhanced Ultrasonography for Transabdominal and Transrectal Ultrasound in Staging Cervical Cancer: A Reliability Study. Ultrasound Med Biol. 2023;49(10):2283-2290. doi: 10.1016/j.ultrasmedbio.2023.06.018.
37. Zhu Y, Lu M, Dai KJ, et al. Comparison Between 360° 3-D Transvaginal Ultrasound and Magnetic Resonance Imaging for Assessment of Vaginal Invasion in Cervical Cancer: A Preliminary Report. Ultrasound Med Biol. 2021 Aug;47(8):2250-2257. doi: 10.1016/j.ultrasmedbio.2021.04.013.

38. Abd elsalam SM, Mokhtar O, Adel L, et al. Impact of diffusion weighted magnetic resonance imaging in diagnosis of cervical cancer. Egypt J Radiol Nucl Med. 2020 Jan 28;51(23). doi: 10.1186/s43055-020-0144-2.
39. Lin YC, Lin CH, Lu HY, et al. Deep learning for fully automated tumor segmentation and extraction of magnetic resonance radiomics features in cervical cancer. Eur Radiol. 2020 Mar;30(3):1297-1305. doi: 10.1007/s00330-019-06467-3.
40. Mansour TMM, Ahmed YAAa, Ahmed, GAER. The usefulness of diffusion-weighted MRI in the differentiation between focal uterine endometrial soft tissue lesions. Egypt J Radiol Nucl Med. 2019 Dec;50(102). doi: 10.1186/s43055-019-0076-x.
41. Penet MF, Sharma RK, Bharti S, et al. Cancer insights from magnetic resonance spectroscopy of cells and excised tumors. NMR Biomed. 2023;36(4):e4724. doi: 10.1002/nbm.4724.
42. Yin L, Zhuang X, Li JL. The value of magnetic resonance blood oxygen level-dependent imaging in evaluating the efficacy of advanced cervical cancer combined with radiotherapy and chemotherapy. Acta Radiol. 2023;64(4):1668-1675. doi: 10.1177/02841851221130302.
43. Christensen S, Lansberg MG. CT perfusion in acute stroke: Practical guidance for implementation in clinical practice. J Cereb Blood Flow Metab. 2019;39(9):1664-1668. doi: 10.1177/0271678X18805590.
44. Yu W, Kou C, Bai W, et al. The diagnostic performance of PET/CT scans for the detection of para-aortic metastatic lymph nodes in patients with cervical cancer: A meta-analysis. PLoS One. 2019 Jul 18;14(7):e0220080. doi: 10.1371/journal.pone.0220080.
45. Ruan J, Zhang Y, Ren H. Meta-analysis of PET/CT Detect Lymph Nodes Metastases of Cervical Cancer. Open Med (Wars). 2018 Sep 22;13:436-442. doi: 10.1515/med-2018-0065.
46. Zhu Y, Shen B, Pei X, et al. CT, MRI, and PET imaging features in cervical cancer staging and lymph node metastasis. Am J Transl Res. 2021 Sep 15;13(9):10536-10544.
47. Peng NJ, Hu C, Chiu YL, et al. Detection of Recurrent Cervical Cancer and Prediction of Its Patient Survival with Serum Squamous-Cell Carcinoma-Antigen and 2-[^{18}F] Fluoro-2-Deoxy-d-Glucose-Positron Emission Tomography/Computed Tomography. Diagnostics (Basel). 2020 Aug 31;10(9):657. doi: 10.3390/diagnostics10090657.
48. Martin H. New mobile cancer scan unit hitting the road to help ease barriers, wait-times [Internet]. Stuff; 2024 [cited 2024 Dec 19]. Available from: https://www.stuff.co.nz/national/health/300667942/new-mobile-cancer-scan-unit-hitting-the-road-to-help-ease-barriers-waittimes
49. Hosono M, Takenaka M, Monzen H, et al. Cumulative radiation doses from recurrent PET–CT examinations. Br J Radiol. 2021 Oct 1;94(1126):20210388. doi: 10.1259/bjr.20210388.
50. Viswanathan C, Faria S, Devine C, et al. [18F]-2-Fluoro-2-Deoxy-D-glucose–PET Assessment of Cervical Cancer. PET Clin. 2018 Apr;13(2):165-177. doi: 10.1016/j.cpet.2017.11.004.
51. Zhang Z, Li X, Sun H. Development of machine learning models integrating PET/CT radiomic and immunohistochemical pathomic features for treatment strategy choice of cervical cancer with negative pelvic lymph node by mediating COX-2 expression. Front Physiol. 2022 Oct 14;13:994304. doi: 10.3389/fphys.2022.994304.
52. Navarro AS, Angeles MA, Migliorelli F, et al. Comparison of SPECT-CT with intraoperative mapping in cervical and uterine malignancies. Int J Gynecol Cancer. 2021;31(5):679-685. doi: 10.1136/ijgc-2020-002198.
53. Alqahtani FF. SPECT/CT and PET/CT, related radiopharmaceuticals, and areas of application and comparison. Saudi Pharm J. 2023 Feb;31(2):312-328. doi: 10.1016/j.jsps.2022.12.013.
54. Che D, Yang Z, Wei H, et al. The Adler grade by Doppler ultrasound is associated with clinical pathology of cervical cancer: Implication for clinical management. PLoS One. 2020 Aug 10;15(8):e0236725. doi: 10.1371/journal.pone.0236725.
55. Hsiao YH, Yang SF, Chen YH, et al. Updated applications of Ultrasound in Uterine Cervical Cancer. J Cancer. 2021 Feb 22;12(8):2181-2189. doi: 10.7150/jca.49479.
56. Li J, Gu C, Zheng H, et al. Ultrasonographic diagnosis in rare primary cervical cancer. Int J Gynecol Cancer. 2021 Dec;31(12):1535-1540. doi: 10.1136/ijgc-2021-002860.
57. Zhang J, Liu X. MRI is more valuable than CT in the diagnosis of cervical cancer. Am J Transl Res. 2023;15(4):2970-2976.

Updated hepatitis C modelling in Aotearoa New Zealand: a lower burden, but clearer elimination targets

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ABSTRACT

As Aotearoa New Zealand progresses toward the elimination of hepatitis C (HCV) as a public health threat by 2030, updated national modelling provides a clearer understanding of the remaining disease burden and treatment targets. Using the Centre for Disease Analysis Foundation's Bright model, we revised earlier estimates to reflect declining incidence among people who inject drugs, treatment uptake and new seroprevalence data. The model now estimates that approximately 18,000 people were living with viraemic HCV in 2023, significantly fewer than prior estimates, but still representing a substantial public health challenge. Current treatment rates (around 450 people per year) fall short of what is needed to meet all World Health Organization targets by 2030. The model suggests that treating more than 1,300 people annually is required. While innovative approaches have expanded access for priority groups, broader general population strategies may be necessary. This recalibrated model highlights the urgency of scaling up testing, improving diagnosis and establishing operational targets to achieve elimination.

As Aotearoa New Zealand progresses toward the World Health Organization's (WHO) goal of eliminating hepatitis C (HCV) as a public health threat by 2030, understanding the background inequities and the true burden of disease remains essential. In 2024, Health New Zealand – Te Whatu Ora and the Public Health Agency, Ministry of Health – Manatū Hauora undertook an updated modelling exercise using the Centre for Disease Analysis Foundation (CDAF) HCV Policy Tool (Bright model).[1] The results offer an updated estimate of current viraemic prevalence and provide clear treatment targets to inform elimination strategies.

Why an update was needed

The previous national estimate, derived in 2013, suggested that approximately 50,000 New Zealanders were living with chronic HCV infection.[2] This figure was increasingly viewed as an over-estimate in 2024 by both local and international HCV experts. A key concern was the infection rate assumption in the 2013 model, which has become outdated due to substantial declines in new HCV cases. Rates of HCV transmission have dropped dramatically over the last decade, particularly among people who inject drugs (PWID).[3] Serial seroprevalence studies conducted at needle exchange centres in Aotearoa New Zealand showed a decline in HCV antibody positivity from 58% in 2013 to 32.6% in 2022, with the study also reporting an HCV RNA positivity of 12.2%.[3] This reflects the success of harm reduction and targeted treatment approaches, often referred to as "treatment as prevention" in PWID. Furthermore, recent small-scale screening programmes in primary care have reported low prevalence of individuals that were RNA-positive for HCV.[4] In addition to this drop in the rate of new infections, more than 13,000 New Zealanders have been cured with direct-acting antivirals either through clinical trials and self-funded generics (2013–2019) or through funded treatments (Viekira Pak, 2016–2018, and Maviret since 2019).[5] Approximately 5,000 people are estimated to have died, with nearly half of these deaths likely due to liver-related causes such as hepatocellular carcinoma or decompensated cirrhosis. An unknown number of people are also believed to have moved overseas. These estimates are informed by programme-level experience and the expert opinion of the authors.

In response, our updated modelling adjusted the underlying parameters of the CDAF model to better reflect observed patterns in comparable

populations, particularly Australia. The revised model was reviewed and validated by a technical working group, including clinicians, epidemiologists and collaborators from the Kirby Institute in Australia; the project was overseen by the National Hepatitis C Oversight Group in Health New Zealand. These refinements bring the model into alignment with current clinical understanding and the best available data.

Overview of the model

The CDAF HCV Policy Tool (Bright model) is a Markov-based model that simulates the natural history of HCV infection, incorporating disease progression, mortality and treatment outcomes (Figure 1). Individuals in the model transition through various health states, including chronic infection, different stages of liver fibrosis (F0–F4), cirrhosis, decompensated cirrhosis, hepatocellular carcinoma, liver transplantation and death.

Model inputs include Aotearoa New Zealand–specific population estimates, historical testing and treatment data, pharmaceutical dispensing records and liver cancer registry data, as well as national and international literature on disease progression and treatment efficacy. Where local data were limited, such as for disease progression or reinfection rates, the model used expert consensus and validated assumptions from international cohorts with similar profiles, such as Australia, or applied baseline assumptions from the original model. These inputs were reviewed for relevance to the Aotearoa New Zealand context. While international data helps fill important gaps, they introduce some uncertainty, particularly where health systems or population risk factors differ. Model outputs should therefore be interpreted with some caution when informing local policy and planning.

The model was validated by comparing estimates of HCV-related liver cancer with national hepatocellular carcinoma data. The modelled incidence of HCV-related liver cancer was consistent with observed trends, based on comparisons with national data and unpublished case listings from the New Zealand Liver Transplant Unit's multidisciplinary meeting records (E Gane, personal communication, July 2024). This alignment supports confidence in the model's broader estimates of national viraemic prevalence.

The current modelling of HCV viraemic prevalence is limited to national-level estimates due to the lack of a unified national platform for laboratory test results, the inability to link between data sources and the lack of granular demographic detail in some aggregate data sources (such as data on PWID). These limitations hinder the ability to capture and analyse detailed data on a regional or ethnic-specific basis.

A lower but still significant burden

The updated modelling estimates that in 2023, around 18,000 people in Aotearoa New Zealand were living with viraemic HCV, equating to a prevalence of 0.35%. While this is a reduction from earlier estimates, it still represents a substantial public health burden. Approximately

Figure 1: Overview of the Centre for Disease Analysis Foundation hepatitis C policy Bright model.

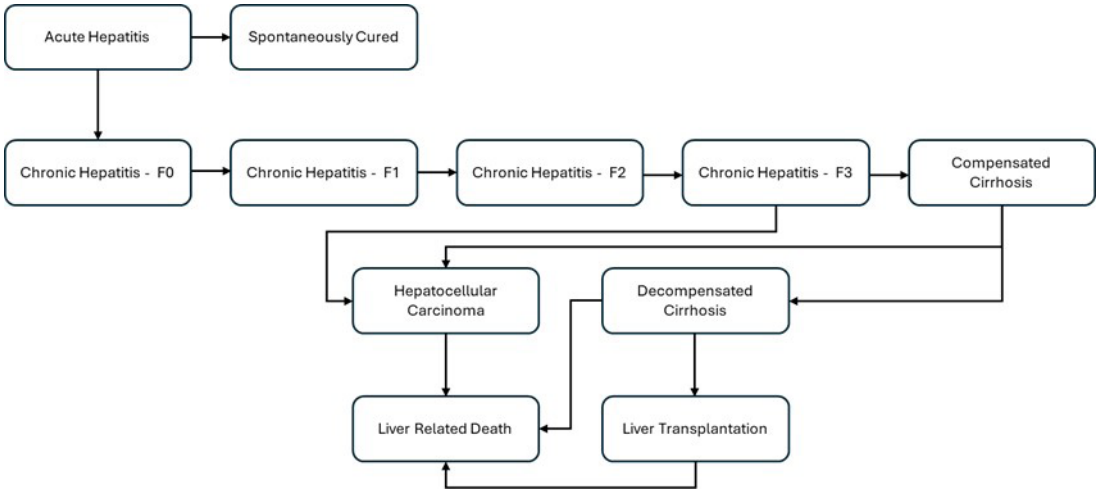


Figure 2: Modelled number of hepatitis C cases by age and sex, 2023.

