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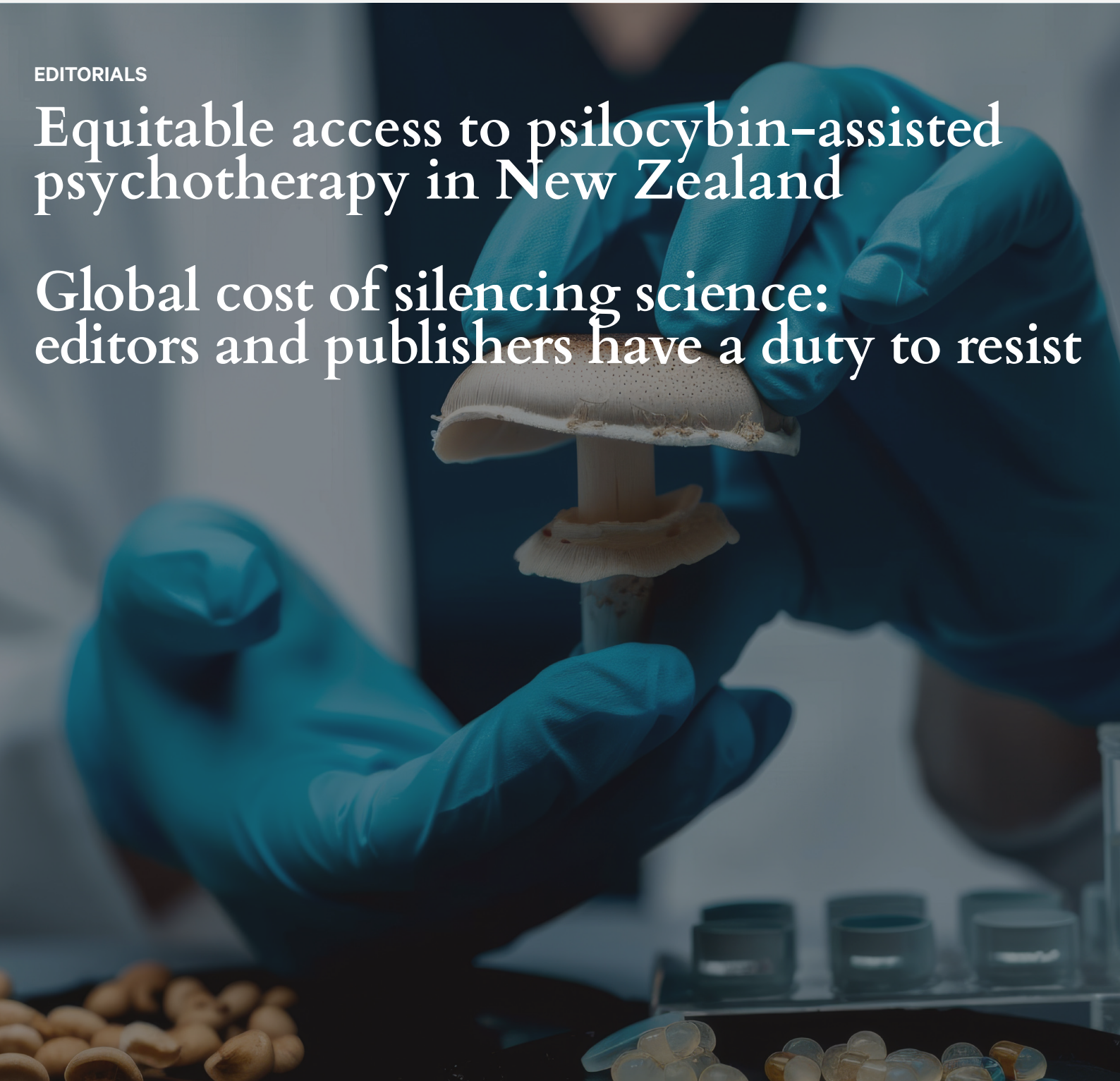

EDITORIALS

Equitable access to psilocybin-assisted psychotherapy in New Zealand

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The recent announcement by the Honourable David Seymour approving the clinical use of psilocybin-assisted therapy for treatment-resistant depression (TRD) has placed New Zealand on the global map, joining a handful of countries at the forefront of psychedelic medicine. There has been intense public, professional and media interest; stories in the *New York Times*, *Time Magazine*, *Stuff* and *Radio New Zealand* have captured imaginations and raised expectations across the country. But with this attention comes a significant challenge: to ensure that this emerging treatment does not become the preserve of the privileged few but is available equitably to all New Zealanders who need it.

Global cost of silencing science: editors and publishers have a duty to resist

Frank Frizelle, Kamran Abbasi, Vivienne C Bachelet, Christopher Baethge, Sabine Kleinert, Jin-Hong Yoo, Lilia Zakhama

Public trust in scientific integrity is eroded by the politicisation of institutions under Donald Trump's United States (US) presidency. The implications extend far beyond US borders, striking at the core of how scientific knowledge is produced, disseminated and trusted worldwide.

Systemic anti-cancer treatment for Māori with stage III and IV non-small cell lung cancer in Aotearoa New Zealand

Kelson Tu'akoi, Janice Wong, Ha Nguyen, Chunhuan Lao, Mark Elwood, Mark McKeage, Ross Lawrenson

Lung cancer is the leading cause of cancer death in Aotearoa New Zealand. Māori are more likely to be diagnosed with non-small cell lung cancer (the most common type of lung cancer), and have lower survival compared with non-Māori. We analysed the use of systemic anti-cancer therapy (which includes treatments such as chemotherapy and other medication-based treatments) for Māori compared with non-Māori to assess if this was a reason for lower survival in Māori. We found no difference in overall use of systemic anti-cancer therapy for Māori patients. However, we did find that Māori were less likely to receive targeted therapy (a type of systemic anti-cancer therapy, which is superior to chemotherapy in appropriately selected patients).

Understanding mental health risk in Aotearoa: an analysis of the 1737 Need to Talk telehealth service

Miriama K Wilson, Fiona Pienaar, Ruth Large, David Codyre, Verity F Todd

The 1737 Need to Talk telehealth service (mental health call and text helpline) was launched in Aotearoa New Zealand in June 2017, providing the public with the ability to call or text when they need mental health support. The aim of this research is to describe the utilisation of the 1737 Need to Talk telehealth service. The study details the growth in the number of specific demographics reaching out for mental health support to 1737 and may be indicative of the need for increasing mental health support.

Evaluation of a facility-specific, prehospital transport policy for trauma patients in a health region of New Zealand

Alastair Smith, Sheena Moosa, Grant Christey

An essential component of trauma systems that provide care for injured patients is the prehospital transport of patients with severe injuries to those facilities best able to provide the required specialised care. The Te Manawa Taki (TMT) Region implements a regional destination policy customised to the known capabilities and capacities of hospitals in the TMT Region of Aotearoa New Zealand to ensure injured patients are transported to the right facilities with the shortest time. This study examined the implementation of this policy in the TMT Region. We observed that 76% of the injured patients were transported consistent with the designated facility in the TMT destination policy.

Low-density lipoprotein cholesterol management after acute coronary syndrome in Aotearoa New Zealand: opportunities for improvement (ANZACS-QI 81)

Jack L He, Mildred Lee, Andrew J Kerr

This study assessed how well people in New Zealand were managing their cholesterol after a heart attack. We found that cholesterol testing after leaving the hospital is not universal and this needed to be improved. We also found that cholesterol lowering medication doses were not increased in the community once patients leave the hospital. Even among those who were on high dose medication, only about one in three reached the optimal cholesterol level. This paper highlights the need to improve monitoring and reduction of cholesterol in the community, and that doctors may need to combine medications with more frequent cholesterol checks, lifestyle changes, diet and exercise. It also highlights the need for New Zealand to access other cholesterol lowering drugs beyond statins.

Why psychiatrists choose to leave public mental health services

Benjamin McBreen, Jenni Manuel, Matthew Tennant

Psychiatrists who had left work in public mental health services were interviewed. There were several factors that contributed to their decisions to leave public mental health services. These included an excessive workload, feeling that their professional skills were undervalued, feeling accountable for poor patient outcomes and concerns about their safety at work. Participants wanted to improve efficacy, safety and quality of care but felt that the system was not responsive and was resistant to change. Addressing these concerns may improve the retention of psychiatrists in the public system.

Hospital resource utilisation for two mass-casualty incidents in New Zealand

Darren Ritchie, Terry Creagh, Andrew McCombie, Laura R Joyce, Christopher Wakeman

This study looked at how hospital resources were used at Christchurch Hospital during two major emergencies in 2019: the Christchurch mosque shootings and the Whakaari (White Island) volcanic eruption. Researchers found that 45 patients from the mosque incident and eight from the volcanic eruption were admitted to the hospital. Most patients were discharged shortly after their treatment, yet the intensity of care needed for burn victims placed a substantial strain on hospital services. This underscores the urgent need for a comprehensive analysis of resource allocation, surge capacity and funding models in New Zealand. Such an evaluation is essential to ensure that trauma centres are well equipped and prepared to respond effectively and efficiently to future crises.

Improving lung cancer survival outcomes for Māori

Jason Gurney, James Stanley, Anna Davies, Virginia Signal, Paul Dawkins, Laird Cameron, Shaun Costello, Christopher GCA Jackson, Kimiora Henare, Ross Lawrenson, Jesse Whitehead, Jonathan Koea

Lung cancer is the most common cause of cancer death for Māori, and Māori are less likely to survive lung cancer than NZ Europeans with the same cancer. Differences between Māori and NZ Europeans in access to good cancer care might be an important driver of this survival disparity. We found that Māori with lung cancer have higher emergency presentation rates, poorer access to early detection, lower surgery rates and disparities in the distance required to travel to bronchoscopy, surgery and radiation therapy. However, we also found some cause for cautious celebration, including equitable access to a bronchoscopy, pathological diagnosis, radiation therapy and systemic therapy, as well as minimal differences in the timing of treatment between ethnic groups.

Chest pain that is hard to swallow—a rare finding of Kommerell diverticulum

Michael Dick, Adam Bateman, Chethan Kasargod

A 50-year-old man with unusual chest discomfort suggestive of reflux was investigated with a computed tomography scan to rule out narrowing of the coronary (heart) arteries. This scan incidentally found an abnormal course of the aorta causing compression on the oesophagus (food-pipe). This is a congenital abnormality called a Kommerell diverticulum, which can cause symptoms related to difficulty swallowing. Risk of complications is low and surgical correction can be considered if symptoms are bad enough.

An update on Helicobacter pylori diagnosis in New Zealand

Jan Kubovy, Murray Barclay

Our study provides an update into the diagnosis of a chronic infection called *Helicobacter pylori* in New Zealand. This infection is important as it is the commonest cause of stomach ulcers and stomach cancer. The way this is diagnosed constantly evolves due to medical advances, financial costs, changes in Census and access to medical care. This study highlights these changes, particularly the ongoing healthcare inequity for Maori and Pacific peoples of New Zealand.

Equitable access to psilocybin-assisted psychotherapy in New Zealand

Cameron Lacey

The recent announcement by the Honourable David Seymour approving the clinical use of psilocybin-assisted therapy for treatment-resistant depression (TRD) has placed New Zealand on the global map, joining a handful of countries at the forefront of psychedelic medicine. There has been intense public, professional and media interest; stories in the *New York Times*, *Time Magazine*, *Stuff* and *Radio New Zealand* have captured imaginations and raised expectations across the country. But with this attention comes a significant challenge: to ensure that this emerging treatment does not become the preserve of the privileged few but is available equitably to all New Zealanders who need it.

The size and cost of TRD

TRD is a profound and growing challenge. International estimates suggest that up to 30% of people with major depressive disorder do not achieve remission with standard treatments.[1] In New Zealand, the numbers are equally sobering: Ministry of Health – Manatū Hauora data indicate that over 600,000 adults experience depression or anxiety each year, and a significant subset do not respond to existing therapies.[2] TRD is associated with higher rates of suicide, unemployment, physical illness and family disruption. The societal costs are immense—globally, the economic burden of depression is estimated at over US$1 trillion annually in lost productivity and healthcare costs.[3] In New Zealand, mental health conditions are estimated to cost the economy more than NZ$12 billion per year.[4]

A system under strain: the limits of current pathways

Despite clinicians' best efforts, our current system struggles to deliver for those with the most persistent depression. Data released under the Official Information Act (OIA) reveal that Health New Zealand – Te Whatu Ora spent over NZ$200 million in the last 5 years on referrals to private mental health facilities, with annual spending rising to over NZ$42 million in 2023.[5] Yet, as the OIA response makes clear, there are a glaring lack of outcome data: Health New Zealand – Te Whatu Ora does not systematically record or report treatment response rates, adverse events or long-term outcomes for these high-cost interventions. This lack of transparency not only undermines accountability but also leaves clinicians and policymakers flying blind when it comes to the effectiveness of our most expensive mental health investments.

The promise of psilocybin-assisted psychotherapy

Against this backdrop, psilocybin-assisted psychotherapy offers a substantially different approach. Multiple randomised controlled trials have demonstrated that psilocybin, administered in a controlled therapeutic setting and integrated with psychotherapy, can produce rapid and sustained improvements in depression symptoms for people who have failed to respond to conventional treatments.[6,7] Remission rates in these studies have often exceeded 60%, with benefits persisting for months after a single course of treatment. The safety profile, when administered by trained professionals, is favourable, and the risk of dependence is negligible compared to many existing pharmacological options.

A moment of opportunity—but also risk

The surge in public interest is palpable, fuelled by international media and local reporting. But unless we act now to create publicly funded pathways—through Health New Zealand – Te Whatu Ora, ACC and private health insurers—psilocybin-assisted psychotherapy will be accessible only to those who can afford to pay out of pocket. This risks deepening the very inequities our health system is meant to address. Māori, Pacific peoples and those in lower socio-economic groups already face disproportionate

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barriers to accessing innovative mental health care.[2,4] If we fail to act, we will entrench a two-tier system in which the most promising treatments are reserved for the wealthy.

We need an approach to funding and delivering psilocybin-assisted psychotherapy, with robust data collection and outcome tracking from day one. This is not just a matter of clinical innovation; it is a matter of social justice and economic common sense. By investing in treatments that offer real promise for those whom current approaches have failed, we can reduce the burden on our overstretched mental health system, improve productivity and—most importantly—save lives.

New Zealand has a unique opportunity to lead the world in the equitable adoption of psychedelic medicine, and this should be the aim from the start of psilocybin-assisted therapy delivery.

COMPETING INTERESTS
Cameron Lacey is the founder of Elimbias Health. Elimbias Health provides private paying psilocybin-assisted therapy.

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Global cost of silencing science: editors and publishers have a duty to resist

Frank Frizelle, Kamran Abbasi, Vivienne C Bachelet, Christopher Baethge, Sabine Kleinert, Jin-Hong Yoo, Lilia Zakhama

Public trust in scientific integrity is eroded by the politicisation of institutions under Donald Trump's United States (US) presidency. The implications extend far beyond American borders, striking at the core of how scientific knowledge is produced, disseminated and trusted worldwide.

Recent directives seek to eliminate diversity, equity and inclusion (DEI) initiatives, cut federal funding to critical health research agencies and restrict references to gender, race and climate science in official documentation. Scientific staff at federal agencies face mounting pressure to comply with politically motivated communication policies. Such institutional interference not only distorts scientific findings—it undermines the principles of transparency and editorial independence outlined in the International Committee of Medical Journal Editors (ICMJE) recommendations.[1] As members of ICMJE we feel compelled to speak out.

The ICMJE underscores that "*Editors should preserve the integrity of the scientific record by critically evaluating manuscripts free from undue influence and without compromising scholarly values*."[1] Yet, under the current administration, several US federal science agencies require pre-approval for external publications—a direct contravention of these editorial standards.[2] This climate of control stifles open inquiry and discourages evidence-based discourse, particularly when scientific conclusions diverge from political narratives.

Health research in the US has historically flourished through bipartisan support and robust institutional independence. Federal investment after the Second World War—guided by frameworks such as Vannevar Bush's *Science: The Endless Frontier*[2] and operationalised through agencies such as the National Institutes of Health (NIH) and National Science Foundation—ushered in decades of biomedical innovation leading to important health advances. Today, that legacy is imperilled by the very government meant to protect it. Budgetary threats to the NIH and the Centers for Disease Control and Prevention, coupled with staffing decisions that prioritise ideological loyalty over expertise, are undermining both the morale and the capacity of federal science agencies.

The administration's executive orders to eliminate DEI-related work in federal research not only violate the ICMJE's call to promote diversity in authorship, peer review and research design,[1] they endanger public health. Inclusive research is not ideological; it is essential. Populations historically marginalised in science—including women, people of colour, and LGBTQ+ individuals—will again be pushed to the periphery. This regression has tangible consequences for the scientific validity and societal relevance of health research. The rollback of DEI initiatives risks deepening existing health inequalities by ignoring the nuanced ways that race, ethnicity, gender and socio-economic status intersect with health outcomes.

Moreover, the administration has actively opposed environmental and climate–related research. This opposition not only impedes the global scientific consensus on climate change but violates the ICMJE's insistence that researchers and editors should advance science in the service of public good.[1] Climate science denial within federal institutions disrupts international collaboration, damages public preparedness for climate-related disasters and disproportionately harms vulnerable populations already at risk of climate-related health effects.

Internationally, the consequences are no less stark. Authoritarian regimes elsewhere see the US as setting a precedent, finding in Trump's agenda a justification to suppress dissent, censor scientific dialogue and delegitimise independent inquiry. The undermining of scientific norms in the US reverberates beyond its borders, threatening global scientific cooperation and weakening international efforts to address pressing health challenges such as pandemics, climate change and health equity.

This trend is not unique to the US. It is also a concern in democratic nations beyond the US, where similar pressures on scientific discourse and editorial independence have been observed.

We are deeply concerned that this dangerous erosion of scientific autonomy recalls some of the darkest episodes in modern history—namely, the rise of fascism during the 1930s and the McCarthy era assaults on academic freedom in the 1950s. The international academic community must treat the US case not as an isolated incident but as a cautionary tale—one that should prompt a thorough re-examination of editorial independence safeguards within their own systems. The suppression of science is a global threat that demands global vigilance. The US has traditionally provided scientific leadership through its role in supporting international bodies such as the World Health Organization, but its decision to no longer fund these institutions now threatens to delegitimise and weaken these multilateral efforts.

Independent scientific communication is equally under threat. Increasing pressure on government researchers to avoid controversial topics or reframe findings to suit political narratives creates an institutional chilling effect. Self-censorship born of fear may be more damaging than overt censorship. Researchers, particularly early career scientists and those from underrepresented backgrounds, may choose to abandon public communication or controversial areas of inquiry altogether. This trend further narrows the scope of scientific innovation, limits the range of perspectives reflected in research agendas, and ultimately harms health.

The ICMJE has repeatedly cautioned against editorial practices influenced by political or commercial pressures, noting that "*Governments must not interfere in editorial decisions or constrain researchers' freedom to communicate their findings*."[1] These principles are foundational not only to scientific publishing but to the broader democratic ideals that underpin open societies. The threats to medical journals, including three that are ICMJE members, are of particular relevance to us. Editors and publishers have a duty to resist governmental efforts to control scientific discourse and must actively protect the autonomy of researchers, and the independence of their decision-making processes.

To safeguard the future of medical science, we call for three actions. First, national and international scientific institutions should adopt clear policies to shield research from political interference. These protections should include codified rules on publication independence, protected speech for scientists, and data transparency standards. Second, medical journals must recommit to editorial independence and advocate for authors who face institutional censorship. Journals must publish work that challenges prevailing political narratives and amplify voices under threat. Third, scientists, scientific organisations and editors must resist silence. As the ICMJE has stressed, the scientific community bears a collective responsibility to uphold integrity and protect vulnerable voices.[1] We appreciate that it is easier to raise your voice from outside a threatened system than from within, and therefore we are speaking up and urge others to do so.

This is a call for science grounded in ethical principles and dedicated to the service of humanity. Scientific research, especially in medicine and public health, is inherently intertwined with social justice. Silencing DEI initiatives, censoring climate science and delegitimising minority researchers is not neutrality—it is complicity in perpetuating harm.

Resistance is not without precedent. Past administrations that sought to control or defund scientific institutions were met with organised dissent. Whistleblowers, journal editors and advocacy organisations have long served as guardians of scientific freedom. Today, that tradition must continue with renewed vigour. Editorial boards must uphold their independence. Universities and scientific bodies must defend faculty facing retribution. Policymakers must embed protections for scientific freedom into the legislative framework.

The Trump administration's actions are not simply domestic political manoeuvres; they are part of a global assault on evidence, inclusion and truth. The stakes are higher than ever. History has shown where censorship and ideological orthodoxy lead. We cannot afford to relearn that lesson.

COMPETING INTERESTS

FF is the Editor in Chief of the *New Zealand Medical Journal*, KA is the Editor in Chief of *The BMJ*, VCB is the Editor in Chief of *Medwave*, CB is the Chief Scientific Editor of *Deutsches Ärzteblatt*, SK is the Deputy Editor of *The Lancet*, JHY is the Editor in Chief of the *Journal of Korean Medical Science*, LZ is the Editor in Chief of *La Tunisie Médicale*. We declare no competing interests.

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Systemic anti-cancer treatment for Māori with stage III and IV non-small cell lung cancer in Aotearoa New Zealand

Kelson Tu'akoi, Janice Wong, Ha Nguyen, Chunhuan Lao, Mark Elwood, Mark McKeage, Ross Lawrenson

ABSTRACT

AIMS: We aimed to assess the frequency of systemic anti-cancer therapy (SACT) use in patients with advanced non-small cell lung cancer (NSCLC), comparing Māori and non-Māori. Secondary aims were to assess predictive factors for patients managed with SACT, SACT agent regimens and lung cancer–specific mortality.

METHODS: A retrospective cohort study of patients with incident advanced NSCLC in the Aotearoa New Zealand Midland Region between 1 January 2011 to 31 December 2021 was undertaken. Data were primarily derived from the Midland Lung Cancer Registry.

RESULTS: The study cohort comprised 2,549 patients with incident advanced NSCLC. A total of 775 patients were Māori (30%). SACT was received by 942 patients (37%). There was no difference in overall SACT rate between Māori and non-Māori: adjusted odds ratio (OR) 0.88 (95% confidence interval [CI] 0.71–1.09), p-value >0.05. For patients who received SACT, Māori were less likely to receive targeted therapy first-line (8.5% vs 16.1%, p-value <0.01). Māori had higher cancer-specific mortality: adjusted OR 1.19 (95% CI 1.08–1.32), p-value <0.001.

CONCLUSION: In this pre-funded immunotherapy era, no difference was observed in overall SACT rate for Māori patients with advanced NSCLC. Māori were less likely to receive targeted therapy first-line, for which the underlying reasons require investigation. Our data suggest other factors, beyond overall SACT use rate, influence the higher cancer-specific mortality in Māori.

Lung cancer is the largest cause of cancer death in Aotearoa New Zealand.[1] Māori, the Indigenous people of Aotearoa, comprise 16.5% of the population;[2] however, they are over-represented in lung cancer statistics. Māori have a higher incidence of lung cancer diagnosis, and even higher mortality, disproportionate to the differences in incidence.[3–5] Potential contributors to these outcome disparities include patient factors (genetics, exposures, deprivation, geography), and differential access and treatment within the health-care system. Contributing patient factors identified to date include Māori having later stage disease at presentation,[3,4] higher frequency of cigarette smoking[4,6] and higher deprivation,[7] which has been shown to correlate with increased incidence of lung cancer and worse cancer outcomes.[3,5]

There are limited data assessing differences in treatment between Māori and non-Māori patients with non-small cell lung cancer (NSCLC). An Aotearoa study showed that Māori patients were marginally less likely to receive systemic anti-cancer therapy (SACT) after age adjustment compared with European patients, and were also less likely to be managed with surgery.[8] Another study, based on data from the point of review in an oncology clinic, showed no difference in Māori patients with advanced NSCLC receiving first-line SACT.[9] However, Māori were less likely than non-Māori to receive second-line SACT. Other studies did not find differences in the management of Māori patients with lung cancer.[3,10]

SACT use in patients with stage III and IV NSCLC improves survival.[11] Given the ongoing inequity in outcomes for Māori patients with lung cancer, clarifying contributing factors is important to help direct healthcare efforts and policy. Our study aimed to assess the frequency of SACT use in patients with advanced NSCLC, comparing Māori patients with non-Māori patients.

Our primary objective was to assess the SACT rate in all cases of incident advanced NSCLC, comparing Māori and non-Māori. Secondary outcomes were to assess predictive factors for patients managed with SACT, SACT agent regimens and lung cancer–specific mortality.

Methods

This retrospective cohort study assessed patients in the Te Manawa Taki/Midland Region of Aotearoa (Waikato, Bay of Plenty, Lakes and Tairāwhiti) with incident advanced NSCLC. Advanced NSCLC was defined as patients with stage III and IV disease. The study period was from 1 January 2011 to 31 December 2021. A patient was considered to have received SACT if the database showed at least one SACT dispensing.

Data source

Data were derived from the Midland Lung Cancer Registry (MLCR), a lung cancer database available in the Te Manawa Taki/Midland Region, including patients from four former hospital-based districts (Waikato, Bay of Plenty, Lakes and Tairāwhiti). The MLCR collates information from regular multidisciplinary meetings (MDM). Our dataset also included lung cancer cases not reviewed at MDM but recorded in the New Zealand Cancer Registry (NZCR).[6] Data on comorbidities were identified from both the MLCR and the National Minimum Dataset. Data on SACT were collected from the Pharmaceutical Information Database (Pharms), which contains claim information from pharmacists for subsidised dispensing. The combined dataset included information on ethnicity (Māori and non-Māori), age, gender, smoking status, rural/urban areas (Geographical Classification of Health classification),[12] New Zealand Index of Deprivation (NZDEP), date of diagnosis, cancer stage, cell type, Eastern Cooperative Oncology Group (ECOG) status, comorbidity and SACT regimens. Smoking status included: 1) never smoked, 2) current smoker, 3) ex-smoker, and 4) unknown. Socio-economic deprivation was defined using the NZDep2018 and analysed as quintile from 1 (least deprived) to 5 (most deprived).[13] The NZDep is an area-based measure of socio-economic deprivation in Aotearoa. ECOG status was categorised as 0, 1 and 2+. The Charlson Comorbidity Index (CCI) score was calculated based on the study of Glasheen et al.,[14] and was classified into three categories: 0, 1 and 2+.

Analysis

The characteristics of patients were compared between Māori and non-Māori using Chi-squared tests for categorical variables and Student's *t*-Tests for continuous variables. Proportion of patients receiving SACT were calculated and compared by patient characteristics before and after stratification by ethnicity. The differences were also examined with Chi-squared tests. First SACT regimen received was compared between Māori and non-Māori patients. The first regimen was classified into three categories: 1) chemotherapy, 2) immunotherapy, and 3) targeted therapy. Chemotherapy was classified into six further groups: 1) carboplatin single agent, 2) carboplatin double agent, 3) cisplatin single agent, 4) cisplatin double agent, 5) non-platinum single agent, and 6) non-platinum double agent. The multivariate logistic regression was used to estimate the odds ratios (OR) and 95% confidence interval (CI) of being treated with SACT, adjusting for age, gender, ethnicity, rurality, NZDep, ECOG, comorbidity and year of diagnosis. The Kaplan–Meier method was used to examine the lung cancer–specific survival by ethnicity and use of SACT, and difference in survival was examined with a Log-Rank test. The hazard ratios (HR) of lung cancer–specific mortality were calculated with the Cox proportional-hazards model, after adjustment for age, ethnicity, gender, smoking status, cancer stage, comorbidities, ECOG status, rurality, socio-economic status, year of diagnosis, use of SACT and radiotherapy. All data analyses were performed in R 4.0 (R Institute, Vienna, Austria).

Ethical approval

Approval for the study's ethics was obtained from the Northern B Health and Disability Ethics Committee, with the reference number 16/STH/167/AM02.

Results

The study cohort comprised 2,549 patients with incident advanced NSCLC, 723 (28.4%) with stage III disease and 1,826 (71.6%) with stage IV disease (Table 1). Adenocarcinoma was the predominant histologic subtype (55.6%), followed by squamous cell carcinoma (27.2%). Demographic analysis showed a mean average patient age of 68.8 years, a cohort comprising 1,195 (46.9%) female patients, and a predominantly urban-living cohort of 1,622 (63.6%). There were 775 (30.4%) Māori patients in the cohort. Patients were more deprived compared to the Aotearoa population, with 37.9% living in the highest deprivation quintile and 7.2% living in the lowest deprivation quintile. Patient comorbidity varied: 757 patients (29.7%) had a CCI score of 0, 610 patients (23.9%) had a CCI of 1 and 1,182 patients (46.4%) had a CCI of ≥2.

Table 1: Cohort characteristics and rates of receiving systemic anti-cancer therapy.

Factors		Total cohort			Māori			Non-Māori		
		Total	**SACT**	**% SACT**	**Total**	**SACT**	**% SACT**	**Total**	**SACT**	**% SACT**
		N=2,549	**N=942**	**37.0%**	**N=775**	**N=307**	**39.6%**	**N=1,774**	**N=635**	**35.8%**
Age (years)	Mean ± SD	68.8 (±10.9)	64.7 (±9.5)		64.4 (±10.2)	62.0 (±8.4)		70.8 (±10.6)	65.9 (±9.7)	
Age group (years)	<50	108 (4.2%)	61	56.5%	50 (6.5%)	23	46.0%	58 (3.3%)	38	65.5%
	50–54	149 (5.8%)	81	54.4%	79 (10.2%)	40	50.6%	70 (4.0%)	41	58.6%
	55–59	233 (9.1%)	123	52.8%	105 (13.5%)	49	46.7%	128 (7.2%)	74	57.8%
	60–64	345 (13.5%)	168	48.7%	166 (21.4%)	75	45.2%	179 (10.1%)	93	52.0%
	65–69	443 (17.4%)	211	47.6%	137 (17.7%)	64	46.7%	306 (17.3%)	147	48.0%
	70–74	489 (19.2%)	164	33.5%	115 (14.8%)	32	27.8%	374 (21.1%)	132	35.3%
	75–79	356 (14.0%)	101	28.4%	74 (9.5%)	22	29.7%	282 (15.9%)	79	28.0%
	>80	426 (16.7%)	33	7.7%	49 (6.3%)	2	4.1%	377 (21.3%)	31	8.2%
Gender	Female	1,195 (46.9%)	464	38.8%	392 (50.6%)	151	38.5%	803 (45.3%)	313	39.0%
	Male	1,354 (53.1%)	478	35.3%	383 (49.4%)	156	40.7%	971 (54.7%)	322	33.2%
Rural/urban	Urban	1,622 (63.6%)	597	36.8%	446 (57.5%)	179	40.1%	1,176 (66.3%)	418	35.5%
	Rural	921 (36.1%)	343	37.2%	327 (42.2%)	128	39.1%	594 (33.5%)	215	36.2%
	Unknown	6 (0.2%)	2	33.3%	2 (0.3%)	0	0.0%	4 (0.23%)	2	50.0%
New Zealand Index of Deprivation	1 (least)	184 (7.2%)	80	43.5%	17 (2.2%)	8	47.1%	167 (9.4%)	72	43.1%
	2	274 (10.7%)	102	37.2%	49 (6.3%)	18	36.7%	225 (12.7%)	84	37.3%
	3	458 (18.0%)	167	36.5%	100 (12.9%)	47	47.0%	358 (20.2%)	120	33.5%

Table 1 (continued): Cohort characteristics and rates of receiving systemic anti-cancer therapy.

