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EDITORIAL

Equity deferred is equity denied: cancer outcomes for Māori and Pacific peoples

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Emma Osborne, Cheryl Davies, Caroline Shaw

Our research followed a marae-led e-bike programme for a year. We explored Māori and Pacific participants' accounts of the health impacts of e-biking and what helped them to start and keep riding. Wanting better health was an important reason for initially trying out e-biking. Participants described e-biking as having a positive effect on their physical and mental health. E-biking could be possible and enjoyable for people who experienced barriers to being active in other ways, although sometimes poor health could be a barrier to e-biking. Factors that supported people to keep e-biking throughout the year included having someone to ride with, finding e-biking fun and integrating e-biking as part of everyday travel.

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Jen-Li Looi, Simon Lee, Mildred Lee, William Harrison, Mansi Turaga, Mariana Lamacie, Ruvin Gabriel, Andrew J Kerr

Computed tomography coronary angiography (CTCA), a heart scan that shows plaque ("atherosclerosis") in the coronary arteries, is widely recommended to help evaluate chest pain. Finding any plaque on this scan—even if it does not significantly block blood flow—is known to increase the risk of future heart problems and usually signals the need for stronger prevention, including cholesterol-lowering medication (statins). In our study of patients who had CTCA for chest pain, those with blocked arteries showed the largest rise in statin use, and most remained on treatment a year later; people with mild plaque also increased their statin use, though to a lesser degree, while those with no plaque showed little long-term change. Overall, seeing plaque on CTCA—whether severe or mild—was linked to higher statin use. These findings suggest we may be able to improve care by ensuring more consistent statin treatment for patients with mild, non-obstructive coronary disease.

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Ghassan Al Aranji, Heather Astell, Timothy Kenealy, Helen Kenealy

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Mental health related callouts to the ambulance service in Aotearoa New Zealand: a descriptive analysis

Gabrielle Harding, Sarah Fortune, Rodrigo Ramalho, Andrew Swain, Aroha Brett, Bridget Dicker

Mental health conditions affect many people in Aotearoa New Zealand, but not everyone receives the same level of support. Māori and Pacific peoples are the most affected by these gaps in care. Ambulance crews can often be the first to respond to individuals experiencing mental health concerns, and these callouts have been rising. This research shows that youth, Māori, Pacific peoples and those living in deprived areas have higher proportions of ambulance callouts for mental health–related concerns. These findings highlight the urgent need for community based and culturally safe mental health care. Addressing upstream factors such as access to economic resources may prevent overburdening community mental health services, emergency departments and the ambulance services.

Vaping behaviour of high-risk and typically developing adolescents: results from the Gauging Risk and Resilience in Teenagers (GRIT) Study

Samantha J Lee, Reisha M Bone, Georgia J M Graat, Lianne J Woodward

Our study examined vaping among teenagers in Canterbury and found that vaping is now extremely common. Two-thirds had tried vaping, and nearly half were vaping regularly, meaning at least weekly. Young people who grew up facing significant hardship were especially affected, with almost 90% of this higher-risk group having ever vaped before and many showing signs of nicotine addiction such as withdrawal and struggling to cut down. Most regular vapers had never smoked cigarettes, showing that vaping is creating a new route into nicotine dependence for teens who might have otherwise never used tobacco. Many were using high-nicotine vape products, which can make quitting even more difficult. These findings show an urgent need for stronger protections and better support to help young people, particularly those already at risk for poorer health outcomes, avoid or reduce vaping.

Effective communication training to support person- and whānau-centred care: what is needed and why isn't it happening?

Melita Macdonald, Brad Peckler

This article looks at how well health staff are supported to communicate clearly, kindly and respectfully with patients and their families, and why this often doesn't happen in practice. Patients told the researchers that good communication means feeling listened to, having information explained in simple language and having their culture and family involved in decisions. Many health workers said they receive little ongoing training or feedback on communication, even though they want to improve. The study suggests that carefully designed artificial intelligence (AI) tools could help by giving staff practical, patient-focussed feedback, as long as these tools are safe, culturally grounded and designed alongside patients and clinicians.

Bicycle face: a timely reminder on discarded diagnoses in the age of anxiety

Robert E Bartholomew, Kate MacKrill, Emerson Bartholomew

During New Zealand's bicycle boom of the 1890s, a health scare emerged after several influential doctors in America issued health warnings to women about the adverse effects of cycling. Chief among these was "bicycle face", a "nervous condition" attributed to a constant state of stress from attempting to balance a bicycle combined with prolonged facial grimacing, which was believed to result in nervous exhaustion and disfigurement. The scare peaked between 1895 and 1910, when it became a common feature in New Zealand newspapers and magazines. The creation of this pseudo-condition was a way for men to exercise control over women by discouraging them to ride bicycles and curtail their newly found independence. This episode mirrors a broader historical pattern in which new technologies have triggered dubious health fears in New Zealand, such as those over the safety of mobile phones, 5G towers and wind turbines.

Spinocerebellar ataxia type 12 in a 52-year-old female

Ray Bose, Andrew Smith

This report describes a rare inherited brain condition called spinocerebellar ataxia type 12 (SCA12), caused by a change (cytosine-adenine-guanine [CAG] repeat expansion) in a gene called *PPP2R2B*. The condition affects balance, movement and sometimes memory or mood. Our patient, a 52-year-old woman of Indian background living in New Zealand, first developed tremors (shaking) that were mistaken for a more common disorder, before later developing problems with walking and speech. A brain scan showed shrinkage of parts of the brain that control co-ordination, and genetic testing confirmed the diagnosis. Although there is currently no cure, recognising this condition early helps patients and families access supportive therapies, understand the cause and receive appropriate genetic counselling.

From sore throat to facial vein thrombosis: a case of Fusobacterium necrophorum bacteraemia with a variant of Lemierre syndrome

Thanikknath S Corattur, Colin N Menezes

This report describes a man who developed a rare complication from a throat infection, or tonsilitis. Instead of the usual blood clot in the main neck vein (called the internal jugular vein), he had a clot in the facial vein, which is unusual and harder to detect. The infection was caused by a bacterium called *Fusobacterium necrophorum*, which can spread from the throat into the bloodstream and cause serious illness. He was treated successfully with antibiotics and did not need any blood thinning medication as there was no extension of his facial vein thrombus. This patient had a penicillin allergy, and this case also discusses the importance of assessing allergies appropriately.

Equity deferred is equity denied: cancer outcomes for Māori and Pacific peoples

Frank Frizelle

ABSTRACT

Persistent inequities in cancer outcomes for Māori and Pacific peoples remain one of the most significant challenges facing the Aotearoa New Zealand health system. These disparities are evident across incidence, stage at diagnosis, access to treatment and survival. While often attributed to behavioural risk factors, the predominant drivers are structural, including barriers to access, health system design, workforce limitations and broader socio-economic determinants. Despite long-standing recognition, progress has been inconsistent and insufficient. Addressing these inequities requires a shift from description to accountability, with equity embedded as a core performance metric. Culturally aligned services, improved access to care, strengthened primary care and the use of registry-based data to drive quality improvement are essential components of a system capable of delivering equitable outcomes. Comprehensive cancer centres could offer a further opportunity to reduce variation and improve access to high-quality multidisciplinary care. In parallel, screening policy must better reflect epidemiological realities, including the earlier onset of colorectal cancer among Māori. Equity in cancer care is fundamental to the definition of a high-performing health system. Without measurable progress, equity remains deferred—and therefore denied.

Cancer remains a leading cause of mortality in Aotearoa New Zealand, with approximately 25,000 new cancer diagnoses annually and a growing burden driven by population ageing.[1] However, this burden is not evenly distributed. Māori experience substantially higher cancer mortality than non-Māori, and Pacific peoples similarly experience poorer outcomes across a range of malignancies.[1] These inequities have been consistently documented over decades and remain a defining feature of the health system.

Equity is frequently articulated as a central objective of health policy in New Zealand, reflecting obligations under Te Tiriti o Waitangi and broader commitments to fairness.[2–4] Yet persistent disparities in cancer outcomes indicate that this objective has not been realised in practice. A health system that delivers high-quality care for some but not for all cannot be considered effective. Equity must therefore move beyond aspiration and become a measurable dimension of system performance.

Incidence, stage at diagnosis and survival

The scale of inequity is evident across incidence, stage at diagnosis and survival. Colorectal cancer alone accounts for about 3,500 diagnoses and more than 1,200 deaths annually in New Zealand, making it one of the leading causes of cancer mortality.[5] More broadly, cancer is one of the principal contributors to premature mortality, with Māori bearing a disproportionate share of this burden.[5]

Disparities in stage at diagnosis are particularly striking. Māori and Pacific peoples are significantly more likely to present with advanced disease, with 28% of Māori and 25% of Pacific patients diagnosed with distant metastatic disease compared with approximately 17–21% in other populations.[6,7] This difference in stage distribution has profound implications for treatment options and survival.

Colorectal cancer illustrates these inequities clearly. While overall incidence has been relatively stable or declining in older populations, early-onset colorectal cancer is increasing, particularly among Māori. Māori are more likely to develop colorectal cancer at younger ages, with approximately 18% of Māori cases diagnosed before age 50 compared with 8.5% in the overall population. Furthermore, more than half of colorectal cancers in Māori occur before the age of 60, compared with less than one-third in non-Māori populations.[6,8]

These epidemiological patterns expose a fundamental misalignment between disease burden and current screening policy. The national bowel screening programme, which begins at an older age threshold, fails to capture a substantial proportion of at-risk Māori. Lowering the screening age, particularly for Māori and Pacific populations, represents a necessary and evidence-based response to these disparities.

Importantly, inequities persist beyond stage at diagnosis. Survival differences remain even after adjustment for stage, indicating that disparities extend into access to treatment, quality of care and broader determinants. These findings confirm that inequity is embedded throughout the cancer pathway rather than confined to a single point.

Structural and behavioural determinants

Explanations for inequity often focus on behavioural risk factors such as smoking, diet and screening participation. While these are relevant, such framing risks obscuring the structural determinants that shape both risk exposure and access to care.[9]

Structural barriers are the dominant drivers of inequity.[9] Access to healthcare is influenced by geography, cost, transport and service availability, all of which disproportionately affect Māori and Pacific communities. Delays in accessing primary care contribute to later diagnosis, while fragmented referral pathways and inconsistent co-ordination further exacerbate delays.

Health system design also plays a role. Systems that assume high levels of health literacy and navigational capacity may disadvantage those who require additional support. Workforce factors are equally important. Limited representation of Māori and Pacific clinicians and variable cultural safety across services can affect communication, trust and engagement. Institutional bias may also influence clinical decision making and access to treatment.

Socio-economic determinants underpin many of these issues. Income, education and housing influence both exposure to risk factors and the ability to engage with healthcare. For example, higher rates of stomach cancer among Māori have been linked to structural factors such as overcrowding and *Helicobacter pylori* exposure, as well as broader socio-economic conditions.

Behavioural factors are therefore best understood as downstream effects of these structural conditions. Addressing inequity requires a primary focus on structural reform, supported by but not limited to behavioural interventions.

Access across the cancer pathway

Inequities are evident across the entire cancer pathway.[9] Preventive interventions have not achieved equivalent impact across populations, and disparities in screening participation persist. Delayed diagnosis remains a critical issue, with barriers to primary care access contributing to missed opportunities for early detection.

Once cancer is suspected, access to diagnostic services such as imaging and endoscopy can be variable. These delays contribute to the higher proportion of advanced disease at presentation among Māori and Pacific patients. Treatment inequities are also evident, with differences in access to surgery, systemic therapy and radiotherapy observed even after adjusting for clinical factors.

In this context, the development of comprehensive cancer centres offers a potential mechanism to reduce variation in care and improve outcomes.[10] By integrating multidisciplinary expertise, advanced diagnostics, surgical services and systemic therapies within coordinated pathways, such centres can standardise care delivery and support adherence to best practice. They also provide a platform for research, training and quality improvement. For Māori and Pacific patients, comprehensive cancer centres may improve access to high-quality care, particularly when supported by effective outreach, navigation services and strong links with regional providers. However, centralisation must be accompanied by investment in transport, accommodation and community-based services to avoid exacerbating existing barriers.

Post-treatment care and survivorship services similarly require attention. Equitable access to follow-up care, rehabilitation and palliative services is essential to improving both survival and quality of life.

Culturally aligned care

Culturally aligned healthcare is central to achieving equitable outcomes. Services that reflect the values and needs of Māori and Pacific peoples are more likely to be acceptable and effective. Whānau-centred approaches recognise the importance of collective decision making and support, while navigation services can assist patients in engaging with complex health systems.

Community-based service delivery can reduce barriers to access and enhance trust. Workforce development, including increasing Māori and Pacific representation and ensuring cultural safety across all services, is critical. These approaches must be embedded within mainstream care rather than treated as peripheral initiatives.

Data, registries and system performance

Robust data systems are essential for understanding and addressing inequity. National cancer registries provide critical information on incidence, treatment and outcomes, while clinical quality registries enable benchmarking and continuous quality improvement. The value of screening programmes in improving stage at diagnosis and survival is well established, with earlier detection associated with significantly improved outcomes.[11]

However, data must be actively used to drive change. Equity metrics should be incorporated into performance frameworks, with disparities monitored and addressed. Registry-based approaches, providing risk-adjusted outcomes and real-time feedback, offer a powerful tool for identifying variation and supporting improvement.

Accountability and the path forward

A key barrier to progress is the lack of clear accountability. While equity is widely acknowledged as a priority, it is often not linked to measurable targets or consequences. A shift is required towards explicit goals for reducing disparities in cancer outcomes, supported by transparent reporting and performance management.

This includes aligning screening programmes with population risk, improving access to primary care, investing in culturally aligned services, strengthening data infrastructure and developing the workforce. These actions are well recognised; the challenge lies in implementation and sustained commitment.

Conclusion

The inequities in cancer outcomes for Māori and Pacific peoples represent a fundamental test of the New Zealand health system. They reflect systemic issues that have persisted despite longstanding recognition. Addressing them requires structural reform, culturally aligned care and robust accountability.

Equity must be understood as a core dimension of quality. A system that fails to deliver equitable outcomes cannot be considered high performing. The continued existence of disparities in cancer outcomes is therefore a reflection of system performance as much as clinical care.

Progress will require leadership and a willingness to act on evidence. This includes lowering the age of colorectal cancer screening to reflect earlier onset in Māori, investing in comprehensive cancer centres to reduce variation in care and ensuring that services are accessible, culturally appropriate and accountable for outcomes. Equity deferred is, in effect, equity denied. The imperative now is to move from recognition to measurable and sustained improvement.

COMPETING INTERESTS
Frank Frizelle is the Editor in Chief of the *New Zealand Medical Journal*; President CSSANZ; Chair PCOR ANZ (prostate cancer registry); Deputy Chair BCOR ANZ (bowel cancer register); Chair Christchurch Cancer Foundation; Board Member Southland Charity Hospital.

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Health benefits of the HIKO e-bike programme: a qualitative study

Emma Osborne, Cheryl Davies, Caroline Shaw

ABSTRACT

AIMS: This paper aims to explore the relationship between e-biking and health in the context of a novel, marae-led e-biking programme for Māori and Pacific adults in a suburban community.

METHODS: Focus groups were conducted with participants in an e-biking programme (n=20) prior to receiving e-bikes, and individual interviews were conducted with participants at approximately 6 months (n=23) and 12 months (n=22).

RESULTS: Wanting to improve health was a motivation for trying e-biking. E-biking supported better physical and mental health, including self-reported improvement in a range of long-term conditions. E-biking was often possible and enjoyable for people who experienced barriers to physical activity, although poor health could also act as a barrier to e-biking. Factors that supported ongoing e-biking included having someone to ride with, the enjoyable nature of e-biking, and integrating e-biking for active travel.

CONCLUSIONS: This study suggests that e-biking is possible and beneficial for a wide range of people who do not currently cycle. Recommendations from individual health practitioners are likely to be important alongside community and population level interventions to support the uptake of cycling. Practice points to support individual health practitioners to discuss e-biking are provided.

Increasing physical activity (PA) is one of the most effective approaches to improve population health. Higher levels of PA are associated with a wide range of positive outcomes for both physical and mental health. These outcomes include a range of cancers, cardiovascular disease, diabetes, osteoarthritis and depression.[1–3] PA not only reduces disease incidence and mortality, but also improves quality of life (for example, through reductions in pain and severity of depressive symptoms).[1]

There has been a range of approaches to increasing PA over recent decades (e.g., through policy frameworks such as Healthy Eating – Healthy Action, through the establishment of organisational infrastructure such as Healthy Families NZ, through Sport New Zealand), and increasing PA remains a priority of the current government.[4] Despite this, population PA has consistently declined. New Zealand Health Survey data show that in 2011/2012 54.4% of adults had sufficient levels of PA, however by 2023/2024 this had reduced to 46.6%,[5] and Ministry of Health – Manatū Hauora officials expect this to decrease further.[6] Due to the dose-response association between PA and health, even those considered to have sufficient levels of PA in the New Zealand Health Survey definition would still experience health benefits from becoming more active.[2,3]

Cycling, particularly for transport (e.g., to work, to shops), has significant potential to increase population PA.[7] Most people travel every day, and the way people travel tends to be highly habituated, meaning change may be more sustainable than more effortful forms of PA such as going to the gym or playing sport. Moreover, transport-related PA does not displace other forms of PA, thus increasing total PA.[8] Cycling for transport is currently uncommon in Aotearoa New Zealand, although historically that has not been the case.[9] The barriers to cycling, particularly for transport, are well understood.[10] Furthermore, these barriers are amenable to policy interventions, as evidenced by multiple examples of increases in cycling globally in recent years.[11]

Given the topography, weather and (lack of) urban density of Aotearoa New Zealand, e-bikes are likely to be required to substantially increase population levels of cycling. In terms of individual health benefits, a recent systematic review found that e-bikes provide moderate PA similar to activities such as recreational lap swimming and slow running.[12,13] There is also evidence that people ride for longer distances on e-bikes than on regular bikes.[14] As well as direct health benefits to individuals,[15] there other potential social, economic and health benefits from higher levels of cycling (both electric and non-electric) in the community. These include reductions in air pollution, overall (net) burden of transport-related injury,

greenhouse gas emissions, travel time, car ownership and costs of road maintenance.[16–19]

Despite the potential health benefits there is limited qualitative research on how people experience e-bikes from a health perspective. The international research has mainly been in specific patient groups, for example diabetics, women being treated for breast cancer, people who are physically inactive and people with high BMI.[20–23] By and large these small studies all suggest e-biking could have a role in supporting people who may find it challenging to be physically active. For example, women being treated for breast cancer considered e-biking an acceptable and enjoyable form of activity. E-biking overcame health related barriers such as fatigue from treatment as well as the more traditional cycling barriers that e-bikes overcome (e.g., feeling safer in traffic because of the speed of e-bikes).[23] McVicar et al. recruited participants who were physically inactive and had a BMI between 28 and 38. They found that participants cycled an average 50km a week on their loaned e-bikes and noted improvements in physiological markers such as diastolic blood pressure.[22]

There is a small body of literature from Aotearoa New Zealand about e-bikes, which have focussed mainly on how e-bikes could support cycling in groups with traditionally lower levels of cycling.[24,25] Neither of these papers specifically considered health, although participants in one of these studies (an e-bike loan pilot project in Māngere, South Auckland) highlighted the mental and physical health benefits of their riding.

The purpose of this paper is to explore the effects of e-biking on physical and mental health in an e-bike pilot programme in a Māori community. This work is part of research component of an e-bike pilot programme that ran in 2023/2024.[26] While another paper covers the outcomes of the programme more generally,[27] this one specifically focusses on physical and mental health.

Methods

HIKO is an e-bike support programme in Wainuiomata, Wellington Region, which is operated by a marae-led Māori health and social service provider. HIKO participants were recruited through the networks of this organisation. The programme co-ordinator identified potential participants who were likely to make use of and benefit from e-biking. Participants were not recruited in their role as patients and nor were they recruited for specific health conditions. Ethical approval was granted by the University of Otago Human Ethics Committee (22/127).

HIKO participant inclusion criteria were:

- Māori or Pacific peoples
- Aged 16+
- Living in Wainuiomata
- Having a secure place to store an e-bike
- Not currently cycling on a regular basis

An exclusion criterion was having a health condition that would prevent a participant from cycling safely.

Participants were given the long-term loan of an e-bike and wrap-around support for riding, including cycling skills training, mechanical support and equipment for safe e-biking (helmet, pannier, lock, high-visibility gear and, where requested, a handlebar mirror). Focus groups were conducted with HIKO participants prior to their receiving e-bikes, then participants were interviewed individually at approximately 6 months and 12 months. Focus groups were conducted in person at two marae and began with mihimihi and whakawhanaungatanga (welcome and relationship building). Focus groups concluded with kai (food) to take away (a modified approach due to COVID-19 considerations). The audio recorded portion of the focus groups took between 36 and 47 minutes. Interviews were conducted both in person and by phone, according to participants' preferences and availability. Interviews lasted between 17 and 58 minutes. All authors were involved in facilitating the focus groups (with 2–3 facilitators for each group), and the first author conducted the 6- and 12-month interviews.

Focus groups explored current travel patterns, perceptions and past experiences of cycling, and anticipated e-bike use, barriers and benefits of e-biking. Interviews explored experiences of e-biking, barriers, benefits and facilitators of e-bike use, and perceptions of the HIKO programme (full focus group and interview guides available in Osborne et al.[26]). While the HIKO programme is ongoing, this study focusses on the first 12 months of its operation. All participants in the first 12 months of the HIKO programme were invited to participate in this research, and all participants took part in at least one interview or focus group.

We analysed the data using a qualitative, pragmatist approach.[28] The first author coded the overall dataset using an inductive approach, with all three authors meeting regularly to discuss the

analysis. For this paper, we identified participants' accounts of the relationship between biking and physical/mental health as an area of interest then selectively revisited and described parts of the dataset relating to these topics of health. We have presented these findings using intervention-oriented thematic sentences,[29] with a view to framing the participants' accounts of the relationship between e-biking and health in ways that may be usable in health professional practice.

Results

Participants

Of the 26 HIKO participants, 20 participated in the focus groups, 23 in the 6-month interviews and 22 in the 12-month interviews. Participants ranged in age from 16–69, 36% were men and 64% women. All participants identified as either Māori (90%) and/or Pacific peoples (19%), with 19% of participants also identifying as New Zealand European and 5% as Chinese (some participants identified multiple ethnicities).

Anticipated health gains motivated people to try e-biking

Wanting to improve health was a major motivation for trying e-biking. Several participants described the programme co-ordinator who recruited them to take part in HIKO as being familiar with their personal health goals (e.g., quitting smoking, weight loss, being more active) and challenges (e.g., pain, depression, limited mobility). This relational approach, which centred participants' goals in the recruitment process, was important for participants' openness to considering an unfamiliar activity such as e-biking as potentially being a good fit for their health needs: "*to get motivated like I did, yeah, and to lose weight …* [project co-ordinator] *is amazing, you know, always thinking about the whānau … even to offer us to be part of the research. I was really blown away when she said to me, would you like an e-bike?*" (Participant 8). Many participants commented that they had not cycled for many years and had no prior experience with e-bikes either personally or through friends/whānau. Other participants had biked occasionally, particularly through occasional recreational rides with children.

Prior to receiving the e-bikes, participants anticipated that e-biking could contribute to better overall physical and mental wellbeing and could support specific health goals, including motivating quitting smoking: "*I'm hoping the biking will just give me enough of a cough attack to want to stop*" (Focus group 2), or losing weight: "*I'd like to lose some weight and yeah, better quality of life*" (Focus group 1). They also viewed e-biking as potentially being a way of staying active in middle and older age: "*knees are just about shot, so this is some ways to keep that momentum going without thrashing your body too much*" (Focus group 3). Several participants described e-biking as an activity which would not aggravate "*old age injuries*", particularly hip, back and knee pain, in the way that some higher-impact activities did. One participant anticipated that e-biking could mitigate incontinence as a barrier to being active (less stress on bladder compared to walking, being able to get to a toilet more quickly). Other anticipated health benefits of e-biking were role modelling a healthy and physically active lifestyle for whānau: "*For Māori and Pasifika … we're role modelling for our kids, our tamariki and our mokopuna*" (Focus group 1).

E-biking had a wide range of health benefits

In follow up interviews at 6 and 12 months, participants described e-biking as leading to better mental and physical health both overall and in relation to a range of chronic health conditions: "*There's been so many other wins with getting out and being active … the weight loss and my diabetes, my gout. Being able to manage my health*" (Participant 15). This description of e-biking as contributing to multiple health outcomes including ability to make further changes to take care of one's health is characteristic of the way many participants described e-biking. Participants often characterised the mental health benefits of being active and being outdoors as particularly significant: "*It's just where you have a moment in time where you are not thinking about work, not thinking about problems of the world … obviously you get the physical benefits but … it's what it does for me mentally*" (Participant 6). Across all participants, self-reported improvements in health included mental health/depression, joint pain/osteoarthritis (particularly hip and knee pain), type 2 diabetes, gout, hypertension, insomnia, perimenopause and asthma and other respiratory conditions. These self-reported improvements in these chronic conditions are consistent with established benefits of increasing levels of moderate PA.[1,30–32] Participants also described e-biking as supporting other aspects of a healthy lifestyle, including weight

loss or maintaining a stable weight, providing an incentive to make dietary changes and building fitness to engage in more vigorous PA. Several participants described e-biking as part of their planned or successfully implemented strategy for quitting smoking: "*I gave up smoking without putting on weight …* [e-biking has] *introduced a healthier lifestyle and a way to get rid of your cravings … instead of chocolate or lollies or food*" (Participant 12). Participants described e-biking as supporting smoking cessation through several mechanisms: displacing cravings, disincentivising smoking as it made cycling harder, and as a way of not gaining weight while quitting.

E-biking was possible and enjoyable for people who experienced barriers to being active

Several HIKO participants who experienced health- or weight-related barriers to being active described e-biking as an achievable and enjoyable form of PA. E-biking was described as well-suited to the needs of older riders, "bigger" riders and people with chronic conditions, especially joint pain: "*I'm an old lady, so if I can do it anyone can do it, and it's good for my arthritis*" (Participant 12). A number of participants recounted times earlier in their lives where they had been very active, but had stopped after injuries or illnesses, which had led to weight gain, which made it harder to resume being active: "*I did use to ride* [a non-electric bicycle] *to work … but then I did my Achilles in and then that was the end of it. I just got bigger and bigger and bigger and decided then I wasn't going to cycle because I was too big*" (Participant 25).

As a manageable form of PA, e-biking disrupted this "vicious circle"[33] of barriers to being active: "*I'm sort of, like, a bit of a big unit so, walking up the hill is a bit of a, it's more of a challenge for me, and the bike has made it a lot easier*" (Participant 18). While participants described e-bikes as overcoming physical barriers, some participants experienced whakamā (shame, embarrassment) associated with exercising in public as a bigger person. However, having a group in the same community riding together helped to reduce whakamā as a barrier to riding.

The HIKO e-bikes were set up to meet the needs of diverse riders. Step-through frames and handlebar mirrors made bicycle handling easier, which supported participants' confidence in cycling. In response to participant feedback during the early stages of the programme, mirrors were sourced for the e-bikes. Mirrors made the experience of cycling more like driving: "*you could see the traffic behind you in the mirror. You could see as if you were driving a car*" (Participant 9). These features were especially useful for participants who had a limited range of motion or impaired balance. One of the models of e-bike included in HIKO was selected for having a higher rider weight limit, and participants were provided with comfortable saddles as a default option. The HIKO programme also included training for participants through an accredited provider, which included techniques for easier bike handling.

Health could occasionally be a barrier to e-biking

Poor health or (non-cycling related) injuries were also a barrier to e-biking for some participants. Two participants stopped riding because of events (stroke, injuries from a fall) which impacted their balance and grip, and thus their ability to ride safely. Other participants described respiratory illnesses, combined with environmental triggers such as cold weather or air pollution, as barriers to cycling: "*I hated riding a bike during peak hour because of the car fumes. They wreak bloody havoc on the asthma*" (Participant 6). One participant described a range of symptoms associated with menopause as a barrier to riding, including heavy bleeding and increased sensitivity to cold weather. Other than long-term respiratory conditions, the health conditions that prevented participants from riding were largely unexpected, emergent issues over the e-bike loan period. In addition to personal illness, some participants also described caregiving commitments as a barrier to e-biking as much as they wished: "*I'm a full-time caregiver for my sister who has Alzheimer's. So, if I do go out, I usually have to take her in the car but if I don't have to take her then definitely, I'd opt for the bike*" (Participant 25). However, participants with caregiving responsibilities also described the riding they were able to do as particularly restorative and as an important break from caregiving work.

E-biking was fun, social and sometimes practical, which supported continuing to be active

Maintaining consistent levels of PA is challenging; however, people are more likely to persist with activities which are enjoyable and supported by others.[34] Incidental PA through active travel also supports overall levels of PA.[8] As in other qualitative studies examining enjoyment of e-biking,[35,36]

participants described e-biking as enjoyable because it could be done with others, was outside, was moderately but not overly challenging and it facilitated adventures in participants' communities. Some participants compared e-biking favourably with other low-impact activities such as aqua-jogging or using a stationary bike, which were seen as less interesting and therefore harder to sustain: "*I don't want to sit in a gym … I don't want to walk on a treadmill. I need something that's going to be interesting … How can you get bored when every bike ride is different?*" (Participant 2).

For many participants, having someone to ride with recreationally was an important aspect of persisting with e-biking. Some participants established regular social e-biking groups, and others e-biked regularly with a friend or whānau member. E-biking meant that people with different levels of fitness or ability could ride together comfortably at the same pace by using different levels of assistance: "*It didn't matter what your fitness levels were, if you knew how to ride your bike and you used the right power level we could stay together*" (Participant 9). This inclusive approach of people with different skills being able to ride together was consistent with participants' values: "*forming a rōpū* [group] *that is all about manaaki* [care], *all about non-judgemental stuff*" (Participant 6). This emphasis on supportive social connections, manaakitanga and whānau is consistent with existing literature on preferred ways of being physically active (including cycling) for Māori and Pacific peoples.[34,37,38] Participants also e-biked with others (especially children) who were using non-electric bikes or scooters. Having someone else to ride with (friend, family or riding group) helped to maintain motivation for e-biking over the year. Conversely, a few participants who stopped e-biking during the year commented that not having someone to ride with was a barrier to e-biking.

Participants who used their e-bikes for transport cycling (e.g., commuting, running errands, visiting friends and family) appreciated integrating incidental PA into their daily routines: "*You don't have to find extra time and you get a bit of mental health in there. You get a bit of physical health in there and you're getting to work*" (Participant 21).

Discussion

Summary of findings

We have described participants' accounts of the relationships between health and e-biking in the HIKO programme. Seeking to improve one's health was a key motivation for initially trying e-biking, and participants described a range of ways their physical and mental health had improved as a result of e-biking in the 6- and 12-month interviews. These benefits included improved mental wellbeing, managing long-term conditions, reducing pain and supporting smoking cessation. E-biking was generally an accessible and enjoyable form of PA for people who experienced health-related barriers to exercising, and e-bikes could be set up to accommodate different individual requirements. However, some participants also found that poor health, particularly unexpected illness or injuries, could be a barrier to e-biking. Participants who continued to e-bike throughout the year identified a combination of enjoyment, social connections and utility of e-biking for short trips as factors that supported them to persist with a new activity.