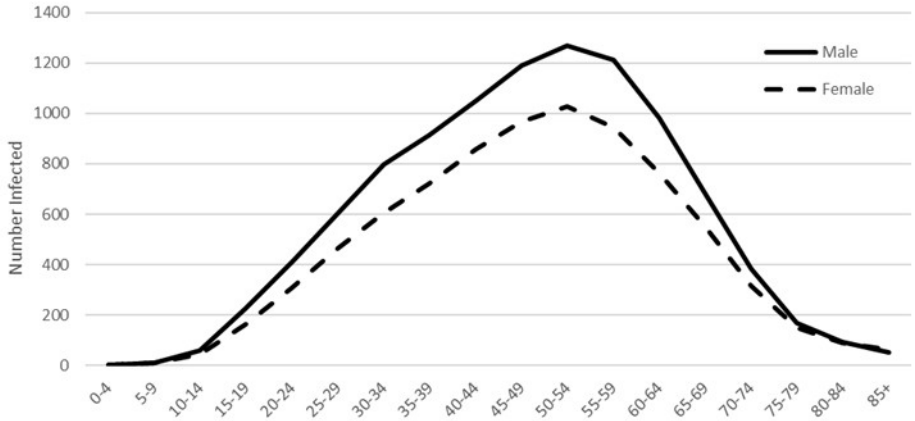
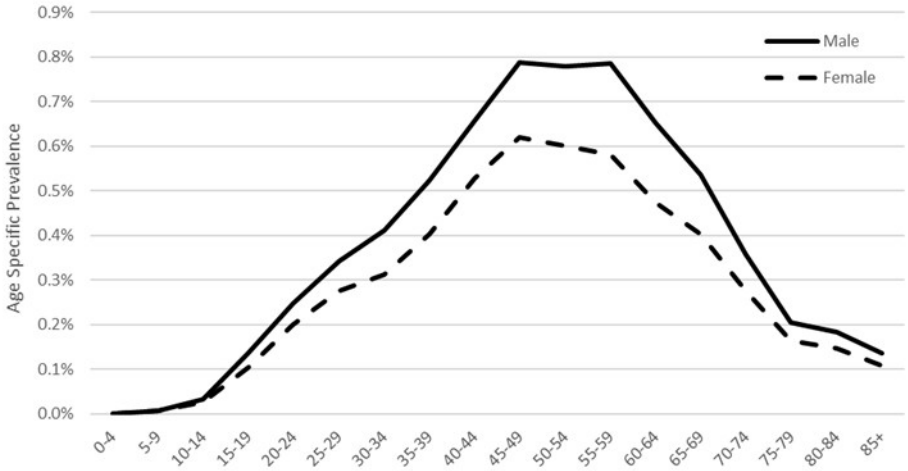


Figure 3: Modelled prevalence of hepatitis C cases by age and sex, 2023.



half of these infections are among people aged 45–64 (Figure 2 and Figure 3), and many have likely been living with the virus for years, if not decades, without being diagnosed. This reflects the historical pattern of HCV transmission in Aotearoa New Zealand, including through medical procedures or injecting drug use in earlier decades when awareness and screening were limited. As a result, many individuals may be unaware of their infection and are at risk of developing serious liver disease, highlighting the importance of targeted testing and engagement strategies for this age group. The model suggests that a significant proportion, potentially more than 20%, of those with HCV have already progressed to advanced stages of liver disease (Table 1). This includes individuals with cirrhosis, decompensated cirrhosis or hepatocellular carcinoma, and underscores the urgency of treatment in this population.

Gaps in testing and treatment

Following the introduction of Maviret, a fully funded, pan-genotypic direct-acting antiviral therapy in 2019, there was an initial surge in treatment uptake.[5] During 2019, around 3,300 people were treated, reflecting strong demand and the clearing of an existing backlog of people infected with HCV genotype 3. Between July 2016 and January 2019, a similar number of

Table 1: Modelled distribution of hepatitis C disease stages, Aotearoa New Zealand, 2023.

	Number	%
Chronic HCV (F0)	4,670	26%
F1	5,230	29%
F2	2,820	16%
F3	2,820	16%
Cirrhosis—F4	2,110	12%
Decompensated cirrhosis	280	2%
HCC	150	1%

HCV = hepatitis C Virus; F0 = fibrosis stage 0 (no fibrosis); F1 = fibrosis stage (mild fibrosis); F2 = fibrosis stage 2 (moderate fibrosis); F3 = fibrosis stage 3 (severe fibrosis); F4 = fibrosis stage 4 (cirrhosis/compensated cirrhosis); HCC = hepatocellular carcinoma.

people infected with HCV genotype 1 were cured with Viekira Pak. However, treatment numbers have steadily declined, and in 2024, only around 450 people were treated.[5] This decline in treatment uptake likely reflects the lack of new diagnoses, highlighting some of the limitations of current testing strategies and the importance of investigating other approaches to build on what has already been achieved.

Drawing on the authors' direct involvement in national and regional HCV programme implementation, regional HCV services, funded by Health New Zealand, have taken a range of innovative steps to improve awareness and make testing and treatment more accessible for priority groups. This work has been done alongside needle exchange services, the Department of Corrections, pharmacies, Hauora Māori and Pacific health providers, alcohol and drug services, mental health and sexual health services and primary and secondary care. New approaches to testing have been introduced in recent years, including the widespread delivery of thousands of point-of-care tests, the rollout of dried blood spot testing, and stronger integration with community laboratories. Nurse-led and peer-led clinics have been established across a wide range of community settings and events, improving access to testing and treatment. Most regions have also launched outreach vans custom-fitted for mobile HCV testing, with one also operating as an authorised needle exchange. Efforts have also focussed on re-engaging people who were previously diagnosed but lost to follow-up. Building on these testing initiatives, HCV treatment has also been reclassified in a world first to allow nurses and pharmacists to supply medication without a prescription, further supporting accessible, community-based care.[6]

Accurately estimating the proportion of individuals undiagnosed with HCV is challenging due to the limited historical population-level data. However, based on the expert opinion of the authors and unpublished data, it is estimated that between 30% and 50% of individuals living with HCV in Aotearoa New Zealand may remain undiagnosed. This proportion may be even higher given the low levels of testing and treatment in recent years. The estimate is supported by unpublished data from the New Zealand Liver Transplant Unit, which indicate that around 30% of individuals with HCV-related hepatocellular carcinoma were undiagnosed at the time they presented with advanced symptomatic disease (E Gane, personal communication, July 2024). In addition to this, extrapolation from treatment data since 2013 suggests that the number of diagnosed but untreated individuals is likely relatively low, further supporting the conclusion that a large proportion of the viraemic population remains undiagnosed.

Future targets

Aotearoa New Zealand's WHO 2030 HCV elimination goals are a reduction of incidence to

less than five per 100,000; reduction in mortality to two per 100,000; increase in diagnosis rate to 90%; and an increase in treatment rate to 80%. Using the 2023 baseline estimate, the updated model was used to simulate various treatment scenarios including status quo and increased treatment to reach targets. These projections assume a constant infection rate, with both treatment and reinfection accounted for.

Key findings include:

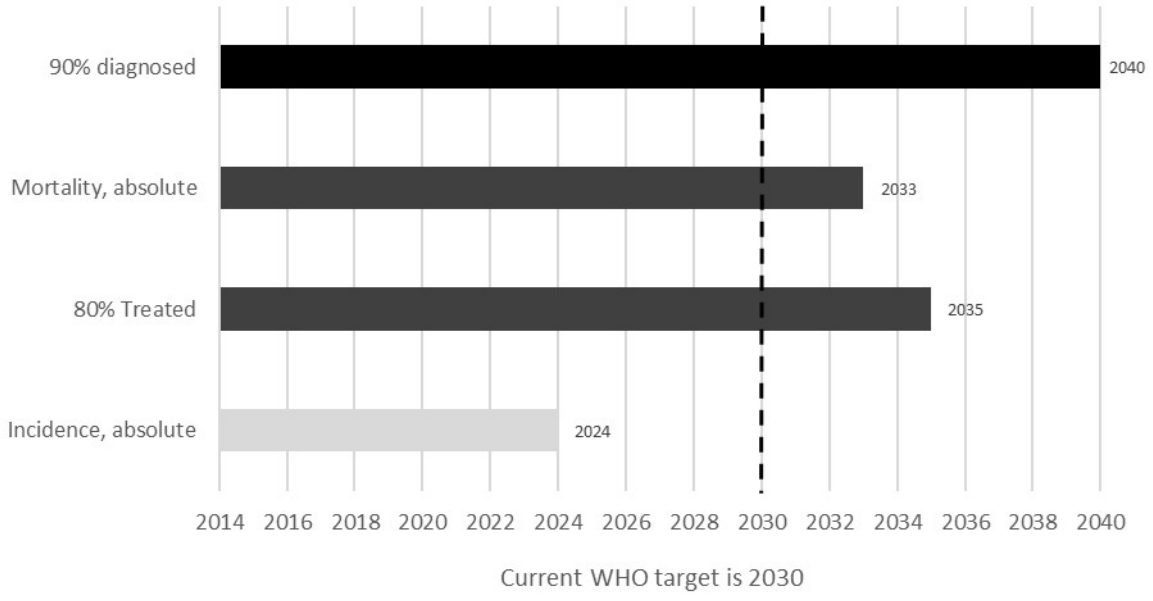
- Maintaining current treatment rates of around 450 per year will delay Aotearoa New Zealand reaching all WHO elimination goals until 2035 and beyond (see Figure 4). To reach these by 2030, a minimum of 1,300+ people per year would need to be treated, an almost threefold increase in treatment uptake.
- Maintaining the current rate would only reduce viraemic prevalence from 0.35% to 0.3% by 2030 and fall short of the treatment targets.
- Delaying the scale-up to at least 1,300 treatments per year by even 1 year will raise the annual treatment target to over 1,600.

These treatment scenarios provide quantification of the gap between current state and potentially new national targets informed by this evidence. With a highly effective cure available, and a lower-than-expected baseline prevalence, Aotearoa New Zealand has a clearer path to HCV elimination—however, only if annual treatment numbers increase substantially and sustainably.

Improving overall testing and linkage to care will be key

This updated analysis and experience with targeted testing to date suggests that an important focus of future work will be identifying undiagnosed individuals and re-engaging people previously diagnosed but not yet treated, providing supportive, flexible and, for some, intensive support and linkage to treatment (via primary care, pharmacy, mental health, alcohol and drug and needle exchange services, as well as more recent innovations such as telehealth or mobile treatment support). In addition, efforts are needed to identify undiagnosed individuals, particularly those lost to follow-up or disengaged from care or who may not access traditional health services. While a large focus has historically been placed on testing and treating high-risk individuals such as PWID, it is estimated that fewer than 20%[2] of those currently living with HCV meet the definition of active PWID and thus only a small proportion of

Figure 4: Time to reach World Health Organization elimination targets based on current levels of testing and treatment—projection based on modelling.



those infected with HCV are likely being reached by current strategies. The remaining 80–90% are likely in the general population and may not be easily identified through existing approaches.

To reach this majority, a much broader general population testing programme may be required. The model suggests that a high proportion (possibly as high as 30%) of people currently infected with HCV may have advanced liver disease, implying many have been living with the virus for a long time. This raises the opportunity, in addition to proactive and targeted testing, of a one-off universal screening programme for adults to find the undiagnosed, such as that implemented in Italy.[7] Cost effectiveness would be an important consideration for a universal approach, which could be supported by measures such as a national registry to assist with avoiding duplicate testing and ensure linkage to care, alongside more affordable diagnostic tests. A national screening programme for HCV could also be paired with a hepatitis B test. This would provide an efficient opportunity to detect and manage both infections, which are each major risk factors for hepatocellular carcinoma, through a single engagement with the health system.[8]

Following on from a successful pilot to test the feasibility of offering HCV testing via community laboratories in the Northern Region, a broader national study is underway. The results of this study will inform the next phase of implementation of the Hepatitis C Action Plan, which focusses on the testing and treatment of HCV within the general population, and inform any future general population national testing/screening programmes. It is important that any approach be appropriately resourced, culturally safe and flexible.[9]

A recalibrated path forward

This modelling update offers a more accurate picture of the HCV burden in Aotearoa New Zealand. While the overall prevalence is lower than previously estimated, it still represents a substantial public health burden, and the modelling provides a clearer understanding of the pathway to meet elimination targets.