Factors		Total cohort			Māori			Non-Māori		
		Total	**SACT**	**% SACT**	**Total**	**SACT**	**% SACT**	**Total**	**SACT**	**% SACT**
		N=2,549	**N=942**	**37.0%**	**N=775**	**N=307**	**39.6%**	**N=1,774**	**N=635**	**35.8%**
	4	660 (25.9%)	234	35.5%	168 (21.7%)	59	35.1%	492 (27.7%)	175	35.6%
	5 (most)	967 (37.9%)	357	36.9%	439 (56.6%)	175	39.9%	528 (29.8%)	182	34.5%
	Unknown	6 (0.2%)	2	33.3%	2 (0.3%)	0	0.0%	4 (0.2%)	2	50.0%
Smoking status	Current smoker	707 (27.7%)	302	42.7%	324 (41.8%)	136	42.0%	383 (21.6%)	166	43.3%
	Ex-smoker	1,238 (48.6%)	447	36.1%	314 (40.5%)	133	42.4%	924 (52.1%)	314	34.0%
	Never smoked	180 (7.1%)	94	52.2%	18 (2.3%)	8	44.4%	162 (9.1%)	86	53.1%
	Unknown	424 (16.6%)	99	23.3%	119 (15.4%)	30	25.2%	305 (17.2%)	69	22.6%
Cancer stage	III	723 (28.4%)	330	45.6%	245 (31.6%)	122	49.8%	478 (26.9%)	208	43.5%
	IV	1,826 (71.6%)	612	33.5%	530 (68.4%)	185	34.9%	1,296 (73.1%)	427	32.9%
NSCLC type	Adenocarci-noma	1,418 (55.6%)	561	39.6%	364 (47.0%)	146	40.1%	1,054 (59.4%)	415	39.4%
	Squamous cell	694 (27.2%)	259	37.3%	274 (35.4%)	119	43.4%	420 (23.7%)	140	33.3%
	Others	437 (17.1%)	122	27.9%	137 (17.7%)	42	30.7%	300 (16.9%)	80	26.7%
ECOG	0	514 (20.2%)	318	61.9%	138 (17.8%)	91	65.9%	376 (21.2%)	227	60.4%
	1	982 (38.5%)	433	44.1%	327 (42.2%)	151	46.2%	655 (36.9%)	282	43.1%

Table 1 (continued): Cohort characteristics and rates of receiving systemic anti-cancer therapy.

Factors		Total cohort			Māori			Non-Māori		
		Total	**SACT**	**% SACT**	**Total**	**SACT**	**% SACT**	**Total**	**SACT**	**% SACT**
		N=2,549	**N=942**	**37.0%**	**N=775**	**N=307**	**39.6%**	**N=1,774**	**N=635**	**35.8%**
	2+	636 (25.0%)	92	14.5%	193 (24.9%)	34	17.6%	443 (25.0%)	58	13.1%
	Unknown	417 (16.4%)	99	23.7%	117 (15.1%)	31	26.5%	300 (16.9%)	68	22.7%
CCI score	0	757 (29.7%)	344	45.4%	229 (29.5%)	105	45.9%	528 (29.8%)	239	45.3%
	1	610 (23.9%)	266	43.6%	195 (25.2%)	92	47.2%	415 (23.4%)	174	41.9%
	2+	1,182 (46.4%)	332	28.1%	351 (45.3%)	110	31.3%	831 (46.8%)	222	26.7%

Table 1 displays cohort characteristics including demographics, patient factors and tumour factors.
The "Total" sub-columns display the number of patients with each characteristic, and the percentage (%) of the total group. "SACT" denotes patients who received SACT within each respective sub-group. "% SACT" displays this as a percentage of the sub-group denominator.
SACT = systemic anti-cancer therapy; SD = standard deviation; NSCLC = non-small cell lung cancer; ECOG = Eastern Cooperative Oncology Group; CCI = Charlson Comorbidity Index.

Table 2: Adjusted odds ratios for receiving systemic anti-cancer therapy.

Variables		Stage III and IV	Stage III	Stage IV
		AOR (95% CI)	AOR (95% CI)	AOR (95% CI)
Ethnicity	Non-Māori	1	1	1
	Māori	0.88 (0.71–1.09)	0.99 (0.67–1.45)	0.82 (0.64–1.06)
Age (years)	-	0.95 (0.94–0.96)***	0.93 (0.91–0.95)***	0.96 (0.94–0.97)***
Gender	Female	1	1	1
	Male	0.98 (0.82–1.17)	0.94 (0.67–1.31)	1.00 (0.81–1.24)
Rural/urban	Urban	1	1	1
	Rural	0.94 (0.78–1.14)	1.16 (0.81–1.65)	0.87 (0.69–1.10)
New Zealand Index of Deprivation	1 (least)	1	1	1
	2	0.73 (0.47–1.12)	0.38 (0.16–0.95)*	0.87 (0.53–1.44)
	3	0.73 (0.49–1.08)	0.46 (0.19–1.09)	0.80 (0.51–1.27)
	4	0.68 (0.46–0.99)*	0.35 (0.15–0.82)*	0.80 (0.52–1.23)
	5 (most)	0.75 (0.51–1.09)	0.42 (0.19–0.96)*	0.86 (0.56–1.32)
Cancer stage	III	1	-	-
	IV	0.73 (0.60–0.89)**	-	-
ECOG	0	1	1	1
	1	0.56 (0.44–0.70)***	0.48 (0.33–0.71)***	0.59 (0.44–0.79)***
	2+	0.14 (0.10–0.18)***	0.13 (0.07–0.23)***	0.14 (0.10–0.20)***
	Unknown	0.23 (0.17–0.32)***	0.29 (0.13–0.66)**	0.23 (0.16–0.33)***
CCI score	0	1	1	1
	1	1.09 (0.85–1.39)	1.17 (0.72–1.90)	1.08 (0.80–1.44)
	2+	0.63 (0.50–0.78)***	0.78 (0.50–1.23)	0.58 (0.44–0.75)***
Year of diagnosis	2011–2014	1	1	1
	2015–2018	1.03 (0.83–1.27)	0.98 (0.66–1.46)	1.04 (0.81–1.34)
	2019–2021	1.26 (1.00–1.59)	1.44 (0.93–2.24)	1.20 (0.90–1.58)

Table 2 displays odds ratios for receiving SACT, calculated by multivariate adjustment for other study variables.
***p<0.001, **p<0.01, *p<0.05.
AOR = adjusted odds ratio; CI = confidence interval; ECOG = Eastern Cooperative Oncology Group; CCI = Charlson Comorbidity Index; SACT = systemic anti-cancer therapy.

Table 3: First systemic anti-cancer therapy regimen received.

First treatment regimen		Māori	Non-Māori	Total
		N=307	N=635	N=942
Chemo-therapy	**Total (%)**	281 (91.5)	532 (83.8)	813 (86.3)
	Carboplatin single agent (%)	16 (5.2)	19 (3.0)	35 (3.7)
	Carboplatin double agent (%)	211 (68.7)	411 (64.7)	622 (66.0)
	Cisplatin single agent (%)	1 (0.3)	4 (0.6)	5 (0.5)
	Cisplatin double agent (%)	27 (8.8)	39 (6.1)	66 (7.0)
	Non-platinum single agent (%)	26 (8.5)	58 (9.1)	84 (8.9)
	Non-platinum double agent (%)	0 (0)	1 (0.2)	1 (0.1)
Immuno-therapy	**Total (%)**	0 (0)	1 (0.2)	1 (0.1)
	Pembrolizumab (%)	0 (0)	1 (0.2)	1 (0.1)
Targeted therapy	**Total (%)**	26 (8.5)	102 (16.1)	128 (13.6)
	Erlotinib (%)	10 (3.3)	49 (7.7)	59 (6.3)
	Gefitinib (%)	12 (3.9)	48 (7.6)	60 (6.4)
	Alectinib (%)	4 (1.3)	5 (0.8)	9 (1.0)

P-value <0.01 (Māori vs non-Māori receiving chemotherapy or targeted therapy as first regime).

Regarding ECOG performance status, 1,469 patients were 0–1 (58.7%), 636 patients were ≥2 (25.0%) and 417 had missing data (16.4%).

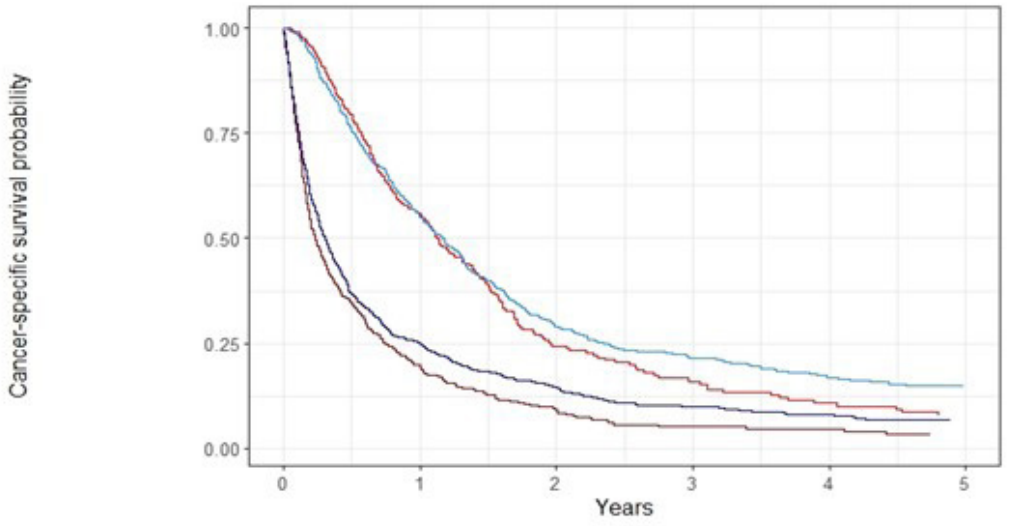
Māori, compared with non-Māori, were younger, with a mean age difference of 6.4 years (64.4 years vs 70.8 years, p-value <0.01). There were more Māori female patients than Māori male patients (50.6% vs 49.4%), whereas the opposite pattern was present for non-Māori (45.3% vs 54.7%, p-value 0.013). Māori were more likely to be living rurally (42.2% vs 33.5%, p-value <0.001). Māori were more likely to be living in deprivation, with the majority of Māori living in the highest deprivation quintile (56.6% vs 29.8%, p-value <0.001). Māori were more likely to have a poor ECOG performance status (p-value 0.035). There were no significant differences in CCI between the groups (p-value 0.609). Although adenocarcinoma was the most common histological cancer type in both Māori and non-Māori, the relative frequency was higher in non-Māori (59.4% vs 47.0%, p-value <0.001), whereas the relative frequency of squamous cell carcinoma was higher in Māori (35.4% vs 23.7%, p-value <0.001).

Overall, 942 patients (37.0%) received SACT. The SACT rate for Māori was 39.6%, compared with 35.8% for non-Māori, which was not statistically different (p-value 0.066). The use of SACT decreased with age for both Māori and non-Māori patients (Table 1). We found significant differences in the proportion of patients receiving SACT between Māori and non-Māori by age at diagnosis, rurality, socio-economic status, cancer stage and cell type.

After adjusting for the younger age of Māori patients, Māori were less likely to receive SACT, with an adjusted OR of 0.80 (95% CI 0.66–0.97),

Figure 1: Lung cancer–specific survival, stratified by ethnicity and systemic anti-cancer therapy use.

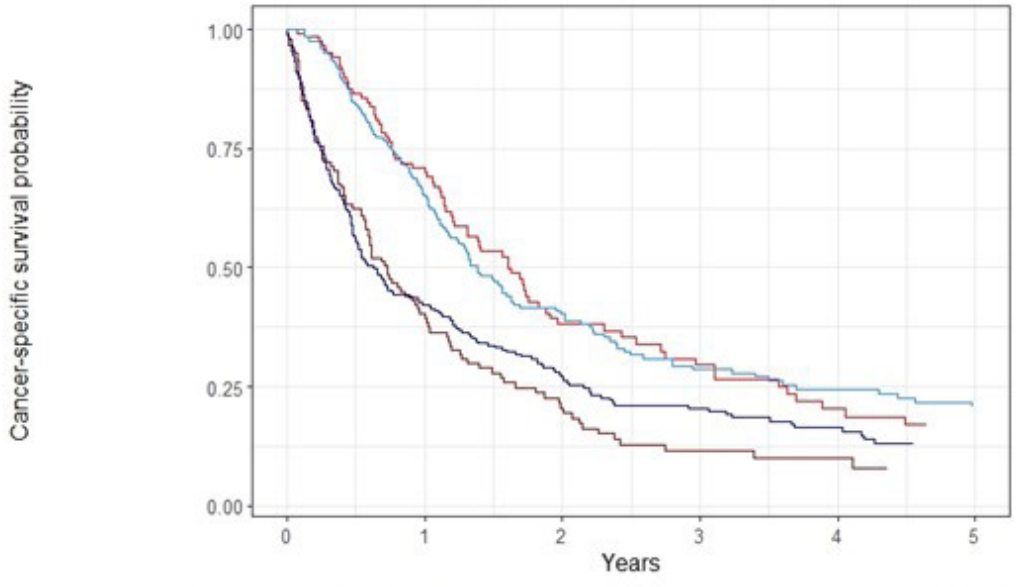
1a. Patients with stage III and IV non-small cell lung cancer.



Number at Risk

Māori with SACT	307	149	50	25	15	10
Māori without SACT	468	69	26	12	10	4
Non-Māori with SACT	635	309	133	82	51	32
Non-Māori without SACT	1139	213	103	54	34	22

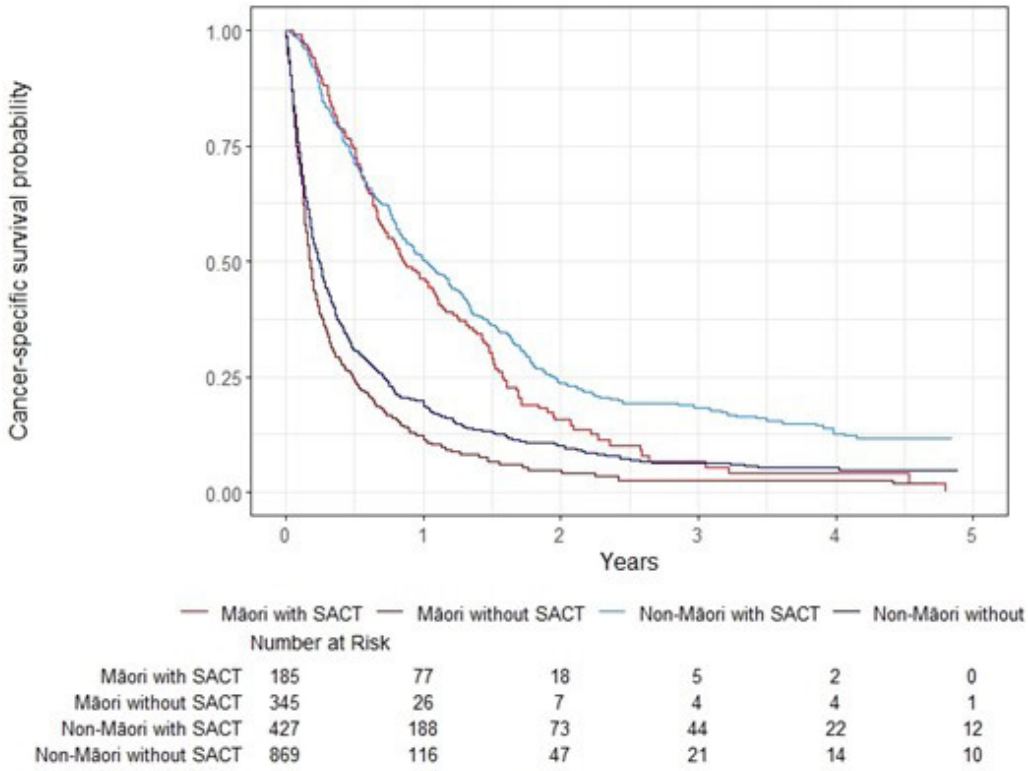
1b. Patients with stage III non-small cell lung cancer.



Number at Risk

Māori with SACT	122	72	32	20	13	10
Māori without SACT	123	43	19	8	6	3
Non-Māori with SACT	208	121	60	38	29	20
Non-Māori without SACT	270	97	56	33	20	12

1c. Patients with stage IV non-small cell lung cancer.



p-value <0.05. Analysis by age grouping (Table 1) showed that for patients younger than 50 years old, 46% (23/50) of Māori received SACT compared with 65.5% (38/58) of non-Māori, p-value 0.04. There were no significant differences in all other age groupings, p-values >0.05. After adjusting for all study variables (age, sex, rurality, deprivation, cancer stage, ECOG, comorbidity, year of diagnosis), there was no statistically significant difference in SACT rate between Māori and non-Māori, with an adjusted OR of 0.88 (95% CI 0.71–1.09), p-value >0.05 (Table 2).

Logistic regression analysis (Table 2) showed individual variables correlating with a lower SACT rate included increased age, stage IV disease, ECOG performance status ≥2 and CCI score ≥2. There was a trend towards increased SACT frequency with lung cancer diagnoses in later years (2019–2021), of borderline statistical significance. Sub-group analysis was performed for patients with stage III and stage IV disease, and the trends were similar to the overall cohort analysis.

Of the 942 patients receiving SACT, chemotherapy was used first-line in 86.3% (813 patients) (Table 3). This was most commonly platinum-based double agent chemotherapy. Targeted therapy was used as first-line in 13.6% (128 patients), most directed at the epidermal growth factor receptor (EGFR) (119 patients). Only one patient received immunotherapy as first-line SACT. Māori receiving SACT were more commonly treated with chemotherapy compared with non-Māori (91.5% vs 83.8%, p-value <0.01), and were less likely to receive first-line targeted therapy (8.5% vs 16.1%, p-value <0.01). The one patient receiving first-line immunotherapy was non-Māori.

The Kaplan–Meier curves (Figure 1) showed significant differences in survival between patients receiving SACT and patients without SACT (p-value <0.001). The HR of lung cancer–specific mortality for patients receiving SACT compared with patients without SACT was 0.52 (p-value <0.001) for all advanced NSCLC, 0.68 for stage III cancers and 0.47 for stage IV cancers, after adjustment for age, ethnicity, gender, smoking status, cancer stage, comorbidities, ECOG status, rurality, socio-economic status, year of diagnosis and radiotherapy (Table 4). Significant difference was found between Māori and non-Māori patients

Table 4: Multivariate adjusted hazard ratio of lung cancer-specific mortality.

Factors		Stage III and IV	Stage III	Stage IV
		AHR (95% CI)	AHR (95% CI)	AHR (95% CI)
Ethnicity	Non-Māori	1	1	1
	Māori	1.19 (1.08–1.32)***	0.98 (0.81–1.19)	1.27 (1.12–1.43)***
Age (continuous)		1.00 (1.00–1.01)	1.01 (0.99–1.02)	1.00 (0.99–1.00)
Gender	Female	1	1	1
	Male	1.17 (1.07–1.28)***	1.32 (1.10–1.58)**	1.13 (1.02–1.25)*
Rural/urban	Urban	1	1	1
	Rural	1.07 (0.97–1.17)	1.05 (0.87–1.27)	1.08 (0.96–1.20)
	Unknown	4.87 (1.21–19.64)*	–	4.47 (1.11–18.07)*
New Zealand Index of Deprivation	1 (least)	1	1	1
	2	1.16 (0.93–1.44)	0.92 (0.58–1.47)	1.22 (0.96–1.57)
	3	1.12 (0.91–1.36)	0.88 (0.56–1.38)	1.17 (0.93–1.46)
	4	1.11 (0.92–1.35)	0.98 (0.63–1.51)	1.15 (0.93–1.42)
	5 (most)	1.15 (0.95–1.39)	0.99 (0.65–1.53)	1.18 (0.96–1.46)
Smoking status	Current smoker	1	1	1
	Ex-smoker	0.89 (0.79–0.99)*	0.71 (0.58–0.87)***	0.97 (0.85–1.11)
	Never smoker	0.96 (0.79–1.16)	0.91 (0.61–1.35)	1.00 (0.79–1.25)
	Unknown	1.11 (0.74–1.66)	1.30 (0.31–5.45)	1.13 (0.74–1.73)
Cancer stage	Stage III	1	-	-
	Stage IV	1.82 (1.64–2.03)***	-	-
SACT	No SACT	1	1	1
	Had SACT	0.52 (0.47–0.58)***	0.68 (0.55–0.84)***	0.47 (0.42–0.53)***
Radiotherapy	No radiotherapy	1	1	1
	Had radiotherapy	0.84 (0.76–0.92)***	0.91 (0.76–1.10)	0.79 (0.71–0.88)***
CCI score	0	1	1	1
	1	1.21 (1.07–1.37)**	1.12 (0.87–1.46)	1.22 (1.05–1.40)**
	2+	1.09 (0.98–1.22)	0.97 (0.75–1.25)	1.10 (0.97–1.25)
ECOG	0	1	1	1
	1	1.39 (1.23–1.59)***	1.37 (1.10–1.70)**	1.46 (1.24–1.71)***

Table 4 (continued): Multivariate adjusted hazard ratio of lung cancer-specific mortality.

Factors		Stage III and IV	Stage III	Stage IV
		AHR (95% CI)	AHR (95% CI)	AHR (95% CI)
	2+	2.08 (1.81–2.40)***	2.37 (1.79–3.12)***	2.06 (1.73–2.44)***
	Unknown	1.47 (0.98–2.21)	1.59 (0.38–6.73)	1.48 (0.96–2.27)
Year of diagnosis	2011–2014	1	1	1
	2015–2018	0.95 (0.86–1.05)	0.90 (0.75–1.09)	0.96 (0.86–1.08)
	2019–2021	0.55 (0.49–0.63)***	0.56 (0.42–0.75)***	0.55 (0.48–0.64)***

***p<0.001, **p<0.01, *p<0.05.
AHR = adjusted hazard ratio; CI = confidence interval; SACT = systemic anti-cancer therapy; CCI = Charlson Comorbidity Index; ECOG = Eastern Cooperative Oncology Group.

with stage IV lung cancer, with an adjusted HR of 1.27 (95% CI 1.12–1.43, p-value <0.001). Men, current smokers, patients with comorbidities and those with a worse ECOG performance status had a higher risk of dying from lung cancer, while those having radiotherapy and those diagnosed in later years (2019–2021) had a lower risk of lung cancer death. Age, rural living and socioeconomic status did not independently correlate with mortality for patients with advanced NSCLC.

Discussion

The overall SACT rate for patients with advanced NSCLC was 37%. In Aotearoa, the proportion of patients with NSCLC receiving SACT is a quality performance indicator established by Te Aho o Te Kahu Cancer Control Agency.[15] National-level data from 2015 to 2018 showed a SACT rate of 29.7%.[16] However, this national audit included all patients with NSCLC, early-stage inclusive, and therefore is not directly comparable to our study population focussed on advanced NSCLC.

Although comparable, our SACT rates are on the lower end compared to countries with similar health systems. A multi-national European study based on national-level data estimations showed SACT rates between ~30–60%[17] for individual countries. An Australian study showed 51% of patients with metastatic NSCLC received first-line SACT.[18] A national audit of patients with advanced NSCLC in England in 2020 showed that for patients with good performance status (ECOG 0–1), 55% received SACT.[19] In our study, 50.2% of patients with good performance status received SACT. Our SACT rate for patients with good performance status is similar to another study, which assessed patients seen in a medical oncology clinic (following referral from MDM), in which their overall SACT rate was 53%.[9] In our study, 49.8% of patients with advanced NSCLC and good performance status did not receive SACT. This is likely to relate to factors including patient decision not to proceed, deterioration in performance status and predicted adverse outcomes at the time of discussion in MDM.

Māori comprised 30% of our study cohort, similar to the background Midland Region Māori population (28.6%).[2] However, given the incidence of lung cancer in Māori is higher than non-Māori,[3,4] it is possible that Māori were under-represented. Our study showed no significant difference in the crude SACT rate for advanced NSCLC between Māori and non-Māori. On average, Māori patients were more than 6 years younger than their non-Māori counterparts. After adjusting for this difference in age, there was a statistically lower rate of SACT in Māori. However, after adjusting for all study variables, although there appeared to be a similar trend in lower SACT rates for Māori patients, this was not statistically different. This concurs with a local study at the point of review in a medical oncology clinic (a step further down the treatment pathway from our patient cohort), which also showed no overall difference in first-line SACT rate for Māori.[9] However, another Aotearoa study,[8] based on national-level data from the NZCR, showed the

adjusted SACT rate for Māori patients with lung cancer was marginally lower compared to European patients. This national study was inclusive of all cancer stages. The contrasting results in our study are likely explained by the different comparator group (non-Māori in our study, instead of European), different adjusting factors (we had more complete data on cell type and cancer stage) and possibly regional population differences.

Māori in our study were living in higher deprivation. Deprivation has been shown to correlate with worse cancer outcomes and higher incidence of lung cancer.[3] Māori were also more likely to be living rurally. Both these factors can contribute to difficulty in accessing healthcare through socio-economic and geographic isolation. However, in our study logistic regression analysis did not show statistical correlation with SACT rate for either of these variables in isolation.

Poor patient performance status, increased comorbidity and increased age all correlated with lower SACT use in our population. Diagnosis of advanced NSCLC in the latter third of our study period (2019–2021) showed a borderline significant correlation with higher SACT use. A contributing factor for this observation is likely to be the increased availability of funded targeted therapy in Aotearoa over our study period.

Although there was no statistical difference in overall first-line SACT use for Māori, we found for those receiving SACT, Māori were treated with first-line targeted therapy less frequently compared with non-Māori (8.5% vs 16.1%, p-value <0.01). The lower frequency of adenocarcinoma in Māori (47.0% vs 59.4%) and higher frequency of squamous cell cancer (35.4% vs 23.7%) is one contributing factor to this difference. It is unknown in our study population if other causative factors coexist, including differences in cancer mutation testing, mutation positivity or targeted therapy prescribing patterns. A study in Northern Aotearoa[20] showed that Māori have higher rates of EGFR mutation positive NSCLC compared with New Zealand European patients: standardised incidence ratio 2.02 (95% CI 1.43–2.87). This suggests that differences in mutation positivity are unlikely to be the cause of lower targeted therapy use in our Māori population. The lower use of targeted therapy in Māori is likely a contributing factor to the observed poorer survival outcomes in our Māori population.

Only one patient in our pre-funded immunotherapy era cohort received immunotherapy as first-line SACT. Now that first-line immunotherapy has been funded in Aotearoa since April 2023, this will change and widen SACT patient candidacy. As Māori are over-represented in advanced stage NSCLC, it is proposed that this will reduce inequities.

Patients receiving SACT had lower cancer-specific mortality compared with those not receiving SACT. Māori patients had higher cancer-specific mortality compared with non-Māori. For those who received SACT, non-Māori had greater 12-month survival compared with Māori—adjusted OR 1.86 (95% CI 1.27–2.73, p-value <0.01)—similar to that seen in another Aotearoa study.[9] Given there was no difference in overall SACT rate for Māori patients in our cohort, this indicates these mortality inequities are derived from other factors (both intrinsic and extrinsic to SACT).

Multivariate adjusted HR analysis showed that Māori had higher mortality. Male patients, current smokers, increased comorbidity and poorer performance status were other patient factors correlating with higher mortality. Diagnosis of advanced NSCLC in the latter third of our study period (2019–2021) was correlated with lower mortality, compared with diagnosis earlier in the study period. We also found a borderline increased SACT rate for patients diagnosed in the latter third of the study period—this increased SACT use is likely to be one driving factor for reduced mortality.

Our study's strengths include having comprehensive data on patient demographics (such as smoking status) and tumour characteristics (including cancer stage and cell type), which are crucial factors influencing the use of SACT and patient survival. These data are not fully available in the NZCR. Adjusting for these factors allows more accurate analysis of the correlating factors for SACT and mortality, and the comparison between Māori and non-Māori. Some limitations in our study should be noted when interpreting results. For patients not receiving SACT, our data do not identify the reason for not proceeding. Reasons likely include patient choice, treatment candidacy and ECOG performance status. Although data are sparse, previous research has suggested that Māori may be less likely to proceed with offered treatment.[21] Qualitative research has identified barriers that Māori may face during lung cancer diagnosis and treatment,[22] cultural mismatch between the health service and patient being a common theme. Therefore, the SACT rates in this

study should not be interpreted purely as a factor of physician treatment selection. Comparison of our SACT rate to international data has limitations due to differences in study population exclusions (for example, exclusion/inclusion of stage IIIA disease, sole inclusion of good ECOG performance status) and data source (patient level vs national estimate calculations).

In conclusion, our study did not find a statistical difference in the overall rate of first-line SACT for Māori patients with advanced NSCLC. However, we found that Māori who received SACT were less likely to be treated with targeted therapy as first-line. The underlying reasons for this require further investigation. Māori had higher cancer-specific mortality compared with non-Māori. Although this outcome disparity was not explained by an overall discrepant SACT use rate, the difference in targeted therapy is likely a contributing factor. Our data indicate that provision of SACT is not the sole explanatory factor for the outcome disparities in Māori with NSCLC. Overall, our SACT rate is on the lower end when compared to other similar health systems internationally. It is envisioned that this will improve following the current era of funded immunotherapy in Aotearoa.

COMPETING INTERESTS
ME is a Member of the National Screening Advisory Committee.

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Understanding mental health risk in Aotearoa: an analysis of the 1737 Need to Talk telehealth service

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ABSTRACT

AIM: The 1737 Need to Talk telehealth service (mental health call and text helpline) was launched in Aotearoa New Zealand in June 2017, providing the public with the ability to call or text when they need mental health support. The aim of this research is to describe the utilisation of the 1737 Need to Talk telehealth service. We describe the patterns of 1737 contacts over time and describe the contact users, including the most at-risk contacts (defined as those contacts who trigger the "Break Glass" procedure).

METHODS: This is a retrospective observational study analysing 1737 Need to Talk data over 5 years and 7 months from June 2017 through to December 2022. A total of 719,904 contacts to the service were analysed.

RESULTS: This research found that contacts to the 1737 Need to Talk service (by call or text) increased until the end of 2021 and then plateaued from 2022. The average proportion of at-risk service users was 0.43% of 1737 Need to Talk contacts, and this grew minimally over the period investigated. Service users most at risk were found to be of the female gender, in the 13–19-year-old age group, and those residing in Whanganui and MidCentral districts.

CONCLUSION: This study details the growth in the number of specific demographics reaching out for mental health support to 1737 and may be indicative of the need for increasing mental health support.

Globally, mental or substance use disorders (as described in the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* [*DSM-5*]) are common, impacting the lives of many across the globe.[1] Most disorders (62.5%) first occur before the age of 25 years, with the peak age of 14.5 years, making early recognition and intervention essential.[2] Experiencing mental illness—including depression and anxiety—is a risk factor for suicide.[3] Overall, suicide rates in New Zealand decreased by 20% from 1996 to 2016; however, not all demographic groups reflected a decrease.[4] New Zealand has been identified as one of the five Organisation for Economic Co-operation and Development (OECD) countries (alongside Lithuania, Finland, Ireland and Chile) with the highest suicide rates for young people (15.6 per 100,000 15–19-year-olds).[5] Between 2015 and 2019, the leading cause of all mortality in 15–19-year-old New Zealanders was suicide. Māori males had the highest rates of suspected suicide, with a rate of 23.9 per 100,000, 1.4-times higher than non-Māori males. Suspected suicide rates for Māori peaked in 2019–2020 at 21.0 (per 100,000 Māori), compared with the New Zealand average rate of 12.9 (2019–2020). The age group with the highest suspected suicide rates was the 20–24-year age group, which peaked in 2018–2019 at 25.8 per 100,000.[6]

For those experiencing high-risk mental health conditions, telehealth services provide critical and timely access to mental health professionals and, where necessary, connection to emergency services, without the barriers associated with traditional support. The 1737 Need to Talk service provides a mental health support service to 5.3 million New Zealanders, 24 hours a day, 7 days a week, using a free-to-call phone and text number, publicly funded by Te Whatu Ora – Health New Zealand.[7] The line is staffed by trained telehealth peer support workers or counsellors, who use a call flow plan to build a rapport with the service user, identify their presenting issue and develop a plan with the service user focussed on making a behaviour change or using their usual coping strategies, to build their resilience.[8] In the case of immediate risk of harm—including risk of suicide—to a service user or another person, risk is assessed, and a plan developed that may include immediate referral to local crisis services. Where a plan cannot be agreed on and risk is serious and imminent, the "Break Glass" procedure allows the call handler to contact emergency services (police or ambulance) without requiring

the consent of the at-risk service user (New Zealand Health Information Privacy Code).[9]

The aim of this research is to describe the utilisation of the 1737 Need to Talk telehealth service (mental health call and text helpline) in New Zealand. We describe the patterns of 1737 contacts over time and describe the contact users, including the most at-risk contacts (defined as those contacts who trigger the "Break Glass" procedure).

Methods

Study design

This is a retrospective observational cohort study using routinely collected demographic and Break Glass data from the 1737 Need to Talk service. Data from 1737 Need to Talk service users was collected between 1 June 2017 and 31 December 2022 (5 years and 7 months).