Implications for policy and practice

Encouraging e-biking has promise as an effective and sustainable way to increase PA and harness associated health and wider economic and social benefits for individuals and wider society.[16,17,39] Health professionals are likely to have an important role in recommending e-biking for their individual patients: people in this study were willing to take up e-biking when it was suggested as suitable for their personal situation by someone who was familiar with their health needs. We have included practice points below (based on the results of this study and/or other literature) for health professionals when thinking about advising people on e-biking for PA.

Individual health professional recommendation alone will not achieve the higher levels of uptake and use of e-bikes (and bikes) needed to increase population PA.[7,43–45] Policy is needed in two key areas to support uptake and use of e-bikes. This would include, firstly, addressing the lack of safe infrastructure to cycle on and, secondly, targeted e-bike support packages. Networks of high quality, safe infrastructure (a combination of cycle paths and low traffic neighbourhoods) have been shown to increase cycling and walking in urban areas.[46,47] E-bike support packages would aim to increase low-cost access to e-bikes (e.g., through loans, subsidies, etc.) and provide additional support such as training, mechanical support and group rides. This more holistic support was essential to the success of both HIKO and a pilot in South Auckland,[25,26] recognising that in low-income, low-

Table 1: Practice points for health professionals advising individual patients.

Who could benefit from e-biking?
• E-biking is both possible and enjoyable for people who would not be willing to ride a non-electric bike.[25]
• E-biking provides moderate physical activity.[12]
• E-biking is associated with a range of self-reported improvements in physical and mental health and wellbeing, consistent with the literature on increasing physical activity.
• E-biking may be especially well suited to the needs of people with long term conditions, including joint pain.[15,21,23]
• The electrical assistance can also enable bigger people to ride comfortably.[15,20,22]
• E-biking is suitable for and enjoyed by older people.[22,40,41]
What do people need to take up and maintain e-biking?
• Social support: for many people, having someone to ride with is important. This could be achieved by riding with a family member or a social cycling group. The electrical assistance provided by e-bikes means that people with lower levels of fitness can cycle at the same pace as friends and family members.
• E-bike selection and set-up: e-bikes have different frame shapes and sizes, and they can be customised to meet individual needs (e.g., fitting mirrors or changing contact points such as pedals, seats and grips).
• Cycle skills training: bike-handling and on-road–skills training may be useful for people who wish to start cycling. Accredited cycle-skills training is available across the country, often at no cost.[42]

cycling communities there are multiple barriers to cycling. This kind of support package should be targeted towards those who would benefit most, for example through green prescriptions and community service card users.

Conclusion

For participants in the HIKO e-bike programme, improving health and modelling healthy behaviours for whānau were motivators to consider and initiate an unfamiliar activity. Once started, the subjective health benefits in a wide range of conditions were a motivator to continue. Moreover, e-biking was suitable for individuals who would not consider non-electric cycling and who had physical health issues that prevented other forms of PA. The role of trusted leaders (e.g., health professionals) in suggesting e-biking as a suitable form of PA was important. However, to improve PA on a larger scale, individual recommendations by health professionals would need to be accompanied by policy and infrastructure to support cycling.

COMPETING INTERESTS
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Statin use in patients with coronary atheroma identified on computed tomography coronary angiography: current practice in South Auckland, New Zealand (ANZACS-QI 82)

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ABSTRACT

AIM: Computed tomography coronary angiography (CTCA) is a sensitive tool for the diagnosis of atherosclerotic coronary artery disease (CAD). The study aim was to determine whether the finding of coronary atheroma on CTCA was associated with the subsequent use of statin therapy.

METHODS: Patients with chest pain who underwent CTCA in 2020–2021 were identified from the Aotearoa New Zealand All Cardiology Services Quality Improvement (ANZACS-QI) cardiac computed tomography (CT) registry at Middlemore Hospital, Auckland, New Zealand. Patients were categorised into three groups: no atheroma, atheroma with non-obstructive CAD and atheroma with obstructive CAD.

RESULTS: There were 548 patients with acute chest pain and 746 with stable chest pain. Of those with acute chest pain, no atheroma, non-obstructive and obstructive CAD was documented in 37.2%, 38% and 24.8%, respectively. In patients with obstructive CAD, statin dispensing was 52.9% pre-admission, 92.6% early post-CTCA and 87.5% at 1 year. In those with non-obstructive CAD, statin dispensing was 45.7% pre-admission, 67.8% early post-CTCA and 59.6% at 1 year. In those without atheroma, statins were dispensed in 23.5% at pre-admission and in 28.9% at 1 year. In the stable chest pain cohort, patterns of statin dispensing post-CTCA were similar to those in the acute chest pain cohort. On multivariate regression the presence of atheroma both with/without obstructive CAD was associated with higher levels of statin dispensing.

CONCLUSION: The finding of atheroma with obstructive CAD on CTCA is associated with appropriate increases in statin use. There are opportunities to optimise care by greater statin utilisation in non-obstructive CAD and down-titration in those without atheroma.

Computed tomography coronary angiography (CTCA) has a high accuracy for the diagnosis of coronary atherosclerosis and is strongly endorsed by international guidelines in the assessment of chest pain syndromes.[1,2] CTCA can non-invasively identify the extent of obstructive coronary artery disease (CAD) with comparable effectiveness to invasive coronary angiography.[3] Moreover, CTCA also detects coronary atherosclerosis in the absence of obstructive CAD. The finding of any anatomic evidence of atherosclerosis is an independent predictor of adverse cardiovascular events even after adjusting for known cardiovascular risk factors.[4] Its presence is an indication for more intensive prevention, including use of statin medications to reduce low-density lipoproteins (LDL) cholesterol.[5] Atherosclerosis associated with obstructive CAD is a well-established indication for statin therapy. Observational studies also suggest that statin therapy in patients with CTCA evidence of atherosclerosis but without obstructive CAD is associated with improved outcomes.[6,7]

With the more routine use of CTCA in the investigation of chest pain there is an opportunity to better target lipid-lowering therapy according to whether or not a patient has coronary atherosclerosis. We have recently implemented a CTCA registry within the Aotearoa New Zealand All Cardiology Services Quality Improvement (ANZACS-QI) programme. The registry is linked with national administrative datasets to track statin dispensing. We therefore have an opportunity to assess whether CTCA finding of coronary atherosclerosis, both with or without obstructive CAD, is associated with changes in the subsequent use of statin therapy.

Methods

Study cohort and data collection

The study cohort was identified from the ANZACS-QI cardiac computed tomography (CT) registry at Middlemore Hospital, Auckland, New Zealand. The ANZACS-QI cardiac CT reporting tool generates a structured clinical report while simultaneously collecting an audit and a research-enabled dataset. The reporting tool is incorporated in the national ANZACS-QI web-based platform.[8] Patient demographics, cardiovascular risk factors and CT findings are captured in this registry, and the de-identified study cohort was linked to national datasets to track the use of statins in patients with chest pain who underwent CTCA, from initial dispensing 6–12 months prior to CTCA to subsequent maintenance up to 9–12 months post-CTCA.

For this study, at least a year of post-CTCA follow-up time was required. Therefore, the study cohort included consecutive patients who underwent CTCA at Middlemore Hospital for investigation of chest pain syndrome from 21 September 2020 to 31 December 2021 in both acute inpatient and outpatient settings. The inpatient cohort comprised patients presenting to hospital with acute chest pain in whom myocardial infarction (MI) was ruled out, and the outpatient cohort comprised those with stable chest pain who had been referred to the cardiology clinic for evaluation. Only the first CTCA for each patient in the time period was used. Medication dispensing data were obtained by individual linkage to routine national datasets, as previously described.[9,10] Data on LDL cholesterol, coronary angiography, percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG) were obtained through linkage to national datasets. 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), was used to link de-identified ANZACS-QI cardiac CT patient records to the national datasets. The encryption and linkage methodology has previously been described.[8–10]

Variables used for this study included age, gender, ethnicity, diabetes, smoking status, family history of cardiovascular disease (CVD), hypertension and LDL cholesterol within 3 months before CTCA. Patients were grouped into those with or without coronary artery atheroma using the segment involvement score (SIS). The SIS score is determined on CTCA by designation of a score of 1 for each one of the coronary artery segments with a detectable atherosclerotic coronary plaque, irrespective of the plaque size or individual plaque burden in that segment.[11,12] In this study, presence of coronary atheroma was defined as a SIS score of 1 or more, and categorised as 0, 1, 2–3 and ≥4 segments.[7] Patients with coronary atheroma were further divided into those with obstructive CAD (defined as ≥50% reduction in the luminal diameter of a major coronary artery) and without obstructive CAD (<50% diameter stenosis).[13]

Predictors of statin dispensing within 3 months post-CTCA was assessed. Sociodemographic variables were derived from the linked national dataset. For patients with more than one ethnic group recorded, ethnicity was prioritised in accordance with health sector protocols, in the following order: Indigenous Māori, Pacific, Indian, and NZ European/Other.[14] Socio-economic deprivation was assessed by the New Zealand Index of Deprivation 2018 (NZDep2018) score, a census-based small-area 10-point index of deprivation based on the person's domicile.[15]

Linkage of the ANZACS-QI CT registry and national datasets has been approved by the National Multi Region Ethics Committee (MEC07/19/EXP) and Auckland Health Research Ethics Committee (AHREC AH26614).

Statistical analysis

Categorical variables were summarised as frequency and percentage and continuous variables as mean and standard deviation (SD) or median and interquartile range (IQR). Comparisons between those with atheroma and those without were made using Pearson's Chi-squared test for categorical data and the Mann–Whitney U test for continuous data as it is not normally distributed. All tests of statistical significance were two-tailed and a p-value <0.05 was considered statistically significant.

For regression analysis, multivariate (modified) Poisson regression models with robust error estimates were used to estimate the relative risk (RR) with a 95% confidence interval (CI) and associated p-value for variables associated with statins dispensed within 3 months post-CT. Variables included in the model were whether patients had atheroma, age, gender, ethnicity, NZDep2018, current smoker, hypertension and diabetes. A two-sided p-value of less than 0.05 was considered to indicate statistical significance.

Data were analysed using SAS version 9.4 (SAS Institute, Cary, North Carolina, United States of America).

Results

Study cohort

Between 21 September 2020 and 31 December 2021, there were 1,294 patients who underwent CTCA and had at least a year of available follow-up. Five-hundred and forty-eight patients had CTCA as an inpatient and 746 patients underwent CTCA in the outpatient setting. Table 1 summarises the clinical characteristics of the cohort.

Acute chest pain cohort

The mean age of the patients was 56.1±11.5 years and 287 (52.4%) were men (Table 1). Of the 548 consecutive patients, 204 (37.2%) had no atheroma, 208 (38.0%) had non-obstructive CAD and 136 (24.8%) had obstructive CAD. There were more men in the sub-groups with CAD and they were older compared with those with no atheroma. Hypertension and diabetes were more frequent in the CAD sub-groups. Of the 136 patients with obstructive CAD, 87 (64%) patients underwent invasive coronary angiography within 2 weeks after CTCA. Thirty-eight (27.9%) patients subsequently had inpatient revascularisation (PCI or CABG) within 2 weeks post-CTCA.

Table 2 shows the initial statin dispensing and maintenance over the year post-CTCA. Of the 548 patients, 52.9% of those with obstructive CAD, 45.7% with non-obstructive disease and 23.5% with no atheroma were on a statin pre-CTCA (p<0.001, Figure 1). Within 3 months post-CTCA, 92.6% of those with obstructive disease and 67.8% with non-obstructive disease were on a statin compared to 33.8% for those with no atheroma (p<0.001). More than 80% of those with obstructive CAD were continued on a statin up to 9–12 months post-CTCA compared with only 59.6% of those with non-obstructive CAD, and 28.9% with no atheroma. Statin use pre- and post-CTCA in those without obstructive CAD also did not differ significantly according to SIS score (Appendix Table 1).

Multivariate regression (Table 3): After adjustment for demographic and cardiovascular risk factors, patients with obstructive CAD were twice as likely to be prescribed statins within 3 months post-CTCA (RR 2.19, 95% CI 1.76–2.71) and the finding of non-obstructive CAD was associated with 55% higher statin dispensing within 3 months post-CTCA (RR 1.55, 95% CI 1.25–1.94). Other variables independently associated with higher statin dispensing were hypertension, male gender, older age and Indian ethnicity.

Stable chest pain cohort

The clinical characteristics of patients who underwent CTCA as outpatient were shown in Table 1. The mean age was 58.6±10.5 years, and 47.5% were men. More than half of the patients (n=454, 60.9%) had atheroma on CTCA and obstructive disease was identified in 140 (30.8%) patients. Those with and without obstructive CAD were younger (p<0.001) and had more cardiovascular risk factors compared with those with no atheroma. There were more men, Māori and Pacific people in the CAD group compared with the no atheroma group. Fifty-eight (41.4%) out of 140 patients with obstructive disease underwent invasive angiography and 36 (25.7%) subsequently had revascularisation (PCI or CABG) within 6 months post-CTCA.

Statin dispensing before and after CTCA is described in Table 2 and Figure 2. Statin dispensing increased in the three groups within 6 months pre-CTCA. Statin dispensing decreased in the no atheroma group post-CTCA, whereas there was a significant increase in statin dispensing in the obstructive disease group 3 months and up to 9–12 months post-CTCA (p<0.001). There was no significant change in statin dispensing in the non-obstructive disease group post-CTCA. Within the group without obstructive CAD there was higher use of statins post-CTCA in those with a greater extent of atheroma (SIS 1: 49.5%; SIS 2–3: 70.3%; SIS ≥4: 66.7 [p=0.002]) (Appendix Table 1).

Multivariate regression (Table 3): The finding of atheroma with and without obstructive disease on CTCA after adjustment for demographic and cardiovascular risk factors was associated with higher statin prescribing within 3 months post-CTCA (without obstructive disease: RR 1.80, 95% CI 1.49– 2.16; with obstructive disease: RR 2.14, 95% CI 1.75–2.62). Other variables independently associated with higher statin prescribing were hypertension, diabetes and older age.

Discussion

In this cohort of symptomatic patients referred for CTCA, over two-thirds have evidence of coronary atherosclerosis. The CTCA finding of atherosclerosis with obstructive CAD was associated with appropriate initiation and maintenance

of statin dispensing. In those without coronary atherosclerosis, statin dispensing fell towards baseline levels after increasing prior to CTCA. However, around a quarter of these patients continued a statin despite the documented absence of atheroma. Just over a third of the cohort had atheroma documented but without obstructive CAD. The use of statins in this sub-group was intermediate between those with obstructive CAD and those with no atheroma. After adjustment for available covariates, the presence of atheroma was strongly associated with statin dispensing in patients with obstructive and non-obstructive CAD.

Statin use in patients with no atheroma

Subsequent atherosclerotic CVD event rates are very low in asymptomatic and symptomatic patients with calcium score of zero, and in primary prevention a calcium score of zero is used to reclassify patients with intermediate CVD risk estimated using traditional risk factors as lower risk.[16–18] Because coronary atheroma is the precursor pathological lesion to coronary calcium, the absence of atheroma would be expected to confer a very low risk. In a Danish registry of patients studied with CTCA for suspected CAD, those with no CAD had a low rate of all-cause mortality or MI (4.13/1,000 patient years).[19] It is likely that many of these patients will have non-cardiac chest pain. However, this group will also include some patients who have ischaemia without obstructive disease. In patients with known non-coronary atherosclerotic CVD, familial hypercholesterolaemia and very high CVD risk estimated from traditional risk factors, continuation of statins may still be considered appropriate.

Statin use in patients with non-obstructive CAD

In our cohort, more than 60% of patients with non-obstructive CAD were dispensed a statin post-CTCA. This finding was similar to the recently published meta-analysis[20] where CTCA resulted in higher statin prescriptions, and the rate of statin dispensing is higher than in prior published series where rates were around 50%.[19,21,22] Neither current primary prevention nor secondary prevention guidelines contain recommendations for medical therapy in patients with non-obstructive CAD beyond traditional cardiovascular risk factors. Several recent observational studies have reported a benefit of statins in patients with non-obstructive CAD.[7,19] A large Danish registry of patients with suspected CAD found a graded relationship between the burden of CAD measured by coronary calcium score (CCS) and CVD outcomes. After adjustment for covariates, the use of statins was associated with improved outcomes even in those with either no CAD or mild non-obstructive CAD with CCS 0–99.[19] However, in that study only a third of patients with mild CAD received a statin and unmeasured confounders may have influenced the results.

Multiple observational studies have shown that the direct demonstration of atherosclerosis on coronary imaging studies is a strong predictor of subsequent atherosclerotic CVD events. The burden of atherosclerotic disease can be reported using CCS or the SIS score. The presence of any atheroma or coronary calcium is associated with increased CVD risk but there is a graded increase in risk with increasing disease burden.[7,23] Statins are clearly indicated in patients with extensive CAD documented by high CCS or SIS scores in whom CVD risk is in the range seen for those with known clinical atherosclerotic CVD. In the Multi-Ethnic Study of Atherosclerosis (MESA),[17,23] a CCS score >300 confers an absolute 10-year hard CVD event rate of over 15%. Even intermediate CCS scores of 100–300 were shown to confer a >7.5% 10-year risk in all the demographic sub-groups studied—the risk threshold endorsed for considering statin initiation in the American College of Cardiology/American Heart Association (ACC/AHA) cholesterol and prevention guidelines.[5] This threshold is similar to the >5% all CVD 5-year risk threshold endorsed in the New Zealand guidelines.[24]

It is, however, less clear what to recommend for those with a lesser extent of disease, in whom the absolute increase in risk may be small.[4] While guidelines have endorsed the use of CCS to re-stratify risk in those with intermediate risk estimated using the traditional risk factors, there is no guidance about what to do with the finding of atheroma on coronary imaging. Multiple studies have shown that the addition of CCS to traditional risk factors improves risk prediction,[25] and it is likely that when atheroma volume is small, the combination of imaging information and a 5- or 10-year CVD risk estimated using traditional risk factors will best inform clinical decision making. All patients, regardless of the anatomic extent of coronary atheroma, should have traditional CVD risk factors measured as these are important modifiers of disease and targets for treatment.

Statin use in patients with obstructive CAD

Use of statins is a Class I indication for secondary prevention in patients with known CVD. The major clinical trials supporting this recommendation were done prior to CTCA availability and largely included patients with symptomatic disease. Although we studied cohorts with suspected CAD, not all those with CTCA evidence of obstructive CAD will have had symptoms clearly attributable to CAD, and our cohort probably includes some patients with asymptomatic obstructive CAD. The 2018 ACC/AHA guideline[5] recommends starting statins even in asymptomatic obstructive CAD as an indication for secondary prevention. Use of CTCA has therefore increased the number of patients identified as appropriate for secondary prevention. In our cohorts around half the patients with CTCA-proven disease were already on a statin prior to presentation, consistent with a cohort that includes patients with known high CVD risk due to either risk factors or known CVD. The finding of obstructive CAD increased the proportion maintained on a statin to over 80%. The maintenance rates for statins in this cohort is similar to the previous published report using the 2015–2017 New Zealand acute coronary syndrome cohort.[26] In that study, which included all acute coronary syndrome patients, 89.8% were dispensed a statin within 3 months, and 79.8% had a medication possession ratio ≥0.8 during the first year, indicating that a high proportion of patients had adequately maintained dispensing over the year post-discharge.[26] The one in five patients with obstructive CAD not on a statin at 1 year is likely due to known intolerances or barriers to getting medication dispensed early after discharge. They are a group who may benefit from strategies to improve medication adherence, and are appropriate as a target for quality improvement.

Temporal changes in statin dispensing

Statin dispensing increased in those who presented with acute chest pain despite no atheroma on CTCA. It is routine practice to prescribe a statin alongside other medications, such as aspirin, for patients with acute chest pain in the hospital, so it is not surprising to find that statin dispensing increased early post-CTCA and subsequently the rate dropped in the first year post-discharge. The rate of statin dispensing also dropped in the non-obstructive disease group post-CTCA. These patients were routinely hospitalised under the care of general medical specialists at our institution. In contrast, outpatients with stable chest pain were seen by the cardiology team, and those with non-obstructive disease were maintained on a statin at 1 year. A prior registry-based study[27] found that patients seen by cardiologists were more likely than others to receive guideline-directed statin therapy in both primary and secondary prevention contexts.

Study limitations

This study provides information on statins dispensed, which may or may not be consumed. However, this method is considered to have high specificity (identify those not taking medication) and is more likely than clinical trials to reflect a "real world" situation.[28] We have also not taken into account the dosing and type of statin used, but we did include anyone who is on a statin regardless of type or dosage. We use the SIS score as a measure of the extent of coronary atherosclerosis instead of the CCS as our CTCA studies did not have a concomitant calcium score performed. SIS is a semi-quantitative measure of extent of atherosclerotic disease, irrespective of severity of plaque. Quantifying extent of CAD as such is consistent with the move from qualitative to standardised quantitative CTCA reporting in the Society of Cardiovascular Computed Tomography's Coronary Artery Disease Reporting and Data System (CAD-RADS) guidelines.[11] Unlike the CCS, it also accounts for non-calcified plaque, which may be the substrate for major adverse cardiac events.[29]

Conclusion

In this study, the finding of atheroma with obstructive disease on CTCA is associated with an appropriate increase in statin use and absence of atheroma leads to appropriate down-titration/discontinuation of statin use. Statin use in patients with non-obstructive CAD is still suboptimal despite evidence supporting the use of statins is associated with a clinically important reduction in the risk of MI and death in patients with non-obstructive CAD. Therefore, initiatives to improve longer-term maintenance of statins in this group of patients are required to improve patient outcomes.

Table 1: Baseline characteristics of patients who underwent CTCA.

Patients with acute chest pain (inpatient)						
		Total n=548	**No atheroma n=204 (37.2%)**	**Atheroma without obstructive CAD n=208 (38.0%)**	**Atheroma with obstructive CAD n=136 (24.8%)**	**p-value**
Age	Mean±SD	56.1±11.5	50.6±12.8	59.4±9.1	59.1±9.5	<.001
Age group	<55	233 (42.5)	127 (62.3)	65 (31.3)	41 (30.1)	<.001
	55+	315 (57.5)	77 (37.7)	143 (68.8)	95 (69.9)	
Gender	Male	287 (52.4)	92 (45.1)	111 (53.4)	84 (61.8)	0.010
Ethnicity	Māori	77 (14.1)	30 (14.7)	25 (12.0)	22 (16.2)	0.725
	Pacific	122 (22.3)	41 (20.1)	45 (21.6)	36 (26.5)	
	Indian	93 (17.0)	36 (17.6)	35 (16.8)	22 (16.2)	
	Other Asian	50 (9.1)	22 (10.8)	17 (8.2)	11 (8.1)	
	European/ Other	206 (37.6)	75 (36.8)	86 (41.3)	45 (33.1)	
NZDep	1–2	73 (13.3)	26 (12.7)	30 (14.4)	17 (12.5)	0.733*
	3–4	95 (17.3)	42 (20.6)	30 (14.4)	23 (16.9)	
	5–6	76 (13.9)	24 (11.8)	32 (15.4)	20 (14.7)	
	7–8	92 (16.8)	38 (18.6)	35 (16.8)	19 (14.0)	
	9–10	211 (38.5)	74 (36.3)	81 (38.9)	56 (41.2)	
	Unknown	1 (0.2)	0 (0)	0 (0)	1 (0.3)	
Cardiac risk factors	Current smoker	79 (14.3)	28 (13.7)	30 (14.4)	21 (15.4)	0.907
	Hypertension	305 (55.7)	91 (44.6)	119 (57.2)	95 (69.9)	<.001*
	Diabetes mellitus	136 (24.6)	39 (19.1)	50 (24.0)	47 (34.6)	0.005
	Family history of premature CVD	35 (6.4)	11 (5.4)	16 (7.7)	8 (5.9)	0.624*
	LDL within 3 months pre-CT					0.864*
	n	483	180	180	123	
	mean ± SD (mmol/l)	2.55 ± 1.02	2.50 ± 0.91	2.58 ± 1.04	2.59 (1.15)	

Table 1 (continued): Baseline characteristics of patients who underwent CTCA.

SIS	SIS 0	204 (37.2)	204 (100)	0 (0)	0 (0)	<.001
	SIS 1	105 (19.2)	0 (0)	88 (42.3)	17 (12.5)	
	SIS 2–3	147 (26.8)	0 (0)	89 (42.8)	58 (42.6)	
	SIS >4	92 (16.8)	0 (0)	31 (14.9)	61 (44.9)	
Invasive angiogram within 2 weeks post-CT, n (%)		87 (15.9)	0 (0)	0 (0)	87 (64.0)	<.001
Inpatient revascularisation (PCI or CABG), n (%)		38 (7.1)	0 (0)	0 (0)	38 (27.9)	<.001
Patients with stable chest pain (outpatient)						
		Total n=746	**No atheroma n=292 (39.1%)**	**Atheroma without obstructive CAD n=314 (42.1%)**	**Atheroma with obstructive CAD n=140 (18.8%)**	**p-value**
Age	Mean±SD	58.6±10.5	54.3±11.1	61.3±9.3	61.7±8.7	<.001
Age group	<55	240 (32.2)	142 (48.6)	70 (22.3)	28 (20.0)	<.001
	>55	506 (67.8)	150 (51.4)	244 (77.7)	112 (80.0)	
Gender	Male	354 (47.5)	126 (43.2)	148 (47.1)	80 (57.1)	0.024
Ethnicity	Māori	85 (11.4)	27 (9.2)	37 (11.8)	21 (15.0)	0.043
	Pacific	111 (14.9)	31 (10.6)	57 (18.2)	23 (16.4)	
	Indian	125 (16.8)	58 (19.9)	44 (14.0)	23 (16.4)	
	Other Asian	135 (18.1)	61 (20.9)	48 (15.3)	26 (18.6)	
	European/ Other	290 (38.9)	115 (39.4)	128 (40.8)	47 (33.6)	
NZDep	1–2	115 (15.4)	39 (13.4)	54 (17.2)	22 (15.7)	0.582*
	3–4	149 (20.0)	64 (21.9)	56 (17.8)	29 (20.7)	
	5–6	109 (14.6)	51 (17.5)	41 (13.1)	17 (12.1)	
	7–8	149 (20.0)	54 (18.5)	64 (20.4)	31 (22.1)	
	9–10	222 (29.8)	83 (28.4)	98 (31.2)	41 (29.3)	
	Unknown	2 (0.3)	1 (0.3)	1 (0.3)	0 (0)	

Table 1 (continued): Baseline characteristics of patients who underwent CTCA.

Cardiac risk factors	Current smoker	74 (9.9)	27 (9.2)	34 (10.8)	13 (9.3)	0.778
	Hypertension	384 (51.5)	120 (41.1)	173 (55.1)	91 (65.0)	<.001*
	Diabetes mellitus	171 (22.9)	42 (14.4)	80 (25.5)	49 (35.0)	<.001
	Family history of premature CVD	48 (6.4)	13 (4.5)	26 (8.3)	9 (6.4)	0.162*
	LDL within 3 months pre-CT					0.070*
	n	333	123	140	70	
	mean±SD (mmol/l)	2.52±1.01	2.62±0.93	2.54±1.06	2.32±1.02	
SIS	SIS 0	292 (39.1)	292 (100)	0 (0)	0 (0)	<.0001
	SIS 1	120 (16.1)	0 (0)	107 (34.1)	13 (9.3)	
	SIS 2–3	218 (29.2)	0 (0)	165 (52.5)	53 (37.9)	
	SIS >4	116 (15.5)	0 (0)	42 (13.4)	74 (52.9)	
Invasive angiogram within 6 months post-CT, n (%)		60 (8.0)	0 (0)	2 (0.6)	58 (41.4)	<.001
Revascularisation within 6 months post-CT (PCI or CABG), n (%)		37 (5.0)	0 (0)	1 (0.3)	36 (25.7)	<.001

CTCA = computed tomography coronary angiography; CAD = coronary artery disease; SD = standard deviation; NZDep = New Zealand Index of Deprivation; CVD = cardiovascular disease; LDL = low-density lipoproteins; CT = computed tomography; SIS = segment involvement score; PCI = percutaneous coronary intervention; CABG = coronary artery bypass grafting.
*p-value excluded the missing data.

Table 2: Initial statin dispensing and maintenance over the year post-CTCA.

Patients with acute chest pain							
	1 No atheroma	**2 Atheroma without obstructive CAD**	**3 Atheroma with obstructive CAD**	**p-value (overall)**	**p-value (1 vs 2)**	**p-value (1 vs 3)**	**p-value (2 vs 3)**
Within 6 months pre-CT	48/204 (23.5)	95/208 (45.7)	72/136 (52.9)	<.001	<.001	<.001	0.187
Within 3 months post-CT	69/204 (33.8)	141/208 (67.8)	126/136 (92.6)	<.001	<.001	<.001	<.001
9–12 months post-CT	59/204 (28.9)	124/208 (59.6)	119/136 (87.5)	<.001	<.001	<.001	<.001
Patients with stable chest pain (outpatient)							
	1 No atheroma	**2 Atheroma without obstructive CAD**	**3 Atheroma with obstructive CAD**	**p-value (overall)**	**p-value (1 vs 2)**	**p-value (1 vs 3)**	**p-value (2 vs 3)**
Within 6–12 months pre-CT	75/292 (25.7)	157/314 (30.0)	71/140 (50.7)	<.001	<.001	<.001	0.888
Within 6 months pre-CT	122/292 (41.8)	194/314 (61.8)	96/140 (68.6)	<.001	<.001	<.001	0.164
Within 3 months post-CT	84/292 (28.8)	197/314 (62.7)	117/140 (83.6)	<.001	<.001	<.001	<.001
9–12 months post-CT	81/292 (27.7)	194/314 (61.8)	119/140 (85.0)	<.001	<.001	<.001	<.001

CTCA = computed tomography coronary angiography; CAD = coronary artery disease; CT = computed tomography.

Table 3: Predictors of statin dispensing within 3 months post-CTCA.

Patients with acute chest pain (inpatients)			
Variable	**Relative risk**	**95% confidence interval**	**p-value**
Atheroma without obstructive CAD vs no atheroma	1.55	1.25–1.94	<.001
Atheroma with obstructive CAD vs no atheroma	2.19	1.76–2.71	<.001
Age, with every 10 years increase	1.13	1.06–1.21	<.001
Gender (male vs female)	1.23	1.07–1.42	0.003
Māori ethnicity vs European/Other	1.14	0.92–1.43	0.235
Pacific ethnicity vs European/Other	0.95	0.77–1.17	0.609
Indian ethnicity vs European/Other	1.24	1.02–1.49	0.024
Other Asian ethnicity vs European/Other	1.14	0.89–1.46	0.316
Socio-economic status, with NZDep quintile increase	1.01	0.99–1.03	0.528
Current smoker (yes vs no)	1.02	0.84–1.22	0.873
Hypertension (yes vs no)	1.32	1.11–1.57	0.002
Diabetes mellitus (yes vs no)	1.09	0.95–1.25	0.234
Patients with stable chest pain (outpatients)			
Variable	**Relative risk**	**95% confidence interval**	**p-value**
Coronary atheroma compared to no atheroma	1.77	1.45–2.15	<.001
Atheroma with obstructive CAD vs no atheroma	2.14	1.75–2.62	<.001
Age, with every 10 years increase	1.09	1.02–1.17	0.009
Gender (male vs female)	1.08	0.96–1.21	0.197
Māori ethnicity compared to European/Other	1.13	0.93–1.36	0.223

Table 3 (continued): Predictors of statin dispensing within 3 months post-CTCA.