The updated modelling can be used to inform an updated elimination strategy. The scenarios modelled here suggest that treating 1,300+ people per year is the threshold for meaningful elimination progress. Innovative practices under the elimination strategy to date have successfully targeted priority populations. In addition, community access to HCV treatment has been expanded through the recent reclassification of Maviret.[6] It is timely to consider options to target the general population to achieve elimination by 2030 via the modelled trajectory of a threefold increase in treatment uptake, alongside a similar increase in new diagnoses. Success is entirely feasible: with updated data, effective and well-tolerated treatment and research that supports novel testing strategies and policy alignment, the path to elimination is clearer than ever.

The challenge now lies in developing operational goals, setting local treatment targets and scaling up testing where it is most needed. While elimination remains within reach, it will require a substantial and sustained increase in both diagnosis and treatment. Achieving this goal would markedly reduce the burden of chronic HCV and its associated harms.

COMPETING INTERESTS
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REFERENCES
1. CDA Foundation. HCV policy tool (Bright model). Lafayette (CO): Centre for Disease Analysis Foundation.
2. Gane E, Stedman C, Brunton C, et al. Impact of improved treatment on disease burden of chronic hepatitis C in New Zealand. N Z Med J. 2014;127(1407):61-74.
3. Noller G, Gauld N, Mexted C, Gane E. Study of the prevalence of previous and active hepatitis C infection in people who inject drugs using dried blood spot testing at needle exchange and pharmacies in Aotearoa New Zealand's Northern Region: Final Report to the Northern Regional Health Alliance. Auckland, New Zealand: Northern Regional Health Alliance; 2023.
4. Tiong HT, Upton A, Lockie A, et al. Hepatitis C virus seroprevalence in defined populations in New Zealand: data from a general practice-based screening programme. N Z Med J. 2025;138(1610):52-59. doi:10.26635/6965.6596.
5. Health New Zealand – Te Whatu Ora. Pharmaceutical Collection (Pharmacy claims data). 2024.
6. Health New Zealand – Te Whatu Ora. Reclassification of hepatitis C treatment [Internet]. Wellington, New Zealand: Health New Zealand – Te Whatu Ora; 2023 [cited 2025 May 19]. Available from: https://www.tewhatuora.govt.nz/for-health-professionals/clinical-guidance/diseases-and-conditions/hepatitis/hepatitis-c/reclassification-of-hepatitis-c-treatment
7. Landini N, Chiericati C, Boni M, et al. Italian screening protocol and genotypes characterization for HCV elimination (2022-2023) in Ferrara's province: a real-world study. Sci Rep. 2025;15(1):8087. doi:10.1038/s41598-025-92654-w.
8. Koea JB, Schauer C, O'Dwyer R, et al. Towards eliminating hepatocellular carcinoma from Aotearoa New Zealand: a nationally coordinated programme to detect and treat chronic hepatitis? J R Soc N Z. 2025:1-13. doi:10.1080/03036758.2025.2491511.
9. Hikaka J, Perumal L, Gauld N, et al. A service evaluation to explore Māori experiences of direct-acting antiviral hepatitis C treatment in Aotearoa New Zealand. N Z Med J. 2022;135(1561):65-75. doi:10.26635/6965.5763.

Blood cancers and Māori: a perspective on current evidence and next steps

Sydney Clough, Myra Ruka, Matt Wheeler, James Stanley, Virginia Signal, Jonathan Koea, Jason Gurney

ABSTRACT

Blood cancers are some of the more common cancers and causes of cancer death among Māori in Aotearoa New Zealand. Leukaemia is the fifth most frequently diagnosed cancer among Māori and the ninth most common cause of Māori cancer death, while non-Hodgkin lymphoma is the eighth most commonly diagnosed and the tenth most common cause of death. Māori have poorer cancer-specific survival for all forms of blood cancer. Overall, the causes of blood cancers are not fully understood, and the proportion of blood cancers that may be attributable to known modifiable risk factors is modest compared to solid tumours. However, there are some risk factors known to influence tumour development. Improving survival for Māori and closing gaps in survival between Māori and non-Māori will require improvements in access to early detection and best-practice treatment for Māori with these cancers. In this viewpoint, we summarise the key actions we may take to reduce blood cancers for Māori, improve survival outcomes and reduce disparities.

Blood cancers, broadly including leukaemia, Hodgkin lymphoma, non-Hodgkin lymphoma and myeloma, are significant in Māori populations. We have previously observed that leukaemia is the fifth most commonly diagnosed cancer among Māori and the ninth most common cause of Māori cancer death, while non-Hodgkin lymphoma is the eighth most commonly diagnosed and the tenth most common cause of death.[1] We have also previously found that Māori have poorer cancer-specific survival for all forms of blood cancer.[2]

Given their importance to Māori, exploring blood cancer outcomes in this population has become an area of research and policy interest. A number of studies have been published examining subtype-specific differences in blood cancer incidence and outcomes between Māori and non-Māori in Aotearoa New Zealand.[3–6] These studies have provided useful insights regarding specific disease characteristics or outcome differences between ethnic groups. However, many of these studies were limited in scope and sample size, and there was a need to build on the available evidence with a broader assessment of the blood cancer burden experienced by Māori. To that end, we recently published a comprehensive national overview of blood cancer incidence, mortality and survival for Māori in Aotearoa New Zealand for the period 2007–2019.[7] In this study we found that, compared to Europeans, Māori are more likely to be diagnosed with (incidence) and to die from (mortality) both leukaemia and myeloma, and are similarly likely to be diagnosed or die from Hodgkin and non-Hodgkin lymphoma. Among those diagnosed with these cancers, Māori had poorer survival outcomes for leukaemia (hazard ratio [HR] 1.77, 95% CI 1.57-2.00), non-Hodgkin lymphoma (1.71, 95 % CI 1.50-1.95) and myeloma (1.40, 95% CI 1.19-1.64), as well as all subtypes of leukaemia and non-Hodgkin lymphoma.

In this viewpoint, we summarise the key actions we may take to reduce blood cancers for Māori, improve survival outcomes and reduce disparities. Our team is Māori led and comprised of Māori researchers and haematologists supported by non-Māori colleagues.

How can we prevent blood cancers for Māori?

Overall, the causes of blood cancers are not fully understood, and the proportion of blood cancers that may be attributable to known modifiable risk factors is modest compared to solid tumours such as those associated with lung cancer.[8] However, there are some risk factors known to influence tumour development. These are listed below by cancer type.

Leukaemia

An individual's risk of developing leukaemia increases with genetic disorders such as Down syndrome, or through risk factors including exposure to high levels of toxins such as radiation

or benzene, smoking (likely due to benzene within tobacco smoke), previous chemotherapy or radiotherapy treatment, and haematological disorders such as myeloproliferative neoplasms (MPNs) or myelodysplastic syndrome (MDS).[9–11] Activities aimed at the prevention of leukaemia for Māori should probably involve primary prevention of exposure to toxins including benzene, including reducing the availability of tobacco. By extension, one specific area of useful future inquiry would be to understand the extent to which tobacco exposure might explain increased incidence and mortality experienced by Māori for this cancer, given strong disparities in tobacco exposure between Māori and Europeans in Aotearoa New Zealand. Such information would usefully contribute to the evidence base supporting stronger tobacco legislation.

Lymphoma

The main known risk factors for both Hodgkin and non-Hodgkin lymphoma are infectious diseases (including previous infection with HIV, hepatitis B, hepatitis C, glandular fever and Epstein–Barr virus), as well as autoimmune conditions (including systemic lupus erythematosus, rheumatoid arthritis and Sjögren's syndrome), treatment with immunosuppressives, and smoking.[12–14] Given these risk factors, and the general increased risk of exposure for Māori to conditions associated with infectious disease,[1] the prevention of these infectious diseases is possibly the most important focus for lymphoma prevention for Māori. For example, the current hepatitis prevention programme in Aotearoa New Zealand underserves Māori,[15] and improving this disparity would serve not only to reduce the burden of hepatitis and subsequent liver disease for Māori, but also potentially reduce incidence of blood cancers (such as lymphoma) that have been aetiologically linked to hepatitis. However, we note that further research is required to understand the importance of hepatitis in the development of lymphoma in Aotearoa New Zealand (and among Māori in particular).

Myeloma

The primary risk factors for myeloma include chronic inflammation, exposure to pesticides or organic solvents, radiation exposure and genetic variants.[16] Activities aimed at preventing these cancers for Māori could involve primary prevention of workplace or other environmental exposure to pesticides and solvents, as well as secondary prevention through screening for myeloma, especially for those with a family history. There is also a suggestion that obesity may be implicated in the progression of monoclonal gammopathy of undetermined significance (MGUS) through to myeloma;[16,17] however, this relationship is highly uncertain and controversial, and further research is required to evaluate the impact of obesity on the development of MGUS and myeloma.[17]

Drivers of blood cancer survival

Leukaemia

Several factors impact a patient's survival of leukaemia, including treatment delays and less intensive treatment regimens. These delays have multiple causes, including adverse events, increased comorbidities, higher prevalence of high-risk genetic profiles, and insufficient ancillary services and support.[18]

Disparities in leukaemia survival highlighted in our recently published study[7] have persisted for decades. Previous analysis among those aged 25–29 years with leukaemia revealed poorer 5-year survival outcomes for Māori compared to non-Māori/non-Pacific peoples (77% versus 88%, respectively).[19] Wong et al.[18] investigated disparities in acute lymphoblastic leukaemia (ALL) survival outcomes between Māori/Pacific peoples and non-Māori/Pacific peoples. They found that Māori/Pacific peoples appeared less likely to achieve measurable/minimal residual disease (MRD) negative status during the induction phase of treatment and also appeared less likely to receive allogeneic stem cell transplants compared to non-Māori/Pacific peoples. Additionally, Māori/Pacific patients appeared to more commonly encounter treatment delays and dose alteration during chemotherapy due to comorbidity or organ dysfunction.[18] However, these observations were made in a small subgroup of patients (n=22), and as such lack precision and should be interpreted with caution.

Hodgkin lymphoma

Hodgkin lymphoma is fortunately a highly curable disease when treated with first-line chemotherapy (+/- radiotherapy).[20] In our recently published study,[7] survival rates from this cancer are generally high, and there were no strong signals of disparity in survival for Māori patients. However, this should be considered alongside the low number of deaths associated with this cancer, which prevented a robust comparison of survival outcomes between Māori and European patients.

Non-Hodgkin lymphoma

For many decades, cancer specific survival of non-Hodgkin lymphoma has been poorer for Māori compared to Europeans.[21] This continued in our recent study,[7] where non-Hodgkin lymphoma had the second highest survival disparity. Timely diagnosis is crucial due to the availability of effective and often curative therapies for non-Hodgkin lymphoma.[22] As such, equitable access to diagnosis and treatment is crucial to achieving equitable outcomes for Māori.

Myeloma

Despite being an incurable haematological malignancy, the introduction of stem cell transplantation and treatment medications such as thalidomide, lenalidomide and bortezomib, has contributed to improved overall survival rates for myeloma patients in Aotearoa New Zealand.[23] Nonetheless, disparities in survival persist, and these may be primarily attributed to barriers such as cost and unequal accessibility of these treatments.[23]

Established variables used for assessing prognosis in myeloma patients are the Revised International Staging System (R-ISS), which includes fluorescence in situ hybridisation (FISH) and lactate dehydrogenase (LDH) amongst other factors.[24] Previous research suggests that Māori with myeloma tend to have a poorer prognosis, leading to an earlier onset of progression/relapse or death following diagnosis.[25] The same study demonstrated poorer survival outcomes for Māori, particularly those living in high deprivation areas.[25] Following the introduction of Bortezomib as a funded treatment for myeloma in 2011, there was an improvement in 3-year survival rates for most groups except Māori, Pacific peoples and those in living in deprivation. This finding emphasises that the benefits of new medicines may not be enjoyed equitably within Aotearoa New Zealand.[25]

Addressing disparities in survival for Māori

Improving access to early detection

Where prevention of cancer is not attainable or not achieved, priority should be shifted to early detection to optimise the chance of curative treatment, or improved prognosis. Unfortunately, early detection is an area which strongly underserves and thus disadvantages Māori. A recent report from Te Aho o Te Kahu – Cancer Control Agency[26] found that Māori were more likely to be diagnosed with blood cancers following an emergency presentation than European/Other patients, with lymphoma (48% versus 37%), myeloma (52% versus 29%) or leukaemia (63% versus 48%). Disparities between Māori and Europeans in accessing timely diagnosis, staging procedures and subsequent high-quality treatment have been observed in multiple cancer contexts,[21,27] and achieving equitable outcomes for Māori involves addressing barriers to equal access for these dimensions of care.[1] Equal access to early detection (as well as subsequent treatment, see below) is important for all blood cancers and may be particularly relevant for chronic cancers (such as chronic lymphocytic leukaemia [CLL] and chronic myeloid leukaemia [CML]) where early warning signs may be slow to arise.