Setting

The 1737 Need to Talk telehealth service is a free service that commenced in June 2017, providing 5.3 million New Zealanders with a platform to call or text message when they feel anxious, overwhelmed by emotions and/or thoughts, depressed and in need of support. 1737 Need to Talk is one of the 37 free telehealth services that Whakarongorau Aotearoa makes available to all New Zealanders.[10] The service provides free 24/7 support utilising a "one-off intervention with an open door to return" model of care.[8] Service users are given the option of either counselling or a peer support service; the latter is provided by people with lived experience of their own mental health or addiction challenges. Through the 1737 Need to Talk service, the counsellor or peer support worker builds rapport with the service user, establishes the problem for which they are seeking help and develops a support plan based on their immediate needs or situation.[8]

In the event of a service user being at risk of harming themselves or others, or if a child is at risk, a safety plan is developed with the service user, which may also involve "warm transfer" to the local mental health crisis team or emergency services. A warm transfer requires the call handler to talk to the service user and then the service they are being transferred to before connecting the two on the phone and ensuring they are talking before disconnecting. However, where a plan to ensure safety cannot be agreed and there is a serious risk of harm, the Break Glass procedure is followed. A Break Glass procedure is initiated in the event of a service user having high-risk physical health needs, being a risk to themselves, a current/future risk of harm to others (including child abuse/neglect) and/or they have disclosed past serious harm to others and are at risk of re-offending (2020, Whakarongorau Aotearoa Internal staff document).

Ethics

This research project was approved by the Auckland University of Technology Ethics Committee (AUTEC) (23/28). STROBE cohort reporting guidelines were followed. Service user data were provided in a de-identifiable form.[11]

Participants

The data included in this research project involved service users who called or texted the free 1737 Need to Talk service. For this research, 1737 Need to Talk total contacts refer to the number of calls and text conversations the service receives. The total number of 1737 Need to Talk contacts includes unanswered calls; however, unanswered calls were not included in the service user data.

Variables

De-identified data collected at the time of contact were provided by Whakarongorau Aotearoa for all service users. During the conversation, the call handler would note the time of call and ask the caller for their demographic details including gender, age and ethnicity group (as identified by service user) (prioritised)[12] and New Zealand district (previously known as district health boards). Population data by New Zealand district is available through StatsNZ.[13] Deprivation data for each of the health districts was obtained from the New Zealand Index of Multiple Deprivation (IMD18).[14]

Study size

Between 1 June 2017 and 31 December 2022, there were 719,904 contacts to the 1737 Need to Talk helpline and 3,089 Break Glass incidents recorded.

Statistical methods

Both the number of offered 1737 contacts and the proportion of 1737 Need to Talk contacts that resulted in the Break Glass procedures were calculated by month. A linear regression model was used to analyse the trend over time, using the month as the independent variable and the number of contacts/proportion of Break Glass incidents as the dependent variables, with R^2

indicating the goodness of fit. Comparative analyses for gender, age and ethnicity were performed based on the relative proportions of Break Glass service users compared to all 1737 Need to Talk service users using the Chi-squared test. A t-Test was used to compare the district data for Break Glass and 1737 contacts rates per 10,000 people to the New Zealand national averages.[13] A linear regression was performed using the IMD18[14] for each district as the independent variable and the 1737 utilisation or Break Glass data per 10,000 as the dependent variables, with R^2 indicating the goodness of fit. R and RStudio were used for statistical analysis.[15] Differences with p-value (p) <0.05 were deemed statistically significant.

Results

Between June 2017 and December 2022, there were 719,904 contacts: 421,367 (58.5%) contacts by call, and 298,537 (41.5%) by text messaging. Of these contacts, 49.9% were from unique users, with an average of 10,745 contacts per month or 353.3 per day (Appendix Table 1).

1737 Need to Talk text and call contacts by month and year

The year with the greatest number of contacts was 2021 (170,532), while the busiest month was April 2020 (17,699). The total number of 1737 Need to Talk contacts increased in a polynomial trend with time, with an R^2 value of 0.8997 (Figure 1). Peaks in contacts to the services were observed around major events in New Zealand (the Christchurch mosque attack and COVID-19 lockdowns) (Figure 1).

Break Glass incidents by month and year

A total of 3,089 Break Glass procedures were applied between 2017 and 2022, with an average of 46.8 Break Glass procedures applied monthly (Appendix Table 1). During this period, the average proportion of Break Glass incidents compared to offered 1737 contacts was 0.43%, ranging from 0.20–1.15%, excluding the introductory month of June 2017 (Figure 2 and Appendix Table 1). Linear regression testing proved a significant increase with time for the proportion of calls resulting in a Break Glass incident compared to total contacts (p<0.05). However, this increase is low—an

Figure 1: The comparison of all offered contacts to 1737 Need to Talk text (yellow), call contacts (green) and total contacts (blue) by month (2017–2022). The trend line for total contacts is shown as a blue dashed line. Black dashed lines correspond with significant New Zealand events as shown. See Appendix Table 1.

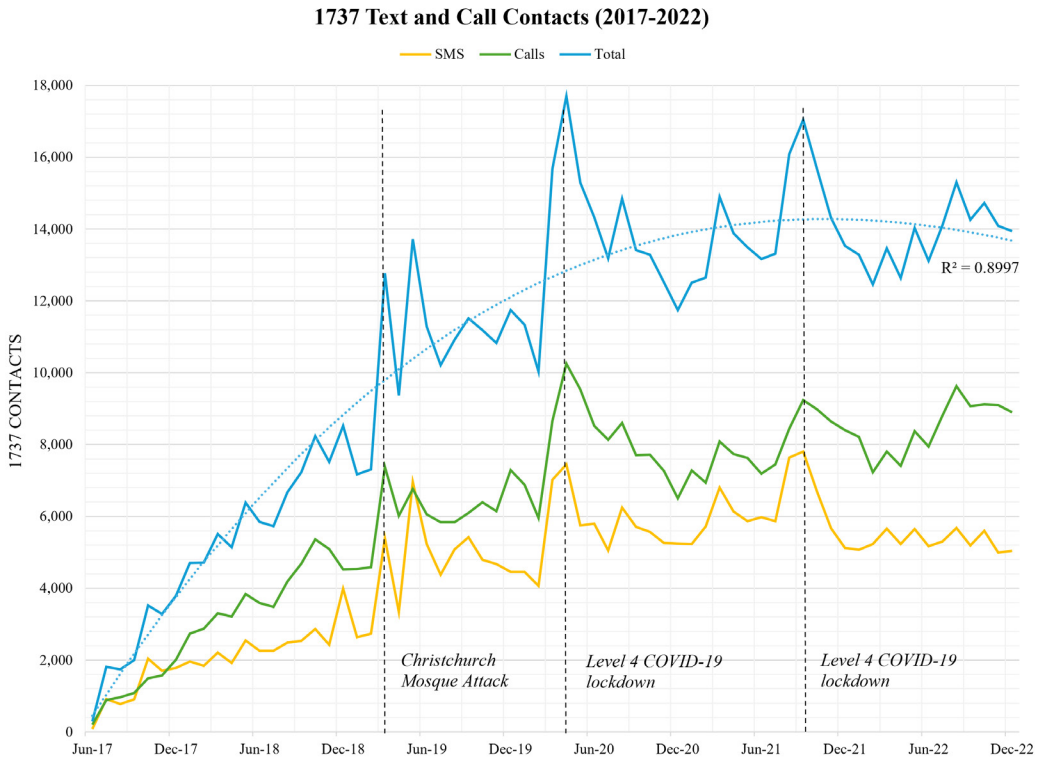


Figure 2: The proportion of Break Glass procedures of all 1737 Need to Talk contacts for each month from 2017 (July) to 2022 (December) (solid green line). The proportion of Break Glass procedures over this entire period is 0.43% (dashed black line). See Appendix Table 1.

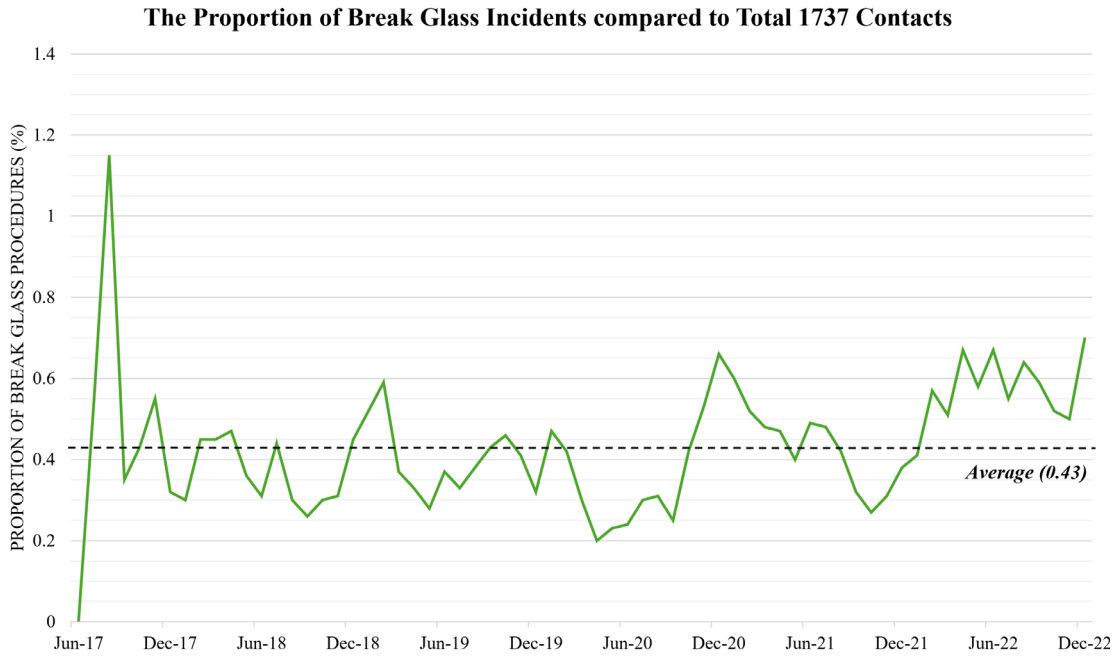


Figure 3: Bar chart representing the gender proportion for Break Glass incidents and total answered 1737 contacts. Break Glass incidents are represented in red, total answered 1737 contacts are represented in yellow. See Appendix Tables 2 and 3.

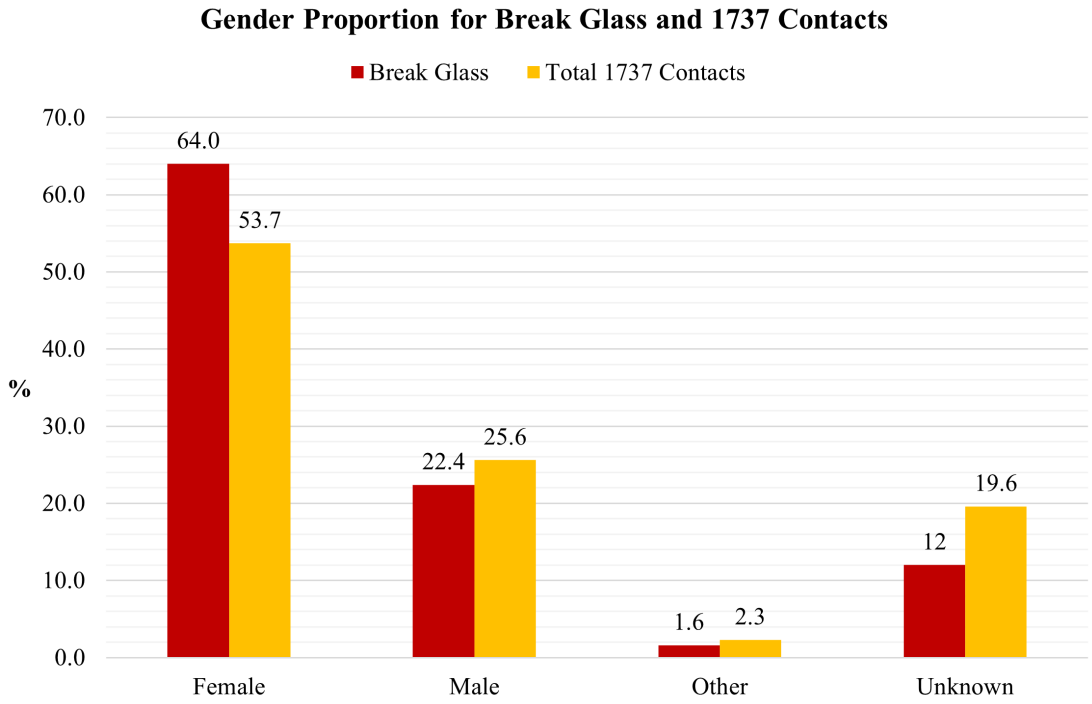


Figure 4: Bar chart representing the proportion of Break Glass incidents and total answered 1737 Need to Talk contacts for each age group. Values under 1% are not shown in the figure. Break Glass incidents are represented in red, total answered 1737 contacts are represented in yellow. See Appendix Table 4.

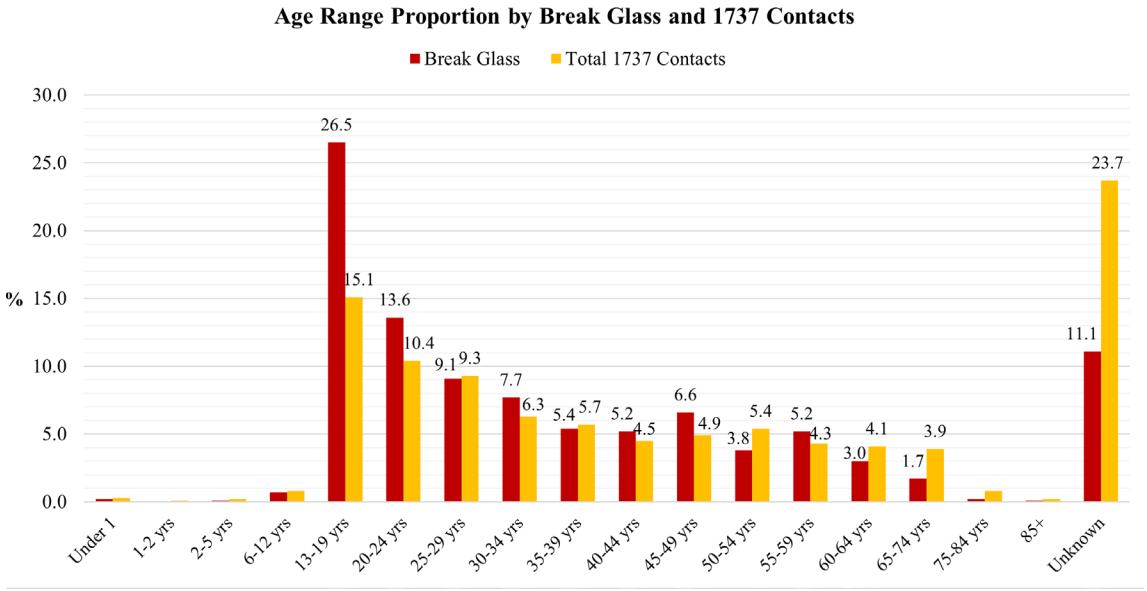
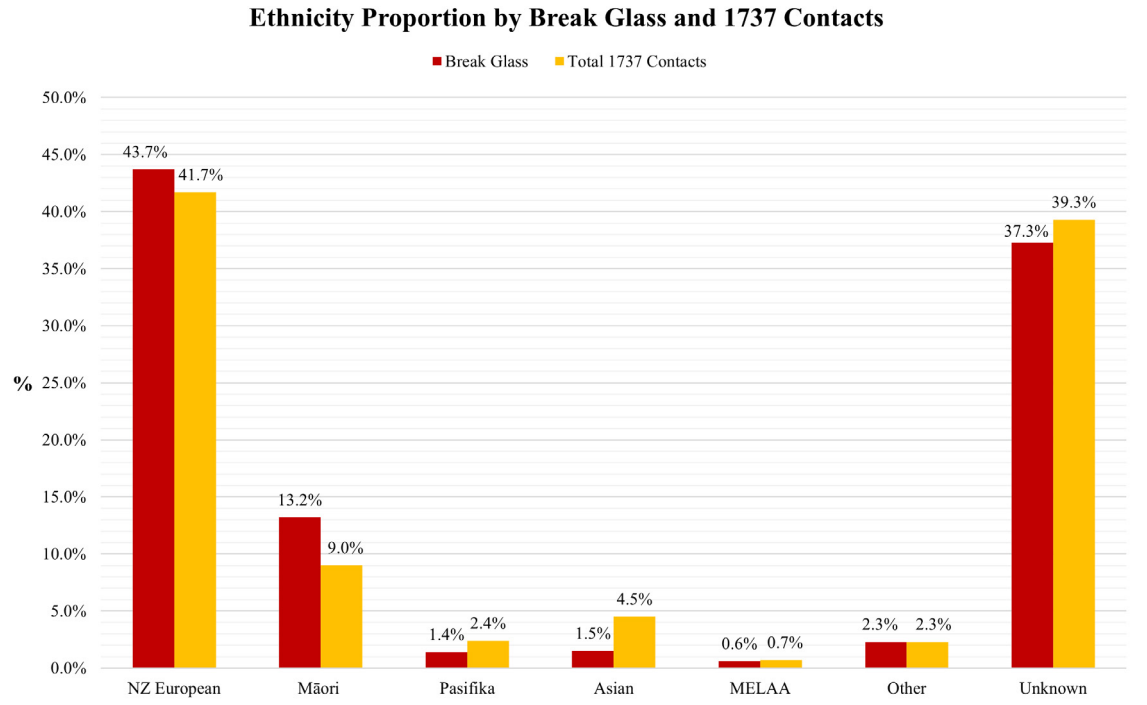
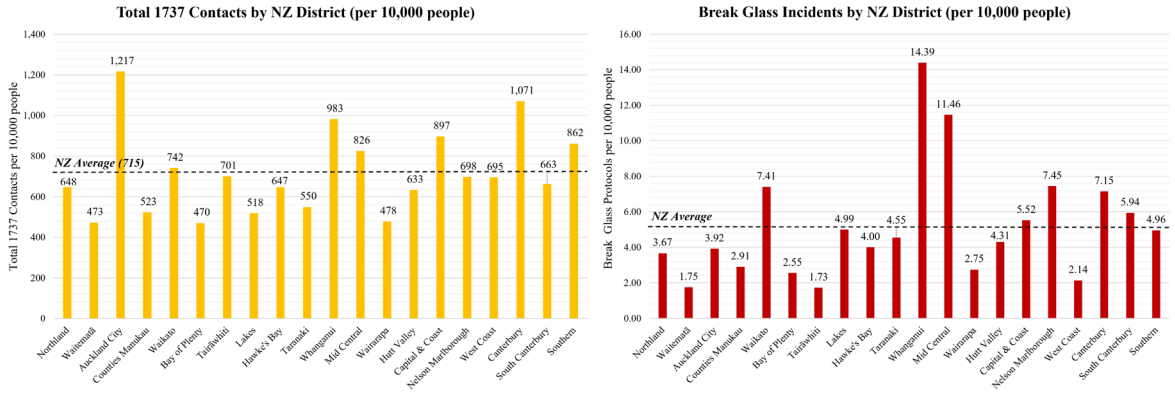


Figure 5: Bar chart representing the ethnicity proportion for the Break Glass incidents and total answered 1737 Need to Talk contacts. See Appendix Table 5.



MELAA = Middle Eastern, Latin American and African.

Figure 6: The district locality of Break Glass incidents (red) and total 1737 Contacts (yellow) per 10,000 people to account for different population sizes (2017–2022).[14] The New Zealand average per 10,000 is shown by a dashed line. See Appendix Table 6.



estimated increase of 0.0021 in Break Glass incidents compared to total contacts per month. The period with the highest number of at-risk contacts was seen in 2022, with 952 Break Glass incidents (30.8% of the total).

Break Glass incidents by gender

There was a significant difference in gender proportions for 1737 Need to Talk contact rates vs Break Glass incidents ($p<0.001$; Figure 3, Appendix Table 2 and Appendix Table 3). There is an over-representation of females in contacts where the Break Glass procedures were initiated: of the total 3,089 Break Glass procedures followed, 1,978 (64.0%) were as a result of calls from female service users (whereas females accounted for 53.7% of 1737 Need to Talk contacts), 691 (22.4%) were from males (males accounted for 25.6% of 1737 Need to Talk contacts) and 48 (1.6%) were from service users who identify as gender diverse (overall, 1.1% of 1737 Need to Talk contacts identify as gender diverse) ($p<0.05$; Figure 3 and Appendix Table 2).

Break Glass incidents by age group

The highest number of Break Glass incidents were regarding 13–19-year-old service users with 819 (26.5%) incidents, followed by 20–24-year-olds with 419 (13.6%) incidents (Figure 4; Appendix Table 4). While 13–19-year-olds account for 15.1% of contacts (the highest of all age groups), they still have a significantly higher proportion of Break Glass procedures initiated (26.5%; $p<0.001$). Significant over-representation in Break Glass procedures was also found for 20–24-year-olds ($p<0.001$), 30–34-year-olds ($p<0.01$), 45–49-year-olds ($p<0.001$) and 55–59-year-olds ($p<0.05$). Interestingly, 82.4% of youth under 20 contacted the service through text messaging, compared to 45.0% of service users aged between 20 and 64 years and only 7.5% of those aged 65 and older.

Break Glass incidents by ethnicity

A significantly higher proportion of Break Glass incidents were observed compared with their 1737 Need to Talk contact proportion for NZ European (43.7% compared to 41.7%; $p<0.05$) and Māori (13.2% compared to 9.0%; $p<0.001$) ethnic groups (Figure 5). There is a large proportion of unknown service users (>37%; Figure 5).

Break Glass incidents by New Zealand district

There were regional differences in the number of 1737 Need to Talk contacts during the study period (Figure 6, Appendix Table 6). The New Zealand national average was 714.7 contacts per 10,000 people, with Auckland city (1,216.9), Canterbury (1,071.1), Capital & Coast (896.8), Mid-Central (826.0), Southern (861.8) and Whanganui (982.7) all reaching levels significantly above the national average ($p<0.05$; Figure 6, Appendix Table 6). Lower utilisation of the 1737 Need to Talk service compared to the national average was observed in Bay of Plenty (470.4), Counties Manukau (522.8), Lakes (518.1), Taranaki (550.0), Wairarapa (478.4), and Waitematā (472.6) ($p<0.05$; Figure 6, Appendix Table 6). While one of the main urban centres—Auckland city—had the highest utilisation (1.7 times the national average use per 10,000 people), the two other regions covering the Auckland region had below average utilisation

(Counties Manukau and Waitematā).

There were also regional differences in the number of Break Glass procedures followed (Figure 6, Appendix Table 6). Whanganui and MidCentral districts (which border each other) had the highest number of Break Glass incidents per capita, with 14.39 and 11.46 per 10,000 people, respectively. From 1737 Need to Talk contacts per capita, the districts with the highest contacts were Auckland city and Canterbury, with 1,216.9 and 1,071.1 contacts (per 10,000 people), respectively. The Whanganui, MidCentral, Nelson Marlborough, Waikato and Canterbury districts were statistically higher than the New Zealand average of 5.18 Break Glass incidents per 10,000 people ($p<0.05$; Figure 6). Conversely, Bay of Plenty, Counties Manukau, Northland, Tairāwhiti, Wairarapa, Waitematā and West Coast all had significantly lower rates of Break Glass incidents per 10,000 people than the New Zealand average ($p<0.05$; Figure 6).

Break Glass incident data were compared with New Zealand district deprivation data.[14] Linear regression analysis revealed no significant relationship between New Zealand deprivation ranking and 1737 Need to Talk utilisation ($R^2=0.063$) or activation of the Break Glass procedures ($R^2=0.015$) (Appendix Table 7).

Discussion

Between 2017 and 2022, there were 719,904 contacts to the free 1737 Need to Talk service, 3,089 of which were from at-risk service users defined as the application of the Break Glass procedures (accounting for less than 0.5% of 1737 Need to Talk contacts). The Break Glass incidents have remained relatively stable over this time, despite fluctuations in overall demand for the 1737 Need to Talk service. Service users most at risk (activating the Break Glass procedures) were found to be of the female gender, in the 13–19-year-old age group, and those residing in Whanganui and MidCentral districts.

Our data suggest that there has been an increase in the number of service users presenting to the 1737 Need to Talk telehealth service. Specific peaks in contacts to the 1737 Need to Talk telehealth service correlate with significant events in New Zealand at the time. On 25 March 2020 and 17 August 2021, New Zealand went into a Level 4 COVID-19 lockdown (the most restrictive) where only essential workers could travel to work, and New Zealanders were required to remain at home.[16] Other significant events correlating with a prominent peak in contacts include the Christchurch terrorist attack on 15 March 2019,[17] and the terrorist attack in September 2021 in Auckland.[18] Our findings suggest that New Zealanders engage with freely available mental health support in times of significant need. The 1737 Need to Talk telehealth service offers the advantage of being free and available 24/7 by text or call. While in-person consultations can pick up on non-verbal cues and may be preferred by some service users, they can also be daunting for those who find it challenging to speak to someone (in-person), and potentially financially prohibitive and challenging to access.[19] The year-by-year increase in the number of people reaching out to 1737 Need to Talk could in part reflect the increasing awareness of the service, in particular in response to the widespread advertising of the service following the Christchurch mosque terrorist attack and through the COVID-19 lockdowns.[16–18,20] Our data suggest that there has been a small growth in the number of service users presenting at risk over the past 5 years and 7 months.

Females were significantly over-represented in Break Glass incident data. The utilisation of the Break Glass procedure is consistent with New Zealand data showing that there was a 132% increase in self-harm hospitalisations from 2016 to 2021, with females comprising 78% of these hospitalisations in 2021.[21] The over-representation of females in the Break Glass cohort is consistent with research demonstrating that females are at increased risk of mental distress.[22] Additionally, males are also less likely to reach out for mental health support when in need.[23]

Māori and NZ European ethnic groups were disproportionately over-represented in Break Glass incidents compared with all contacts to the 1737 Need to Talk telehealth service. However, caution should be given due to the large proportion of unknown ethnicity data and the relatively small number of Break Glass events.

There were significant variations in the utilisation of the 1737 Need to Talk service across New Zealand. Further research is needed to determine whether these fluctuations reflect differing mental health demand, or whether the communities are as informed about the availability of the 1737 Need to Talk service. Concerningly, Whanganui and MidCentral, neighbouring districts, have rates more than double the New Zealand average for Break Glass (2.8 and 2.2 times, respectively). No

significant correlations could be found with New Zealand Index of Deprivation (NZDep) or suicide data. This discrepancy suggests that suicide risk is not the main or only factor contributing to a Break Glass procedure through the 1737 Need to Talk service. One theory is that this could be due to the high rates of family violence in these regions, with one in 10 calls for help to the police concerning family violence reported for Whanganui.[24] It is, however, likely that there are multiple factors that contribute to these Break Glass district data.

Adolescents (13–19 years old) are disproportionately represented in this data as presenting with serious risk (i.e., Break Glass), at almost double the proportion of the next highest age group of young adults (20–24-year-olds). This youngest age group preferentially reaches out by text, a medium that is used increasingly as a tool for delivering mental health support and services to young people.[25] The increased complexity through text messaging could be reflected in the high number of Break Glass incidents observed for this age group. Adolescents have the highest rates of first onset of several mental disorders, including obsessive compulsive disorder (14.5 years), eating disorders (15.5 years), anxiety (5.5 years and 15.5 years) and substance disorders (19.5 years). Schizophrenia and mood and personality disorder onset peak slightly later at 20.5 years old; these mental disorders correlate with critical brain development stages.[26] This study was unable to record the proportion of LGBTQIA+, a group with high rates of mental illnesses.[27]

Since 2012, the mental health needs of New Zealand adolescents have shown significant increase across all demographics, particularly females, Māori, Pacific peoples and Asian ethnicities, and those residing in areas of high deprivation.[28] International literature has also shown significant increases in the number of mental health concerns for youth (12–17 years) and young adults (18–25 years), especially in females.[29,30]

Limitations

Limitations of this research include the secondary use of clinical data collected primarily for continuity of care and clinical audit. The use of prioritised ethnicity data—where only a single ethnicity is counted, may under-represent some ethnic groups. Where text messaging is concerned, one contact involves multiple text messages back and forth, meaning each message only results in multiple contacts if they occur on different occasions. Individual contacts refer to the number of (unique) individuals using the service. This research does not detail the specific symptoms that triggered a Break Glass incident. As these data values are relatively low, due to the high proportion of missing data for some user characteristics as a result of the anonymity of service users included in this research, these results should be interpreted with caution.

Conclusion

This study has detailed the monthly trends and demographics of service users who contacted the all-hours, freely available 1737 Need to Talk service (between 2017 and 2022) and those users deemed most at risk through the Break Glass procedure. The number of Break Glass incidents has remained consistent, whereas contacts through the service appear to have plateaued towards the end of the analysis period. This research identified the most at-risk service users in New Zealand for each demographic: the female gender, the 13–19-year-old age group, and the Whanganui and MidCentral districts. This research supports the need for ongoing mental health support for these at-risk demographics to prevent increases in Break Glass incidents. Whakarongorau Aotearoa leverages technology to provide the safe, easily accessed 1737 Need to Talk service in an increasingly complex environment when the workforce is stretched and more New Zealanders are seeking support.

COMPETING INTERESTS
This article uses Whakarongorau Aotearoa data. Several authors of this article are employees of Whakarongorau Aotearoa (as stated in the author's information).
DC: Co-opted member of NZ National Committee, RANZCP (Tū Akaakaroa); Board member/Deputy Chair Safe Man Safe Family trust.
VT: Deputy Chair of the Australasian College of Paramedicine's Research Advisory Committee.
RL: Chair of NZ Telehealth Forum.

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Appendix

Appendix Table 1: 1737 SMS, calls, total offered contacts and Break Glass protocols applied by month and year (2017–2022). The total offered contacts data includes all calls, regardless of whether they were answered or abandoned.

Date	SMS	Calls	Total	Break Glass	Proportion of Break Glass procedures (%)
Jun 2017	85	202	287	0	0.00
Jul 2017	915	891	1,806	10	0.55
Aug 2017	775	965	1,740	20	1.15
Sep 2017	910	1,086	1,996	7	0.35
Oct 2017	2,035	1,488	3,523	15	0.43
Nov 2017	1,703	1,577	3,280	18	0.55
Dec 2017	1,777	2,009	3,786	12	0.32
Jan 2018	1,964	2,737	4,701	14	0.30
Feb 2018	1,840	2,874	4,714	21	0.45
Mar 2018	2,207	3,300	5,507	25	0.45
Apr 2018	1,920	3,217	5,137	24	0.47
May 2018	2,545	3,842	6,387	23	0.36
Jun 2018	2,256	3,592	5,848	18	0.31
Jul 2018	2,254	3,477	5,731	25	0.44
Aug 2018	2,485	4,190	6,675	20	0.30
Sep 2018	2,541	4,688	7,229	19	0.26
Oct 2018	2,867	5,364	8,231	25	0.30
Nov 2018	2,424	5,092	7,516	23	0.31
Dec 2018	3,992	4,527	8,519	38	0.45
Jan 2019	2,641	4,530	7,171	37	0.52
Feb 2019	2,733	4,580	7,313	43	0.59
Mar 2019	5,386	7,376	12,762	47	0.37
Apr 2019	3,343	6,020	9,363	31	0.33
May 2019	6,958	6,761	13,719	38	0.28
Jun 2019	5,233	6,054	11,287	42	0.37
Jul 2019	4,371	5,839	10,210	34	0.33
Aug 2019	5,081	5,837	10,918	42	0.38

Appendix Table 1 (continued): 1737 SMS, calls, total offered contacts and Break Glass protocols applied by month and year (2017–2022). The total offered contacts data includes all calls, regardless of whether they were answered or abandoned.

Date	SMS	Calls	Total	Break Glass	Proportion of Break Glass procedures (%)
Sep 2019	5,424	6,091	11,515	49	0.43
Oct 2019	4,797	6,390	11,187	52	0.46
Nov 2019	4,678	6,146	10,824	44	0.41
Dec 2019	4,458	7,286	11,744	38	0.32
Jan 2020	4,451	6,886	11,337	53	0.47
Feb 2020	4,072	5,958	10,030	42	0.42
Mar 2020	7,024	8,656	15,680	47	0.30
Apr 2020	7,445	10,254	17,699	36	0.20
May 2020	5,752	9,540	15,292	35	0.23
Jun 2020	5,800	8,526	14,326	34	0.24
Jul 2020	5,049	8,136	13,185	40	0.30
Aug 2020	6,241	8,599	14,840	46	0.31
Sep 2020	5,704	7,709	13,413	34	0.25
Oct 2020	5,567	7,713	13,280	56	0.42
Nov 2020	5,259	7,264	12,523	66	0.53
Dec 2020	5,238	6,502	11,740	77	0.66
Jan 2021	5,231	7,279	12,510	75	0.60
Feb 2021	5,715	6,936	12,651	66	0.52
Mar 2021	6,806	8,084	14,890	71	0.48
Apr 2021	6,138	7,739	13,877	65	0.47
May 2021	5,869	7,628	13,497	54	0.40
Jun 2021	5,972	7,189	13,161	64	0.49
Jul 2021	5,870	7,448	13,318	64	0.48
Aug 2021	7,641	8,445	16,086	67	0.42
Sep 2021	7,802	9,238	17,040	54	0.32
Oct 2021	6,684	8,979	15,663	42	0.27
Nov 2021	5,669	8,642	14,311	44	0.31
Dec 2021	5,126	8,402	13,528	51	0.38
Jan 2022	5,072	8,211	13,283	55	0.41

Appendix Table 1 (continued): 1737 SMS, calls, total offered contacts and Break Glass protocols applied by month and year (2017–2022). The total offered contacts data includes all calls, regardless of whether they were answered or abandoned.