Pacific ethnicity compared to European/Other	1.03	0.85–1.25	0.741
Indian ethnicity compared to European/Other	1.15	0.97–1.36	0.108
Other Asian ethnicity compared to European/Other	1.02	0.85–1.22	0.842
Socio-economic status, with NZDep quintile increase	1.02	0.99–1.04	0.154
Current smoker (yes vs no)	1.13	0.94–1.36	0.193
Hypertension (yes vs no)	1.28	1.12–1.46	<.001
Diabetes mellitus (yes vs no)	1.20	1.06–1.36	0.003

CTCA = computed tomography coronary angiography; CAD = coronary artery disease; NZDep = New Zealand Index of Deprivation.

Figure 1: Statin dispensing prior to and post-CTCA in patients with acute chest pain.

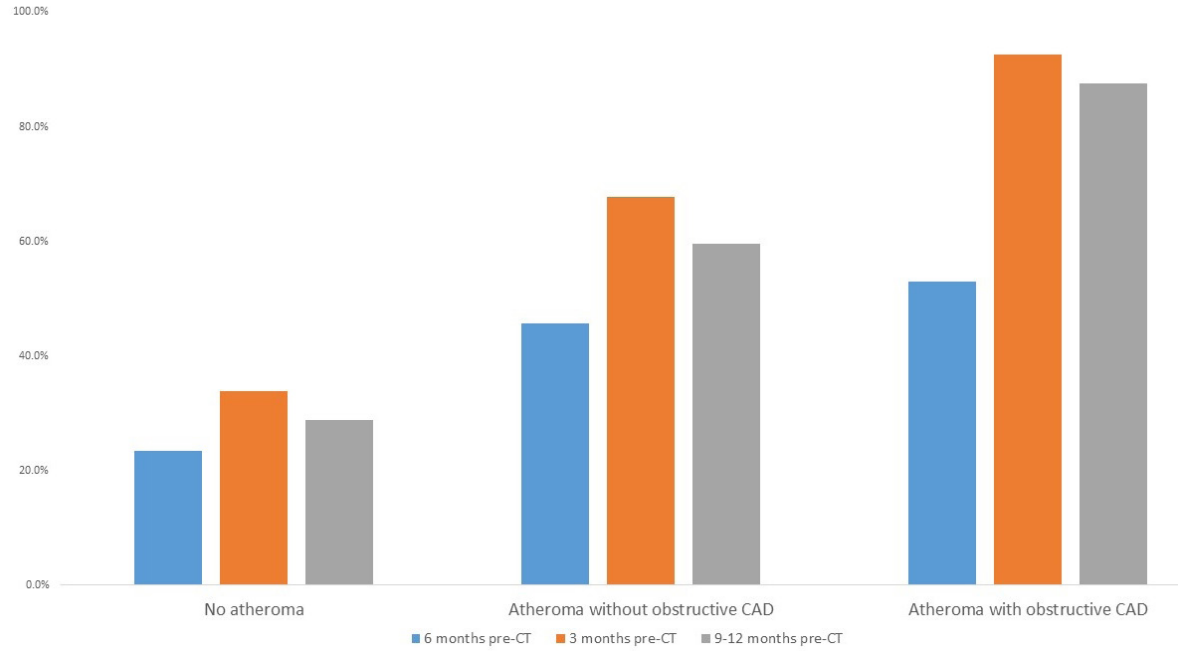
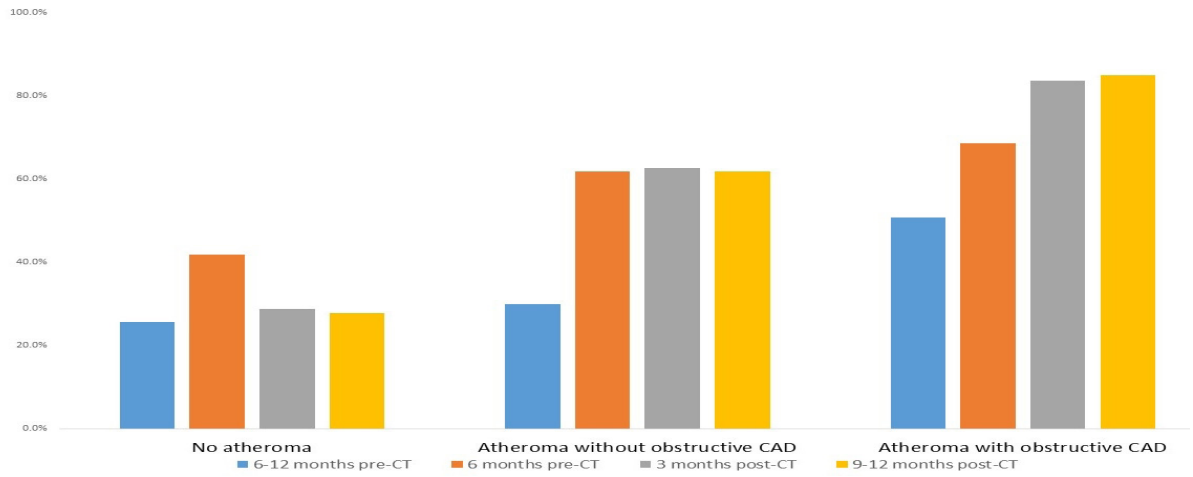


Figure 2: Statin dispensing pre- and post-CTCA in patients with stable chest pain.



COMPETING INTERESTS
Nil.

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Appendix

Appendix Table 1: Statin use pre- and post-CTCA in patients with non-obstructive CAD according to SIS.

Patients with acute chest pain (n=208)							
	SIS 1 (n=88)	**SIS 2–3 (n=89)**	**SIS >4 (n=31)**	**p-value (overall)**	**p-value (1 vs 2)**	**p-value (1 vs 3)**	**p-value (2 vs 3)**
6 months pre-CT	36 (40.9)	44 (49.4)	15 (48.4)	0.495	0.254	0.469	0.920
3 months post-CT	55 (62.5)	61 (68.5)	25 (80.6)	0.174	0.398	0.064	0.198
9–12 months post-CT	46 (52.3)	58 (65.2)	20 (64.5)	0.181	0.081	0.238	0.948
Patients with stable chest pain (n=314)							
	SIS 1 (n=107)	**SIS 2–3 (n=165)**	**SIS >4 (n=42)**	**p-value (overall)**	**p-value (1 vs 2)**	**p-value (1 vs 3)**	**p-value (2 vs 3)**
6–12 months pre-CT	40 (37.4)	94 (57.0)	23 (54.8)	0.006	0.002	0.053	0.797
6 months pre-CT	57 (53.3)	111 (67.3)	26 (61.9)	0.068	0.020	0.340	0.512
3 months post-CT	53 (49.5)	116 (70.3)	28 (66.7)	0.002	0.001	0.059	0.648
9–12 months post-CT	57 (53.3)	107 (64.8)	30 (71.4)	0.061	0.057	0.043	0.421

CTCA = computed tomography coronary angiography; CAD = coronary artery disease; SIS = segment involvement score; CT = computed tomography.

Prediction of unplanned hospital admissions using the interRAI DIVERT scale among community-dwelling older adults in Aotearoa New Zealand

Ghassan Al Aranji, Heather Astell, Timothy Kenealy, Helen Kenealy

ABSTRACT

AIM: We aimed to validate the interRAI Detection of Indicators and Vulnerabilities for Emergency Room Trips (DIVERT) scale in predicting unplanned hospital admissions following emergency department (ED) visits among community-dwelling older adults in an urban Aotearoa New Zealand population.

METHODS: We conducted a retrospective cohort study of adults aged ≥55 years who underwent interRAI home care (HC) version 9.1 assessment between May 2021 and April 2022. The DIVERT score, derived from HC assessment data, categorised patients into risk levels. Hospital records were reviewed for unplanned hospital admissions via ED within 90 days of assessment. Statistical analyses, including survival and regression models, were used to evaluate predictive validity and explore risk factors.

RESULTS: Between May 2021 and April 2022, 2,006 patients were assessed, with a mean age of 79.8 years (range 55–103). Admission rates within 90 days increased with higher DIVERT scores, from 18.2% (score 1) to 41.9% (score 6). Among high-risk groups (scores 5–6), a higher comorbidity burden was significantly associated with admission ($p<0.001$), while age, ethnicity and deprivation showed no statistically significant association. Primary causes of admission included infections, heart failure and falls. Mortality rates were notably higher in admitted patients at both 30 and 90 days.

CONCLUSIONS: This study confirms the predictive validity of the interRAI DIVERT scale for unplanned hospital admissions among community-dwelling older adults in urban Aotearoa New Zealand. The strong association between higher scores and increased admission rates supports its use in risk-stratification within this population.

Older adults constitute a sizeable proportion of emergency department (ED) presentations.[1] They often present with complex, undifferentiated symptoms that can lead to diagnostic uncertainty, delays in care and an increased risk of hospital-acquired complications, functional decline and mortality.[1,2] In response to these challenges, healthcare systems are increasingly focussing on strengthening community-based care to support older adults with complex needs, with the goal of preventing avoidable hospital presentations and their associated risks.[3]

In Aotearoa New Zealand, the interRAI home care (HC) version 9.1 assessment is mandated to assess the health, functional status and social needs of older adults receiving publicly funded home and community care.[4] From this assessment, the Detection of Indicators and Vulnerabilities for Emergency Room Trips (DIVERT) scale was developed to identify individuals at risk of ED use.[5] The DIVERT tool stratifies risk based on factors such as cardio-respiratory symptoms, mood, functional decline and comorbidities.[4]

The DIVERT scale was originally derived and validated in a large Canadian HC cohort of 361,942 older adults, where 41% had an ED visit within 6 months; risk increased stepwise across the six DIVERT levels, and the model achieved an area under the receiver operating characteristic curve (AUC) of 0.62 (95% confidence interval 0.61–0.62).[5] Subsequent external validations in over one million Canadian clients[6] and in Finnish HC populations[7] reported similar discrimination (AUC 0.61–0.66) and confirmed that clients in the highest DIVERT classes had the shortest time to hospitalisation and greatest overall risk. Compared with other RAI HC–derived indices—such as Changes in Health, End-Stage Disease, Signs, and Symptoms Scale (CHESS), Activities of Daily Living (ADL) Hierarchy or Method for Assigning Priority Levels (MAPLe)—the DIVERT scale demonstrated superior or comparable performance for predicting unplanned admissions. Locally, an Aotearoa New Zealand study of frail

community-dwelling older adults receiving transitional care reported 42% readmission within 3 months despite multidisciplinary support, underscoring the importance of accurate early risk stratification and preventive approaches.[8] However, the DIVERT scale has not yet been validated within the country. This is particularly relevant in Aotearoa New Zealand, where population characteristics differ substantially, with a high burden of multimorbidity and marked health inequities affecting Māori and Pacific peoples.

Local validation of the DIVERT scale is essential to assess its performance across ethnic and socio-economic groups within the Aotearoa New Zealand context. This study therefore aims to confirm the validity of the interRAI DIVERT scale in predicting unplanned hospital admissions following ED presentation among older adults in an urban Aotearoa New Zealand population.

Aim

The aim of this study was to confirm the validity of the interRAI DIVERT Scale in predicting the risk of unplanned hospital admissions following ED presentations for home and community care patients in Counties Manukau, an urban population in Aotearoa New Zealand.

Our hypothesis was that patients with higher DIVERT scores (5 and 6) would be more likely to be admitted to hospital than those with lower scores. Understanding the characteristics and presenting complaints of older adults with high DIVERT scores in the ED could provide a better understanding of the common conditions that lead to unplanned hospital admissions.

Methods

This study is reported in accordance with the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) guidelines.[9] The interRAI HC version 9.1 assessment tool is mandated by the Aotearoa New Zealand government for all older adults who are being assessed for publicly funded home support services or aged residential care, and no other tool is used for this specific purpose. It is not administered to all older adults in the community, but rather to those with identified health or functional needs. The assessment is typically repeated annually, or earlier if there is a significant change in health status.[4]

Study design

This retrospective cohort study validated the interRAI DIVERT scale's ability to predict unplanned ED visits and hospital admissions among older adults in Counties Manukau. The study also investigated the risk factors and reasons for admission. Additionally, a *post hoc* analysis was performed using survival analysis and regression models to evaluate the time to admission or death.

Setting

This was a community study conducted in the catchment area of Middlemore Hospital between 1 May 2021 and 30 April 2022.

Participants

All community patients aged over 55 years for Māori or Pacific people, and over 65 years for others, underwent an interRAI HC version 9.1 assessment between 1 May 2021 and 30 April 2022 in the Counties Manukau area and received a DIVERT score (Table 1). We retrospectively reviewed these patients' files. This study included only interRAI HC version 9.1 assessments, which are administered to older adults living in the community who are being evaluated for publicly funded home support or potential residential care placement. Individuals already residing in aged residential care facilities, as well as those assessed with other interRAI tools such as the Contact Assessment or Long-Term Care Facilities Assessment, were excluded.

Variables

The primary outcome was an unplanned hospital admission via the ED within 90 days of the assessment. Only the first ED presentation within this period was considered. An unplanned admission was defined as any hospital admission that was not scheduled electively. In our health system, virtually all unplanned acute medical and surgical admissions for community-dwelling patients are processed through the ED; direct admissions from primary care are exceptionally rare. Although previous validation studies of the DIVERT scale used a 6-month follow-up, a 90-day period was selected for this study to reflect the shorter review cycles and intervention windows typical of Aotearoa New Zealand community-care services. This timeframe captures hospitalisations most relevant to immediate care-planning decisions while maintaining consistency with the timing of interRAI reassessments.

interRAI is an internationally validated suite of tools for assessing health functionality and social needs across various settings.[4] Costa et al. have developed and validated the DIVERT scale, which is derived from the interRAI HC version 9.1 assessment tool.[5]

DIVERT scores range from 1 (lowest risk) to 6 (highest risk), highlighting key determinants including cardiorespiratory symptoms, cardiac conditions, mood symptoms and functional decline.[4] Both international research and local studies indicate that individuals with higher DIVERT scores are more likely to exhibit a greater likelihood of experiencing unplanned hospital admissions.[6–8] DIVERT scores can aid in resource allocation, chronic disease management and symptom control.[5] The tool can be used to guide early intervention and tailored support, aiming to reduce hospital visits and improve patient outcomes by addressing specific health risks and enhancing primary-care connections.[5]

Two investigators reviewed admission and discharge summaries for patients admitted to the hospital during the study period to discern their primary reasons for admission. A primary diagnosis and secondary diagnosis were recorded for each case (secondary diagnosis was recorded as none if there was no secondary diagnosis). Diagnoses were categorised as follows: infection, decompensated heart failure or other cardiac problem, falls with no injuries, falls with injuries, unmanaged pain, acute surgical problem, anaemia, delirium or dementia, problems with constipation or catheters, acute neurological problems, problems with lack of adequate social supports or other. These diagnosis categories were based on some of the symptoms that contribute to the DIVERT score as well as our clinical experience of common reasons for admission.

Diagnosis classification and inter-rater agreement

Two investigators independently reviewed admission and discharge summaries to determine the primary and secondary reasons for hospital admission. Agreement was reached in 93 of 132 cases (70.5%). For the remaining 39 cases, a third investigator adjudicated, agreeing with one of the initial reviewers in 31 instances. The remaining eight cases were discussed collectively until consensus was reached. Because the diagnostic categories were discrete and mutually exclusive, agreement was summarised as percent concordance rather than using Cronbach's alpha, which is not applicable to categorical classification data.

Data sources/measurement

Data were obtained from the Aotearoa New Zealand interRAI data warehouse. All interRAI HC version 9.1 data are collected as part of the mandatory national assessment for older adults receiving publicly funded community services in Aotearoa New Zealand. De-identified data were accessed under ethics approval; individual participant consent was not required. We collected the following data: age at the time of interRAI assessment, gender, ethnicity (Māori, Pacific peoples, European, Asian, and Other), deprivation quintile and comorbidity index. Ethnicity was coded using the prioritised (first order) ethnicity classification in accordance with Stats NZ Tatauranga Aotearoa and interRAI New Zealand conventions.

Among patients with DIVERT scores of 5 and 6, we explored potential risk factors for admission by comparing the characteristics of those who were admitted to hospital with those who were not.

Deprivation quintiles were derived from routinely collected data by government agencies as well as census data at the neighbourhood level using custom designed data zones. These zones are ranked from 1 (least deprived) to 6,181 (most deprived). These zones are then grouped in five quintiles, with quintile 1 representing the 20% least deprived, while quintile 5 represents the 20% most deprived data zone in Aotearoa New Zealand.[10]

With regards to comorbidity index, we initially planned to use the Charlson Comorbidity Index (CCI).[11,12] However, due to difficulties in obtaining complete and coded diagnostic data, we developed a simplified scoring system where each of the following comorbidities was assigned one point: solid tumour, cerebrovascular disease, chronic kidney disease, chronic obstructive pulmonary disease (COPD), diabetes mellitus, leukaemia/lymphoma, liver disease, myocardial infarction, peptic ulcer disease and peripheral vascular disease.

Although we were unable to apply the full CCI due to data limitations, prior research has shown that simple counts of selected chronic conditions correlate well with CCI scores and can serve as a valid proxy for multimorbidity burden in older adults.[13]

Hypertension and dementia were not included in this simplified index. Hypertension was

excluded as it is highly prevalent in this population and may not meaningfully discriminate risk in this high-risk cohort. Dementia was excluded due to inconsistent recording in available datasets and the difficulty in reliably distinguishing it from delirium or cognitive decline in clinical summaries. These conditions, however, were captured as primary or secondary reasons for hospital admission when relevant.

Statistical methods

Data were recorded in REDCap. Statistical analyses were performed using R studio version 4.2.2, OpenEpi and Stata version 13. Descriptive statistics show Chi-squared unless otherwise stated. Univariable and multivariable associations were tested with Cox regressions. Kaplan–Meier plots were used to show time to admission analysis, where time is days since interRAI assessment, and the event is hospital admission. Tests were two-sided and p-values <0.05 were considered statistically significant.

The project was registered with the Counties Manukau Health Research Office, registration number #1765. Ethical approval was obtained, reference number AH25500, date 22 May 2023. Locality approval was given by the Auckland Health Research Ethics Committee (AHREC). All analyses used de-identified data extracted from the interRAI New Zealand database.

Results

Part 1: the relationship between DIVERT scores and the rates of admission

A total of 2,007 eligible patients had an interRAI HC version 9.1 assessment with a DIVERT score, in the community, between 1 May 2021 and 30 April 2022, inclusive. As shown in Table 1, the percentage of patients admitted within 90 days of assessment rose with each increment in DIVERT score, from 18.2% for those with score 1 to 41.9% for score 6 (p<0.001).

Predictive performance of the DIVERT scale

The positive predictive value (PPV) for unplanned hospital admission within 90 days increased with each increment in DIVERT score, ranging from 18.2% (score 1) to 41.9% (score 6). Using a threshold of DIVERT ≥5, the PPV was 36.9%, and the negative predictive value (NPV) for DIVERT ≤4 was 78.5%. These values indicate moderate discriminative ability, comparable to previous validation studies, with a clear stepwise gradient of risk across DIVERT categories (Table 1).

Part 2: characteristics of patients admitted and not admitted within 90 days

Table 2 presents the characteristics of patients with DIVERT scores of 5 and 6, comparing those who were admitted to the hospital within 90 days with those who were not. The global Chi-squared p-values suggest significant differences were observed in comorbidity scores, with higher scores associated with an increased likelihood of admission (p<0.001). In the second part of the analysis, we examined hospital admission within 90 days among patients with high DIVERT scores (5 and 6), stratified by our simplified comorbidity index. Of

Table 1: Unplanned hospital admission within 90 days of assessment, by DIVERT score, and mortality within 30 and 90 days by DIVERT score, N=2,007.

DIVERT score	N (total)	Admitted within 90 days n (%)	Died within 30 days n (%)	Died within 90 days n (%)
1	352	64 (18.2)	N/A	N/A
2	626	118 (18.8)	N/A	N/A
3	339	79 (23.3)	N/A	N/A
4	335	94 (28.1)	N/A	N/A
5	200	66 (33.0)	25 (19.2)	37 (28.5)
6	155	65 (41.9)	24 (18.8)	37 (28.5)
Total	2,007	486 (24.2)	—	—

these, 130 patients were admitted and 224 were not. The comorbidity score ranged from 0 to 5, with each point representing one chronic condition from the predefined list. Patients with no comorbidities (score 0) were significantly less likely to be admitted (14% of admitted vs 29% of non-admitted; relative risk (RR)=0.6, p=0.002). The likelihood of admission increased progressively with higher comorbidity scores (score 2: RR=1.3, p=0.006; score 3: RR=1.2, p=0.031; score 4: RR=2.1, p=0.0001). The global p-value (<0.001) confirmed a statistically significant overall association between comorbidity burden and hospital admission. No patients in this dataset had a comorbidity score of 5, and score 1 did not reach statistical significance. Overall, there was a clear positive relationship between comorbidity burden and the risk of unplanned hospital admission among high-risk patients (DIVERT 5 and 6). Those with three or more chronic conditions were approximately twice as likely to be admitted compared with those with none, underscoring comorbidity as a major driver of admission risk in this group. No significant associations were found for age, gender, ethnicity or deprivation quintile. Rate ratios with 95% confidence intervals were calculated to quantify the strength of associations.

We used bivariate analysis to characterise differences between admitted and non-admitted patients in the high-risk group. This exploratory approach was appropriate for hypothesis generation and pattern recognition. While a multivariable logistic regression model could adjust for confounding, the sample size and multicollinearity between variables (e.g., age and comorbidity) limited the utility of such modelling in this context.

Admission and discharge summaries were reviewed by two investigators, with discrepancies resolved through independent adjudication and group consensus as described in the methods section. The final categorisation of primary and secondary admission diagnoses for patients with DIVERT scores 5 and 6 is presented in Table 3.

Part 3: admission diagnosis

Table 3 shows the primary and secondary admission diagnoses for patients with DIVERT score 5 and 6. After "other", the most common reasons for admission were infection, heart failure or other cardiac problem, falls without injuries, pain, and surgical problems. "Other" as a diagnosis included diverse problems such as metastatic lung cancer for three patients, knee calcium pyrophosphate deposition disease, abdominal lump, motor neurone disease causing reduced mobility, fungal rash under pannus, oral thrush, hypothermia, heel haematoma, low Glasgow Coma Scale, metastatic ovarian cancer, acute kidney injury, squamous cell carcinoma of the scalp, musculoskeletal pain in the context of fluid overload and chronic kidney disease, alcoholic intoxication and general decline post-coronavirus infection.

Mortality rates for patients with DIVERT scores 5 and 6 within 30 and 90 days

Both unplanned hospital admission and mortality increased with higher DIVERT scores, with the steepest gradients observed in categories 5 and 6 (Table 1). Among patients with DIVERT scores of 5 and 6, mortality rates were significantly higher for those who were admitted to the hospital compared with those who were not. Within 30 days, 38% (49 out of 130) of admitted patients died, whereas no deaths were observed among non-admitted patients (p<0.001). Similarly, within 90 days, 57% (74 out of 130) of admitted patients died, while, again, no deaths occurred among non-admitted patients (p<0.001). These findings highlight that patients with high DIVERT scores who are admitted have a profoundly high mortality rate, underscoring the severity of illness and frailty within this group.

Table 4 displays the time from assessment to admission for patients with DIVERT scores of 5 and 6, with the number of admissions for different time intervals. Fifteen percent of patients are admitted within 72 hours and a further 27% are admitted within 14 days of interRAI assessment.

Time to event analysis for patients with DIVERT scores of 5 and 6

A Cox regression indicated that a higher comorbidity score was significantly associated with increased risk of admission, (hazard ratio 1.51, p<0.001) after adjustment for age, gender, ethnicity and deprivation quintile. Higher deprivation quintile was associated with increased risk of admission on univariate regression but not on the adjusted model. None of age, gender or ethnicity were significant in univariate or adjusted models.

Figure 1 consists of four graphs, showing time to event analyses separately by age group, ethnicity, deprivation quintile and comorbidity scores. Only comorbidity scores show statistically significant differences in a fully adjusted model.

As shown in Table 4, 15% of admitted high-risk patients were admitted within 72 hours of

Table 2: Characteristics of patients admitted and not admitted within 90 days, DIVERT score 5 and 6.

	Patients admitted n=130 (%)	**Patients not admitted n=224 (%)**	**Rate ratio (95% confidence interval)**	**p-value**	**Global p-value**
Age at assessment					
>84	38 (29)	94 (42)	0.7 (0.5–0.9)	0.01	0.087
75–84	57 (44)	78 (35)	1.3 (1.0–1.7)	0.08	
65–74	24 (18)	40 (18)	1.0 (0.7–1.5)	0.91	
55–64	11 (8)	12 (5)	1.3 (0.8–2.0)	0.26	
Gender, n (%)					
Female	67 (52)	116 (52)	1.0 (0.8–1.3)	0.98	*0.96*
Male	63 (48)	108 (48)	1.0 (0.8–1.3)	0.98	
Ethnicity, n (%)					
Māori	22 (17)	27 (12)	1.3 (0.9–1.8)	0.15	*0.063*
Pacific	32 (24)	37 (16)	1.3 (1.0–1.8)	0.07	
Asian	15 (11)	23 (10)	1.1 (0.7–1.6)	0.73	
Other	61 (46)	137 (61)	0.7(0.5–0.9)	0.01	
Comorbidity score, n (%)					
0	19 (14)	65 (29)	0.6 (0.4–0.8)	0.002	***<0.001***
1	42 (32)	87 (39)	0.8 (0.6–1.1)	0.22	
2	36 (27)	43 (19)	1.3 (1.0–1.8)	0.006	
3	18 (14)	23 (10)	1.2 (0.8–1.8)	0.031	
4	15 (11)	6 (3)	2.1 (1.5–2.8)	0.0001	
5	0 (0)	0 (0)	0	0	
Deprivation quintile, n (%)					
1	10 (7)	27 (12)	*0.7 (0.4–1.2)*	0.19	*0.196*
2	12 (9)	32 (14)	*0.7 (0.4–1.2)*	0.16	
3	19 (14)	38 (17)	*0.9 (0.6–1.3)*	0.54	
4	16 (12)	27 (12)	*1.0 (0.7–1.5)*	0.96	
5	70 (54)	91 (41)	***1.4 (1.1–1.9)***	0.01	
N/A	3 (2)	9 (4)	*0.7 (0.3–1.8)*	0.39	

Table 3: Primary and secondary admission diagnoses for patients with DIVERT score 5 and 6.

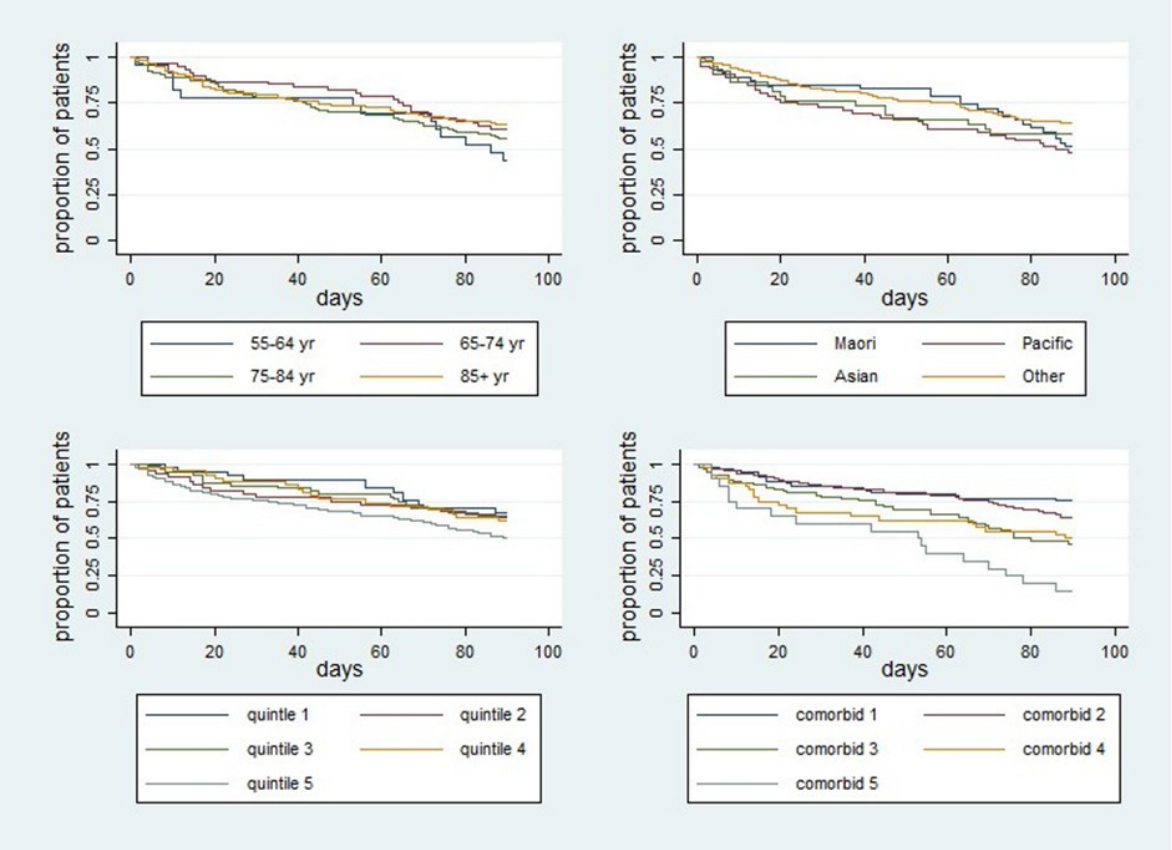
Reasons	Primary diagnosis n=130 (%)	Secondary diagnosis n=130 (%)
Other	24 (18.5)	15 (11.5)
Infection, e.g., pneumonia, urinary tract infection, COVID-19	24 (18.5)	9 (6.9)
Decompensated heart failure or other cardiac problem	16 (12.3)	13(10)
Falls with no injuries	10 (7.7)	1 (0.8)
Unmanaged pain, e.g., back pain	10 (7.7)	2 (1.5)
Acute surgical problem, e.g., bowel obstruction	10 (7.7)	1 (0.8)
Decompensated chronic obstructive pulmonary disease or other chronic respiratory illness	9 (6.9)	4 (3.1)
Falls with injuries (excluding skin lacerations)	7 (5.4)	1 (0.8)
Anaemia	5 (3.9)	8 (6.2)
Delirium/dementia	5 (3.9)	5 (3.9)
Problems with indwelling catheters or constipation	5 (3.9)	3 (2.3)
Acute neurological problems, e.g., stroke/seizure	3 (2.3)	2 (1.5)
Problems with lack of adequate social supports	1 (0.8)	8 (6.2)
None	1 (0.8)	58 (44.6)

"None" as primary diagnosis was due to a single patient presentation over concern about low oxygen saturation measured at home; the patient was asymptomatic, and saturation was normal in the emergency department.
"None" as the secondary diagnosis was used in cases where only one primary reason for admission was identified in the clinical records, and no clear secondary diagnosis was documented. This applied to 58 patients.

Table 4: Time from interRAI assessment to hospital admission among patients with DIVERT scores of 5 and 6 who were admitted within 90 days (n=130 of 2,007 total patients).

Time from assessment to admission (DIVERT score 5 and 6) N (%)	
Fewer than 72 hours	19 (15)
4–14 days	35 (27)
15–28 days	24 (18)
29–60 days	23 (18)
61–90 days	29 (22)

Figure 1: Kaplan–Meier time to event (admission) analyses by age group, ethnicity, deprivation quintile and comorbidity score for DIVERT scores of 5 and 6.



assessment, and 42% were admitted within the first 14 days. This indicates a particularly vulnerable period immediately following the assessment. A Kaplan–Meier analysis confirmed a steep initial rate of admission in the first few weeks.