Improving access to treatment

A comprehensive approach to the treatment of blood cancers generally involves a combination of chemotherapy, immunotherapy, radiotherapy and stem cell transplant.[12,13,18,28] More recently, targeted cellular therapy has been developed.[28] The survival disparities in this study may, in part, be driven by differential access to and quality of these treatments. Māori are substantially more likely to live in socio-economic deprivation,[29] and this can lead to difficulty accessing healthcare, delays in diagnosis and treatment, and is also associated with higher levels of comorbidities which could delay or prevent curative treatment.[23] However, we also know that deprivation is only a partial driver of disparities in access to treatment and ultimate survival for Māori with cancer.[2] New research is required to examine whether there are differences in access to best-practice therapies for Māori compared to non-Māori with blood cancers, and also the extent to which any such disparities might drive the differences in survival outcomes reported in our recent study.[7]

Building further evidence

The rarity of many blood cancers in Aotearoa New Zealand means it has been difficult to establish with reasonable precision the extent of cancer subtype-specific disparities in outcomes such as survival. This also impacts our ability to examine potential disparities in access to early detection and treatment. As such, there is a need for research specific to cancer subtypes in this area that has a sufficient sample size to examine outcomes by subtype with reasonable precision. Such research would benefit from access to the kinds of granular data that would allow investigation of potential disparities across the care pathway, such as genetic data, comorbidities, treatments

received and subsequent outcomes. Such detailed investigation would enable us to deepen our understanding of the nature of disparities in blood cancer incidence and outcomes between Māori and non-Māori and could subsequently inform health system and health policy change.

Conclusions

Our understanding of the causes of blood cancers remains incomplete, and the proportion attributable to known modifiable risk factors is modest. However, although risk factors are many and varied, there remain opportunities to prevent these cancers through public health action, particularly in infectious diseases. Advances in treatment have led to significant gains in survival from most blood cancers over time; however, these gains are not equally shared by Māori. Improving survival for Māori, and closing gaps in survival between Māori and non-Māori, will require improvements in access to early detection and timely treatment for Māori with these cancers.

COMPETING INTERESTS
Nil.

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REFERENCES
1. Gurney JK, Robson B, Koea J, et al. The most commonly diagnosed and most common causes of cancer death for Māori New Zealanders. N Z Med J. 2020 Sep 4;133(1521):77-96
2. Gurney J, Stanley J, McLeod M, Koea J, Jackson C, Sarfati D. Disparities in Cancer-Specific Survival Between Māori and Non-Māori New Zealanders, 2007-2016. JCO Glob Oncol. 2020 Jun;6:766-774. doi: 10.1200/GO.20.00028
3. Pettit T, Cole N, Leung W, Ballantine K, Macfarlane S. Analysis of common cytogenetic abnormalities in New Zealand pediatric ALL shows ethnically diverse carriage of ETV6-RUNX1, without a corresponding difference in survival. Pediatr Blood Cancer. 2017 Dec;64(12). doi: 10.1002/pbc.26676
4. Varghese C, Liu VY, Immanuel T, Chien N, Green T, Chan G, Theakston E, Kalev-Zylinska M. Ethnic differences in acute promyelocytic leukaemia between New Zealand Polynesian and European patients. Hematology. 2021 Dec;26(1):215-224. doi: 10.1080/16078454.2021.1882146
5. Varghese C, Immanuel T, Ruskova A, Theakston E, Kalev-Zylinska ML. The Epidemiology of Myeloproliferative Neoplasms in New Zealand between 2010 and 2017: Insights from the New Zealand Cancer Registry. Curr Oncol. 2021 Apr 18;28(2):1544-1557. doi: 10.3390/curroncol28020146
6. Immanuel T, Green TN, Holmes AV, et al. Impact of socioeconomic status on acute myeloid leukemia outcomes in New Zealand's universal health care. Blood Global Hematology. 2025;1(1):100006
7. Clough S, Wheeler M, Stanley J, et al. Blood cancer incidence, mortality and survival for Māori in New Zealand. Cancer Epidemiol. 2024 Dec;93:102656. doi: 10.1016/j.canep.2024.102656
8. Brown KF, Rumgay H, Dunlop C, et al. The fraction of cancer attributable to modifiable risk factors in England, Wales, Scotland, Northern Ireland, and the United Kingdom in 2015. Br J Cancer. 2018 Apr;118(8):1130-1141. doi: 10.1038/s41416-018-0029-6
9. DiNardo CD, Erba HP, Freeman SD, et al. Acute myeloid leukaemia. Lancet. 2023 Jun 17;401(10393):2073-2086. doi: 10.1016/S0140-6736(23)00108-3
10. Malard F, Mohty M. Acute lymphoblastic leukaemia. Lancet. 2020 Apr 4;395(10230):1146-1162. doi: 10.1016/S0140-6736(19)33018-1
11. Poopak A, Saeedi Moghaddam S, Esfahani Z, et al. National and subnational burden of leukemia and its risk factors, 1990-2019: Results from the Global Burden of Disease study 2019. PLoS One. 2023 Nov 30;18(11):e0287917. doi: 10.1371/journal.pone.0287917
12. Chang J, Koniaris L, Paneesha S. Non-Hodgkin's lymphoma - symptoms, diagnosis and treatment [Internet]. BMJ Best Practice; 2023 [cited 2024 Oct 20]. Available from: https://bestpractice.bmj.com/topics/en-gb/312
13. Motskowski A. Hodgkin's lymphoma - symptoms, diagnosis and treatment [Internet]. BMJ Best Practice; 2024 [cited 2024 Oct 20]. Available from: https://bestpractice.bmj.com/topics/en-gb/311
14. NZ LBC. Lymphoma [Internet]. Leukaemia & Blood Cancer New Zealand; 2025 [cited 2024 Oct 20]. Available from: https://www.leukaemia.org.nz/blood-cancer-information/lymphoma
15. Clough S, Cleverley T, Kerrison C, et al. The past, present and future of liver cancer control for Māori. N Z Med J. 2022 Dec 16;135(1567):91-104. doi: 10.26635/6965.5852
16. van de Donk NWCJ, Pawlyn C, Yong KL. Multiple myeloma. Lancet. 2021 Jan 30;397(10272):410-427. doi: 10.1016/S0140-6736(21)00135-5

17. Tentolouris A, Ntanasis-Stathopoulos I, Terpos E. Obesity and multiple myeloma: Emerging mechanisms and perspectives. Semin Cancer Biol. 2023 Jul;92:45-60. doi: 10.1016/j.semcancer.2023.04.003
18. Wong SHC, Offner M, Hu R, et al. Treatment outcomes of adult acute lymphoblastic leukaemia in Auckland, New Zealand. N Z Med J. 2023 Mar 24;136(1572):10-18. doi: 10.26635/6965.5952
19. Ballantine KR, Utley V, Watson H, Sullivan MJ, Spearing R. The burden of cancer in 25-29 year olds in New Zealand: a case for a wider adolescent and young adult age range? N Z Med J. 2018 Jan 19;131(1468):15-24
20. Brice P, de Kerviler E, Friedberg JW. Classical Hodgkin lymphoma. Lancet. 2021 Oct 23;398(10310):1518-1527. doi: 10.1016/S0140-6736(20)32207-8
21. Cormack D, Robson B, Purdie G, et al. Access to cancer services for Māori [Internet]. Wellington (NZ): Ministry of Health; 2005 [cited 2024 Oct 20]. Available from: https://niphmhr.aut.ac.nz/__data/assets/pdf_file/0019/6544/maoricancerserviceaccess.pdf
22. Shankland KR, Armitage JO, Hancock BW. Non-Hodgkin lymphoma. Lancet. 2012 Sep 1;380(9844):848-57. doi: 10.1016/S0140-6736(12)60605-9
23. Lim SL, Wellard C, Moore E, et al. Real-world outcomes in relapsed refractory multiple myeloma patients exposed to three or more prior treatments: an analysis from the ANZ myeloma and related diseases registry. Intern Med J. 2024 May;54(5):773-778. doi: 10.1111/imj.16277
24. Palumbo A, Avet-Loiseau H, Oliva S, et al. Revised International Staging System for Multiple Myeloma: A Report From International Myeloma Working Group. J Clin Oncol. 2015 Sep 10;33(26):2863-9. doi: 10.1200/JCO.2015.61.2267
25. Chan HSH, Milne RJ. Impact of age, sex, ethnicity, socio-economic deprivation and novel pharmaceuticals on the overall survival of patients with multiple myeloma in New Zealand. Br J Haematol. 2020 Mar;188(5):692-700. doi: 10.1111/bjh.16238
26. Te Aho o Te Kahu – Cancer Control Agency. Quality Improvement Monitoring Report – Route to diagnosis: People diagnosed with cancer within 30-days of an emergency or acute (unplanned) hospital admission. Wellington (NZ): Te Aho o Te Kahu; 2024.
27. Gurney J, Campbell S, Jackson C, Sarfati D. Equity by 2030: achieving equity in survival for Māori cancer patients. N Z Med J. 2019 Nov 8;132(1506):66-76
28. Santo L, Lei MM, Raje N. Multiple myeloma - symptoms, diagnosis and treatment | BMJ best practice. 2023.
29. Ministry of Health. Wai 2575 Māori Health Trends Report [Internet]. Wellington (NZ): Ministry of Health; 2019 [cited 2024 Oct 20]. Available from: https://www.health.govt.nz/publications/wai-2575-maori-health-trends-report

Granulomatous heart: unmasking tubercular constrictive pericarditis

Jeco Jacob Kuttykandathil, Subhash Surya Venkata Sri Palakurthi, Gauri Malavalli Girish, Arfath Ahmed, Chakrapani Mahabala, Rakshatha Nayak, Vipul K Rathan

Tuberculosis (TB) remains a global health challenge, particularly in developing nations where it ranks among the leading causes of extrapulmonary infections, including pericardial disease.[1] *Mycobacterium tuberculosis* (MTB) is the causative organism of TB.

Tuberculous pericarditis (TBP) is rare, comprising 1–2% of all TB infections.[2] It is the predominant cause of massive pericardial effusion in regions with a high prevalence of TB. TBP accounts for 60–80% of pericardial disease cases, underscoring its high prevalence in endemic areas.[3]

TBP presents with vague symptoms, loss of appetite and non-specific chest discomfort, often leading to misdiagnosis and delayed treatment if not recognised promptly. It is characterised by an exudative pericardial effusion, typically haemorrhagic, requiring advanced imaging techniques and pericardial biopsy for a definitive diagnosis. Real-time polymerase chain reaction (PCR) test to detect MTB deoxyribonucleic acid (DNA) and interferon gamma release assay may be negative, highlighting a need for a high index of suspicion in regions where the disease is endemic. Establishing diagnostic criteria based on clinical symptoms, laboratory findings and imaging studies is crucial for timely treatment.[3]

The standard treatment for TBP consists of 2 months of quadruple therapy with isoniazid, rifampicin, pyrazinamide and ethambutol, followed by isoniazid, rifampicin and ethambutol for 4 months. In constrictive pericarditis, adjunctive corticosteroid therapy may improve outcomes and mitigate complications.

Case report

A 23-year-old truck driver presented with chest pain, abdominal distention, bilateral pedal oedema for 2 months and progressive shortness of breath for 15 days. He was on anti-tubercular therapy for pulmonary TB, which was diagnosed a month prior to this presentation. The patient had no other comorbidities.

On examination, anasarca and left submandibular and jugular lymphadenopathy were noted. His jugular venous pressure was elevated, with a paradoxical rise on inspiration. Auscultation of the chest revealed muffled heart sounds and vesicular breath sounds of reduced intensity over the right hemithorax. Shifting dullness was noted on abdominal examination, indicating ascites. Contrast-enhanced computerised tomography (CECT) of the chest showed right-sided, moderate-to-gross pleural effusion and loculated effusion along the posterior wall of the left thoracic cavity with ground glass opacities in right middle lobe and bilateral lower lobes, with peribronchial cuffing that was suggestive of pulmonary oedema. It also showed a turbid pericardial collection of 12mm with associated thickening and enhancement of pericardium and features suggestive of right heart dysfunction (reflux of contrast into inferior vena cava and left hepatic vein in arterial phase).

