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Summaries

Public health vandalism: new Government scraps world-leading smokefree legislation

Richard Edwards, Chris Bullen, Janet Hoek, Collin Tukuitonga, Andrew Waa, Natalie Walker

One of the new Government's first actions was to announce its intention to repeal New Zealand's world-leading smokefree legislation. This has created enormous controversy and opposition. The Government's actions suggest it attaches a low priority to improving population health through prevention and is applying its target-focussed approach highly selectively. Its actions align closely with the tobacco industry's position of opposing key smokefree policies included in the legislation and show scant regard for the views of New Zealanders. The intention to repeal was not included in the National Party election manifesto and hence the Government lacks a democratic mandate for its action, and the decision raises concerns about disproportionate influence of junior coalition partners.

Audit of antimicrobial stewardship in medical inpatients in Waikato, New Zealand 2021

Thomas AC Wong, Mohammed Issa, Cameron Dyer, Jared K Green, Jade AU Tamatea, Gabriella Paoloni, Jessica Hadlow, Hugh McGann

We describe an audit method using 10 standards in antibiotic prescribing that can be used in individual hospital departments on a regular basis. We audited 205 medical patients in Waikato and Thames hospitals and found specific areas for improvement for diagnostic testing and antimicrobial stewardship (AMS) in the management of infections. We found similar outcomes for Māori and non-Māori patients. We hope that our findings can contribute to the development of a strong, nation-wide AMS programme for New Zealand.

Considerations in the assessment and management of ADHD within the TGDNB Population

Zoe Kristensen, Caitlyn Drinkwater, Rachel Johnson, David B Menkes

There is not much research considering ADHD in transgender people specifically, despite it being significantly more common in this group. In this paper we discuss how we might need to assess differently, and considerations as to how gender-affirming treatments might be combined with ADHD treatments. We also identify the potential for progesterone to be used to assist with attention and cognitive issues for ADHD.

A diabetes registrar assisted workflow intervention in general practice for systematic initiation of cardiorenal medications for patients with type 2 diabetes and albuminuria in Aotearoa New Zealand

Anjana Niyagama, Allan Moffitt, Mahesh Patel, Minnie Strickland, Sara Aprea, Lynne Chepulis, Ryan Paul, Ole Schmiedel, Rinki Murphy

Chronic kidney disease is a known complication of type 2 diabetes, which manifests as reduction in kidney function and presence of a protein called albumin in urine (albuminuria). Early detection and treatment of this condition with appropriate medications (such as angiotensin-converting enzyme inhibitor/angiotensin receptor blocker [ACEi/ARB], as well as sodium-glucose cotransporter-2 inhibitor [SGLT2i]/glucagon-like peptide-1 agonist [GLP1RA]) are known to improve long-term outcomes of these patients. In this study we looked at whether providing a visiting diabetes registrar in primary care practices in Auckland would help in improving medication prescribing, and it shows an excellent success rate in prescribing new medications to eligible patients. SGLT2i/GLP1A was successfully initiated in 92%

and ACEi/ARB was initiated in 89% of the patients. We suggest training registrars to have a primary care placement or to participate in outreach clinics during their training, which will likely provide mutual gains to both training registrars as well as to general practitioners, while providing convenience to the patient to attend at their local clinic.

Key informant perspectives on a centralised contact tracing system for sexually transmitted infections

Catriona Murray, Sally B Rose, Amanda Kvalsvig, Michael G Baker

A centralised contact tracing workforce was established in 2020 to help reduce transmission of COVID-19. Given high population STI rates and local research revealing gaps in contact tracing (or partner notification) for STIs, we asked key informants for their views on the utility of a centralised contact tracing service for STIs. There was agreement that more resourcing, support and training is needed for STI contact tracing, with potential benefits of a centralised system including training, standardisation and reduced demand on already stretched clinical services. Drawbacks included trust and privacy concerns, lack of local-level knowledge and the possibility that the needs of priority populations might not be met. Given that high levels of trust are critical to the success of STI contact tracing, this might best be achieved through known local providers who could be supported, as needed, by central expertise.

Raise the Flag I: the impact of a sepsis quality improvement programme on delivery of a sepsis resuscitation bundle at a tertiary hospital in New Zealand

Katherine M Walland, Camilla Howard, Odette Paul, Paul J Huggan

Sepsis is a life-threatening response to infection. It is a common cause of death and disability in New Zealand, with Māori and Pasifika people, the elderly and those experiencing socio-economic disadvantage most at risk. Urgent administration of simple treatments including bloods tests, intravenous fluids and antibiotics has been shown overseas to save lives. Education and resources focussed on sepsis in Waikato Hospital improved the delivery of these treatments from 50% in 3 hours to 64% in 3 hours. These resources should be ongoing to maintain improvements in sepsis care, as 18 months later the improvements were not sustained.

Who Australasians trusted during COVID-19: Lessons from the pandemic response

Raven August, Ashleigh Barrett-Young, Hayley Guiney, Sean Hogan, Sandhya Ramrakha, Richie Poulton

We investigated which sources of COVID-19 advice were most trusted by a primarily New Zealand-based cohort. Based on data from a COVID-19 vaccine intention survey presented to Australia- and New Zealand-based members of the Dunedin Study, we assessed participants' trust in specific sources of COVID-19 advice and investigated whether the pattern of responses differed by sex, socio-economic status, or education. We found that doctors and healthcare providers were the most trusted source of COVID-19 advice, above and beyond other institutional sources, regardless of sex, socio-economic status or education. These findings suggest that doctors and healthcare providers should be empowered by the government to share pandemic advice with the public, to promote a successful pandemic response.

Robot-assisted general surgery in Aotearoa New Zealand

Phillip P Chao, Jonathan B Koea, Andrew G Hill, David Resoli, Sanket Srinivasa

Robot-assisted surgery refers to a surgeon controlling a robotic device that performs an operation. This viewpoint explores the current state of robot-assisted surgery in Aotearoa New Zealand using the da Vinci surgical system (Intuitive Surgical, Sunnyvale, California, USA), the only currently available robotic surgical system for general surgery in the country. We describe the contemporary progress in

Aotearoa New Zealand compared to Australia and globally and present emerging high-level evidence from randomised controlled trials regarding the utility of the robot-assisted approach for general surgery procedures. From the available evidence, we suggest that the value of robot-assisted general surgery in the public healthcare system arises from its emerging clinical benefits for complex procedures and its potential to engender equitable access and outcomes, particularly for Māori and Pacific peoples, improve education and training and contribute towards quality assurance and workforce development. Therefore, its implementation aligns with the New Zealand Health Strategy's long-term goals and priority areas to achieve pae ora, a healthy future for all.

A case of imported rabies in Aotearoa New Zealand

Hamish Wright, Andrew Fox-Lewis

Rabies is a highly lethal viral infection, normally presenting with fever, progressing to agitation, increased saliva production and intolerance of liquids or movement of air, and then coma and death. It is most commonly spread by dog bites, and the majority of cases are acquired in Asia and Africa. This is New Zealand’s first recorded case, having most likely been acquired in the Philippines.

Public health vandalism: new Government scraps world-leading smokefree legislation

Richard Edwards, Chris Bullen, Janet Hoek, Collin Tukuitonga, Andrew Waa, Natalie Walker

In one of its first acts, the new Government announced its intention to repeal the 2022 *Smokefree Environments and Regulated Products Amendment Act* (SERPA) and overturn its three key measures: mandated de-nicotinisation of smoked tobacco to make it non-addictive, a 90% reduction in the number of tobacco retailers and protecting future generations by ending tobacco sales to anyone born after 1 January 2009.

This action has aroused huge controversy locally and internationally. For example, Professor Boyd Swinburn, co-chair of the Health Coalition Aotearoa, commented: *"This is a major loss for public health and a huge win for the tobacco industry—whose profits will be boosted at the expense of Kiwi lives."*[1] Indeed, the Government's action is nothing short of deliberate public health vandalism.

Our legislation created one of the most comprehensive and rigorous strategies in the world to address the tobacco epidemic.[2] Modelling studies suggest the measures, with mandated de-nicotinisation being particularly pivotal, will result in profound, rapid and equitable reductions in smoking prevalence, substantial reductions in deaths and disease and huge savings in healthcare costs.[3] The new Government's decision to rescind these measures will result in more cancer, more heart attacks and stroke, more incurable lung disease and more cot deaths than would otherwise occur. It will create and increase health inequities because smoking and smoking-related diseases place a disproportionate burden on Māori and Pacific peoples.[4,5]

So, what lessons can we learn, and is there any light at the end of the tunnel?

The first lesson is that the coalition Government attaches a low priority to improving health through prevention or addressing health inequity.

The National Party pre-election policy priorities include this statement: *"National is working closely with women's health organisations to develop policies in the key areas that New Zealanders have told us really matter to them – that includes the* ***prevention*** [our emphasis] *and treatment of women's cancers."*[6] Evidently, it is not working to prevent lung cancer, the commonest cause of cancer death among women,[7] or any of the other nine cancers caused by smoking.[8] The Government appears wholly unconcerned about promoting a fairer society by addressing health inequities, given smoking contributes around a quarter of the life expectancy gap for Māori and Pacific peoples compared to non-Māori, non-Pacific peoples.[5]

Nicola Willis, the new finance minister, illustrated this disregard for health, wellbeing and equity when explaining that the Government would use excise tax from tobacco to fund promised tax cuts. In other words, the lives of people who smoke can fill the fiscal gap that dropping the foreign buyers tax on house sales created.[9]

The Health Minister, Dr Shane Reti, is a general practitioner who has previously expressed support for the SERPA measures, particularly mandated de-nicotinisation. During the third reading debate for SERPA, National MP (and now Associate Health Minister) Matt Doocey summarised National's position: *"As Dr Reti clearly outlined, the National Party agrees with the end goals. In fact, to a point, we actually even agree with the three policy levers of reducing retail shops, de-nicotinisation, and making it illegal for a certain cohort of New Zealanders born after 2009 to buy cigarettes. But where we differ on this side of the House is the order of those three levers."*[10] However, disappointingly, Dr Reti too has failed to promote health and equity and stand up for these vital public health interventions.

Lesson two is that the Government will apply its new targets-based approach very selectively. National announced: *"Health targets save lives so we will restore them to focus the system on doing better for New Zealanders."*[11] Unfortunately, this new focus seems not to apply to one of the most

long-standing health targets, adopted by the National-led Government in 2011, "*to reduce the number of people smoking and tobacco availability to minimal levels, thereby making New Zealand essentially a smokefree nation by 2025*."[12] Dropping the three SERPA measures will inevitably delay realisation of the smokefree goal and is incongruent with a targets-led approach.[3]

A third and sobering lesson is how closely the new Government's views align with those of the tobacco industry. Three major multinational tobacco companies submitted to the consultation process for the SERPA legislation and recommended all three key measures should be dropped. The Health Select Committee considered and rejected those recommendations. Now, despite Health Minister Dr Shane Reti's previous support for the individual measures, the new Government has adopted the tobacco industry viewpoints in full, effectively mirroring the tobacco industry's agenda. In justifying this decision, the health minister and prime minister have emphasised specious industry arguments such as the risk of an explosion in the black market and in retail crime.

What has triggered this *volte-face*? This question merits thorough investigation to ensure the Government is meeting its obligations under section 5.3 of the World Health Organization's Framework Convention on Tobacco Control to exclude the tobacco industry from any influence on policy.

Lesson four is that this Government has displayed scant regard for New Zealanders' views on public health policy issues. Evidence from the ITC New Zealand survey shows that the vast majority of people who smoke regret starting (82%), acknowledge they are addicted (93%), want to quit (71%) and have already tried to quit (84%), often multiple times.[13] Unsurprisingly, most people (76%) who smoke and most Māori who smoke (59%) also support the key measure of de-nicotinising tobacco so these become non-addictive and much easier to quit.[13,14] General population support is also very strong. For example, preliminary data from a 2023 survey of young people found very strong support for all three of the key SERPA measures: 65–78% support among 16–19-year-olds and 69–80% from 20–29-year-olds.[15]

A final lesson is the concern this episode raises about how the Government will operate, and the courage and ability of National Party leadership. These events demonstrate and potentially establish a precedent for the new Government to introduce policies and make decisions for which there are no democratic mandates (neither National or ACT referred to repealing SERPA in their election campaigns), no consultative processes and that lack public support. The events suggest junior coalition partners will have influence disproportionate to their public support. New Zealand First (the only party to include repealing the SERPA measures in its manifesto) and ACT seem likely to have insisted on the repeal of SERPA in the coalition negotiations. Rather than show consistency with the health minister's statements during the third reading of the *Bill*, the prime minister has ceded to the demands of his junior coalition partners. It seems that when Winston Peters says "jump" the response of Prime Minister Christopher Luxon is "how high"?

However, there is light at the end of the tunnel. The outpouring of international support and the outrage expressed by communities, non-governmental organisations and health professionals in Aotearoa New Zealand to get this perverse action overturned has been heartening. It is not too late for the health minister to stand up for health and health equity, or for Prime Minister Christopher Luxon to demonstrate that he leads a government that values health, wellbeing and evidence over tobacco industry propaganda, and is big enough to admit it made a mistake. If they do, we promise to be first with our congratulations.

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Audit of antimicrobial stewardship in medical inpatients in Waikato, New Zealand 2021

Thomas AC Wong, Mohammed Issa, Cameron Dyer, Jared K Green, Jade AU Tamatea, Gabriella Paoloni, Jessica Hadlow, Hugh McGann

ABSTRACT

AIMS: Given the threat of rising antimicrobial resistance (AMR), 10 audit standards were selected to audit antimicrobial stewardship (AMS) in secondary care to assess guideline adherence and establish quality improvement initiatives in antimicrobial prescribing.

METHODS: Patients were included if they received intravenous (IV) antibiotics across seven medical wards in Waikato or Thames hospitals, New Zealand, in November 2021. Audit standards were defined from the regional antimicrobial prescribing policy and adult antimicrobial guidelines.

RESULTS: In total, 205 patients were audited. Microbiological sampling standards were met in 87 of 126 occasions (69.0%). Antimicrobial choices adhered to guidelines in 89 of 163 patients (54.6%), where guidelines were available. Documentation of antimicrobial indications in the medical notes and antimicrobial review at 48 to 72 hours met the standards at over 90%. Only 2 of 13 patients (15.4%) receiving piperacillin/tazobactam or a carbapenem were discussed with Infectious Diseases (ID). Documentation of indications and durations on paper-based medication charts was infrequent, around 12%. Evaluating for health equity, similar results were observed for Māori and non-Māori.

CONCLUSIONS: Our audit identified specific areas for AMS quality improvement initiatives. Regular audit should become an essential element of the New Zealand AMS strategy. We believe increased AMS resources are required.

With the creation of Te Aka Whai Ora – Māori Health Authority and Te Whatu Ora – Health New Zealand, a coordinated national plan for antimicrobial stewardship (AMS) to reduce antimicrobial resistance (AMR) is highly relevant.[1,2] Upsurges in AMR remain a critical risk to global health and economic development, with global antibiotic use increasing by 65% from 2000 to 2015.[3]

In a recent systematic analysis, AMR was associated with 4.95 million deaths (3.62 to 6.57) in 2019, making AMR the third leading cause of death in the 2019 Global Burden of Disease report, after ischaemic heart disease and stroke.[4] The World Health Organization has denoted AMR as one of the top 10 global public health threats.[5]

While antimicrobials are essential to protect human health, they can be used inappropriately and excessively; conversely, relative under-prescribing of antimicrobials occurs for Māori and Pacific peoples in New Zealand.[6,7] In the most recent OECD comparison, New Zealand had the fourth highest level of antibiotic prescribing,[8] with more than 50% of use classed as inappropriate.[9] Although most inpatient settings in New Zealand have antimicrobial prescribing policies, adherence with these policies is not known.[10]

The December 2021 report from the Prime Minister's Chief Science Advisor strongly recommends AMS in all sectors to combat AMR, with an equity focus and Māori and Pacific engagement.[2] A key AMS strategy is prospective audit and feedback after antimicrobial prescriptions, recommended by international guidelines.[11] This provides an educational benefit to clinicians while maintaining prescriber autonomy. Audit data can identify areas requiring improvements, although the process is typically labour intensive and relies on the availability of antimicrobial specialists. Therefore, we selected standards for antimicrobial audit which can be easily replicated for quality improvement initiatives.

Methods

Setting

We audited medical inpatients at two hospitals in the mid-North Island of New Zealand: Waikato Hospital in Hamilton, a 673-bed tertiary care hospital, and Thames Hospital, a 52-bed rural

secondary care hospital. Neither hospital had electronic prescribing or a formulary restriction programme. Antimicrobial advice from the Waikato Hospital Infectious Diseases (ID) department needs to be actively requested and there is no coordinated surveillance of antimicrobial use.

Inclusion criteria

Inpatients aged 15 years and above were eligible if they received at least one dose of an IV antibiotic in the six general medicine, stroke or respiratory wards at Waikato Hospital or the Thames inpatient unit, which is the single inpatient ward at Thames Hospital. Patients were included if their first IV antibiotic was prescribed in the national medication chart between Sunday 7 November and Friday 3 December 2021. Patients receiving only oral antibiotics were not included.

We excluded patients where IV antibiotics were not commenced in one of the medical wards or the emergency department to reflect medical inpatient prescribing and minimise auditing of prophylactic antibiotics.

Audit process

At Waikato Hospital, the clinical informatics pharmacist generated daily electronic lists of patients receiving IV antibiotics from medDispense® machines (TouchPoint Medical) located in the six medical wards. At Thames Hospital, all new inpatient notes were checked for IV antibiotic prescriptions.

Eleven auditors (medical students, house officers, registrars, pharmacists and consultants) reviewed paper-based national medication charts, clinical notes and electronic laboratory records on weekdays on the wards. Individual clinicians were not aware of the audit, to minimise the Hawthorne effect. Acknowledging the limitations,[12] ethnicity data were collected from the hospital patient management database and categorised as Māori and non-Māori. Multiple ethnicities were managed using prioritisation. Information on colonisation with multidrug-resistant organisms was taken from alerts on the electronic record.

Auditors reviewed what happened within the first 24 hours (defined as the end of the post-acute ward-round for new admissions) and at 48 to 72 hours, to document if antibiotics had been rationalised according to microbiology or changed to the oral route if appropriate. Our aim was to have two separate prospective reviews for all patients. Due to time limitations or patients admitted on weekends, data were collected prospectively at the 24-hour and 48-to-72-hour time points in 93 of 205 patients (45.4%) by the same auditor. For 112 of 205 patients (54.6%), data were collected at 48 to 72 hours, and information for the first 24 hours was retrospectively collected at that review. All patients had complete data for both time points.

Single data entry was standardised using a pre-coded Microsoft Form™ on smartphone browsers (available via Appendix 1 and online: https://forms.office.com/r/8fKeiKGAbf). Data were stored on an online, secure server on Microsoft Teams™.

Audit standards

We selected 10 audit standards shown in Table 1, defined from Waikato Hospital's antimicrobial prescribing policy (Appendix 2, version 01, issued 23 June 2020) and adult antimicrobial guide on the MicroGuide™ app (version 4.22, November 2021, Horizon Strategic Partners Ltd. Leeds, UK): https://viewer.microguide.global/WDHB. Aspirational audit targets of 100% were chosen by the ID department, after applying inclusion and exclusion criteria to make this as practical as possible.

We referenced MicroGuide™ to categorise documented indications and define the recommended empirical antibiotic regimens. The most senior clinicians' documented diagnoses within the first 24 hours were matched to MicroGuide™ categories. To focus on antibiotic choice, dose optimisation was not audited. Gentamicin use was not obligatory in sepsis of unknown source, as ceftriaxone monotherapy was acceptable. Patients without neutropenia were categorised as having non-neutropenic sepsis if the word "sepsis" or "urosepsis" was documented in the clinical impression. Diagnostic accuracy and infection severity scores were not verified, to audit against real world practice. Uncertain entries were clarified by an ID physician.

Local approval for the audit and reporting of results was obtained from the Waikato audit and research unit (registration number 4289P). Data interpretation was reviewed by a senior Māori researcher and the local Māori research review committee in line with the CONSIDER statement for strengthening reporting of health research involving Indigenous peoples.[13]

The sample size was determined by a 4-week auditing period. Based on medDispense® data, we estimated at least 280 patients would be

Table 1: Antimicrobial stewardship audit standards.