Discussion

The present study aimed to evaluate the interRAI DIVERT assessment tool in predicting unplanned hospital admissions and identifying opportunities for preventive interventions. The findings contribute to the growing body of literature on the utility of the DIVERT tool and highlight potential areas for targeted interventions to reduce avoidable admissions among older adults.

The study's first part confirmed a significant positive association between higher DIVERT scores and increased rates of unplanned hospital admissions within 90 days of assessment. This finding is consistent with previous research validating the DIVERT scale's predictive ability for unplanned admissions.[5]

The DIVERT scale showed a strong dose–response relationship with admission risk, though overall discriminative ability was moderate (PPV 18–42%; NPV 79%), supporting its use for risk stratification rather than precise prediction. High admission rates among low scorers highlight the frailty of the interRAI HC population, emphasising the need to interpret DIVERT scores alongside clinical judgement. Trends in admission and mortality across categories further validate its predictive utility. Among high DIVERT scorers (5 and 6), higher comorbidity was strongly associated with 90-day admissions, underscoring the role of multimorbidity and the importance of proactive chronic disease management and coordinated community care.

We observed non-significant trends toward higher admission rates among older adults, Māori and Pacific peoples, and those from more socio-economically deprived backgrounds, possibly due to limited power (n=130 high DIVERT

score admissions) or true null associations. Interestingly, patients over 84 in the high-score group tended to be less likely admitted, which could relate to advance care planning or home support. These findings generate hypotheses for future research, and larger studies are needed to confirm whether targeted interventions for high-comorbidity and vulnerable sub-groups could reduce avoidable admissions. Among high DIVERT scorers, primary reasons for admission were diverse, including infections, heart failure, falls and unmanaged pain, highlighting multiple potential areas for early intervention, particularly prompt infection management.

Our findings broadly align with prior studies validating the DIVERT scale as a predictor of unplanned healthcare utilisation. Costa et al., who developed the tool, demonstrated that higher DIVERT scores were associated with increased rates of ED visits and hospitalisations in a large Canadian HC cohort.[5] Subsequent external validation studies in Finland, Canada and Europe have confirmed the scale's predictive performance across diverse populations and health systems.[6,7] These studies consistently show that individuals with higher DIVERT scores are more likely to experience unplanned ED presentations or hospital admissions. Our study supports international findings by validating the DIVERT scale in an Aotearoa New Zealand population with a high proportion of Māori and Pacific peoples within a distinct publicly funded community care model. Higher DIVERT scores were associated with increased unplanned admission risk, and receiver operating characteristic (ROC) curve analysis showed moderate discriminative ability (AUC=0.68), consistent with prior studies. While our analysis did not find statistically significant differences in admission rates by age or ethnicity within high-risk groups, this may reflect either local care practices—such as early intervention or advance care planning—or limitations in statistical power. Overall, our findings affirm the broader utility of the DIVERT scale and reinforce the importance of considering population context when interpreting its predictive performance.

Falls, both with and without injuries, were also substantial contributors to hospital admissions. This suggests that fall prevention programmes and home safety assessments could play a crucial role in reducing hospital visits.

Additionally, cardiac symptoms and complications from chronic diseases like COPD were prevalent, indicating that enhanced chronic disease management could be beneficial. These findings are consistent with the literature, highlighting the significance of these factors in contributing to unplanned hospitalisations among older adults.[14,15]

The *post hoc* analysis revealed a statistically significant difference in mortality rates within 30 and 90 days between admitted and non-admitted groups, with higher mortality rates observed in the admitted group. Patients with a high DIVERT score are frail, often older and comorbid, and the high mortality rate is not unexpected. It is surprising to see that all the deaths within 90 days occurred in hospital. This should not be interpreted as a causal effect of the admission itself, but rather as a validation that the DIVERT score identifies a cohort with such significant frailty and morbidity that they are nearing the end of life. This finding underscores the importance of integrating advance care planning and palliative care approaches for patients identified as high-risk by the DIVERT scale, regardless of whether they are admitted.[16,17]

The time-to-event analysis showed that close to 20% of patients scoring 5 and 6 on the DIVERT scale were admitted within 20 days of assessment. This finding aligns with previous research suggesting that any interventions must be delivered early during this crucial time frame in order to prevent unplanned admissions.[18] Our analysis shows that 15% of patients admitted were admitted within 72 hours, which would require a very quick response from a community intervention team, and this may not be possible to achieve. However, intervening within 4–14 days should be achievable and this may be able to reduce the risk of admission for many patients. From our analysis we can see that to attempt to reduce admissions an intervention team would need to be able to address acute infections, chronic disease management (particularly cardiac and respiratory illnesses), falls prevention, pain management and advance care planning and palliative care.

Limitations

This observational study has several limitations. Potential biases arose from coding errors and missing data on conditions such as dementia, cognitive impairment and delirium. Immediate interventions by assessors and frailty were not systematically recorded, and our simplified comorbidity index excluded dementia and hypertension. The interRAI Cognitive Performance Scale

was not used, limiting assessment of cognitive impairment. We relied on bivariate comparisons rather than multivariable models, so associations may be confounded. The study validates predictive ability but does not assess interventions or avoidable admissions. Finally, as interRAI HC assessments target older adults needing publicly funded support, findings may not generalise to more independent older populations.

Conclusions

Our study validates the interRAI DIVERT tool as a significant predictor of unplanned hospital admissions in an Aotearoa New Zealand cohort, with risk increasing across score categories. It effectively stratifies high-risk patients, where comorbidity is a key driver. Common admission reasons—such as infections, heart failure and falls—highlight areas of clinical burden. These findings support the tool's use in local practice and policy. Future research should apply formal predictive modelling and evaluate targeted interventions guided by DIVERT-based risk stratification.

COMPETING INTERESTS
HA is chairperson of the training programme subcommittee—geriatric medicine for the Royal Australasian College of Physicians.

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Data availability statement: De-identified individual-level data were obtained from the Aotearoa New Zealand interRAI data warehouse with ethics approval (AHREC reference AH25500, 22 May 2023). The committee allowed secondary research use but prohibited public release of individual datasets. Aggregated data supporting the findings are available from the corresponding author on reasonable request, subject to interRAI New Zealand governance and privacy regulations.

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Mental health–related callouts to the ambulance service in Aotearoa New Zealand: a descriptive analysis

Gabrielle Harding, Sarah Fortune, Rodrigo Ramalho, Andrew Swain, Aroha Brett, Bridget Dicker

ABSTRACT

AIMS: This study aimed to determine the association between demographic and clinical characteristics of mental health–related callouts to the ambulance services in Aotearoa New Zealand, focussing on differences among Māori, Pacific peoples and non-Māori non-Pacific peoples (NMNPP).

METHODS: A retrospective cross-sectional study analysed routinely collected data from electronic patient report forms between 1 July 2022 and 30 June 2023. Mental health–related callouts were identified using clinician-coded impressions from the Aotearoa New Zealand Paramedic Care Collection.

RESULTS: Of 26,847 callouts, a higher proportion involved individuals under the age of 24 among Māori (31.9%) and Pacific people (29.3%) compared to NMNPP (19.1%) ($p<0.001$). Callout proportion was higher in the most deprived areas, particularly among Māori (47.7%) and Pacific peoples (49.9%) versus NMNPP (24.5%) ($p<0.001$). Of total individual callouts, 15.8% presented more than once, with a higher proportion among Māori.

CONCLUSIONS: This study demonstrates an association between ethnicity, deprivation and mental health–related ambulance callouts, with Māori and Pacific populations in deprived areas experiencing proportionately higher callouts. Findings highlight the need for culturally responsive interventions and equitable access to care. Ambulance data can inform policy and monitor mental health trends.

Mental health conditions are common in Aotearoa New Zealand, affecting individuals across all communities. Globally, one in eight individuals is affected by a mental health condition, most commonly depression and anxiety.[1] The most recent Aotearoa New Zealand based prevalence study, conducted in 2006, suggested that 38.5% of the population met the criteria for one or more mental health condition.[2] In the 2023/2024 New Zealand Health Survey, 19.1% of adults reported moderate levels of psychological distress and 13% experienced high or very high levels of psychological distress.[3] In addition to the widespread prevalence of mental health conditions, there are disparities in both access and quality of mental health services available to Māori and Pacific peoples in Aotearoa New Zealand.[4] For mental health conditions, Māori have higher rates of being undiagnosed, admission to hospital and poorer outcomes.[5] Pacific peoples also have higher rates of mental health conditions but lower rates of mental health service access compared to other ethnicities.[6]

Recent health sector reforms in Aotearoa New Zealand highlight the need to strengthen mental health services. The 2018 Government Inquiry into Mental Health and Addiction, He Ara Oranga, called for a paradigm shift: from crisis response, described as the "*ambulance at the bottom of the cliff*", toward early intervention, community-based care and an equity focus.[7] The establishment of Te Aka Whai Ora – Māori Health Authority ensured Māori leadership in health service design and delivery in response to Te Pae Tata, the Interim New Zealand Health Plan.[8] However, the recent disbanding of Te Aka Whai Ora – Māori Health Authority raises concern over the Crown's commitment to Te Tiriti o Waitangi/the Treaty of Waitangi obligations and equitable health outcomes.[9]

Ambulance clinicians may be the first point of contact for individuals experiencing a mental health–related problem. Frontline ambulance services around Aotearoa New Zealand operate under the same *Clinical Procedures and Guidelines* authored by the National Ambulance Sector Clinical Working Group. Ambulance officers have a range of medications in their scope of practice and the ability to refer to general practitioners, urgent care centres or transport to emergency departments.[10] There have been increasing numbers of mental health calls to emergency services.[11,12] To reduce pressure on police and ambulance

services, telehealth mental health services have been expanded. At the same time, police have signalled their intention to reduce involvement in mental health–related callouts.[13,14]

Although international studies have explored mental health–related ambulance callouts, there is currently no Aotearoa New Zealand–based literature on this topic, highlighting a gap in understanding local, demographic, clinical and service use patterns.

The relatively limited international literature suggests that mental health–related ambulance callouts are common and often involve younger patients, females, frequent presentations and limited pre-hospital intervention.[15–19] These findings demonstrate the complexity associated with mental health presentations, reinforcing the need for locally relevant data.

This study aimed to address the gap by determining the association between demographic and clinical presentations of mental health–related callouts to the ambulance service among Māori, Pacific peoples and non-Māori non-Pacific peoples (NMNPP).

Methods

Study design

The study was a retrospective, observational, cross-sectional design using routinely collected data from electronic patient report forms (ePRFs) from 1 July 2022 to 30 June 2023. Mental health–related callouts were identified through clinical impression codes documented by the attending ambulance clinicians in the ePRF. When an individual dials 111, calls are triaged using the Medical Priority Dispatch System (MPDS) and a response level is assigned, ranging from non-urgent to a lights-and-sirens response.[20] This study does not include inter-hospital transfers, or mental health–related calls triaged to telehealth services. Emergency ambulance services are primarily provided by Hato Hone St John (covering 90% of the population) and Wellington Free Ambulance (serving 10% in the Wellington region).[20] These services cater to approximately 5.2 million people and incorporate rural and urban locations.[21]

Eligibility criteria

Observations were included if the attending ambulance clinician selected one of six mental health–related terms as either the primary or secondary clinical impression, as recorded in the ePRFs (Table 1). Cases were excluded if no ambulance attended the scene or if the clinical impression did not include any of the six specified mental health terms. However, if a patient presented with a mental health condition alongside a non-included clinical impression (e.g., alcohol intoxication) the case was still included. Notably, our selection of six mental health–related conditions did not encompass the terms listed as "Not included" in Table 1.

Data sources

The main data source for this study was the Aotearoa New Zealand Paramedic Care Collection (ANZPaCC). Both ambulance services routinely use electronic ePRFs to collect clinical and demographic data during patient attendance and are required to meet HISO 10052:2015 Ambulance Care Summary Standards.[22] Clinical terms are standardised using SNOMED Clinical Terms (SNOMED CT), which the attending ambulance clinician selects. The ANZPaCC dataset is managed by both Wellington Free Ambulance and Hato Hone St John, ensuring data privacy and integrity through de-identification processes.[22,23]

Table 1: Inclusion and exclusion criteria for mental health–related clinical impressions.

Inclusion	Clinical impressions
Included	Mental health problem, intentional poisoning, suicidal, self-harm, hanging, anxiety
Not included	Abnormal behaviour, accidental poisoning by drug (ACC), acute confusion, acute drug intoxication, agitated state, agitation of unknown cause, alcohol abuse, alcohol intoxication, altered level of consciousness (ALOC), confusion, delirium, dementia, drug withdrawal, hallucinations, laceration, poisoning of unknown intent, presentation for social reasons

Measures

Ethnicity was the independent variable, categorised into three groups: Māori, Pacific peoples and NMNPP. These classifications follow single ethnicity prioritisation as outlined in the minimum standards of ethnicity data by Ministry of Health – Manatū Hauora in HISO 10001:2017.[24] The level of socio-economic deprivation was measured using the meshblocks within the New Zealand Deprivation Index 2018 (NZDep18).[25] Status codes assigned by ambulance clinicians are as follows: zero (deceased), one (immediate threat to life), two (serious threat to life), three (potential threat to life) and four (no threat to life). The number of mental health–related callouts was tracked using a unique encrypted identifier (encrypted National Health Index, NHI). This allowed us to determine the number of repeat callouts to the ambulance services over the year-long period.

Data analysis

All descriptive statistics were analysed using IBM SPSS Statistics, version 29.0.2.0. We retained all the available data, but for variables with missing data we used pairwise deletion. This means that any data points with missing values were excluded from the specific analyses involving those variables, resulting in smaller denominators for those calculations.

Ethics

Māori oversight was provided through consultation with Hato Hone St John's Māori Responsiveness Team, in line with Te Tiriti o Waitangi and the principle of rangatiratanga. This ensured that Māori had meaningful input and authority over the relevance and direction of the study.

This study was approved by the Northern B Health and Disability Ethics Committee. Reference: Aotearoa New Zealand, Paramedic Care Collection (ANZPaCC), 2022 FULL 13415.

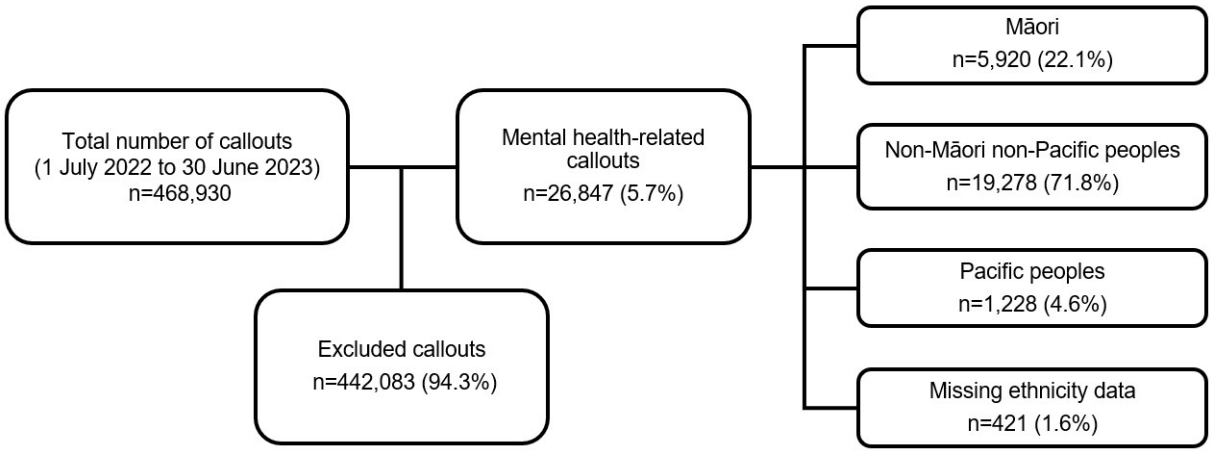
Results

In the period from 1 July 2022 to 30 June 2023 there were a total of 468,930 callouts, of which 26,847 callouts met inclusion criteria (Figure 1). Missing data constituted less than 4% for all variables (Appendix Table 1). The total number of mental health–related callouts were 5,920 (22.1%) for Māori, 1,228 (4.6%) for Pacific peoples and 19,278 (71.8%) for NMNPP.

Demographic characteristics

Among all individuals presenting with a mental health–related callout, 22.4% were 24 years and under, 30.9% were aged 25 to 44, 24.4% were 45 to 64 years and 22.2% were 65 years or older (Table 2). There was a significant difference in the proportion of mental health callouts among younger Māori and Pacific peoples, with 31.9% and 29.3% respectively being under the age of 24, compared to 19.1% among NMNPP ($p<0.001$). Similarly, there was a significantly higher proportion of mental health callouts in the 25–44 age group that were for Māori (39.7%) and Pacific peoples

Figure 1: Distribution of mental health–related callouts by ethnicity in the dataset.



(37.6%) compared to NMNPP (28.8%) (p<0.001).

In terms of sex differences, 64.3% of all mental health callouts were among females and 35.7% among males, with no significant differences across the three ethnicity groups (p=0.092). Specifically, the proportions of mental health callouts among females were 63.3% for Māori, 62.9% for Pacific peoples and 64.7% for NMNPP.

Nearly one-third (30.8%) of mental health callouts occurred in the most deprived quintiles (9 and 10), with the highest proportions among Māori (47.7%) and Pacific peoples (49.9%), compared to 24.5% among NMNPP. There was a trend of higher mental health callouts in areas of greater deprivation for Māori and Pacific peoples, with lower proportions in less deprived areas. The association between NZDep18-quintile and ethnicity was statistically significant (p<0.001) (Table 2).

Table 2: Demographics of mental health–related callouts.

		Total mental health–related callouts (N=X)		**Māori**		**Pacific peoples**		**Non-Māori/ non-Pacific peoples**		**Pearson Chi-squared p-values***
Total	Missing ethnicity N=421(1.6%)	N	%	N	%	N	%	N	%	
		26847	100%	5920	22.1%	1228	4.6%	19278	71.8%	
Age	≤ 24	5821	22.4%	1836	31.9%	352	29.3%	3633	19.1%	<0.001
	25–44	8020	30.9%	2284	39.7%	452	37.6%	5284	27.8%	
	45–64	6334	24.4%	1176	20.4%	283	23.5%	4875	25.7%	
	≥65	5762	22.2%	459	8%	115	9.6%	5188	27.3%	
Sex	Female	16926	64.3%	3733	63.3%	772	62.9%	12421	64.7%	0.092
	Male	9410	35.7%	2165	36.7%	456	37.1%	6789	35.3%	
Location type	Home	20703	78.3%	4456	75.3%	984	80.1%	15263	79.2%	<0.001
	Healthcare facility	1244	4.7%	222	3.8%	40	3.3%	982	5.1%	
	Other	4479	16.9%	1242	21%	204	16.6%	3033	15.7%	
Rurality	Urban	21125	81%	4607	78.7%	1142	93.8%	15376	80.9%	<0.001
	Rural	4960	19%	1244	21.3%	75	6.2%	3641	19.2%	
NZDep18 quintile	1 and 2	2894	11.2%	297	5.2%	73	6%	2524	13.4%	<0.001
	3 and 4	3865	15%	512	8.9%	106	8.8%	3247	17.2%	
	5 and 6	4872	18.8%	829	14.5%	146	12.1%	3897	20.6%	
	7 and 8	6241	24.2%	1354	23.6%	281	23.2%	4606	24.4%	
	9 and 10	7960	30.8%	2734	47.7%	604	49.9%	4622	24.5%	

*p<0.05 is significant; $\chi 2$ test for nominal values. Denominator variations are due to <4% variable-specific missing data.

Clinical characteristics

Final clinical status analysis revealed similar statistics across the three ethnicity groups for both status zero and status one mental health–related callouts. Specifically, the proportions for status zero were 1.1% among Māori, 0.9% among NMNPP and 0.7% among Pacific peoples. For status one, the proportions were 1.8% among Māori, 1.5% among NMNPP and 1.4% among Pacific peoples. However, there was a slight difference in the proportions for status two; Pacific peoples had a lower proportion at 5.8% compared to 7.8% for both Māori and NMNPP. For status three and four, Pacific peoples had a slightly higher proportion at 92.1%, while Māori had 89.3% and NMNPP had 89.9% (p=0.045).

Analysis showed a statistically significant association between transport status and ethnicity (p<0.001). Of the total cases, 67.2% were transported by the ambulance services and 32.8% were not. Māori had a higher proportion of transportation by ambulance at 69.9%, compared with NMNPP (66.5%) and Pacific peoples (63.9%) (p<0.001).

For repeat calls, 19,801 cases were valid, with a statistically significant association between repeat calls and ethnicity (p<0.036). In the year-long dataset, 84.2% of mental health–related callouts were non-repeating. Of the total patients, 9.8% presented twice, 2.8% presented three times and 3.2% presented four or more times. Pacific peoples had a lower proportion of patients presenting four or more times (2%) compared to Māori (3%) and NMNPP (3.3%). Pacific peoples also had fewer patients presenting three times (1.6%) compared to Māori (2.7%) and NMNPP (2.9%). Māori had a higher proportion of patients presenting twice (10.2%) compared to NMNPP (9.7%) and Pacific peoples (9.1%).

Discussion

This study explored the associations between demographic and clinical presentations and mental health–related callouts to emergency ambulance services among Māori, Pacific peoples and NMNPP in Aotearoa New Zealand. The total number of mental health–related callouts during the study period was 26,847. Key findings indicate disproportionately high rates of mental health–related callouts among younger Māori and Pacific peoples compared to younger NMNPP. Female patients accounted for over half of callouts across all ethnicities. The data also highlighted concerning trends, such as higher proportions of callouts in areas of lower socio-economic deprivation for Māori and Pacific peoples. Additionally, the study revealed that most callouts were of low acuity, with a notable proportion of repeat callouts, suggesting unmet need for mental health care.

In regards to sex differences, females constituted 64.3% of the callouts, consistent with findings from Australian ambulance literature.[15,17,18] This contrasts the higher suicide rates among males in Aotearoa New Zealand.[26] Data from the 2023/2024 New Zealand Health Survey show that very high psychological distress was more prevalent among females than males, with Māori females disproportionately affected.[3] Despite being more likely to consult a healthcare professional in the last 12 months, females aged over 15 years reported a higher unmet need for mental health services than men.[3] Ataera-Minster et al. identified a higher prevalence of diagnosed mental disorders and psychological distress among Pacific women compared to Pacific men.[27] This contrasts Te Rau Hinengaro's earlier findings, which found no significant difference.[2,27] The authors suggest the discrepancy may reflect sex differences in self-reporting, service presentation and unconscious gender bias in clinical assessment.[27] Visibility in this study does not equate to adequate mental health care for women, nor does lower proportions of male callouts imply lower need. These patterns may reflect differences in help seeking, gendered perceptions of distress, or potential biases in clinical decision making by ambulance clinicians. While these factors are not measured in this study, they warrant further investigation.

Regarding age, the study identified that younger Māori and Pacific peoples had higher proportions of mental health–related ambulance callouts, aligning with the broader context of mental health statistics and socio-economic deprivation in Aotearoa New Zealand.[28] Over a third of young adults in Aotearoa New Zealand face socio-economic deprivation, which is linked to increased depression, anxiety and self-harm.[28,29] These factors, combined with barriers to accessing services, contribute to the higher proportion of callouts among younger individuals.[28] Recent data from the 2023/2024 New Zealand Health Survey shows the unmet need for professional mental health or substance use support has increased, has disproportionately affected Māori and Pacific peoples and is highest among those 25–34 years.[3]

Socio-economic deprivation significantly impacts mental health callouts, with higher

Table 3: Clinical characteristics of mental health–related callouts.

		Total mental health–related callouts (N=X)		Māori		Pacific peoples		Non-Māori/non-Pacific peoples		Pearson Chi-squared p-values*
Total		N	%	N	%	N	%	N	%	
Missing ethnicity N=421(1.6%)		26,847	100%	5,920	22.1%	1,228	4.6%	19,278	71.8%	
Final clinical status	0	241	0.9%	66	1.1%	9	0.7%	166	0.9%	0.045
	1	409	1.5%	104	1.8%	17	1.4%	288	1.5%	
	2	2,034	7.7%	461	7.8%	71	5.8%	1,502	7.8%	
	3 and 4	23,739	89.8%	5,288	89.3%	1,131	92.1%	17,320	89.9%	
Patient transported	Not transported by ambulance	8,677	32.8%	1,784	30.1%	443	36.1%	6,450	33.5%	<0.001
	Transported by ambulance	17,746	67.2%	4,135	69.9%	785	63.9%	12,826	66.5%	
Repeat presentations**	1	16,681	84.2%	3,780	84.2%	862	87.2%	12,039	84.0%	0.036
	2	1,942	9.8%	456	10.2%	90	9.1%	1,396	9.7%	
	3	553	2.8%	120	2.7%	16	1.6%	417	2.9%	
	≥4	625	3.2%	133	3.0%	20	2.0%	472	3.3%	
Repeat presentations**	>1	3,120	15.8%	709	15.9%	126	12.7%	2,285	15.9%	

*p<0.05 is significant; $\chi 2$ test for nominal values. Denominator variations are due to <4% variable-specific missing data.
**This variable is based on the total number of patients (n=19801) not the total number of incidents (n=26847).

callouts in more deprived areas. This trend was more pronounced among Māori and Pacific peoples, who had the largest portion of callouts in high deprivation areas. This may reflect population trends, as a greater proportion of Māori and Pacific peoples live in areas of higher socio-economic deprivation. These findings are consistent with studies from Australian regions showing higher ambulance callouts in more deprived areas.[15,18]

Final clinical status and transportation status provide insight into the management of mental health–related callouts. The predominance of lower acuity cases (89.8%) and the high rate of cases not transported to healthcare facilities (32.8%) suggest that many mental health callouts may be managed outside emergency settings. Duncan et al. (2019) reported a lower rate of patients left at home by the ambulance (11.8%), but transportation statistics may vary by local protocols and pathways.[19]

The high proportion of repeat callouts (15.9%) indicates a need for more comprehensive care pathways and support services. This finding is consistent with those of Australia and Scotland.[15,19] Limited demographic data on repeat presenters in Aotearoa New Zealand highlight the need for a better understanding of this group's needs. Continued reliance on emergency services suggests inadequate access to or insufficient community-based support. Additionally, Māori individuals often face negative experiences, stigmatisation, fear and distrust which may contribute to delays in help-seeking of mental health care.[4]

Limitations

As a cross-sectional observational design, this study identifies associations but cannot establish causation between demographic and clinical variables and mental health–related callouts. Although missing data were minimal (<4% per variable), their absence could introduce bias. Reliance on clinician coded impressions may oversimplify complex mental health presentations and reflect subjective interpretation. The use of single ethnicity prioritisation, where Māori is prioritised first, followed by Pacific peoples, may undercount Pacific peoples, particularly those who identify as both Māori and Pacific. Since Māori is prioritised above Pacific in the hierarchy, individuals with both identities are counted only as Māori. Future studies could utilise total ethnicity rather than prioritised ethnicity to address this limitation, however this would require careful analysis due to multiple sampling of individual patients.

Recommendations for practice, policy and research

The findings of this study have a number of practical implications. Ensuring appropriate emergency systems, services and support for Māori and Pacific peoples should be a priority for future mental health policies. Addressing socio-economic determinants of mental health such as financial strain, unemployment and inadequate access to healthcare services can improve mental health outcomes.[30] Addressing these issues requires comprehensive policy changes and a targeted approach to mitigate stressors such as racism, socio-economic inequities, stigmatisation and systemic barriers to healthcare. In addition, addressing upstream factors such as access to economic resources may prevent overburdening community mental health services, emergency departments and ambulance services.

These findings must be considered within the context of mental health policy reforms in Aotearoa New Zealand. He Ara Oranga called for a fundamental shift in the mental health system, reinforced by Te Pae Tata, leading to the briefly established Te Aka Whai Ora – Māori Health Authority. The disbanding of Te Aka Whai Ora – Māori Health Authority raises concerns about the sustainability of equity focussed mental health systems and Te Tiriti obligations.[7–9] The reliance on ambulance services for low acuity and repeat mental health–related callouts indicates the need for strengthening community-based and culturally safe services which have yet to be realised in practice.[4] Strengthening community mental health support, educating ambulance staff and establishing clear referral pathways to comprehensive mental health care may help reduce reliance on emergency services and improve continuity of care.

Broadly, this study demonstrated that utilising ambulance data to monitor mental health service trends offers valuable insights into help-seeking behaviours and real-time trends.[23] Australia's successful integration of ambulance data for monitoring mental health and substance use provides a useful example that could inform local approaches.[17,32]

Conclusion

In conclusion, this study has identified significant disparities in mental health–related callouts to Aotearoa New Zealand ambulance services across different ethnicities. The high rates of

callouts, particularly among younger Māori and Pacific peoples, highlight an unmet health need. These findings suggest areas of concern regarding access to timely and appropriate mental health care, particularly in communities experiencing socio-economic deprivation. As an observational cross-sectional study, it identified associations but did not establish causation between clinical and demographic variables and mental health callouts. Nonetheless, the descriptive data provide a valuable foundation for further investigation into service use, unmet need and equity in mental health care. The study has emphasised the value of ambulance data; future studies could explore the use of these data to monitor mental health trends. These findings may help identify policy priorities, including improving access pathways from ambulance services to community-based mental health care and addressing the broader socio-economic determinants that shape mental health.

COMPETING INTERESTS
Bridget Dicker is an employee of Hato Hone St John, and this work was undertaken in "time only" as part of her employment.
Gabrielle Harding is an employee of Hato Hone St John, and this research was conducted as part of her studies at The University of Auckland.
The remaining authors have no other conflicts of interest to declare.

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Appendix

Appendix Table 1: Summary of missing data by variable.

Variables:	Cases valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Age group and ethnicity	25,937	96.6%	910	3.4%	26,847	100.0%
Clinical impression and ethnicity	26,426	98.4%	421	1.6%	26,847	100.0%
Clinical status at scene and ethnicity	26,425	98.4%	422	1.6%	26,847	100.0%
Clinical status final and ethnicity	26,423	98.4%	424	1.6%	26,847	100.0%
ePRF* sex and ethnicity	26,336	98.1%	511	1.9%	26,847	100.0%
GCH and ethnicity**	26,085	97.2%	762	2.8%	26,847	100.0%
Location type and ethnicity	26,426	98.4%	421	1.6%	26,847	100.0%
NZDep18 quintile and ethnicity	25,832	96.2%	1,015	3.8%	26,847	100.0%
Repeat visit and ethnicity	19,801	97.9%	421	2.1%	20,222	100.0%
Transported by ambulance and ethnicity	26,423	98.4%	424	1.6%	26,847	100.0%

*ePRFs=electronic patient report forms.
**GCH=Geographical Classification for Health.

Appendix Table 2: Inclusion criteria for mental health related clinical impressions.