Diagnostic thoracocentesis was performed and the analysis revealed an exudative effusion as per Light's criteria. Analysis of the ascitic fluid revealed elevated protein levels and a high serum ascites albumin gradient. Low-voltage complexes and generalised P-R interval depression were noted on electrocardiography.

Echocardiography (2D-ECHO) findings revealed pericardial thickening consistent with constrictive physiology, a ventricular septal shift, increased medial mitral annular velocity >9cm/sec, pericardial effusion, moderate mitral regurgitation (MR) and severe tricuspid regurgitation with an overall left ventricular ejection fraction (EF) of 50%.

The patient underwent a pericardiectomy via median sternotomy. Histopathological examination of the excised pericardium revealed granulomas with epithelioid cells and Langhans multinucleated giant cells (granulomatous inflammation) suggestive of TB. Follow-up echocardiography showed mild MR, with an EF of 60%.

Discussion

TBP can result from contiguous spread from a lung lesion, retrograde lymphatic spread from

paratracheal, peribronchial and mediastinal lymph nodes or hematogenous spread from a primary focus.

The immune response to MTB in the pericardium is key to the morbidity of TBP, with protein antigens inducing delayed hypersensitivity and stimulating lymphokines that activate macrophages, leading to granuloma formation.[4] This results in a dissociation between intrathoracic and intracardiac pressures, impairing left-sided diastolic filling, transmitral flow and increasing interventricular dependence. Echocardiography shows major restrictive physiology pattern, such as an increased (E) to late (A) ratio of mitral filling velocities and preserved or raised diastolic mitral annular relaxation velocity (e'). This manifestation of extrapulmonary TB poses a diagnostic challenge due to late presentation and multiple differentials. Early identification and pericardiectomy are critical for timely management.

Conclusion

It is imperative to investigate the clinical manifestations, diagnostic challenges and therapeutic outcomes in patients diagnosed with TB-associated constrictive pericarditis. Such studies will augment our comprehension and management of TBP and its related complications.

Figure 1: a) Contrast-enhanced computerised tomography (CECT) of chest axial section in soft tissue window showing diffusely thickened pericardium (predominantly anterior pericardium) with mild hyperdense pericardial collection, shown by red arrow; b) CECT of chest coronal section in soft tissue window showing thickened pericardium with mild hyperdense pericardial collection, shown by red arrow.

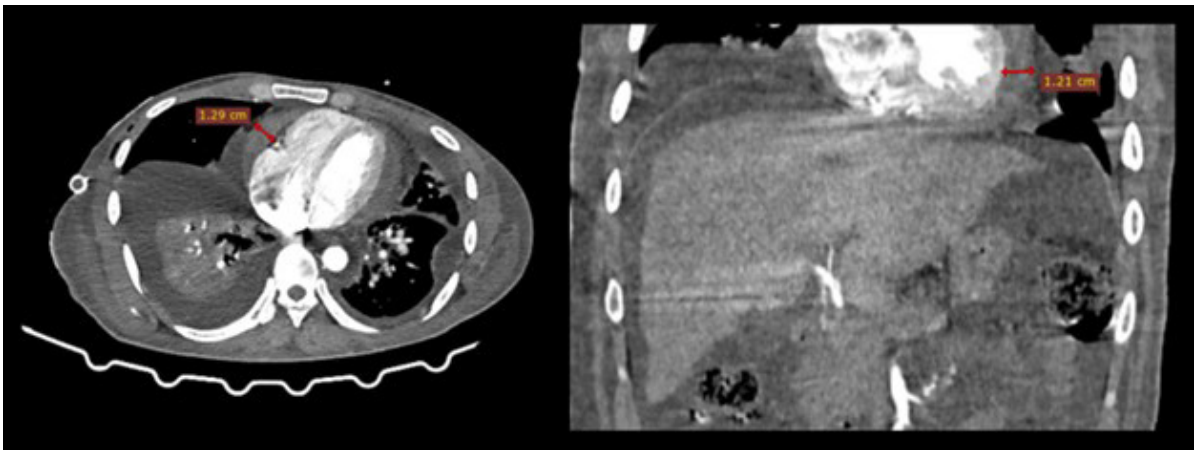
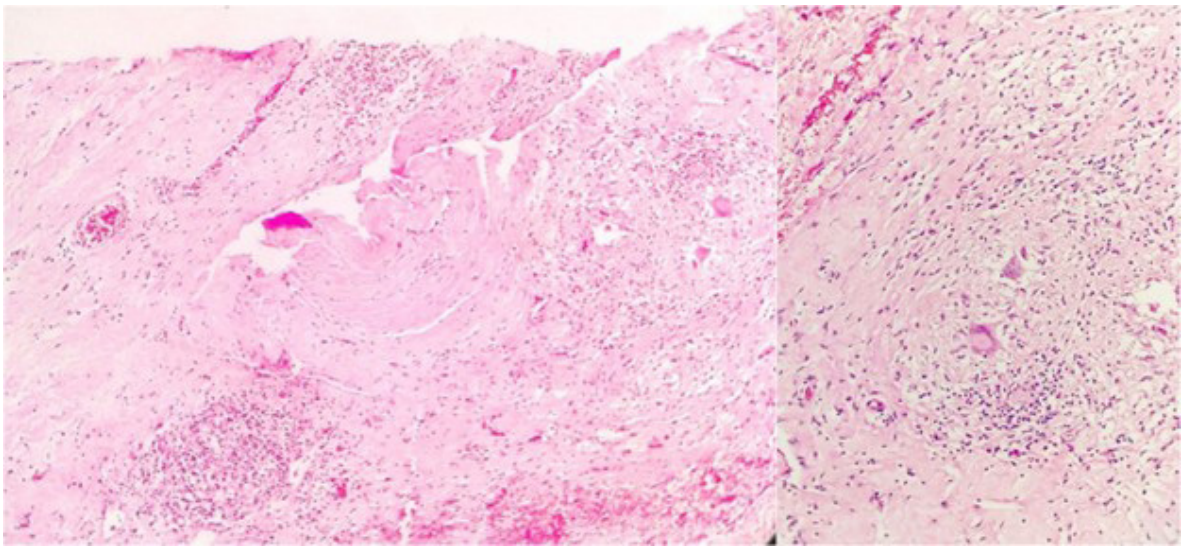


Figure 2: 10x and 40x magnification showing granulomas with epithelioid cells and Langhans multinucleated giant cells.



COMPETING INTERESTS
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URL
https://nzmj.org.nz/journal/vol-138-no-1620/granulomatous-heart-unmasking-tubercular-constrictive-pericarditis

REFERENCES
1. World Health Organization. Global tuberculosis report 2024 [Internet]. Geneva: World Health Organization; 2024 [cited 2025 May 2]. Available from: https://www.who.int/teams/global-programme-on-tuberculosis-and-lung-health/tb-reports/global-tuberculosis-report-2024
2. Wig N, Gupta A, Agrawal A, et al. Training Modules on Extrapulmonary Tuberculosis (2023) [Internet]. New Delhi: Central TB Division, Ministry of Health and Family Welfare, Government of India; 2023 [cited 2025 May 5]. Available from: https://tbcindia.mohfw.gov.in/wp-content/uploads/2023/05/7702334778Training_Module_on_Extrapulmonary_TB_-_Book_24032023.pdf
3. Wang S, Wang J, Liu J, et al. A case report and review of literature: Tuberculous pericarditis with pericardial effusion as the only clinical manifestation. Front Cardiovasc Med. 2022 Nov 2;9:1020672. doi: 10.3389/fcvm.2022.1020672.
4. Howlett P, Du Bruyn E, Morrison H, et al. The immunopathogenesis of tuberculous pericarditis. Microbes Infect. 2020 May;22(4-5):172-181. doi: 10.1016/j.micinf.2020.02.001.

Laparoscopic cholecystectomy after endoscopic gallbladder drainage: a case report

Fraser Welsh, Jasen Ly, Bernadette Goodwin, Christopher Tse, Frank Weilert

Endoscopic ultrasound (EUS) gallbladder drainage (EUS-GBD), described by Baron in 2007,[1] offers an alternative treatment option for patients with cholecystitis who might otherwise be managed with percutaneous cholecystostomy (PT-GBD). EUS-GBD may be a definitive intervention in patients who are unfit to undergo cholecystectomy. Like percutaneous cholecystostomy,[2] EUS-GBD could also be proposed as a bridging therapy to cholecystectomy. Cholecystectomy in the presence of a cholecystoduodenal fistula may provoke surgical concerns. The following work has been reported in line with surgical case report (SCARE) guidelines.[3]

Case report

A 70-year-old man with ischaemic heart disease, hypertension and dyslipidaemia presented with acute cholecystitis. Ultrasound showed a thick-walled gallbladder, impacted stones and normal ducts. Seven months before, he underwent percutaneous intervention (PCI) for cardiac disease, complicated by in-stent restenosis. Dual antiplatelet therapy (Aspirin and Ticagrelor) was recommended for 12 months. He was perceived to be high-risk for cholecystectomy and was offered EUS-GBD as an alternative.[4] During working hours, under EUS guidance, a fistula between duodenum and gallbladder was created with a cautery-tipped 10Fr cystotome, across which was deployed a fully covered lumen-apposing stent with saddle (HOT AXIOS) dilating to 10mm. Symptoms improved and he was discharged 2 days later.

Four weeks later the AXIOS stent was endoscopically exchanged for two double-pigtail (DP) 7Fr (2.33mm diameter) plastic stents. He remained well.

Twelve months after PCI, and 5 months after EUS-GBD, laparoscopic cholecystectomy was performed. The DP stents were removed using a standard gastroscope and a snare. During laparoscopy the cholecystoduodenal fistula was identified and isolated (Figure 1). The fistula was traversed and divided (Figure 2) using an endo-GIA stapler (Ethicon, 45mm purple cartridge [med-thick staple depth]). Cholecystectomy could then be completed in a routine fashion (Figure 3).

Discussion

EUS-GBD as a bridge to laparoscopic cholecystectomy has not previously been reported in New Zealand. EUS-GBD for malignant biliary obstruction has been demonstrated to be effective with low incidence of adverse events in New Zealand.[5] Overseas studies[6,7] have demonstrated similar technical and clinical success between EUS-GBD and PT-GBD with shorter hospital stays, lower pain scores and fewer repeat interventions or adverse events in the EUS-GBD group.

Some authors have recommended against EUS-GBD in patients where underlying comorbidity is reversible, citing a negative impact on minimally invasive cholecystectomy.[8] Pre-operative removal or exchange of AXIOS for smaller DP stents may mitigate against this, avoiding the need for technically challenging sutured closure of larger defects.

Saumoy et al[9] compared 13 patients undergoing cholecystectomy after EUS-GBD with 21 patients undergoing cholecystectomy after PT-GBD. There was no difference in rates of open and laparoscopic cholecystectomy (p=1) and no difference in post-surgical adverse events (p=0.23). Tyberg et al[10] described 43 patients who had cholecystectomy after EUS-GBD. Sixty-five percent were achieved laparoscopically, versus 71% of 93 patients completed laparoscopically after PT-GBD (p=0.07). A larger portion of cholecystectomies were begun open after EUS-GBD versus PT-GBD (23.9% vs 8.7%, p=0.07) at the operating surgeon's discretion.

EUS-GBD is an emerging treatment option for patients with cholecystitis in New Zealand. Timely cholecystectomy remains the standard of care for "fit" patients. Local utilisation has predominantly been as a "definitive" treatment for

patients deemed unfit for cholecystectomy. As experience with this technique evolves, it is likely that a demand may exist for cholecystectomy after EUS-GBD. Laparoscopic cholecystectomy following EUS-GBD can feasibly be performed, after appropriate surgical preparation. Exchange of lumen-apposing AXIOS for DP stents, followed by time for the tract to mature, can facilitate later laparoscopic surgery. This approach may be suitable for selected patients. Discussion between surgical and endoscopic teams to guide case selection is recommended. Ongoing monitoring for adverse events with this approach, particularly compared to cholecystectomy after PT-GBD, is appropriate.

Figure 1: Isolation of cholecystoduodenal fistula tract.