Date	SMS	Calls	Total	Break Glass	Proportion of Break Glass procedures (%)
Feb 2022	5,235	7,226	12,461	71	0.57
Mar 2022	5,658	7,802	13,460	68	0.51
Apr 2022	5,230	7,408	12,638	85	0.67
May 2022	5,652	8,375	14,027	81	0.58
Jun 2022	5,168	7,943	13,111	88	0.67
Jul 2022	5,299	8,814	14,113	77	0.55
Aug 2022	5,677	9,621	15,298	98	0.64
Sep 2022	5,188	9,072	14,260	84	0.59
Oct 2022	5,603	9,122	14,725	76	0.52
Nov 2022	4,990	9,096	14,086	71	0.50
Dec 2022	5,042	8,897	13,939	98	0.70
Total	308,875	421,367	719,904	3,089	0.43

Appendix Table 2: Gender proportion of Break Glass protocols applied compared to a total of 1737 answered contacts between 2017–2022 (abandoned calls are excluded). Using the Chi-squared test, p-values below 0.05 are deemed statistically significant for differences in proportions.

Gender	Break Glass	%	Answered 1737 contacts	%	P-value
Female	1,978	64.0	319,592	53.7	0.0000
Male	691	22.4	152,680	25.6	0.0000
Other	48	1.6	6,672	1.1	0.0282
Unknown	372	12.0	116,537	19.6	0.0000
Total	3,089	100	595,481	100	

Appendix Table 3: The proportion of all answered 1737 contacts that resulted in a Break Glass incident stratified by gender.

Gender	Break Glass	Answered 1737 contacts	Proportion Break Glass (%)
Female	1,978	319,592	0.62%
Male	691	152,680	0.45%
Other	48	6,672	0.72%
Unknown	372	116,537	0.32%
Total	3,089	595,481	0.52%

There is a significant difference in the gender distribution between the Break Glass and the 1737 contacts ($p<0.001$).

Appendix Table 4: Age group proportion of Break Glass protocols applied compared to total answered 1737 contacts (2017–2022). Using the Chi-squared test, p-values below 0.05 are deemed statistically significant for differences in proportions.

Age group	Break Glass	%	1737 contacts	%	P-value
Under 1	6	0.2%	1,588	0.3	0.5457
1–2	0	0.0%	554	0.1	0.1617
2–5	2	0.1%	1,276	0.2	0.1095
6–12	23	0.7%	4,790	0.8	0.7869
13–19	819	26.5%	89,884	15.1	0.0000
20–24	419	13.6%	61,822	10.4	0.0000
25–29	280	9.1%	55,453	9.3	0.6586
30–34	238	7.7%	37,369	6.3	0.0012
35–39	166	5.4%	34,229	5.7	0.3939
40–44	160	5.2%	26,814	4.5	0.07756
45–49	203	6.6%	29,077	4.9	0.0000
50–54	117	3.8%	32,056	5.4	0.0000
55–59	161	5.2%	25,872	4.3	0.0207
60–64	92	3.0%	24,452	4.1	0.0019
65–74	51	1.7%	23,040	3.9	0.0000
75–84	6	0.2%	4,816	0.8	0.0000
85+	2	0.1%	965	0.2	0.2633
Unknown	344	11.1%	141,424	23.7	0.0000
Total	3,089	100	595,481	100	

Appendix Table 5: Ethnicity proportion of Break Glass protocols applied compared to total answered 1737 contacts (2017–2022). Using the Chi-squared test, p-values below 0.05 are deemed statistically significant for differences in proportions. Prioritised ethnicity is used in accordance with data collection in the New Zealand health and disability sector, where only one prioritised ethnic group is recorded. This avoids issues including multiple data points for one service user.[1]

Ethnicity	Break Glass	%	Answered 1737 contacts	%	P-value
NZ European	1,351	43.7%	248,393	41.7%	0.0241
Māori	409	13.2%	53,785	9.0%	0.0000
Pacific peoples	44	1.4%	14,351	2.4%	0.0005
Asian	45	1.5%	26,793	4.5%	0.0000
MELAA	17	0.6%	4,456	0.7%	0.2422
Other	70	2.3%	13,617	2.3%	0.9871
Unknown	1,153	37.3%	234,086	39.3%	0.0255
Total	3,089	100%	595,481	100%	

MELAA = Middle Eastern, Latin American and African.

Appendix Table 6: New Zealand district proportion of Break Glass protocols applied (per 10,000) compared to total 1737 contacts (per 10,000), population size[2] and suspected suicide rates per 100,000.[3] Using a t-Test, p-values below 0.05 are deemed statistically significant, meaning a significant difference from the New Zealand average per 10,000 people (5.18 for the Break Glass contacts and 714.72 for total 1737 contacts, respectively).[4]

DHB	Break Glass (no.)	Break Glass (per 10,000 people)	Comparison to Break Glass national average (P-value)	Total 1737 contacts (per 10,000 people)	Comparison to total contacts national average (P-value)	District population size (2022)[2]	Suspected suicide rates per 100,000 (2017–2021)[3]
National average	**125**	**5.18**	-	**714.72**	-	-	**14.67**
Auckland city	189	3.92	0.0964	1,216.92	0.0000	481,600	9.10
Bay of Plenty	70	2.55	0.0017	470.44	0.0000	274,700	13.98
Canterbury	423	7.15	0.0129	1,071.09	0.0000	591,500	12.50
Capital & Coast	178	5.52	0.6392	896.84	0.0009	322,300	10.02
Counties Manukau	176	2.91	0.0052	522.79	0.0006	605,100	9.14
Hawke's Bay	73	4.00	0.1179	647.21	0.1612	182,600	18.56
Hutt Valley	69	4.31	0.2423	633.46	0.0954	160,200	8.68
Lakes	59	4.99	0.797	518.10	0.0004	118,200	15.78
MidCentral	218	11.46	0.0000	825.96	0.0267	190,300	15.68
Nelson Marlborough	123	7.45	0.0051	698.00	0.722	165,000	10.74
Northland	74	3.67	0.0496	648.04	0.1661	201,500	20.52
South Canterbury	37	5.94	0.3021	662.76	0.2758	62,300	14.55
Southern	174	4.96	0.7655	861.77	0.0050	350,500	14.62
Tairāwhiti	9	1.73	0.0001	700.77	0.7665	52,100	25.70

Appendix Table 6 (continued): New Zealand district proportion of Break Glass protocols applied (per 10,000) compared to total 1737 contacts (per 10,000), population size[2] and suspected suicide rates per 100,000.[3] Using a t-Test, p-values below 0.05 are deemed statistically significant, meaning a significant difference from the New Zealand average per 10,000 people (5.18 for the Break Glass contacts and 714.72 for total 1737 contacts, respectively).[4]

DHB	Break Glass (no.)	Break Glass (per 10,000 people)	Comparison to Break Glass national average (P-value)	Total 1737 contacts (per 10,000 people)	Comparison to total contacts national average (P-value)	District population size (2022)[2]	Suspected suicide rates per 100,000 (2017–2021)[3]
Taranaki	58	4.55	0.3936	549.96	0.0021	127,500	12.10
Waikato	335	7.41	0.0058	741.73	0.5666	451,900	12.76
Wairarapa	14	2.75	0.0032	478.43	0.0000	51,000	18.33
Waitematā	111	1.75	0.0001	472.63	0.0000	633,500	10.02
West Coast	7	2.14	0.0005	694.80	0.6719	32,700	20.17
Whanganui	100	14.39	0.0000	982.73	0.0000	69,500	20.36

DHB = district health board.

Appendix Table 7: The district deprivation ranking by each social category using the New Zealand Index of Multiple Deprivation.[5] Each ranking is out of 20, making 20 the highest deprivation and 1 the lowest.

District health board region	NZ Deprivation Index Ranking[5]	Break Glass (per 10,000 people)	Total 1737 contacts (per 10,000 people)
Auckland city	5	3.92	1,216.92
Bay of Plenty	13	2.55	470.44
Canterbury	3	7.15	1,071.09
Capital & Coast	1	5.52	896.84
Counties Manukau	8	2.91	522.79
Hawke's Bay	10	4.00	647.21
Hutt Valley	9	4.31	633.46
Lakes	14	4.99	518.10
MidCentral	15	11.46	825.96
Nelson Marlborough	7	7.45	698.00
Northland	19	3.67	648.04
South Canterbury	6	5.94	662.76
Southern	2	4.96	861.77
Tairāwhiti	17	1.73	700.77
Taranaki	11	4.55	549.96
Waikato	16	7.41	741.73
Wairarapa	12	2.75	478.43
Waitematā	4	1.75	472.63
West Coast	20	2.14	694.80
Whanganui	18	14.39	982.73

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Evaluation of a facility-specific, prehospital transport policy for trauma patients in a health region of New Zealand

Alastair Smith, Sheena Moosa, Grant Christey

ABSTRACT

AIM: A facility-specific, prehospital trauma destination matrix has been implemented in the Te Manawa Taki (TMT)/Midland Region of Aotearoa New Zealand to support decisions on the most appropriate destination hospital for injured patients. This study evaluates the implementation of this policy.

METHODS: Injury data obtained from the TMT Trauma Registry were linked with Global Positioning System (GPS) data from Hato Hone St John and Land Information New Zealand Data Service for trauma events within the region from 1 January to 31 December 2023. Analysis of spatial relationships between injury location, specific injuries and hospital admission was performed using ArcGIS and R statistical programming.

RESULTS: A total of 214 trauma events met the TMT Matrix criteria, of which 163 (76.1%) were transported to a hospital consistent with the destination specified. Lowest consistency (43.8%) of prehospital transport was seen with severe traumatic brain injury likely to require neurosurgery among adults aged >15 years. Approximately 32% of patients with matrix conditions requiring direct transport were lower severity (Injury Severity Score [ISS] <13). When the specified destination was that closest to the incident, there was 93.9% TMT Matrix consistency. Patients with a TMT Matrix condition who did not go directly to the defined facility and had a subsequent transfer took a median 10.5 hours to reach the defined facility.

CONCLUSIONS: The majority of trauma patient transports were consistent with the TMT prehospital matrix. A primary influence on compliance was the distance from point of injury to designated facility. This study prompts further exploration of factors associated with appropriate prehospital triage and refinement of TMT prehospital destination policy.

The overall incidence of trauma in Aotearoa New Zealand increased approximately 17% between 1990 and 2017.[1] Similarly, the incidence of major trauma has also been generally increasing over recent years.[2] Trauma systems worldwide have been established to provide an organised network of prehospital providers, facilities and other medical professionals with the aim of optimising trauma patient outcomes. This involves an integrated approach to trauma care extending from prevention, prehospital care and transport to in-hospital care and rehabilitation. An essential component of such systems is the prehospital transport of patients with severe injuries to those facilities best able to provide the required specialised care.[3,4] The Te Manawa Taki (TMT)/Midland Region developed the TMT/Midland Prehospital Trauma Destination Matrix (TMT Matrix) to provide a regional destination policy customised to the known capabilities and capacities of hospitals in the TMT Region of New Zealand.[5] A unified New Zealand Major Trauma Destination Policy (MTDP) was developed between the New Zealand Major Trauma National Clinical Network (MTNCN) and prehospital providers to help guide ambulance officers, which has been further revised as the New Zealand Major Trauma Triage policy,[6] with the destination policies customised to each health region of New Zealand.[7]

The TMT Matrix combines both injury location and specific injuries with regional facility knowledge to help guide ambulance officers during destination triage decision making, and is consistent with national policy. The TMT Trauma System encompasses the health districts of Bay of Plenty, Lakes, Tairāwhiti, Taranaki and Waikato, serving a resident population of approximately 1 million in 2023,[8] comprising 22% of the population of New Zealand. Waikato Hospital is the central Level 1 trauma centre and definitive care facility, providing leadership and management of care to approximately 45% of TMT trauma patients.[8]

Other TMT district base hospitals include Tauranga, Gisborne, Rotorua, Taupō and Taranaki, with a further seven local or rural hospitals present in the region. Hato Hone St John is the primary road ambulance service provider across the region.

In 2012, The Royal Australasian College Surgeons New Zealand Trauma Committee recommended that major trauma patients be transported directly to "*a facility identified as having the capability to stabilise or definitively manage severe trauma*."[9] While the Ministry of Health has previously noted that trauma patients are not always referred directly to definitive care,[10] recent analysis of MTDP shows 94% adherence.[11] The current study provides an evaluation of the facility-specific TMT Matrix implementation to assess compliance and identify opportunities to improve the content and application of the prehospital destination policy in the region.

Methods

Study design

A retrospective preliminary post-implementation review of the TMT Matrix was undertaken for trauma patients that met the prehospital diagnostic criteria. The study was ruled out of scope for detailed ethics evaluation from the New Zealand Health and Disability Ethics Committee since all patient information used was de-identified. Locality approval was obtained from Health New Zealand Waikato – Te Whatu Ora (RD024087).

Study population

The TMT Trauma Registry collects information on trauma patients of all severities admitted to the hospitals in the TMT Region. Trauma patients injured within the TMT Region from 1 January to 31 December 2023 and who met the prehospital clinical criteria for direct trauma transfer to designated destinations were included in the review (Table 1).[7] Data on prehospital clinical parameters, Abbreviated Injury Scale (AIS) codes, injury severity and injury location for trauma incidents were extracted from the TMT Trauma Registry, which collects information on all trauma admission to the hospitals in the TMT Region. Each incident was matched to specific Global Positioning System (GPS) coordinates representing the Hato Hone St John ambulance "pick up point". GPS data were provided by the Hato Hone St John ambulance service. Additional geographical data to support analysis, including road centreline data, were sourced from Land Information New Zealand.

Prehospital matrix conditions were defined using selected clinical parameters of prehospital triage data and hospital AIS diagnosis and procedure codes recorded in the TMT Trauma Registry. Prehospital clinical parameters used include vital signs, Glasgow Coma Scale (GCS) scores and information on intubation. Condition AIS selection codes were applied across all trauma patients independent of final total Injury Severity Score (ISS). When a patient had more than one Matrix condition, the most serious condition was selected for each patient. Appendix 1 presents the TMT Matrix condition definitions and AIS selection codes used, and Appendix 2 presents the subjective severity ranking of TMT Matrix conditions for those patients with more than one such Matrix condition.

Data analysis

Data analysis was performed by creating an algorithm using R code applied in RStudio 1.2.5033.[12] Incident locality was determined using the closest facility analysis tool within ArcGIS 10.3.1 to calculate the distance from the GPS location of each major trauma incident to the nearest hospital along the road network. The data were imported into ArcGIS and the trauma incident GPS points plotted. A manual review of all points was performed and verified by comparing the territorial local authority that the GPS point fell within with the territorial local authority that contained the location recorded within the trauma registry. Closest hospital data were then imported into R for comparison to actual patient arrival facility and a conditional statement was applied to the algorithm to assign destination facility according to the Matrix for comparison with actual arrival facility. In cases where patients had more than one of the Matrix-specified conditions, the most severe condition was used in the analysis. Incidents that matched the Matrix criteria were designated as "Matrix consistent", while those that did not match were designated as "Matrix not consistent".

Results

A total of 214 patients with one or more TMT Matrix conditions with an ambulance pick up point corresponding to those used in the TMT Matrix were admitted to a TMT facility during 2023. Table 2 shows the demographic characteristics of trauma patients according to TMT Matrix triage consistency. No significant associations were found between TMT Matrix consistency and

Table 1: The Te Manawa Taki/Midland Major Trauma Prehospital Destination Matrix (TMT Matrix).

District	**Waikato**					**Bay of Plenty**		**Lakes**		**Taranaki**		**Tairāwhiti**
Incident locality	**WKO**	**THA**	**TOK**	**TAU**	**TEK**	**TGA**	**WHK**	**ROT**	**TPO**	**TBH**	**HAW**	**GIS**
Condition	**Destination facility**											
Life-threatening problem requiring immediate medical intervention	Destination for life-threatening problem is the closest medical facility that can provide the immediate medical intervention											
Shock (SBP <90mmHg)	WKO	WKO	WKO	WKO	WKO	TGA	TGA	ROT	ROT	TBH	TBH	GIS
GCS motor score ≤5	WKO	WKO	WKO	WKO	WKO	TGA	TGA	ROT	WKO	TBH	TBH	GIS
Severe TBI likely to need neurosurgery,* age ≥15	WKO	WKO	WKO	WKO	WKO	WKO	WKO	WKO	WKO	WKO	WKO	GIS
Severe TBI likely to need neurosurgery, age <15	WKO	SSH	WKO	WKO	WKO	TGA	TGA	ROT	ROT	TBH	TBH	GIS
Penetrating trauma to neck or torso	WKO	WKO	WKO	WKO	WKO	TGA	TGA	ROT	ROT	TBH	TBH	GIS
Flail chest	WKO	WKO	WKO	WKO	WKO	TGA	TGA	ROT	ROT	TBH	TBH	GIS
More than one long bone fracture	WKO	WKO	WKO	WKO	WKO	TGA	TGA	ROT	ROT	TBH	TBH	GIS
Crushed/mangled/ amputated limb	WKO	WKO	WKO	WKO	WKO	WKO	WKO	WKO	WKO	TBH	TBH	GIS
Clinically obvious pelvic fracture	WKO	WKO	WKO	WKO	WKO	TGA	TGA	WKO	WKO	TBH	TBH	GIS
Burns >20% body surface area	WKO	WKO	WKO	WKO	WKO	WKO	WKO	WKO	WKO	TBH	WKO	GIS
Major facial injury	WKO	WKO	WKO	WKO	WKO	WKO	WKO	WKO	WKO	TBH	WKO	GIS
Severe multisystem injuries	WKO	WKO	WKO	WKO	WKO	TGA	TGA	WKO	WKO	TBH	WKO	GIS

Hospital codes: GIS = Gisborne Hospital; HAW = Hāwera Hospital; ROT = Rotorua Hospital; SSH = Starship Hospital; TAU = Taumarunui Hospital; TBH = Taranaki Base Hospital; TEK = Te Kuiti Hospital; TGA = Tauranga Hospital; THA = Thames Hospital; TOK = Tokoroa Hospital; TPO = Taupō Hospital; WHK = Whakatāne Hospital; WKO = Waikato Hospital.
GCS = Glasgow Coma Scale; SBP = systolic blood pressure; TBI = traumatic brain injury.
*Criteria for "severe TBI likely to need a neurosurgeon": 1) intubated or ventilated, 2) lateralising motor signs or unilateral pupillary dilation, 3) clinically obvious penetrating brain injury.

Table 2: Demographic characteristics of patients by Te Manawa Taki Matrix consistency, 2023.

Variable	Matrix consistent, n (%)	Matrix not consistent, n (%)	χ^2 test statistic	P-value
Total	163 (76.2)	51 (23.8)		n/a
Gender				
Female	55 (77.5)	16 (22.5)	0.098	.75
Male	108 (75.5)	35 (24.5)		
Ethnicity				
Māori	65 (77.4)	19 (22.6)	0.112	.74
Non-Māori	98 (75.4)	32 (24.6)		
Life stage (age, years)				
0–14	12 (92.3)	1 (7.7)	n/a	.198*
15–64	104 (77.6)	30 (22.4)		
65+	47 (70.1)	20 (29.9)		

*Fisher's exact test.

Table 3: Te Manawa Taki Matrix consistency by Te Manawa Taki Matrix condition, 2023.

Matrix condition	Matrix destination consistent	Matrix destination not consistent	Total, n (%)
Severe TBI likely to require neurosurgery, age <15 years	0 (100)	0 (100)	0 (100)
Severe TBI likely to require neurosurgery, age ≥15 years	7 (43.8)	9 (56.2)	16 (100)
Severe multisystem injuries	14 (63.6)	8 (36.4)	22 (100)
GCS motor score ≤5	61 (79.2)	16 (20.8)	77 (100)
Shock (SBP <90)	20 (90.9)	2 (9.1)	22 (100)
Penetrating trauma to neck or torso	0 (100)	0 (100)	0 (100)
Flail chest	31 (77.5)	9 (22.5)	40 (100)
More than one long bone fracture	18 (81.8)	4 (18.2)	22 (100)
Crushed/mangled/amputated limb	0 (100)	0 (100)	0 (100)
Clinically obvious pelvic fracture	5 (100)	0 (0.0)	5 (100)
Major facial injury	4 (57.1)	3 (42.9)	7 (100)
Burns >20% of body surface area	3 (100)	0 (100)	3 (100)
Total	163 (76.1)	51 (23.9)	214 (100)

GCS = Glasgow Coma Scale; SBP = systolic blood pressure; TBI = traumatic brain injury.

Table 4: Te Manawa Taki Matrix consistency according to destination facility closest or not closest to incident location facility, 2023.

Destination facility versus incident location	Matrix consistent, n (%)	Matrix not consistent, n (%)	Total Matrix events, n (%)	χ^2 test statistic	P-value
Destination facility different from facility closest to the incident location (not closest facility)	24 (36.4)	42 (63.6)	66 (100)	83.29	<.001
Destination facility was the closest to incident location (closest facility)	139 (93.9)	9 (6.1)	148 (100)	reference	
Total	163 (76.2)	51 (23.8)	214 (100)		

gender, ethnicity or life stage.

Of the 214 patients with a Matrix condition, 44 (20.6%) had two or more Matrix conditions and the most serious condition was selected as specified in the methods. Table 3 shows the TMT Matrix consistency by specific injury matrix condition. Among the 214 patients, 163 (76.1%) were Matrix consistent and transported to a hospital consistent with the TMT Matrix destination policy and 63 (23.9%) to another hospital (Matrix not consistent). There were no admissions during the study period for three TMT Matrix conditions: severe traumatic brain injury (TBI) likely to need neurosurgery, age <15 years, penetrating trauma to neck or torso or crushed/mangled/amputated limb.

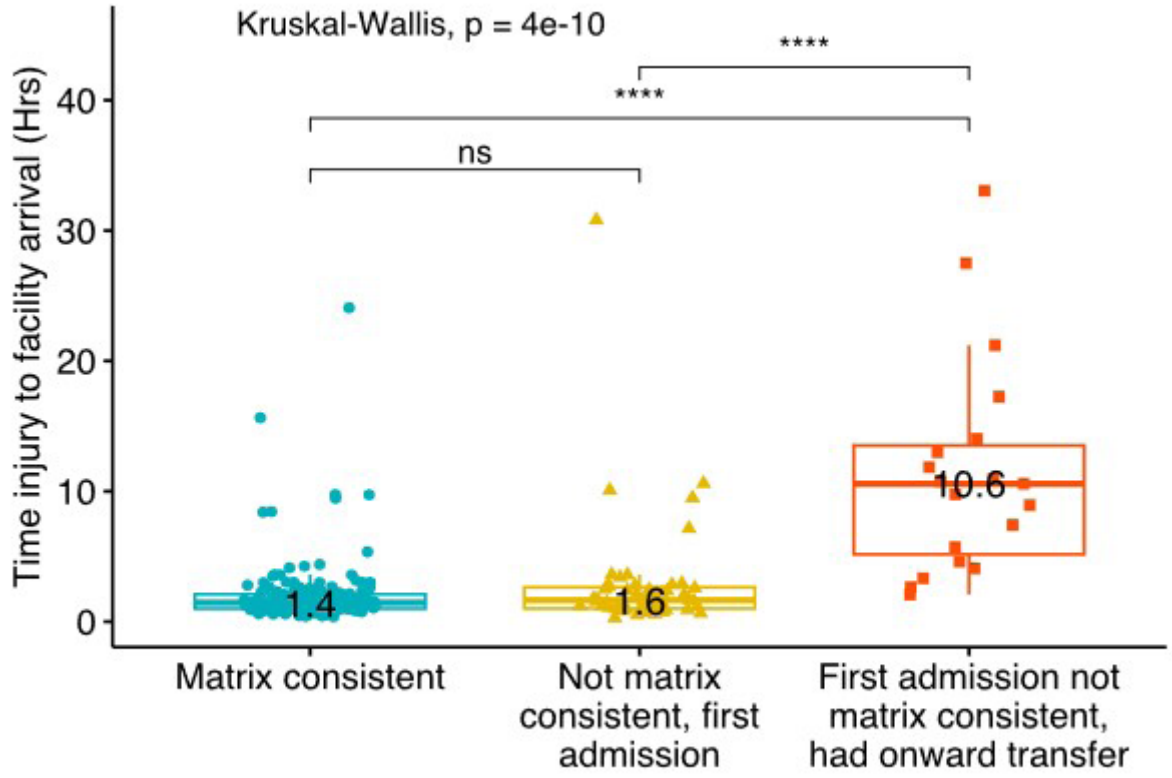
The lowest level of TMT Matrix consistency was accompanied by severe TBI likely to need neurosurgery, age ≥15 years (43.8%), followed by major facial injury (57.1%) and severe multisystem injuries (ISS ≥35) (63.6%) meeting the TMT Matrix transport criteria. Highest levels of TMT Matrix consistency were observed among cases with shock (systolic blood pressure [SBP] <90mmHg) (90.9%), followed by more than one long bone fracture (81.8%), GCS motor score ≤5 (79.2%) and flail chest (77.5%).

Table 4 shows TMT destination policy consistency according to whether the defined destination facility was the same as the incident location (i.e., facility closest to incident) or the destination facility differed (i.e., not the closest facility relative to incident location). When the policy destination facility was the same as the closest facility to the incident location (closest facility) there was 93.9% Matrix policy consistency. When the policy destination facility was different from the closest facility to the incident location (closest facility) there was 36.6% matrix policy consistency.

Of the total 214 TMT Matrix condition patients, there were 69 (31.8%) who had a total ISS <13. For example, there were 14 low severity scoring patients with an ISS <13 who had a prehospital GCS motor score less than or equal to 5. These may represent low-scoring, isolated but potentially life-threatening injuries requiring immediate and effective triage decision making.

When TMT Matrix condition patients went directly by ambulance to a facility that was Matrix consistent, the median time from injury to arrival at that Matrix-consistent facility was 1.4 hours (Figure 1). When trauma patients with a Matrix condition went to a facility that was not Matrix consistent, the median time from injury to policy not consistent facility was slightly higher at 1.6 hours; however, this was not statistically

Figure 1: Time from injury to facility emergency department arrival by Te Manawa Taki Matrix consistency, 2023.



Note: values = median time from injury to facility arrival (ns = not significant; *p<.05, **p<.01, ***p<.001), excludes three extreme outliers where time from injury to second facility following Matrix inconsistent admission >48 hours.

significant. Among trauma patients with a Matrix condition who first went to a facility that was not consistent with TMT Matrix destination ("staged"), and then had an additional subsequent onward transfer to the other facility, the median time from injury to arrival at that second subsequent facility was significantly higher at 10.6 hours (p<.001).

Discussion

This study presents a post-implementation evaluation of a facility-specific prehospital destination matrix established in the TMT Region of New Zealand. The study reveals that approximately 76% of major trauma patients attended by ambulance services at scene are transported to facilities consistent with the Matrix. This is a modest improvement on the 66% triage consistency noted by Whitehead et al. in a retrospective assessment prior to implementation.[13] However, when considering those patients whose TMT Matrix–defined destination facility was not the facility closest to the incident, only 36.6% of patients were transported directly to the TMT Matrix destination facility. Several reviews and meta-analyses suggest that, worldwide, accurate prehospital triage rates may range from 21% to 93%.[4,14] Similarly, such reviews have highlighted variation in compliance from 41% to 94% for different categories within a triage protocol.[15] In the present study, more than 80% Matrix consistency was achieved for patients with shock (SBP <90mmHg), clinically obvious pelvic fracture and burns >20% body surface area.

Reasons for transport to the closest facility rather than the TMT Matrix–designated destination could be driven by several factors. One is the distance to the designated facility, as observed in this study with lower Matrix consistency when incident localities were further from the destination facility. Other factors include presence of another facility closer to the injury

location where there is faster access to clinical skills or resources that the ambulance paramedics do not have, such as advanced pain management and anaesthesia, and access to blood.[16] Other operational factors such as ambulance resources in more rural areas, familiarity in triaging TMT Matrix conditions at the scene and timings of injury and staff shifts could also influence practices. However, factors that affect prehospital triage to TMT Matrix conditions and transport logistics were not examined in this study and thereby need to be explored in future studies to better understand the practical challenges faced by prehospital and hospital services to comply with the destination policy.

While some studies have found older age to be a factor[17] for transfer to non-trauma destinations, another New Zealand study has found adherence to the destination policy improved with age.[11] This study, however, did not find any significant difference by demographic characteristics according to adherence to the TMT Matrix, indicating equitable provision of prehospital transport service.

Direct transport of patients from scene of injury to a TMT Matrix–prescribed facility took a median of 1.4 hours. This is higher than that reported in a meta-analysis of 14 studies, where the average prehospital interval is less than 1 hour, even from rural areas.[18] In the present study, patients with a TMT Matrix condition who did not go directly from scene of injury to the prescribed destination facility, and had a further additional onward transfer to a larger facility/definitive care facility, took a median of 10.6 hours to reach such an appropriately resourced facility. This was significantly higher than the direct transport of patients from scene of injury to a TMT Matrix–prescribed facility, which has implications for patient outcomes and lends support to the use of such a transfer policy. Other studies have reported no significant difference in trauma patient mortality has been reported by direct or indirect transfers to a trauma service.[19] This study did not examine the patient outcomes associated with the TMT destination policy. However, TMT trauma service data showed a gradual decline of major trauma case fatality from 8.6% in 2016, when the policy was adopted, to 7.5% in 2020.[8] This observation cannot be directly linked solely to the TMT destination policy as other quality improvement initiatives implemented during the study period also may have influenced mortality. While there is ongoing research on prehospital mortality of major trauma patients,[20] there is a need to explore the influence of the destination policy on a broader range of patient outcomes other than mortality, such as complications and functional outcomes, alongside factors such as with timing of key clinical intervention to inform trauma quality improvement.

A limitation of this study is the potential variance between prehospital clinical diagnoses and retrospective AIS severity scoring for prioritisation purposes. The Matrix conditions are specifically chosen to be clinically obvious in the field; however, further definition that evolves from in-hospital scoring may potentially change the relative severity scores to assist the priority rankings as more information comes to hand. As such, the method of ranking severity of the condition for patients with more than one TMT Matrix condition is subjective and other researchers may use different rankings. Similarly, there may be gradations of severity related to each condition that require expert interpretation by ambulance crews to influence triage decisions in the field. The small number of events over the period did not allow detailed examination of the locality-specific factors for ethical reasons, as it poses risk of patient identification. Furthermore, locality-specific analysis introduces inherent extremely high or low performance variation depending on the number of facilities in that area and exclusion of destinations out of the TMT Region. Further research is needed over a longer period to examine locality-specific variations. However, the findings provide new evidence to further research and decisions on improving the TMT Matrix to enable robust methods of assessment.

A strength of the present study is the inclusion of all trauma patients independent of ISS. Approximately, a third of patients with a Matrix-defined condition, requiring specialised care at a defined facility, had a total ISS <13. This may also help explain the lower Matrix consistency compared to the 94% adherence to the MTDP, where only ISS >12 were considered and serious injury may have been more clinically obvious at scene of injury.[21] Furthermore, this study presents the significant time difference in direct and non-direct transport to designated facility for definitive care. A range of additional factors can influence the decisions of ambulance crews when considering patient transport, such as delayed arrival of emergency services, complex extrication of patients, weather, traffic conditions and resource allocation, which are not considered in this study. Future research involving feedback from prehospital care providers

would be valuable to get insights into these factors and inform improvement of the TMT Matrix, improve compliance and reduce the time to definitive care for trauma patients.

Conclusions

The findings support that a facility-specific, prehospital destination policy matrix adds value in guiding decision making by prehospital teams and getting patients directly to appropriately resourced facilities in the TMT Region. As the capabilities of hospitals and out-of-hospital care providers evolve, future work will focus on refinement of the Matrix and improving the practical application of the policy at prehospital triage to ensure patients get to the right facility in a safe and timely manner.

COMPETING INTERESTS
The authors declare no competing interests.