Inclusion	Clinical impressions	SNOMED code
Included	Mental health problem	413307004
	Intentional poisoning	410061008
	Suicidal	267073005
	Self-harm	248062006
	Hanging	219329006
	Anxiety	48694002
Not included	Abnormal behaviour	25786006
	Accidental poisoning by drug (ACC)	59369008
	Acute confusion	130987000
	Acute drug intoxication	231466009
	Agitated state	24199005
	Agitation of unknown cause	24199005
Not included	Alcohol abuse	15167005
	Alcohol intoxication	25702006
	Altered level of consciousness (ALOC)	3006004
	Confusion	40917007
	Delirium	2776000
	Dementia	52448006
	Drug withdrawal	363101005
	Hallucinations	7011001
	Laceration	312608009
	Poisoning of unknown intent	269736006
	Presentation for social reasons	313331005

Vaping behaviour of high-risk and typically developing adolescents: results from the Gauging Risk and Resilience in Teenagers (GRIT) Study

Samantha J Lee, Reisha M Bone, Georgia J M Graat, Lianne J Woodward

ABSTRACT

AIM: To describe the extent and nature of vaping behaviour in a high-risk group of adolescents compared to a regionally representative comparison group of same-age peers at 17.5 years (range 16–19). Vaping rates were examined by sex, age, socio-economic status (SES) and ethnicity.

METHODS: Participants were 53 high-risk adolescents with prenatal substance exposure and family psychosocial adversity and 83 adolescents randomly recruited at birth. At mean age 17.5 years, participants were interviewed about current and lifetime vaping.

RESULTS: Overall, two-thirds of adolescents reported having *ever* vaped, and 43% reported vaping *regularly* (>monthly). Adolescents in the high-risk group were more likely to report both ever (87% vs 55%; $p<.001$) and regular vaping (64% vs 30%; $p<.001$). Regular vaping was associated with lower family SES, although this effect was not significant after accounting for high-risk group status. Māori youth were significantly over-represented among regular vapers compared to non-vapers, but this association was largely explained by family SES.

CONCLUSION: Vaping rates among Canterbury youth are high, with findings suggesting elevated rates for already higher-risk health-vulnerable adolescents. Offering accessible support for existing users and stronger regulations to limit vape product accessibility will be critical to minimise population harm and reduce longer-term health impacts.

Vaping or e-cigarette use among adolescents is a growing public health problem in Aotearoa New Zealand. Results from the Youth19 survey showed that almost 40% of secondary school students (age 13–18 years) had *ever* vaped, with 7.6% being *regular* users (monthly or more).[1] More recent data from the 2024/2025 New Zealand Health Survey showed that 16% of adolescents (15–17 years) and 30% of young adults (18–24 years) regularly vaped, with 14% and 23% respectively vaping daily.[2] These combined data suggest clear upward population trends in youth vaping over the last 10 years.[1,2] The one exception to this general trend is a small decline in daily vaping among youth under age 18 years in 2024. This was further confirmed by the 2024 ASH Year 10 Snapshot Survey, which found that rates of regular vaping among 14–15-year-olds had decreased from 20% in 2021 to 14% in 2024.[3]

E-cigarettes and vape products were initially developed as a less harmful alternative to combustible tobacco products (e.g., cigarettes) in adults, that could be used to aid smoking cessation. However, youth-targeted marketing and ease of availability of vape products corresponded with increases in vaping by young people, most of whom had never smoked before.[1,3] Moreover, youth smoking was declining rapidly before the introduction of vape products in New Zealand.[3] As such, the introduction of higher nicotine concentrations in vaping products and the potential for nicotine addiction among previously non-smoking young people has been of concern.

Thus, to reduce the appeal of vaping and prevent vape use uptake in non-smoking youth, the New Zealand government has progressively amended its vaping legislation.[4] Recent vaping regulations since mid-2023 include banning the use of cartoons and food imagery on vaping devices and packaging, using generic flavour descriptions and limiting nicotine concentrations in vaping products. Selling these products to young people under age 18 remains illegal. Despite these regulations, a recent study found that specialist vape retailers had poor age verification practices, and many did not comply with current regulations by selling disposable vape devices with high nicotine concentrations at discounted prices.[5] *The*

Smokefree Environments and Regulated Products Amendment Bill (No 2) was passed in December 2024.[6] This now prohibits the sale of disposable vapes, bans visible displays of vape products in general stores and online and enforces strict advertising bans and higher penalties for breaches of the law. Further proximity restrictions have been added, and all new specialist vape retailers must now be located at least 300m from schools and marae and more than 100m from early childhood centres.

In addition to curtailing youth appeal and access to vape products, efforts must now be made to assist those young people who are already regular vapers and addicted to nicotine, to reduce or quit vaping and lessen long-term harms. This is particularly urgent given growing evidence of social inequities in vaping, with higher rates of use and addiction among Māori, Pacific and lower socio-economic youth,[2,3] and increased concentrations of specialist vape retailers in the most deprived neighbourhoods.[7] Importantly, the harms associated with vaping, including physical and mental health risks,[8–11] are unlikely to be experienced equally, with high-risk youth—that is, those already experiencing significant health, social or economic disadvantage—more likely to be disproportionately affected.[3,12]

Yet, little is known about vaping behaviour among these high-risk youth in New Zealand. Therefore, the primary objective of this study was to describe rates of vaping in a high-risk group of 16–19-year-old adolescents who were born to mothers with a substance use disorder and, in most cases, raised in adverse socio-economic and psychosocial family circumstances. We aimed to compare the extent and nature of vaping in this high-risk group with a regionally representative group of their same-age peers. We also aimed to examine vaping rates by sex, age, family socio-economic status (SES) and ethnicity.

Methods

Sample

This study reports cross-sectional data from a late adolescent follow-up of a prospective longitudinal study: Gauging Risk and Resilience in Teenagers (GRIT). The GRIT Study sample comprised two groups of adolescents aged 16 to 19 years, who were born between 2003 and 2008 at Christchurch Women's Hospital in the Canterbury region of New Zealand. Exclusion criteria across both groups included very preterm birth (≤32 weeks), congenital abnormality, HIV diagnosis, suspected foetal alcohol syndrome, intent to deliver outside the Canterbury region and non-English speaking parents. A detailed description of the study cohort recruitment procedure is provided in an earlier paper.[13] Characteristics of the sample are shown in Table 1.

High-risk group

The first group included 100 high-risk young people who were born to mothers who were prescribed methadone as part of their Opioid Substitution Treatment (OST) during pregnancy. All pregnant mothers who were in OST during the recruitment period were approached to take part, and 83% were successfully recruited. The median third-trimester methadone dose for participating mothers was 65.0mg/day (12.5–195.0mg/day). Excluding infant (n=4) and adolescent (n=2) deaths, 56% of the original sample was retained at the adolescent follow-up. There were no differences in individual or social background variables between those participants seen and those lost to follow-up, suggesting the retained sample remained broadly representative of children born to mothers with an opioid use disorder in Canterbury during that period.

Comparison group

The second group consisted of 110 non–opioid-exposed comparison children whose mothers were randomly selected from the delivery schedule of Christchurch Women's Hospital, based on the expected due dates of children in the high-risk group (65% recruitment rate). A comparison of the socio-economic profile of this group of families with regional census data showed that they were generally representative of the Canterbury region during the recruitment period. Retention to late adolescence was 78%, excluding three children who were excluded due to severe neurodevelopmental impairment. Participants lost to follow-up were significantly more likely to have been born to mothers who smoked during pregnancy (p=.001), consumed any alcohol during pregnancy (p=.012) and whose mother had low educational attainment at the time of birth (p<.001).

Procedures

All study procedures and measures were approved by the Southern Health and Disability Ethics Committee (ref: 2021 FULL 11202). Between the ages of 16 and 19 years, study participants were contacted via their parents/caregivers and invited

Table 1: Sample characteristics.

Variable		High-risk group (*n*=53)	Comparison group (*n*=83)	*p*
Adolescent characteristics				
Age at follow-up, M (SD)		17.94 (1.23)	17.50 (0.76)	.021
Female sex, %		47.2	49.4	.80
Ethnicity[a]				
	Māori, %	32.1	15.9	.039
	NZ/Other European, %	86.8	84.3	.69
	Pacific, %	5.7	3.6	.57
	Asian, %	0.0	7.2	-
IQ score (FSIQ-2), M (SD)[b]		89.98 (13.88)	103.73 (11.14)	<.001
Family social background				
Mother's age at birth, M (SD)		30.17 (4.93)	32.16 (5.05)	.025
Single mother at birth, %		47.2	9.6	<.001
Low maternal education at birth, %		84.9	13.3	<.001
Low family socio-economic status (SES) at birth, %		92.5	22.9	<.001
Family SES at age 9.5				
	High, %	3.8	55.4	<.001
	Medium, %	28.3	32.5	
	Low, %	67.9	12.0	
Maternal pregnancy characteristics				
Depression at birth,[c] %		44.2	7.2	<.001
History of psychiatric illness, %		57.7	18.3	<.001
Any prenatal cigarette use, %		92.5	10.8	<.001
Any prenatal alcohol use, %		15.1	19.3	.53
Any prenatal cannabis use, %		54.7	0.0	-
Any prenatal benzodiazepine use, %		49.1	0.0	-
Any prenatal stimulant use, %		28.3	1.2	<.001

Table 1 (continued): Sample characteristics.

Infant clinical characteristics			
Gestational age (weeks), M (SD)	38.89 (1.76)	39.08 (1.81)	.18
Birth weight (grams), M (SD)	3067.962 (437.48)	3418.67 (585.37)	<.001
Treated for Neonatal Abstinence Syndrome, %	88.7	-	-

[a] Some participants identified as more than one ethnicity, therefore percentages for ethnic group exceed 100%.
[b] IQ data available for 49 high-risk and 77 comparison group participants.
[c] Probable maternal depression at birth, measured using the Edinburgh Postnatal Depression Scale (score >12).

to participate in an adolescent phase of the GRIT Study. In six instances in the high-risk group, parents did not grant the research team permission to contact the young person. Written informed consent was obtained from all participants. Each of these young people completed a comprehensive semi-structured interview administered by trained postgraduate students or research staff about their lifetime and current drug use, including vaping. These were predominantly in-person face-to-face interviews at the University of Canterbury's Puke-manu Centre. However, where more convenient, some interviews were conducted in participant's homes, over the phone or online via REDCap surveys. Interviewers were blinded to the partici-pants' study group wherever possible.

Measures

Vaping

Participants were asked about their lifetime and current vaping as part of their GRIT Study interview. Participants who responded yes to *"Have you ever vaped?"* were then asked a series of questions, including the age they first tried vaping, how frequently they currently vaped, extent of cigarette use prior to vaping and nico-tine strength of vape products commonly used. In addition, those who reported vaping regularly (more than monthly) were asked a series of custom-written questions based on DSM-IV[14] and DSM-5[15] symptom criteria for nicotine dependence and adapted for vapers. For the present analyses, we report the total number of symptoms of nicotine dependence, as well as the proportion of adolescents reporting two or more dependence symptoms.

Individual and social background variables

Age was examined as a continuous variable. Sex was based on sex at birth. To examine vaping by ethnicity, participants reported all ethnicities they identified with (as reported in Table 1) and were then assigned a single ethnicity using the Ministry of Health – Manatū Hauora ethnicity prioritisation protocol.[16] Family SES was assigned based on parents'/caregivers' occupations at age 9.5 years. The highest-ranked occupation per household was used, with high, medium and low SES codes assigned using ANZSCO classifications[17] and the Elley-Irving scale[18]. High SES included professional and managerial roles, medium SES included technical and skilled jobs, and low SES included semi/unskilled jobs and unemployment.

Statistical analysis

Descriptive statistics were used to determine vaping rates and vape product nicotine concen-trations for the total sample. Vaping rates by study group and by individual and social background variables were then analysed using Chi-squared tests of independence and *t*-Tests for independent means. Logistic regression was used to examine independent associations between SES and vaping and Māori ethnicity (yes/no) and vaping.

Results

Self-reported youth vaping behaviour

Vaping data were available for 52 of the 53 high-risk participants (one incomplete interview) and all 83 comparison participants. Overall, vap-ing rates were high across both adolescent groups, with two-thirds of all adolescents having ever tried vaping and 43% reporting they were current regular (more than monthly) vapers. However, as shown in Table 2, adolescents in the high-risk group were 1.6 times more likely to report ever vaping (87% vs 55%, p<.001) and were more than

twice as likely to regularly vape compared to control peers (64% vs 30%, $p<.001$). A tendency was also observed for the high-risk group to be more likely to convert from ever to regular vaping, but this did not reach statistical significance (73% vs 54%, $p=.06$). Further, a linear-by-linear association test indicated a significant trend toward more frequent use among those who had ever vaped in the high-risk group, $\chi^2(1, N=91)=4.55$, $p=.033$. The median age (15 years) of vaping onset was the same in both groups.

We also examined rates of combustible cigarette smoking among the young people who reported regular vaping (Table 2). Findings showed that vaping was not commonly used for smoking cessation. While a large proportion (particularly within the high-risk group) reported ever smoking (84% vs 60%), less than a quarter of regular vapers had tried smoking before they started vaping, and less than a quarter smoked regularly (at least monthly). Two young people in the high-risk group reported smoking daily, and both were regular vapers.

Table 2: Vaping among high-risk and randomly recruited comparison adolescents.

	High-risk group	**Comparison group**	***p***	**Odds ratio (95% CI)**
Total sample	**(*n*=52)**	**(*n*=83)**		
Ever tried vaping, % (n)	86.5 (45)	55.4 (46)	<.001	5.2 (2.1–12.8)
Current regular vaping,[a] % (n)	63.5 (33)	30.1 (25)	<.001	4.0 (1.9–8.4)
Ever vapers	**(*n*=45)**	**(*n*=46)**		
Converted from ever to regular use, % (n)	73.3 (33)	54.3 (25)	.06	2.3 (1.0–5.6)
Current vaping frequency				
Daily or most days, % (n)	60.0 (27)	39.1 (18)	.03[b]	-
Weekly to monthly use, % (n)	13.3 (6)	15.2 (7)		
Less than monthly, % (n)	6.7 (3)	6.5 (3)		
Not currently vaping, % (n)	20.0 (9)	39.1 (18)		
Age first vaped				
Mean (SD)	14.70 (1.71)	14.57 (1.56)	.70	-
Median (range)	15 (11–18)	15 (10–18)	.66	-
Regular vapers[a]	**(*n*=33)**	**(*n*=25)**		
Ever smoked cigarettes, % (n)	84.8 (28)	60.0 (15)	.03	3.7 (1.1–13.0)
Smoked before vaping, % (n)	27.3 (9)	20.0 (5)	.52	1.5 (0.4–5.2)
Current regular smoker,[a] % (n)	27.3 (9)	16.0 (4)	.31	2.0 (0.5–7.3)

[a] Regular use refers to use more than monthly use.
[b] Linear-by-linear association.

Vaping by sex

There were no sex differences in rates of ever vaping or regular vaping in the total sample, or within the high-risk group alone.

Vaping by age

As shown in Figure 1, there was a tendency towards higher rates of regular vaping with increasing age in the total sample (linear-by-linear association, p=.14). This association was not observed in the high-risk group alone, where similar proportions of the younger participants and older participants reported regular vaping (Figure 2).

Figure 1: Rates of regular vaping by age in the total sample.

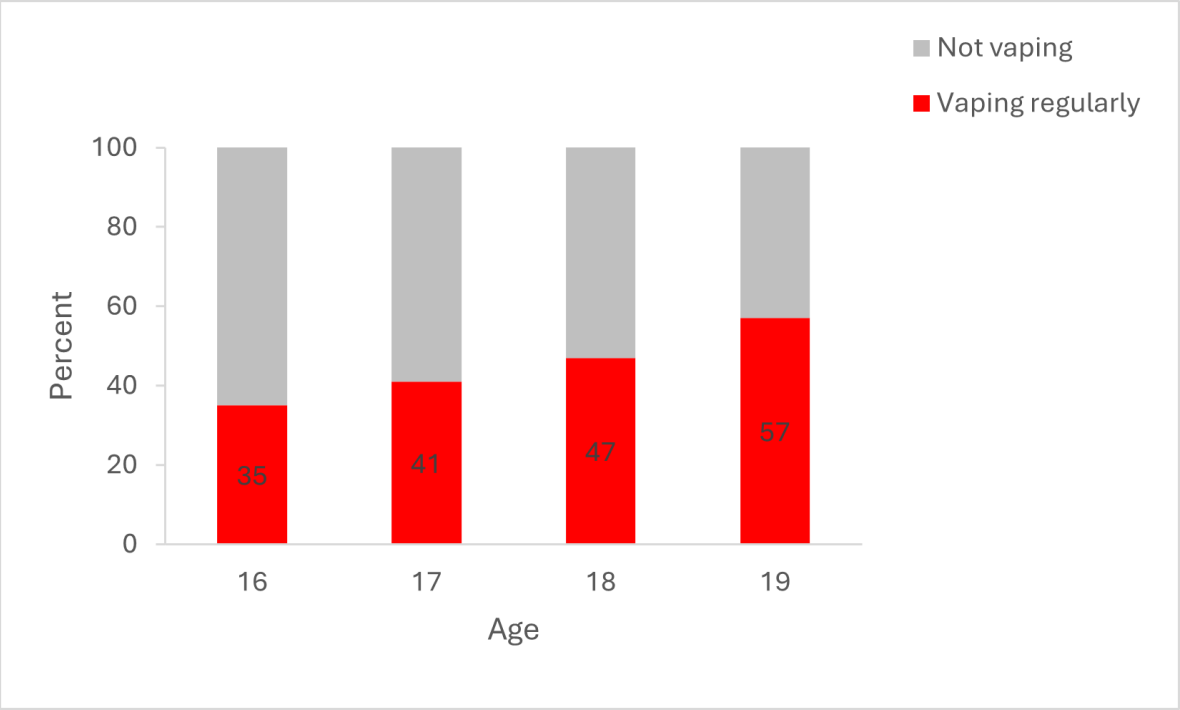
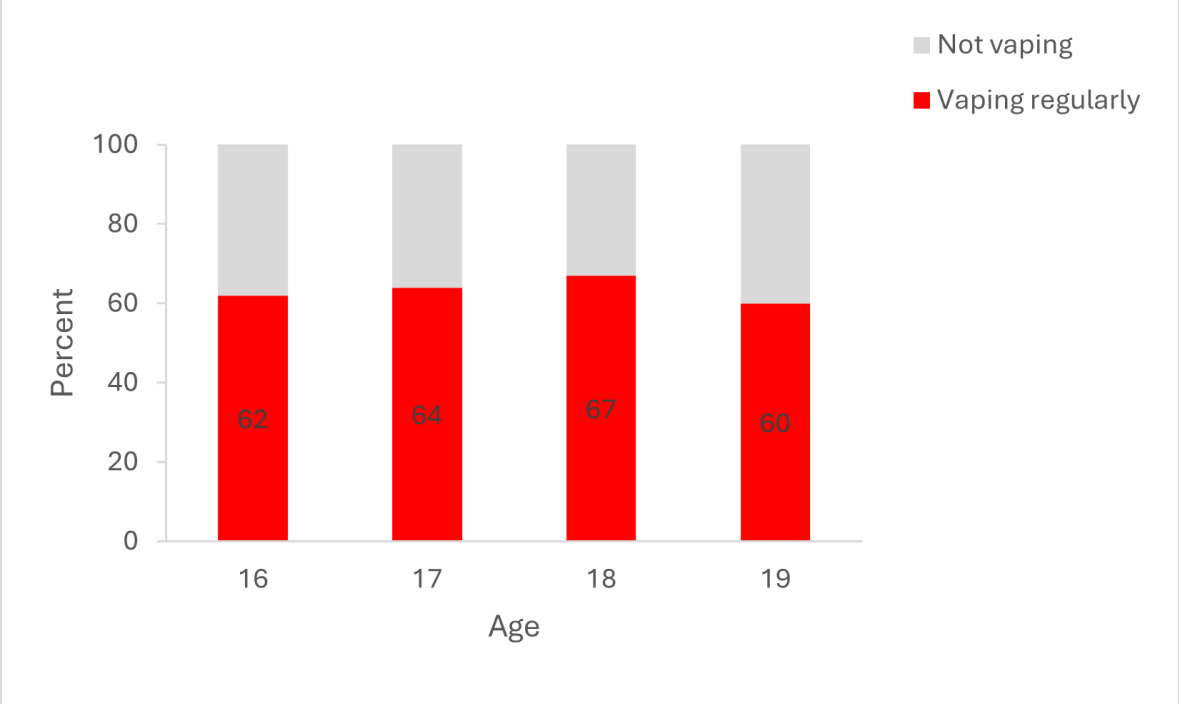


Figure 2: Rates of regular vaping by age in the high-risk group.



Vaping by family SES

Figure 3 shows the proportion of regular vapers within each family SES band. There was a significant linear association between regular vaping and family SES (χ^2[1, N=135]=5.56, p=.018) in the total sample, indicating that adolescents from lower-SES backgrounds were more likely to report regular vaping. This association was not observed within the high-risk group due to the limited variability in SES, as most participants in this group were from low-SES families. We therefore re-examined this association in the total sample, controlling for high-risk group status, with results showing that SES was not significantly associated with regular vaping (B=-0.008, SE=0.289-6, p=.98, OR=1.0 [0.6–1.7]).

Vaping by ethnicity

Rates of ever vaping were similar across all ethnic groups in the total sample. However, as shown in Table 3, a significant association was found between ethnicity and regular vaping in the total sample (χ^2[3]=8.38, p=.039), with Māori youth over-represented among regular vapers (31%) compared to non-vapers (16.9%). The proportions of regular vapers within each ethnic group are shown in Figure 4.

We also examined rates of regular vaping

Figure 3: Rates of regular vaping by family socio-economic status (SES) in the total sample.

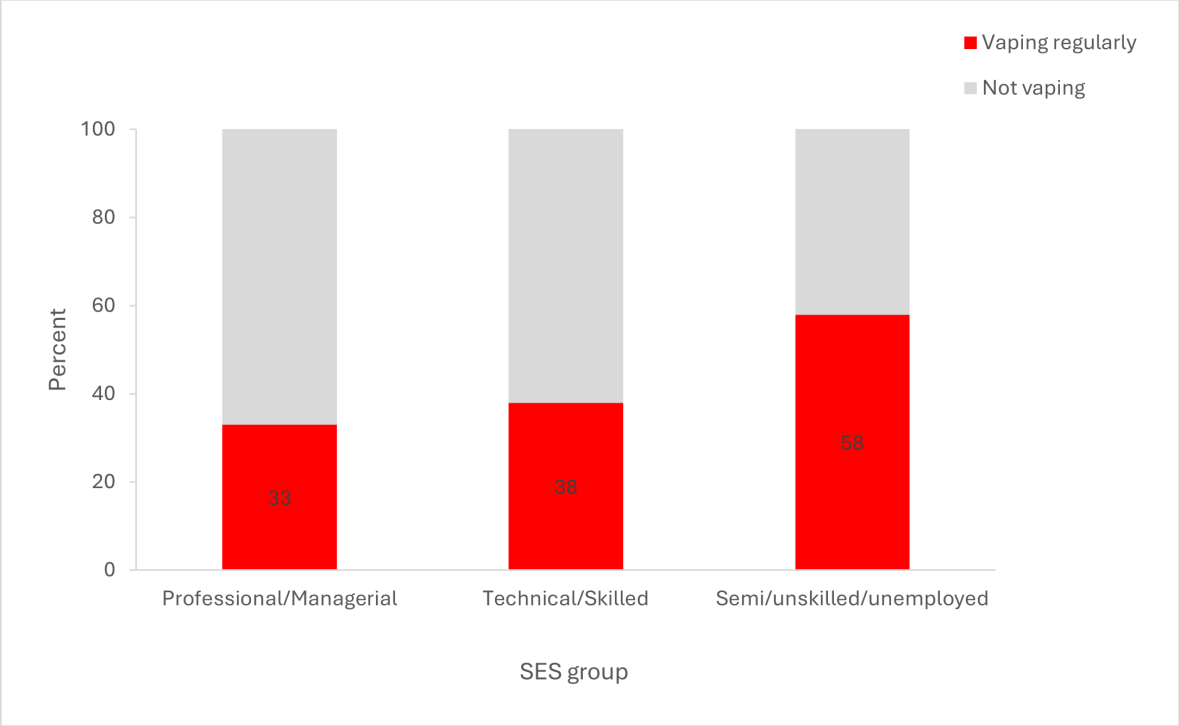
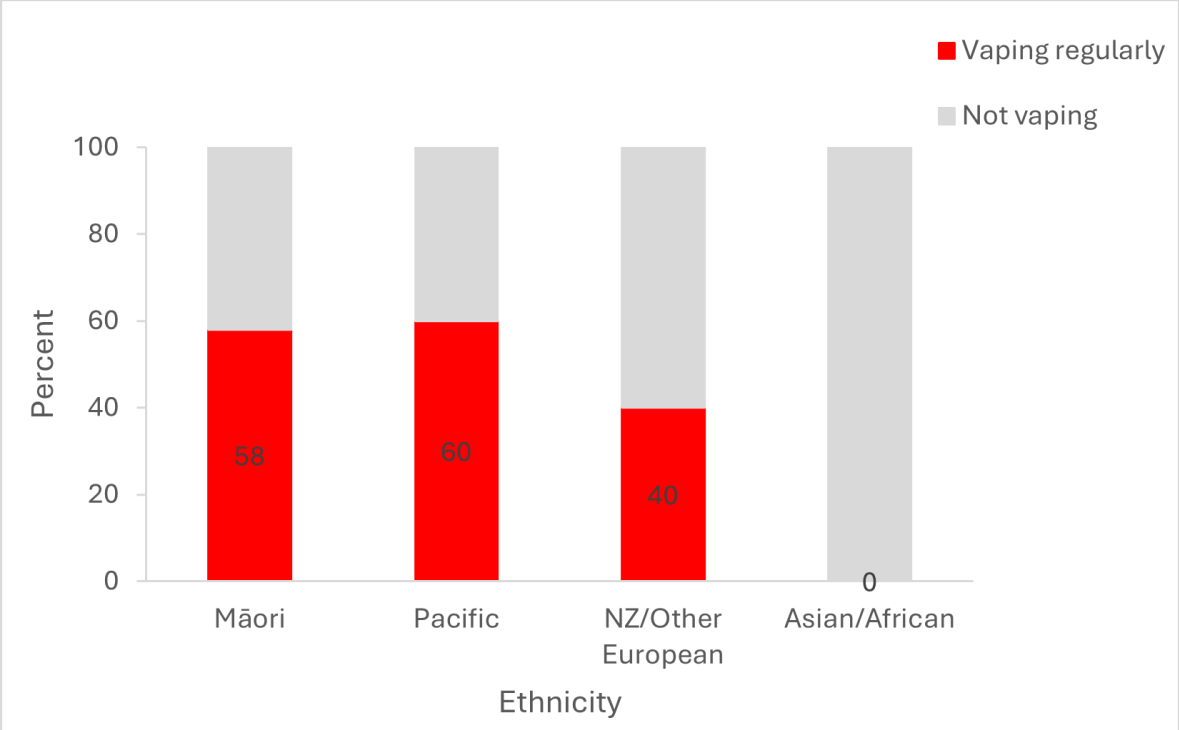


Table 3: Rates of regular vaping by ethnicity for the total sample.

	Percentage of regular vapers (*n*=55)	**Percentage of non-vapers (*n*=75)**	***n* vapers/total *n***
Māori	31.0	16.9	18/31
NZ/Other European	63.8	72.7	37/93
Pacific	5.2	2.6	3/5
Asian/African	0.0	7.8	0/6

Figure 4: Rates of regular vaping within each ethnic group for the total sample.



across ethnic groups within the high-risk sample and found no association between Māori ethnicity and regular vaping. We therefore re-examined this association in the total sample accounting for family SES and found that Māori ethnicity was no longer significantly associated with regular vaping (*B*=0.57, *SE*=0.44, *p*=.19, OR=1.8 [0.8–4.1]).

Nicotine concentration

As shown in Figure 5, participants who were regular vapers most frequently reported using products containing 50–60mg/ml nicotine. Of the participants using these products, 87% were interviewed before the introduction of new labelling regulations mandating the reporting of freebase nicotine concentration, rather than the strength of nicotine salt, in vaping products. For those participants interviewed after these regulations were introduced, use of reusable vape pods and e-liquids containing 20–28.5mg/ml freebase nicotine, approximately equivalent in nicotine concentration to the 50mg/ml nicotine salt products, was common. Only a small proportion of regular vapers in the sample reported using lower-strength (≤15mg/ml) products.

Nicotine dependence

The proportions of regular vapers from each group who experienced symptoms of nicotine dependence are shown in Table 3. Common symptoms included having unsuccessfully tried to cut down or quit vaping (59% vs 54%, *ns*), being unable to go a day without vaping (52% vs 42%, *ns*) and having friends, family members or medical professionals concerned about their use or suggesting they cut down (46% vs 38%, *ns*). Adolescents in the high-risk group were 2.2 times more likely to report feeling tense or irritable if they needed to vape and couldn't (67% vs 30%, *p*=.005), and 1.8 times more likely to want to vape first thing in the morning (61% vs 33%, *p*=.04). Further, adolescents in the high-risk group reported a significantly higher mean number of symptoms than comparison group adolescents (*p*=.03). Three-quarters, compared to less than half of the comparison adolescents (*p*=.02), reported two symptoms or more.

Discussion

This study provides valuable contemporary insights into current adolescent vaping in New Zealand, particularly among young people exposed to significant early life adversity, including prenatal substance exposure and family

Figure 5: Nicotine concentration in vape products of regular vapers in the total sample.

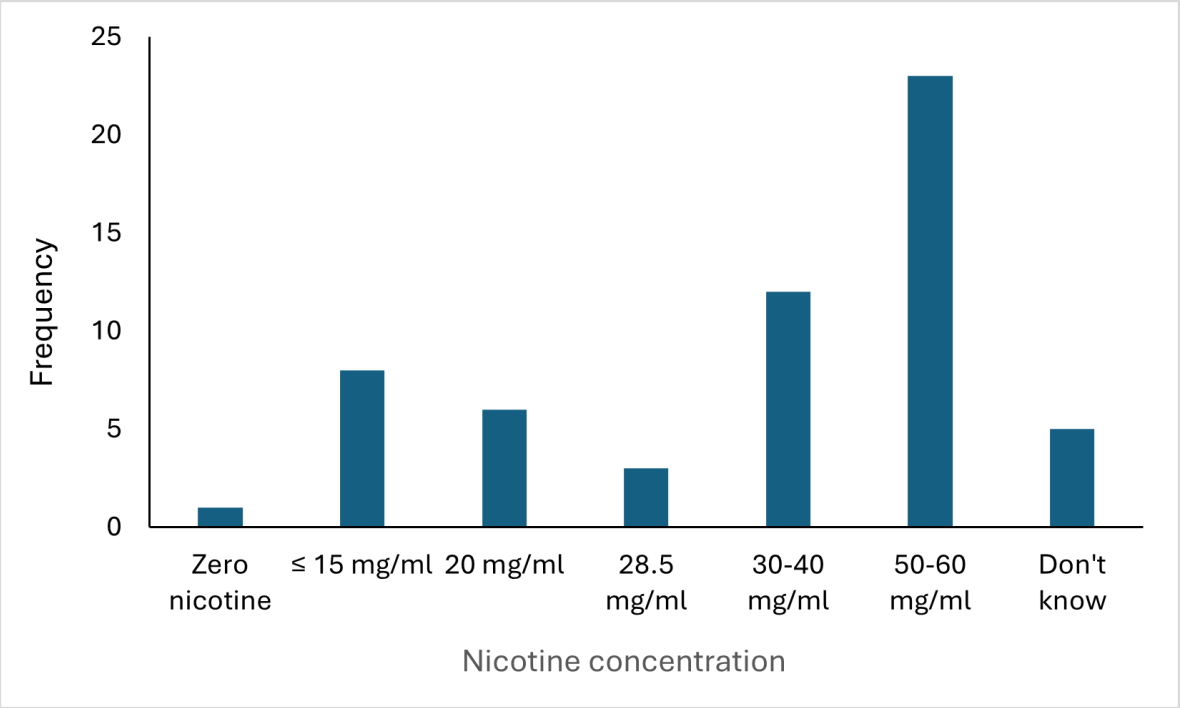


Table 4: Symptoms of nicotine dependence among regular vapers.