Definition		Inclusions/exclusions
Standards 1–3: diagnostic stewardship		
1	Blood cultures are taken before IV antibiotics are administered in hospital for essential diagnoses*	**Inclusions:** non-neutropenic sepsis, neutropenic sepsis, meningitis, encephalitis, endocarditis, osteomyelitis, septic arthritis, necrotising soft tissue infections, pyelonephritis, urinary tract infection receiving IV antibiotics and IV catheter-related infection
2	Urine culture is taken before IV antibiotics are administered in hospital when a urine infection is suspected	**Inclusions:** pyelonephritis, urinary tract infection receiving IV antibiotics and urinary sepsis ("urosepsis") **Exclusions:** sepsis where the clinician did not document a possible urinary tract source
3	Cerebrospinal fluid (CSF) is taken before IV antibiotics are administered in hospital, or up to 4 hours after antibiotics	**Inclusions:** meningitis and encephalitis
Standards 4–7: antimicrobial stewardship—indication and antimicrobial choice		
4	The indication is written in the notes and on the medication chart within 24 to 48 hours of prescribing antibiotics	**Inclusions:** all patients
5	A planned duration or review date is written in the notes and medication chart	**Inclusions:** all patients
6	Antibiotic choices should be consistent with MicroGuide™	**Exclusions:** a guideline is not available for the condition, ID specialist advice was given, significant antibiotic allergy or intolerances exist that are not covered by MicroGuide™, there is known causative microbiology within the prior 7 days, the patient is failing treatment despite taking the recommended antibiotic already and known MRSA/ESBL carriage not covered by the guideline†
7	Patients on selected restricted IV antibiotics require discussion with ID within 48 to 72 hours‡	**Inclusions:** all patients receiving piperacillin/tazobactam, ertapenem or meropenem **Exclusions:** all other restricted antimicrobials

Table 1 (continued): Antimicrobial stewardship audit standards.

Standards 8–10: antimicrobial review—duration, IV-oral switch and de-escalation		
8	IV antibiotics are reviewed within 48 to 72 hours of the start date of IV antibiotics	**Inclusions:** all patients
9	Patients who meet IV-oral SWITCH criteria should be changed to oral antibiotics§	**Inclusions:** all patients meeting IV-oral SWITCH criteria‡
10	Patients should change to a targeted, narrow-spectrum antibiotic to complete therapy when a suitable antibiotic can be identified from microbiology results	**Inclusions:** all patients where microbiology results are available demonstrating safe, narrower spectrum antibiotic options

*Waikato MicroGuide™ recommended at least one set of blood cultures as being acceptable for standard 1.
†MRSA: methicillin-resistant Staphylococcus aureus, ESBL: extended spectrum beta-lactamase.
‡Restriction criteria were defined by the Pharmac Section H (Hospital Medicines List).
§IV-oral SWITCH criteria, Waikato Hospital adult antimicrobial guide:
Suitable oral option—an oral antibiotic is listed in the susceptibilities, or there is an oral formulation of the IV antibiotic.
When afebrile for >24 hours, defined as a tympanic temperature of 37.9C or less for 24 hours.
Infection suitable for oral—excluding meningitis, endocarditis, neutropenic fever and necrotising skin/soft tissue infection.
Tolerating oral or nasogastric food and fluid.
Clinical and laboratory improvement—patient documented as clinically improved and a neutrophil count improving towards normal values.
Haematology and oncology patients excluded.

Figure 1: Age distributions of Māori and non-Māori.

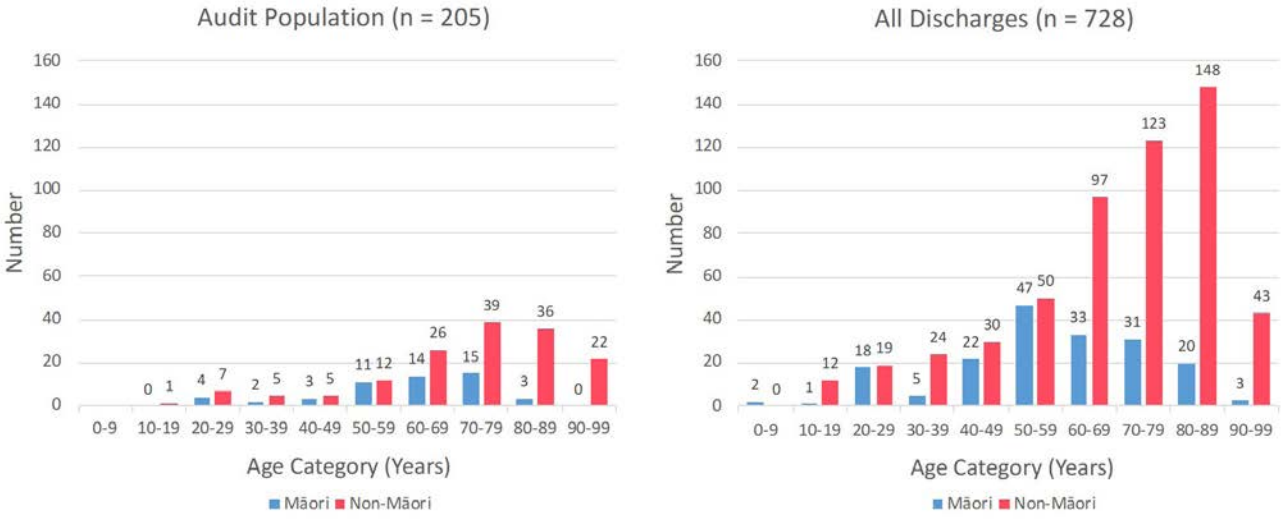

Table 2: Baseline characteristics.

Audit population		**Total n=205 (%)***	**Māori n=52 (%)***	**Non-Māori n=153 (%)***	**p-value for Māori compared to non-Māori**
Ethnicity					
Māori		52 (25.4)	52	-	-
European		139 (67.8)	-	139	
Asian		5 (2.4)	-	5	
Pacific		4 (2.0)	-	4	
Not stated		4 (2.0)	-	4	
Other ethnicity		1 (0.5)	-	1	
Age					
Mean, years (SD)		68.7 (18.2)	61.1 (16.1)	71.2 (18.2)	p=0.001
Sex					
Male		98 (47.8)	26 (50.0)	72 (47.1)	p=0.714
Female		107 (52.2)	26 (50.0)	81 (52.9)	
Known multidrug-resistant organism colonisation†					
None known		184 (89.8)	44 (84.6)	140 (91.5)	p=0.157
MRSA alert		11 (5.4)	6 (11.5)	5 (3.3)	p=0.022
ESBL alert		9 (4.4)	2 (3.8)	7 (4.6)	p=0.825
MRSA and ESBL alerts		1 (0.5)	0 (0.0)	1 (0.7)	p=0.559
Ward location					
Waikato Hospital n=175	General medicine	135 (65.9)	36 (69.2)	99 (64.7)	p=0.552
	Respiratory	34 (16.6)	14 (26.9)	20 (13.1)	p=0.020
	Stroke	6 (2.9)	1 (1.9)	5 (3.3)	p=0.619
Thames inpatient unit		30 (14.6)	1 (1.9)	29 (19.0)	p=0.003
All discharges		**Total n=728 (%)***	**Māori n=182 (%)***	**Non-Māori n=546 (%)***	**p-value for Māori compared to non-Māori**
Ward location					
Waikato Hospital n=578	General medicine	436 (59.9)	105 (57.7)	331 (60.6)	p=0.485
	Respiratory	93 (12.8)	38 (20.9)	55 (10.1)	p <0.001
	Stroke	49 (6.7)	18 (9.9)	31 (5.7)	p=0.049
Thames inpatient unit		150 (20.6)	21 (11.5)	129 (23.6)	p <0.001

*Percentages may not add to 100% due to rounding.
†MRSA: methicillin-resistant Staphylococcus aureus, ESBL: extended spectrum beta-lactamase from electronic record alerts.

Table 3: Clinician-documented indications and initial antibiotic.

	Total n=205 (%)*	Māori n=52 (%)*	Non-Māori n=153 (%)*	p-value for Māori compared to non-Māori
Clinician-documented indications				
Respiratory	70 (34.1)	24 (46.2)	46 (30.1)	p=0.035
Genitourinary	34 (16.6)	8 (15.4)	26 (17.0)	p=0.788
Skin and soft tissue	33 (16.1)	7 (13.5)	26 (17.0)	p=0.549
Sepsis, unknown source†	19 (9.3)	2 (3.8)	17 (11.1)	p=0.119
Gastrointestinal	19 (9.3)	4 (7.7)	15 (9.8)	p=0.650
Not documented	12 (5.9)	2 (3.8)	10 (6.5)	p=0.475
Other‡	18 (8.8)	5 (9.6)	13 (8.5)	p=0.806
Initial antibiotic				
Ceftriaxone	80 (39.0)	18 (34.6)	62 (40.5)	p=0.451
Amoxicillin/clavulanate	69 (33.7)	24 (46.2)	45 (29.4)	p=0.027
Flucloxacillin	20 (9.8)	3 (5.8)	17 (11.1)	p=0.262
Piperacillin/tazobactam	8 (3.9)	2 (3.8)	6 (3.9)	p=0.981
Cefuroxime	7 (3.4)	0 (0.0)	7 (4.6)	p=0.117
Cefazolin	5 (2.4)	1 (1.9)	4 (2.6)	p=0.780
Other§	16 (7.8)	4 (7.7)	12 (7.8)	p=0.972

*Percentages may not add to 100% due to rounding.
†Fifty-five patients had sepsis documented: respiratory (7), genitourinary (14), skin and soft tissue (7), unknown source (19), gastrointestinal (5), neutropenic sepsis (3).
‡Other indications: head and neck (5), central nervous system (5), bone and joint (4), neutropenic sepsis (3), infective endocarditis (1).
§Other antibiotics: gentamicin (3), metronidazole (3), ertapenem (2), meropenem (2), ciprofloxacin (2), penicillin (1), amoxicillin (1), ceftazidime (1), clarithromycin (1).

Table 4: Antimicrobial stewardship audit results.

Audit standards			Total n/N (%)*	Māori n/N (%)*	Non-Māori n/N (%)*
Standards 1–3: diagnostic stewardship					
1	Blood cultures are taken before IV antibiotics are administered in hospital for essential diagnoses†		**57/86 (66.3)**	8/18 (44.4)	49/68 (72.1)
2	Urine culture is taken before IV antibiotics are administered in hospital when a urine infection is suspected		**27/34 (79.4)**	6/8 (75.0)	21/26 (80.8)
3	Cerebrospinal fluid (CSF) is taken before IV antibiotics are administered in hospital, or up to 4 hours after antibiotics		**3/6 (50.0)**	1/2 (50.0)	2/4 (50.0)
	All microbiological sampling events combined		**87/126 (69.0)**	15/28 (53.6)	72/98 (73.5)
Standards 4–7: antimicrobial stewardship—indication and antimicrobial choice					
4	The indication is written in the notes and on the medication chart within 24 to 48 hours of prescribing antibiotics	Notes	**193/205 (94.1)**	50/52 (96.2)	143/153 (93.5)
		Medication chart	**23/205 (11.2)**	5/52 (9.6)	18/153 (11.8)
5	A planned duration or review date is written in the notes and medication chart	Notes	**87/205 (42.4)**	23/52 (44.2)	64/153 (41.8)
		Medication chart	**25/205 (12.2)**	8/52 (15.4)	17/153 (11.1)
6	Antibiotic choices should be consistent with MicroGuide™‡		**91/167 (54.5)**	25/44 (56.8)	66/123 (53.7)
7	Patients on selected restricted IV antibiotics require discussion with ID within 48 to 72 hours		**2/13 (15.4)**	1/4 (25.0)	1/9 (11.1)
Standards 8–10: antimicrobial review—duration, IV-oral switch and de-escalation					
8	IV antibiotics are reviewed within 48 to 72 hours of the start date of IV antibiotics		**186/205 (90.7)**	47/52 (90.4)	139/153 (90.8)
9	Patients who meet IV-oral SWITCH criteria should be changed to oral antibiotics		**124/140 (88.6)**	32/37 (86.5)	92/103 (89.3)
10	Patients should change to a targeted, narrow-spectrum antibiotic to complete therapy when a suitable antibiotic can be identified from microbiology results		**122/132 (92.4)**	35/36 (97.2)	87/96 (90.6)

*n = number meeting audit standard, N = number remaining after inclusions/exclusions. Audit targets were 100% after applying inclusion/exclusion criteria. The audit was not designed to compare Māori and non-Māori outcomes.
†Waikato MicroGuide™ recommended at least one set of blood cultures as being acceptable for standard 1.
‡No MicroGuide™ guideline was available for 21 patients: unclear indications (8), two or more simultaneous infections (3), infective exacerbations of bronchiectasis or cystic fibrosis (3), cirrhosis-related conditions (2), cancer-related pneumonia (1), empyema (1), parotitis (1), prosthetic valve infective endocarditis (1), diverticulitis (1).

commenced on IV antibiotics in this period. A non-stratified random sample size of 500 would be required (125 Māori, 375 non-Māori) for 80% power to detect a difference of 10% between Māori and non-Māori with the Chi-squared test. Given this number was not feasible, ethnicity groups were not compared directly. Proportions were presented for categorical data and compared using Two-Sample tests of proportions, with a confidence level of 95%. Normally distributed continuous data were presented as means with standard deviations (SDs) and compared using Two-Sample *t*-Tests, with a confidence level of 95%. We analysed data using Microsoft Excel™ and STATA™ software (StataCorp. 2019. *Stata Statistical Software: Release 16.1* College Station, TX: StataCorp LLC).

Results

Baseline characteristics

There were 728 discharges from the selected wards during the audit period, 578 from Waikato Hospital and 150 from Thames. IV antibiotics were dispensed to 262 of 578 Waikato Hospital patients (45.3%). We excluded 87 of these 262 patients (33.2%): those starting antibiotics outside the audit period or the selected wards, patients whose notes were unavailable and patients with missing data. A remaining 175 of 262 patients were audited (66.8%). Adding 30 patients from Thames Hospital, this totalled 205 audited patients.

Compared to 20.3% of people aged 15 and older in the Waikato Region identifying as Māori in the 2018 Census,[14] Māori comprised 182 of all 728 discharges (25.0%) from the seven wards during the audit period (p = 0.002), and 52 of 205 audited patients (25.4%, p=0.074), acknowledging likely undercount of Māori.[12] Ethnicity differences in methicillin-resistant *Staphylococcus aureus* (MRSA) colonisation and ward location are shown in Table 2.

The mean age of Māori was 61.1 years (SD 16.1) compared to non-Māori at 71.2 years (SD 18.2), a mean difference of 10 years (p=0.001). Waikato data from the 2018 Census for people aged 15 and older showed a mean age of 39.0 years (SD 17.2) for Māori and 47.9 years (SD 19.5) for non-Māori, with a similar mean difference of 9 years.[14] Figure 1 demonstrates the age distributions.

Antimicrobial use

The clinician-documented indications for antibiotics are shown in Table 3, most commonly respiratory, genitourinary, skin and soft tissue infections in 137 of 205 patients (66.8%). The indication was not documented in 12 of 205 cases (5.9%). Sepsis was documented in 55 of 205 patients (26.8%), with 8 of 55 recorded as Māori (14.5%). Only one patient had documented COVID-19 infection. Of the 205 audited patients, the most common initial antibiotics were ceftriaxone and amoxicillin/clavulanate, together comprising 149 of 205 prescriptions (72.7%).

Audit standards

The primary outcomes are shown in Table 4.

Diagnostic stewardship

1: Blood cultures were taken prior to IV antibiotics for 117 of the 205 audited patients (57.1%) and for 57 of 86 patients with essential diagnoses (66.3%): non-neutropenic sepsis (52), neutropenic sepsis (3), meningitis (6), endocarditis (1), septic arthritis (4), pyelonephritis (11) and urinary tract infection receiving IV antibiotics (9). Blood cultures were taken prior to antibiotics for 13 of 19 patients with sepsis of unknown source (68.4%). Our audit was not designed to compare Māori and non-Māori outcomes and the difference in outcomes for this standard may be due to chance, particularly with a low proportion of Māori patients documented as having sepsis (14.5%).

2: Urine culture was taken before IV antibiotics for 27 of 34 (79.4%) patients with pyelonephritis (11), urinary tract infection receiving IV antibiotics (9) or urinary sepsis/"urosepsis" (14). Urine culture prior to IV antibiotics is not mandatory in sepsis guidelines,[15] as this can cause unnecessary delays. Therefore, we only applied this standard to sepsis with suspected urinary tract origin, and not to other sources of sepsis.

3: CSF was sampled before IV antibiotics, or up to 4 hours after, for three of six patients with meningitis suspected initially (50.0%). None of the patients had bacterial meningitis on follow-up.

Antimicrobial stewardship—indication and antimicrobial choice

4: An indication was written in the notes for 193 of 205 patients (94.1%). In contrast, an indication was written in the medication chart in 23 of 205 patients (11.2%).

5: A planned duration or a review date was present in the notes for 87 of 205 patients (42.4%)

and in the medication chart in 25 of 205 patients (12.2%).

Only three of 205 (1.5%) patients had the indication and duration documented in both the notes and medication chart.

6: A relevant MicroGuide™ page was available in 167 of 205 patients (81.5%), with 91 of these 167 patients having antibiotic choices consistent with MicroGuide™ (54.5%). We excluded 38 of 205 patients (18.5%): guideline not available (21), ID specialist advice was given (2), significant antibiotic allergy or intolerances (3), known causative microbiology within the prior 7 days (4), already failing the recommended antibiotic (6) and MRSA/ESBL carriage not covered by the guideline (2). Ceftriaxone use was consistent with MicroGuide™ in 28 of 80 patients (35.0%) and amoxicillin/clavulanate in 46 of 69 patients (66.7%).

7: Piperacillin/tazobactam or a carbapenem were administered to 13 of 205 patients (6.3%) and discussed with ID in only two of 13 patients (15.4%). Piperacillin/tazobactam was prescribed for nine patients: four were consistent with MicroGuide™, three had no relevant MicroGuide™ page available and two were not consistent with MicroGuide™. A carbapenem was administered empirically to four patients: one was discussed with ID and the other three were colonised by multidrug-resistant organisms.

Antimicrobial review—duration, IV-oral switch and de-escalation

8: Antibiotics were reviewed within 48 to 72 hours after the start date for 186 of 205 patients (90.7%). Antibiotics were stopped at this point for 31 of these 186 patients (16.7%).

9: IV-oral SWITCH criteria were met for 140 of 205 patients (68.3%). A switch to oral antibiotics occurred for 101 of 140 patients (72.1%) and antibiotics were stopped for 23 of 140 (16.4%), totalling 124 of 140 patients who met the audit standard (88.6%).

10: Microbiology results were available to target antibiotic therapy for 132 of 205 patients (64.4%). Antibiotics were targeted in 122 of these 132 patients (92.4%) at the 48-to-72-hour review.

Discussion

Our audit identified specific areas for AMS quality improvement initiatives. The ID and microbiology departments currently do not engage in regular planned stewardship rounds. A business case for increased AMS resources to enable this activity has been submitted. To complete the audit cycle, the Waikato AMS programme plans to support medical and surgical teams to undertake quarterly antimicrobial prescribing audits, to measure improvements from planned AMS interventions outlined below.

Diagnostic stewardship

Microbiological sampling standards were met on 69.0% of occasions. For comparison, 24.0% of patients prescribed antibiotics in an AMS study in Vietnam had microbiological sampling. This occurred before starting antibiotics for 34.8% of those patients.[16] Microbiological testing sensitivity reduces rapidly after commencing IV antibiotics.[17,18] When sampling is delayed, opportunities for antimicrobial optimisation may be lost. Auditing the timing of microbiological sampling in relation to antibiotics for specific diagnoses has not been widely reported and is not measured by the Australasian National Antibiotic Prescribing Survey (NAPS).

We are in the process of updating MicroGuide™ to reflect our local laboratory guidance on optimising blood and urine cultures.[19] For adults, we now advise taking two sets of blood cultures from a single venepuncture site, with 8–10mL of blood per bottle. Single-site sampling for the first two blood culture sets is compatible with updated Duke-ISCVID endocarditis criteria.[20] In future audits we would document the number and type of blood culture bottles taken before antibiotics. Online surveys, educational campaigns and audits around improving microbiological sampling for phlebotomy, nursing and medical colleagues are planned.