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Appendices

Appendix 1

Appendix 1: TMT Matrix condition definitions with clinical parameters and Abbreviated Injury Scale codes.

TMT Matrix condition	Definition used to extract data from trauma registry
Severe multisystem injuries	ISS >=35
Shock (SBP <90mmHg)	Prehospital systolic BP <90 value
GCS motor score <= 5	GCS prehospital motor score <=5
Intubated prehospital	Intubated prehospital
Flail chest	AIS codes: 450209, 450211, 450212, 450213, 450214
Clinically obvious pelvic fracture	AIS codes: 856162, 856163, 856164, 856171, 856172, 856173, 856174
Burns >20% body surface area	AIS codes: 912018, 912020, 912024, 912026 ,912030, 912032
Penetrating trauma to neck or torso	AIS codes: 416006, 516006
Major facial injury	AIS codes: 216006, 216008, 220099, 250808, 250810, 251900, 251902
More than one long bone fracture	More than 1 AIS code: 853000, 853001, 853111, 853112, 853151, 853152, 853161, 853162, 853171, 853172, 853221, 853222, 853251, 853252, 853261, 853262, 853271, 853272, 853331, 853332, 853351, 853352, 853361, 853362, 853371, 853372, 854000, 854001, 854111, 854112, 854151, 854152, 854161, 854162, 854171, 854172, 854221, 854222, 854251, 854252, 854261, 854262, 854271, 854272, 854331, 854332, 854351, 854352, 854361, 854362, 854371, 854372
Severe TBI likely to need neurosurgery,* age >=15	Patient age >14 and an AIS code: 116002, 116004, 140216, 140434, 140446, 140466, 140472, 140473, 140474, 140476, 140477, 140478, 140618, 140655, 140656, 140690, 140691, 140692
Severe TBI likely to need neurosurgery, age <15	Patient age <15 and an AIS code: 116002, 116004, 140216, 140434, 140446, 14066, 140472, 140473, 140474, 140476, 140477, 140478, 140618, 140655, 140656, 140690, 140691, 140692

AIS = Abbreviated Injury Scale; BP = blood pressure; GCS = Glasgow Coma Scale; ISS = Injury Severity Score; SBP = systolic blood pressure; TBI = traumatic brain injury; TMT = Te Manawa Taki.
*Criteria for "severe TBI likely to need a neurosurgeon": 1) intubated or ventilated, 2) lateralising motor signs or unilateral pupillary dilation, 3) clinically obvious penetrating brain injury.

Appendix 2

Ranking of most serious condition when more than one TMT condition is present for a patient (1 most "serious"):

1. Severe traumatic brain injury likely requiring neurosurgery, age <15 years
2. Severe traumatic brain injury requiring neurosurgery, age >=15 years
3. Severe multisystem injuries
4. Glasgow Coma Scale motor <6 (prehospital)
5. Shock systolic blood pressure <90 (prehospital)
6. Intubated (prehospital)
7. Penetrating trauma to neck or torso
8. Flail chest
9. More than one long bone fracture
10. Crushed/mangled/amputated limb
11. Pelvic fracture
12. Major facial injury
13. Burns total body surface area >20

Low-density lipoprotein cholesterol management after acute coronary syndrome in Aotearoa New Zealand: opportunities for improvement (ANZACS-QI 81)

Jack L He, Mildred Lee, Andrew J Kerr

ABSTRACT

AIM: Our aims are to describe low-density lipoprotein (LDL) management in the year after a first acute coronary syndrome (ACS) hospitalisation and identify opportunities to further improve management.

METHODS: Thirteen thousand two hundred and two patients aged over 20 years of age presenting with their first ACS (2014 to 2019), who underwent coronary angiography in the Northern Region of Aotearoa New Zealand, were identified from the All New Zealand All Cardiology Services Quality Improvement (ANZACS-QI) registry. De-identified linkage with Northern Region TestSafe and National Pharmaceutical databases enabled tracking of LDL levels and statin dispensing. Statin adherence in the year post-discharge was estimated using a medication possession ratio (MPR) with an MPR=1 defined as optimal coverage.

RESULTS: Seventy-eight percent (n=10,395) of patients had a repeat lipid study within 12 months. Of these, 78.6% received post-discharge dispensing of high-intensity statin. Mean LDL fell from 2.69±1.14mmol/L in-hospital to 1.92±0.85mmol/L post-discharge. A total of 2,484 (23.9%) patients achieved LDL <1.4mmol/L. Among patients with optimal adherence who were dispensed high-intensity statins, 29% of patients achieved LDL <1.4 (mean LDL 1.7±0.63mmol/L). After repeat LDL testing, statin therapy was intensified in 7% but reduced in 11.2%.

CONCLUSION: Although lipid management was appropriately intensified in-hospital, only a quarter of patients achieved the current guideline LDL target. Improvements in lipid management require use of these more intensive therapies in combination with lifestyle interventions and more regular lipid testing.

Reduction in serum low-density lipoprotein cholesterol (LDL) following acute coronary syndromes (ACS) reduces risk of myocardial infarction and all-cause mortality.[1] Studies have found that regardless of pre-treatment LDL concentrations, there is a 20% relative reduction in adverse cardiovascular events per 1mmol/L of LDL lowering using statin medications.[1] To lower LDL, local and international guidelines unanimously recommend initiation and maintenance of the highest tolerated dose of statins.[2–4] Other lipid-lowering medications such as ezetimibe and PCSK9 inhibitors, when used in combination with statins, further improve outcomes.[5–7] Guideline recommended targets for LDL post-ACS prior to the year 2020 varied between <1.4 to <1.8mmol/L.[8–11] More recent guidelines have settled on a target of <1.4 and <1.0 for recurrence of ACS within 2 years.[12]

In a previous study using the All New Zealand All Cardiology Services Quality Improvement (ANZACS-QI) ACS cohort linked to the National Pharmaceutical dataset, we reported that statins were dispensed in 93% of patients and 80% were adequately maintained over the year post-discharge, but only 60% were optimally adherent.[13] In that study we had no access to post-discharge LDL results. Our group has now linked the ANZACS-QI registry data with the TestSafe laboratory data repository, which holds laboratory data for the Northern Region of Aotearoa New Zealand, allowing us to track post-discharge LDL monitoring and achieved LDL levels for patients residing in that region.

The aim of this study is to use these linked datasets to describe the management of LDL in the year following an index ACS event and to identify opportunities for improvement. We also aim to explore the relationship between medication adherence and dose intensity on achieving target LDL.

Methods

Cohort

The study cohort was comprised of patients over 20 years of age resident in the Northern Region of Aotearoa New Zealand who were admitted with their first ACS hospitalisation and underwent coronary angiography between 1 January 2014 and 30 November 2019. Patients who died within 30 days from discharge were excluded. There are 1,771,308 people in the Northern Region, which represents 37% of the country's total.[14]

Data sources and linkage

The study cohort was identified from the ANZACS-QI registry, a web-based electronic database that captures a mandatory dataset for patients admitted to Aotearoa New Zealand public hospitals with ACS who are investigated with coronary angiography. Details regarding data collection have previously been reported.[15,16] The registry is subject to monthly auditing to ensure capture of >99% of all patients, and annual audit to check the accuracy of data entry.

TestSafe is a Northern Region data depository that captures all in-hospital and community laboratory data, including the LDL levels used in this study. The National Pharmaceutical collection captures all publicly funded medication dispensing, including the dispensing of statin and ezetimibe medications used in this study.

An encrypted version of the National Health Index (NHI) number, a unique identifier assigned to everyone who uses health and disability support services (>98% of the population),[17] was used to anonymously link in-hospital ANZACS-QI patient records to TestSafe and national administrative datasets, including the medication dispensing, hospitalisation and mortality data, as previously described.[15]

Outcomes measures

LDL cholesterol

LDL was calculated using the Friedewald equation. LDL in mmol/L at the index hospitalisation and the first repeat estimation between 30 days and 1 year post-discharge were obtained. The mean LDL levels and percentage of patients achieving a target LDL of <1.4mmol/L are reported.

Medications

Statin and ezetimibe dispensing in the 6 months prior to the index admission, within 30 days of discharge and between 30 days and 1 year post-discharge, were analysed. Rosuvastatin was not publicly funded in Aotearoa New Zealand over the time course of this study.

Statin initiation was defined as statin dispensing post-discharge in a patient who was not dispensed a statin in the 6 months prior to admission. Statin intensity was divided into two categories: high-intensity therapy that typically lowers LDL level by >50% and lower intensity statin doses.[3,4] The statin intensity and ezetimibe dispensing prior to index admission, within 30 days of discharge and by 1 year, were reported. Changes in medication use and doses after the first repeat LDL estimation were assessed.

Statin use over the year after discharge was assessed by calculating an MPR.[13] The MPR is the number of days the drug was assumed to be in a patient's possession (based on dispensed drugs) divided by the number of days spent out of hospital from the date of hospital discharge through to the end of the follow-up period or the date of death, whichever came first. An MPR ≥1.0 indicates optimal dispensing, MPR ≥0.8 was used to classify those adequately maintained on medications and MPR=0 indicates no dispensing.[18]

Statistics

Categorical data were summarised in terms of frequency and percentage and were compared using the Chi-squared test. Continuous data were presented in terms of mean with standard deviation (SD), and/or median with interquartile range (IQR) and range, and Mann–Whitney U test was used for comparison, as the continuous data were not normally distributed. When a variable had multiple categories, we tested whether there was a significant difference across all categories between groups. A two-sided P-value of less than 0.05 was considered to indicate statistical significance. Data were analysed using SAS statistical package, version 9.4 (SAS Institute, Cary, NC).

Ethics

This ANZACS-QI study is part of a programme of research originally approved by the Northern Region Ethics Committee in 2003 (AKY/03/12/314), with subsequent approval by the National Multi Region Ethics Committee in 2007 (MEC07/19/EXP), and with annual re-approval since as part of a vascular research programme (2022 EXP 13442). Individual patient consent was not required as all data are de-identified.

Results

LDL assessment in-hospital and in the community

Between 2014 and 2019 there were 13,424 patients admitted with first ever ACS who survived beyond 30 days post-discharge in the Northern Region of Aotearoa New Zealand. Two hundred and twenty-two patients without in-hospital LDL assessment, including cases where LDL could not be estimated due to severe dyslipidaemia, were excluded. Thirteen thousand two hundred and two patients (98.3%) had an LDL result recorded during the hospital admission (Table 1). Of the 13,202 eligible patients, 10,395 (78.7%) had a follow-up LDL performed in the community beyond 30 days post-discharge. This cohort (n=10,395), with at least one repeat LDL test, was used to describe statin initiation and intensification in subsequent tables and figures. Over the next 12 months, a second follow-up LDL test was performed in 5,595 (42.4%) of patients.

Seventy percent of patients were male, and the mean age was 65 +/- 12 years. Sixty-four percent of the population were European/other, 11% Māori and 10% of Pacific origin. Twenty-five percent presented with ST elevation myocardial infarction (STEMI). The median time to the first repeat LDL post-discharge was 112 days (IQR 67–191 days). Patients with repeat LDL testing were more likely to be male, aged under 80 years, of Indian or Pacific ethnicity (Table 1), discharged on a statin and to have more consistent medication dispensing (Table 2).

Statin dispensing at hospital discharge and post-discharge achieved LDL

At the index admission, 2,019 (19.4%) patients had statin intensity increased, while 4,821 (46.4%) patients were initiated on statin therapy. At discharge from hospital, 78.6% patients were on high-intensity statin therapy, 10.6% on a lower

Table 1: Characteristics of those with and without follow-up LDL.

	Total (n=13,202)	**LDL measured post-discharge (n=10,395)**	**No LDL measurement post-discharge (n=2,807)**	**P-value**
Gender				<.001
Male	9,224 (69.9)	7,338 (70.6)	1,886 (67.2)	
Female	3,978 (30.1)	3,057 (29.4)	921 (32.8)	
Age (years)				<.001
<50	1,498 (11.3)	1,109 (10.7)	389 (13.9)	
50–59	2,968 (22.5)	2,379 (22.9)	589 (21.0)	
60–69	3,815 (28.9)	3,130 (30.1)	685 (24.4)	
70–79	2,400 (25.8)	2,762 (26.6)	638 (22.7)	
≥80	1,521 (11.5)	1,015 (9.8)	506 (18.0)	
Mean (SD)	64.8 (12.1)	64.6 (11.6)	65.4 (13.9)	
Ethnicity				<.001
Māori	1,457 (11.0)	1,108 (10.7)	349 (12.4)	
Pacific peoples	1,324 (10.0)	1,075 (10.3)	249 (8.9)	
Indian	1,179 (8.9)	1,035 (10.0)	144 (5.1)	
Other Asian	819 (6.2)	683 (6.6)	136 (4.9)	
European/Other	8,423 (63.8)	6,494 (62.5)	1,929 (68.7)	

Table 1 (continued): Characteristics of those with and without follow-up LDL.

New Zealand Index of Deprivation score				<.001
1–3	3,389 (25.7)	2,728 (26.2)	661 (23.6)	
4–6	3,736 (28.3)	2,914 (28.0)	822 (29.3)	
7–10	6,038 (45.7)	4,749 (45.7)	1,289 (45.9)	
Unknown	39 (0.3)	4 (0.04)	35 (1.2)	
MI type				<.001
STEMI	3,275 (24.8)	2,565 (24.7)	710 (25.3)	
NSTEMI	7,847 (59.4)	6,170 (59.4)	1,677 (59.7)	
Unstable angina	2,080 (15.8)	1,660 (16.0)	420 (15.0)	
Admission LDL				<.001
LDL ≥1.8	10,291 (78.0)	8,119 (78.1)	2,172 (77.4)	
LDL 1.6–<1.8	801 (6.1)	626 (6.0)	175 (6.2)	
LDL 1.4–<1.6	766 (5.8)	613 (5.9)	153 (5.5)	
LDL <1.4	1,344 (10.2)	1,037 (10.0)	307 (10.9)	
Median (IQR)	2.6 (1.8–3.4)	2.6 (1.8–3.4)	2.6 (1.8–3.4)	

Note: All numbers are frequency and % unless otherwise specified.
P-value compares distribution of demographic variables between those who had LDL testing post-discharge, and those who did not.
LDL = low-density lipoprotein cholesterol; SD = standard deviation; MI = myocardial infarction; STEMI = ST elevation myocardial infarction; NSTEMI = non-ST elevation myocardial infarction; IQR = interquartile range.

intensity statin and 10.8% of patients had no statin therapy (Figure 1). Overall, mean LDL fell 0.78mmol/L from 2.69mmol/L to 1.92mmol/L. The percentages of patients meeting the LDL target at admission and post-discharge are shown in Figure 2. Two thousand four hundred and eighty-four (23.9%) patients achieved the target LDL <1.4mmol/L in the first follow-up community LDL (Table 4).

The greatest change in mean LDL between the index admission and follow-up occurred in those not previously dispensed a statin (−1.2mmol/L) followed by those on a low/medium statin dose (−0.38mmol/L) and was least in those already dispensed high-intensity statin (−0.23mmol/L). The achieved LDL post-discharge was similar in each group (1.94mmol/L, 1.83mmol/L and 1.95mmol/L) respectively (Table 3).

Characteristics of patients achieving target LDL <1.4 post-discharge

Only 23.9% of patients successfully achieved <1.4mmol/L LDL target on the first community test. Male patients, those of Indian or Other Asian ethnicity, those with a myocardial infarction rather than unstable angina diagnosis, those discharged with high-intensity statin and those with higher adherence to statins were more likely to achieve this target (Tables 4 and 5).

Changes in lipid therapy between discharge and 1 year

In the cohort with post-discharge LDL testing, by 1 year statin therapy was initiated in 5.5% (574 of 1,119) of patients initially discharged without statin therapy. It was intensified in 161 (1.5%) of patients. In contrast, statin therapy was stopped in 668 (6.4%) patients and reduced in 502 (4.8%) patients. The majority of 7,945 (76.4%) patients had unchanged statin dose. At discharge, 3.3% were dispensed ezetimibe, which increased to 6.1% post-discharge (Table 5).

Table 2: Lipid lowering therapy in those with and without follow-up LDL.

	Total (n=13,202)	**LDL measured post-discharge (n=10,395)**	**No LDL measurement post-discharge (n=2,807)**	**P-value**
Statin intensity 6 months prior to admission				<.001
Low/medium	3,585 (27.2)	2,896 (27.9)	689 (24.6)	
High	2,515 (19.1)	2,060 (19.8)	455 (16.2)	
No statin	7,102 (53.8)	5,439 (52.3)	1,663 (59.2)	
Statin intensity at discharge				<.001
Low/medium	1,385 (10.5)	1,102 (10.6)	283 (10.1)	
High	10,192 (77.2)	8,174 (78.6)	2,018 (71.9)	
No statin	1,625 (12.3)	1,119 (10.8)	506 (18.0)	
Statin intensity by 1 year				<.001
Low/medium	2,135 (16.2)	1,748 (16.8)	387 (13.8)	
High (Atorvastatin 40–80mg)	9,772 (74.0)	7,909 (76.1)	1,863 (66.4)	
No statin	1,295 (9.8)	738 (7.1)	557 (19.8)	
Ezetimibe use at discharge				<.001
Ezetimibe alone	119 (0.9)	96 (0.9)	23 (0.8)	
Ezetimibe with statin	300 (2.3)	252(2.4)	48 (1.7)	
Ezetimibe use by 1 year				<.001
Ezetimibe alone	138 (1.0)	113 (1.1)	25 (0.9)	
Ezetimibe with statin	653 (4.9)	578 (5.6)	75 (2.7)	
1 year statin MPR				<.001
0	789 (6.0)	465 (4.5)	324 (11.5)	
>0–< 0.8	1,955 (14.8)	1,359 (13.1)	596 (21.2)	
0.8–<1	2,425 (18.4)	1,941 (18.7)	484 (17.2)	
1	8,033 (60.8)	6,630 (63.8)	1,403 (50.0)	

Note: All numbers are frequency and % unless otherwise specified.
P-value compares distribution of clinical variables between those who had LDL testing post-discharge, and those who did not.
LDL = low-density lipoprotein cholesterol; MPR = medication possession ratio.

Table 3: Statin therapy at hospital discharge and impact on LDL change at follow-up.

Statin dose change at time of discharge	Number	Average LDL at time of admission with ACS Mean (SD)	Average LDL 30 days post-DC to 1 year Mean (SD)	Absolute change in LDL Mean (SD)	Percent of repeat LDL <1.4
On high statin 6 months prior	2,060				
Intensity increased	0	2.18 (1.04)	1.95 (0.81)	−0.23 (0.98)	417 (20.2)
Intensity unchanged	1,755	2.19 (1.05)	1.93 (0.78)	−0.26 (0.97)	367 (20.9)
Intensity decreased	27	2.30 (1.18)	2.23 (0.74)	−0.07 (1.28)	3 (11.1)
Statin stopped	278	2.11 (0.98)	2.11 (0.93)	−0.007 (1.02)	47 (16.9)
On low/med statin 6 months prior	2,896	2.21 (0.98)	1.83 (0.74)	−0.38 (0.95)	712 (24.6)
Intensity increased	2,019	2.28 (0.98)	1.77 (0.72)	−0.50 (0.94)	565 (28.0)
Intensity unchanged	647	2.02 (0.96)	1.90 (0.70)	−0.13 (0.89)	118 (18.2)
Intensity decreased	7	3.27 (1.61)	3.03 (1.10)	−0.24 (1.05)	0 (0)
Statin stopped	223	2.17 (0.91)	2.17 (0.90)	0.003 (0.96)	29 (13.3)
Not on statin 6 months prior	5,439	3.14 (1.06)	1.94 (0.91)	−1.20 (1.11)	1,355 (24.9)
Statin started	4,821	3.17 (1.05)	1.85 (0.83)	−1.32 (1.05)	1,282 (26.6)
Never on statin	618	2.90 (1.11)	2.65 (1.14)	−0.25 (1.03)	73 (11.8)

Table 3 (continued): Statin therapy at hospital discharge and impact on LDL change at follow-up.

Statin dose change at time of discharge	Number	Average LDL at time of admission with ACS Mean (SD)	Average LDL 30 days post-DC to 1 year Mean (SD)	Absolute change in LDL Mean (SD)	Percent of repeat LDL <1.4
Overall	10,395	2.69 (1.14)	1.92 (0.85)	−0.78 (1.14)	2,484 (23.9)
Intensity increased	2,019	2.28 (0.98)	1.77 (0.72)	−0.50 (0.94)	565 (28.0)
Intensity unchanged	2,402	2.14 (1.03)	1.92 (0.76)	−0.23 (0.95)	485 (20.2)
Intensity decreased	34	2.50 (1.32)	2.40 (0.87)	−0.11 (1.22)	3 (8.8)
Statin started	4,821	3.17 (1.05)	1.85 (0.83)	−1.32 (1.05)	1,282 (26.6)
Statin stopped	501	2.14 (0.94)	2.14 (0.91)	0.003 (1.00)	76 (15.2)
Never on statin	618	2.90 (1.11)	2.65 (1.14)	−0.25 (1.03)	73 (11.8)

LDL = low-density lipoprotein cholesterol; ACS = acute coronary syndrome; SD = standard deviation; DC = discharge.

Figure 1: Statin dispensing.

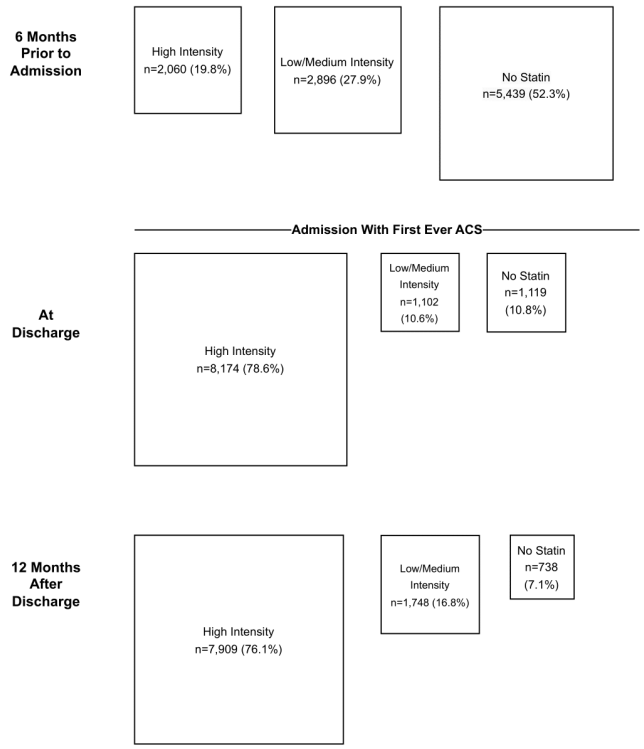


Figure 2: Percentage of patients achieving specific LDL levels at admission and post-discharge.

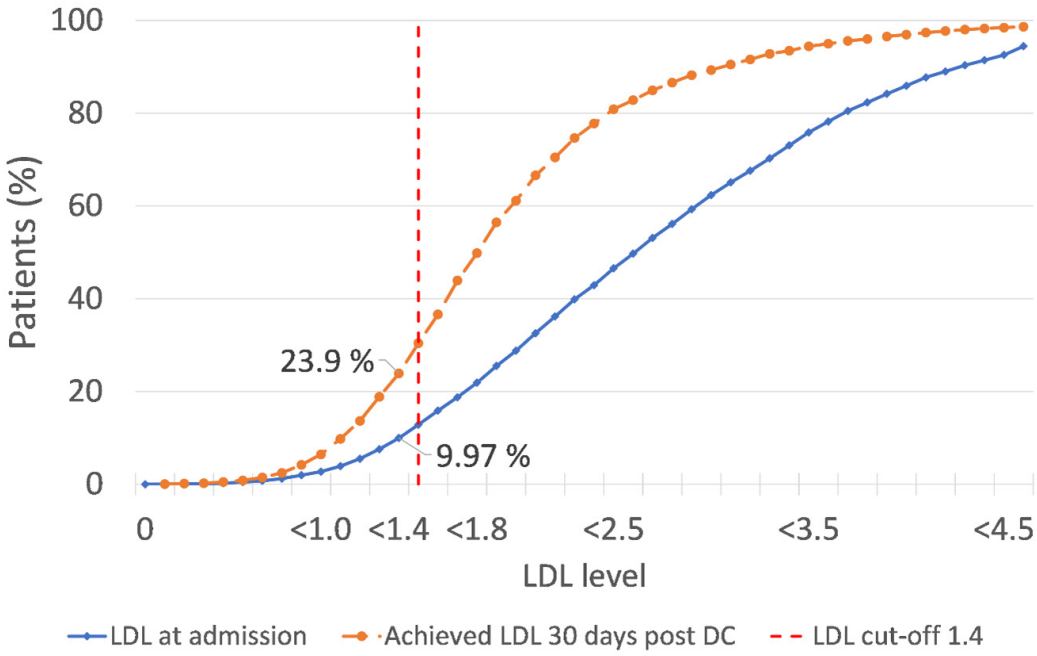


Table 4: Comparison of demographic and clinical characteristics between individuals achieving LDL <1.4 and those with LDL ≥1.4 post-discharge.

	Total (N=10,395)	Mean (SD) LDL achieved	LDL <1.4 (n=2,484)	LDL ≥1.4 (n=7,911)	P-value
Gender					<.001
Male	7,338 (70.6)	1.84 (0.78)	1,921 (77.3)	5,417 (68.5)	
Female	3,057 (29.4)	2.10 (0.95)	563 (22.7)	2,494 (31.5)	
Age (years)					0.049
Mean (SD)	64.6 (11.6)	1.92 (0.85)	65.0 (11.6)	64.5 (11.5)	
Ethnicity					<.001
Māori	1,108 (10.7)	2.03 (0.92)	245 (9.9)	863 (10.9)	
Pacific	1,075 (10.3)	1.89 (0.83)	250 (10.1)	825 (10.4)	
Indian	1,035 (10.0)	1.72 (0.77)	352 (14.2)	683 (8.6)	
Other Asian	683 (6.6)	1.67 (0.70)	237 (9.5)	446 (5.6)	
European/Other	6,494 (62.5)	1.96 (0.85)	1,400 (56.4)	5,094 (64.4)	
NZDep score					0.002
1–3	2,728 (26.2)	1.89 (0.81)	643 (25.9)	2,085 (26.4)	
4–6	2,914 (45.7)	1.93 (0.84)	637 (25.6)	2,277 (28.8)	
7–10	4,749 (45.7)	1.92 (0.87)	1,203 (48.4)	3,546 (44.8)	
Unknown	4 (0.04)	NA	1 (0.04)	3 (0.04)	
MI type					0.001
STEMI	2,565 (24.7)	1.85 (0.80)	653 (26.3)	1,912 (24.2)	
NSTEMI	6,170 (59.4)	1.91 (0.84)	1,489 (59.9)	4,681 (59.2)	
Unstable angina	1,660 (16.0)	2.03 (0.93)	342 (13.8)	1,318 (16.7)	

Note: All numbers are frequency and % unless otherwise specified.
P-value compares distribution of demographic variables between those who reached LDL <1.4 and those who did not.
LDL = low-density lipoprotein cholesterol; SD = standard deviation; NZDep = New Zealand Index of Deprivation; MI = myocardial infarction; STEMI = ST elevation myocardial infarction; NSTEMI = non-ST elevation myocardial infarction.

Patients with at least one follow-up LDL were more likely to continue high-intensity statin at 12 months (76.1% vs 66.4%), and less likely to be off statins entirely (7.1% vs 19.8%) (Table 2).

Relationship between MPR, statin intensity and the LDL target

Achieved LDL levels were lowest in those with optimal adherence measured by an MPR=1 with mean LDL of 1.73mmol/L. Mean LDL was 1.91mmol/L for MPR 0.8–<1 and 2.39mmol/L for MPR >0–<0.8. In the 54% of the cohort who had optimal adherence (MPR=1) and were dispensed high-intensity statins, only 29% of patients achieved target LDL (mean LDL 1.69 [SD 0.63] mmol/L). Mean achieved LDL levels were higher

Table 5: Comparison of pharmacological therapy and adherence between individuals achieving LDL <1.4 and those with LDL ≥1.4 post-discharge.

	Total (N=10,395)	Mean (SD) LDL achieved	LDL <1.4 (n=2,484)	LDL ≥1.4 (n=7,911)	P-value
Statin intensity at discharge					<.001
High	8,174 (78.6)	1.82 (0.77)	2,159 (86.9)	6,015 (76.0)	
Low/medium	1,102 (10.6)	2.11 (0.88)	176 (7.1)	926 (11.7)	
No statin	1,119 (10.8)	2.42 (1.07)	149 (6.0)	970 (12.3)	
Statin intensity change by 12 months					<.001
Intensity increased	161 (1.5)	2.14 (0.89)	21 (0.8)	140 (1.8)	
Intensity unchanged	7,945 (76.4)	1.79 (0.71)	2,094 (84.3)	5,851 (74.0)	
Intensity decreased	502 (4.8)	2.03 (0.94)	120 (4.8)	382 (4.8)	
Statin started	574 (5.5)	2.21 (1.00)	89 (3.6)	485 (6.1)	
Statin stopped	668 (6.4)	2.47 (1.20)	100 (4.0)	568 (7.2)	
Never on statin	545 (5.2)	2.64 (1.08)	60 (2.4)	485 (6.1)	
Ezetimibe at discharge	348 (3.3)	2.14 (1.00)	65 (2.6)	283 (3.6)	0.020
On ezetimibe at 6–12 months	634 (6.1)	2.26 (0.98)	89 (3.6)	545 (6.9)	<.001
1 year statin MPR					<.001
0	465 (4.5)	2.63 (1.09)	52 (2.1)	413 (5.2)	
>0–< 0.8	1,359 (13.1)	2.53 (1.15)	154 (6.2)	1,205 (15.2)	
0.8–<1	1,941 (18.7)	1.94 (0.79)	407 (16.4)	1,534 (19.4)	
1	6,630 (63.8)	1.73 (0.66)	1,871 (75.3)	4,759 (60.2)	

Note: All numbers are frequency and % unless otherwise specified.
P-value compares use of lipid lowering agents, statin intensity changes and medication adherence between those who reached LDL <1.4 and those who did not.
LDL = low-density lipoprotein cholesterol; SD = standard deviation; MI = myocardial infarction; NSTEMI = non-ST elevation myocardial infarction; STEMI = ST elevation myocardial infarction; MPR = medication possession ratio.

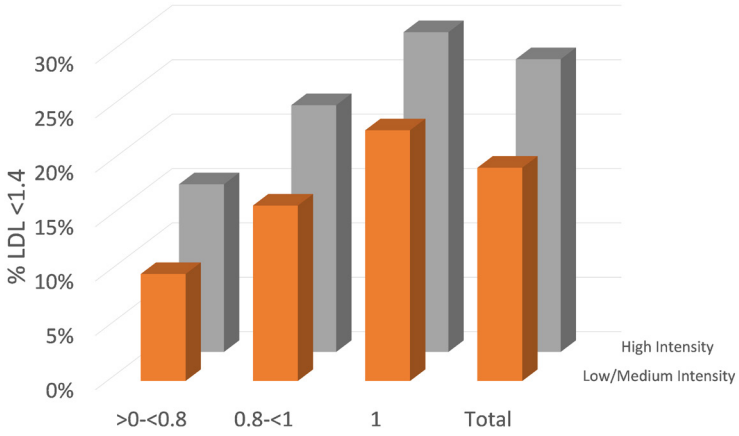
but similar for those dispensed high-intensity statin but with an MPR of 0.8–<1 compared with those dispensed a lower intensity statin who had optimal adherence (1.87 [SD 0.75] mmol/L vs 1.91mmol/L [SD 0.77] mmol/L). When compared with those with an optimal MPR, those with an MPR <0.8 had higher LDL for both classes of statin intensity—2.31 (SD 1.04) mmol/L for high-intensity statin and 2.60 (SD 1.11) mmol/L for low/medium-intensity statin (p<0.001 for both) (Table 6, Figure 3).

Table 6: Relationship between statin intensity by 1 year and statin MPR for patients initially dispensed statin at discharge.

	Low/medium-intensity statin (n=1,499)		High-intensity statin (n=7,527)		Total (n=9,026)	
	n (%)	Achieved LDL (Mean [SD])	n (%)	Achieved LDL (Mean [SD])	n (%)	Achieved LDL (Mean [SD])
1 year statin MPR						
>0–< 0.8	244 (16.3)	2.60 (1.11)	642 (8.5)	2.31 (1.04)	886 (9.8)	2.39 (1.07)
0.8–<1	279 (18.6)	2.11 (0.83)	1,463 (19.4)	1.87 (0.75)	1,742 (19.3)	1.91 (0.77)
1	976 (65.1)	1.91 (0.78)	5,421 (72.0)	1.69 (0.63)	6,397 (70.9)	1.73 (0.66)

MPR = medication possession ratio; LDL = low-density lipoprotein cholesterol; SD = standard deviation.