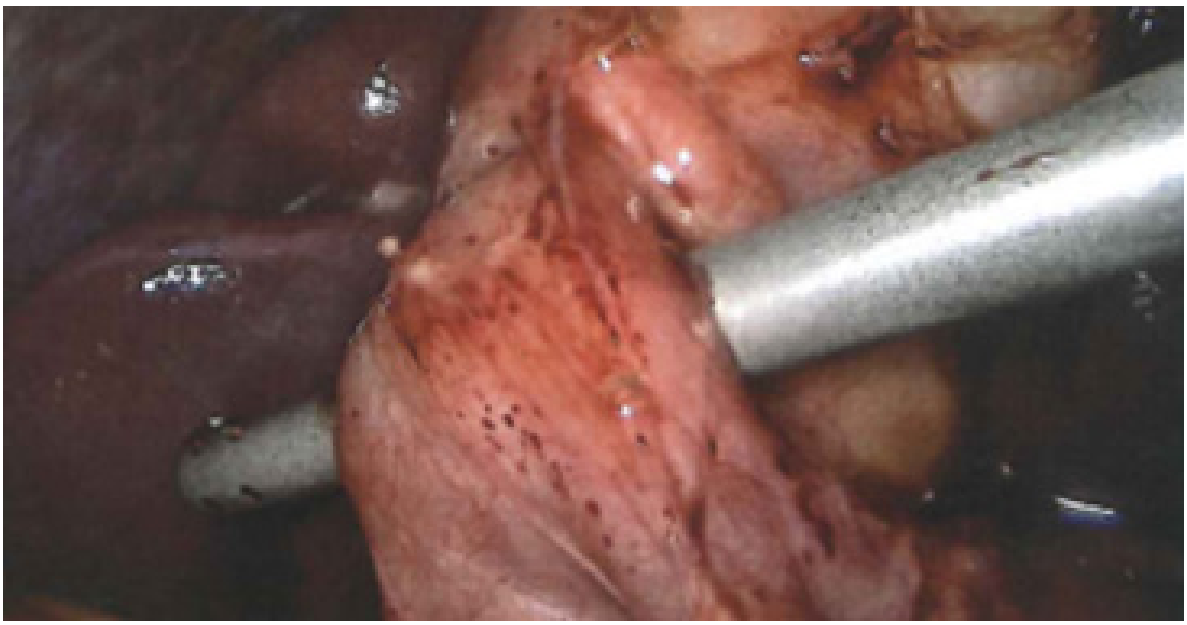


Figure 2: Division of fistula with endo-GIA stapler.

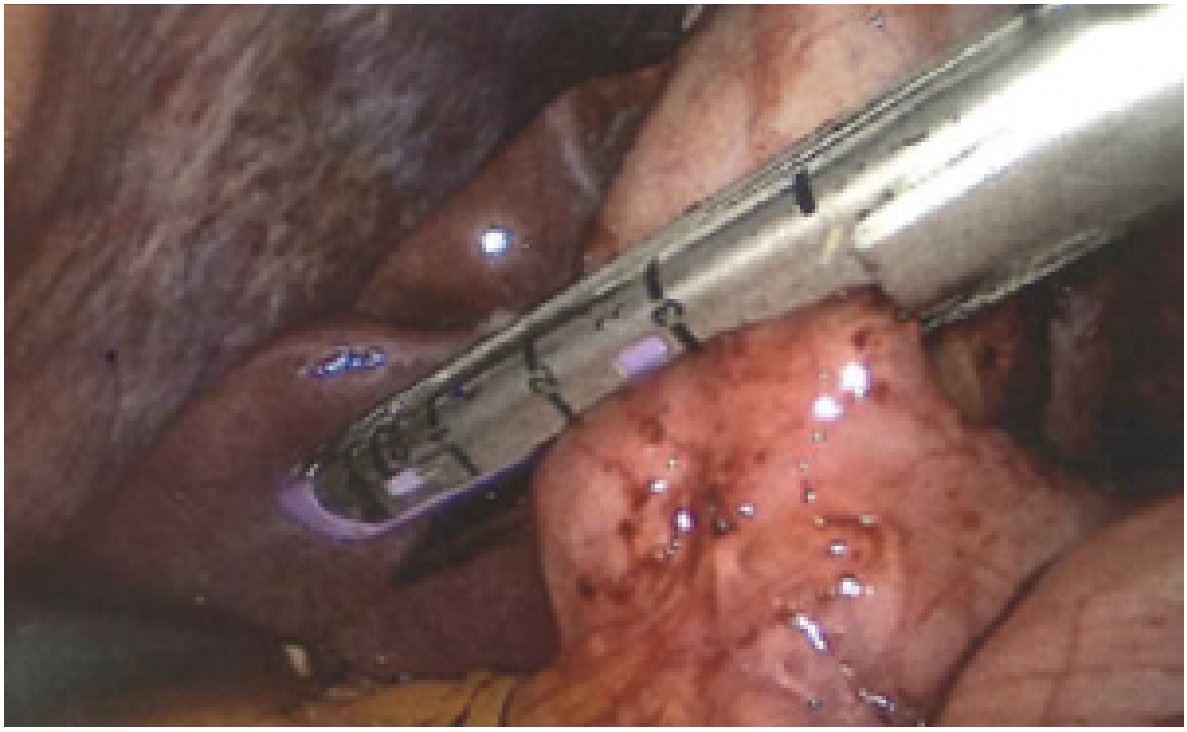
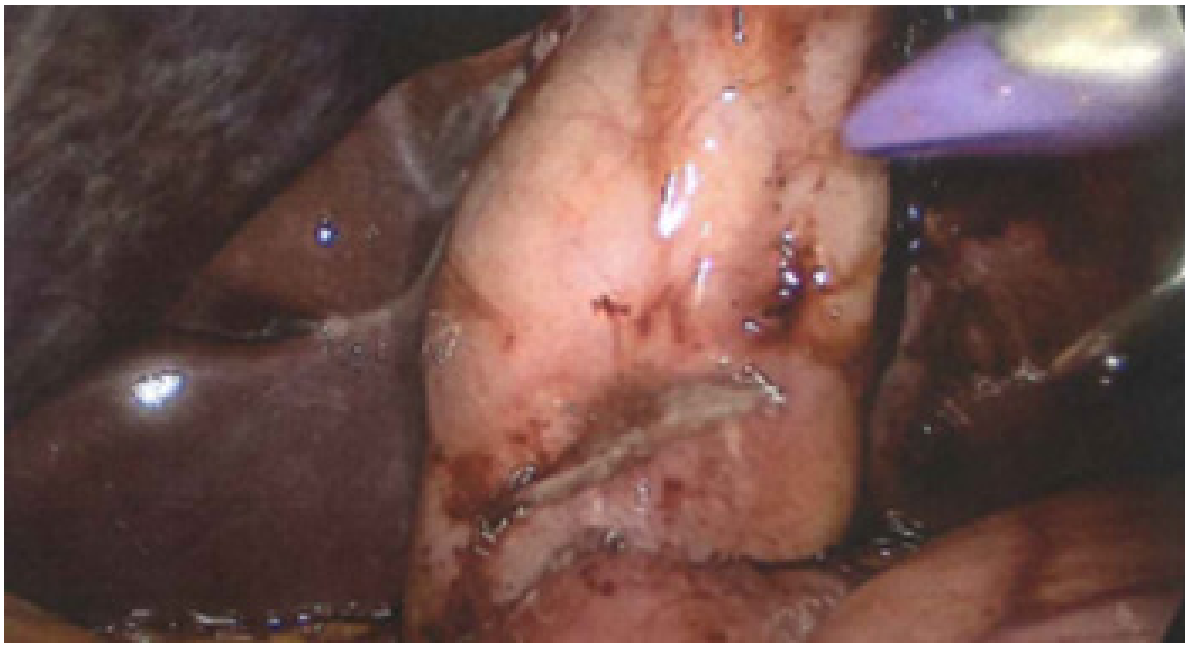


Figure 3: Fistula closed. Cholecystectomy can now proceed.



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REFERENCES
1. Baron TH, Topazian MD. Endoscopic transduodenal drainage of the gallbladder: implications for endoluminal treatment of gallbladder disease. Gastrointest Endosc. 2007 Apr;65(4):735-7. doi: 10.1016/j.gie.2006.07.041
2. Patterson EJ, McLoughlin RF, Mathieson JR, et al. An alternative approach to acute cholecystitis. Percutaneous cholecystostomy and interval laparoscopic cholecystectomy. Surg Endosc. 1996 Dec;10(12):1185-8. doi: 10.1007/s004649900275
3. Sohrabi C, Mathew G, Maria N, et al. The SCARE 2023 guideline: updating consensus Surgical CAse REport (SCARE) guidelines. Int J Surg. 2023 May 1;109(5):1136-1140. doi: 10.1097/JS9.0000000000000373
4. Vozzo CF, Simons-Linares CR, Abou Saleh M, et al. Safety of EUS-guided gallbladder drainage using a lumen-apposing metal stent in patients requiring anticoagulation. VideoGIE. 2020 Sep 4;5(10):500-503.e1. doi: 10.1016/j.vgie.2020.07.009
5. Chin JY, Seleq S, Weilert F. Safety and outcomes of endoscopic ultrasound-guided drainage for malignant biliary obstruction using cautery-enabled lumen-apposing metal stent. Endosc Int Open. 2020 Nov;8(11):E1633-E1638. doi: 10.1055/a-1236-3217
6. Ishii K, Fujita Y, Suzuki E, et al. The Efficacy and Safety of EUS-Guided Gallbladder Drainage as a Bridge to Surgery for Patients with Acute Cholecystitis. J Clin Med. 2023 Apr 8;12(8):2778. doi: 10.3390/jcm12082778
7. Irani S, Ngamruengphong S, Teoh A, et al. Similar Efficacies of Endoscopic Ultrasound Gallbladder Drainage With a Lumen-Apposing Metal Stent Versus Percutaneous Transhepatic Gallbladder Drainage for Acute Cholecystitis. Clin Gastroenterol Hepatol. 2017 May;15(5):738-745. doi: 10.1016/j.cgh.2016.12.021
8. Bang JY, Arnoletti JP, Wagner A, et al. EUS-guided gallbladder drainage in acute cholecystitis: long-term problems with surgical approach. Gut. 2024 Feb 23;73(3):395-397. doi: 10.1136/gutjnl-2023-331245
9. Saumoy M, Tyberg A, Brown E, et al. Successful Cholecystectomy After Endoscopic Ultrasound Gallbladder Drainage Compared With Percutaneous Cholecystostomy, Can it Be Done? J Clin Gastroenterol. 2019 Mar;53(3):231-235. doi: 10.1097/MCG.0000000000001036
10. Tyberg A, Duarte-Chavez R, Shahid HM, et al. Endoscopic Ultrasound-Guided Gallbladder Drainage Versus Percutaneous Drainage in Patients With Acute Cholecystitis Undergoing Elective Cholecystectomy. Clin Transl Gastroenterol. 2023 Jun 1;14(6):e00593. doi: 10.14309/ctg.0000000000000593

Manaaki Mamao—to care from a distance: evaluating a telehealth service for Māori and Pacific peoples with hypertension

Tiffany Neary, Kwan-Lyn Lim, Vola Betham, Nick Coley, Sarah Maessen

Life expectancy is 6.6 and 6.1 years shorter for Māori and Pacific peoples, respectively, compared to the non-Māori/non-Pacific population of Aotearoa New Zealand (Aotearoa). Cardiovascular disease (CVD) is the largest avoidable contributor to this health gap.[1]

Hypertension (raised blood pressure [BP]) is a major CVD risk factor, with higher BP exponentially increasing risk for coronary heart disease and stroke.[2] Conversely, effective BP management reduces this risk dramatically.[3] In Aotearoa, hypertension is managed in primary care, but over a quarter of New Zealanders have unmet primary healthcare needs due to long waits or cost.[4] Māori and Pacific peoples are more likely to have a hypertension diagnosis and also face greater barriers to primary healthcare access.[4] Accessible CVD risk-management programmes for these groups are therefore essential, with research showing that respectful, reciprocal communication and relationships are critical to culturally safe cardiac care.[5]

Telemonitoring services utilise clinician-led education and interactive digital interventions to enhance hypertension management through improved monitoring and health literacy.[6] Manaaki Mamao is a 6-month telehealth-based programme delivered by Hato Hone St John that aims to reduce health inequities for Māori and Pacific peoples by taking a culturally safe, people led and technology enabled approach to hypertension management. It supports home-based hypertension monitoring and management with flexibility to meet individuals' needs. The aim of this study was to evaluate patient outcomes and engagement with Manaaki Mamao over the first 2 years of the programme.

Methods

Manaaki Mamao

Manaaki Mamao was developed in consultation with Māori and Pacific peoples, who highlighted the importance of feeling heard and validated.