Interview item	High-risk group (*n*=33)	Comparison group (*n*=24)[a]	*p*	Odds ratio/ Cohen's *d* (95% CI)
Tried to cut down and couldn't, % (n)	59.4 (19)	54.2 (13)	.79	1.1 (0.4–3.3)
If can't vape, feels tense, irritable, needs a vape, % (n)	66.7 (22)	29.2 (7)	.005	4.9 (1.6–15.2)
Can not go a day without vaping, % (n)	51.5 (17)	41.7 (10)	.46	1.5 (0.5–4.3)
Wakes up in the morning coughing, % (n)	21.2 (7)	8.3 (2)	.19	3.0 (0.6–15.7)
Wants a vape first thing in the morning, % (n)	60.6 (20)	33.3 (8)	.04	3.1 (10–9.2)
Has taken money out of savings to buy vapes, % (n)	39.4 (13)	25.0 (6)	.26	2.0 (0.6–6.2)
Has stolen money to buy vapes, % (n)	9.1 (3)	8.3 (2)	.92	1.1 (0.2–7.2)
Had family, friends, or health professional concerned about use or suggest cutting down, % (n)	45.5 (15)	37.5 (9)	.55	1.4 (0.5–4.1)
Total n. symptoms, M (SD)	3.51 (2.21)	2.38 (2.36)	.03	0.5 (0.0–1.0)
≥2 symptoms, % (n)	75.8 (25)	45.8 (11)	.02	3.7 (1.2–11.4)

a One participant did not complete.

psychosocial risk. Vaping was widespread across the full sample of 16–19-year-olds, with two-thirds having tried vaping and 43% reporting regular (more than monthly) use. However, use was substantially higher among adolescents in the high-risk group, where almost 90% had tried vaping, and close to two-thirds were already regular vapers. Moreover, these youth were more likely to progress from experimentation to regular use and to vape more frequently than their peers. Notably, regular vaping in our high-risk cohort was around four times higher than national prevalence estimates,[1–3] underscoring the urgency of preventing and addressing vaping in vulnerable populations.

Consistent with prior research,[1] vaping was rarely used as a smoking cessation tool. More than three-quarters of regular vapers had never smoked cigarettes before trying vaping, thus raising serious concerns about new pathways to nicotine dependence for youth who might otherwise have never used tobacco. Alarmingly, most regular users reported using very high-nicotine devices, which deliver large doses of nicotine per puff. The rapid nicotine delivery, ease of concealment and the difficulty young people can face in monitoring or limiting their intake heighten the risk for dependence and longer-term health and neurodevelopmental harm.[9,12,19] Among regular vapers in the high-risk group, three-quarters reported two or more symptoms of nicotine dependence, including withdrawal, craving and difficulty quitting, indicating a clinically concerning level of addiction in this already vulnerable group.

While a trend toward age-related increases in regular vaping was observed in the total sample, this pattern was absent among the high-risk adolescents, who showed consistently high rates of use across age groups. This indicates that developmental stage alone did not account for increased vaping risk and suggests the need to consider the role of other prenatal and postnatal biopsychosocial experiences and exposures in placing these youth at increased risk of substance use. Such factors may include prenatal as well as childhood/adolescent exposure to parental nicotine and other substance use, and exposure to a range of adverse childhood experiences (e.g., child maltreatment, family violence, family instability, household mental illness, neighbourhood disadvantage), all of which can affect neurodevelopmental pathways related to self-regulation and reward sensitivity.[7,20–24] This highlights the importance of early identification and intervention efforts that address the broader developmental and environmental contexts of high-risk youth.

Similar mechanisms may help explain the higher rates of regular vaping among adolescents from low-SES backgrounds in the total sample. Although this association was attenuated after adjusting for high-risk group status, likely reflecting the substantial overlap between low SES and inclusion in the high-risk group, previous research indicates that socio-economic disadvantage independently contributes to elevated substance use risk.[25–27]

Ethnic disparities were also evident, with Māori youth significantly over-represented among regular vapers, consistent with national findings.[2,3] However, this association was no longer significant after controlling for SES, suggesting that structural economic disadvantage may underlie much of the observed ethnic disparity. These findings highlight the need for culturally responsive and equity-focussed prevention and intervention strategies.

Public health implications

Although adolescent smoking has declined in New Zealand, the independent surge in vaping popularity among adolescents has disproportionately affected those already facing systemic disadvantage, including Māori, low-income, and high-risk youth. This has not only widened existing health inequities but also created new challenges for our public health system. There are existing gaps in cessation support for vulnerable youth, who are unlikely to access general practitioner support or to sign up for online plans and mobile helplines proactively. Enforcing current restrictions around marketing, product strength and retail access is vital, but not sufficient. Equity-focussed strategies also need to include the development of accessible, youth-friendly and culturally appropriate cessation pathways.

Strengths and limitations

This study draws on a prospectively followed cohort of high-risk adolescents, providing unique insight into vaping among youth exposed to early life adversity and family psychosocial risk. Blinded interviewers, detailed vaping and dependence measures, and robust measures of individual and social background variables strengthen the validity of the findings. Limitations include modest retention in the high-risk group (56%) and selective attrition in the comparison group, which may

have led to underestimation of vaping rates and inflated group differences. The sample size was relatively small, limiting power to detect more subtle associations. Finally, data relied on self-reporting and were collected during a period of regulatory change, which may affect generalisability over time. Despite these limitations, the study provides important evidence of significant and inequitable patterns of vaping and likely nicotine dependence among New Zealand youth, with clear implications for public health responses.

Conclusion

Vaping is widespread among adolescents in Aotearoa New Zealand, but disproportionately affects high-risk youth already disadvantaged by social inequities. Targeted prevention, stronger regulation and culturally responsive cessation support tailored to the unique vulnerabilities of these young people are urgently needed to tackle this growing public health problem.

COMPETING INTERESTS
Nil.

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Effective communication training to support person- and whānau-centred care: what is needed and why isn't it happening?

Melita Macdonald, Brad Peckler

ABSTRACT

AIMS: We sought to investigate the current state of education to support person- and whānau-centred care (PWCC) in our setting and to inform a new approach to teaching and learning. Additionally, we investigated the potential use case of an artificial intelligence (AI) tool to enable clinical communication skill development.

METHODS: A mixed-method co-design approach was used, combining data from a consumer group, an anonymous staff survey (n=312) and a clinician focus group. The project captured lived experiences of communication in clinical care, enablers and barriers to effective training, and perspectives on future educational innovations including AI.

RESULTS: Consumers emphasised the importance of individualised, culturally safe communication and clear, jargon-free language. Findings confirmed that while clinicians generally gain confidence with experience, existing training in communication and PWCC is inconsistent and often inaccessible. Clinicians identified a need for more frequent feedback and practical opportunities for skill development. This feedback should be from a person and whānau perspective. Notably, 90% of clinicians expressed openness to using an AI-based tool for improving communication skills.

CONCLUSION: Traditional workplace education models are insufficient to meet the growing need for effective PWCC, including culturally safe communication in healthcare. An AI-enabled, feedback-driven tool may present a viable complementary solution to current offerings, provided it is co-designed with consumers and clinicians, is culturally grounded and is integrated into existing systems. Further investigation into the development and validation of a tool is warranted.

Studies show that better communication improves health outcomes, safety and equity, while reducing costs.[1,2] Conversely, communication issues contribute to 80% of patient harm events.[3] Health Quality & Safety Commission Te Tāhū Hauora's recent national patient experience survey shows that Māori rate their communication with healthcare providers lower than other ethnic groups, including feeling uncomfortable asking questions.[4] This hampers shared decision-making and affects health outcomes and equity. Māori still experience poorer health outcomes and shorter life expectancy compared to other New Zealanders.[5]

Patient-centred care focusses on respecting individual preferences and ensuring that clinical decisions align with patients' values. It is a partnership between practitioners, patients and their families, empowering them with the education and support needed for informed decision-making.[6] For this report, we use the term "person- and whānau-centred care" (PWCC), which emphasises the importance of recognising the whole person, not just their symptoms or disease, and the role of whānau in Māori health and decision-making[7,8] and of family in Pacific people's health[9]. PWCC is central to the 2022 Te Pae Tata Interim New Zealand Health Plan and is supported by the Health and Disability Commissioner's regulations, which protect patient rights, including the right to respectful, informed care and shared decision-making.[10,11]

People possess a unique understanding of the impacts of their current health and their future functional needs, which is vital to the clinical decision-making process.[13] Effective communication is therefore essential to PWCC, ensuring a two-way sharing of information that explores the patient's values and preferences and supports people and whānau to make decisions based on these.[13,14]

In 2020, the leading causes of death in New Zealand were cancers, ischaemic heart disease, stroke and chronic lower respiratory diseases.[15]

These conditions are largely modifiable, but effective prevention requires a health system that actively involves patients and their whānau in decision-making.[16] This approach depends on health professionals' attitudes, behaviours and their ability to support behaviour change through PWCC.[16] While clinician bias and inherent stereotyping of patients can contribute to poorer quality of care for some, quality of care is also reliant on a system that supports behaviour change: recognising that social determinants also have significant impact on health outcomes.[17]

One challenge to PWCC is the level of health literacy in New Zealand, which the World Health Organization defines as the ability to access, understand and use health information to promote well-being.[3,5,13] Health literacy varies depending on the situation, and low health literacy is linked to poorer health outcomes, particularly among Māori.[18,19,20] Despite tools to improve health literacy and communication, the implementation of these tools in clinical practice remains inconsistent.[5] Healthcare professionals often lack adequate training in communication skills that support PWCC and shared decision-making, including plain language to support health literacy.[5] While some education exists, it is often insufficient or not transferred effectively into practice.[5,13,21,22] Factors such as time constraints, tool familiarity and the de-prioritisation of communication training contribute to this issue.[23]

Simulation-based education is widely used in healthcare, generally including reflection or feedback. Practice and supportive feedback are key to developing skills, with feedback being most effective right after a learning event.[24,25] At Health New Zealand – Te Whatu Ora (HNZ), beyond basic graded clinical escalation training, there is often no mandated communication education, despite known risks to patient safety and health equity. Clinical demands often hinder participation in any training, indicating the need for accessible, motivating and effective education strategies. This places the onus on teaching and learning in the workplace. Clinical teachers themselves identify time as a key barrier to coaching in the workplace.[26] The effectiveness of the current apprenticeship model of clinical education has been brought into question.[27]

Artificial intelligence (AI) shows promise in healthcare communication training by offering cost-effective, time-efficient and accessible learning tools.[28] Evidence-based virtual patients can safely help learners build communication skills, while supporting development in person-centred care and shared decision-making.[29,30] AI models have the potential to provide a more accessible learning platform that provides clinician learners with feedback and support to grow their capabilities in PWCC and shared decision-making.

Methods

This project was a quality improvement project initiated in 2024 with staff from HNZ and Te Herenga Waka—Victoria University of Wellington on the project team. Research ethics approval was granted by the Human Ethics Committee of Victoria University of Wellington (#31569). The project was funded via Te Titoki Mataora Rapid Acceleration Programme (RAP)1 funding. The project team included consumers, clinicians, the HNZ New Technology and Innovation Manager, a health literacy researcher, AI researchers and representatives from Microsoft.

We took a mixed-method co-design approach utilising a clinician survey and focus groups with consumers and clinicians. We enrolled a non-clinical patient navigator alongside four consumers from the HNZ Consumer Engagement Group who represented Māori, Pacific, older adult, youth, rainbow and disability groups. They engaged in a structured group interview utilising an appreciative enquiry approach. An analysis was completed by two of the clinical project team members and the outputs were then reviewed and endorsed by the consumers themselves.

An anonymous clinician survey was sent to all clinical staff via the chiefs of medicine, nursing, and allied professions; education teams; and senior nursing groups. This gave us a degree of confidence that we were considering all views of the problem we had identified in the literature as they applied to our context, and the desirable features of a potential learning solution.

Twelve clinicians with particular interest in the project, or skills and interest in clinical communication education, were invited to participate in a focus group. Three of the consumers and six of the project team members also attended. With representation from nursing, medicine and allied professions, we facilitated a structured presentation of the data gathered via the consumer focus group and the clinician survey and used the session to further understand and discuss the topic. An analysis was completed by two of the clinical project team members and the outputs were then reviewed and endorsed by the clinicians who

attended the focus group.

Results

Consumer respondents

The consumers were asked to describe "good" communication in health interactions with clinicians. Scenarios were used, and they reflected on their own experiences. The appreciative inquiry approach taken provided qualitative data to help guide the learning solution design. In particular, cultural safety, the language and words used, and the need for individualised approaches to communication were highlighted. The focus group outputs were categorised and supported the findings from the literature as outlined below.

1. **Communication is individualised:** Each person's communication needs depend on their values, beliefs and emotional state (e.g., feeling unwell, stressed or in pain).
2. **Building connection is important:** There is no single communication method that works for everyone. Building a personal connection is crucial for encouraging questions, aiding understanding and supporting shared decision-making.
3. **Clear language is essential:** Many people still struggle with medical language. Using simple, accessible terms, such as those recommended by the *Health Literacy Universal Precautions Toolkit*, can help improve communication.
4. **Empowerment to ask questions:** People want to feel comfortable asking questions and accessing the information they need without feeling judged or uninformed.
5. **Cultural sensitivity:** Recognise and respect cultural differences in communication styles and expectations.
6. **Power dynamics in healthcare:** The power imbalance between clinicians and patients is especially significant in cultures where respect for authority is emphasised. In such contexts, involving patients and their families in decision-making may require working within existing hierarchical structures.
7. **Transparency about health information:** Being open about diagnoses, prognosis and treatment options is important, but the approach to delivering this information should be tailored to each individual's needs.

When the potential use of AI to coach and provide feedback on communication to clinicians was discussed, concerns were raised about the realism of AI and whether it could truly provide a consumer's perspective. However, if this concern could be allayed, and given the gap in learning opportunities identified in the literature, the group felt there was a potential benefit to a tool for providing feedback on communication from a PWCC perspective; in particular, a tool to support clinicians to create a connection and develop some understanding of what communication methods will be effective for specific people and whānau, and more importantly establish an environment of trust where patient/whānau are able to communicate what their needs are. Feedback on the language used was also seen as critically important.

Clinician survey respondents

The clinician survey has given the project team a picture of learning experiences from undergraduate level to current-state in our district. This is broken down by key topics below with some consideration of the demographics of the workforce.

Three hundred and twelve clinicians responded to the survey from most disciplines and across all ages and levels of experience. This corresponds to approximately 4% of the current clinical workforce in this district. Of the respondents, 84% were women, 14% were men, 2% preferred not to say and 1 person identified as non-binary. Tables 1–2 and Figure 1 describe the demographics of the respondents. The key survey results are described in Figures 2–8.

The self-reported ethnicity of the clinician respondents differs from the ethnic profile of the New Zealand and the Capital, Coast and Hutt Valley (CCHV) population. Unfortunately, due to an inability to access data from the human resources department, we are unable to compare these data to our workforce demographic profile.

Although newer graduates are more regularly receiving this education at undergraduate level, only 44% of senior clinicians reported to have received undergraduate education in relation to PWCC or shared decision-making themselves. Although this relies heavily on memory, it speaks to their perception of being taught and learning these skills at an undergraduate level.

Figures 5–7 indicate that accessing education when it is available is not easy for most (61% of 275 respondents), while learning in the workplace through observation and feedback is challenging.

Table 1: Clinical disciplines of respondents.

	Allied health professional n*(%)*	Doctor n*(%)*	Nurse n*(%)*	Midwife n*(%)*	Scientific and technical professional n*(%)*
Number of respondents n=312	59*(19)*	49*(16)*	186*(59)*	15*(5)*	3*(1)*

Table 2: Survey respondents age distribution and years of experience in healthcare.

	Age in years							Total years experience
Years of experience in healthcare	20–25	26–30	31–35	36–40	41–45	46–50	51+	
0–1 year	63	14	7	3		1	1	89
1–2 years	4	1	1		1			7
2–5 years	11	10	4			1		26
5–10 years	1	9	13	4	2		5	34
>10 years			9	27	28	20	72	156
Total	79	34	34	34	31	22	78	312

The survey data present a picture of the current level of confidence and skill, alongside the realities of accessing and implementing learning into practice. Not surprising is the reporting that comfort and confidence with these skills generally improves with time and experience. Interestingly, there were a small number of experienced older clinicians who rated themselves as less comfortable and confident having this type of conversation effectively. It must be noted that confidence does not always equate with competence.

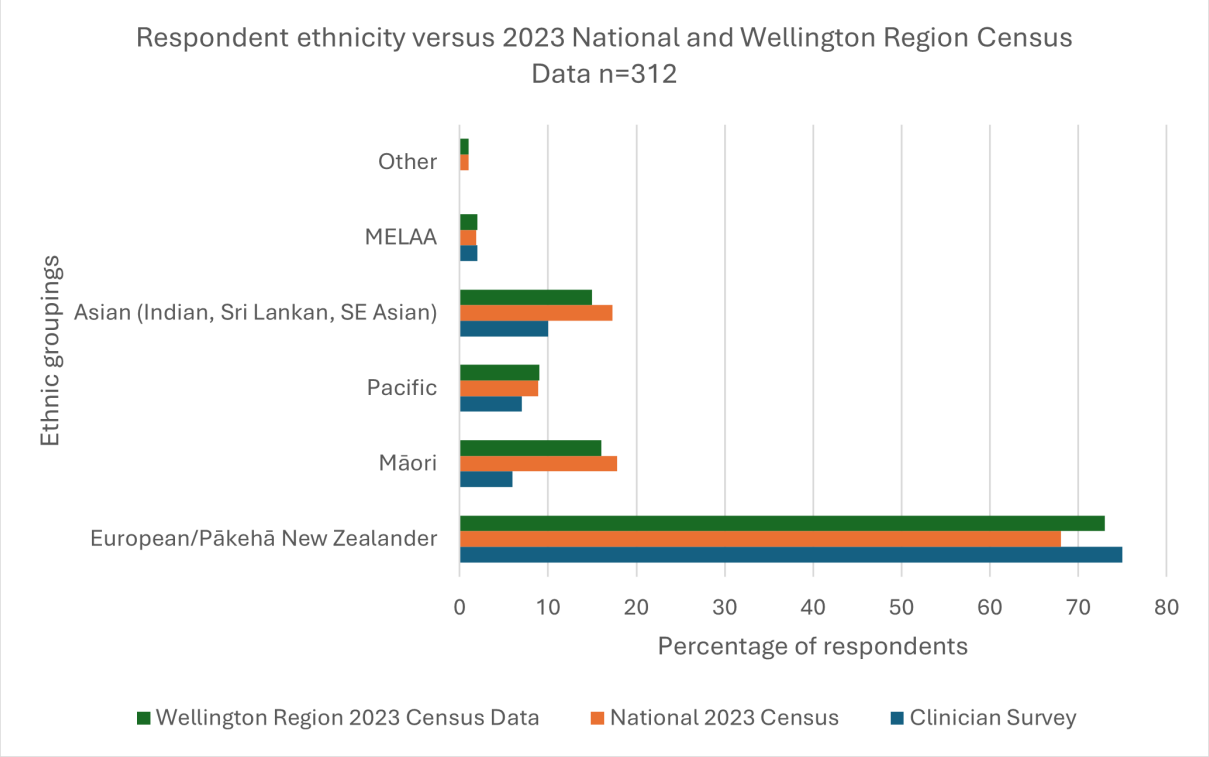
Two hundred and fifty-five (82%) respondents do not regularly have the opportunity to receive feedback from experienced colleagues on their person-centred communication skills with real people in their care or their whānau. Yet 85% of respondents feel that feedback would be useful to improve their skills.

Although 90% of clinicians indicated an openness to using an AI tool that provides feedback on communication skills (Figure 7), concerns were also raised about AI (Table 3). These were categorised into five general domains.

Clinician focus group

The aim of this focus group was to consider, in more depth, the current approach to PWCC education and the options for a new approach. The group concurred with the clinician survey and consumer focus group conclusions. They expanded on these challenges and stated that clinicians are often unaware of their strengths and weaknesses due to a lack of feedback. This hinders their ability to effectively engage with patients and tailor their communication to individual needs and preferences. Access to education to enable this and culturally safe communication is limited. They raised the fact that the apprenticeship model may not be conducive to open and honest feedback due to concerns about vulnerability and power dynamics. The group described positives and negatives to using AI to provide feedback on communication skills that mirrored the findings

Figure 1: Ethnic breakdown of respondents.



Note: Total response ethnic groups have been used (where everyone is included in every ethnic group they identify with) so percentages add to more than 100%.

Figure 2: Reported current level of comfort and confidence explaining medical or care-related information in a way that is understandable to people and whānau in their care, by years of experience in healthcare.

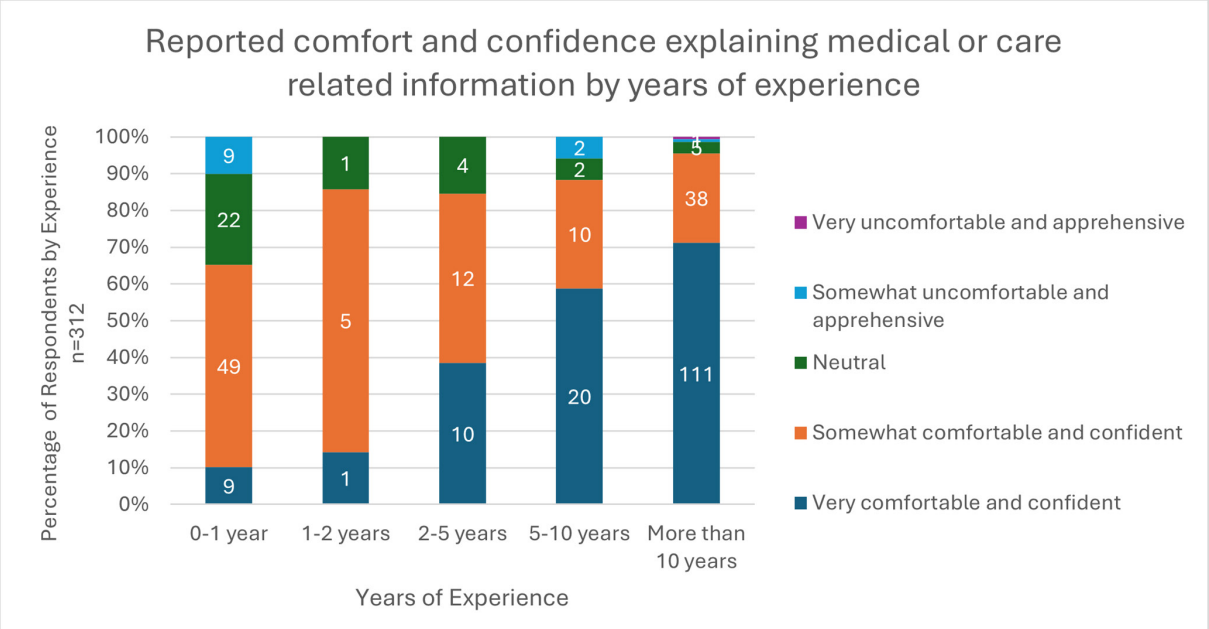


Figure 3: Specific undergraduate training in communication skills to support person- and whānau-centred care (PWCC) by years of experience.

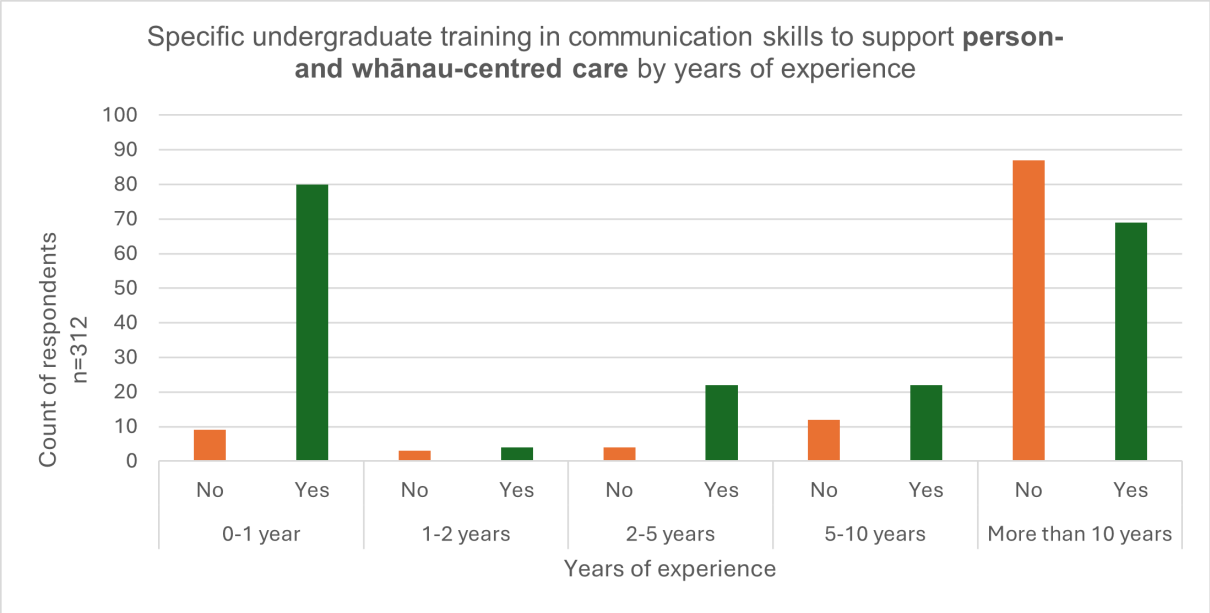


Figure 4: Specific undergraduate training in communication skills to support shared decision-making by years of experience.

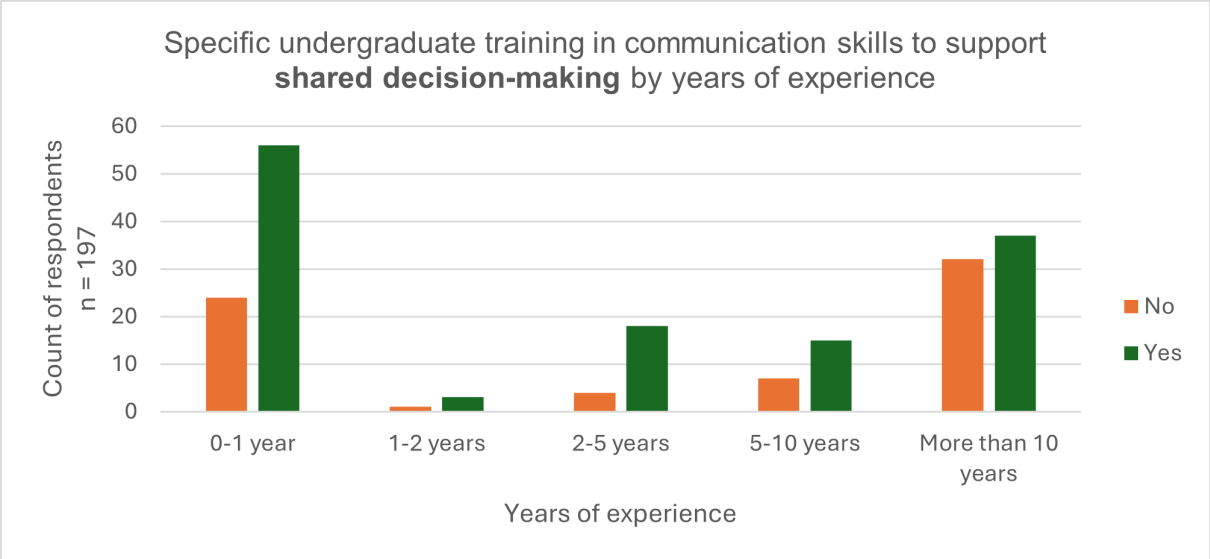


Figure 5: Ease of access to communication skills training when it is available.

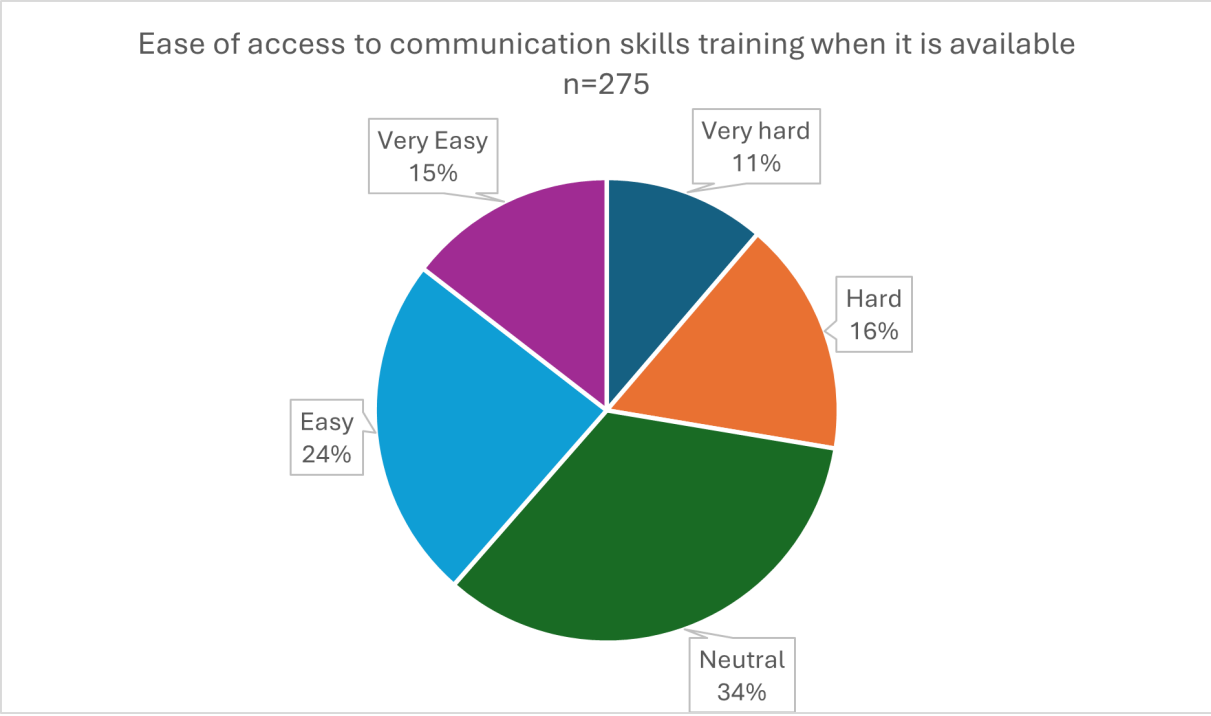


Figure 6: Opportunity to observe person- and whānau-centred care communication in the workplace.