Antimicrobial stewardship—indication and antimicrobial choice

Documenting indications and duration for antimicrobial prescriptions is strongly recommended by the US Centers for Disease Control and Prevention[21] and the UK National Institute for Health and Care Excellence.[22] This facilitates AMS audit and is included in our antimicrobial prescribing policy. Benefits include error prevention, enhanced communication, patient empowerment and promoting responsible antimicrobial prescribing.[23] Our documentation results were similar to Canterbury NAPS data, where the indication was documented in 73.5% of prescriptions, and a

review or stop date in 30.2%.[24] One factor may be that the New Zealand national medication chart does not have a mandatory space for documenting indications and duration. Subsequent to this audit, an antimicrobial sticker was designed to place on the national medication chart with areas to document indication and review date. This has been implemented in the intensive care unit. Electronic prescribing significantly improves the documentation of antimicrobial indication.[25] Until this is available, our AMS committee is working with pharmacy and nursing colleagues to empower them to remind prescribers to include indications and durations for antibiotic prescriptions.

MicroGuide™ adherence was 54.5% in our audit. Of concern, 65.0% of empirical ceftriaxone and 33.3% of amoxicillin/clavulanate prescribing was outside of guidelines. This may be due to familiarity with these antibiotics to cover for sepsis when there is clinical uncertainty, and the absence of formulary restriction for ceftriaxone. In the Canterbury NAPS, guideline adherence was 74%[24] and adherence to the Auckland SCRIPT app has rates from 9 to 50%.[26] Given only one of four carbapenem prescriptions were discussed with ID in our audit, we implemented a carbapenem restriction policy in January 2023 and are in the process of auditing this policy. Empirical prescribing of restricted antibiotics does not need immediate ID approval when consistent with MicroGuide™. However, discussion with ID within 48 to 72 hours allows for dose optimisation, defined durations, targeted prescribing based on microbiology results and facilitation of outpatient IV antibiotics if required.

To improve documentation in the medication chart and familiarity with MicroGuide™, our local AMS committee is introducing an antimicrobial prescribing journey initiative. This is an educational campaign outlining antimicrobial prescribing for a patient from admission until discharge following the antimicrobial prescribing policy. It incorporates elements from other local campaigns, including sepsis tools and IV-oral SWITCH. Interventions include visual aids, posters and education sessions with prescribers, pharmacists and nursing staff. Utilising a straightforward infographic, it encourages holistic staff, patient and whānau engagement.

Antimicrobial review—duration, IV-oral switch and de-escalation

The results for these standards were around 90%. Only 64.4% of patients had microbiological results available to optimise antimicrobials at 48 to 72 hours, highlighting the importance of diagnostic stewardship to enhance AMS interventions. Our results were encouraging, as a study in Melbourne found IV-oral switch occurrence in only 57.0% of patients, despite a tightly regulated AMS programme.[27]

Strengths of our audit include a range of infections over a representative 1-month period, urban and rural locations and reporting by ethnicity. The inclusion method ensured most patients on IV antibiotics in these wards were audited. Data were collected for the early 24-hour period and also for the 48-to-72-hour review, capturing the effect of initial diagnostic uncertainty on empirical antimicrobial prescribing. There was only one COVID-19 infection, minimising confounding by this condition.

Limitations include retrospective data collection in 54.6% of patients. Ethnicity was not self-identified.[12] Direct comparisons by ethnicity were limited by differences in baseline characteristics and the sample size; however, these data could help to plan for future audits with sufficient power. Results cannot be extrapolated to critical care or surgical specialties, particularly for perioperative IV antibiotic prophylaxis. To reduce complexity, we focused on IV antibiotic choice. In future audits we would include dose optimisation and oral antimicrobials. The 100% target for each standard was aspirational, as we did not want to choose arbitrary targets for these important standards of care. Retaining high targets specifically for Māori, Pacific and rural patients may help to address documented inequities.[28,29]

Our audit adds to the narrative of AMS intervention in New Zealand. There is a need for increased use of equity-focused audit and feedback as an essential element of the New Zealand AMS strategy. We suggest small, focused AMS audits at frequent intervals, with Māori and Pacific patients included to allow for better understanding around inequities related to infectious diseases. As up to 95% of antibiotic consumption is in the community,[7,30] dedicated audits on community antibiotic use are also required, including in residential care facilities. We hope that our audit findings may contribute to the process of developing a strong, nation-wide AMS programme. We believe that increased ID and AMS resources are vital for success, as has been advocated by AMS colleagues across New Zealand.[1]

COMPETING INTERESTS
None declared.

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Appendix 1: AntiMicrobial Stewardship Audit—example form

- Inclusion Criteria: Inpatients receiving IV antibiotics while in wards _____ under ALL specialties, on Mondays to Fridays. Duration from _____ to _____.
- The first 24 hours of IV antibiotics must be charted after 08:00H _____ on the medication chart, in wards _____ and patients followed to the 72H mark wherever they go (including discharge).
- Exclusion Criteria: If the first 24 hours of IV antibiotics were NOT started in these wards or ED, EXCLUDE the patient.

*Required

First Audit Capture	
Captures information on the first 24-48 hours of antibiotic charting, typically **from the start date until the end of the next day ward round.**	
1. Auditor	
○ 1 - Auditor A	○ 3 - Auditor C
○ 2 - Auditor B	○ 4 - Auditor D
2. NHI*	
3. Age * in years The value must be a number	
4. Sex* ○ 1 - Female ○ 2 - Male ○ 3 - Other	
5. Primary ethnicity*	
○ 1 - European	○ 5 - Middle Eastern/Latin American/African
○ 2 - Māori	○ 6 - Other ethnicity
○ 3 - Pacific Peoples	○ 7 - Not stated
○ 4 - Asian	
6. Ward on first audit capture * The first 24 hours of IV antibiotics must be started in ED, or in wards AMU, A2, A3, A4, OPR4, OPR5, Thames Inpatient Unit	
○ 1 - Ward 1	○ 5 - Ward 5
○ 2 - Ward 2	○ 6 - Ward 6
○ 3 - Ward 3	○ 7 - Ward 7
○ 4 - Ward 4	

Appendix 1 (continued): AntiMicrobial Stewardship Audit—example form.

7. **MRSA** colonised on patient Alerts? *

- ○ 1 - Yes
- ○ 2 - No

8. **ESBL** colonised on patient Alerts? *

- ○ 1 - Yes
- ○ 2 - No

9. For the IV antibiotic currently being received, **start date** when the first IV antibiotic was first charted on the national medication chart (not the ED chart) *

The first 24 hours of IV antibiotics must be **charted after 08:00H _____ on the medication chart.**

Be careful to look for older charts from earlier in the admission, if there has been a re-chart (mm/dd/yyyy).

Please input date (M/d/yyyy)

10. **On Medication Chart**, first charted IV antibiotic *

Include all antibiotics charted from the start date to the end of the next day's ward round, usually a 24H period.

- ○ 13 - Amoxicillin
- ○ 14 - Amoxicillin/clavulanate
- ○ 63 - Amikacin
- ○ 31 - Aztreonam
- ○ 21 - Cefazolin
- ○ 25 - Cefepime
- ○ 26 - Ceftaroline
- ○ 24 - Ceftazidime
- ○ 27 - Ceftazidime/Avibactam
- ○ 23 - Ceftriaxone
- ○ 22 - Cefuroxime
- ○ 51 - Ciprofloxacin
- ○ 82 - Clarithromycin
- ○ 71 - Clindamycin
- ○ 111 - Colistin
- ○ 103 - Daptomycin
- ○ 41 - Ertapenem
- ○ 81 - Erythromycin
- ○ 12 - Flucloxacillin
- ○ 61 - Gentamicin
- ○ 42 - Meropenem
- ○ 131 - Metronidazole
- ○ 52 - Moxifloxacin
- ○ 11 - Penicillin
- ○ 15 - Piperacillin/tazobactam
- ○ 102 - Teicoplanin
- ○ 91 - Tigecycline
- ○ 62 - Tobramycin
- ○ 121 - Trimethoprim/sulfamethoxazole
- ○ 101 - Vancomycin

11. **On Medication Chart**, second charted IV antibiotic

Include all antibiotics charted from the start date to the end of the next day's ward round, usually a 24H period

Appendix 1 (continued): AntiMicrobial Stewardship Audit—example form.

- 999 - None
- 13 - Amoxicillin
- 14 - Amoxicillin/clavulanate
- 63 - Amikacin
- 31 - Aztreonam
- 21 - Cefazolin
- 25 - Cefepime
- 26 - Ceftaroline
- 24 - Ceftazidime
- 27 - Ceftazidime/Avibactam
- 23 - Ceftriaxone
- 22 - Cefuroxime
- 51 - Ciprofloxacin
- 82 - Clarithromycin
- 71 - Clindamycin
- 111 - Colistin
- 103 - Daptomycin
- 41 - Ertapenem
- 81 - Erythromycin
- 12 - Flucloxacillin
- 61 - Gentamicin
- 42 - Meropenem
- 131 - Metronidazole
- 52 - Moxifloxacin
- 11 - Penicillin
- 15 - Piperacillin/tazobactam
- 102 - Teicoplanin
- 91 - Tigecycline
- 62 - Tobramycin
- 121 - Trimethoprim/sulfamethoxazole
- 101 - Vancomycin

12. **On Medication Chart**, third charted IV antibiotic

Include all antibiotics charted from the start date to the end of the next day's ward round, usually a 24H period.

- 999 - None
- 13 - Amoxicillin
- 14 - Amoxicillin/clavulanate
- 63 - Amikacin
- 31 - Aztreonam
- 21 - Cefazolin
- 25 - Cefepime
- 26 - Ceftaroline
- 24 - Ceftazidime
- 27 - Ceftazidime/Avibactam
- 23 - Ceftriaxone
- 22 - Cefuroxime
- 51 - Ciprofloxacin
- 82 - Clarithromycin
- 71 - Clindamycin
- 111 - Colistin
- 103 - Daptomycin
- 41 - Ertapenem
- 81 - Erythromycin
- 12 - Flucloxacillin
- 61 - Gentamicin
- 42 - Meropenem
- 131 - Metronidazole
- 52 - Moxifloxacin
- 11 - Penicillin
- 15 - Piperacillin/tazobactam
- 102 - Teicoplanin
- 91 - Tigecycline
- 62 - Tobramycin
- 121 - Trimethoprim/sulfamethoxazole
- 101 - Vancomycin

Appendix 1 (continued): AntiMicrobial Stewardship Audit—example form.

13. **On Medication Chart**, fourth charted IV antibiotic

Include all antibiotics charted from the start date to the end of the next day's ward round, usually a 24H period.

- ○ 999 - None
- ○ 13 - Amoxicillin
- ○ 14 - Amoxicillin/clavulanate
- ○ 63 - Amikacin
- ○ 31 - Aztreonam
- ○ 21 - Cefazolin
- ○ 25 - Cefepime
- ○ 26 - Ceftaroline
- ○ 24 - Ceftazidime
- ○ 27 - Ceftazidime/Avibactam
- ○ 23 - Ceftriaxone
- ○ 22 - Cefuroxime
- ○ 51 - Ciprofloxacin
- ○ 82 - Clarithromycin
- ○ 71 - Clindamycin
- ○ 111 - Colistin
- ○ 103 - Daptomycin
- ○ 41 - Ertapenem
- ○ 81 - Erythromycin
- ○ 12 - Flucloxacillin
- ○ 61 - Gentamicin
- ○ 42 - Meropenem
- ○ 131 - Metronidazole
- ○ 52 - Moxifloxacin
- ○ 11 - Penicillin
- ○ 15 - Piperacillin/tazobactam
- ○ 102 - Teicoplanin
- ○ 91 - Tigecycline
- ○ 62 - Tobramycin
- ○ 121 - Trimethoprim/sulfamethoxazole
- ○ 101 - Vancomycin

14. **On Medication Chart**, fifth charted IV antibiotic

Include all antibiotics charted from the start date to the end of the next day's ward round, usually a 24H period.

- ○ 999 - None
- ○ 13 - Amoxicillin
- ○ 14 - Amoxicillin/clavulanate
- ○ 63 - Amikacin
- ○ 31 - Aztreonam
- ○ 21 - Cefazolin
- ○ 25 - Cefepime
- ○ 26 - Ceftaroline
- ○ 24 - Ceftazidime
- ○ 27 - Ceftazidime/Avibactam
- ○ 23 - Ceftriaxone
- ○ 22 - Cefuroxime
- ○ 51 - Ciprofloxacin
- ○ 82 - Clarithromycin
- ○ 71 - Clindamycin
- ○ 111 - Colistin
- ○ 103 - Daptomycin
- ○ 41 - Ertapenem
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- ○ 12 - Flucloxacillin
- ○ 61 - Gentamicin
- ○ 42 - Meropenem
- ○ 131 - Metronidazole
- ○ 52 - Moxifloxacin
- ○ 11 - Penicillin
- ○ 15 - Piperacillin/tazobactam
- ○ 102 - Teicoplanin
- ○ 91 - Tigecycline
- ○ 62 - Tobramycin
- ○ 121 - Trimethoprim/sulfamethoxazole
- ○ 101 - Vancomycin

Appendix 1 (continued): AntiMicrobial Stewardship Audit—example form.

15. Was the **indication** on the medication chart, within 24-48H of the start date? *

Documented for at least 1 charted antibiotic

Audit standard 4: 100% of patients should have the indication written in the notes and on the drug chart within 24-48H of prescribing.

- 1 - Yes
- 2 - No

16. Was the **duration and/or a review date** on the medication chart, within 24–48H of the start date? *

Audit standard 6: 100% of IV antibiotics should have a planned duration or review date written in the notes and drug chart

- 1 - Yes
- 2 - No

17. **On ED Chart**, first charted IV antibiotic *

Only include antibiotics charted by ED up to 24H prior to the start date on the national medication chart.

- 999 - None
- 13 - Amoxicillin
- 14 - Amoxicillin/clavulanate
- 63 - Amikacin
- 31 - Aztreonam
- 21 - Cefazolin
- 25 - Cefepime
- 26 - Ceftaroline
- 24 - Ceftazidime
- 27 - Ceftazidime/Avibactam
- 23 - Ceftriaxone
- 22 - Cefuroxime
- 51 - Ciprofloxacin
- 82 - Clarithromycin
- 71 - Clindamycin
- 111 - Colistin
- 103 - Daptomycin
- 41 - Ertapenem
- 81 - Erythromycin
- 12 - Flucloxacillin
- 61 - Gentamicin
- 42 - Meropenem
- 131 - Metronidazole
- 52 - Moxifloxacin
- 11 - Penicillin
- 15 - Piperacillin/tazobactam
- 102 - Teicoplanin
- 91 - Tigecycline
- 62 - Tobramycin
- 121 - Trimethoprim/sulfamethoxazole
- 101 - Vancomycin

18. **On ED Chart**, second charted IV antibiotic

Only include antibiotics charted by ED up to 24H prior to the start date on the national medication chart.

Appendix 1 (continued): AntiMicrobial Stewardship Audit—example form.

- ○ 999 - None
- ○ 13 - Amoxicillin
- ○ 14 - Amoxicillin/clavulanate
- ○ 63 - Amikacin
- ○ 31 - Aztreonam
- ○ 21 - Cefazolin
- ○ 25 - Cefepime
- ○ 26 - Ceftaroline
- ○ 24 - Ceftazidime
- ○ 27 - Ceftazidime/Avibactam
- ○ 23 - Ceftriaxone
- ○ 22 - Cefuroxime
- ○ 51 - Ciprofloxacin
- ○ 82 - Clarithromycin
- ○ 71 - Clindamycin
- ○ 111 - Colistin
- ○ 103 - Daptomycin
- ○ 41 - Ertapenem
- ○ 81 - Erythromycin
- ○ 12 - Flucloxacillin
- ○ 61 - Gentamicin
- ○ 42 - Meropenem
- ○ 131 - Metronidazole
- ○ 52 - Moxifloxacin
- ○ 11 - Penicillin
- ○ 15 - Piperacillin/tazobactam
- ○ 102 - Teicoplanin
- ○ 91 - Tigecycline
- ○ 62 - Tobramycin
- ○ 121 - Trimethoprim/sulfamethoxazole
- ○ 101 - Vancomycin

19. **On ED Chart**, third charted IV antibiotic

Only include antibiotics charted by ED up to 24H prior to the start date on the national medication chart.

- ○ 999 - None
- ○ 13 - Amoxicillin
- ○ 14 - Amoxicillin/clavulanate
- ○ 63 - Amikacin
- ○ 31 - Aztreonam
- ○ 21 - Cefazolin
- ○ 25 - Cefepime
- ○ 26 - Ceftaroline
- ○ 24 - Ceftazidime
- ○ 27 - Ceftazidime/Avibactam
- ○ 23 - Ceftriaxone
- ○ 22 - Cefuroxime
- ○ 51 - Ciprofloxacin
- ○ 82 - Clarithromycin
- ○ 71 - Clindamycin
- ○ 111 - Colistin
- ○ 103 - Daptomycin
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- ○ 81 - Erythromycin
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- ○ 61 - Gentamicin
- ○ 42 - Meropenem
- ○ 131 - Metronidazole
- ○ 52 - Moxifloxacin
- ○ 11 - Penicillin
- ○ 15 - Piperacillin/tazobactam
- ○ 102 - Teicoplanin
- ○ 91 - Tigecycline
- ○ 62 - Tobramycin
- ○ 121 - Trimethoprim/sulfamethoxazole
- ○ 101 - Vancomycin

Appendix 1 (continued): AntiMicrobial Stewardship Audit—example form.

20. Was at least 1 **blood culture** taken BEFORE the first IV antibiotic was administered in the hospital? (Take the first time of administration by the nursing staff. Include antibiotics given in ED and in the wards, but do not include ambulance antibiotics) *

Audit Standard 1: 100% of patients with sepsis, neutropenic fever, meningitis, endocarditis, osteomyelitis, septicarthritis, necrotising soft tissue infections, pyelonephritis and IV catheter-related infection should have at least 1 blood culture taken before antibiotics

- ○ 1 - Yes
- ○ 2 - No, but blood cultures were taken up to 4 hours after IV antibiotics were administered
- ○ 3 - No

21. For pyelonephritis, UTI (upper) or sepsis (urinary tract), was a **urine culture** (not just dipstick) taken for MC/S BEFORE the first antibiotic was administered? (Take the first time of administration by the nursing staff. Include antibiotics given in ED and in the wards, but do not include ambulance antibiotics) *

Audit Standard 2: 100% of patients with pyelonephritis, UTI (upper) or sepsis (urinary tract) should have a urine culture taken before antibiotics.

- ○ 9 - Not a UTI
- ○ 1 - Yes
- ○ 21 - No, but urine was taken up to 4H after IV antibiotics were administered
- ○ 22 - No

22. For meningitis/encephalitis, was **CSF** culture taken before the first antibiotic was administered? (Take the first time of administration by the nursing staff. Include antibiotics given in ED and in the wards, but do not include ambulance antibiotics).

(This question can be skipped if not meningitis/encephalitis)
Audit Standard 3: 100% of patients with meningitis/encephalitis should have CSF taken before antibiotics, or up to 4 hours after IV antibiotics were administered.

- ○ 9 - Not meningitis
- ○ 1 - Yes
- ○ 2 - No, but CSF was taken up to 4H after IV antibiotics were administered
- ○ 3 - No, but CSF was taken eventually, greater than 4H after IV antibiotics were administered
- ○ 4 - No, CSF was not taken at all

23. Was the **indication** documented in the notes, within 24–48H of the start date? *

Audit standard 4: 100% of patients should have the indication written in the notes and on the drug chart within 24-48H of prescribing.

- ○ 1 - Yes
- ○ 2 - No

24. What was the **indication documented** in the notes and/or drug chart? *

Categories are from MicroGuide, Waikato Hospital guidelines (available via app or intranet).

Appendix 1 (continued): AntiMicrobial Stewardship Audit—example form.