Patients are referred to Manaaki Mamao by hauora Māori providers and GPs. Enrolled patients receive a pre-provisioned electronic tablet, a paired BP monitor (Andesfit ADF-B180 or ADF-B19) and face-to-face training in their use. Patients are encouraged to take daily BP measurements. The tablet supports scheduled video consultations, health literacy content, medication reminders, messaging, and check-in calls from Hato Hone St John clinicians, who are available for questions or concerns throughout the programme. Health education content includes regularly updated resources on healthy diets, lifestyle choices and other topics relevant to hypertension management. This content is reinforced with personalised advice from the Manaaki Mamao clinical advisor by video or audio call.

Each participant receives a personalised care plan tailored to their specific health needs. BP medication is managed by the patient's GP, who remains the primary healthcare provider throughout the programme. Clinical advisors do not advise on medication changes, but may initiate medication revisions through referrals to the GP, including a detailed summary of patient BP data to support clinical decision making. If urgent concerns arise, a clinician will contact the GP directly.

Engagement with Manaaki Mamao clinicians and referrals to other services are based on BP readings and patient preferences, established at programme entry and revised as needed. More information about Manaaki Mamao can be found on the website.[7]

Participants

All patients referred to Manaaki Mamao between 13 December 2021 and 15 December 2023 were included in this retrospective evaluation. Referral was open to Māori or Pacific peoples

aged 18 years or older with uncontrolled hypertension and on hypertensive medication. Patients with BP consistently higher than 180/110mmHg, resistant hypertension (uncontrolled hypertension despite three or more antihypertensive medications), chronic kidney disease (CKD) stage 4–5 or unmanaged by GP (likely too medically unstable for community BP management), terminal illness, pregnant or breast feeding, postural hypotension, atrial fibrillation, or an acute cardiovascular event in the previous 3 months were not eligible for referral. Patients' other relevant medical diagnoses and current medications were included in the referral.

Data and analysis

Patient referrals to the programme, and from the programme to other services, were recorded. Patient demographics included gender, age and ethnicity. Systolic and diastolic BP was recorded as a weekly mean from patient readings across the 26 weeks of the programme. Participants were grouped by whether they had mean blood pressure readings for at least 13 of the 26 weeks (strong engagement), or for fewer than 13 weeks (light engagement). Descriptive statistics were calculated for patient characteristics. Paired Samples *t*-Tests were used to compare patients' first and last recorded mean systolic and diastolic BP for all participants and for strong and light engagement groups. Mean change in systolic and diastolic BP from first to last recorded reading was compared between engagement groups using Independent Samples *t*-Tests. All statistical analysis used SPSS v29 (IBM), with significance at $p<.05$ (two-sided).

Ethics

This study was approved by the Northern B Health and Disability Ethics Committee (2024 FULL 19004).

Results

There were 173 referrals to Manaaki Mamao in the 24 months, and 143 were successfully onboarded to the programme. At least one weekly BP reading was available for 139 patients.

Sixty-nine percent of patients remained in the programme for 6 months, with a median of 26 weeks in the programme (range 1–26). The median number of weeks with no BP recordings was 5 (range 0–26). Seventy-one referrals were made from the programme to other services.

Overall, participants' last recorded mean weekly systolic BP was an average of 7.78mmHg lower than the first (Table 3). On average, those with strong engagement had a systolic BP decrease of 9.9mmHg and diastolic BP decrease of 6.5 over the programme, while those with light engagement had no statistically significant change in mean BP across their time in the programme (Table 3).

Table 1: Manaaki Mamao patient characteristics.

Characteristic		Enrolled (n, % of total)	Remaining in programme for 26 weeks (n, % retained)
Gender	**Female**	100 (70%)	73 (73%)
	Male	43 (30%)	26 (60%)
Age (years)	**31–40**	5 (3%)	3 (60%)
	41–50	25 (17%)	15 (60%)
	51–60	41 (29%)	30 (73%)
	61–70	45 (31%)	36 (80%)
	71–80	18 (13%)	8 (44%)
	81–90	3 (2%)	3 (100%)
	Missing	6 (4%)	4 (67%)
Ethnicity	**Māori**	61 (43%)	44 (72%)
	Pacific peoples	45 (32%)	36 (80%)
	Other/missing	37 (26%)	19 (51%)
Total		143	99

Table 2: Mean systolic and diastolic blood pressure of Manaaki Mamao participants at programme entry and exit.

		First recorded BP		Last recorded BP	
		Systolic m(SD)	Diastolic m(SD)	Systolic m(SD)	Diastolic m(SD)
All participants		151.8 (17.6)	90.0 (13.6)	144.0 (18.3)	84.5 (13.3)
Gender	**Female**	151.0 (18.1)	88.3 (13.4)	143.9 (18.8)	82.7 (13.1)
	Male	153.6 (16.4)	93.7 (13.2)	144.2 (17.4)	88.4 (13.1)
Age (years)	**31–40**	160.6 (15.0)	105.0 (5.1)	149.2 (14.3)	93.8 (16.4)
	41–50	154.8 (17.8)	97.5 (12.9)	140.6 (16.8)	86.2 (11.1)
	51–60	149.5 (19.5)	91.4 (12.2)	141.8 (17.5)	87.9 (12.5)
	61–70	150.0 (17.3)	85.8 (12.6)	144.3 (17.9)	81.3 (13.2)
	71–80	151.1 (14.1)	81.0 (14.7)	147.4 (16.4)	78.1 (12.3)
	81–90	161.3 (9.0)	91.3 (12.6)	142.7 (15.0)	79.7 (20.3)
Ethnicity	**Māori**	151.4 (21.3)	89.7 (11.1)	144.5 (18.5)	84.8 (12.1)
	Pacific peoples	153.4 (16.7)	91.6 (15.2)	144.3 (19.2)	83.8 (13.7)
	Other/missing	150.4 (21.3)	88.4 (14.6)	142.7 (17.5)	84.8 (12.1)

Table 3: Mean systolic and diastolic blood pressure and change over time by programme engagement.

	All participants	Strong engagement	Light engagement
N	139	106	33
Systolic BP mmHg m(SD)			
First	151.8 (17.6)	150.9 (16.8)	154.7 (19.7)
Last	144.0 (18.3)	141.0 (17.1)	153.7 (19.0)
Change	-7.8 (18.0)[a]	-9.9 (17.7)[a]	-1.0 (17.4)[b]
Diastolic BP mmHg m(SD)			
First	90.0 (13.6)	89.0 (12.9)	93.0 (15.4)
Last	84.5 (13.3)	82.5 (12.6)	90.8 (13.9)
Change	-5.4 (11.6)[a]	-6.5 (10.7)[a]	-2.3 (13.7)[b]

BP = blood pressure.
Strong engagement: those with at least 13 weekly BP readings.
Light engagement: those with fewer than 13 weekly BP readings.
[a]p<.001 for comparison between first and last measurement using paired *t*-Test.
[b]p<.05 for comparison of BP change between high and low engagers using Independent Samples *t*-Test.

Discussion

Over 80% of the 173 referrals to Manaaki Mamao were successfully onboarded, with 69% completing 6 months in the programme. Most participants were from target ethnicity groups, but referral forms did not always differentiate between Māori and Pacific ethnicity. BP reduced significantly over this period, with the strong engagement group experiencing a reduction in systolic and diastolic BP of 9.9mmHg and 6.5mmHg, respectively. This reduction aligns with studies demonstrating a 10mmHg drop in systolic and 5mmHg in diastolic BP is clinically significant, reducing coronary artery disease risk by more than 20%[8,9] and cerebrovascular events by 20–40%.[3,8]

Though we were unable to assess causality in this study, BP reductions were likely due to a combination of education, increased monitoring, improved medication adherence and regular medication review. We were unable to find literature about comparable interventions with a focus on Māori and/or Pacific peoples. However, a Turkish study demonstrated that individualised hypertension, lifestyle, and medication education sessions across a 9-month period resulted in greater medication adherence and significantly reduced BP compared to usual care.[10] A recent integrative review emphasized the effectiveness of education as part of hypertension treatment, as well as the importance of information that is tailored to and delivered in the community. Meta-analysis demonstrated that this education, when combined with consistent personalised communication via messages or phone calls, had a moderate to large effect on sustained lifestyle change, blood pressure reduction, and overall improved cardiovascular health.[11] Home BP monitoring alone has also been shown to have additional modest positive effects on BP.[12]

CVD is estimated to cost the Aotearoa health system NZ$3.3 billion annually, with high systolic BP contributing the largest health loss.[13] In general, telehealth interventions can produce equal or better outcomes compared to in-clinic care.[14] The present study demonstrates their potential in the setting of hypertension management in Aotearoa, addressing a health burden that falls disproportionately on Māori and Pacific peoples.

In 2023/2024, 25% of Māori and 38% of Pacific adults reported unmet health needs due to long wait times to see a GP, with both groups also more likely to face cost and transport barriers.[4] Manaaki Mamao brings care into the home, eliminating these barriers and easing burden on primary care services while providing a clinical safety net for incidental findings. High engagement and retention rates indicate the programme was acceptable for the majority of patients referred.

Limitations and future directions

This evaluation used data that was routinely collected in the delivery of the programme, meaning patient satisfaction, improvements to health literacy, and medication adherence could not be examined. It was not possible to formally evaluate the reasons why the programme was not successful for participants with light engagement, but this group includes some patients who left the programme because they no longer met inclusion criteria (e.g., did not appear to have hypertension after being monitored at home). While Manaaki Mamao shows promise for scale throughout Aotearoa, additional data including qualitative assessment of the patient experience, impacts on health literacy, and durability of health improvements are recommended.

Conclusion

Manaaki Mamao successfully onboarded 143 patients in the first 24 months of delivery, providing an accessible and effective option to manage hypertension for patients not achieving this in primary care. Participants experienced reductions in BP at levels likely to significantly reduce cardiovascular risks, however outcomes were dependent on engagement with the programme. This telehealth model shows promise for reducing inequities in cardiovascular health outcomes if implemented on a wider scale.

COMPETING INTERESTS
All authors are employed by Hato Hone St John. TN is involved in clinical delivery of Manaaki Mamao. The authors have no further conflicts of interest to declare.

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REFERENCES
1. Life Expectancy in Aotearoa New Zealand: An Analysis of Socioeconomic, Geographic, Sex and Ethnic Variation from 2001 to 2022 [Internet]. Health New Zealand – Te Whatu Ora. November 2024 [cited 2025 February]. Available from: https://www.tewhatuora.govt.nz/publications/life-expectancy-in-aotearoa-an-analysis-of-socioeconomic-geographic-sex-and-ethnic-variation-from-2001-to-2022
2. Fuchs FD, Whelton PK. High Blood Pressure and Cardiovascular Disease. Hypertension. 2020 Feb;75(2):285-292. doi: 10.1161/HYPERTENSIONAHA.119.14240
3. Carey RM, Moran AE, Whelton PK. Treatment of Hypertension: A Review. JAMA. 2022 Nov 8;328(18):1849-1861. doi: 10.1001/jama.2022.19590
4. Ministry of Health – Manatū Hauora. Annual Data Explorer: New Zealand Health Survey [Internet]. November 2024 [cited 2025 February]. Available from: https://minhealthnz.shinyapps.io/nz-health-survey-2023-24-annual-data-explorer/_w_71cc3992c64940e9bdade554ccb863bc/#!/home
5. Brewer KM, Taueetia-Su'a T, Hanchard S, et al. Māori and Pacific families' experiences and perspectives of cardiovascular care; A qualitative study. Aust N Z J Public Health. 2024 Jun;48(3):100149. doi: 10.1016/j.anzjph.2024.100149
6. Kitt J, Fox R, Tucker KL, et al. New Approaches in Hypertension Management: a Review of Current and Developing Technologies and Their Potential Impact on Hypertension Care. Curr Hypertens Rep. 2019 Apr 25;21(6):44. doi: 10.1007/s11906-019-0949-4
7. Manaaki Mamao - to care from a distance [Internet]. Hato Hone St John. [cited 2025 February 28]. Available from: https://www.stjohn.org.nz/medical-alarms/manaaki-mamao/?srsltid=AfmBOoqaAxPCiD5rtOgUJ8erDN-udPjQp-8P7E1YLiEjnAaqwYsGNt1-n.d.
8. Volpe M, Gallo G, Tocci G. Is early and fast blood pressure control important in hypertension management? Int J Cardiol. 2018 Mar 1;254:328-332. doi: 10.1016/j.ijcard.2017.12.026
9. Law M, Wald N, Morris J. Lowering blood pressure to prevent myocardial infarction and stroke: a new preventive strategy. Health Technol Assess. 2003;7(31):1-94. doi: 10.3310/hta7310
10. Hacihasanoğlu R, Gözüm S. The effect of patient education and home monitoring on medication compliance, hypertension management, healthy lifestyle behaviours and BMI in a primary health care setting. J Clin Nurs. 2011 Mar;20(5-6):692-705. doi: 10.1111/j.1365-2702.2010.03534.x
11. Tam HL, Wong EML, Cheung K. Effectiveness of Educational Interventions on Adherence to Lifestyle Modifications Among Hypertensive Patients: An Integrative Review. Int J Environ Res Public Health. 2020 Apr 7;17(7):2513. doi: 10.3390/ijerph17072513
12. Cappuccio FP, Kerry SM, Forbes L, et al. Blood pressure control by home monitoring: meta-analysis of randomised trials. BMJ. 2004 Jul 17;329(7458):145. doi: 10.1136/bmj.38121.684410.AE. Epub 2004 Jun 11. Erratum in: BMJ. 2004 Aug 28;329(7464):499
13. Wilson N, Cleghorn C, Nghiem N, et al. Prioritization of intervention domains to prevent cardiovascular disease: a country-level case study using global burden of disease and local data. Popul Health Metr. 2023 Jan 26;21(1):1. doi: 10.1186/s12963-023-00301-1
14. Snoswell CL, Chelberg G, De Guzman KR, et al. The clinical effectiveness of telehealth: A systematic review of meta-analyses from 2010 to 2019. J Telemed Telecare. 2023 Oct;29(9):669-684. doi: 10.1177/1357633X211022907. Epub 2021 Jun 29. Erratum in: J Telemed Telecare. 2024 Dec;30(10):1667. doi: 10.1177/1357633X241262510

John Scott Werry

Tēnā koutou katoa,

It is with great sadness that we acknowledge the passing of Emeritus Professor John Scott Werry, CNZM.