Figure 3: Relationship between statin intensity, medication adherence and achieving the LDL target.



Discussion

This study demonstrated there was good initiation and appropriate up-titration of statin therapy in-hospital, with nearly 80% of patients discharged on high-intensity statins. However, one in five patients did not have the repeat lipid testing in the year post-discharge and of those with repeat lipid tests, only one in four met the current recommended LDL target. Despite this, there was little further statin intensification and only very low use of ezetimibe, the other evidence-based medication available in Aotearoa New Zealand during this period. Patients on high-intensity statins and those who had optimal medication adherence were most likely to achieve the LDL target. However, even for the patients with both optimal adherence and high-intensity statins, the mean achieved LDL was 1.7mmol/L, with only 29% under 1.4mmol/L.

Lipid testing

In this study repeat lipid testing was performed by 1 year in 78% of patients, but a second test was performed in only 42%. International guidelines recommend initiating LDL assessment upon hospital admission for ACS. Subsequent testing is recommended in 4–12 weeks to evaluate response to therapy, with a follow-up test in 6–12 months.[3,4]

Lipid assessment is an objective and effective method to assess patient adherence and monitor response to lipid lowering therapy.[19] Patients who undergo follow-up lipid assessment after an ACS event are more likely to receive statin up-titration and optimisation of LDL.[20,21] Our study supports this finding.

Initiation, maintenance and intensification of therapy

At discharge, among patients with community LDL testing and follow-up, 89.2% of patients received statin therapy, and 78.6% received high-intensity statin. The statin dispensing data from this study are concordant with a similar study of statin prescription following ACS event in Aotearoa New Zealand between 2015 and 2017, which reported that 79% of patients were initially dispensed high-intensity statins.[22] Unsurprisingly, individuals on high-intensity statin at discharge were more likely to reach target LDL than those on medium, low or no statin therapy.

When compared with international experience, statin initiation in Aotearoa New Zealand is similar or better, and the initiation of high-intensity statin was markedly better. A recent study of over 160,000 patients in Scotland between the years of 2009 to 2017 reported that 88% of patients were initiated on statin therapy following ACS, but only 40% were started on high-intensity statin.[23] In a study of almost 8,000 ACS patients in the United States (US), 83.6% of patients were on statin therapy but only 47.3% were on high-intensity statin.[24]

In the 12 months after discharge, there is no evidence of greater utilisation of high-intensity statins late after discharge; in the study population of those with follow-up LDL-testing, 78.6% were prescribed high-intensity statin at discharge and 76.1% remained on high-intensity statin at 12 months. In those with no follow-up LDL-testing, 71.9% were discharged on high-intensity statin and only 66.4% remained on this by 12 months. International data suggest that statin intolerance may be the main reason for failure to maintain or achieve high-intensity statin dose.[25,23]

Impact of medication adherence on LDL levels

The generally accepted criterion for satisfactory adherence is an MPR ≥0.8. We found that this was associated with much lower LDL levels for each level of statin intensity compared with lower adherence. However, we also found important differences in achieved LDL even within the MPR ≥0.8 band. The lowest mean LDL levels were in those with optimal adherence on high-intensity statin. In contrast, achieved LDL levels were similar for those with either optimal adherence (MPR=1) on low/medium-intensity statin, or on high-intensity but only adequate (MPR=0.8–<1) adherence. We are unaware of any prior studies demonstrating this. The finding stresses the importance of utilising medication adherence strategies if the benefits of high-dose statins are to be realised. In this observational study we cannot be certain that this lower LDL level is solely due to better medication adherence. It is likely that patients with excellent medication adherence may also be more adherent to positive lifestyle changes: the "healthy adherer" effect.[18]

In our prior work we found that Māori, Pacific peoples and younger people who were classified as adherent using the 0.8–1 target were more likely than other ethnic groups or older people to have adequate (MPR 0.8–<1.0) rather than optimal (MPR=1) adherence.[13] The current study suggests that aiming for optimal rather than merely adequate adherence may be an important part of a strategy to reduce known inequities in cardiovascular disease (CVD) for Māori and Pacific peoples.

What is required to achieve LDL targets

Both high-intensity statins and optimal adherence are associated with meeting the LDL target and both criteria were achieved in half of our patients. Despite this optimal combination, the mean LDL was 1.7mmol/L, and only 29% met the LDL target. To further improve LDL in patients we now have the opportunity to use other lipid lowering agents—ezetimibe and rosuvastatin. For some patients more intensive lifestyle changes will also be useful.

During the study period, options for further therapy intensification were limited. Access to ezetimibe, an evidence-based add-on to statins, was restricted by Pharmac's special authority criteria,[26] which have been shown to disproportionately affect vulnerable populations.[27] Additionally, high-dose rosuvastatin, a more potent alternative to atorvastatin, was not funded by Pharmac, resulting in minimal use. Since then, ezetimibe restrictions have been lifted, and rosuvastatin is now funded with special authority approval from any medical practitioner. Ezetimibe added to statin therapy can potentially reduce LDL levels by around 20%, and maximum dose rosuvastatin may lower LDL more than the maximum dose

of atorvastatin.[5] Nevertheless, even with these agents there are still likely to be a substantial proportion of patients who still do not reach the LDL <1.4 target. There is good evidence that lowering LDL well below this level using PSK9 inhibitors, which are currently unfunded in Aotearoa New Zealand, has additional benefits in further reducing recurrent ischaemic events.[6,7]

The most recent European Society of Cardiology (ESC) guideline recommends an even more aggressive target of <1.1mmol/L for those with recurrent events. Local and international data suggest that setting an LDL target improves statin intensification in the community.[19,21,28] However, there is a risk that setting a dichotomous LDL target may be demotivating for some patients. An alternative motivational target, which is endorsed in guidelines,[12] is to aim for a 50% reduction in LDL. This may be particularly appropriate for patients with high baseline LDL for whom currently available medications may not be sufficient to reach the 1.4mmol/L target. Target setting should be combined with more regular LDL monitoring to guide medication up-titration.

Limitations

This study utilised dispensing data, but we cannot confirm whether the medication was taken or whether it was prescribed but not dispensed. This study did not include patients with recurrent ACS events or those not investigated with coronary angiography. This cohort included patients through 2019 to examine lipid medication use and LDL levels during a stable healthcare period, avoiding the impact of the COVID-19 pandemic. Ezetimibe and rosuvastatin are now fully funded, and follow-up studies will assess the impact of this change.

Summary

This study identified several opportunities to improve lipid management, and therefore clinical outcomes, post-ACS. Repeat lipid testing is needed to optimise lipid lowering therapy. Clinicians should ensure that patients are on the maximum statin dose tolerated. Similarly, the significance of lifestyle modifications cannot be overstated. Changes such as reducing weight, engaging in regular exercise and lowering dietary intake of saturated and trans fats are all directly linked to a reduction in CVD disease risk and plasma LDL levels.[11] Practical considerations include simplifying the dosing regimen and encouraging patients to have their medications blister packed or utilisation of a similar adherence facilitating process. Financial barriers have an impact on adherence and should be addressed, and although there are programmes to reduce this for high needs populations, it is likely that some patients defer medications because of cost considerations. Ideally there should be referral to culturally appropriate cardiac rehabilitation programmes after discharge to continue to support patients and facilitate the transition to primary care. Beyond hospital, primary care–based self-monitoring and self-management programmes have proven effectiveness to improve medication adherence use, and technology to ensure re-prescription of medications continues after discharge should be adopted.

COMPETING INTERESTS
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Why psychiatrists choose to leave public mental health services

Benjamin McBreen, Jenni Manuel, Matthew Tennant

ABSTRACT

AIM: Our aim was to explore why psychiatrists are choosing to leave publicly funded mental health services in New Zealand.

METHOD: A qualitative descriptive design was employed. Twelve psychiatrists who had left permanent positions in public mental health services in the last 5 years were recruited. Semi-structured interviews were recorded, transcribed and analysed using thematic analysis.

RESULTS: Four themes were identified: "a burnout job", "responsibility and accountability but without authority", "a lot of near misses" and "inertia". Participants reported an excessive workload in an under-resourced and inefficient system. They reported that their role within the multidisciplinary team had changed, and that their professional skills were undervalued. They felt accountable for poor patient outcomes but unable to improve the quality of care provided.

Participants were concerned about their safety at work and reported a desire to improve efficacy, safety and quality of care but believed that the system was non-responsive and resistant to change. Consequently, they reported feeling no option but to leave.

CONCLUSION: Retention of psychiatrists in public mental health services may be improved by increasing resourcing, embracing innovative change, recognising the unique role of a psychiatrist within the multidisciplinary team and promoting positive organisational culture and medical leadership.

Twenty three percent of psychiatrists working in New Zealand report an intention to resign within a year.[1] A 2023 Association of Salaried Medical Specialists (ASMS) survey noted that "*psychiatry has the highest proportion of respondents thinking about working outside the public system (34 per cent).*"[2] ASMS exit surveys indicate approximately 215 psychiatrists have left public mental health services within New Zealand in the past 5 years (In an email from V Mills, virginia.mills@asms.org.nz, September 2024). Similar difficulties in retaining psychiatrists are being seen across Australia, with massive resignations being attributed to chronic underfunding.[3]

Forensic psychiatrists have highlighted that psychiatrists are leaving the public sector due to an inability to protect basic patient rights, and identifying ethically and possibly legally unacceptable practices without the ability to resolve them.[4,5] *He Ara Oranga*,[6] a government inquiry into public mental health and addiction services, advocated for redistribution of resources from specialist services to community providers. This has been criticised by psychiatrists who have noted that specialist services in New Zealand are already under-resourced.[7]

The exodus of psychiatrists from public mental health services needs to be urgently remedied if we are to avoid a major crisis in the public provision of mental health care.[3] An in-depth exploration of why psychiatrists have left permanent positions with public mental health services in New Zealand has the potential to illuminate modifiable factors contributing to resignations.

Methods

Qualitative approach

This study utilised a descriptive qualitative design to explore why psychiatrists have left permanent positions with public mental health services in New Zealand.[8] This project takes a critical realist approach with an underlying assumption that an effective public mental health system is important for New Zealand, and that all those involved in the public mental health system want to improve psychiatrist retention and the overall function of the system.

Researcher characteristics

The primary researcher was a New Zealand European male undertaking psychiatric registrar training through The Royal Australian and New Zealand College of Psychiatrists (RANZCP). The study was supervised by a psychiatrist working in the public mental health service and a senior lecturer in psychiatric nursing with extensive experience with qualitative methodologies.

Setting and sampling

The study was undertaken in New Zealand across four urban mental health and addiction service settings. Purposive and snowball sampling were utilised to recruit participants with initial communication via email or telecommunication via researcher networks. For those considering participation, written information about the study was provided with further communication prior to each interview.

Twelve psychiatrists who had left public mental health services while on a permanent contract within the last 5 years were recruited. Smaller sample sizes are often adequate in qualitative research to reach data saturation.[9] Data saturation was achieved when no new themes or data were emerging.

Data collection

Data collection occurred through semi-structured interviews either in-person or via audio–visual link. The semi-structured interview schedule covered various topics with the flexibility to follow participant responses. Topics included job satisfaction, reasons for leaving, stress and burnout, support available, the resignation process, how their resignation could have been prevented and necessary changes needed for their return. The semi-structured interview format allowed for the exploration of emotive topics with sensitivity.[10]

The duration of the interviews ranged from 38 to 57 minutes. Interviews were audio recorded, and a professional transcriber transcribed the audio recordings.

Data analysis

Data analysis was undertaken with thematic analysis.[11] Inductive coding was used. Data were manually coded by the primary researcher (BM) for both latent and manifest content and checked by a secondary coder (MT). An initial round of inductive descriptive coding was conducted. The wording of the initial codes was refined throughout the analytic process, and similar codes were clustered. A second cycle of pattern coding was used to create higher order themes. Coded data were input into Microsoft Excel for code categorisation. The relationship between the emerging themes were reviewed using thematic mapping. Theme development occurred through discussion between the primary researcher (BM) and a secondary researcher (MT). The final phase involved reviewing the raw data in relation to the themes to ensure a good fit. Data were not reported where they could make the participant identifiable.

Ethical and cultural considerations

Ethical approval was obtained through the University of Otago Human Ethics Committee (24/0375 – UOHEC). Māori consultation confirmed fulfilment of the University of Otago Māori health advancement requirements. Written informed consent was obtained.

Results

The sample consisted of twelve participants: three female and nine male psychiatrists. A range of years of experience and ethnicities were represented. Ethnicity data have not been reported to maintain confidentiality.

Four themes were identified during thematic analysis. These themes were: “a burnout job”, “responsibility and accountability but without authority”, “a lot of near misses” and “inertia”.

“A burnout job”

The job was noted to be busy, with excessive clinical and non-clinical work. A lack of resources, including understaffing and an inefficient system, appeared to exacerbate the workload, putting staff at risk of burnout.

Many of the participants felt that their workloads had been excessive. Many described doing overtime, struggling to keep up with the administrative work and having a lack of non-clinical time. There was an increased mental burden of looking after an excessive number of patients and covering multiple roles, leading participants to feel stretched and less effective at their jobs.

> *“I feel like I was constantly exhausted by the work.”* – Participant 10

Excessive workloads were exacerbated by understaffing and high turnover rates. There was little redundancy in the system, meaning that staff struggled to manage workloads when anyone was sick or on leave. Insufficient resourcing was particularly noted in the inpatient setting, where there were insufficient beds. This resulted in pressure to discharge patients. In community teams, insufficient resourcing meant that only patients considered “high risk” could be seen.

> *“It felt like we were constantly short of staff. To me, it felt like even if we were*

fully staffed, we would be stretched rather thin… We didn't really have redundancy built into the system… It felt like we were always in crisis mode." – Participant 8

Inefficiency of the system was noted by many participants. They wanted more patient contact time and less time in staff meetings. Participants said that resources would be more efficiently utilised by spending more time consulting and less time focussed on administrative work. Administrative tasks were felt to be excessive both for medical and non-medical staff.

"I don't think we work to scope. I'm just doing an admin job." – Participant 5

"Responsibility and accountability but without authority"

Participants stated that psychiatrists carry a high level of responsibility and accountability, but with a lack of authority. This led to feelings of being undervalued or that their skills were not being adequately utilised. It was noted by many that feeling undervalued within the public service was more important than financial imbursement when making the decision to leave publicly funded services.

This perceived lack of authority within the multidisciplinary team impacted the participants' job satisfaction, alongside feeling they did not have the ability to manage the safety of their patients. Participants reported concerns that their professional recommendations were, at times, disregarded by the multidisciplinary teams and this could lead to adverse patient outcomes.

"The bureaucracy, the disrespect and the devaluing of medical hierarchy and leadership through time … we just became vessels for people's projections of their resentment … and a symbol of a sick system." – Participant 11

Many felt that that their professional skills were not valued by other clinicians or by service management. This led to dissatisfaction for participants who felt that the multidisciplinary teams did not seem to understand the role of the psychiatrist, leaving them less able to integrate their expert knowledge into patient care.

"It's hard to say I didn't feel valued, but I would say that my professional skills weren't valued or appreciated or fully understood." – Participant 2

Most participants felt that they were earning enough money in the public system, and that this had not been a factor when considering leaving, with a preference for working in the public system to deliver care to those most in need.

"I thought I would like to be there in the long term, I could be there as a locum, take a bunch of money … but actually I'd rather be part of the system and potentially be able to work towards making changes and helping improve it." –Participant 1

"A lot of near misses"

Participants reported that there were "a lot of near misses", as well as numerous assaults on staff, particularly nursing staff. This led many to feeling the work environment was unsafe. Concerns were also noted about dangerous practices that were occurring, including premature discharges, inexperienced nursing staff being required to lead shifts and difficulties having treatment plans implemented.

Safety from assaults was a significant concern for a number of participants, particularly those who had worked on inpatient units. They reported that the physical environment on the ward was unsafe. They felt pressure for patients to be moved into less contained environments, which the participants perceived as unsafe. Participants had observed frequent assaults on clinical staff and felt that hospital management had not been responsive to their safety concerns. Participants recommended increased security staff as a means of improving staff safety on inpatient units.

"I noticed that there are some really significant safety concerns and there was very little done about them, and that over time made that inpatient job feel quite untenable." – Participant 7

Participants perceived that safety was compromised by a push towards early discharge due to bed shortages. They reported that their assessment plans were frequently not followed by ward staff, with many near misses and some serious adverse events perceived to be occurring as a result.

"The relationship with the ward was a challenge… A ward who was reluctant to accept people … they were also very keen to discharge people … too early, too unwell." – Participant 4

"Inertia"

Participants described a system that lacked innovation, enthusiasm and a desire to better itself. The system was described as unresponsive and taking little action when its psychiatrists were considering leaving or when issues arose. The system was described as ineffective and unreasonably rigid. Management's response to difficulties was usually empathetic, but participants reported that it was often not accompanied by meaningful actions.

A lack of innovation or possibility for change within the public mental health system was identified. The system was described as stagnant, with a lack of focus on quality improvement and creativity. This was described as disempowering, demoralising and inconsistent with the desires of the psychiatrists.

"The people I've spoken to would all want to work in an environment in which innovation was supported, and in which part of our role as consultants is seen as supporting change within the service to provide better service." – Participant 3

There was a sense that some people in leadership positions were apathetic and nihilistic, rather than enthusiastic to drive change.

"I felt, in certain areas of the service there was just apathy and nihilism, and it really filtered down that we can't change anything." – Participant 7

This idea was reinforced by a lack of responsiveness of the service to issues that arose. Many participants reported a lack of response when they indicated that they were thinking of leaving.

"I was signalling … that I was thinking about leaving… They knew it all, they just weren't doing anything about it. Not that I was waiting for that, but I think if I was running a service, I would notice that and I would try and do something about it." – Participant 5

Participants described support from leadership but noted that this was superficial. They felt that leadership was empathetic to their concerns but that this was often not followed by meaningful action.

"Superficially very supportive, empathetic … but no one wanted to sit with me and talk about it… No one did so that, for me, was just superficial and just like token support." – Participant 6

There was a widespread belief that the system lacked medical leadership with the authority to make meaningful changes. When concerns were raised about dysfunction in the system, medical leadership seemed ineffective to evoke change.

"They need really effective medical leadership. But they also need an environment where the medical leadership actually has some authority and power." – Participant 9

Participants reported a lack of flexibility when considering leave, changing work hours (full-time equivalent), job reassignment and timetabling day-to-day activities. This hindered the development of the service due to the subsequent resignations.

"They've lost a lot of people basically for the same kind of reasons, thinking they can deal with a shortage of consultants by being rigid… It doesn't work." – Participant 3

Discussion

Participants have described an explanatory model of how chronic resource limitations and system rigidity have led to difficulties retaining the psychiatrist workforce in New Zealand. They described excessive workloads and system inefficacy setting them up for "burnout". They reported their role within the multidisciplinary team had eroded, and their professional skills were undervalued. They felt accountable for poor patient outcomes but felt unable to improve the quality of care provided because of under-resourcing and a perceived diminishing authority to shape service provision. Participants were concerned for the safety of themselves and others. Participants reported a desire to improve efficacy, safety and

quality of care. However, they reported being met with inertia in a resistant, unresponsive system. Consequently, they felt the need to leave.

The *He Ara Oranga* report recognised difficulties accessing appropriate mental health care.[6] Current resourcing is based on an assumption that 3% of the population have moderate-to-severe mental illness; however, the true prevalence is closer to 5%.[12] Insufficient resourcing and excessive workloads have been associated with burnout in psychiatrists,[13] and reported as a reason for psychiatrists' decision to leave public services.[3] Our results support these assertions but suggest that broader systematic factors have a role in retention rather than funding alone. The current system was felt to be inefficient, with excessive paperwork and administrative tasks. The provision of better administrative support has previously been highlighted as a factor that could bring significant benefits to staff wellbeing and system efficiency.[1]

Psychiatrists tend to conceptualise themselves as leaders within a multidisciplinary team, integrating the skills and perspectives brought by team members into a collaborative management plan.[14] In this study, participants reported that psychiatrists held the ultimate burden of responsibility when things went wrong, but did not carry equally weighted authority. This perception of holding "ultimate responsibility" is not supported by the RANZCP, who state that "*duty of care and standards of care, rests with every health care professional*."[15] However, this distributed model of responsibility does carry significant challenges. Firstly, there is ambiguous terminology regarding responsibility across position statements. For example, another position statement by RANZCP states that the psychiatrist is best placed to "lead" multidisciplinary teams by virtue of their training.[16] Secondly, psychiatrists have described feeling blamed in coronial inquiries and serious event reviews following suicide or homicide, creating a clear sense of accountability.[17,18] This is reinforced if other disciplines abdicate responsibility to psychiatry as a means of defensive practice.[19] Lastly, a significant aspect of psychiatrists' clinical care in the public system is conducting compulsory treatment under the *Mental Health Act* as responsible clinicians. Thus, psychiatrists have particular medico-legal duty of care requirements relative to other members of the multidisciplinary team. Importantly, changes in authority and accountability need to be considered through the lens of recovery-orientated treatment. Services users have described an inherent power imbalance and experiences of oppression.[20] This has led to increasing emphasis on the need for person-centred care and service user self-determination and empowerment.[21]

Safety and risk management were identified as serious concerns. All employees should feel safe going to work.[22] Unsafe work environments featuring violence towards staff are associated with poor staff retention.[23] Participants identified insufficient staff experience and poor resourcing as factors contributing to unsafe inpatient environments. They recommended increased security as a stopgap measure. Interestingly, reducing restrictive practices rather than physical or environmental security has been associated with reduced incidence of violence in inpatient units.[24] Recognising the underlying causes of violence within inpatient units is critical.[25] Improving safety with relational, recovery-orientated risk management will require adequate clinical staffing, experience and education. Staff need to be empowered to implement appropriate risk management strategies.[24,25]

Organisational adaptability and responsiveness with good leadership have been associated with improved staff retention in healthcare, and positive organisational and workplace cultures are associated with a wide range of positive patient outcomes.[26,27] The current situation risks a reduction in recruitment of trainees into psychiatric speciality training and has implications for long-term viability of mental health services. Interviews should be offered to all staff who leave, or are thinking of leaving, to identify organisational issues that could be addressed. Many desire to better the service, and allowance for this needs to be made with an embrace of innovation rather than a resistance to change.

This study has allowed an in-depth exploration of the perspective of psychiatrists who have left permanent positions in public mental health services. The themes were consistent across the interviews. Further work could include interviewing psychiatrists who have stayed to gain their perspectives on what factors facilitate retention.

There are some limitations to this study. This study examines the explanatory model of psychiatrists that have left mental health services and therefore only provides one perspective on the system. Transferability may be limited for services outside of New Zealand. Some psychiatrists were also unable to take part due to an employment mediation prohibiting them from

speaking about their experience.

Conclusion

This study has highlighted four themes that accounted for the participants leaving public mental health services. Participants were concerned about workload, psychiatrists feeling undervalued, safety at work and a system in a state of inertia. Factors that could improve psychiatrist retention include improving staffing and resourcing, embracing innovation, recognising psychiatrists' expert knowledge and skills, addressing safety concerns, improving the organisational culture and ensuring effective medical leadership. Systematic changes may improve psychiatrist retention and ultimately improve service provision for those with major mental illness.

COMPETING INTERESTS
Nil.

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Hospital resource utilisation for two mass-casualty incidents in New Zealand

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ABSTRACT

AIM: To analyse hospital resource utilisation at Christchurch Hospital in New Zealand during two mass-casualty incidents (MCIs) in 2019: the Christchurch mosque shootings and the Whakaari (White Island) volcanic eruption.

METHODS: A cross-sectional retrospective analysis was conducted to assess hospital resource utilisation during the two MCIs.

RESULTS: A total of 45 patients from the mosque MCI and eight patients from the Whakaari MCI were admitted to Christchurch Hospital. The total length of stay was mosque MCI: 15,054 hours (average 335 hours per patient) and Whakaari MCI: 1,841 hours (average 230 hours per patient). Mean surgeon time (operative length multiplied by number of surgical staff) was mosque MCI: 6.5 hours and Whakaari MCI: 14.7 hours. Burns represented a significantly greater surgical workload per operative event. There were notable differences in staffing, investigations, consumables, blood products, theatre time and the number of operative events between the MCI cohorts.

CONCLUSION: The studied MCIs had significant effects on hospital resource utilisation. Burn trauma was more resource intensive than non-burn trauma, despite most patients being repatriated within days of the index event. An analysis of resourcing, surge capacity and funding models in New Zealand is required to ensure trauma centres can effectively respond to future crises.

A mass-casualty incident (MCI) is defined in New Zealand's *National Health Emergency Plan: Mass Casualty Action Plan* (2011) as any event that presents a serious threat to the health of a community, disrupts health services or results in (or is likely to result in) a number or type of casualties that require special measures by the appropriate responding agencies.[1]

Christchurch Hospital, a major trauma centre and multispeciality tertiary hospital in the South Island of New Zealand, has a local catchment area covering an estimated 600,000 people. The hospital receives trauma referrals from across New Zealand and has played a key role in treating casualties from several MCIs over the last decade, including the February 2011 Christchurch earthquake, March 2019 Christchurch mosque shootings and the December 2019 Whakaari (White Island) volcanic eruption.

Context

The Christchurch mosque shootings were two consecutive mass shootings in a terrorist attack that occurred in Christchurch, New Zealand, during Friday prayers on 15 March 2019. Fifty-one individuals died as a result of their injuries: 49 at the scene, one after being admitted to the emergency department and one in the intensive care unit 48 days later. Many others were seriously injured.

The Whakaari volcanic eruption was a large volcanic eruption in New Zealand that occurred on 9 December 2019. The eruption resulted in 22 fatalities: 17 on the day of the event and five after hospital transfer. Additionally, 25 people were injured. Victims were initially triaged at Whakātane Hospital before transfer to other hospitals, including New Zealand's four burn units: Auckland (national burn centre), Hamilton, Wellington and Christchurch (regional burn units).

Funding of MCIs in New Zealand

The Accident Compensation Corporation (ACC) is the Crown entity that administers New Zealand's injury insurance scheme, providing compensation and funded healthcare to those with personal injuries. "Public health acute services" (PHAS) refers to public health services provided for injury treatment as per the *Injury Prevention, Rehabilitation, and Compensation (Public Health Acute Services) Regulations 2002*.[2] For patients presenting to a hospital due to an

MCI, PHAS cover emergency department presentations, acute inpatient admissions and related outpatient services within specific timeframes—typically, either 7 days or 6 weeks following treatment or discharge, depending on the specific services provided.

ACC cannot directly purchase PHAS from Health New Zealand – Te Whatu Ora. Instead, hospitals receive funding for these acute health services through devolved government funding (Vote Health). ACC makes a fixed monthly payment to the Treasury, via the Ministry of Health, as per the PHAS service agreement. This payment is adjusted and agreed annually and is not allocated to individual claims. For example, in 2019/2020, ACC's PHAS funding totalled NZ$555 million[3] compared with $996.5 million for 2024/2025. The PHAS agreement includes a clause for additional payment in the case of major burn incidents, such as the Whakaari volcanic eruption, but not for non-burn MCIs.

Aim

To investigate hospital resource utilisation for two MCIs at Christchurch Hospital in New Zealand.

Methods

Retrospective cross-sectional data from pre-existing local hospital datasets were analysed to assess resource utilisation for the two relevant MCIs at Christchurch Hospital.

The following data were collected, where possible, for each patient admitted to Christchurch Hospital in relation to the MCIs studied: demographic data; medical, nursing and allied health staffing during inpatient admission; use of blood products and other consumables; radiological, pathological and other medical services; theatre utilisation; number of operative events; and trauma, injury and/or burns classification. Data were collected and then de-identified prior to analysis.

Theatre utilisation data were retrieved from the Christchurch Hospital surgical dataset. Operative timings were calculated from time of anaesthetic commencement to patient retrieval from theatre. Theatre staffing was manually recorded from operative documentation for each surgery within the study period. Laboratory, pathology and radiology services were classified from title data within the investigation management system. Data were retrieved from Australian hospitals for Whakaari MCI patients repatriated from Christchurch Hospital.

Descriptive statistics were conducted for both MCI cohorts. Inferential analysis was not conducted due to the significant heterogeneity between the cohorts. Analysis was restricted to resource utilisation occurring within the period of each patient's index admission to within 6 weeks of their respective date of discharge.

This study was approved by the University of Otago Ethics Committee (HD20/053).

Results

A total of 45 patients were admitted to Christchurch Hospital during the mosque MCI, and eight patients during the Whakaari MCI. Table 1 presents the demographic data and admission characteristics for both cohorts. The total hospital length of stay (LOS) was 15,054 hours (627.3 days; average 14.0 days per patient) for the mosque MCI and 1,841 hours (76.7 days; average 9.6 days per patient) for the Whakaari MCI. This difference is attributed to the repatriation of six of the eight Whakaari patients to Australian hospitals within 72 hours of index admission date (Appendix A). Despite this, mean intensive care unit (ICU) LOS was similar for both cohorts. Emergency department LOS was significantly lower for the Whakaari MCI, as patients received initial triage and resuscitation before hospital transfer to burn units. These six repatriated patients (total 217% total body surface area [TBSA] affected) accounted for approximately 328 additional days of total LOS and 65 days of ICU LOS in Australia. The in-hospital mortality was two of 45 patients for the mosque MCI and zero of eight patients for the Whakaari MCI. The Injury Severity Score (ISS) was higher for the Whakaari MCI; however, validity of ISS is known to be reduced in burn trauma compared with non-burn trauma. All patients in the Whakaari cohort underwent operative intervention, compared with approximately 80% in the mosque cohort.

Table 2 demonstrates surgical and theatre utilisation. There were 88 operative events in the mosque MCI and 26 in the Whakaari MCI, totalling approximately 294 hours of operative time. Within the Whakaari cohort, the six repatriated patients underwent 11 operative events at Christchurch Hospital, with a further 36 operative events occurring in Australia (excluded from further analysis).

The mean operative time per patient was 1.3

times greater in the Whakaari cohort than in the mosque cohort. To assess surgical workload, "surgeon time" (number of surgical registrars and consultants present, as listed within the operative report, multiplied by operative length) was calculated (Figure 1). The total surgeon time was 569 hours for the mosque MCI and 381 hours for the Whakaari MCI. The mean surgeon time was 2.3 times greater for the Whakaari cohort (14.7 compared with 6.5 hours). When stratified by staff seniority, the additional surgeon time in the Whakaari cohort was mainly due to registrars (2.8 compared with 1.0 registrars per case), while consultant surgeons per case were similar between the cohorts. Scrub nurses and anaesthetists were similarly represented between cohorts, but there were more circulating nurses and anaesthetic technicians in the Whakaari cohort (Appendix B). When stratified by case complexity, there was a non-linear increase in surgeon time with increasing case complexity. However, this classification is subjective, which may have influenced these findings. Appendix C demonstrates the utilisation of radiological, laboratory, blood bank and other medical services. X-ray was the primary imaging modality for the Whakaari MCI, whereas X-ray, computed tomography, magnetic resonance imaging, fluoroscopy, ultrasound and interventional radiology were significant modalities for the mosque MCI. This difference reflects the predominant mechanisms of injury in each cohort (i.e., gunshot wounds versus thermal and chemical burns). The absence of cross-sectional imaging in the Whakaari cohort is attributed to the length of pre-hospital resuscitation and transfer prior to definitive burn treatment.

A total of 24 patients received blood product transfusion in the mosque MCI, compared with four patients in the Whakaari MCI. In the mosque cohort, 282 units of red blood cells, 198 units of fresh frozen plasma, 81 units of cryoprecipitate and 23 units of platelets were administered, totalling 584 units. A single patient accounted for 63%, 78%, 78% and 69% of these units, respectively.[4] On the index date, 323 units were administered, and eight patients required mass transfusion protocol during admission. In comparison, 50 units of red blood cells, 14 units of fresh frozen plasma, two units of cryoprecipitate and seven units of platelets were administered in the Whakaari cohort, totalling 73 units. No blood products were required on the index date of the Whakaari MCI. Additionally, a total of 15,717cm^2 of cadaveric skin graft was procured for the Whakaari MCI.

Time to first operation is demonstrated in Figure 2. For the mosque MCI, admission timings are based on the initial presentation of the first patient, whereas actual admission timings were used for the Whakaari cohort. This was necessary due to inaccurate admission timings in the mosque cohort, caused by retrospective clerking processes completed after resuscitative efforts. Patients with high ISS scores were more likely to receive prompt surgical care in both cohorts, reflecting appropriate trauma triage processes.