- 999 - Indication not documented anywhere
- 11 - Sepsis, source unknown
- 12 - Sepsis, source known, pneumonia
- 13 - Sepsis, source known, urinary tract infection
- 14 - Sepsis, source known, skin and soft tissue infection
- 15 - Sepsis, source known, hepatobiliary disease/ obstruction
- 16 - Sepsis, source known, peritonitis
- 17 - Sepsis, source known, line infections
- 18 - Sepsis, source known, central nervous system
- 19 - Sepsis, maternal sepsis
- 21 - Respiratory, pneumonia community-acquired mild/moderate
- 22 - Respiratory, pneumonia community-acquired severe
- 23 - Respiratory, pneumonia hospital-acquired
- 24 - Respiratory, bronchitis and COPD infective exacerbation
- 25 - Respiratory, aspiration pneumonia
- 26 - Pneumocystis jiroveci pneumonia
- 31 - Central nervous system, meningitis community-acquired
- 32 - Central nervous system, brain abscess
- 33 - Central nervous system, neurosurgical infections, EVD ventriculitis
- 34 - Central nervous system, neurosurgical infections, post-neurosurgical nosocomial brain abscess
- 41 - Gastrointestinal, cholecystitis/cholangitis
- 42 - Gastrointestinal, Clostridium difficile infection
- 43 - Gastrointestinal, acute peritonitis
- 44 - Gastrointestinal, typhoid/paratyphoid fever
- 51 - Head and neck, acute bacterial tonsillitis/ quinsy
- 61 - Skin and soft tissue, celluliits - mild/moderate
- 62 - Skin and soft tissue, cellulitis severe
- 63 - Skin and soft tissue, necrotising STI, limb fasciitis
- 64 - Skin and soft tissue, necrotising STI, abdo/ perineal fasciitis
- 65 - Skin and soft tissue, diabetic foot infection
- 66 - Skin and soft tissue, leg ulcer infection
- 67 - Skin and soft tissue, animal and human bites
- 68 - Skin and soft tissue, post-operative wound infection
- 71 - Bone and joint, septic arthritis - native joint
- 72 - Bone and joint, osteomyelitis
- 73 - Bone and joint, prosthetic joint infection
- 81 - Genitourinary, UTI lower
- 82 - Genitourinary, UTI upper/pyelonephritis
- 83 - Genitourinary, catheter-associated UTI
- 84 - Genitourinary, cystitis
- 91 - Cardiovascular, infective endocarditis, streptococcal
- 92 - Cardiovascular, infective endocarditis, staphylococcal
- 93 - Cardiovascular, infective endocarditis, prosthetic valve
- 94 - Cardiovascular, infective endocarditis, HACEK
- 101 - Eye infections, bacterial endopthahlmitis
- 102 - Eye infections, orbital cellulitis
- 111 - Haematology, neutropenic fever
- 121 - Women's health, UTI lower, pregnancy
- 122 - Women's health, UTI upper/pyelonephritis, pregnancy
- 123 - Women's health, non-sexually acquired PID
- 131 - Sexual health, sexually acquired PID
- 132 - Sexual health, syphilis
- 141 - Renal, catheter related bacteraemia protocol
- Other

Appendix 1 (continued): AntiMicrobial Stewardship Audit—example form.

25. Do the antibiotic choices of the first medication chart antibiotic(s) **match MicroGuide** guidelines, by the end of the next day ward round?
(If multiple reasons exist for 'No', then choose the highest option on the list) *

Exact doses are not required in this case. For sepsis ?source - gentamicin use is not obligatory.
Audit Standard 5: Excluding the reasons below (31 to 37), 100% of antibiotic choices should match MicroGuide.

- ○ 1 - Yes
- ○ 2 - No, and **no reason** provided
- ○ 31 - No, guideline **not available** for condition
- ○ 32 - No, due to **Infectious Diseases** specialist advice
- ○ 33 - No, due to **allergy**/intolerances
- ○ 34 - No, due to targeted prescribing for **known recent microbiology within 7 days**
- ○ 35 - No, due to patient **already failing** on that antibiotic in community
- ○ 36 - No, due to known **MRSA/ESBL** colonisation
- ○ 37 - No, due to **no IV access**

26. Was the **duration and/or a review date** in the notes? *

Documented within 24–48 hours of the start date.
Audit standard 6: 100% of IV antibiotics should have a planned duration or review date written in the notes and drug chart.

- ○ 1 - Yes
- ○ 2 - No

27. Any additional comments or issues?

28. Is there information available for Second Audit Capture? *

After 48–72H on IV antibiotics.

- ○ 1 - Yes, continue to next page
- ○ 2 - No, click *Submit Form* and write down patient details for second audit capture to be done at the 72H mark, wherever the patient moves to. If required, handover the case to another auditor.

Second Audit Capture

Captures information after 48–72H on IV antibiotics

29. Was **ID consulted** for piperacillin/tazobactam, ertapenem or meropenem? *

Is there a progress note from ID on CWS?
Audit Standard 7: 100% of patients on these antibiotics require discussion with ID.

- ○ 9 - Patient was not on piperacillin/tazobactam, ertapenem or meropenem
- ○ 1 - Yes
- ○ 2 - No

30. Was an **antibiotic review** undertaken within 48–72 hours of charting? *

Audit Standard 8: 100% of patients should receive an antibiotic review within 48–72H of the start date.

- ○ 1 - Yes
- ○ 2 - No, antibiotic review occurred after 72H, or not at all

Appendix 1 (continued): AntiMicrobial Stewardship Audit—example form.

31. Were IV-to-oral **SWITCH** criteria met within 48–72 hours? *

Suitable oral option—an oral antibiotic is listed in the susceptibilities, or there's an oral version of the IV abx

When afebrile >24h [37.9C or less for 24H]

Infection suitable for oral - exclude meningitis, endocarditis, neutropenic fever, necrotising skin/soft tissue

Tolerating oral/NG food/fluid

Clinical+lab improvement—patient described as better + neutrophil count improved towards normal range

Haem/Onc excluded

Auditor is to determine if SWITCH criteria are met by the end of the day 3 ward round, regardless of what actually happened to the patient.

- ○ 1 - Yes
- ○ 2 - No

32. Were antibiotics **changed** at the 48–72 hour review? *

In response to clinical improvement or named organism on microbiology results.
Audit Standard 9: 100% of patients who meet SWITCH criteria should be swapped to oral antibiotics.
Audit Standard 10: For patients where microbiology results are available demonstrating safe, narrower spectrumantibiotic options to complete therapy, 100% of patients should swap to that option.

- ○ 1 - Yes, antibiotics **stopped**
- ○ 21 - Yes, switched to all oral, narrow spectrum antibiotic chosen **(de-escalated)**
- ○ 22 - Yes, switched to all oral, unnecessarily broad spectrum antibiotic chosen **(de-escalated)**
- ○ 23 - Yes, changed to narrower spectrum IV antibiotic **(de-escalated)**
- ○ 31 - No, current IV abx continued **(no microbiology results)**
- ○ 32 - No, current IV Abx continued **(microbiology result available, already narrowest spectrum option)**
- ○ 33 - No, current IV Abx continued **(microbiology result available, but not narrowed)**
- ○ 41 - Yes, antibiotics escalated **(due to no clinical improvement)**
- ○ 42 - Yes, antibiotics escalated **(due to microbiology results)**
- ○ 5 - Yes, antibiotics changed based on **ID/ microbiologist** advice
- ○ 9 - Yes, antibiotics changed **(no clear indication)**

33. Any additional comments or issues?

Appendix 2: Antimicrobial prescribing

Waikato District Health Board

POLICY

Antimicrobial Prescribing

Policy Responsibilities and Authorisation

Department Responsible for Policy	Pharmacy
Document Facilitator Name	Mohammed Issa
Document Facilitator Title	Pharmacist, Infectious Diseases and Antimicrobial Stewardship
Document Owner Name	Gary Hopgood
Document Owner Title	Chief Medical Officer
Target Audience	All staff involved in the prescribing, administering and monitoring of antimicrobials
Committee Endorsed	Medicines and Therapeutics Committee
Date Endorsed	25 March 2020
Authorised By	Board of Clinical Governance Lite
Date Authorised	23 June 2020
Disclaimer: This document has been developed by Waikato District Health Board specifically for its own use. Use of this document and any reliance on the information contained therein by any third party is at their own risk and Waikato District Health Board assumes no responsibility whatsoever.	

Policy Review History

Version	Updated by	Date Updated	Summary of Changes

Doc ID:	6244	Version:	01	Issue Date:	23 JUN 2020	Review Date:	23 JUN 2023
Facilitator Title:		Pharmacist			Department:	Pharmacy	
IF THIS DOCUMENT IS PRINTED, IT IS VALID ONLY FOR THE DAY OF PRINTING							Page 1 of 12

Appendix 2 (continued): Antimicrobial prescribing

Waikato District Health Board

POLICY

Antimicrobial Prescribing

Contents

Appendix 2 (continued): Antimicrobial prescribing

Waikato District Health Board

POLICY

Antimicrobial Prescribing

1 Introduction

1.1 Purpose

This policy forms part of Waikato District Health Board's (DHB) quality improvement strategy for patient safety and is a requirement under the Health and Disability Services (Infection Prevention and Control) Standards NZS 8134:2008. It provides a framework for staff to follow to help reduce inappropriate prescribing and optimise antimicrobial use.

Waikato DHB aims to:

- Reduce harm associated with antimicrobial use;
- Improve patient safety in relation to the use of antimicrobials;
- Reduce costs associated with the management of infections;
- Optimise antimicrobial prescribing, particularly in the management of severe infections;
- Ensure that antimicrobial stewardship initiatives are recognised and celebrated appropriately;
- Promote appropriate prudent prescribing in line with accepted national and international best practice.

The policy specifies the roles and responsibilities of healthcare personnel in ensuring that antimicrobial prescriptions are appropriate and regularly reviewed.

1.2 Background

Antimicrobials may be life-saving but their use, whether appropriate or inappropriate, may drive antimicrobial resistance. An Antimicrobial Stewardship Programme is a key component in slowing the development of antimicrobial resistance and in the reduction of healthcare associated infections.

Choosing Wisely is an international initiative to reduce unnecessary tests, treatments and procedures. This includes the unnecessary use of antibiotics which contributes to antimicrobial resistance. It is important that all clinical staff recognise the relationship that appropriate laboratory testing has on antibiotic prescribing. For example ordering a urine culture in asymptomatic elderly patients can result in a positive culture, therefore unnecessary antibiotics. Refer to the Waikato DHB Laboratory Testing guidelines for guidance on appropriate testing.

1.3 Scope

All staff involved in the prescribing, administering and monitoring of antimicrobials or the management of those involved in the prescribing (including transcribing), administering and monitoring of antimicrobials must be familiar with this policy.

1.4 Patient/client group

This policy is inclusive of every patient prescribed an antimicrobial within Waikato DHB services.

Doc ID:	6244	Version:	01	Issue Date:	23 JUN 2020	Review Date:	23 JUN 2023
Facilitator Title:		Pharmacist			Department:	Pharmacy	
IF THIS DOCUMENT IS PRINTED, IT IS VALID ONLY FOR THE DAY OF PRINTING							Page 3 of 12

Appendix 2 (continued): Antimicrobial prescribing

Waikato District Health Board

POLICY

Antimicrobial Prescribing

2 Definitions

Administrator	A healthcare practitioner who, for the purposes of this policy, has administered a medicine to a patient. For the purposes of this policy this is predominantly healthcare practitioners involved in the administration of antimicrobials.
Antimicrobial	All anti-infective agents when used for the purpose of the treatment or prevention of infection in any dosage form including systemic and topical dosage forms.
Drug Allergy	Immunologically mediated drug hypersensitivity reactions. These may be either immunoglobulin E (IgE)–mediated (immediate) or non–IgE-mediated (delayed) hypersensitivity reactions
Drug Intolerance	Adverse Drug Reactions (ADRs) that are not immunologically mediated.
Microguide®	A resource for prescribing antimicrobials, grouped by body system. https://viewer.microguide.global/WDHB/ADULT
Prescriber	Anyone who prescribes an antimicrobial prescription including non-medical prescribers

3 Policy Statements

It is essential that:

- Antimicrobials must **only** be started when there is a clear expectation of patient benefit.
- Antimicrobial prescribing will be as per Waikato MicroGuide® or relevant service guideline.
- Review takes place within 48 hour and a subsequent review date clearly documented to ensure regular assessment.
- When surgical prophylaxis is indicated, use must not be for more than 24 hours unless directed otherwise in MicroGuide® or relevant service guideline.
- Antimicrobials prescribed on the regular section of the prescription chart must include times for administration along with a review or discontinuation date.

4 Policy Processes

4.1 Roles and Responsibilities

All Staff

Antimicrobial stewardship is the responsibility of all staff involved in or who oversee the prescribing, administration, and monitoring of antimicrobials (including managers).

Prescribers, pharmacists and those who administer antimicrobials

The antimicrobial policy is required to be followed by all who prescribe, administer, and monitor antimicrobials.

The checklist found in Appendix A must be utilised by prescribers, pharmacists and those who administer antimicrobials, where appropriate.

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Infectious Disease team

The Infectious Diseases Doctors, Clinical Microbiologists and Infectious Diseases Pharmacist have the authority to challenge inappropriate practice and inappropriate prescribing decisions. Reporting of repeated, unjustified non-compliance should include the Infectious Diseases Team to ensure robust liaison with relevant medical staff.

Managers

Where non-adherence to policy is identified it is the responsibility of managers to ensure there is a process in place to address areas for practice improvement, assess for gaps in knowledge and ensure adequate training.

Employees

Employees who identify inappropriate antimicrobial prescribing have a responsibility to challenge the prescriber. Challenge/clarification in the form of Waikato DHB's endorsed safety C.O.D.E is encouraged where a prescription appears to fall outside of the antimicrobial prescribing policy.

4.2 Prescribing and Monitoring Antimicrobials

4.2.1 Initiating Antimicrobials

Antimicrobials must **only** be started when there is a clear expectation of patient benefit.

This expectation must be based on sound clinical judgement informed by the available published evidence.

Antimicrobial prescribing will be as per Waikato DHB MicroGuide® or relevant service guideline, e.g. Paediatrics will use the Starship Paediatric Antimicrobial Prescribing Guidelines and mobile Script App. If information available is insufficient, consult the Infectious Diseases Team for further advice (refer to Appendix A).

Prompt (within one hour of diagnosis) initiation of antimicrobials in severe sepsis

Start promptly, within one hour of diagnosis with sepsis

At the time of prescribing, it is the prescriber's responsibility to ensure that the nurse caring for the patient knows that antimicrobial therapy has been prescribed, so that these medicines(s) can be administered in a timely manner.

For further sepsis guidance please see Waikato DHB ED Severe Sepsis, Management of guideline.

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Allergy and other adverse drug reactions

Allergy and other adverse drug reactions, including the name of the medicine and nature of the reaction, must be ascertained and documented prior to administration of any antimicrobial. Wherever possible severe allergic reactions must be clearly differentiated from other more minor forms of intolerance to medications. This is to help ensure that patients avoid life-threatening reactions, and also to help ensure that patients are not denied access to effective first-line antimicrobial therapy on the basis of a minor side effect.

If amendments are made to allergy status during hospital admission, there must be adequate verbal and written communication with the patient and other healthcare professionals.

Changes to allergies and adverse effects must be reflected with a signature and date on the medication chart and recorded in iPM as a patient medical warning. This includes de-labelling when the labelled allergy is found to be incorrectly documented. Allergy de-labelling also requires appropriate primary care provider notification.

Penicillin allergy

Specialist advice (from an infectious disease physician, or paediatrician for patients under 16) must be sought and documented in the clinical notes for patients appearing to require cephalosporins or carbapenems who have a documented history of type 1 hypersensitivity to one of the penicillin class of antimicrobials, to identify the most appropriate available antimicrobial in the specific circumstances. See also Waikato DHB Paediatric Service's Allergy Evaluation for Children Presenting with a Past History of Penicillin Allergy guideline.

Cultures and sensitivity

If cultures are appropriate, they must be obtained as soon as possible and ideally before administering any antimicrobial therapy. However, antimicrobials **must never be unduly delayed** in patients demonstrating systemic signs of sepsis or when the suspected diagnosis is meningitis.

Duration

For the majority of infections, the duration of therapy is to be as short as possible to balance effective treatment against emergence of resistance whilst minimising the potential for an adverse drug reaction. Guidance on course lengths has been included in MicroGuide® and relevant service guideline wherever possible.

Monitoring

Therapeutic drug monitoring (TDM) and pharmacist consultation must be considered for antimicrobials with a narrow therapeutic index (e.g. glycopeptides and aminoglycosides), to ensure safe use of high risk medication.

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4.2.2 48 hour review

Review and changes made to a patient's antimicrobial therapy must be clearly documented in the clinical notes.

Within 48 hours the clinical diagnosis, microbiology results, radiology and other tests must be reviewed. At the time of review, a clear plan of action is to be detailed in the clinical notes confirming one of the following five decisions:

1. Stop therapy if no longer necessary.
2. De-escalate
   a. Intravenous to oral switch

      Assess for ongoing need for IV therapy (see also step 5):

      Intravenous to oral switch should be based on culture and sensitivity results where possible or on the recommended step-down regimes detailed in MicroGuide® or relevant service guideline.

   b. Transition to a narrower spectrum antimicrobial

      The spectrum of antimicrobial cover should be narrowed wherever possible based on culture and sensitivity results in order to limit the emergence of antimicrobial resistance and potential antibiotic-related morbidity such as *Clostridium difficile* infection.
3. Continue current therapy. Document a further review date when treatment will be reassessed.
4. Escalate treatment depending on infection severity if the patient is not responding. Senior clinicians should discuss the patient with an Infectious Disease Specialist. In treatment failure after prolonged courses, it may be appropriate to stop all antimicrobials and reassess the case.
5. Discuss Outpatient Intravenous Antibiotic Therapy (OPIVA) with the OPIVA co-ordinator and Infectious diseases specialist (see exceptions in Waikato DHB Provision of Parenteral Antimicrobial Therapy for Patients in Community Settings policy) for clinically stable patients requiring ongoing IV antimicrobials.

4.2.3 Ongoing review of antimicrobials

Therapy must be focused (targeted) where appropriate

The need for antimicrobials, and the results of further investigations including available microbiology results must be reviewed daily together with the ongoing need for intravenous therapy where prescribed.

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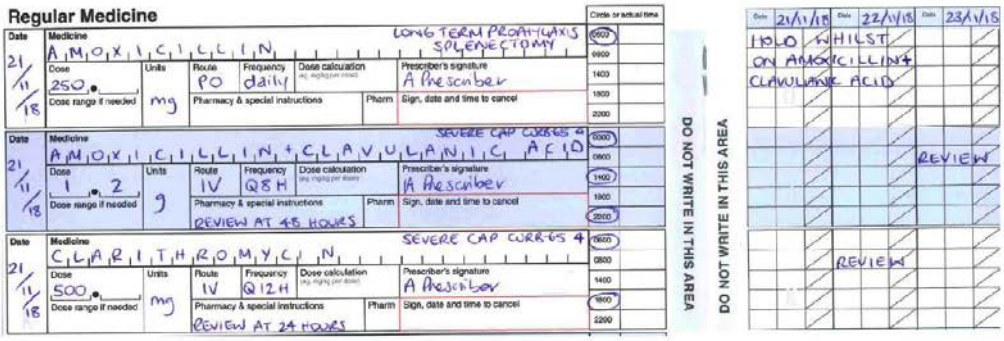
4.2.4 Long term antimicrobials for medical prophylaxis

Antimicrobials for medical prophylaxis must be endorsed with the words "long term prophylaxis for X" where "X" refers to the infection the antibiotic is there to prevent.

If treatment antimicrobials have been started, it may be appropriate to withhold medical prophylaxis where antimicrobial spectrum of the new agent is adequate for both. In such circumstances, long term prophylaxis should remain prescribed on the chart and administration put on hold during the acute course – see example below.

If the patient has had breakthrough infections despite being on prophylaxis or there is evidence to suggest the development of antimicrobial resistance, a decision should be taken regarding the risks versus the benefits of continuing prophylaxis.

Example:



4.2.5 Documentation

Documentation in the clinical record and on the medication chart must include

- Medicine, route and dose
- Indication (and severity where appropriate)
- Stop or review date **or** statement indicating for long term medical prophylaxis

All antimicrobial prescriptions must include an indication and a review or stop date including:

- All new courses of antimicrobials
- Antimicrobials for medical and surgical prophylaxis
- Antimicrobials the patient was taking prior to admission for which a decision is taken to continue during hospital stay.

A review or stop date must be clearly indicated in the clinical notes **and** on the medication chart.

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5 Audit

5.1 Indicators

Global monitoring will be undertaken by the Antimicrobial Steering Group via the annual National Antimicrobial Prescribing Survey (NAPs) and quarterly consumption data.