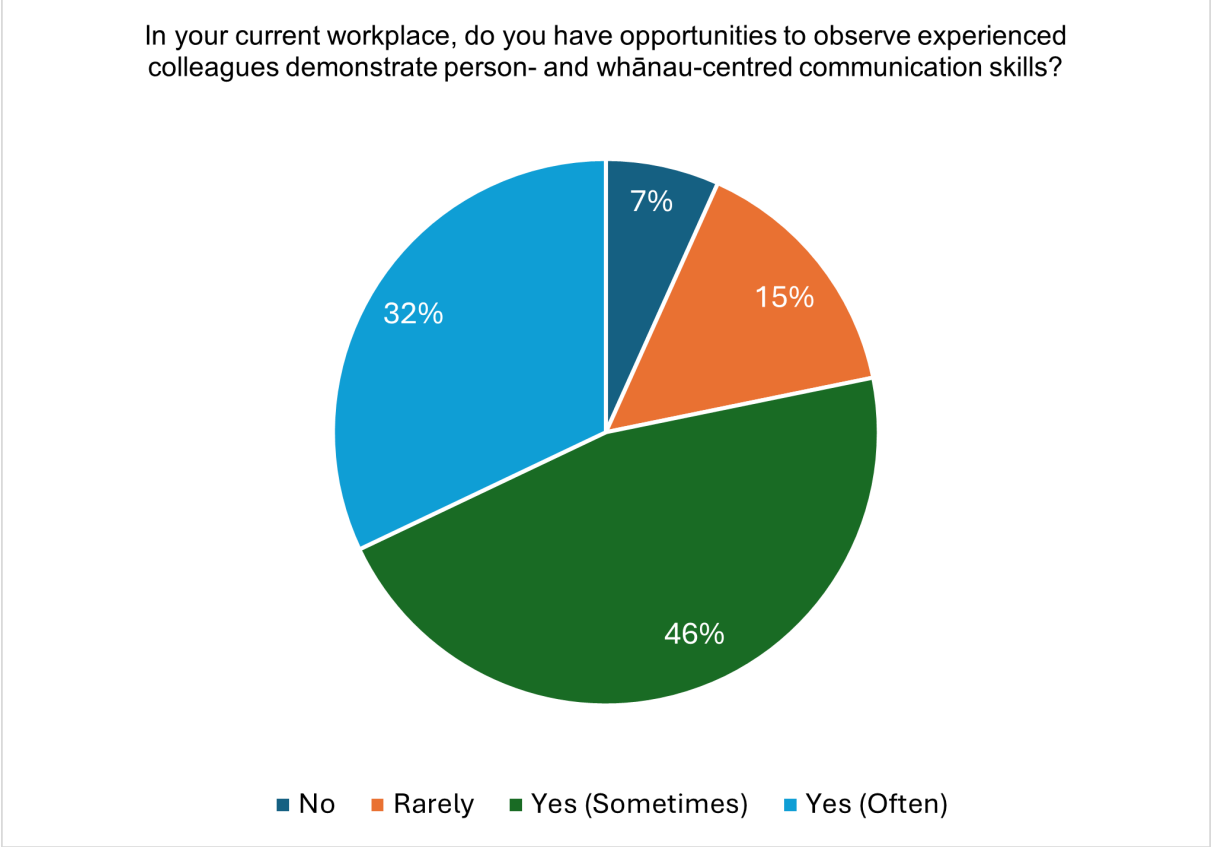


Figure 7: Receiving feedback on person- and whānau-centred care (PWCC) skills in the workplace.

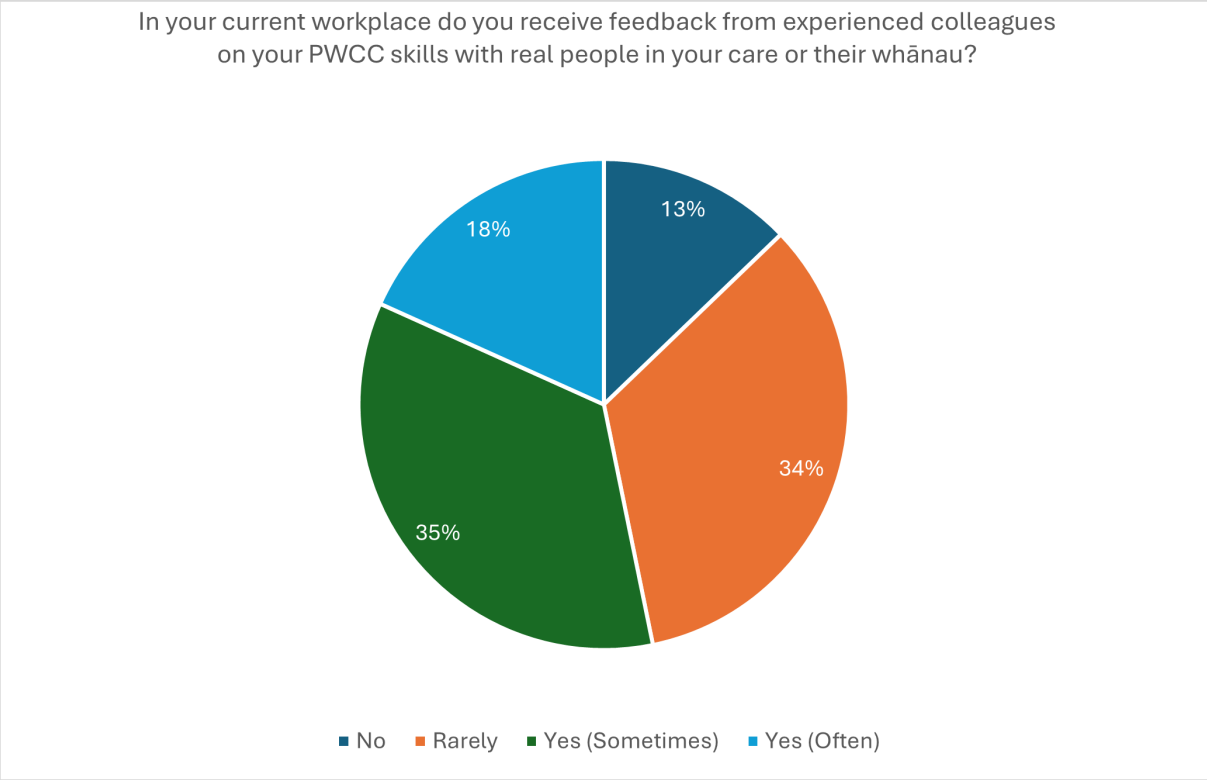


Figure 8: Openness to using an interactive artificial intelligence (AI) tool.

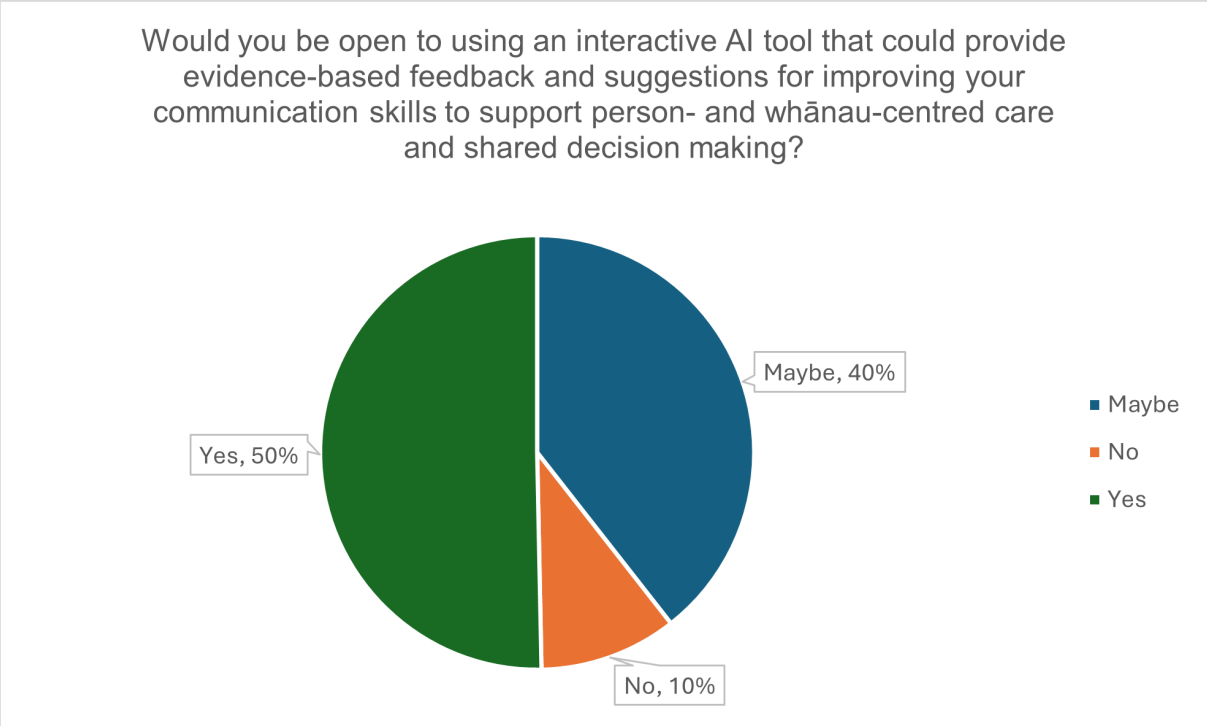


Table 3: Survey respondents reported concerns regarding an artificial intelligence (AI) teaching and feedback tool.

Humanity and authenticity	Privacy and data security + IT	Accuracy and reliability	Effectiveness and engagement	Ethical considerations
• Lack of human experience—each person and interaction is unique • Artificiality of AI feedback—not personalised • Inability to capture non-verbal cues • Lack of empathy and understanding of human nuances	• Security and privacy of data collection, analysis and usage • Risks to confidentiality • Lack of IT skills to use the tool • IT systems • Being audited—"Big Brother"	• Inaccurate information—validity • Lack of cultural sensitivity • Loss of subtleties and nuances	• Less engaging or impacful • Lack of real-world context—too prescribed • Preference for in-person training • Concerns about effectivenss of AI-based feedback	• Bias • Indigenous perspectives on person-centred care not led by Indigenous • Impact on the planet • Perpetuating and reinforcing stereotypes • Lack of New Zealand centric focus

in the survey (Figure 7 and Table 3).

Discussion

Feedback from consumers has provided further validation of the New Zealand patient survey data and the literature in relation to health literacy and PWCC. Despite there being tools available, and recommended approaches to communication in the clinical setting, the lived experience is that these are not regularly being used or used effectively. Health literacy is not being well supported through the routine use of proven tools. Consumer experience reinforces the literature finding that the application of the Hui Process or other culturally safe and person-centred approaches are not yet fully embedded into practice in this setting.

With continuous practice, including the opportunity to make mistakes, have new experiences and critically receive feedback that supports improvement, we are more likely to build skill and confidence. Access to relevant education that supports integration into practice appears to be a barrier to improving PWCC. Current access to communication-focussed education is limited. Only 17% of survey respondents reported attending communication related training in the last 12 months. Senior clinicians are also not receiving regular feedback; yet, in our current apprenticeship approach, senior clinicians are expected to teach the more junior staff.

The current apprenticeship model—learning in the workplace with feedback—does not appear to be teaching or reinforcing these skills in a meaningful way for all levels. Clinician respondents reinforced the challenge of the apprenticeship model as a way of learning due to concerns about vulnerability.

The differing ethnic profile of our workforce to the New Zealand and CCHV population may be a factor in relation to the consumer experience of culturally safe communication skills. Although the small survey sample may bias the results, it does increase the significance of teaching and enabling implementation of culturally safe practice and communication when considering known health inequities. This may be an area for further exploration and highlights the importance of Indigenous input into this project.

This project has confirmed the need for accessible, effective communication observation and feedback from a person and whānau perspective. AI may have a role in this given the workforce education challenges we have highlighted. Despite the small numbers of survey respondents, the input from consumer and clinician respondents, as well as the clinical project team members' own experiences, support the overarching findings that the traditional approach to teaching these skills is lacking. This includes attending in person training in our currently resource constrained environment and receiving feedback in the workplace (the apprenticeship model).

If our clinicians are not regularly experiencing

learning opportunities in the classroom or in clinical settings and are not receiving feedback in a safe and supportive way, they are not likely to build and use the skills people and whānau say they need. Equally, learning that has occurred has not always translated to skills that effectively support PWCC as suggested by the literature and our consumer group. The potential disconnect between the person and whānau experience and the clinician's perceptions of interactions is a gap, and therefore a learning need we have identified. Addressing these issues requires improved access to communication training that varies with the learners' experience, confidence and skill, alongside regular and trusted feedback mechanisms, and the creation of safe learning environments that prioritise cultural safety and individual needs. The feedback the learners receive needs to be from the person and whānau perspective to bridge this gap.

An AI feedback tool may be a feasible option that can bridge some of the gap identified. Ninety percent of respondents stated they would be open to using an interactive AI tool that could provide evidence-based feedback and suggestions for improving their communication skills to support PWCC and shared decision making. The staff survey and the clinician focus group indicated that the potential for individualised and valid feedback, which is contextualised to the New Zealand context, incorporates cultural safety, and that can be accessed easily at any time, was seen as a potential advantage of this option over the current state.

However, concerns were also raised in relation to validity, data security, potential lack of Indigenous perspectives, perpetuation of stereotypes, environmental impacts, and whether the tool would offer an engaging way of learning. To mitigate this, any tool would need to be co-designed and tested with consumers to ensure that the feedback and coaching given was representative of their perspectives. If designed and built in this way, with appropriate governance, AI may provide a valid, personalised, and more easily accessed learning opportunity. AI has the potential to provide a foundational learning experience to complement more resource intensive simulation-based education.

Limitations

The low response rate to the clinician survey may not adequately reflect the entire workforce views. Clinicians who attended the focus group may have been more invested in communication education or be biased for or against AI. They may have stronger opinions than other members of the workforce, although their inputs echoed the survey findings. The consumer group was not representative of the general population.

Implications

The implications of this work signal the need for effective communication education in healthcare, specifically focussing on PWCC. This must include methodologies that support embedding of learning into practice. Tools will need to be developed to provide accessible and supportive feedback to clinicians. These should be co-designed to ensure they truly reflect consumers perspectives.

Conclusion

There may be merit in investigating the ability to build an AI feedback tool for more rigorous research and testing of validity, and the impact on learning and skill development. The understanding and transparency of any environmental impacts of such a tool, as well as the importance of Indigenous and broad consumer input into a tool's vector build, design and outputs has been highlighted. Appropriate governance is important. Alongside these key features, the co-design approach needs to remain at the forefront to ensure the PWCC aim is achieved. The project team are investigating options to further this work.

COMPETING INTERESTS
Nil.

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With funding from Te Tītoki Mataora this work has been completed with a team of clinicians, consumers, the HNZ New Technology and Innovation Manager, health literacy and AI researchers, and a key business partner—Microsoft. Without all these people, who are willing to think outside the box, to innovate and to think of new ways of doing things in a resource constrained environment to improve patient outcomes and increase equity, this work could not have happened.

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Appendix

Appendix: Clinician survey.

VICTORIA UNIVERSITY OF WELLINGTON TE HERENGA WAKA

Person-Centred Care Communication Survey

Thank you for participating in this short survey to help us understand the training and support available to health professionals in developing communication skills for person-centered care and shared decision making.

Person-centred care and shared decision making can be described as "*a partnership among practitioners, patients, and their families that ensures that decisions respect the persons' wants, needs, and preferences, and that people have the education and support they need to make decisions and participate in their own care*" (Institute of Medicine, 2001).

You are invited to take part in this project. Please read the information below before deciding whether or not to take part. If you decide to participate, thank you. If you decide not to participate, thank you for considering this request. This survey should take about 6 minutes of your time.

* Required

A co-design approach to utilising AI to improve communication skills within healthcare

INFORMATION FOR PARTICIPANTS

Ko wai ahau / Who am I?
My name is Melita Macdonald and I am a Masters student enrolled in *HLTH551 Professional Project* at Te Herenga Waka—Victoria University of Wellington. This project is work towards the final course of my Masters degree. I am also the Manager of the Simulation Service at Health NZ | Te Whatu Ora Capital, Coast and Hutt Valley.

He aha te whāinga mō tēnei rangahau / What is the aim of the project?
The purpose of this survey is to help us understand the training and support available to health professionals in developing communication skills for person-centred care and shared decision making. We aim to co-design a novel teaching and feedback tool for clinicians that supports increased capability in person-centred communication. Through improving the clinician's communication skills, we aim to empower patients and whānau - enabling increased health literacy, shared decision-making and equity of health outcomes. This project assignment has been approved by the Te Herenga Waka—Victoria University of Wellington Human Ethics Committee, Reference number #0000031569.

Ka pēhea tō āwhina mai / How can you help?
Your participation will support the project outcomes by providing a contemporary picture of the communication skills learning you engaged in as an undergraduate – and in your current role.

Ka ahatia ngā kōrero ka tukuna mai / What will happen to the information you give?
Your survey responses are anonymous. This means that nobody, including me or my supervisor will be aware of your identity. By answering it, you are giving consent for me to use your responses in the report that is written about the project. Your answers will remain completely anonymous and unidentifiable. Once you submit the survey, it will be impossible to retract your answer. Please do not include any personal identifiable information in your responses.

He aha ngā hua o te rangahau / What will the project produce?
The information from the project will be used in my final Project Report assignment and possibly academic publications and conferences.

Mehemea ngā pātai, he raruraru rānei, me whakapā ki a wai / If you have any questions or problems, who can you contact?
Student: Melita Macdonald
Email: Macdonmeli1@myvuw.ac.nz
Supervisor: Dr Jill Wilkinson Email : Jill.wilkinson@vuw.ac.nz
Role: Course Coordinator, School of Nursing Midwifery & Health Practice
Phone: +64 4 887 3819

Appendix (continued): Clinician survey.

Note that all responses are anonymous

Participating in this survey implies that you are willing for anonymous data collected to be used to inform an improvement project run by the Simulation Service, HNZ | Te Whatu Ora Capital, Coast and Hutt Valley.

1. What is your primary field of clinical practice at present? *

- ◯ Doctor - PGY1
- ◯ Doctor - PGY2
- ◯ Doctor - PGY3 or above including Registrars and SMOs
- ◯ Registered Nurse - NETP
- ◯ Registered Nurse (not NETP) - New Zealand qualified
- ◯ Registered Nurse - Internationally qualified
- ◯ Registered Nurse - Nurse Practitioner
- ◯ Midwife - New Graduate
- ◯ Midwife - Not new graduate
- ◯ Allied Health Profession
- ◯ Scientific or Technical Profession

2. Please select your age group *

- ◯ 20 - 25 years
- ◯ 26 - 30 years
- ◯ 31 - 35 years
- ◯ 36 - 40 years
- ◯ 41 - 45 years
- ◯ 46 - 50 years
- ◯ 50 years +

Appendix (continued): Clinician survey.

3. Please indicate your ethnicity - choose as many that apply *

- [ ] Māori
- [ ] European/Pākehā
- [ ] Pacific Peoples
- [ ] Asian
- [ ] Middle Eastern
- [ ] Latin American
- [ ] African
- [ ] Other

4. Please indicate your gender *

- ◯ Woman
- ◯ Man
- ◯ Non-binary
- ◯ Prefer not to say

5. How many years of experience have you had working in healthcare? *

- ◯ 0-1 year
- ◯ 1-2 years
- ◯ 2-5 years
- ◯ 5-10 years
- ◯ More than 10 years

6. How comfortable and confident are you currently with explaining medical or care-related information in a way that is clear and understandable to people in your care and their whānau? *

- ◯ Very comfortable and confident
- ◯ Somewhat comfortable and confident
- ◯ Neutral
- ◯ Somewhat uncomfortable and apprehensive
- ◯ Very uncomfortable and apprehensive

Appendix (continued): Clinician survey.

Undergraduate Communication Skills Training - Person Centred Care

7. Did your undergraduate programme include any specific training in communication skills to support **person-centred care**? *

- ◯ Yes
- ◯ No

8. What type of training did you receive? *Select all that apply* *

- ☐ Workshops
- ☐ Coursework
- ☐ Online learning
- ☐ Role play
- ☐ Simulations
- ☐ Patient feedback
- ☐ Other

9. How well did this training prepare you to effectively communicate with people and their whānau to enable person-centred care? *

- ◯ Very effective
- ◯ Somewhat effective
- ◯ Neutral
- ◯ Somewhat ineffective
- ◯ Not effective

Appendix (continued): Clinician survey.

Undergraduate Communication Skills Training - Shared Decision Making

10. Did your undergraduate programme include any specific training in communication skills to support **shared decision making**? *

- ◯ Yes
- ◯ No

11. What type of training did you receive? *Select all that apply* *

- ☐ Workshops
- ☐ Coursework
- ☐ Online learning
- ☐ Role play
- ☐ Simulations
- ☐ Patient feedback
- ☐ Other

12. How well did this training prepare you to effectively communicate with people and their whānau to enable shared decision making? *

- ◯ Very effective
- ◯ Somewhat effective
- ◯ Neutral
- ◯ Somewhat ineffective
- ◯ Not effective

Appendix (continued): Clinician survey.

Your Current Workplace

13. Does your workplace provide opportunities to attend training where you can **practice and receive feedback** on your person-centred communication skills (e.g. lectures, role-playing, simulations)? *

- ◯ Yes (often)
- ◯ Yes (sometimes)
- ◯ Rarely
- ◯ No

Appendix (continued): Clinician survey.

Your Current Workplace

14. How easy is it to attend communication skills training when it is available? *

☆ ☆ ☆ ☆ ☆

15. Have you attended any communications skills training at work in the last year? *

- ◯ Yes
- ◯ No

16. What communication skills training have you attended at work in the last year? *

17. How much time did the training take? *

- ◯ 0-1 hour
- ◯ 1-2 hours
- ◯ 2-3 hours
- ◯ 3-4 hours
- ◯ 4 - 8 hours
- ◯ 1-2 days
- ◯ Other

18. How useful and applicable was the training to your work? *

☆ ☆ ☆ ☆ ☆

Appendix (continued): Clinician survey.

'On the Job' Learning and Mentoring

19. In your current workplace, do you have opportunities to **observe** experienced colleagues demonstrate person-centered communication skills? *

- ◯ Yes (often)
- ◯ Yes (sometimes)
- ◯ Rarely
- ◯ No

20. In your current workplace, do you have the opportunity to **receive feedback** from experienced colleagues on your person-centred communication skills with real people in your care or their whānau? *

- ◯ Yes (often)
- ◯ Yes (sometimes)
- ◯ Rarely
- ◯ No

Appendix (continued): Clinician survey.

'On the Job' Learning and Mentoring

21. Is the feedback you receive beneficial to improving your skills? *

- ◯ Yes
- ◯ Somewhat
- ◯ No

Appendix (continued): Clinician survey.

'On the Job' Learning and Mentoring

22. Would feedback be useful to help you improve your skills? *

- ◯ Yes
- ◯ Perhaps - please explain why below
- ◯ No - please explain why below

23. Please explain why you feel feedback may not be useful to help you improve your skills

Appendix (continued): Clinician survey.

AI-Based Learning

24. Would you be open to using an interactive AI tool that could provide evidence-based feedback and suggestions for improving your communication skills to support person-centred care and shared decision making? *

- ◯ Yes
- ◯ Maybe
- ◯ No

Appendix (continued): Clinician survey.

AI-Based Learning

25. What features would you find most helpful in an interactive AI tool for communication skills development and feedback? (Select all that apply) *

- [ ] Identifying my areas of strength and areas for improvement based on simulated interactions with the tool/avatar
- [ ] Offering feedback on the clarity and understandability of language I use
- [ ] Offering feedback on cultural appropriateness of the communication and approach I use
- [ ] Providing examples of clear and person-centered communication
- [ ] Providing examples of opportunities for shared decision-making
- [ ] Other

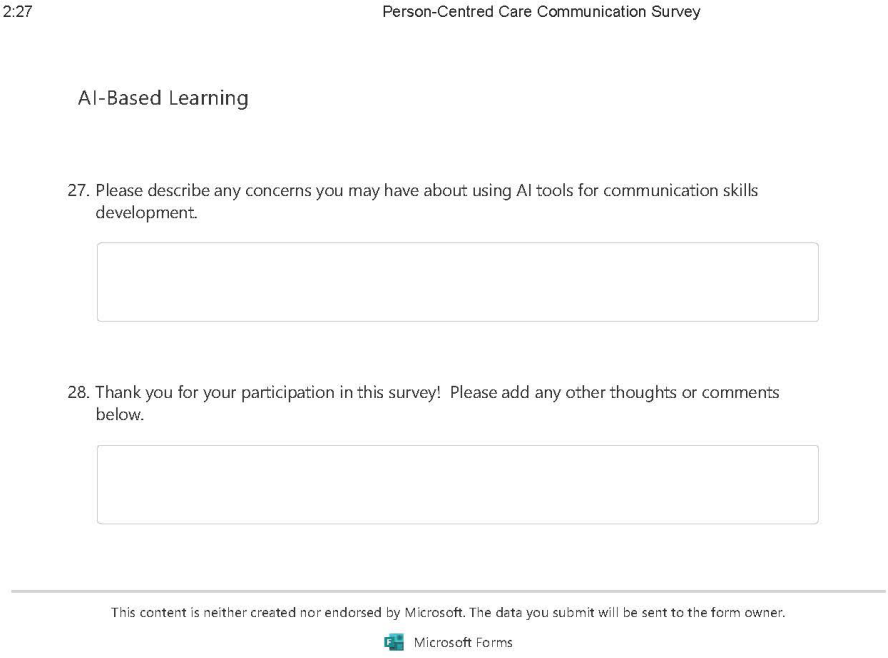
Appendix (continued): Clinician survey.

AI-Based Learning

26. What potential benefits do you think there might be to using evidenced-based AI tools for communication skills development? *

- [ ] Ease of access to training
- [ ] Evidenced based - reliability and validity
- [ ] Ability to practice more often
- [ ] Tailored feedback
- [ ] No risk to you or the patient and whānau when practicing
- [ ] Less threatening
- [ ] Having a transcript or summary of the interaction of the AI tool and key learning points
- [ ] Other

Appendix (continued): Clinician survey.



23/12/2024, 12:27 Person-Centred Care Communication Survey

AI-Based Learning

27. Please describe any concerns you may have about using AI tools for communication skills development.

28. Thank you for your participation in this survey! Please add any other thoughts or comments below.

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Microsoft Forms

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Bicycle face: a timely reminder on discarded diagnoses in the age of anxiety

Robert E Bartholomew, Kate MacKrill, Emerson Bartholomew

ABSTRACT

In the late nineteenth century, the popularity of cycling prompted a series of medicalised warnings, particularly for women. Among these was "bicycle face": a "nervous condition" attributed to a constant state of stress from attempting to balance a bicycle combined with prolonged facial grimacing, which was believed to result in nervous exhaustion and facial disfigurement. In New Zealand, media coverage peaked between 1895 and 1897, framing it as a threat to women's health, beauty and morals. Related conditions included "cyclemania", "bicycle stoop", "bicycle hump", "bicycle walk" and "bicycle heart". These designations reflected gender norms and anxieties over female independence, rather than medical evidence. The episode mirrors a broader historical pattern in which emerging technologies have triggered dubious health fears which parallel contemporary concerns over the safety of mobile phones, 5G towers and wind turbines. The authors explore the cultural and medical construction of "bicycle face" during the late nineteenth and early twentieth centuries, showing how a small number of rogue physicians used the media to amplify unfounded fears, implanting them into the public consciousness. The historical tendency for health practitioners to superimpose prevailing attitudes and beliefs onto health risks linked to new technologies highlights the need for evidence-based evaluations and vigilance against allowing cultural anxieties to masquerade as novel medical conditions.

There was a young Maiden named Grace,

Once the prettiest girl in the place;

But she's changed a great deal,

Since she took to the wheel,

For she now has a bicycle face.[1]

During the 1880s, bicycle riding exploded in popularity across North America and Europe, affording women new-found freedoms.[2] During the 1890s, newspapers and magazines began publishing articles describing how the practice could have deleterious effects, especially to the "delicate" bodies of female cyclists. One prominent concern held that anxiety from having to maintain a constant state of balance, coupled with prolonged facial grimacing, could lead to the double-whammy of nervous exhaustion and facial disfiguration. This new condition was dubbed "bicycle face".[3,4]

This medicalisation of female bicycle riding was given credence and popularised by several prominent members of the medical profession writing in the colloquial press. Foremost among them was British physician and author Arthur Shadwell (1854–1936) who coined the term and believed that cycling rendered women susceptible to nervous depression.[5] Another influential figure was Arabella Kenealy (1859–1938), a British physician and anti-feminist. In 1899, she warned readers of the literary magazine *The Nineteenth Century*, that a strained facial expression from vigorous riding could result in females acquiring the masculine features of bicycle face while jeopardising their ability to bear children.[6]

Reaction from the medical community was largely cautious. The *American Medico-Surgical Bulletin* viewed the condition as questionable and fad-like.[7,8] The New York–based *Medical Record* portrayed Shadwell as a respected but misguided figure and asserted that unless statistics could be produced clearly showing harm to female riders, his claims must be viewed with scepticism.[9] Sarah Hackett Stevenson, the first female member of the American Medical Association, also rejected Shadwell's claims by noting that the anxious facial expression in bicycle face was no different than that of a swimmer straining in water.[10]

The first known mention of bicycle face in the New Zealand press was in October 1895 when a reporter for the *Otago Witness* described it as a

nervous condition caused by one who is "addicted" to pedalling rapidly.[11] There were no less than 13 articles discussing the condition that year, followed by 27 in 1896 and a peak of 30 in 1897, after which reports gradually declined.[12] During its heyday, a writer for the Tasman-based *Golden Bay Argus* expressed concern over facial strain during bicycle riding that he believed was diminishing female attractiveness. The editor urged New Zealand women to "*submit themselves to the universal mandate of the medical profession against indulging in excess in the new pastime*".[13] The following year the "Ladies Gossip" column of the *Otago Witness* warned against the "disfiguring" condition,[14] which by now had become the subject of poems.[15,16] Between 1896 and 1908, there were 11 references to this "nervous condition" in *New Zealand Geographic* alone. In one instance, a commentator described it as "*the hard, tense, muscular expression*" which creates "*deflections from the lines of feminine beauty* [that] *make a good looking woman look masculine, and a homely woman look intensely ugly*".[17] A specific concern was the overdevelopment of the muscles in the female legs and thighs which were considered unfeminine.