Discussion

The mosque and Whakaari MCIs led to critical strain on resource utilisation at Christchurch Hospital. Consistent with international evidence,[4–6] MCIs significantly impact acute emergency, intensive care and surgical services, and affect wider hospital staffing; radiological, laboratory and other medical services; and the use of blood products and consumables.

MCIs can result from various events, including, but not limited to, weather, terrorism, biological threats, infrastructure failures or seismic activity.[7] They can occur at any time and require prompt responses from healthcare organisations, often during near- or over-capacity workloads. The ability of these organisations to respond to such events is known as "surge capacity".[8] Major trauma centres, at a persistent state of readiness and with multidisciplinary trauma expertise, have an essential role in MCI management.[7] In keeping with this, a survey of Australasian trauma centres found that the majority have specific plans to address surge capacity, including managing MCI-related and non-MCI patients simultaneously.[7] Despite this, New Zealand does not meet international benchmarks for MCI response capability (e.g., number of operating theatres, ICU beds, and X-ray machines).[9]

To address this, verification of major trauma facilities, such as the Royal Australasian College of Surgeons' *Trauma Care Verification Process*, should be supported by health policy and funding.[10] These are peer-review mechanisms that ensure international standards are met across the full spectrum of trauma care. Additionally, the events studied justify dedicated trauma education for medical staff in New Zealand, such as rotations at the national burn unit for registrars and consultants to maintain burn management skills.

Consistent with the international literature on terrorism-related MCIs,[11] patients from the

mosque MCI required immediate operative intervention, predominantly involving general surgical, cardiothoracic, and vascular procedures, often performed in parallel. Following this initial period, orthopaedic, plastic and reconstructive and other procedures increased with ongoing treatment needs. This contrasts with major burn MCIs, where nearly all procedures are performed by burn surgeons, where this capacity is available. High demand for ICU and Anaesthetic Services persists for days or weeks in both forms of MCI. The demand for blood products, radiology and other medical services is greater for terrorism-related MCI.

Major burn trauma requires prolonged hospitalisation and numerous operative interventions, often extending for weeks or months post-injury.[12] Consequently, compared with other trauma, burn injuries are among the most expensive for health systems. TBSA-affected and inpatient LOS are the main factors determining cost and resource utilisation during a burn admission.[13,14] Historical data from the national burn unit indicate an operative time requirement of approximately 22 minutes per percentage of TBSA for patients between 10–50% TBSA.[15] This correlation could not be made for the Whakaari cohort due to a lack of granular operative information for repatriated patients. ICU capacity is frequently a limiting factor in responding to a burn MCI, especially with a high frequency of inhalational injuries,[16] such as in a volcanic eruption.

MCIs often require significant utilisation of consumables. Modern health systems, which rely primarily on "just-in-time" logistic models, often have reduced resource inventories compared to historical practices. Correspondingly, only half of Commonwealth trauma centres surveyed report adequate stored resources for an MCI.[7] Cadaveric skin grafts in sufficient quantity were not available for the acute management of the Whakaari cohort and had to be imported and allocated to treatment institutions after debridement had been performed. Despite this, consumables and medication do not represent a significant cost relative to other factors in MCI management.[12]

The *Multiple Complex Burn Action Plan* provides New Zealand–specific guidance to the health sector in the event of a burn MCI. Planning for multiple forms of MCI is crucial to allow efficient and integrated regional and national responses.[6] Decanting patients to Australia is not considered an integral part of the *Plan*. However, if Whakaari MCI patients had remained locally hospitalised without further operational support this would have led to untenable capacity issues. This highlights that New Zealand is under resourced for major, complex burn MCI. A national review of resourcing requirements for burn units in New Zealand has been completed; however, with limited recent increases in burn capacity, there remains a gap in trauma preparedness and further consideration should be given to strengthening Australasian partnerships.

Health New Zealand – Te Whatu Ora is funded for MCIs through devolved government funding, which is not allocated to individual claims. Additional funding is available for burn MCIs through the PHAS agreement, but there is no similar provision for non-burn MCIs. Following an MCI, the government can choose to appropriate additional funding as needed; however, discrepancies in funding for the various forms of MCI are likely, despite their significant impact on hospital resource utilisation. Notably, of the 47 individuals present during the Whakaari volcanic eruption, only five were New Zealand citizens. ACC's injury insurance scheme covers international visitors, meaning the cost of their treatment, prior to repatriation, is ultimately borne by New Zealand funding mechanisms. Consequently, both the operational impact and funding of international visitors involved in New Zealand MCIs should be considered in future trauma planning.

Research on hospital resource utilisation is typically limited by significant methodological variation and incomplete information.[12] This is amplified for MCI research, where administrative and reporting processes often occur retrospectively after acute management. This research was limited by inadequate documentation, the need for extrapolation/triangulation of several variables (e.g., LOS), and truncated data due to repatriation and a lack of a shared dataset for the Whakaari cohort. However, in part, this reflects the reality at a regional trauma centre, where significant effects on local resource utilisation may occur despite patient transfer or repatriation.

It is essential that health systems are adequately funded for MCIs. This requires robust data collection systems that integrate data from the pre-hospital, hospital and rehabilitation environments. Without data, funding discrepancies cannot be identified and corrected. Both retrospective funding mechanisms and pre-emptive funding for trauma preparedness are necessary. This will ensure that our staff are trained to manage MCIs, our hospital infrastructure has sufficient surge capacity

and available resources and our regions can collaborate effectively to respond in real time to these highly complex, dynamic events.

Conclusion

MCIs at Christchurch Hospital have significantly impacted hospital resource utilisation. MCIs involving major burn trauma are likely to require more surgical resources than non-burn trauma. While a specific mechanism for additional funding for burn MCIs exists and has been enacted, there are no similar provisions available for non-burn MCIs, leading to potential funding discrepancies. Surge capacity varies between MCIs, and the events studied highlight the risk of capacity deficits in responding to complex trauma events. Health policy and funding should support trauma verification, benchmarking and staff education to meet international standards. Health New Zealand – Te Whatu Ora must ensure that data collection informs appropriate funding mechanisms for MCIs. Future analyses at regional and national levels are essential to ensure our trauma system can respond effectively to future crises.

Table 1: Demographic summary and admission characteristics by mass-casualty incident cohort.

	Mosque MCI	**Whakaari MCI†**
Patient characteristics	**n (%)**	**n (%)**
Sex		
Male	43 (96)	3 (37)
Female	2 (4)	5 (63)
Age		
0–18	3 (7)	0
19–29	7 (16)	1 (13)
30–44	15 (33)	3 (37)
45–59	14 (31)	4 (50)
60–74	6 (13)	0
>75	0	0
ISS		
1–8	20 (44)	1 (12)
9–14	9 (20)	2 (25)
16–24	7 (16)	1 (12)
25–75	9 (20)	4 (50)
Underwent operative intervention	35 (78)	8 (100)
In-hospital mortality	2 (4)	0 (0)
Burn characteristics		
Inhalational injury		5 (63)
TBSA – all patients (mean)		292 (37)
Admission characteristics	**Sum (mean)**	**Sum (mean)**
ED LOS (hours)	142 (3)	9 (1)
ICU LOS (hours)	3,177 (71)	582 (73)
Total LOS (hours)	15,054 (335)	1,841 (230)

†Six of the eight Whakaari patients were repatriated to Australia within 72 hours of the index admission date.
MCI = mass-casualty incident; ISS = Injury Severity Score; TBSA = total body surface area; ED = emergency department; LOS = length of stay; ICU = intensive care unit.

Table 2: Surgical and theatre resource utilisation by mass-casualty incident cohort.

	Mosque MCI	**Whakaari MCI†**
Theatre utilisation	**Sum (mean)**	**Sum (mean)**
Operative events	88	26
Operative time (hours)	210.5 (2.4)	83.1 (3.2)
Surgeon time (hours)	569.4 (6.5)	380.8 (14.7)
Total theatre staff time (hours)	2,066.4 (23.5)	1,210.3 (46.3)
Theatre staffing per operative event	**Mean**	**Mean**
Surgical consultants	1.5	1.3
Surgical registrars	1.0	2.8
Scrub nurses	1.2	1.4
Circulating nurses	3.5	4.0
Anaesthetists	1.6	1.7
Anaesthetic technicians	1.2	1.8
Total theatre staff per operative event	9.4	12.9

†Six of the eight Whakaari patients were repatriated to Australia within 72 hours of the index admission date.
MCI = mass-casualty incident.

Figure 1: Operating and surgeon time duration by mass-casualty incident cohort.

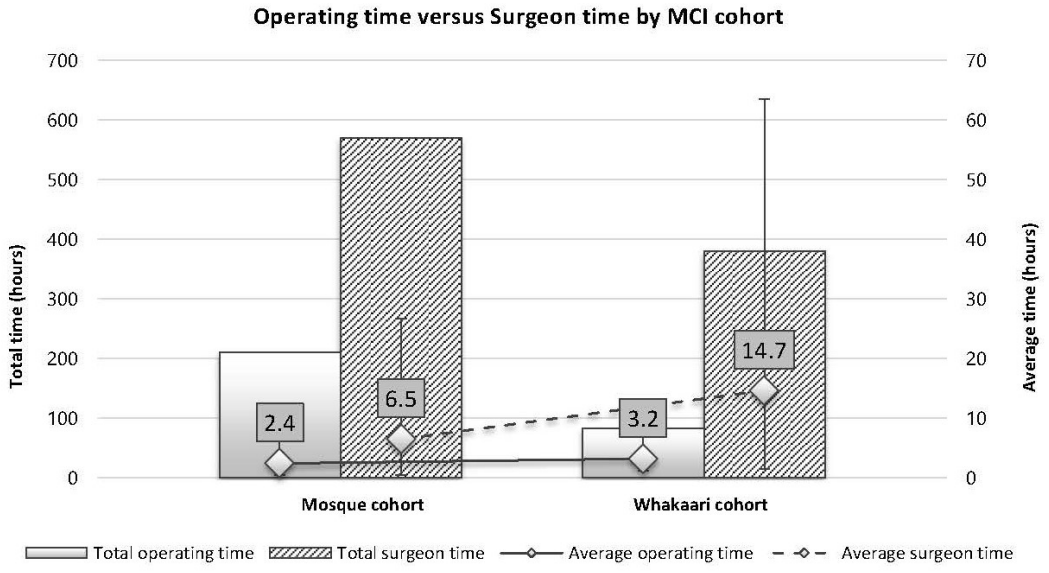
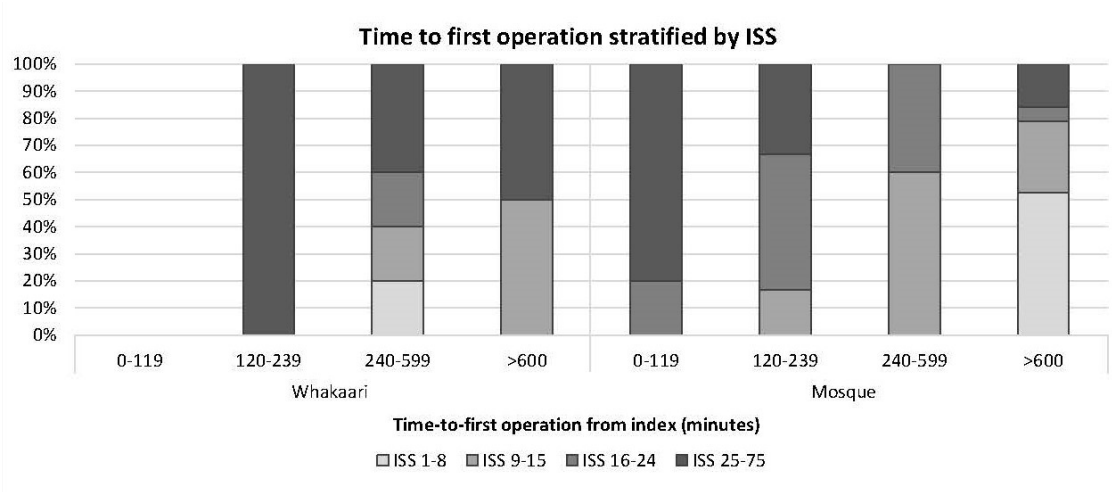


Figure 2: Timing to first operation by mass-casualty incident cohort.



COMPETING INTERESTS
Nil.

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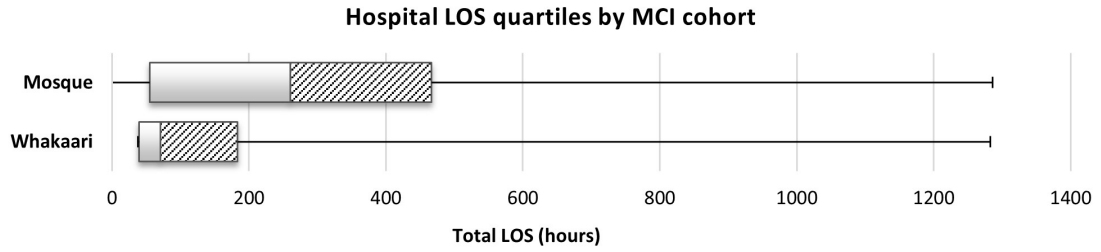
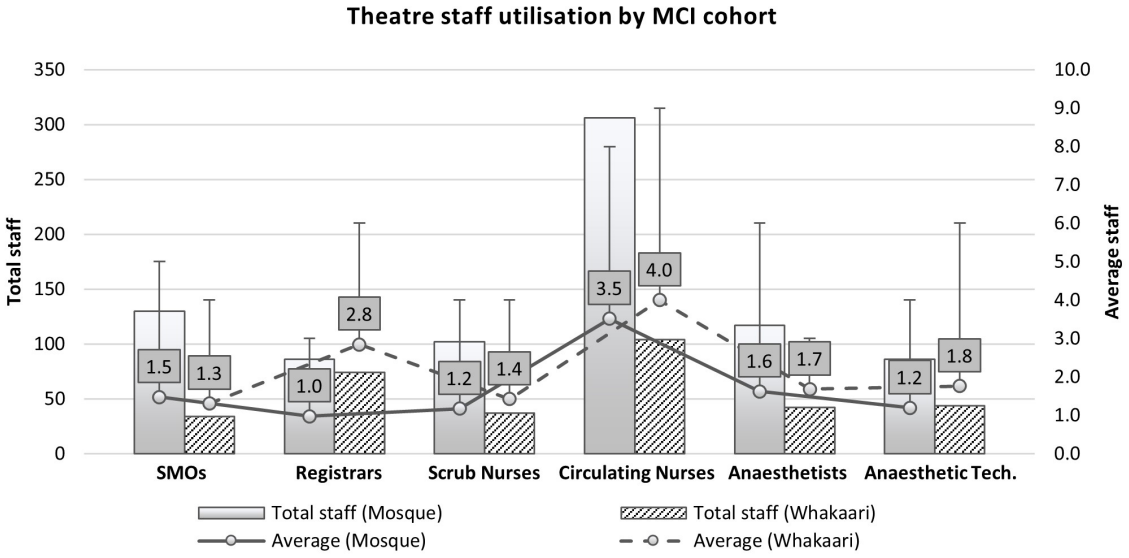
Appendices

Appendix A: Hospital length of stay quartiles by mass-casualty incident cohort.



Appendix B: Summary of theatre staff utilisation by mass-casualty incident cohort.



†Error bars represent the maximum staff required for an operative intervention within each cohort.

Appendix C: Summary of hospital resource utilisation by MCI cohort.

	Mosque MCI	**Whakaari MCI†**
Radiology	**n**	**n**
X-ray	295	37
CT scan	108	5
MRI scan	5	0
Fluoroscopy	21	2
Ultrasound	24	1
Interventional radiology	20	3
Radiology MDM	37	0
Total	510	48
Laboratory		
Haematological		
Blood count	486	53
Blood gas analysis	148	37
Blood bank testing	71	19
Coagulation screening	198	31
Biochemistry and toxicology		
Routine biochemistry	457	52
Glycaemia measurement	146	7
Toxicology	43	5
Myocardial injury markers	142	36
Other	43	14
Microbiology		
Blood culture	50	8
Aspirates	45	9
Swabs	35	8
Urine testing	60	15
Screening	43	35
Other	25	3
Specialist and other testing		
Miscellaneous	31	5

Appendix C (continued): Summary of hospital resource utilisation by MCI cohort.

Total	2,023	337
Blood bank		
Red blood cells (units)	282	50
FFP (units)	198	14
Cryoprecipitate (units)	81	2
Platelets (units)	23	7
Total	584	73
Other		
Endoscopy	9	0
Echocardiography	15	0

MCI = mass-casualty incident; CT = computed tomography; MRI = magnetic resonance imaging; MDM = multidisciplinary meeting; FFP = fresh frozen plasma.

Improving lung cancer survival outcomes for Māori

Jason Gurney, James Stanley, Anna Davies, Virginia Signal, Paul Dawkins, Laird Cameron, Shaun Costello, Christopher GCA Jackson, Kimiora Henare, Ross Lawrenson, Jesse Whitehead, Jonathan Koea

ABSTRACT

Lung cancer is the most lethal cancer for Māori in Aotearoa New Zealand, with more Māori dying from lung cancer each year than the next five most common causes of cancer death combined. Māori have far poorer lung cancer survival outcomes than our majority European population, and access to timely, best-practice diagnosis and care could be an important driver of these disparities. We recently conducted a nationwide project to augment existing evidence and identify points along the clinical pathway where there are ethnic differences in access to this care. We found some cause for cautious celebration, including equitable access to bronchoscopy, pathological diagnosis, radiation therapy and systemic therapy, as well as minimal differences in the timing of treatment between ethnic groups. However, we identified a number of disparities along the treatment pathway that require intervention, including higher emergency presentation rates, poorer access to early detection, lower surgery rates and disparities in the distance required to travel to bronchoscopy, surgery and radiation therapy. Based on our observations from this project, along with the context provided by literature review and discussions with stakeholders, we have made five recommendations for areas of action to address these disparities, with a view to ultimately improving survival outcomes for Māori. Our results suggest that it is possible to achieve equitable outcomes for Māori in key areas; we must now push forward toward closing further gaps if we are to achieve equity in lung cancer survival for our Indigenous peoples.

Lung cancer kills more New Zealanders per year than any other cancer. Around 1,800 New Zealanders die each year of this disease, more than the total number of deaths from melanoma, breast and prostate cancer—three of our most commonly diagnosed cancers—combined.[1,2]

While lung cancer is an important problem for Aotearoa New Zealand as a whole, it is a deep crisis for Māori. Māori are more than three times more likely to be diagnosed with lung cancer than non-Māori.[3] Once diagnosed, Māori are 30% more likely to die of their lung cancer than non-Māori.[4] Cancer type and stage are partial drivers of this disparity: around 16% of Māori are diagnosed with the more aggressive small cell lung cancer (SCLC) compared with 11% of Europeans,[5] and while Māori are similarly likely to have advanced stage at diagnosis, fewer Māori are diagnosed with localised stage when curative treatment is most viable.[6] Because of these incidence and survival disparities, Māori in the general population have three times the lung cancer mortality rate of non-Māori.[3] Lung cancer kills more Māori each year than the next five most common causes of cancer death combined.[4]

The significant and enduring lung cancer problem faced by Māori drove Te Aho o Te Kahu, the national Cancer Control Agency, to partner with the Ministry of Health and the Health Research Council to fund new research into the cancer disparities in Aotearoa New Zealand.[7] Part of this funding was earmarked for projects focussed on lung cancer, including those relating to lung cancer screening and clinical lung cancer research. Our research group, along with several other research teams, received funding as part of this round. In this viewpoint we briefly describe our project and summarise its key findings.

Our project

Despite the lethality of lung cancer, along with its burden as the most common cause of cancer death for Māori, there has been a lack of research on the determinants of the enduring lung cancer survival disparity between Māori and non-Māori. Only two research studies (Stevens et al.[8] and Lawrenson et al.[9]), along with Te Aho o Te Kahu's recent *Lung Cancer Quality Improvement Monitoring Report*,[10] have explicitly considered disparities in access to lung cancer services, and as such these studies provide the only evidence to inform

interventions aimed at closing the survival gap.

The overarching aim of our project was to draw together new and existing information to **inform improvements in lung cancer services for Māori**, in the pursuit of equity in lung cancer survival for Māori.[11] To achieve this aim, we had two objectives: 1) to understand the extent to which there are differences between Māori and non-Māori lung cancer patients in access to treatment, and 2) to consider and describe how these differences might be modified through discussions with lung cancer experts within our team as well as through key stakeholder interviews.

In order to achieve these objectives, we first conducted a global literature review, and then drew together all available sources of relevant, nationally collected quantitative health information. We included all lung cancer registrations (ICD-10-AM code: C33–C34) from 2007 to 2019 on the New Zealand Cancer Registry (N=27,869, 5,601 Māori, 19,698 European) and linked these registrations to: all public and reporting private hospital inpatient records (National Minimum Dataset); emergency department and outpatient records (National Non-Admitted Patients Collection); the Mortality Collection; the Primary Health Organisation Enrolment Collection (PHO) dataset; the Pharmaceutical Collection dataset; and the Radiation Oncology Collection. Between these sources, we identified access to surgery, systemic therapy and radiation therapy across our cohort, and used descriptive statistics along with regression methods to achieve our study objectives. We then discussed our key findings internally and with key stakeholders to understand the extent to which the differences we identified between Māori and non-Māori are modifiable, and how these differences might be modified. Our findings were subsequently published in various international journals, but are pooled and summarised here, along with five specific recommendations that could be used to help close the lung cancer survival gap for Māori.

What we found

We identified a number of points along the lung cancer care pathway where Māori with lung cancer are clearly doing worse than the Europeans with lung cancer:

Routes to diagnosis: We found that Māori are more likely to have an emergency presentation within 30 days of their lung cancer diagnosis than Europeans (age standardised 54% vs 47%), even when adjusted for differences between these groups in age, sex, deprivation, rurality, comorbidity, PHO enrolment status, tumour type and stage of disease (adjusted odds ratio [aOR] 1.21, 95% confidence interval [CI] 1.13–1.30).[12] This difference is important, because those diagnosed following an emergency presentation are much more likely to die of their lung cancer than those who are not (1 year survival: 48% vs 78%, aOR 2.32, 95% CI 2.19–2.46). This difference between Māori and Europeans in likelihood of emergency presentation prior to diagnosis is likely to partially explain the survival disparities experienced by Māori.

Access to diagnostics: We found no differences in access to a pathological diagnosis between Māori and Europeans with lung cancer, and could find no differences in access to bronchoscopy.[5] However, we did find that Māori needed to travel further—for longer—to access that bronchoscopy: after adjusting for differences between Māori and Europeans in terms of age, sex, tumour type, stage and comorbidity, Māori had lower odds of living within 25 kilometres (km) of the location of their bronchoscopy (aOR 0.79, 95% CI 0.72–0.87), and higher odds of living more than 200km away (aOR 1.36, 95% CI 1.15–1.61). These findings suggest that when offered a significant procedure such as bronchoscopy to diagnose lung cancer, Māori pursue that investigation despite needing to overcome greater travel barriers to do so. This finding was echoed in our subsequent investigation of travel to access lung cancer treatment (see below).

Access to and timeliness of treatment: We found evidence that Māori are less likely to receive any primary surgery for their lung cancer (age-standardised proportions: Māori 14%, European 20%), and this difference was mostly for curative surgery (Māori 10%, European 16%) but not palliative surgery (Māori 4%, European 5%).[13] This finding is similar to that of Lawrenson et al.[9] in their regional investigation of stage I and II lung cancer using granular clinical registry data, in which they found that 40% of Māori received curative surgery compared with 50% of Europeans (both crude proportions). In combination, these observations suggest that Māori are not receiving this treatment to the same extent as Europeans. As noted later in this article, differences in stage of disease and comorbidity are important drivers of this difference.

Māori appeared more likely to access any radiation therapy than Europeans when examining crude data (44% vs 39%), but this difference disappeared when age standardised (both

44%). We were unable to discern using the data that we used for this study whether there were differences between Māori and Europeans in terms of curative vs palliative radiation therapy. Māori appeared more likely to access systemic therapy than Europeans in the crude data (31% vs 23%), but this disparity closed once age standardised (31% vs 32%). Because we standardised to the age structure of the (younger) Māori lung cancer cohort, this gave higher weighting to the treatment experience of those in younger age groups, who tended to be more likely to have local, regional or advanced disease, but were less likely to have unstaged disease. The upshot of this is that age, stage and treatment are intertwined, and therefore understanding the independent relationship between ethnicity and treatment requires additional careful modelling (see *Variation in patterns of treatment* below).

Among those who were treated, we did not find strong differences between Māori and Europeans in the average timeliness of surgery (median time in days from diagnosis: Māori 26 days, interquartile range [IQR] 1–55; European 23 days, IQR 1–51), radiation therapy (Māori 39 days, IQR 22–92; European 36 days, IQR 18–73) or systemic therapy (Māori 40 days, IQR 19–75; European 43 days, IQR 21–76). However, we did note that a somewhat larger proportion of European patients received radiation therapy within 4 weeks of diagnosis (age standardised %: Māori 31%, European 38%). The absence of strong differences in the timing of treatment between Māori and Europeans is reassuring, and our findings suggest that this gap has closed since the earlier clinical audit published by Stevens et al. in 2008.[8]

Travel required to access treatment: Building on our observations in the context of bronchoscopy, we found that Māori tend to need to travel further (with longer travel times) to access both surgery (median travel distance: Māori 57km, European 34km) and radiation therapy (Māori 75km, European 35km) than Europeans.[14] Māori have greater odds of living more than 200km away from both surgery (aOR 1.83, 95% CI 1.49–2.25) and radiation therapy (aOR 1.41, 95% CI 1.25–1.60). These findings reinforce our previous findings for stomach and liver cancer:[15] when cancer care is centralised—ideally for reasons of improving care quality—we systematically make accessing that care more difficult for our Māori patients than our European patients. This increased difficulty is compounded by the fact that Māori are much more likely to live in deprivation, and therefore have fewer resources (financial and otherwise) to overcome these heightened travel barriers.

Variation in patterns of treatment: As well as examining ethnic differences in access to surgery, radiation therapy and systemic therapy in silo, we also examined whether the combination/pattern of these treatments varied between groups (e.g., surgery alone, surgery plus radiation, etc.).[16] As noted earlier, this also gave us the opportunity to further explore ethnic disparities in access to surgery while controlling for other factors that might influence this disparity. We found that once adjusted for age, sex, comorbidity, deprivation, rurality, tumour type and stage, Māori did not appear to be receiving a different pattern of lung cancer treatment compared with Europeans. We also found that once adjusted for all these factors, Māori and Europeans appeared equally likely to receive surgery either alone or in some combination with other treatments (both 15%).

At a glance, this finding could erroneously lead us to the conclusion that treatment access is unlikely to contribute to disparities in lung cancer survival for Māori. However, this finding must be considered alongside two factors: a) our observation of lower surgical rates among Māori with lung cancer when viewed in silo (see above),[13] and b) the fact that when examining different combinations of treatment, disparities between Māori and Europeans in access to any surgery combination only disappeared once we adjusted for factors other than age (age-standardised proportion: Māori 15%, Europeans 21%; fully adjusted proportion: Māori 15%, European 15%).[16] As such, Māori are indeed less likely to receive surgery than Europeans—but this difference is largely explained by differences in factors including comorbidity and stage. However, this should not be misinterpreted as meaning that there is no difference between Māori and Europeans in terms of received surgery; it merely suggests that there is no apparent impact of Māori ethnicity that is independent of factors such as comorbidity and stage. Of note, Lawrenson et al.[9] also previously found that current smokers were less likely to receive curative surgery for early lung cancer, with this relationship likely to impact Māori to a greater extent than Europeans due to higher smoking rates in the former compared with the latter.[17] In a broad sense, this finding reinforces the need for strong tobacco legislation as a means of improving Māori access to curative surgery.

Recommendations based on findings

Based on the key findings above, as well as those identified from previous research, we make the following five recommendations:

Recommendation 1

We need to shift as many lung cancer diagnoses as possible away from emergency rooms to primary care and/or screening contexts.

Stage of disease is a modifiable driver of disparities in cancer survival for Māori. Around half of all lung cancers in this study—Māori and other ethnicities—occurred within 30 days of an emergency presentation.[12] While there are multiple reasons for why this is the case, the fact that Māori are more likely to have this outcome suggests that we can do better. The key to improving access to early detection of lung cancer is to a) enhance initiatives that improve access to early symptomatic detection and rapid access to secondary assessment, and b) enhance access to early detection of asymptomatic cancers. As such, improvements in this context should focus on two key areas: increased vigilance for lung cancer presentation in primary care and targeted low-dose computerised tomography (CT) screening of those at risk of lung cancer.

In terms of primary care, we did find that both Māori and Europeans who had an emergency presentation were less likely to have had a recent visit to their PHO, suggesting that improvements in access to primary care, with low thresholds to investigate lung cancer symptoms such as cough, will lead to a reduction in emergency presentations prior to diagnosis. This will subsequently impact lung cancer survival in general and has the potential to impact survival disparities between Māori and Europeans. If targeted to Māori—through, say, enhanced resourcing of Māori primary health providers to target early lung cancer diagnosis—these improvements could help to close the survival gap between Māori and Europeans. If a universal approach is taken to improve this access, then the survival gap may reduce somewhat (since Māori are more likely to have emergency presentation and so have more to gain than Europeans in terms of access to primary care diagnosis), but not as much as might be achieved with a Māori-focussed approach.

In terms of lung cancer screening, our finding of poorer access to curative surgery (amid existing evidence of poorer survival outcomes) among Māori supports the need for a low-dose CT lung cancer screening programme to shift the proportion of Māori diagnosed with lung cancer towards the earlier stages of disease, where curative treatment is more viable. Each step of a screening programme and subsequent referral pathways should be carefully designed to ensure that it will maximise access for Māori; for example, a randomised controlled trial is currently underway, examining the best method of inviting people into the screening programme in order to maximise uptake among Māori.[18] The approach taken to a lung cancer screening rollout will have similar implications for the survival gap noted above with respect to improving access to a primary care diagnosis. Getting our lung cancer screening programme right for Māori is a critical priority in the wider context of improving Māori access to curative treatment and improving survival outcomes.

Recommendation 2

We need to ensure that Māori who are good candidates for surgery are offered this treatment.

Māori appear to be receiving similar patterns of lung cancer treatment, other than (principally curative) surgery. As noted above, this is partially driven by fewer Māori having localised disease, which further emphasises the need to maximise early detection of lung cancers in this population. It will also be partially driven by greater rates of comorbidity among Māori with lung cancer. Like stage of disease, comorbidity is a modifiable driver of disparities in access to cancer treatment, and thus cancer survival outcomes, for Māori. Other (unmeasured) factors are also likely to be driving this disparity: at a broad level these will likely be related to institutional racism wherein our cancer care systems are working sub-optimally for Māori by design, which is manifesting in reducing the availability, affordability and acceptability of these systems for Māori.[19] There are three key areas that we can focus on to improve Māori access to lung cancer surgery:

- shift the distribution of stage of disease at diagnosis toward earlier stage to enable more curative surgery (see above);
- prevent comorbidity through effective public health policy (e.g., diabetes prevention initiatives), and improve access to prehabilitation and comorbidity management;[20]

- re-design our surgical services to improve the availability, affordability and acceptability of these services for Māori with lung cancer. In their review of factors that can improve surgical services for Indigenous peoples, Koea and Ronald[21] noted several key actions that can be taken to achieve this:
  - ask Māori to help develop and provide medical and surgical services;
  - structure services so that the community is involved in governance and service review;
  - work with and empower community primary healthcare to assist with fast-tracking eligible Māori with lung cancer through to surgery;
  - grow the Māori health workforce, which in this context would include the thoracic surgery and respiratory physician workforce.[21]

Recommendation 3

We need to reduce the treatment travel burden on Māori with lung cancer.

We found that Māori needed to travel further, for longer, for bronchoscopy, surgery and radiation therapy (we did not examine travel to systemic therapy). This is compounded by the fact that Māori have poorer access to financial resources required to manage this increased travel burden. We must a) deliver those aspects of lung cancer treatment that can be decentralised (such as pre-surgery appointments) via telehealth or in physical locations close to where Māori live, wherever feasible, and b) where travel is required, provide financial support up-front to facilitate and support the travel required to access care. We are aware that Hauora Māori and other providers are investing in cancer care navigation with an emphasis on transport support, and these initiatives are important and should continue to be resourced. However, it is clear that a substantial overhaul of our current National Travel Assistance Scheme[22] would be required to meaningfully improve the way this programme works for Māori. Such actions could include:

- a shift away from a reimbursement model to an up-front payment model, with a strong emphasis on trust between the scheme and the patient on their cancer journey, accompanied by a low-impact auditing process to ensure correct use;
- ongoing examination of eligibility criteria used to determine who can access the scheme to ensure that resources are being directed toward those who need it the most;
- increases in the amount of support available to cover transport and accommodation costs, with this amount to reflect the actual whole reality of the cost of travel to the patient and their whānau;
- extension of the scheme to provide accommodation for patients and whānau as part of standard care (currently only provided under certain circumstances in Aotearoa New Zealand[23]).