5.2 Tools

Antimicrobial Consumption Data
Antimicrobial consumption will be measured via the monthly collation of Defined Daily Dosage (DDDs) data and will be fed back via the Antimicrobial Steering Group in the form of quarterly reports.

Prescribing Quality
Annual National Antimicrobial Prescribing Survey (NAPS).

6 Legislative Requirements

6.1 Legislation

This policy complies with the New Zealand Standard NZS 8134.3:2008: Health and Disability Services (Infection Prevention and Control) Standard 6 – Antimicrobial usage.

6.2 External Standards

This policy is in keeping with the Ministry of Health and Ministry for Primary Industries. 2017. New Zealand Antimicrobial Resistance Action Plan. Wellington: Ministry of Health.

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7 Associated Documents

7.1 Associated Waikato DHB Documents

- Medicines Management policy (Ref. 0138)
- Provision of parenteral antimicrobial therapy for patients in community settings policy (Ref. 5434)
- Waikato DHB Infection Prevention and Control Procedures Index and Hyperlinks (Ref. 3128)
- Waikato Microguide: Adult Antimicrobial Guidelines https://viewer.microguide.global/WDHB/ADULT (external website)
- Severe Sepsis, Management of guideline (Ref. 3506)
- Allergy Evaluation for Children Presenting with a Past History of Penicillin Allergy guideline (Ref. 5970)
- District Nursing Community Outpatient Long Term Antibiotics Clinical Pathway (Ref. 3100)
- District Nursing IV Antibiotic Cellulitis protocol Clinical Pathway (Ref. 3062)
- Perioperative Antibiotic Prophylaxis in Endoscopy Unit guideline (Ref. 3135)
- Women's Health Antibiotic Prophylaxis in Caesarean Section guideline (Ref. 5013)
- NICU Antibiotic Usage in Newborn Unit guideline (Ref. 1659)
- Waikato DHB Laboratory Testing Guidelines (Ref. 3104)

Multiple drug guidelines and treatment guides for specific pathogens/diagnoses – see policies and guidelines library.

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Appendix A – Checklist

When initiating antimicrobials the following must occur:

1. Check allergy status and adverse drug reaction (drug intolerances) history prior to every antimicrobial prescription, administration or prescription review.	
2. Ensure prompt (within one hour of diagnosis) antimicrobial prescribing and administration in patients with sepsis or life-threatening infections.	
3. Obtain appropriate samples for culture, where doing so will not unduly delay therapy.	
4. Review the patient for potential, significant drug/disease and drug/drug interactions.	
5. Review recent antimicrobial use, past history of resistant organisms and recent history of Clostridium difficile infection/s.	
6. Consult MicroGuide® or relevant service guideline for appropriate antimicrobial choice and guidance. If information available is insufficient, consult with Infectious Disease Specialists or Infectious Diseases Pharmacist for further advice.	
7. Ensure all antimicrobial prescriptions are necessary. Document indication and antimicrobial name, dose, route and review or stop date on the medication chart and in the clinical notes.	
8. Ensure a documented plan to investigate source of infection where infection is suspected but source is initially unclear.	
9. Check all doses are prescribed with times for administration which are spaced through the 24-hour period or as appropriate.	
10. Where necessary for antimicrobials requiring therapeutic drug monitoring, check antimicrobial concentrations to ensure appropriate/safe use. Consult pharmacy where possible.	
11. Ensure the administration of all prescribed antimicrobials at the times prescribed. Where necessary checking for additional administration instructions e.g. in relation to meal times	
12. Query every prescription continuing beyond a review or stop date with the responsible prescriber. Nursing staff should continue to administer doses until directed otherwise.	
13. Be alert for omitted or delayed antimicrobial doses. Observations should be taken, and the responsible team alerted if an omitted dose is identified in order that the patient can be reviewed for ongoing signs of worsening infection.	
14. Be alert for the loss of access (intravenous, oral). The responsible team should be alerted immediately if a patient cannot receive prescribed antimicrobials for any reason.	
15. In cases where the team cannot be contacted to ensure the above in a timely manner, escalate up through the clinical team until such information is forthcoming. Report any difficulties encountered to the charge nurse manager (CNM) for further escalation to the appropriate Clinical Director if there is any further delay in the prescription being clarified.	
16. All new antimicrobials should be reviewed at/by 48 hours and regularly thereafter.	

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Considerations in the assessment and management of ADHD within the TGDNB population

Zoe Kristensen, Caitlyn Drinkwater, Rachel Johnson, David B Menkes

ABSTRACT

AIMS: In this article we consider current literature around Attention Deficit Hyperactivity Disorder (ADHD) in the transgender, gender diverse and non-binary (TGDNB) population.

METHODS: Literature review.

RESULTS: N/A

CONCLUSIONS: We outline specific considerations pertaining to the assessment and treatment of ADHD in this group and highlight evidential gaps and avenues for future research. We conclude that TGDNB individuals should be considered a "special population" with regards to ADHD and encourage mental health practitioners to consider specific TGDNB mental health needs beyond capacity assessments and gender-affirming care.

In this article we consider Attention Deficit Hyperactivity Disorder (ADHD) in the transgender, gender diverse and non-binary (TGDNB) population. We outline specific considerations pertaining to the assessment and treatment of ADHD in this group and highlight evidential gaps and avenues for future research. We conclude that TGDNB individuals should be considered a "special population" with regards to ADHD and encourage mental health practitioners to consider specific TGDNB mental health needs beyond capacity assessments and gender-affirming care.

Background

ADHD is a neurodevelopmental disorder with an estimated prevalence of 5–9% in children and adolescents and 3–5% for adults.[1] It is associated with difficulties with hyperactivity and/or sustaining attention, often including features of impulsivity. ADHD can negatively impact on functioning in several areas including psychological, social, educational, occupation and activities of daily living.[2] There is widespread recognition of the under-diagnosis of ADHD, particularly among adults, especially women.[3,4]

The prevalence of TGDNB individuals is estimated to be up to 4.5% of adults and 8.4% of children and adolescents worldwide,[5] with precise figures depending on a number of factors including location and age.[6] ADHD is estimated to be 1.72 to 7.21 times more prevalent among TGDNB individuals than in the general population.[7] Additionally, TGDNB individuals have poorer mental health, experience more difficulties at school and are more likely to experience material poverty than the general population.[8,9] This article considers the extent to which the under-recognition and under-treatment of ADHD in this group may contribute to these more general difficulties and poor outcomes.

ADHD diagnosis and assessment

Diagnosis of ADHD requires both symptom criteria and functional impact in multiple domains (i.e., home, work, school, social).[10] In clinical practice, this is often assessed through a combination of detailed clinical history, collateral information from others and psychometric instruments such as the Conners IV or the SNAP-IV.[1,11]

While it is often assumed psychometrics are equally applicable to all, available evidence indicates that these may under-detect ADHD among females versus males.[3,11] Studies have not yet been conducted to ascertain applicability of ADHD psychometrics to TGDNB individuals. This is problematic both in terms of understanding whether—and how (i.e., up or down)—a threshold might need to be adjusted for those with a non-binary gender, but also in terms of whether one's assigned gender (i.e., natal sex) or whether one's

asserted gender (i.e., stated gender identity) should determine whether a "male" threshold or a "female" threshold for diagnosis should be used. These issues are not unique to ADHD psychometrics, and are considered in detail in Anderson et al. (2022).[12]

ADHD psychometrics require feedback from multiple responders related to the patient. However, TGDNB individuals are more likely to experience bullying and discrimination at school, and less likely to feel they are cared about by education providers.[8] This may impact on attendance and the likelihood of remaining within a given school, and so make gaining accurate feedback from educational settings more challenging. Secondly, as TGDNB individuals are significantly more likely to be estranged from family,[8,9] it may not be possible to gain collateral or assess developmental history. Finally, gaining a true sense of functional impact on employment may too be challenging. TGDNB individuals are more likely to experience workplace discrimination,[8,9] which may act as a confounding factor in ADHD assessment. Furthermore, as TGDNB individuals are less likely to hold stable employment,[8,9] it may not be possible to assess the functional impact of ADHD symptoms alone on employment. Clinicians may need to exercise additional flexibility when assessing ADHD among those with TGDNB identities, for example, by placing greater weight upon self-reported symptoms and relying correspondingly less on psychometrics and collateral history.

To compound the difficulty, reaching a specialist for ADHD assessment may be more challenging for TGDNB individuals, who are less likely to access healthcare due to a number of factors, including experiences of mistreatment or discrimination.[8,9] TGDNB individuals experience more diagnostic overshadowing,[13] are less likely to have easy access to a GP and are more likely to be denied or delayed in accessing healthcare.[14] In the context of the so-called "mental health crisis" in many countries, it is more likely that TGDNB individuals will "fall through the cracks". Additionally, higher rates of poverty mean private assessment is often unattainable for this population.[14] Public providers should be mindful of these realities when triaging referrals; meanwhile, private providers may assist by offering sliding-scale fees or payment plans to the TGDNB population as they are encouraged to do for other marginalised groups, including Indigenous peoples.[2]

Finally, it is important to recognise that it may be more challenging to differentiate ADHD from other diagnoses within the TGDNB population. Numerous conditions commonly considered differential diagnoses to ADHD have higher prevalence among the TGDNB population, including: anxiety, depression, emotional regulation difficulties and PTSD.[16] These may in themselves be manifestations of minority stress.[16,17] The impact of these psychological and social factors on TGDNBs' ability to focus their attention may lead to the diagnosis of ADHD being applied when it is not appropriate. This creates a risk of further pathologising a minority group who are often over-medicalised, which can impact a young person's self-esteem and locus of control when confronted with future stressors. Autistic spectrum conditions also have higher prevalence among TGDNB populations.[7] While co-occurring syndromes should not contraindicate an ADHD diagnosis, providers should be aware of these overlaps in assessment, formulation and management planning.

Considerations in treating ADHD among TGDNB individuals

Treatment of ADHD is multifaceted and may consist of psychoeducation, psychosocial interventions and lifestyle changes, and pharmacological options. Medications are generally effective in treating more severe forms of ADHD, with psychostimulant medications considered more effective than other drugs.[1,2,11,18]

Concurrent puberty suppression in adolescents

Appetite suppression is a common side effect of both stimulant and non-stimulant ADHD medications.[1] A reduction in adult height is also well-recognised as a side-effect of these treatments, considered related (at least in part) to the aforementioned appetite suppression.[19,20]

For TGDNB adolescents who seek this as part of gender affirmation, guidelines recommend commencing puberty blockers (PBs) at Tanner Stage 2 to "buy time" to allow them to make a capacitous decision whether to commence estrogen or testosterone gender-affirming hormone therapy (e-GAHT/t-GAHT, respectively).[5] Concerns have been raised around the impact of prolonged PB treatment on bone-density,[21] with debate as to whether this is due to the medications themselves or due to wider societal factors such as exclusion from sport.[5] Regardless, inadequate

nutrition from ADHD medication-induced appetite suppression may exacerbate this issue.

Concerns might be mitigated through employing the same three-pronged approach to management of psychoeducation, psychosocial intervention, and accounting for this (non-pharmacological) interaction within prescribing.

Where a young person is being treated with PBs, patients and families should be warned around the possibility of appetite suppression further contributing to reduced bone density, as well as how this might be addressed. Standard recommendations, including eating prior to taking medications, taking medication breaks, encouraging eating and using nutritional supplements and encouraging physical activity[1,11] are perhaps more crucial in TGDNB youth on PBs. However, providers should be aware of the lower rates of physical activity among TGDNB individuals due to concerns around discrimination and hostility.[8] Therefore, there may be a need for providers to signpost these patients to TGDNB-inclusive (and safe) sports clubs, recreational facilities or exercise groups to reduce barriers to participation. Similarly, professional bodies supporting those with ADHD might consider releasing statements supporting TGDNB inclusion in sport to help address barriers at a societal level.

It may be beneficial for ADHD treatment providers to provide education around the relationship between eating and attainment of gender-goals. Those identifying as male may be motivated to eat by understanding the link between nutrition and maximising adult height or optimising muscle mass, while those identifying as female may be motivated by understanding the link between eating and breast growth or gynoid fat deposition. Through these discussions patients may come to consider eating as a gender-affirming intervention in itself, thus improving motivation to eat and increasing oral intake as a result. Anecdotally, the authors have seen significant benefits in routinely having this discussion in clinical practice.

It is unclear whether providers should routinely deviate from standard prescribing guidance for TGDNB individuals on PBs. Guanfacine, a second-line agent, is thought to have less impact on appetite[1,2] than other ADHD medications, and so—in the context of a young person on concurrent PBs—may be helpful in minimising impact on bone density and (particularly in those assigned female at birth) optimising growth. However, as guanfacine is less efficacious than stimulants in treating ADHD,[18] then restricting access to stimulant medications to those on PBs may instead serve to worsen current healthcare inequality experienced by TGDNB individuals. Additionally, guanfacine is only obtainable under Section 28 in Aotearoa New Zealand, meaning it is not routinely prescribed and is less likely to be accessible to impoverished marginalised groups owing to associated costs, thus posing equity issues. More evidence is needed to understand how to best optimise ADHD management in the TGDNB population, and particularly those on PBs or undergoing GAHT. In the meantime, the authors would advocate for a patient-led and informed consent approach to agent selection when treating this group.

The role of gender-affirming hormone treatment (GAHT) optimisation

GAHT involves the blocking of natal sex steroids and artificial supplementation with sex steroids aligning with the gender-goals of a given patient. t-GAHT generally involves testosterone administration alone. Meanwhile, e-GAHT generally involves administration of an androgen-blocker and estrogen.[5] Progesterone has not been routinely recommended as part of e-GAHT.[21] However, more recent guidelines allow for an informed-consent approach to its inclusion based on a lack of strong evidence suggesting either benefit or harm.[22]

Guidelines around GAHT dosage have often balanced optimising desired physical changes with minimising physical harm, with little to no consideration of also optimising mental health.[21] Evidence around physical effects and harm is often extrapolated from trials on the cisgender population, and there is a distinct lack of quality evidence on the neuropsychiatric effects of GAHT on TGDNB people specifically. Those which do tend to show differences are of unknown relevance, and so lack clinical applicability.[23]

Studies around other conditions in which low levels of sex-steroids are implicated have shown various cognitive and psychiatric symptoms are associated with low-hormone states, and that these can be relieved by exogenous hormone supplementation (HRT). Low testosterone states in cisgender men are associated with higher rates of depression and fatigue and lower quality of life scores, all of which are improved by testosterone supplementation.[24] Prescribing progesterone and/or estrogen to cisgender women with low levels has been shown to improve mood, improve

executive function[25] and to reduce suicidal ideation.[26] Progesterone monotherapy has also been shown to improve sleep in both sexes.[27,28]

It may therefore be reasonable to consider increasing testosterone or estrogen dose to alleviate ADHD symptoms in TGDNB adults where GAHT dose is not already maximised. Similarly, given the well-established role between sleep quality, quality of life scores and ADHD symptomatology,[29] progesterone might have potential as a novel agent in the treatment of ADHD among TGDNB individuals on e-GAHT. Anecdotally, the authors are aware of several cases where patients have discontinued stimulant medication following starting progesterone, with these individuals reporting that symptoms had improved to a degree where stimulant medications were no longer needed. Overall, more research is needed in this area to clarify the best evidence-based practice options.

Conclusion

While there are specific challenges in the assessment and management of ADHD in TGDNB individuals, these come alongside opportunities for new approaches to treatment and novel areas of research. We encourage providers to consider the interplay between gender-affirming medical treatments (i.e., PBs, e-GAHT, t-GAHT) and ADHD, and how both might be approached and optimised synergistically to optimise outcomes for particular patients. To this end, we recommend close collaboration with both the patient and the gender-affirming care provider. We emphasise current gaps in research pertaining to this overlap and encourage others to conduct studies in this largely unexplored area.

COMPETING INTERESTS
Nil.

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A diabetes registrar assisted workflow intervention in general practice for systematic initiation of cardiorenal medications for patients with type 2 diabetes and albuminuria in Aotearoa New Zealand

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ABSTRACT

AIMS: To evaluate whether a weekly diabetes registrar clinic and case discussions conducted over 12 weeks in primary care improves guideline management of type 2 diabetes (T2D).

METHODS: A registrar-led diabetes clinic was incorporated into two primary care practices in Tāmaki Makaurau Auckland for 3 months. Patients with T2D and albuminuria appearing on practice dashboards as not prescribed angiotensin-converting enzyme inhibitor/angiotensin receptor blocker (ACEi/ARB), or sodium-glucose cotransporter-2 inhibitor/glucagon-like peptide-1 receptor agonist (SGLT2i/GLP1RA) were booked into these clinics. Opportunistic education sessions were provided by the diabetes registrar and prescribers were surveyed to understand the challenges in management of T2D.

RESULTS: Of 125 patients booked, 80 attended the registrar clinic. Of these, 68% were clinically suitable for SGLT2i/GLP1RA and 8% for ACEi/ARB. SGLT2i/GLP1RA were initiated in 92% and ACEi/ARB in 89% of eligible patients. Two patients had contraindications for SGLT2i/GLP1RA, and one patient declined both. Additional cardiorenal medications were initiated in 16% of patients.

Survey responses of 12 prescribers indicated acute illness takes priority over diabetes management, and lack of time and knowledge are main barriers to optimising diabetes care.

CONCLUSIONS: A visiting diabetes registrar intervention was successful in initiating guideline medications for T2D in primary care. It remains to be evaluated whether this leads to practice-wide improvements in prescribing gaps in the short or longer term.

Type 2 diabetes (T2D) is a chronic condition that currently affects more than 258,000 New Zealanders (4.7% of the population).[1] Within the next 20 years, this number is projected to increase by 70–90% to 390,000–430,000 people (6.6–7.4% of the population) as the population ages and becomes more ethnically diverse.[1] T2D is associated with increased morbidity, mortality and healthcare cost, primarily through diabetes-induced cardiovascular disease (CVD) and renal disease.[2] Publicly funded treatment of diabetes and its complications now costs Aotearoa New Zealand 0.67% of its GDP, and 10% of the total health budget, or $2.1 billion NZD per annum.[3]

Chronic kidney disease (CKD) is a major microvascular complication of T2D that affects between 25% to 40% of all patients, and is typically characterised by initial albuminuria, accelerated by persistent uncontrolled hyperglycaemia and hypertension towards end-stage kidney disease requiring renal replacement therapy.[4] Māori and Pasifika in Aotearoa New Zealand are disproportionately affected by T2D and they are significantly more likely to experience cardiovascular and renal complications.[5]

In patients with T2D, screening for nephropathy and treatment with renoprotective antihypertensive agents such as angiotensin-converting enzyme inhibitor/angiotensin receptor blocker (ACEi/ARB) are known to improve outcomes.[6] Empagliflozin, a sodium-glucose cotransporter-2 inhibitor (SGLT2i), and dulaglutide, a glucagon-like peptide-1 receptor agonist (GLP1RA), have been shown to improve cardiorenal outcomes[7,8] as add-on therapies, and hence are recommended to be included early in the treatment

algorithm in people with cardiorenal risk factors.[9] Empagliflozin and dulaglutide have been funded for T2D indication (from 1 February 2021 and from 1 September 2021 respectively) under special access criteria, with prioritisation for those of Māori and Pacific ethnicity, requirement for some signs of renal disease (at least micro-albuminuria/or reduced estimated glomerular filtration rate [eGFR]) or estimated cardiovascular risk of >15% or young-adult onset of T2D.[10] Despite national and international guidelines for optimal T2D and cardiorenal risk management, many studies indicate that these medications are under-prescribed in many countries, including Aotearoa New Zealand.[11–15]

As per the Manatū Hauora – Ministry of Health virtual diabetes register, there are over 80,000 patients with T2D in the metro Auckland Tāmaki Makaurau Region, across seven primary healthcare organisations (PHOs). Several of these PHOs report anonymised practice-level data showing excellent coverage of CVD risk factor and diabetes screening measurements (~95% of adults with diabetes). However, quality indicators for processes undertaken and treatment targets achieved are much lower and have not changed over the past 5 years. As per the metro Auckland Clinical Governance Forum on diabetes and CVD Clinical Indicators report, (Quarter Three 2022/23), the proportion with glycated haemoglobin (HbA1c) <64mmol/mol ranges from 68% to 45%, with lowest attainment of glycaemic control noted in Pasifika. The proportion with systolic blood pressure <140mmHg ranges between 53–58%. Only 72–76% of people with diabetes and micro-albuminuria are on ACEI/ARB. As per the same report, treatment quality indicators have been noted to be lowest in Māori, followed by Pasifika.