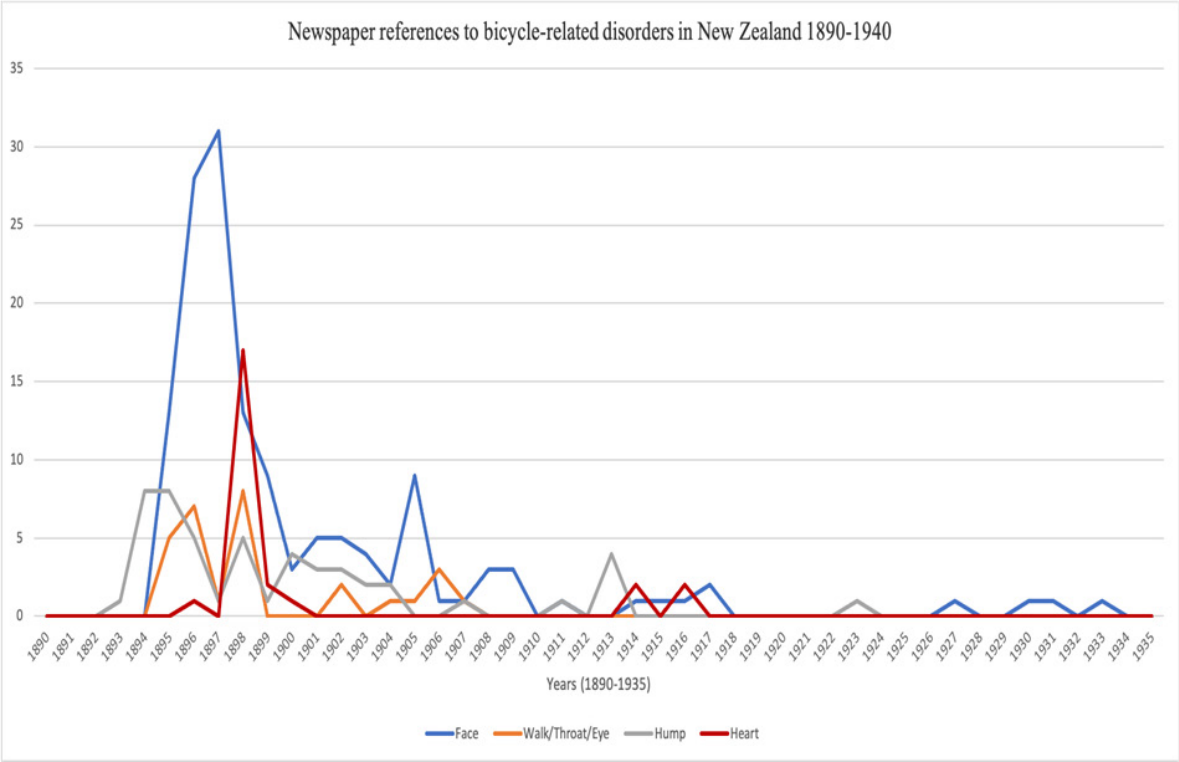
Despite widespread scepticism within the medical profession, the existence of bicycle face gained a foothold in Western consciousness through a few influential physicians who popularised such claims in the lay press. This opened the floodgates for an array of other kindred ailments being promoted by journalists and rogue physicians. One such condition was cyclemania, supposedly a chronic psychosis that motivated sufferers to ride to excess: too far, too fast and to the point of exhaustion. Cyclemaniacs were believed to have an unnatural obsession with cycling, akin to an addiction or intoxication, which left them more inclined to engage in risky behaviours. A prominent opponent of women cyclists, British writer and early anti-feminist Eliza Lynn Linton, wrote that the chief danger of cycling was the "*intoxication which comes with unfettered liberty*".[18] Chief among these was concern over the corruption of female morals and fears that straddling the seat "*combined with the motion required to propel a bicycle would lead to sexual arousal*".[19] It was also thought that the riding position on a bicycle could cause hernias and curvature of the spine which became known as "bicycle stoop" and "bicycle hump".[20] Another condition of concern was "bicycle walk" which was described as the gait of the cyclemaniac who "*did not swing his foot forward, but lifted it off the ground in a rising, circular motion, as if he were riding the pedal*".[21]

Excessive cycling was also believed to make the rider, particularly women and their supposedly delicate constitutions, more vulnerable to other illnesses.[22] The list of ailments tied to bicycle riding was extensive and included cardiovascular diseases (bicycle heart), muscular overdevelopment, anaemia, eyestrain (bicycle eye), hysteria and disorientation. It was also seen as a threat to motherhood as it was said that cycling while pregnant could cause foetal deformities, difficult labour and an inability to breastfeed.[23] There was also concern that "pressure" on the reproductive organs could result in infertility and if one did give birth the supposed pelvic changes made women susceptible to difficult labour. Another complaint was "bicycle throat" characterised by irritation and hoarseness attributed to riding at speed in cold weather, potentially leading to permanent vocal injury.

The fear of new technologies

The emergence of bicycle face is a reminder of the longstanding relationship between health scares and new technologies. During the sixteenth and seventeenth centuries, the strains from certain musical instruments were linked to an array of suspected nocebo-generated health complaints.[24] The invention of the telephone by Alexander Graham Bell in 1876 generated anxiety over its possible health effects and the appearance of a new condition in switchboard operators, "telephone tinnitus", which was attributed to long periods of listening on the device. In September 1889, a writer in the *British Medical Journal* warned of this new malady which was typified by "*nervous excitability, with buzzing noises in the ear, giddiness, and neuralgic pains*".[25] During the late nineteenth and early twentieth centuries "railway spine" was used to describe a constellation of symptoms including chronic pain and fatigue that were experienced by people who were involved in serious train accidents but who had suffered no obvious damage to the spinal cord. While these complaints were initially attributed to microscopic spinal damage, a major shift in perspective occurred in 1883, when London surgeon Herbert Page established "*that in many cases no damage had been sustained to the spinal cord*", which led him to conclude that "fright alone" precipitated the symptoms. There is now a consensus in the medical community that "railway spine" resulted from psychological trauma and stress-related

Figure 1: Newspaper references to bicycle-related disorders in New Zealand 1890–1940.



conditions including post-traumatic stress disorder (PTSD) and functional neurological disorder as opposed to structural injury to the spine.[26]

The spread of medical misinformation

The history of bicycle face is a germane illustration of how anxieties and moral panic around new technologies can become medicalised and propagated by the media. In the 1890s, bicycle face and kindred conditions circulated through newspapers and periodicals. Today's social media age has had a profound impact on the spread of health-related misinformation about new technologies by creating a global village where fears can attain international saturation within hours. A major mechanism of spread involves the business model of algorithmic biases which prioritise user engagement over factual accuracy by exacerbating fear, outrage and division. Sensational and often negative claims about the health risks of new technologies tend to be more engaging than cautious, peer-reviewed reports and consequently are spread more quickly.[27] Another factor is the echo chamber effect whereby social media platforms create, attract and reinforce self-validating online communities of people with similar beliefs. This allows pseudo-medical conditions to quickly transition from fringe theories to group consensus, effectively replacing the colloquial press of the Victorian era.

Another factor amplifying contemporary health concerns is the rise of social media influencers. During the 1890s, figures like Shadwell and Kenealy needed a medical degree and an established publication to attract a large readership. Today, prominent influencers without a medical degree can attract more followers in a week from a single video than their Victorian counterparts could have attained over months. Influencers often utilise anecdotes and conspiracy theories to establish audience credibility. A related factor is the erosion of institutional trust. Unlike the scepticism of the Victorian medical community toward bicycle face, today misinformation is accelerated by the widespread distrust of governments, large corporations and big pharma, while online personalities are often trusted more than mainstream medical authorities.[28]

The modern equivalent of bicycle face is not a single condition but a series of techno-somatic

syndromes which are centred on the effects of electromagnetic radiation from mobile phones, Wi-Fi and 5G towers,[29] and ultrasound from the turning of windfarm turbines.[30] "Wi-Fi Sickness", "5G sensitivity" and "Wind Turbine Syndrome" parallel the Victorian fear of bicycle-induced "nervous exhaustion" where non-specific anxiety and physical symptoms have been misattributed to a novel, invisible technology that is poorly understood by the public.

Managing pseudo-medical conditions

How should physicians manage pseudo-medical conditions, which are as common today as in the past? Focus should be on acknowledging and validating anxieties around new technologies as common and real; a strategy that was alluded to by Dr Sarah Hackett Stevenson's comparison of bicycle face to a swimmer's strain. Instead of dismissing fears around new technologies as imaginary, physicians can validate a patient's feelings of discomfort and fear of unseen forces. In this regard, the history of bicycle face can be used as a teaching tool to illustrate how the fear of new technologies is a historical pattern from railway spine and telephone sickness to contemporary fears surrounding Wi-Fi and 5G towers. This frames the problem as a cultural phenomenon instead of a biological one.

Medical organisations and journals should seek to partner with social media companies to counter the appearance of pseudoscientific videos with productions from authoritative sources such as the National Institutes of Health or the American Medical Association. These videos should be placed at the top of the video feed or search results. The medical community should exhibit the scepticism shown by the *Medical Record*, demanding statistics and empirical evidence, while working to improve how that information is communicated. One area of focus is on relative risk. Instead of asserting that a claim is false, the risk should be placed in context.

Concluding remarks

It is important to keep the fear of technology-related health concerns in perspective. Not all new technologies have been benign. While bicycle face proved to be a pseudo-medical condition, the early design of the penny farthing posed a genuine risk of physical injury due to the large front wheel and ineffective braking system, which resulted in riders suffering serious injuries after tumbling head-first over the handlebars. This manoeuvre became so common that it even had a name—"taking a header"—and earned it the nickname the "widow maker".[31] It should be noted that bicycle face was more than a technical health concern articulated by physicians: fundamentally it was a response to female mobility and independence at a time when Victorian era patriarchal culture was firmly entrenched in British society. This may have contributed as much if not more to the fear of new technology. The condition was less about public health and more about males using the medicalisation of bicycle riding to enforce traditional gender roles and exercise social control over women.

The diagnosis and treatment of bicycle face serves as a cautionary tale of how cultural anxieties can shape popular perceptions of health and how physicians can lend scientific legitimacy to unfounded fears, inadvertently solidifying the perceived reality of unfounded conditions in the public consciousness. The history of bicycle face illustrates that while some socially and culturally driven fears about new technologies were without merit, others such as X-rays and radiation exposure have been scientifically proven, underscoring the need for evidence-based assessments that are free of cultural bias. The re-examination of discarded diagnoses is a timely reminder of the complex interplay between culture and health, and the importance of ensuring that public health discourse about new technologies is guided by evidence rather than the shifting sands of popular opinion.

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Nil.

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Spinocerebellar ataxia type 12 in a 52-year-old female

Ray Bose, Andrew Smith

Spinocerebellar ataxia type 12 (SCA12) is a rare autosomal dominant neurodegenerative disorder caused by a cytosine-adenine-guanine (CAG) repeat expansion in the *PPP2R2B* gene. It typically presents with tremor, progressive ataxia, dysarthria and, in some cases, cognitive impairment. Most reported cases have originated from India; the condition has only rarely been described outside that context.

Case presentation

A 52-year-old woman of Indian descent was referred in March 2022 for evaluation of progressive tremor, cognitive changes and movement difficulties. Symptoms began 2 years earlier, initially with tremor of the lips, followed by tremor of the upper limbs and head. The tremor was most prominent during posture maintenance, interfering with daily tasks such as holding objects or pouring tea. She was initially diagnosed with essential tremor; however, the progressive nature of her symptoms prompted referral for a second opinion.

Her husband reported an impaired ability to walk in a straight line. Additional features included slowed speech, word-finding difficulty and memory impairment.

Family history was notable for multiple relatives overseas in India diagnosed with movement disorders initially thought to be Parkinson's disease. Her father developed symptoms in his late 40s, with subsequent cognitive decline until his death at 63. Other affected relatives included her paternal grandfather and several paternal uncles (see Figure 3 pedigree chart).

Past medical history included type 2 diabetes mellitus, gastro-oesophageal reflux disease and spondyloarthritis. Medications were atorvastatin, salazopyrin, oxybutynin and metformin.

Examination revealed disrupted pursuit eye movements with saccadic intrusions, consistent with broken pursuit. She exhibited postural tremor of the upper limbs and head, without bradykinesia or rigidity. Gait was slow but without shuffling or reduced arm swing. On the Mini-Addenbrooke's Cognitive Examination, she scored 20/30.

A range of investigations was performed to rule out other potential causes of progressive tremor and ataxia. Routine blood tests including full blood count, electrolytes, liver and thyroid function, vitamin B12 and vitamin E were normal, excluding metabolic, nutritional or endocrine causes. Ceruloplasmin and serum copper levels were within normal range, making Wilson's disease unlikely. Autoimmune and paraneoplastic antibody panels were negative, excluding immune-mediated cerebellar ataxia. No exposure history or medication use suggested a toxin- or drug-induced tremor.

Magnetic resonance imaging of the brain (March 2022) demonstrated global brain volume reduction, most marked in cortical grey matter and the cerebellum. Symmetrical T2 hyperintensities were noted in the superior cerebellar peduncles. Volumetric analysis revealed whole brain and brainstem volume at the first centile, cerebellar grey matter at the fifth centile and cortical grey matter at the sixth centile (see Figure 1 and 2).

Genetic analysis confirmed a CAG repeat expansion in one allele of *PPP2R2B*, establishing the diagnosis of SCA12.

By September 2024, symptoms had progressed with further impairment in daily living. Broken pursuit eye movements persisted, and she developed persistent hiccups likely due to brainstem involvement.

Diagnosis

The diagnosis of SCA12 was confirmed by genetic testing. Neuroimaging findings of cerebellar and brainstem/cord atrophy supported the diagnosis.

Management

She was commenced on propranolol for tremor and low-dose amitriptyline for mood disturbance and muscle stiffness. She was referred to physiotherapy and clinical psychology for supportive

care, and to gastroenterology for evaluation of persistent hiccups. A multidisciplinary approach was established to optimise function and quality of life. There is currently no curative treatment for SCA12.

Discussion

SCA12 is a slowly progressive autosomal dominant ataxia caused by a CAG repeat expansion in the *PPP2R2B* gene on chromosome 5q32.[1,2] The disease has a distinctive clinical profile, with tremor frequently presenting as the initial symptom in mid-life, followed by the gradual emergence of ataxia, dysarthria, cognitive decline and, occasionally, psychiatric symptoms.

Although rare worldwide, SCA12 has been reported with notable frequency in India,[2–5] particularly among members of the Agarwal community, an endogamous business group originally from Northern India. In this population, SCA12 is considered the second most common form of spinocerebellar ataxia after SCA2. This clustering suggests a strong founder effect. Other neurogenetic disorders, such as limb–girdle muscular dystrophy and megalencephalic leukodystrophy, have also been observed at higher prevalence in the same community.

The clinical spectrum of SCA12 is wide and overlaps with more common conditions such as essential tremor and Parkinson's disease. Tremor is usually action-induced, is often of slower frequency and higher amplitude compared with essential tremor and may include proximal "wing-beating" movements. Ataxia, dysarthria and eye movement abnormalities tend to evolve later, which can delay recognition. Misdiagnosis as essential tremor is well documented, particularly when ataxia develops over years.

Neuropsychiatric symptoms including depression, irritability, apathy and occasionally psychosis have been reported, and functional decline is common over time. Imaging typically shows cerebellar and cortical atrophy, though this is not uniformly present. While longer repeats may be associated with earlier onset, severity does not consistently correlate with expansion size.

There is no disease-modifying therapy for SCA12. Management focusses on tremor suppression, gait rehabilitation, cognitive support and psychiatric symptom control within a multidisciplinary framework. Recognition of its distinctive clinical and ethnic associations is essential for timely diagnosis, genetic counselling and supportive planning.

Conclusion

This case highlights the importance of considering genetic ataxia in patients with progressive tremor, particularly when there is a strong family history. Early recognition and genetic confirmation allow for appropriate counselling, supportive care and family risk assessment.

Figure 1: Axial 3D fluid-attenuated inversion recovery (FLAIR) magnetic resonance imaging (MRI) showing hyperintensity within each superior cerebellar peduncle, which has not been previously reported in cases of spinocerebellar ataxia type 12 (SCA12). Of note, there were no other significant areas of signal disturbance, such as a "hot cross bun" sign within the pons or increased FLAIR signal within the inferior peduncles (to suggest multiple system atrophy, cerebellar type).

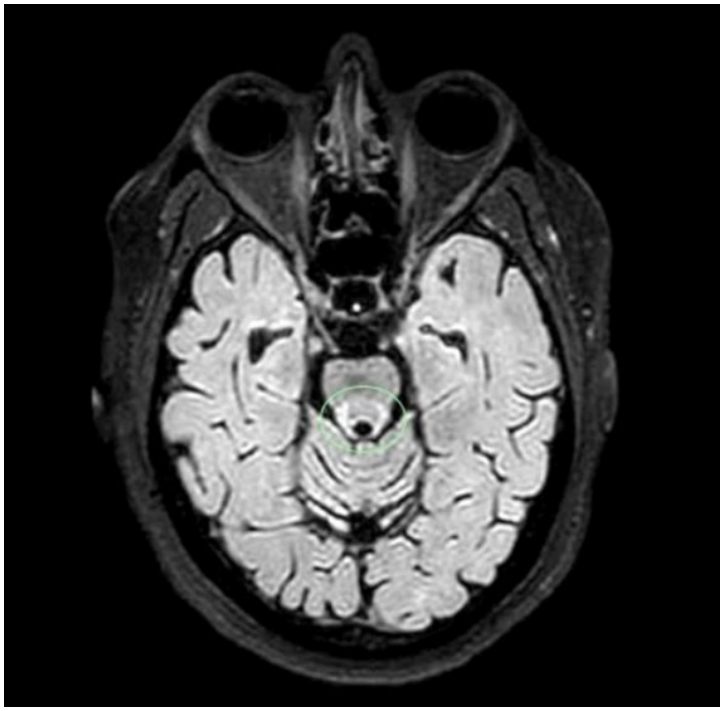


Figure 2: Para-midline sagittal 3D T1 MRI image showing volume loss through the cerebellum, in particular the vermis, as well as prominence of the fourth ventricle and foramen magnum. There is also prominence of the cerebral sulci, indicating cerebral volume loss. These features have all been reported in cases of SCA12.

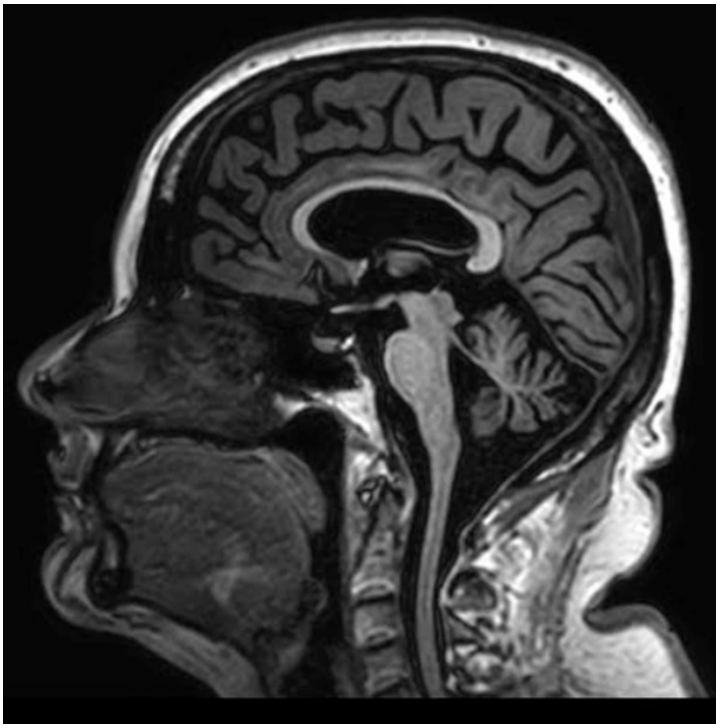
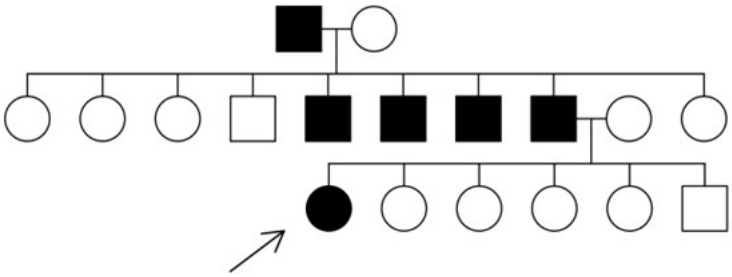


Figure 3: Pedigree chart showing affected and unaffected family members, with the index case indicated by the arrow.



COMPETING INTERESTS
Nil.

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From sore throat to facial vein thrombosis: a case of Fusobacterium necrophorum bacteraemia with a variant of Lemierre syndrome

Thanikknath S Corattur, Colin N Menezes

A 34-year-old man presented with a 10-day history of malaise, sore neck and dysphagia with marked left cervical lymphadenopathy.

A contrast-enhanced computed tomography (CT) scan of the neck revealed bilateral tonsillitis (Figure 1). Due to a reported penicillin allergy from childhood, the details of which were unknown (PEN-FAST score 0), clindamycin—an acceptable alternative—was prescribed for 1 week before discharge. However, he was recalled to the hospital after blood cultures isolated a Gram-negative bacillus, later identified as *Fusobacterium necrophorum* (*FN*). Antimicrobial therapy was escalated to ceftriaxone and metronidazole to provide better empirical coverage in the setting of bacteraemia, given that *FN* is typically highly susceptible to metronidazole. Susceptibility testing was not routinely performed. His peak serum white blood cell count was 17.3x10^9/L and C-reactive protein was 290mg/L.

An interval scan performed 3 days later due to progressive neck swelling confirmed a filling defect within the left facial vein with no internal jugular vein (IJV) thrombus identified. The left temporal vein failed to opacify, raising suspicion of an associated thrombus (Figure 2).

Based on the absence of thrombus extension

Figure 1: Bilateral tonsillitis seen on computed tomography (CT) on initial admission.

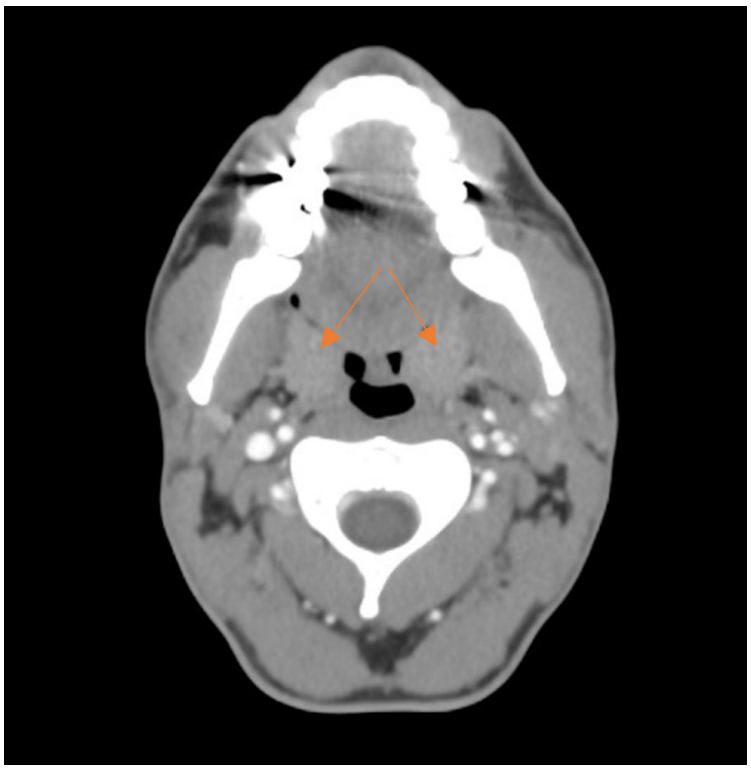
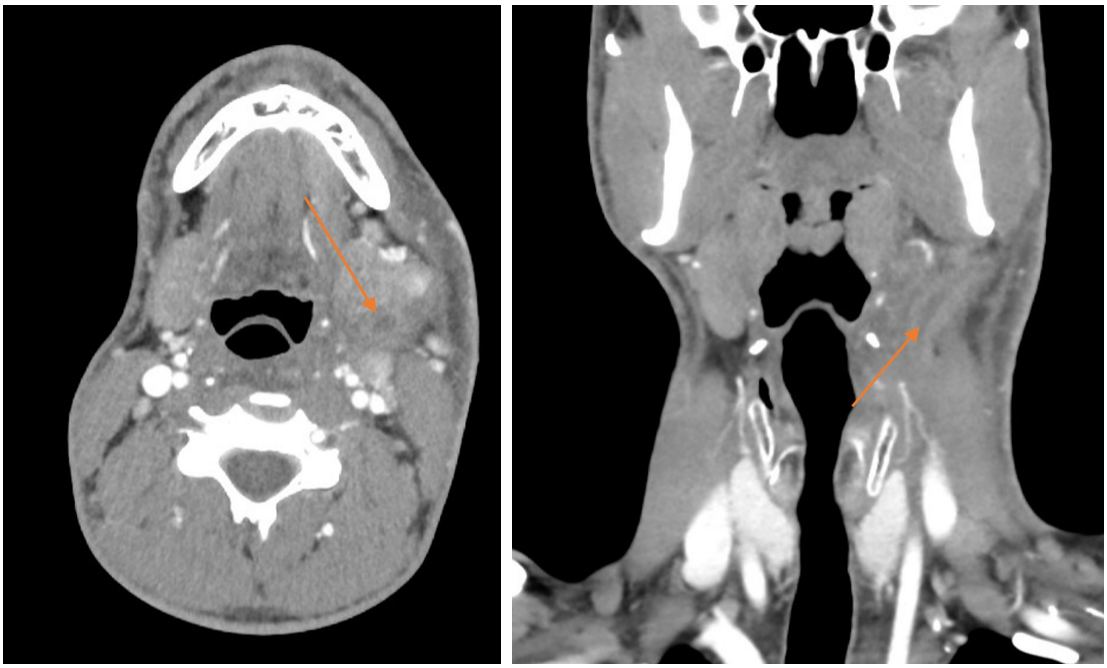


Figure 2: a) axial view, and b) coronal view. Left facial vein thrombus seen on the second CT with arrows pointing to the thrombus.



in the cerebral sinuses and the patient's stable clinical course, the risks outweighed the benefits of therapeutic anticoagulation and thus was not initiated. He completed a 4-week course of antibiotics with complete symptom resolution and was discharged from clinic with no further complications.

Discussion

André Lemierre described Lemierre syndrome in 1936. It is typically characterised by thrombophlebitis of the IJV alongside bacteraemia caused by the anaerobic organism, *FN*, following an oropharyngeal infection.[1] It was common in the era before antibiotics; however, after the introduction of antibiotics, it became known as the "forgotten disease".[1] Over recent decades, the incidence has been increasing, potentially due to increasing antimicrobial resistance associated with widespread antibiotic use for pharyngitis and awareness of this syndrome.[1–3] Although susceptibility testing is not routinely performed, clindamycin resistance in *FN* has been reported internationally, with rates ranging from 6.7 to 25%.[4] Therefore, when alternative agents are used due to penicillin allergy, culture and sensitivity testing should be considered.

In New Zealand, epidemiological data are limited; however, globally, the incidence is estimated between 0.6 to 6 cases per million people per year.[1]

Facial vein thrombosis represents an uncommon variant. The facial vein lacks valves and communicates directly with the ophthalmic veins, allowing retrograde spread into the cavernous sinus, increasing the risk for intracranial complications such as cavernous sinus thrombosis.[5] While IJV thrombosis is well documented, isolated facial vein involvement is rare, leading to a delay in diagnosis due to its atypical presentation.[5] The prognosis of facial vein thrombosis is less defined in comparison with IJV thrombosis.

Given its smaller calibre, spontaneous resolution may occur, and the role of anticoagulation remains controversial.[1,6,7] Some authors advocate for anticoagulation in all cases, while others recommend it only if thrombosis extends into the cerebral sinuses or there is no improvement with antibiotics.[7,8] The risk of septic embolisation remains a concern, highlighting the need for close monitoring.[2,9] The cornerstone of treatment remains appropriate antimicrobial therapy, with anticoagulation being individualised based on thrombus size, progression and response to antibiotics.[9] Increased recognition is critical for timely diagnosis and intervention, preventing further complications and improving patient outcomes.[3]

In this case, the reported penicillin allergy led

clinicians to use clindamycin as first-line therapy, a PEN-FAST score was not calculated and further details of the allergy were not obtained. Given that many reported penicillin allergies are not true Immunoglobulin E (IgE) mediated reactions, inaccurate labelling may limit optimal therapy. This case underscores the importance of structured allergy assessment, such as PEN-FAST scoring, to guide antibiotic selection and potentially avoid suboptimal alternatives.

Conclusion

This case highlights an atypical presentation of Lemierre syndrome, characterised by facial vein thrombosis rather than the typical IJV involvement. *FN* bacteraemia remains an important differential in patients with persistent tonsillitis and systemic features of infection. The rarity of facial vein thrombosis underscores the need for increased awareness to ensure timely diagnosis and management. Furthermore, this case emphasises the importance of structured assessment of reported penicillin allergies and demonstrates that antibiotic therapy alone may be curative in the absence of thrombus extension, despite the ongoing debate regarding the role of anticoagulation.

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Nil.

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Head Injuries

NZMJ, 1926

By Carrick Robertson, M.B., F.R.C.S.

With the remarkable increase in motor traffic, there has been a coincident increase in the number of head injuries. At the Auckland Hospital during the last year over 100 cases have been admitted.

But these head injuries are not only occurring in the larger towns, they must be occurring in the practice of all of us, and as they are of such serious import, not only in their immediate mortality, but in the remote effects on those that recover, it would seem to be of no small importance that at our Annual Meeting we should discuss the ways and means of dealing with these cases. Moreover, a considerable amount of work has been done during the last few years in working out the problems presented by these cases.

Although our profession has always taught and recognised the inherent possibilities of catastrophe in every case of head injury, it would seem that in the past this type of case has received too much of what we are pleased to term "expectant" treatment ; with the result that if they recover, an almost worse fate is in store for them.

How often, when an epileptic is brought to us, does the mother relate a history of "concussion" as being the predecessor of the fits, and as there are often some years between the accident and its alleged effect, we have been inclined to sweep these histories aside, more especially when we remember how common such accidents are in the life of every child. Surely these histories should receive more consideration—not that they will help us to cure this particular patient—but that it may impress on us the importance of seeing that our next "concussion" patient shall have the fullest investigation, for, any so-called concussion which lasts for more than a few minutes is due to brain laceration with effused blood, the unconsciousness being then caused by compression, and requires more treatment than a few hours in bed and a dose of castor oil. The old term "concussion" should be kept for those cases which show only a minute or two of unconsciousness. Concussion is the same thing as shock—the shock being caused by the sudden compression of the cranial components (the brain being incompressible) the force causes a displacement of the blood and cerebro-spinal fluid—resulting in a sudden acute anaemia of the medullary centres with instantaneous suppression of all vital processes. In a mild case the medullary centres soon re-establish themselves and consciousness quickly returns.

The old theory of concussion being due to a series of punctate haemorrhages is not now generally held. It is not unlikely that, in some of these cases of so-called concussion, a careful radiological examination would have revealed a fracture of the skull, and although I am fully aware that a fracture of the skull is only important when it can be demonstrated that the cranial contents themselves have been injured, it is at least a guide as showing that what may have appeared a trivial fall from an apple tree is really a serious accident.

In trying to find some statistics as to the frequency of epilepsy and other psychoses after cranial injury in the literature at my disposal I have found most conflicting results—in epilepsy, for example, it varies from 2 per cent. (Neuhof) to 12 per cent. (Frazier) up to 70 per cent. (Villandre). In a series of 52 cases of Coleman's, 31 per cent. had epilepsy or epileptoid condition, and he notices that there was noticeably less epilepsy in these cases which were operated on. This agrees with my own impressions that the subsequent psychoses are less when the patient has been treated by operation or lumbar puncture than when they have been allowed to recover with rest alone. Cases of injury in the fronto-parietal region are much more liable to epilepsy than those having injuries in other regions of the skull. It is also strange that an apparently slight injury—*viz*., one with no fracture and only a passing hypertension—may develop a permenant cerebral affection.

Eagleton, a recognised authority, gives it as his opnion that traumatic epilepsy is generally preventable by early operation.

Before dealing with a few of the points in the management of head injuries, we must not forget that all these cases are liable to develop an

increased intracranial tension, which may be cause by intracranial haemorrhage, such as ruptured meningeal artery, or more commonly, by an oedema of the brain from contusion. The gravity of any heady injury case depends upon the amount and duration of this increased tension, for it produces cerebral compression. It is, therefore, necessary to have a clear understanding of the effects of this on the patient before we are in a position to deal with a case of cranial injury.