Professor Werry, a child and adolescent psychiatrist, was the foundation professor of psychiatry at the Auckland School of Medicine and worked at the university from 1970 to 1991 after doing his medical training at Otago University and his psychiatry training at McGill University in Canada. Professor Werry held academic positions at McGill, the University of Illinois and the University of Chicago before returning to New Zealand to take up his position at The University of Auckland. He published widely, particularly in the fields of behavioural difficulties and psychopharmacology, with over 180 publications, including two highly regarded and widely used textbooks, one on psychopathology and one on psychopharmacology. He contributed to the development of the DSM diagnostic system, which is still used widely in clinical practice internationally. He had a keen intellect and strongly supported evidence-based practice before this became well-established and at a time when psychoanalysis was to the fore in psychiatry.

Professor Werry also encouraged several colleagues into research careers, both in New Zealand and in the United States. He encouraged and supported colleagues to apply for funds, and to carry out research in important and neglected areas. His vision for a centre for research excellence and high-quality training in child and adolescent mental health was realised in the establishment, by others, of the Werry Centre for Infant Child and Adolescent Mental Health. The naming of the Centre was supported by many, particularly by Māori advisors, to recognise his

considerable support of rangitahi and tamariki. The Centre grew from a small start in early times to two centres, one for research and teaching within the Faculty, Te Aro Hāra, and one under Uniservices for national workforce development, Whāraurau. Both are driven by the fundamental aim to work in accordance with Te Tiriti, with a multi-disciplinary focus and stressing the importance of taking an evidence-based approach to the delivery of care. He was well known by various ministers over the years for his strong advocacy for the rights of young people with mental health difficulties. His keen, and at times acerbic, wit and his strong advocacy never left you in doubt where you stood. His core mission was to deliver the best care possible for all people with mental health difficulties in New Zealand, and especially for children and adolescents.

Alongside his academic position, Professor Werry worked clinically, establishing a network of child and adolescent outpatient services alongside the in-patient facility in Auckland. He was also influential in the establishment of Youth Horizons Trust (now Kia Puāwai) for young people with behavioural difficulties. After 21 years in an academic position, he retired from the university as he was keen to improve psychiatric clinical practice in New Zealand. He worked in many sites across New Zealand, filling vacant positions until a definitive appointment could be made, mostly in rural and remote areas where psychiatry services were difficult to access. He also worked in NGOs, most notably Ngati Porou Hauora in the remote East Coast and Te Korowai Hauora o Hauraki.

Although child and adolescent mental health services are under constant pressure, his hard work, his desire for excellence and his vision have ensured that our mental health services have been set on a strong foundation that compares favourably internationally, and from which improvements can be made.

Professor Werry leaves behind his wife, Dianne Moffit, his five children, 12 grandchildren and three great grandchildren.

Kua hinga te tōtara i te wao nui a Tāne.

Ngā mihi nui,

Professor Warwick Bagg

Professor Emeritus Sally Merry

AUTHOR INFORMATION

This obituary was written by Professor Warwick Bagg, Manukura Mātauranga Hauora Dean, Faculty of Medical and Health Sciences, The University of Auckland, and Professor Emeritus Sally Merry, Te Ara Hāro Centre for Infant Child and Adolescent Mental Health, Department of Psychological Medicine Faculty of Medical and Health Sciences, The University of Auckland.

Des Gorman

Tēnā koutou katoa,

It is with immense sadness that we acknowledge the passing of Emeritus Professor Des Gorman (Ngāti Kuri and Ngāpuhi).

An alumnus of Waipapa Taumata Rau, Des started as an associate professor in occupational medicine at the University of Auckland School of Medicine in 1995 before being promoted to professor (personal chair). He later took on the role of head of the school of medicine, the first University of Auckland graduate to hold that role, and then the role of associate dean—health workforce. Des was deeply committed to the selection and development of a suitable health workforce for Aotearoa, serving as director of medical admissions here.

During his early career, Des served in the Royal Australian Navy and the Royal New Zealand Navy. He also worked as the medical director of the Royal Adelaide Hospital Hyperbaric Medicine Unit. His extraordinary record of teaching and research in diving and hyperbaric medicine has cemented an enduring legacy as one of the field's most influential figures of modern times. His research on the pathophysiology of arterial gas embolism was innovative and groundbreaking and is still frequently cited 35 years later. His articulate commentary and incisive wit ensured he was a sought-after speaker at international meetings and a presence in all the field's standard-setting workshops and textbooks.

Des inspired multiple young doctors and scientists towards doctoral degrees. In that regard, Des would want mention to be made of the special relationship he developed with the Royal Navy of Oman, from where a series of young medical officers came to Aotearoa to train with him. Decades later several of these young doctors, along with many other students, still reflect on the debt of gratitude owed to Des in their

personal development.

Among his many professional achievements, Des was the chairman of the Oranga Mahi Governance Group (the New Zealand Ministry of Social Development's health initiatives), the chairman of the Strategy and Impact Committee of Mahitahi Hauora (the primary care provider in Northland) and the chairman of the Diving Industry Advisory Group (DIAG) for WorkSafe New Zealand. He served for a decade as the executive chairman of Health Workforce New Zealand, during which time he publicly and rigorously outlined the workforce issues facing Aotearoa and how these might be addressed. Legacy effects of his work include a new national Resident Medical Officers (RMO) agency and a promising project to build the general practice career development pathway from medical school, through internship to general practitioner training and beyond.

He also founded the 24-hour Diver Emergency Service (DES) in Australia, Aotearoa and the South Pacific.

After retiring in 2020, Des became an honorary professor and then was awarded the title of professor emeritus. Des was a dedicated family man, and colleagues were never in doubt that his family was the heart of his life.

We extend our deepest sympathies to his wife Christine, daughters Anna, Sarah and Emily, and his mokopuna.

Moe mai rā e te rangatira.

Ngā mihi nui,

Professor Warwick Bagg

Professor Phillippa Poole

Professor Simon Mitchell

AUTHOR INFORMATION

This obituary was written by Professor Warwick Bagg: Manukura Mātauranga Hauora Dean, Faculty of Medical and Health Sciences, Professor Phillippa Poole: Head of the School of Medicine, and Professor Simon Mitchell: Head of the Department of Anaesthesiology, School of Medicine, University of Auckland.

Blood Transfusion

By JAMES A. JENKINS, Ch.M., F.R.C.S.

The task which I have the privilege of performing is to give a paper on "Blood Transfusion" which will cover: Firstly, a method of testing the suitability of bloods of the prospective donors in the absence of any laboratory facilities; and, secondly, a simple method of performing transfusion which requires neither any high degree of technical skill nor any special apparatus. Success in blood transfusion depends entirely on careful attention to detail, and I ask to be forgiven if I mention points that are well known to most of you present.

I shall consider first the methods of testing for donors. In order to make my paper as practical as possible I have distributed 25 outfits for testing. If at the termination of the paper those interested will carry out the steps I indicate later on, I think they will learn much more as regards the technique than I can put before them verbally.

You are all aware of the four blood groups into which human beings fall, and the relationship of the various groups to one another in transfusion. Many of you will have seen how groups are ascertained by testing with the known sera of Groups II. and III. This method of typing bloods I am not going to discuss further, except to say that having got a Group IV., the so-called universal donor, or a donor whose blood is compatible according to the Moss blood grouping, it is still necessary to do a direct test of the patient's serum to the proposed donor's corpuscles. This necessity depends on the following facts:—(1) Occasional incompatibility of persons of apparently the same Moss group. There is evidence that the four main groups can be further subdivided. (2) Patients suffering from severe anæmias, cachectic persons, patients suffering from malignant disease, are liable to prove incompatible with certain members of their own group. (3) A patient may apparently change his group after one transfusion, due to the development of aggluterins in his serum.

I have twice transfused patients with blood from the wrong group. The first case was one of profuse hæmorrhage from a perforated splenic artery into the base of a gastric ulcer. The patient was blanched, pulseless and quite unconscious. His daughter was with him, and I took one pint of her blood and transfused this together with some saline. I made no attempt to test the compatibility of the bloods. I might mention here that the chances of any donor being suitable are well over 50 per cent. In this case the patient became conscious a few minutes after the transfusion had started, and colour and pulse came back. A severe rigor 15 minutes after the transfusion was the only clinical ill effect.

The cause of error in the second case was due to inert II. and III. serum, and the donor necessarily appearing to be a Group IV., whereas he was really Group III. and the recipient Group II. Immediately after the transfusion commenced, the recipient complained of pain and a sense of pressure on the chest, and of severe headache. The pulse became weak and rapid. I stopped the flow and she improved, and the remainder of the blood was given more slowly. A few minutes later she had a severe rigor, dyspnœa, and pain in the back. Next day the urine was dark, due to hæmoglobinuria resulting from blood destruction. In this case the hb. rose from 15 per cent. to 35 per cent. in spite of the use of the wrong group and the blood destruction.

Except in great emergency, I would not now do a transfusion without directly testing the donor's corpuscles to the recipient's serum. This can be done by anyone without knowledge of blood groups.

The method in use is:—(1) Take 2 c.c. of blood from a vein of the recipient. This is best done with a hypo. springe and needle. Let it clot in a small test tube. Serum separates in the cold in ½ to 1 hour and more rapidly if kept warmed. [I have distributed serum—group unknown—and you can use this as representing the serum of the patient to be transfused.] (2) Take the prospective donor and clean either the lobe of the ear or the thumb with methyl. spirits. Prick and get one to two drops of blood and let it run into the tube containing 1 c.c. of normal saline. Shake and mix. (3) Take a clean piece of glass, microscope slide or white glazed china. With a pipette take up 2 drops of recipient's serum and run this on to the glass. Wash the pipette and then take two drops of the recipient's serum and run this on to the glass. Wash the pipette and then take two drops of the saline corpuscle mixture. Run this on to the serum and

let mix. The serum corpuscle mixture should be a decidedly reddish tint due to the blood present. (4) Gently rock the slide at intervals until agglutination or 15 minutes has elapsed. Agglutination usually occurs in 3 to 5 minutes and is recognised by a coarse brick-dust-like deposit being formed. This is due to large aggregations of red cells. They float on a clear field of serum and saline, and are not broken up by rocking the slide. If this agglutination occurs, the donor is unsuitable and another one will have to be tested. If no agglutination occurs the corpuscles remain evenly spread throughout the drop of fluid. Do not mistake for agglutination their settling together on a slide that has been left at rest. Sometimes they sink in the fluid, and give a false appearance of clumping, but on rocking the slide they spread evenly through it and no brick-dust-particles are seen. If no clumping occurs, the donor is a suitable one, insofar as compatibility of blood is concerned. It is not necessary to mention that the choice of donor should not fall on anyone suffering from tuberculosis, syphilis, and other contagious diseases.