Failure to achieve these glycaemic goals and other cardiovascular targets, at least in part, can be attributable to lack of timely commencement and treatment intensification.[16]

Inappropriate delays in commencement and treatment intensification by healthcare professionals is referred to as clinical or therapeutic inertia.[17] A number of factors including time constraints, lack of support (for example, limited nursing staff), lack of information or understanding of new treatment options and fear of causing harm, such as hypoglycaemia, are known to contribute to clinical inertia and force practitioners to provide reactive rather than proactive care.[18]

Introducing multi-disciplinary strategies for the management of diabetes (e.g., healthcare teams comprised of general practitioners, diabetes specialists, nurses and educators) tends to target causes of therapeutic inertia at multiple levels.[19–20] Shared care provided by the diabetes specialist nurses, dieticians, podiatrists and pharmacists is cost effective and efficient in managing patients, including more timely treatment intensification.[21] Due to their inter-disciplinary and collaborative nature, these interventions often aim to improve the decision-making process across healthcare professionals.[22]

Specialist outreach clinics in general practices have been shown to increase accessibility and improve health outcomes, as has case conferencing with virtual and face-to-face consultations, with and without patients being present.[23] Over the years, the Auckland Diabetes Centre has carried out a number of initiatives for improved integration of primary and secondary care for diabetes management. These initiatives have included diabetes shared medical appointments, a visiting specialist nurse at primary care, specialist mentoring for primary care staff and community podiatry services. However, this is the first study to evaluate whether providing a visiting diabetes registrar in primary care practices helps to optimise diabetes medication prescribing.

The aim of this study was to implement a 12-week diabetes registrar clinic intervention to review patients with prescribing gaps in guideline diabetes medications according to routine practice data on diabetes treatment gaps.

Methods

Setting

Several primary care practices in the Tāmaki Makaurau Auckland Region were invited to take part in the study, of whom two primary care practices—expected to have a high proportion of enrolled Māori and Pasifika—were selected for the registrar-based intervention. Each practice manager provided informed consent for the practice to take part in the intervention. Ethics approval was granted by Auckland Health Research Ethics Committee (AH24752).

Eligibility for diabetes registrar clinic

Patients with T2D aged ≥16 years to 80 years with confirmed albuminuria (defined as urine albumin creatinine ratio (ACR) more than 3mg/mmol) who were not prescribed on ACEi/ARB or SGLT2i/GLP1RA within the selected general practice (as per their routine diabetes care quality practice reports) were

requested to be booked into the registrar clinic.

Intervention

One diabetes registrar (AN) visited each of the intervention practices on a fortnightly basis over a 3-month period between September 2022 to January 2023 to conduct diabetes clinics and opportunistic diabetes education sessions with staff at each practice. All patients were assessed within an allocated time slot of 15–30 minutes for diabetes management, together with cardiovascular risk factor assessment. All were evaluated for eligibility for initiation with ACEi/ARBs and SGLT2i/GLP1RA as per clinical guidelines.

Registrar clinic booking process

At Intervention Practice 1, all patients were selected by the lead general practitioner (GP), according to the diabetes dashboard, to identify the patients with already developed albuminuria who were not on either ACEi/ARB or SGLT2i/GLP1RA. The nurse in charge individually contacted the patients via phone or text messages and booked patients to the clinic as per usual practice scheduling processes. Electronic referrals were made by the lead GP to secondary care specialty diabetes services, as per usual referral process, identifying the registrar clinic. At Intervention Practice 2, eligible patients were identified by individual GPs and were referred to the diabetes registrar clinic. The centre manager and the booking team at the practice scheduled the patients after contacting them via phone or text messages following the usual process in booking patients to clinics.

Data collection

Out of the people booked to these dedicated diabetes registrar clinics, the proportion suitable for prescribing additional medications, the proportion who did not attend or those who declined these additional medications were summarised.

A brief questionnaire designed to assess primary care prescribers' understanding and confidence of commencing new diabetes medications (SGLT2i/ GLP1RA) and to identify the factors that could contribute to clinical inertia as well as staff perception of registrar-assisted workflow intervention was sent to prescribers through the practice managers at each practice. The questionnaire was comprised of 17 multiple choice questions (out of which five were ranking type, as order of importance) and one free-text question (see Appendix).

Results

A total of six clinics were conducted by the registrar at Practice 1 and five clinics at Practice 2. Baseline characteristics of each practice at baseline is shown in Table 1.

A total of 125 patients were booked into the diabetes registrar over the period of 12 weeks. The proportion of patients with diabetes who had prescribing gaps in management of albuminuria (defined as UACR >3mmol/l and not on ACEi/ARB/SGLT2i/GLP1RA ascertained by practice-level data) were 38% in Practice 1 and 37% in Practice 2. According to routine practice reports, out of the total patients eligible for SGLT2i/GLP1RA, including other special authority criteria, 34% and 52% were not on these medications at each practice at the beginning of diabetes registrar intervention.

Of those who attended the registrar clinic, 91% were represented by Pacific and Māori ethnicities. (59% and 32% respectively). Attending patients' ages ranged from 22–74 years, with HbA1c ranging from 35–127mmol/L.

GP survey and education sessions

A total of 18 GPs were invited to participate in the prescribing survey, and 12 returned completed surveys. Out of the 12 GPs who completed the survey, eight were trained in Aotearoa New Zealand and four were trained overseas. Eight of them had more than 10 years of experience in primary care, and the rest had experience ranged between 1 to 10 years. Out of the responders, nine out of 12 confirmed that they review their patient's diabetes medications every 3 months. Only two indicated that they reviewed diabetes medications every visit and only one did opportunistic review of these medications. Nine of the GPs found health pathways their most useful guideline in management of diabetes.

Regarding level of confidence in starting newly funded medications, eight out of 12 GPs indicated that they were confident or very confident in starting empagliflozin, as opposed to starting dulaglutide where only five GPs felt confident.

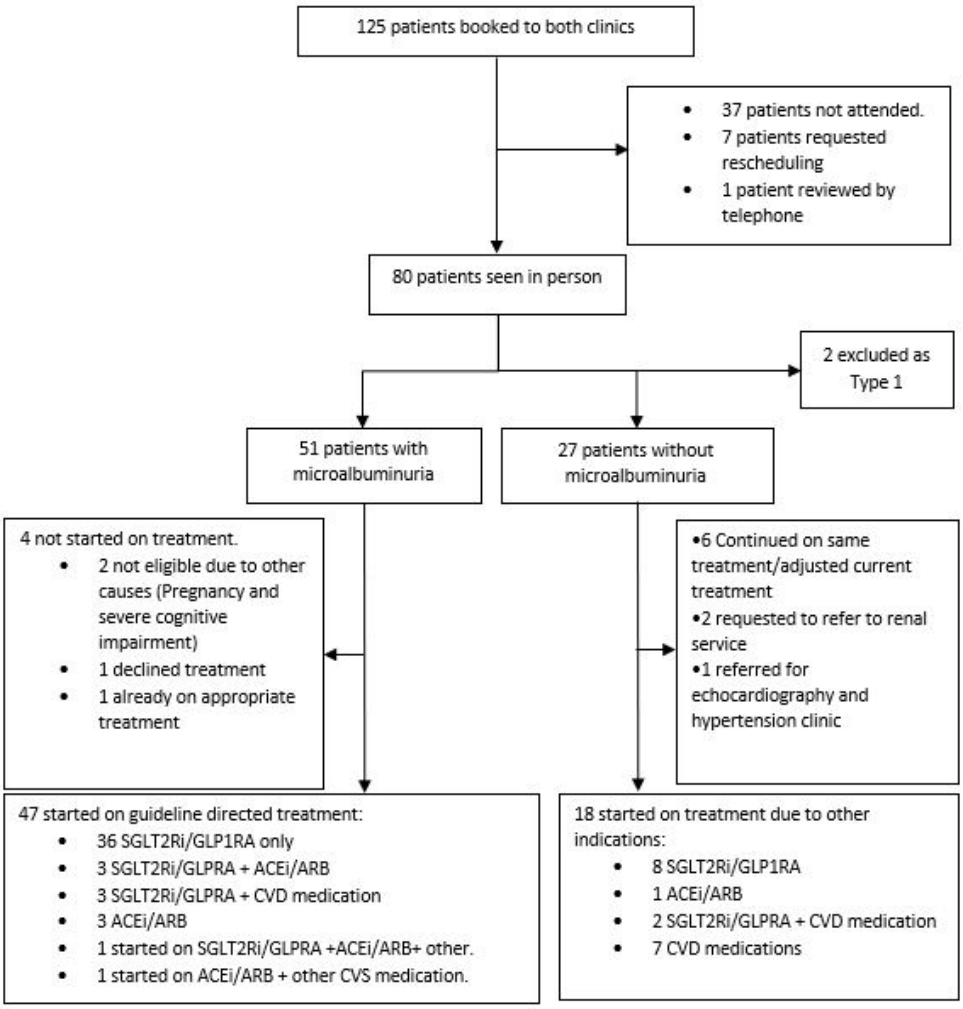
The main barriers in prescribing new diabetes medications included acute illness or comorbidities that took priority, lack of time and lack of knowledge. The majority of the practitioners indicated having poor glycaemic control as the main reason to initiate additional therapy, rather than guideline recommendations for cardiorenal indications.

Table 1: Key characteristics of each practice at baseline.

Key characteristics	Case practice 1	Case practice 2
Number (N) of patients total	N=14,249 (Māori = 14.8%, Pasifika = 38.2%)	N=5,254 (Māori = 9 %, Pasifika = 82%)
N with diabetes (and proportion Māori/Pasifika)	N=1,249 (Māori = 10.4%, Pasifika = 51%)	N=745 (Māori = 5.6%, Pasifika = 88.7%)
N with prescribing gaps in management of albuminuria*	N=478	N=277
N patients with diabetes and new medication prescribed	N=115	N=65
N still eligible for SGLT2i/GLP1RA according to routine practice reports	N=699	N=376
N not on SGLT2i/GLP1RA despite being eligible	N=244	N=196
N patients with systolic BP >140mmHg	N=534	N=386
Fees	$15 fee for a consultation and $20 for after-hours	Free consultation for all enrolled patients
Staff (note health coach)	6 registered GPs 4.5 FTE nurses 0 nurse prescribers/pharmacists 0 health coaches (at present)	8 registered GPs 8 nurses 0 nurse prescribers/pharmacists 0 health coaches
Hours	8 am–8 pm	8:30 am–5 pm
Additional features	Operates 7 days a week, serving a large community on a walk-in basis	Primary healthcare, accident and medical services and Whānau Ora services to Pasifika patients and whānau

*Defined as UACR >3mg/mmol and not on ACEi/ARB/SGLT2i/GLP1RA ascertained by practice-level data pulled from GP prescribing and routine laboratory data.

Figure 1: Summary of diabetes registrar intervention.



Weekly administration and improved adherence were the most popular reasons to start dulaglutide compared to empagliflozin.

Having more time allocated for complex patients was ranked high with regard to medication initiation and up-titration, as well as having planned reviews. Educational meetings, webinars, local education, clinical practice guidelines/materials and computer-based reminders/alerts had similar ratings on decision making and prescribing. Out of 12 GPs, six reported that having Special Authority (SA) criteria for prescribing SGLT2i (empagliflozin) or GLP1RA (dulaglutide) to Māori and Pasifika patients would likely reduce the health inequity in Aotearoa New Zealand. Having access to a diabetes registrar in clinics was reported as being highly beneficial to all. Having patient pamphlets in different languages to improve patient acceptance for new medications was also recommended.

During the practice visits, two formal discussions/educational sessions for 1 hour were conducted with the staff regarding the use of new medications and included discussions of complex patients and management options. Multiple opportunistic discussions were held in between patients during the clinics or during lunchtime.

Discussion

In this paper we discuss a diabetes registrar intervention to enhance diabetes management in primary care, in a more local and convenient setting to patients. It also emphasises that such a

model of care not only benefits patients but also benefits primary care practitioners, as well as trainee registrars, in number of ways.

A key feature of our study was the excellent success rate in prescribing new medications to eligible patients. SGLT2i/GLP1RA was successfully initiated in 92% and ACEi/ARB was initiated in 89% of the patients. In addition, 16% of the patients were initiated on additional cardiorenal and diabetes medications. This emphasises that most patients accepted the recommended medical treatment if these were discussed in an appropriate setting. Another advantage in this study was creating an opportunity to reach patients who had not attended appointments in secondary care clinics. While there was still a significant proportion (29% and 54% at each practice) of patients who did not attend the diabetes registrar clinic in primary care, approximately 10% of patients who had previous multiple non-attendances to secondary care managed to attend the registrar clinic in primary care and were successfully initiated on treatment. Our study also highlights the efficient use of diabetes practice reports or dashboards to help early recognition of patients requiring clinical review for initiation of appropriate treatment.

All GPs indicated having a diabetes registrar onsite would help them to improve guideline diabetes medication prescribing through formal and informal education sessions and discussions around complex patients. We suggest having allocated training for diabetes education would benefit most GPs and could be integrated into the GP registrar training programme.

Having an opportunity for endocrinology trainees to move out of the secondary care environment could make them sensitive to the wider health needs of the local population. Working collaboratively with GPs allows the trainees to establish meaningful partnerships, which could further improve working practices across traditional professional boundaries. It also allows them to incorporate a population perspective of specialist care and would help design care pathways for chronic illnesses such as diabetes, and provide an opportunity to assist with quality improvement processes for diabetes management in primary care. Having the benefit of closer communication with GPs, who are generally much more familiar with the context of their patient and their whānau background, culture and beliefs, is most likely to produce more favourable outcomes. Formal and informal discussions with GPs suggested mutual gains on exposure and experience on new medications as well as overall management of diabetes. Furthermore, this process enables training registrars to work closely with novel workforce resources in primary care, such as health coaches and wellness advisors, sharing more experience and knowledge among the team.

In Australasia, advanced training in endocrinology requires 36 months of fulltime-equivalent training. However, it is not mandated for trainees to have a primary care placement or to participate in outreach clinics as per current Royal Australasian College of Physicians training requirements. We suggest having such an opportunity would benefit trainees as well as patients.

In Aotearoa New Zealand, there is growing demand on primary care for people with diabetes.[3] Manatū Hauora – Ministry of Health emphasise a "closer to home" approach, with a focus on integrating primary and secondary health services for chronic conditions such as diabetes.[24] Two such models of specialist outreach care that have been described in literature include a shifted outpatient model and a liaison-attachment model. In the shifted outpatient model, the specialist outreach clinic is much the same, except for location, as a hospital clinic. On the other hand, the liaison-attachment model is based on collaboration between consultants and GPs, aiming to provide more effective joint care.[25] An Australian study that integrated a primary/specialist model of community care for complex T2D management at an outpatient department in a tertiary hospital showed significantly better glycaemic control and improvement in blood pressure and total cholesterol compared with those in the usual care group.[26] A similar approach in the United Kingdom with specialist outreach clinics for multiple specialities including cardiology, general medicine, rheumatology, ENT, general surgery and gynaecology concluded in better patient satisfaction compared to routine outpatient clinics.[27] Fifteen joint consultation models between specialists and GPs have been shown to reduce waiting lists for rheumatology in secondary care in a Dutch randomised trial.[28]

Most importantly, these partnership models have advantages for patients, such as shortened waiting times,[29] better communication and educational exchange between primary and secondary care professionals[30] and improved patient satisfaction. They are also found to have greater efficiency resulting from a reduction in unnecessary follow-up attendances and lower non-

attendance rates.[31]

Overall, the success of such a diabetes registrar initiative requires the commitment of both primary and secondary care professionals. It remains to be seen whether the educational component of the registrar intervention could lead to long-term improvement of overall prescribing of cardiorenal medications at these practices. The cost effectiveness of such an intervention needs to be evaluated before scaling up to other practices with future diabetes registrar placements.

Conclusion

A visiting diabetes registrar intervention was successful in improving guideline diabetes medication prescribing in primary care. It remains to be evaluated whether this intervention contributed to a practice-wide decrease in prescribing gaps in the short or longer term.

COMPETING INTERESTS
Nil.

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Appendix

Survey for Healthcare Professionals

Thank you for taking part in our survey. This survey is a part of a study designed to help overcome clinical inertia in the management of type 2 diabetes at general practices in Auckland.

This is a quality improvement study involving diabetes registrar-assisted clinics at general practice to improve systematic initiation of ACEi/ARB and SGLT2i/GLP1RA for patients with microalbuminuria and to codesign resources and practice workflow solutions to support ongoing systematic medication commencement and titration at each practice.

We are keen to understand the factors of what works in your practice and how we can improve overall prescribing rates of these medications.

Please note that all answers are confidential and anonymous and you may choose to not answer all questions.

Your involvement in this survey is completely optional. The information and contents of this document could be translated to te reo on your request, if required.

Please note that informed consent is assumed upon submission of this survey.

1. Which primary health organisation (PHO) are you affiliated with?		
A	ProCare	
B	Total Health Care	
C	East Health Trust	
D	Alliance Health Plus Trust	
E	Other	
2. Are you (as the person completing this survey) a?		
A	General practitioner (GP)	
B	Nurse practitioner/prescriber	
C	Practice manager	
D	Health coach	
E	Other	
3. If a GP or nurse, where were you trained?		
A	In New Zealand	
B	Overseas	
4. For how many years have you been working in primary care?		
A	0–1 y	
B	2–3 y	
C	4–5 y	
D	6–10 y	
E	More than 10 y	

5. How often do you review their diabetes medication/glycaemic control on a standard visit?		
A	Every visit	
B	Every 3 months	
C	Every 6 months	
D	Every 12 months	
E	If the time permits/opportunistic	
6. What proportion of your patients with diabetes do you screen for eligibility for prescribing new medications, SLT2 inhibitor (empagliflozin) or GLPA1 agonist (dulaglutide) on a usual visit on average?		
A	100%	
B	80–100%	
C	60–80%	
D	50–60%	
E	<50%	
7. What would be the most useful guideline that you would refer to when starting on empagliflozin or dulaglutide?		
A	Health pathways	
B	NZSSD guidelines	
C	BPAC guidelines	
D	Medsafe	
E	Other/practice-based	
8. How do you find navigating New Zealand Society for the Study of Diabetes (NZSSD)/health pathways to check recent guidelines for management of diabetes?		
A	Very difficult/never accessed	
B	Difficult	
C	Average	
D	Easy	
E	Very easy	
9. How confident are you in prescribing and educating your patient on newly funded medication, empagliflozin(SGLT-i)?		
A	Not confident at all	
B	Less confident	
C	Average	
D	Confident	
E	Very confident	

10. How confident are you in prescribing and educating your patient about using dulaglutide (GLP1 agonists)?		
A	Not confident at all	
B	Less confident	
C	Average	
D	Confident	
E	Very confident	
11. In your opinion what is the main reason you would initiate empagliflozin to a patient? Please rank your order of importance 1–5 (1 most important reason to 5 least important).		
A	Fulfils special authority criteria	
B	Improved cardiovascular and renal outcomes	
C	Poor glycaemic control	
D	Less adverse effects than GLP1 agonists	
E	Other/PHO providing lists of eligible patients	
12. In your opinion what is the main reason you would initiate dulaglutide to a patient? Please rank your order of importance 1–5 (1 most important reason to 5 least important).		
A	Fulfils special authority criteria	
B	Weekly administration/improved adherence	
C	Weight loss effect	
D	Fewer adverse effects than SGLT2i	
E	Guidelines	
13. In your opinion what are the main barriers that prevent you from prescribing empagliflozin/dulaglutide to a suitable patient?		
A	Lack of information/knowledge	
B	Lack of support from practice/staff	
C	Comorbidities or acute illness took priority	
D	Lack of time	
E	Fear of harm/adverse effects	
14. In your opinion, what is the best method that will improve you as a clinician to prescribe and up-titrate diabetes medications? Please rank your order of importance 1–5 (1 most important reason to 5 least important).		
A	Better availability of written information/knowledge	
B	Having more support from practice/staff	
C	Planned reviews	

D	Having more time allocated for complex patients	
E	Involving family/whānau	
15. What would influence you most as a clinician to prescribe a new medication such as empagliflozin or dulaglutide? Please rank your order of importance 1–5 (1 most important reason to 5 least important).		
A	Educational meetings/webinars/local education	
B	Clinical practice guidelines/materials	
C	Computer-based reminders/alerts	
D	Patient requesting the medication	
E	Having a diabetes registrar on site	
16. In your opinion, would having SA criteria for prescribing empagliflozin or dulaglutide to Māori and Pacific Island patient be likely to reduce the health inequity in New Zealand?		
A	Very unlikely	
B	Unlikely	
C	Average	
D	Likely	
E	Very likely	
17. In your opinion what would be most beneficial approach to improve diabetes-related health outcomes in the New Zealand healthcare system? Please rank your order of importance 1–5 (1 most important reason to 5 least important).		
A	Enhanced primary care	
B	Improved links between primary and secondary (specialist) care such as registrar-assisted clinics	
C	Nurse-led approach	
D	Improve funding	
E	Patient-centred approach	
18. Any other suggestions to improve diabetes-related health outcomes in the New Zealand healthcare system? (Free text.)		