Recommendation 4

We need to make our lung cancer pathway as approachable or acceptable to our Māori population as possible.

A consistent theme from our global literature review, as well as our internal and stakeholder discussions,[24] was that our healthcare system is not set up to work well for our Indigenous patients. This presents a key barrier to improving survival outcomes for Māori, particularly given that Māori are disproportionately more likely to need to access our health system (particularly lung cancer services). Building on the previous observations of Koea and Ronald noted above,[21] the acceptability of our services for Māori can be optimised through activities such as normalising traditional medicines within lung cancer treatment,[25] improving clinical communication so that it works well for Indigenous peoples[26] and investing in Māori patient navigators who support and advocate for the Māori patient throughout their cancer care.[27,28] A large expansion in the number of Māori cancer care navigators would improve the support available to Māori with lung cancer as they navigate the often-complex, prolonged and geographically distant lung cancer treatment pathway.[28]

Recommendation 5

We need to get the data right.

While we were able to make several key observations, the absence of robust clinical staging information, and the likelihood that our cohort was missing some patients who were only diagnosed clinically, emphasises the importance of constant improvement to the completeness and quality of our national health data collections. The four most important factors are: a) clinical stage information, b) the timeliness of data to ensure that decision making is driven by up-to-date records,

c) clinical outcome data including patient-centred outcomes, and d) data on cancer treatment from private providers. In the case of the clinical-stage information, this information should be collected within multidisciplinary meetings, and as such should be available for centralised collation and management; however, beyond regional registries like the Midlands register, this is not currently the case. In the case of data from private providers, we were (for example) unable to examine access to immunotherapy or best-practice targeted therapies since these medicines were not funded publicly and, as such, data on their use have not been nationally collected nor reported. It is imperative that all cancer care provided in Aotearoa New Zealand is reported centrally to Health New Zealand – Te Whatu Ora, regardless of who is funding it, to ensure that the datasets used to monitor care access and variation are as complete as they can possibly be. A central comprehensive database capable of driving quality improvement would have significant long-term benefits. Addressing this important issue may require legislative intervention to ensure data collection and provision by private providers. Making this sort of cancer monitoring and surveillance work well for Indigenous peoples is a complex undertaking[29]—but it is achievable, and should be prioritised in the context of cancer control for Māori.

Conclusions

Over the course of this 2-year project, we identified a number of areas across the lung cancer clinical pathway where Māori are faring worse than our majority European population. Some of these observations reinforce knowledge that already existed, either within the broad context of cancer or specifically for lung cancer, while some were relatively novel. Iterative changes to our health system across the five recommendations outlined above must be prioritised within health policy and budgeting at a central government level if we are to expect any improvements in lung cancer survival outcomes for Māori, let alone the achievement of survival equity.

COMPETING INTERESTS
Nil.

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Chest pain that is hard to swallow—a rare finding of Kommerell diverticulum

Michael Dick, Adam Bateman, Chethan Kasargod

A 50-year-old man was investigated for atypical reflux-like chest discomfort and gradually progressive exertional dyspnoea, with echocardiogram demonstrating mild–moderate global left ventricular impairment (ejection fraction 40–45%). Further investigation of the possible non-ischaemic cardiomyopathy with cardiac magnetic resonance imaging (MRI) and computed tomography coronary angiogram (CTCA) demonstrated no clear aetiology, with now low–normal left ventricular systolic function (ejection fraction 50–55%), mild right ventricular systolic dysfunction and normal coronary arteries. An incidental finding of a classical Kommerell diverticulum was also observed.

A Kommerell diverticulum is a congenital abnormality where the right subclavian artery arises as the last branch from the proximal descending aorta in a diverticulum, before travelling to the right arm by passing posterior to the oesophagus, where it may have a mass effect (Figure 1–2).[1] Approximately 5% of adult patients with a Kommerell diverticulum develop symptoms, with most being detected incidentally. Common symptoms include chest discomfort, dyspnoea and dysphagia.[1–3]

Further questioning confirmed a history of worsening dysphagia to solids and liquids, with subsequent barium swallow clearly demonstrating oesophageal compression (Figure 3). Gastroscopy further confirmed extrinsic compression of the upper oesophagus by a pulsatile mass, and Kommerell diverticulum was felt to likely explain his symptoms.

There are no established treatment guidelines for Kommerell diverticula as many are incidentally discovered in asymptomatic individuals. In such cases intervention is not necessarily required. However, intervention may be considered, particularly for symptomatic patients, as potential complications include rupture and dissection.[3,4] While conventional open surgical repair remains a consideration, the past decade has seen a shift in preference for hybrid and endovascular approaches to management.[3–6] Surgical correction was offered to our patient to treat symptoms and reduce the risk of future complications; however, his preference is for conservative management and monitoring of symptoms at this stage.

Figure 1: Computed tomography coronary angiogram (CTCA) demonstrating aberrant right subclavian artery (RSA) with diverticulum (*).

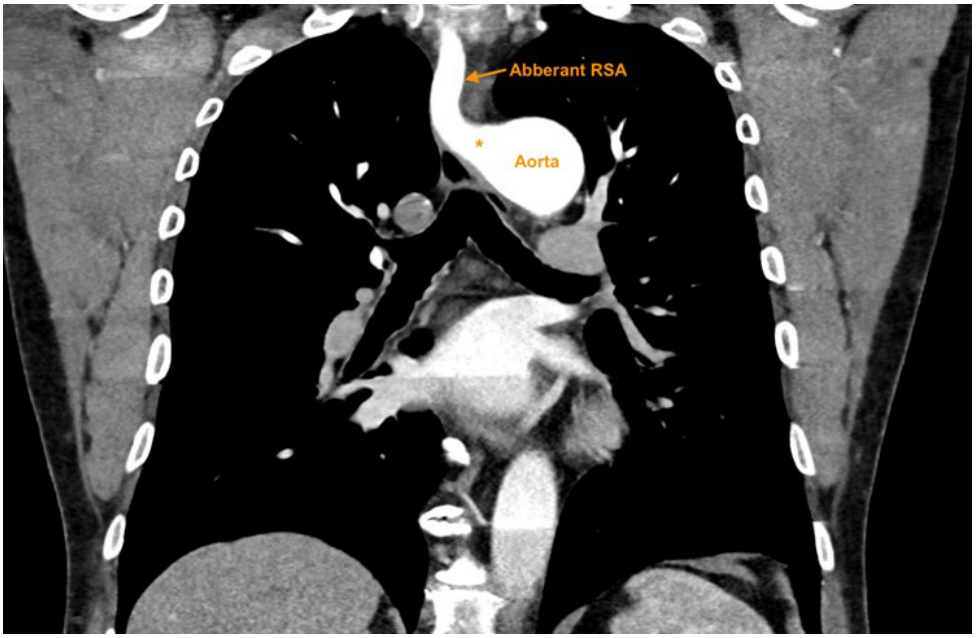
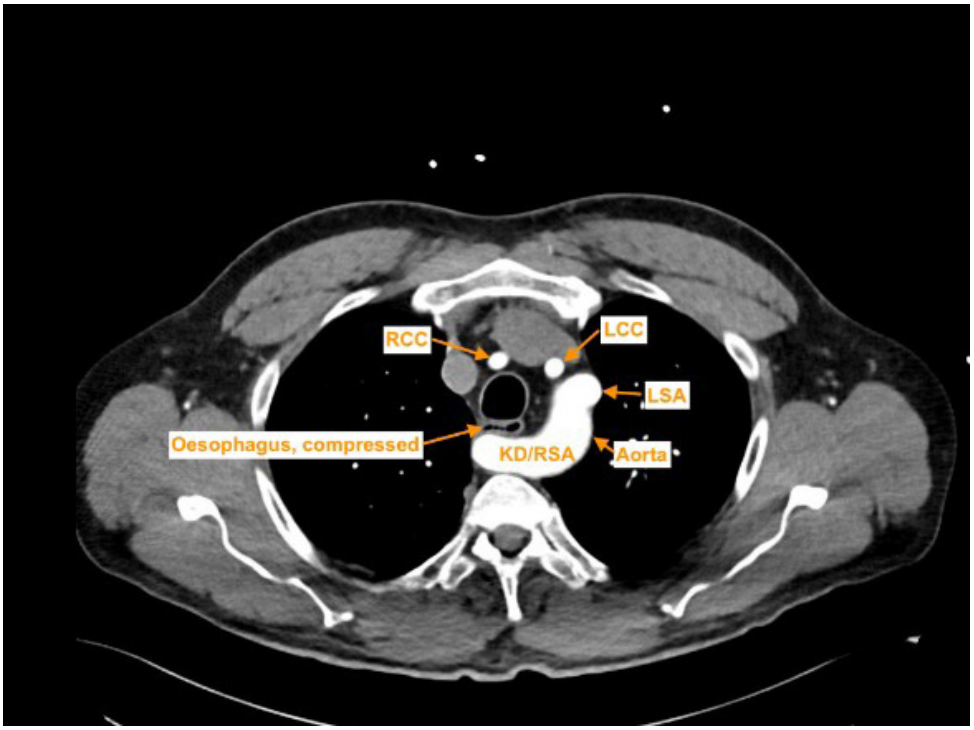
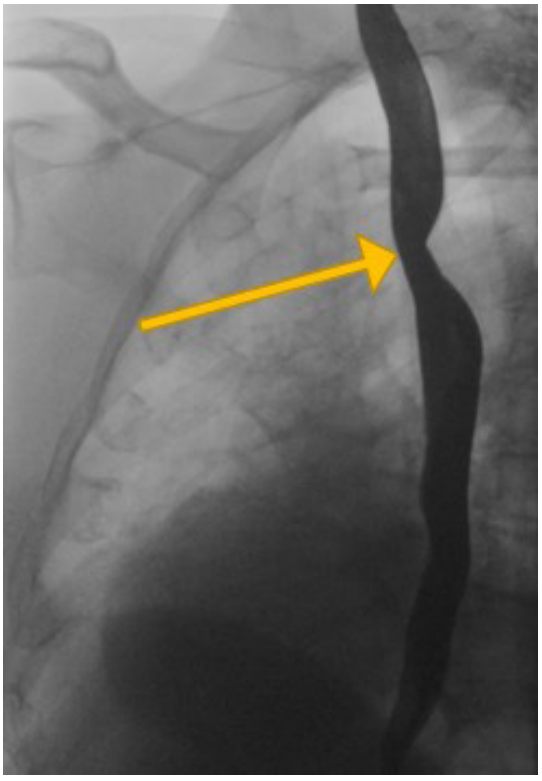


Figure 2: CTCA demonstrating aortic arch vessels, including aberrant RSA with retroesophageal course and resultant oesophageal compression.



KD = Kommerell diverticulum; LCC = left common carotid; LSA = left subclavian artery; RCC = right common carotid; RSA = right subclavian artery.

Figure 3: Barium swallow showing oesophageal compression at level of the Kommerell diverticulum.



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Nil.

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An update on Helicobacter pylori diagnosis in New Zealand

Jan Kubovy, Murray Barclay

We would like to update the data in your article *Helicobacter pylori in New Zealand: current diagnostic trends and related costs*, depicting the state of *Helicobacter pylori* (*HP*) testing in Canterbury, New Zealand, published in your journal in 2022.[1]

Much has since changed in Canterbury New Zealand regarding *HP* testing, including progressive population growth that has increased by 20.6% since 2013.[2] Along with this growth came significant changes to the ethnic pool. For example, Europeans decreased by 7.6%, while ethnicities with high *HP* prevalence such as Māori, Pacific peoples and Asians increased by 30.8%, 48% and 92.7% respectively. Although we report regional data, this change is likely reflected on a national level. The last paper reported 6 years of tests, ending in the year 2018. We present an update for the 2022–2023 years. We have applied the same methodology for data acquisition and analysis and have obtained locality approval.

There were two major developments in terms of *HP* testing: the national shortage of C_{13} isotope labelled urea, thus negating the use of urea breath test (UBT), and that the *HP* serology test has been abolished by the lab and is nowadays used only in very few sanctioned paediatric patients. Microbiological testing (*HP* culture and antibiotic sensitivity) remains severely underutilised. Incidental histological diagnosis is beyond the scope of our study and was not included. This leaves essentially only two available tests in use, either a gastroscopy-dependent *Campylobacter*-like organism test (CLO) or *HP* stool antigen test (SAT), the latter utilised predominantly in primary care.

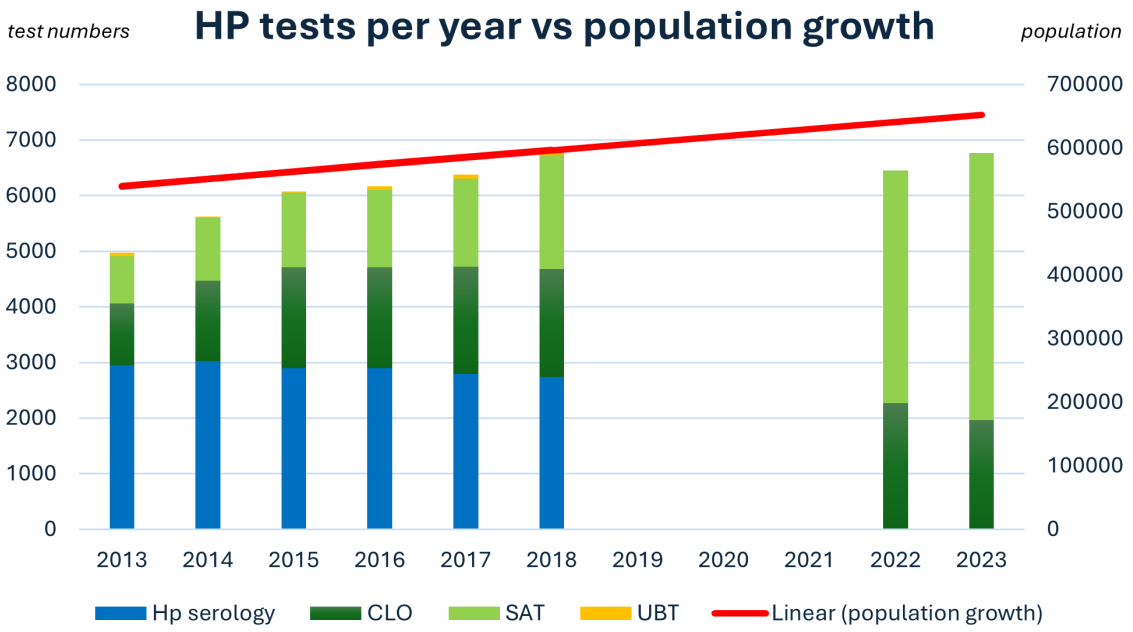
Our previous article reported on the marginality of the cumbersome UBT, previously the gold standard test. Additionally, international guidelines have long advised against routine *HP* serological testing, due to differing test performance in a given population and inability to differentiate past and present infection.[3] This is now reflected in New Zealand guidelines.[4] SAT and CLO are now the only two major remaining test modalities in our region. SAT utilisation has more than doubled since 2018 and is now the dominant test modality, at least partly due to taking over *HP* serology (Figure 1). CLO test utilisation remains essentially unchanged despite the population growth. Limited endoscopy access would seem the obvious explanation, reflecting the current severe endoscopy resource constraint with additional pressure coming with the national bowel cancer screening programme implementation in late 2020.

The total annual test numbers for 2022–2023 are essentially unchanged from previous years. While the limited endoscopy access certainly explains the CLO numbers, we are uncertain about the reasons behind SAT utilisation relative to the population growth.

Related annual costs in NZD, excluding goods and services tax (GST), are marginally lower than in 2018 (NZ$212,568 and NZ$226,078 in 2022 and 2023 respectively). Although the total test numbers for SAT, previously the most expensive test, have more than doubled since 2018, the price of NZ$35.66 per test (excl. GST) is 50% less than in 2018, related to having a different test provider, thus keeping the overall costs down.

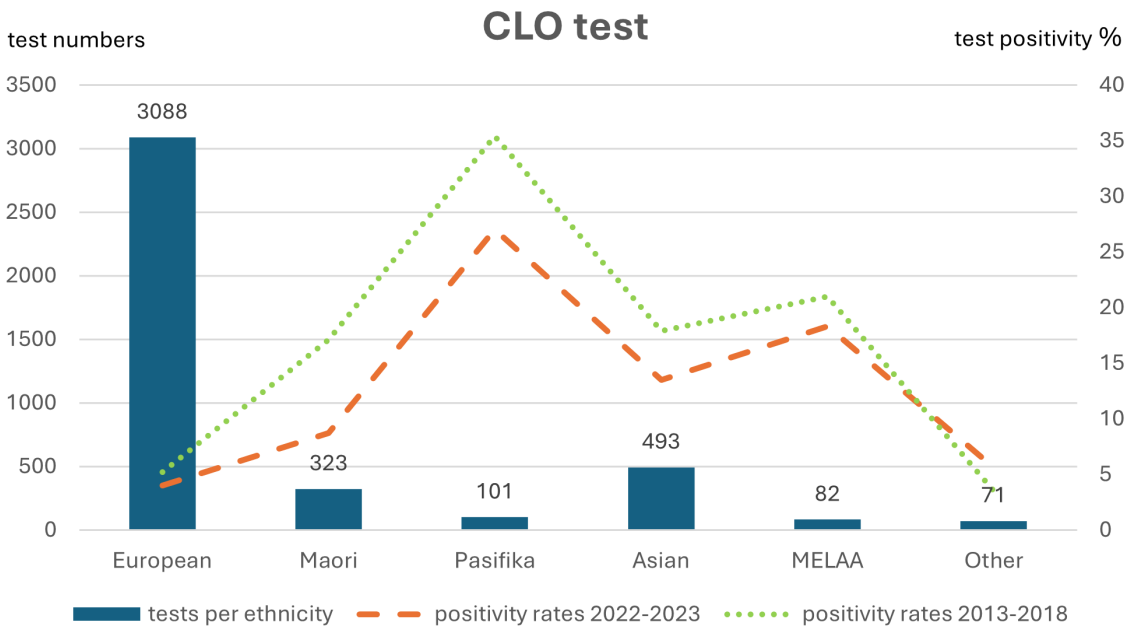
We also present the test positivity rates and ethnic cohort breakdown (Figure 2A–B). Comparing the current with previous results, there are minor variations in the test positivity rates for each ethnic cohort, as well as the test means and compound test means. However, these results remain comparable, and we do not consider these differences significant. Māori and Pacific peoples remain proportionately under-represented in the tested population despite their relatively high positivity rates in both CLO and SAT cohorts (Figure 3). The relative SAT overutilisation in Asian and Middle Eastern, Latin American and African (MELAA) cohorts is notable, and yet unchanged from the previous paper.[1] As before, we do not see a clear explanation for this phenomenon, but cultural preferences in terms of choice of test modality could play a role here. Mean test positivity rates were comparable with the previous study: CLO=6.3% and SAT=13.8% vs CLO=7.2% and SAT=10.2% in the previous study.[1] The compound mean positivity across both modalities was 11.2% vs 10.4% reported previously; that, however,

Figure 1: Number of tests per modality and year with population growth.



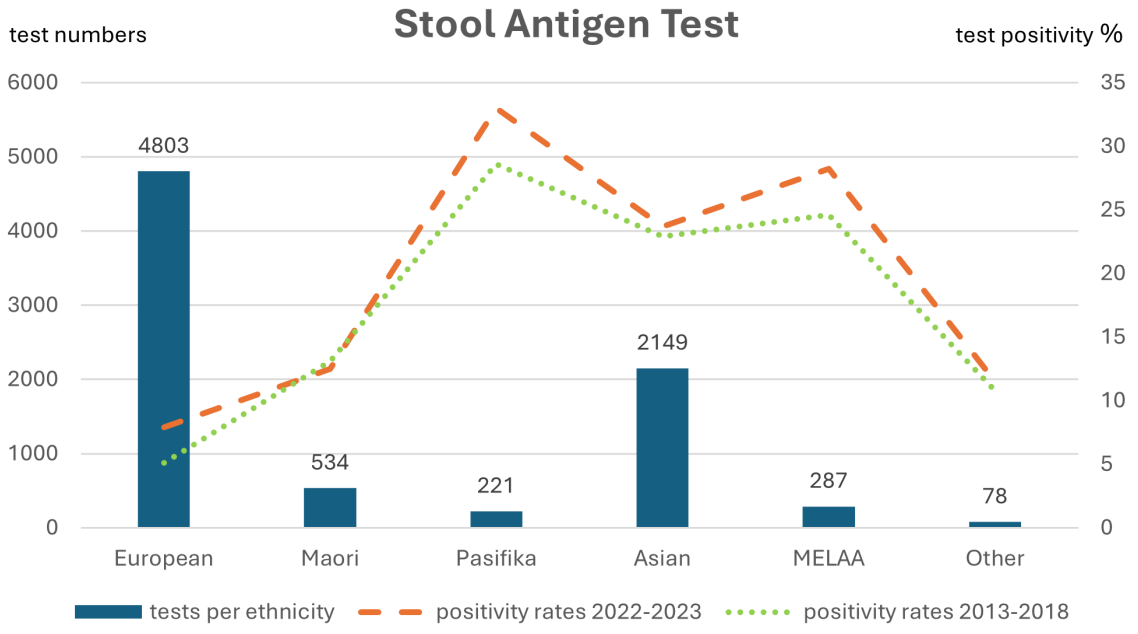
HP = Helicobacter pylori.

Figure 2A: Combined years 2022–2023 CLO test numbers and positivity rates with 2013–2018 positivity rates (dotted lime green line) for comparison.



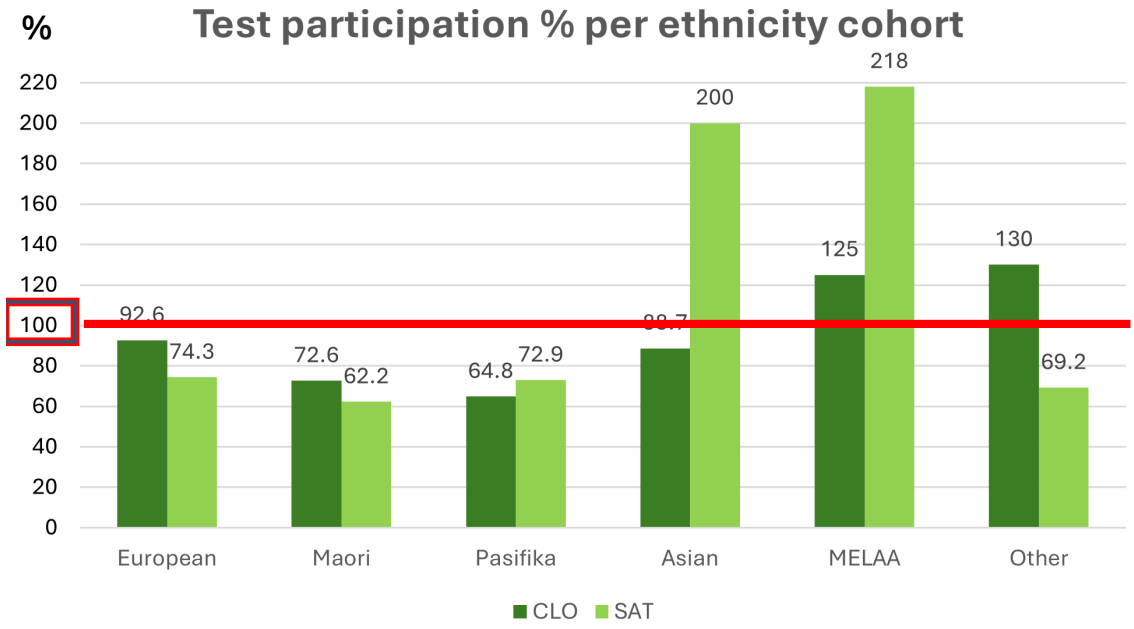
CLO = *Campylobacter*-like organism; MELAA = Middle Eastern, Latin American and African.

Figure 2B: Combined years 2022–2023 SAT test numbers and positivity rates with 2013–2018 positivity rates (dotted lime green line) for comparison.



SAT = stool antigen test; MELAA = Middle Eastern, Latin American and African.

Figure 3: Ethnic cohort test proportion compared with 2023 Canterbury Census. The red line indicates equitable 100% test participation for each ethnic cohort. Note significant under-representation in Māori and Pacific peoples.



MELAA = Middle Eastern, Latin American and African.

also included *HP* serology and UBT modalities. We stress that these results apply to the tested cohort only and do not represent a true population prevalence.

Perhaps the most important message of this updated analysis is the ongoing health inequity for non-European populations in New Zealand, specifically Māori and Pacific peoples. Those exposed to chronic undiagnosed *HP* infection are at increased risk of the sequalae, including gastric cancer. We believe the time has come to recommend routine primary care level *HP* testing of at-risk patients, perhaps as part of standard health screening checks such as blood pressure, cholesterol or glycated haemoglobin. Previous New Zealand–based studies have already proven the robust indication and cost-effectiveness of such intervention in at-risk cohorts.[5,6]

COMPETING INTERESTS
We declare no conflicts of interest.

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The Treatment of Fractures of the Forearm by Immediate Mobilisation and Massage

NZMJ, 1925

By MARION A. RADCLIFFE-TAYLOR, M.B., Ch.B., *Assistant to Surgeon-in-Charge of the Orthopaedic Department, Dunedin Hospital.*

INTRODUCTION.—The following study of fractures of the forearm has been undertaken with a view to ascertaining the effect on the final result of immediate mobilisation and massage. The cases have not been specially selected, but are those treated during the last two-and-a-half years in the Physiotherapy Department, Dunedin Hospital.

Fractures complicated by nerve lesions, fractures within one inch of the elbow joint, compound fractures and those which had to be reduced by open operation have been omitted because the treatment was so diverse that a comparison of the final results would be useless.

CLASSIFICATION.—There are eighty-six cases, which fall into the following groups:—

Type 1.—*Fractures within one inch of the Wrist Joint*.—(a) Both bones, 25 cases; (b) radius only, 2 cases; (c) ulna only, 4 cases. *Separated Lower Epiphyses*.—(a) both bones, 2 cases; (b) radius only (with or without fracture of the ulnar styloid process) 10 cases; (c) ulna only, no cases. Total 43 cases.

Type 2.—*Fractures of the Shaft*.—(a) Both bones—(i) Sub-periosteal, 6 cases; (ii) with displacement, 15 cases. (b) Radius only—(i) Sub-periosteal, 5 cases; (ii) with displacement, 14 cases. (c) Ulna only—(i) Sub-periosteal, no cases; (ii) with displacement, 3 cases. Total 43 cases.

METHOD OF REDUCTION.—When a fracture of the forearm was diagnosed in the Casualty Department, it was immobilised on a temporary splint, and, if convenient, a radiograph was taken immediately. Impacted fractures which had only slight deformity, sub-periosteal fractures without angulation, and fissure fractures were not reduced, but were splinted as described below. In all other cases reduction was performed under a general anæsthetic, and took place in all cases within 16 hours, in the majority within 8 hours, and in many within 2 or 3 hours of the time of the accident.

In the cases of type 1, *e.g*., Colles fractures, reduction was performed by manipulation, not by traction, in the following manner:—The posterior angulation was increased in order to disengage the bone ends, the lower fragment was then pushed forwards and downwards, and the radial deviation was corrected by pushing the hand over to the ulna side.

In the cases of type 2 *e.g*., fractures of the shaft of both radius and ulna with displacement, reduction was performed by traction and manipulation. Traction was applied to the forearm, the anæsthetist giving counter-extension by fixing the position of the elbow. The bone fragments were then manipulated into position, special attention being given to the radius, which was reduced first, as when it was in a satisfactory position, the ulna did not always require manipulation.

SPLINTING.—After reduction, the position was maintained by a plaster slab splint made in the following manner:—Plaster bandages 4in. wide and 4 yards long made from No. 12 and Ash's superfine dental plaster were stored in air-tight tins ready for use. These bandages were soaked in tepid water without any salt. It was found, that, although the addition of salt to the water caused the plaster slab splints to set more rapidly, it made them brittle and they frequently broke before the end of the treatment; whereas plaster slabs made without the addition of salt to the water were more durable and did not need to be renewed during the course of the treatment. Two plaster slab splints were made by folding the bandages on themselves, the anterior one long enough to extend from about 4in. above the elbow to the base of the fingers, the posterior one from a point about 1½in. below the olecranon process to the knuckles. If a splint were too wide, the requisite amount was cut off at this stage.

The arm was thoroughly powdered with

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French chalk or was covered with a thin layer of vaseline to prevent the hairs from adhering to the plaster. French chalk was found to serve this purpose quite as well as vaseline and it had the advantage of being more easily applied and more agreeable to both patient and operator. The plaster slabs were applied with the elbow flexed to right angle, the forearm fully supinated (care being taken to make sure that both upper and lower fragments were supinated) and the wrist slightly dorsi-flexed.

The anterior slab was adjusted first, a slit about 2in. long being made for the thumb, and small slits on either side of the plaster at the bend of the elbow, in order to make the splint fit the arm more accurately. The plaster slabs were carefully moulded to the arm, any pressure over the bony prominence being avoided. I cannot remember any cases which developed a pressure sore.

When the plaster slab splints had set, unless there was difficulty, which occasionally occurred, in maintaining the reduction, they were removed, the edges were trimmed with a sharp knife, and the arm was washed and thoroughly dried. Before the splints were re-applied, the inner surfaces of the splints and the entire arm were well powdered. The slabs were kept in position by means of 1in. wide strips of adhesive plaster, one above the elbow, two round the forearm (one above and one below the site of fracture if possible), and one round the hand. These were not put on tightly in case there was much subsequent swelling. A roller bandage was applied over the splint for warmth and the arm was then supported by either a greater arm, or a Hannequin's sling.

In order to avoid any possible occurrence of ishæmic myositis, patients were advised to sleep with the arm raised on a pillow to reduce the œdema, and were asked to report at once if the arm became very painful or if there should be marked blueness, tingling or numbness of the fingers.

I cannot remember any cases returning on account of the above symptoms or on account of the tightness of the plaster, but all cases were seen as routine next morning.

When these plaster slab splints were used, the patient could dress and undress without difficulty, and next day, when the plaster had dried, a radiograph which showed sufficient bony detail for purposes of treatment could be obtained.

The splints have the advantage of being light and inexpensive, the anterior splint usually weighing about 3ozs., the posterior 2ozs., the cost being about eighteenpence each.

MASSAGE AND MOBILISATION.—The following is an account of the treatment given to those cases which commenced massage on the first day after injury.

Type 1.—*Fractures within one inch of Wrist Joint*: *Separated Lower Epiphyses* (one or both bones).—During the First Week:—First Day—If the case was massaged within 24 hours of reduction, the first treatment was given with the anterior splint in position. Light superficial stroking was used, firstly, to assist the circulation which had become disorganised by the injury, and secondly, by its reflex effect to get rid of muscular spasm, and thereby to relieve pain.

Mobilisation was commenced at once, active movements being given to the finger, thumb, elbow and shoulder joints, and gentle passive movements to the wrist joint.

Second Day.—This treatment was repeated, the anterior splint as well as the posterior being very gently removed so that the arm was kept in supination. It was massaged resting on a pillow, with one hand supporting it at the site of fracture. While still wearing the splint, the patient was instructed to exercise the fingers and thumb occasionally between treatments.

Third Day.—Before the treatment was given, the splints were gently removed and the arm carefully placed in the whirlpool bath for ten minutes (temp. 100). Gentle kneading was given, starting at the proximal part of the arm and working down the forearm. This was frequently found to be more effective in allaying muscular spasm, and therefore in relieving pain, than light stroking massage, and it has also a beneficial effect on the deep circulation. Movements were given as before.

Erratum

URL: https://nzmj.org.nz/journal/vol-138-no-1616/blunt-cerebrovascular-injury-in-trauma-patients-an-under-recognised-injury-pattern-at-auckland-city-hospital

Blunt cerebrovascular injury in trauma patients: an under-recognised injury pattern at Auckland City Hospital

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On 11 July 2025, one correction was applied to this manuscript:

1. On page 59 under Methods, the New Zealand Trauma Registry was incorrectly given. This should be the Auckland City Hospital Trauma Registry.