Thank you for your time with this survey!
For any questions about this survey or the study please contact Prof Rinki Murphy (r.murphy@auckland.ac.nz) or Dr Anjana Niyagama (AnjanaN@adhb.govt.nz).

Key informant perspectives on a centralised contact tracing system for sexually transmitted infections

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ABSTRACT

AIM: To meet the demand of contact tracing requirements associated with Aotearoa New Zealand's COVID-19 pandemic response, a national contact tracing service was established. Contact tracing for sexually transmitted infections (STIs) like chlamydia, gonorrhoea and syphilis is usually done at the clinic level, and evidence suggests it is under-resourced and often incomplete.

METHOD: We considered the utility of a centralised contact tracing service for STIs by interviewing key informants. Interviews took place between December 2021 and March 2022, and were audio-recorded, transcribed and analysed using thematic analysis.

RESULTS: Twelve key informants from disciplines including sexual health, primary care, public health, research and contact tracing participated. Perceived benefits of a centralised system included efficiency, standardisation and reduced demands on clinician time. Potential challenges and considerations included concerns about trust and privacy, the importance of cultural safety, meeting the needs of priority populations and lack of local-level knowledge.

CONCLUSION: A centralised contact tracing service could enable a more consistent and comprehensive approach to contact tracing for STIs and alleviate some of the burden on already stretched clinicians. However, successful contact tracing requires high levels of trust and for some populations this may be best achieved through trusted local providers, who could be supported, if needed, by centralised expertise.

Contact tracing played a vital role in limiting the transmission of COVID-19 during Aotearoa New Zealand's (Aotearoa) pandemic response.[1] Contact tracing is defined by the World Health Organization as "*the process of identifying, assessing, and managing people who have been exposed to a disease to prevent onward transmission*".[2] This process helps identify other potential cases and is used in the control of infectious diseases including tuberculosis, measles, HIV and other sexually transmitted infections (STIs) such as syphilis, gonorrhoea and chlamdyia.[3] Initiation of contact tracing (or partner notification) for STIs is the responsibility of the diagnosing clinician. All contacts at risk need to receive testing.[4] Cases often choose to tell contacts themselves ("patient referral") or providers may do so anonymously on their behalf ("provider referral"). For STIs, these processes are usually referred to as partner notification rather than contact tracing. The terms have been used interchangeably in this report. STIs are diagnosed in a range of services in Aotearoa including general practice, family planning, youth and student health services, maternity and prison services. New Zealand Sexual Health Society guidelines recommend that in situations where contact tracing is complex, support is sought from sexual health or public health services.[4]

In the United Kingdom (UK) and United States (USA), regional responses to COVID-19 involved re-deployment of skilled contact tracers working in sexual health to support COVID-19 contact tracing efforts.[5] In some instances this diversion of expertise came at a cost to STI case management, leaving a shortage of staff to manage an already high and increasing workload.[6] Unlike the UK or USA, there was no dedicated workforce of specialised sexual health contact tracers with capacity to be reassigned in Aotearoa. Contact tracing for COVID-19 was initially undertaken by the 12 public health units (PHUs), but as the workload soon exceeded capacity a National Close Contact Service was set up to support PHUs (March 2020).[7] That service was also quickly overloaded,[7,8] and with additional resourcing, the National Investigation and Tracing Centre (NITC) was established, which supported PHUs in their contact tracing and took on a "finding service" to locate individuals who, to that point, were uncontactable. To facilitate this national work, a cloud-based national electronic database (the "National Contact Tracing Solution") was developed to store details of cases, contacts

and exposure events, and to assist in locating individuals by linking to contact details held in the National Enrolment Service.[8,9]

While some research looked to sexual health contact tracing experience to inform approaches to contact tracing for COVID-19 in the first years of the pandemic,[10] we consider here how Aotearoa's experience with COVID-19 contact tracing might inform the future of STI control. Aotearoa has ongoing high rates of curable STIs including chlamydia, gonorrhoea and syphilis[11,12] and, with the exception of HIV and syphilis,[13,14] there has been no significant undertaking to reduce STI prevalence. Evidence from clinic-based studies suggests partner notification for chlamydia and gonorrhoea is often incomplete, under-resourced and needs to be improved in Aotearoa.[15–18] We sought key informant views on whether contact tracing for STIs would benefit from a centralised approach as used for COVID-19, with particular consideration of effectiveness for priority populations in Aotearoa (Māori, Pasifika, and gay, bisexual and other men who have sex with men [GBM]).

Methods

Participants

Purposive sampling was used to select potential participants to take part in a one-off key informant interview, and included people working in roles or services where STI contact tracing is undertaken, and/or were known to be knowledgeable on this topic. This included individuals working in primary care, sexual health, public health and research roles. A target of 12 interviews was set due to time constraints of the project, with 21 invitations sent out (three declined or passed the request to a colleague; six did not reply). Ethical approval was granted by the University of Otago Human Ethics Committee (reference D21/313, 14 October 2021).

Data collection and analysis

Interviews were conducted by CM between December 2021 and March 2022; 10 via Zoom and two in-person (audio-recorded with permission). CM has a background as a clinician in family planning, where sexual healthcare is a core part of service delivery. Interviews followed a semi-structured schedule and sought participant views on use of a centralised workforce for STI contact tracing as part of a wider discussion about contact tracing. The data presented here relate to discussion about a centralised system, while the rest of the data are reported in a separate paper to enable full presentation of participant views.

Data were analysed using reflexive thematic analysis guided by Braun and Clarke's six-phased approach.[19] At the conclusion of each interview, brief reflective notes were made to facilitate recollection of the circumstances of the interview. Participants were asked if they wanted a copy of the transcript so they could check that it was an accurate account. The interviews were transcribed verbatim and read by CM and SR while listening to the audio recordings. CM did the initial coding looking for sections in the transcripts that related to the issue, and coded these with their explicit or implicit meaning. The codes, along with supporting quotes, were stored in a Microsoft Excel file and reviewed by SR. Themes were developed and refined. Quotes were selected by CM and SR to illustrate salient points.

Box 1: Interview questions related to use of a centralised system for STI contact tracing.

Question prompt
A National Investigation and Tracing Centre has been set up for COVID-19 that supports public health units to do contact tracing.
• Do you think it would be useful to have a centralised workforce like this to help with STI partner notification?
• What do you think would be good about a centralised service for partner notification and what problems or risks do you think there might be?
• What are your thoughts about the logistics of passing people's contact details and diagnoses to another service while maintaining trust and confidentiality?
• What do you think the key considerations are for a centralised service to work well for Māori, Pacific peoples and gay and bisexual men?

Results

The characteristics of the 12 participants are described in Table 1. The mean interview duration was 38 minutes (range 28–50 minutes). An alpha-numeric code (shown in brackets after roles) was assigned to each participant to denote their role or expertise when presenting illustrative quotes. Some comments have been edited for brevity and to ensure anonymity (e.g., names, fillers and repetitions removed).

Views of a centralised system for contact tracing

The data centred around four key themes: i) potential benefits of a centralised system, ii) concerns and considerations, iii) meeting the needs of priority populations and iv) sharing experience gained from COVID-19. The extent to which participants working in clinical roles undertook comprehensive contact tracing was variable and impacted by time, resources, type of STI and status as a notifiable disease. There was consensus that more effective approaches are needed, with some

Table 1: Characteristics of participants interviewed as key informants (n=12).

Characteristics	n
Region of residence	
Auckland	4
Rural North Island	1
Wellington	6
Christchurch	1
Role	
Sexual health physician (SHDr)	2
Sexual health nurse, nurse specialist (SN)	3
General practitioner/public health physician (GP/PH)	2
Manager (M) [a]	3
Public health researcher (PHR)	2
Population expertise [b]	
Sexual health service attendees	5
Primary care patients [c]	2
Māori	3
Pasifika	1
Men who have sex with men (MSM)	4
People with or at risk of HIV	3

[a] Managers included people working in sexual health, HIV and contact tracing
[b] Some people are included in more than one category
[c] Primary care: inclusive of family planning

Table 2: Theme 1: potential benefits of a centralised STI contact tracing system.

Potential benefits	Illustrative quotes
Efficiency, consistency and clarity: Participants suggested that a centralised system would provide a systematic approach with adoption of standard national guidelines and would save clinics from establishing and staffing individual systems. A national free phone number for patient queries that is always staffed would be beneficial.	*Guidelines around how it's done, what can be done, what can't be done, to make sure that patient confidentiality and privacy is maintained. It can be a bit of a minefield, you know, to go down and we're not all setting up our own individual training. So there's one standardised system for the whole country. (M2)*
Specialised training: Currently, clinicians receive very little or no training in contact tracing and the legal and practical boundaries are not always clear.	*It could have advantages, because you're kind of sharing the same workforce. Specialised, specially trained people doing it. (SN2)*
Improve capacity of clinical services: A national service would require less clinician time and relieve pressure on already stretched sexual and public health services.	*The challenge is nobody has the capacity to do it. GPs don't. I understand in most regions the PHUs don't even see it as part of their work to do STI contact tracing. (M3)*
Trust and acceptability: Public awareness of the national model used for COVID-19 contact tracing may facilitate acceptance and trust of a national STI contact tracing system.	*I mean, the whole nation has got experience of the contact tracing network for COVID ... maybe they would have more trust in such a system now from the experience from COVID. (M2)*
Anonymity: Some people prefer that a contact tracer does not know them personally.	*No relationship is actually very beneficial because you're not known to the family … we've learned that some people don't want to be linked back to their GP. (M1)*
Mobile populations: A national approach could provide services for highly mobile populations more effectively than a local approach.	*I think the other limitation is, each DHB* [District Health Board] *has their own contact tracing system and so there's no national reference point of, you know, like people are, particularly among MSM, sexual contacts are quite mobile. (M3)*
Potential to provide a national picture of transmission networks: Ability to collate and analyse national-level data would facilitate timely auditing and improvements.	*We need to get a clearer picture of what's happening and how successful different strategies are and how we can improve those strategies and kind of improve contact tracing. (SN2)*

supporting one well-delivered national contact tracing system; others felt a choice of approaches would enable a more patient-centred response.

Themes 1 and 2: potential benefits, concerns and considerations

The potential benefits of a centralised system identified by participants are drawn together in Table 2. Concerns that would need to be addressed if a centralised approach were utilised for STI contact tracing are summarised in Table 3.

Theme 3: meeting the needs of priority populations

Trust, relationships and cultural responsiveness were seen as key to meeting the needs of priority populations. Participants noted that for many Māori, the experience of ongoing and historic racism and related deep-rooted mistrust of the health system impacts on willingness to engage with health services. Establishing trusting relationships between providers, cases and contacts was identified as essential to effective engagement.

> *From a Māori point of view that trust with the provider is probably even more important. And I think continuity of care is particularly important for Māori, more so than others because of the systemic, multi-generational trauma that these people, on the whole, have experienced. (GP/PH2)*

Table 3: Theme 2: concerns and considerations for a centralised STI contact tracing system.

Concerns and considerations	Illustrative quotes
Lack of trust, privacy and confidentiality concerns: Suspicion from both patients and clinicians about third-party involvement and possible privacy breaches. This could be mitigated by providing explanation of the privacy and confidentiality arrangements and raising public awareness to build confidence in a national service.	*There's a kind of trust model between the provider and the person. So I would see a potential barrier if it was central, you've then got a hand over. (SHDr1)* *We've* [the NITC] *also had a number of incidents where the trust has been so high that families have contacted us voluntarily to say things are not quite as they should. (M1)*
Appropriate training and skills: It is critical that staff employed as contact tracers are appropriately trained, have good communication skills and understand and respect the communities they are interacting with.	*Having someone that both is skilled enough to know what's required to be done, but to be done in a way that is going to support the mana and hold the integrity of that person up … you're not going to learn that from a book, you're going to learn it from knowing the community. (GP/PH2)*
Immediacy: The pathway and time required to link with an external provider for contact tracing may not always be appropriate. Some circumstances require swift intervention.	*A pregnant woman who turned up in hospital ready to give birth who's had no antenatal care, and they have got syphilis. That needs to be dealt with there and then—you wouldn't want to be passing that on to a contact tracing team. It needs to be done immediately. (SN1)*
Continuity of care and links with local services: A national service might not have local knowledge and relationships that allow cases to be linked to services in a timely way. Potential suspicion of an unknown provider may decrease engagement.	*There's no real connection to the community. And, if I will be diagnosed here, for example, and then someone calls me from a random call centre, following up on my contacts, it might not go down so well. (SN2)*
Sensitivity and stigma around STIs: Individual and societal attitudes towards COVID-19 are quite different to STIs. Normalising and destigmatising STIs is crucial.	*It's way more sensitive than COVID-19 as a breaking bad news thing because of the implications of what that news means and the stigma associated with it. (GP/PH2)*
Cultural safety and considerations for priority populations: It is critical that the social and cultural norms of Māori, Pasifika and GBM are understood and met.	Addressed in theme 3.

Interacting with contact tracers who are known to, and have existing relationships with, Māori was deemed likely to have the most success in reaching people for contact tracing:

> *The best people that generally contact these marginalised communities isn't going to be the public health unit. It's going to be the nanny who works with the clinic who knows the community, who knows that [name] attends the RSA at five o'clock on a Sunday and doesn't have a phone number but answers his Facebook Messenger. (GP/PH2)*

However, a participant suggested this was not necessarily the case for Pasifika people, citing the example that a lack of any pre-existing relationship between the contact tracer and case was often preferred with respect to COVID-19 contact tracing:

> *The other learning is that for Pasifika, a lot of them do not want Pasifika people … they are a very close, close-knit community and there's a suspicion that the information will be shared. Some people prefer a completely fresh face that's nothing to do with that community whatsoever. (M1)*

Several participants regarded community-generated solutions as having more potential for success than a centralised approach. Having the skills to approach contact tracing in a way that supports the mana and upholds the integrity of individuals was identified as key.

> *I think it would be really good if you can upskill Māori health workers to be whānau champions in this area. Maybe build close relationships with those Māori providers … especially the nurses and the community workers, because they know the community and they know the language that they use. (PHR2)*

Some interviewees expressed concern over whether a centralised approach would be sensitive enough to the needs of GBM. A non-judgemental approach, which reflects understanding of and respect for the community, was regarded as critical to ensure GBM feel safe and supported to facilitate disclosure. Those in contact tracing roles need to ensure that their language, terminology and tone is appropriate and suggested that employing some GBM contact tracers would help this.

> *We consistently do get this feedback, that there is value in knowing that the person you're talking to has lived experience, you're not talking to someone who doesn't get it, or who's going to cast judgment. (M3)*

Some participants explained that many cases have sexual contacts that are difficult to follow-up ("anonymous contacts") and that the proportion of anonymous contacts is higher among GBM due to the way sexual encounters are often facilitated using hook-up apps (which do not require names or contact details), at cruising sites or at public parks. In some situations, carefully considered interventions by those with local knowledge and cultural awareness may be needed.

> *If it's someone who's in the GBM context at a cruising park, you can't contact them other than being there, so if it's really important to get someone, you need some specialists in the community or peer educators to know where to go and to do that carefully and sensitively. (PHR1)*

Theme 4: experience gained from COVID-19

Participants reflected on the public's willingness, on the whole, to co-operate with contact tracing for COVID-19, suggesting a collective understanding of the advantages of quarantining contacts for community benefit. They felt this could potentially translate into a willingness to engage with contact tracing for STIs. There was recognition that contact tracers had developed skills and been effective in supporting people to disclose information about their contacts. Participants expressed a desire for the lessons learnt from COVID-19 contact tracing to be shared with other providers.

A participant involved in the NITC identified a number of strengths of the service, including: good staff training, use of a structured but flexible approach and the ability to review, adapt and improve processes. They explained that the NITC team had gained expertise in delivering information, supporting people to make choices and refer if needed. Staff were trained to quickly develop rapport, establish trust and had developed ways to engage and encourage people to share pertinent information.

> *The case investigators become experts in reading people very quickly, and knowing … what are the hooks to get them to engage with the information, get them to trust. (M1)*

The NITC optimised approaches; analysing optimal times to phone people, when to call back and what to include in a text message to facilitate contact. Some people reportedly felt more confident talking to a "stranger" than to someone already known to them (e.g., their GP) because it felt more private. However, it was also noted that having a trusted brand and established reputation as a contact tracing service became an important way to reassure those people being contacted that it was not a hoax call.

A participant involved with the NITC stressed that they had sought guidance and worked closely with Māori and Pasifika providers to ensure contact tracers tailored their approach to the needs of Māori and Pasifika. Examples of this were: establishing relationships before asking for information, giving feedback to show they were being heard and use of "storytelling".

Discussion

Key informants in this study saw value in the use of a centralised STI contact tracing system. Benefits identified included improved efficiency and consistency, reduced demands on clinician time and provision of a more comprehensive overview of transmission networks nationally. Concerns were raised that staff must have the knowledge, skills and understanding of cultural norms to communicate effectively with priority groups. Privacy and confidentiality were seen as paramount; lack of trust was identified as a potential concern for Māori and GBM, as was reluctance of cases and clinicians to release details of sexual contacts to an external provider. The potential for missed opportunities to link contacts with testing services and lack of local and contextual knowledge were also identified as limitations of a centralised service. Some participants expressed support for improved access to locally based expertise for STI contact tracing, particularly for Māori, whose experience of and trust in colonial systems that have maintained stark health inequities may not be good.[20] In the same way that Māori and Pacific communities designed and implemented successful approaches to COVID-19 vaccination, STI contact tracing services designed by and for Māori and Pacific communities are needed.[21]

Information shared about the NITC suggested that the concerns raised by many key informants had been considered and addressed or could be overcome if contact tracing for STIs was centralised. Referring clinicians would need a clear understanding of staffing, training, operational, privacy and data collection processes to have confidence in referring their patients to a centralised contact tracing service. Establishment or extension of a national service to accommodate STI contact tracing would need to involve co-design alongside priority groups.[21] Participants' support for a centralised service to assist with STI contact tracing aligns with calls made by other sexual health physicians to "*utilise the newly created COVID-19 contact tracing workforce*".[22] Furthermore, the *Aotearoa New Zealand Sexually Transmitted and Blood Borne Infection Strategy 2023–2030* identified improved "*capability and capacity to undertake contact tracing, including by using digital tools and learnings from COVID-19 contact tracing successes*"[23] as a priority area for health service quality improvement.

The centralised STI contact tracing service could involve some or all the following elements that have been utilised in other countries or situations:

i. Utilise Aotearoa's NITC (or a similar model) to undertake high volumes of straightforward contact tracing where there is low overall risk to public health. For example, there were 32,326 chlamydia cases in 2019, and 26,045 in 2020;[12] many of these would have contacted partners themselves, but some would have opted for their clinician to assist with the contact tracing.
ii. Provide expert contact tracing for situations where there is elevated public health risk or other complexities that may require cultural, medical and/or legal expertise. This approach would align with use of "disease intervention specialists" who are affiliated with public health departments in the USA to provide "partner services" to people diagnosed with infectious syphilis, HIV and drug-resistant gonorrhoea.[24] This would also be similar to the specially trained workforce of sexual health advisors in the UK who provide expert partner notification services, although they are based in sexual health or genitourinary medicine clinics.[25]
iii. Develop internet-based partner services, which are well developed in the USA and have the potential to reach otherwise "anonymous contacts".[26,27] Such approaches require a high level of understanding of social media, technology and privacy and therefore may be best suited to a centralised system where expertise can be concentrated. There is also potential for central co-ordination of other digitally based partner notification services such as SXT, which is currently used in only one region of Aotearoa; its impact would be increased by universal uptake.[28]

The recent health system reforms aim to provide equitable services. The 12 PHUs have been brought together into a National Public Health Service, and the National Contact Tracing Solution established for COVID-19 has been extended to manage measles. This provides an opportunity for STI contact tracing to be prioritised within these newly established services. In Aotearoa, the network of STI providers is fragmented with poor provision of services in rural areas.[29] A national STI contact tracing

workforce could provide a consistent expert telehealth service, either directly to cases and contacts or by supporting local clinicians.

Strengths and limitations

Given experiences with COVID-19, mpox[30] and the health system reforms, this qualitative exploration of whether a centralised contact tracing system would work for STIs is timely, and has not previously been considered in Aotearoa literature. Participants were selected for their specific knowledge of clinical practice, public health and priority populations for whom effective contact tracing strategies are critical. The interviewer (CM) had clinical experience in sexual health and contact tracing so was able to tailor interviews to draw out salient information related to participants' expertise. Limitations include the narrow geographical spread of participants, with input from only one rural provider, which might have narrowed the scope of perspectives. Attempts were made to interview a range of key informants but we did not secure participation by Pasifika interviewees, although some participants had extensive experience working with Pasifika. Our target of 12 interviews was set due to project constraints (time and scope of a dissertation), but data generated were sufficiently rich in breadth to provide us with a range of views on the topic. Future work could explore in more detail STI contact tracing in rural locations, primary care (where most chlamydia and gonorrhoea cases are diagnosed) and issues related to young people, who are disproportionately impacted by STIs. Understanding priority group perspectives on a centralised STI contact tracing system is needed and should be sought in future work.

Conclusion

This study has identified potential benefits of a centralised STI contact tracing service. Although simple in its objective, contact tracing for STIs can be complex to carry out successfully. The best outcomes may be achieved by the establishment of a centralised STI contact tracing service that also provides training and support for local practitioners. The lessons learnt from the COVID-19 public health response must be shared with other disciplines. Adequate resourcing and prioritisation are required to reduce the high and inequitable rates of STIs, and to facilitate a rapid response to new or emerging infections that can be spread via sexual contact.

COMPETING INTERESTS
Nil.

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Raise the Flag I: the impact of a sepsis quality improvement programme on delivery of a sepsis resuscitation bundle at a tertiary hospital in New Zealand

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ABSTRACT

AIMS: To study changes in sepsis resuscitation practice at a tertiary hospital before and after the introduction of a quality improvement programme, and to identify variables associated with its delivery.

METHODS: "Raise the Flag", a quality sepsis programme, including the Sepsis Six, was launched in 2018. Adult patients with sepsis were sampled prior to the intervention and during two subsequent periods.

RESULTS: Clinicians were more likely to deliver the resuscitation bundle in the post-implementation period (adjusted odds ratio [aOR] 2.20, 95% confidence interval [CI] 1.27–3.79, p=0.005). This was not sustained at 18–30 months (aOR 1.22, 95% CI 0.89–1.66, p=0.21). After adjusting for potential confounders, each additional decade of patient age was associated with reduced odds of receiving the bundle (aOR 0.83, 95% CI 0.73–0.95, p=0.005). Admission to intensive care increased in the combined post-implementation periods (aOR 2.81, 95% CI 1.13–6.97, p=0.03).

CONCLUSION: The odds of receiving a resuscitation bundle improved immediately following the launch of the Raise the Flag programme. Resuscitation practice differed based on patient age. Odds of admission to intensive care were increased.

Global epidemiological studies suggest that sepsis may contribute directly, or indirectly, to as many as 20% of deaths world-wide.[1] In New Zealand, sepsis exerts a significant burden of cost and population morbidity, with Māori and Pasifika people, the elderly and those experiencing socio-economic disadvantage most at risk.[2] System-wide efforts to improve sepsis recognition and outcomes are a crucial response to this challenge.

Translation of best practice clinical guidelines into practice is facilitated using care bundles. Longitudinal studies show that it is possible to improve sepsis care using these bundles. For example, the "Sepsis Kills" programme was associated with a 22% increase in the delivery of antibiotic therapy within 60 minutes of arrival in participating emergency departments in New South Wales between 2011 and 2013.[3] Prompt receipt of a sepsis resuscitation bundle is associated with reduced mortality. Mortality after Sepsis Kills fell from 19.3% to 14.1%. In the United Kingdom (UK), an observational study reported by Daniels et al. showed that the receipt of a sepsis resuscitation bundle within 1 hour was associated with a mortality of 20%, compared to a mortality of 44.1% in those who did not receive it.[4] In response to this and other evidence, the National Institute of Clinical Excellence published guidance recommending screening and resuscitation of sepsis based on the presence of clinical findings associated with a high risk of in-hospital mortality.[5]

In 2018, New Zealand adopted these recommendations as a national standard for sepsis care. This provided the opportunity to develop, implement and study the performance of a sepsis screening and action tool within a whole-of-system quality improvement programme. Introduced to public hospitals in the Waikato Region, the whole sepsis advocacy and change programme became known as "Raise the Flag". Within this, collaboration with the UK Sepsis Trust (UKST) led to adoption of the UKST Red Flag Sepsis Screening Tool and the Sepsis Six, which was modified to suit practice in our setting. The Raise the Flag programme (available at www.sepsis.org.nz) aimed to empower front-line clinical staff to deliver the sepsis resuscitation bundle. We conducted a pre- and post-implementation evaluation of the Red Flag Sepsis Screening Tool and the Sepsis Six at Waikato Hospital, a 600-bed, publicly funded, tertiary-level academic hospital in the North Island of New Zealand.

Methods

Setting

A multi-disciplinary Sepsis Action Group (SAG) was established in 2016. The SAG consisted of clinical champions, quality improvement experts, senior executives and data analysts. To lead and sustain programme implementation, a nurse coordinator was appointed in 2018. The Red Flag Sepsis Screening Tool and the Sepsis Six were launched to all clinical areas in Waikato Hospital in August 2018. A package of interventions aimed at changing clinical behaviour included a sepsis e-learning package for all clinical staff, the addition of sepsis screening prompts to all vital sign charts, and commissioning of a multi-media design package to increase programme visibility in clinical and non-clinical areas.

Direct feedback on Sepsis Six compliance in individual cases admitted to high dependency units (HDUs) or intensive care units (ICUs) was provided to clinical teams via email from the sepsis nurse coordinator during 2019 and 2020. Audit results were presented to the SAG in July 2018, July 2019 and September 2020, and to the hospital via a grand round presentation in August 2019 and August 2022, coinciding with yearly hospital-wide promotion of World Sepsis Day. A sepsis newsletter was circulated to all staff quarterly from December 2018.

Case definition and audit strategy

The study was registered prospectively with the Waikato Hospital Quality and Patient Safety office. As a low-risk observational study, it was considered exempt from Health and Disability Ethics Committee review.

We identified potential cases of sepsis using the New Zealand Sepsis Indicator (NZSI).[2,6] This makes use of the International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australasian Modification (ICD-10-AM) to identify patients in hospital discharge data who have both a primary infection diagnosis and a secondary diagnosis consistent with organ failure. Eighty-six percent of cases identified in this way satisfy the third international consensus definition of sepsis.[6, 7]

A random number-generating algorithm was used to select 10 cases a month, satisfying NZSI criteria to review. Selected cases went forward for full data collection, where clinician documentation of infection and at least one high-risk clinical finding (red flag) were found together. The red flags used to select cases for this study are the same as those in the Red Flag Sepsis Screening tool that qualifies patients for receipt of the Sepsis Six, and are: responds only to voice or pain or unresponsive; systolic blood pressure less than or equal to 90mmHg; heart rate more than 130 beats per minute; respiratory rate more than or equal to 25 breaths per minute; needs oxygen to keep saturations more than or equal to 92%; non-blanching rash, mottled, ashen or cyanotic; not passed urine in the last 18 hours; urine output less than 0.5 ml/kg an hour; lactate more than or equal to two; and receipt of recent chemotherapy. The earliest recorded time where both were present was termed "time zero" (T0).

Excluded were those aged <15, those admitted only for palliative management and those transferred from other hospitals. We audited continuously from December 2017 to May 2019. The pre-implementation group (subsequently referred to as Group 1) represents cases presenting to Waikato Hospital between October 2017 and July 2018. The post-implementation group (Group 2) includes cases presenting between August 2018 and May 2019. To assess whether changes were sustained, we audited throughout calendar year 2021 (Group 3).

Variables

Our primary outcome measure was completion of the first five components of the Sepsis Six bundle ("the sepsis bundle") within 3 hours. The final component of the Sepsis Six bundle, measure urine output, was excluded as fluid balance charts are not routinely filed and this could not be determined reliably in our retrospective audit. The included actions are: administer oxygen; take blood cultures; give intravenous (IV) antibiotics; give IV fluids; and check serum lactate. In accordance with advice provided on the Sepsis Six tool, oxygen delivery was deemed mandatory only if oxygen saturations were <94%, and a fluid bolus only if systolic blood pressure was <90mmHg or the serum lactate was ≥2mmol/l. The time to receipt of each item was recorded where these data were available.

Our secondary outcome was the association of Māori/Pasifika ethnicity with the delivery of the sepsis bundle to assess for equitable roll out. Other secondary outcomes included: the number of red flags present for each patient; location of the patient when sepsis was diagnosed; location of hospital placement after recognition of sepsis; source of sepsis; 30-day mortality and Charlson Comorbidity Index.[8] The association between the

Raise the Flag programme and ICU admissions was a *post hoc* analysis to examine the wider impact of the programme.

Data collection

A pre-specified data collection sheet, including definitions, was used to standardise data collection and all data collectors were trained in its use. Data on red flags, mode of transport to hospital, hospital location, infectious diagnosis and delivery of the sepsis bundle were determined using paper and electronic records. Demographic and ethnicity data were collected using iPM (iPatient Manager, DXC Technology, Tysons Corner, United States of America [USA]). We used each patient's national health identifier (NHI) to determine comorbidity index and mortality 30 days following T0. All ambiguities were reviewed and resolved by a second investigator (KW).

Statistical analysis

Audit data were collected in Microsoft Excel (Microsoft Corporation, Redmond, USA). Simple statistics were used to describe data. Pearson's Chi-squared test was used to compare groups containing categorical and binary data. Mantel–Haenszel odds ratios (OR) were calculated for associations of possible confounders with delivery of the sepsis bundle within 3 hours. Variables associated with either the exposure or outcome variable with $p<0.1$ were included in multivariate logistic regression. All data analysis was performed in STATA version 16 (StataCorp, College Station, USA). As this was an audit of an intervention established as effective overseas, sample size was determined pragmatically by the resources available to collect data.

Results

In total, 610 records were selected for review. Of these, 133 were excluded (98 presented to another hospital, 13 were children, 22 were for palliative care only). Of the remaining 477 records, 71 (14.9%) had no red flags, and 21 (4.4%) had no documentation of infection. We collected complete data for 385 eligible cases: 117 patients in Group 1, 149 in Group 2 and 119 in Group 3. Key demographic and clinical variables for these patients are shown in Table 1.

The average age was 67±18 years; this was 9 years lower at 58± 16 years in patients of Māori or Pasifika ethnicity. Eighty-seven (23%) people died within 30 days of T0.

Table 2 describes the infection-related characteristics of our cohort. Two hundred and eighty-five (74%) patients arrived by ambulance. Three hundred and eleven (81%) patients were under the care of the emergency department at T0. Six percent of patients in Group 1 and 14% of patients in Group 3 were admitted directly to the ICU after sepsis diagnosis.

Tables 1 and 2 show the association of potential confounding variables with pre- and post-implementation periods. Patients were more likely to present with haemodynamic instability in the pre-implementation group than subsequent groups ($p<0.001$). They were more likely to be older than 75 years ($p=0.05$) and present with skin, soft tissue, bone and joint infection ($p=0.098$).

We performed a univariate analysis of the association between potential confounding variables and the receipt of the sepsis bundle within 3 hours. Age ≥75 was associated with a reduced odds of sepsis bundle delivery (OR 0.58, $p=0.01$). The presence of haemodynamic instability (OR 1.71, $p=0.01$), three or more red flags (OR 2.05, $p=0.001$), arrival by ambulance (OR 1.99, $p=0.003$) and being under emergency department at T0 (OR 3.81, $<p=0.001$) were associated with increased odds of sepsis bundle delivery. There was no evidence to support a crude association between gender, Charlson Comorbidity score or ethnicity and delivery of the bundle. Noting inter-ethnic differences in population age structure, we used Mantel–Haenszel methods to look for an association between Māori/Pasifika ethnicity and receipt of the sepsis bundle adjusted for age by decade. In this analysis, Māori/Pasifika ethnicity was associated with reduced odds of sepsis bundle delivery (OR 0.55, 95% confidence interval [CI] 0.33–0.91, $p=0.018$).

On the basis of univariate associations, we performed a logistic regression adjusting for 10-year age group, Māori/Pasifika ethnicity, final diagnosis, the presence of haemodynamic instability, the presence of three or more red flags at T0, arrival by ambulance and management under ED. Table 3 shows the associations of these potential confounding factors with delivery of the sepsis bundle across the whole study population.

Being under emergency medicine at T0 was associated with an increased adjusted odds ratio (aOR) for delivery of the sepsis bundle (aOR 3.33, 95% CI 1.85–5.98, $p<0.001$). Age was negatively associated with bundle completion. For every increase in 10-year age group, the odds

Table 1: Demographic characteristics of 385 adults with infection and high-risk clinical findings presenting to Waikato Hospital, a tertiary centre in New Zealand, before and after a sepsis quality programme introduced in 2018.

	Total	**Group 1: pre-implementation**	**Group 2: post-implementation**	**Group 3: maintenance**	**p-value (Group 1 vs Group 2+3)**
	N=385	**N=117**	**N=149**	**N=119**	
Mean age (SD)	67 (18)	69 (19)	67 (18)	65 (18)	0.23
Mean age Māori/ Pasifika	58 (16)	60 (18)	60 (15)	52 (15)	0.50
Age ≥75	161 (42%)	58 (50%)	61 (41%)	42 (35%)	0.05
Male gender	225 (58%)	71 (61%)	91 (61%)	63 (53%)	0.56
Ethnicity					0.52
Asian	13 (3%)	6 (5%)	3 (2%)	4 (3%)	
NZ European	253 (66%)	78 (67%)	97 (65%)	78 (66%)	
NZ Māori	103 (27%)	27 (23%)	45 (30%)	31 (26%)	
Pasifika	7 (2%)	2 (2%)	3 (2%)	2 (2%)	
Other	9 (2%)	4 (3%)	1 (1%)	4 (3%)	
Median Charlson Comorbidity Index (IQR)	1 (0–3)	1 (0–3)	1 (0–2)	1 (0–3)	0.63
Missing	6	3	3	0	
30-day mortality	87 (23%)	29 (25%)	33 (22%)	25 (21%)	

ICU = intensive care unit; HDU = high dependency unit; IQR = interquartile range

of receiving the bundle fell by 17% (aOR 0.83, 95% CI 0.73–0.95, p=0.005).

Table 4 shows the crude and adjusted association between Group 1 and Group 2 and between Group 1 and Group 3 in delivery of the sepsis bundle. In the unadjusted analysis, clinicians in the post-implementation period (Group 2) were more likely to deliver the sepsis bundle within 3 hours than those in pre-implementation Group 1 (OR 1.79, 95% CI 1.09–2.95, p=0.02). There was no difference in sepsis bundle delivery comparing Group 3 and Group 1 (OR 1.07, 95% CI 0.64–1.78, p=0.8).

In the adjusted analysis there remained a significant positive association between the post-implementation period and delivery of the sepsis bundle (aOR 2.20, 95% CI 1.27–3.78, p=0.005). Treatment in 2021 (Group 3) was not associated with an increased odds of sepsis bundle delivery over baseline (aOR 1.22, 95% CI 0.89–1.66, p=0.21).

In a *post hoc* analysis we assessed whether the implementation of the Raise the Flag programme was associated with admission to our ICU. The crude OR for ICU admission comparing the post-implementation groups (Groups 2 and 3) with the pre-implementation group (Group 1) was 2.36 (95% CI 1.01–5.51, p=0.04). Age group, the presence of haemodynamic instability, being under emergency department at T0 and number of red flags were all associated with admission to ICU with a p-value of <0.1. In multivariate analysis, the association between post-implementation periods and admission to the ICU remained significant (aOR 2.81, 95% CI 1.13–6.97, p=0.03).

Table 2: Infection-related characteristics of 385 adults with infection and high-risk clinical findings presenting to Waikato Hospital, a tertiary centre in New Zealand, before and after a sepsis quality programme introduced in 2018.

	Total	**Group 1: pre-implementation**	**Group 2: post-implementation**	**Group 3: maintenance**	**p-value (Group 1 vs Group 2+3)**
	N=385	**N=117**	**N=149**	**N=119**	
Arrival by ambulance	285 (74%)	89 (76%)	111 (74%)	85 (72%)	0.55
Final diagnosis					0.098
Pneumonia	93 (24%)	22 (19%)	48 (32%)	23 (19%)	
Urinary tract infection	91 (24%)	32 (27%)	26 (17%)	33 (28%)	
Intra-abdominal infection	46 (12%)	14 (12%)	17 (11%)	15 (13%)	
Skin, soft tissue, bone and joint infection	63 (16%)	26 (22%)	21 (14%)	16 (13%)	
Meningitis/CNS infection	3 (1%)	0 (0%)	1 (1%)	2 (2%)	
Device-related infection	5 (1%)	1 (1%)	4 (3%)	0 (0%)	
Endovascular infection	11 (3%)	1 (1%)	9 (6%)	1 (1%)	
Source unclear	52 (14%)	18 (15%)	16 (11%)	18 (15%)	
Other	21 (5%)	3 (3%)	7 (5%)	11 (9%)	
Under emergency medicine at T0	311 (81%)	101 (86%)	120 (81%)	90 (76%)	0.11
Median number of red flags (IQR)	2 (1–3)	2 (1–4)	2 (1–3)	2 (1–3)	0.11
Presence of haemo-dynamic instability (SBP<90 or lactate>4)	141 (37%)	63 (54%)	60 (40%)	18 (15%)	<0.001
Red flags					
Responds only to voice or pain/unresponsive	60 (16%)	12 (10%)	28 (19%)	20 (17%)	0.15
Systolic BP ≤90mmHg	124 (32%)	51 (44%)	47 (32%)	26 (22%)	0.002
Heart rate >130 per minute	79 (21%)	21 (18%)	35 (23%)	23 (19%)	0.50
Respiratory rate ≥25 per minute	194 (50%)	59 (50%)	87 (58%)	48 (40%)	0.013
Needs oxygen to keep SpO2 ≥92%	159 (41%)	51 (44%)	70 (47%)	38 (32%)	0.04

Table 2 (continued): Infection-related characteristics of 385 adults with infection and high-risk clinical findings presenting to Waikato Hospital, a tertiary centre in New Zealand, before and after a sepsis quality programme introduced in 2018.

Non-blanching rash, mottled/ashen/cyanotic	56 (15%)	21 (18%)	21 (14%)	14 (12%)	0.40
Not passed urine in last 18 hours UO <0.5 ml/kg/hr	24 (6%)	7 (6%)	12 (8%)	5 (4%)	0.43
Lactate ≥2mmol/l	200 (52%)	68 (58%)	59 (40%)	73 (61%)	<0.001
Recent chemotherapy	29 (8%)	7 (6%)	11 (7%)	11 (9%)	0.63
Placement after diagnosis of sepsis					0.21
General ward	250 (65%)	81 (69%)	96 (64%)	73 (61%)	
HDU	88 (23%)	28 (24%)	32 (21%)	28 (24%)	
ICU	42 (11%)	7 (6%)	18 (12%)	17 (14%)	
Mortuary	5 (1%)	1 (1%)	3 (2%)	1 (1%)	

T0= time zero; IQR = interquartile range; BP = blood pressure; SpO2 = oxygen saturation; UO = urine output; HDU = high dependency unit; ICU = intensive care unit

Table 3: Adjusted odds of sepsis resuscitation bundle delivery within 3 hours among 385 patients with infection and high-risk clinical findings, based on key demographic and clinical variables in Waikato Hospital from 2018 to 2021.

	Adjusted odds ratio	**95% confidence interval**	**p-value**
Māori or Pasifika ethnicity	0.71	0.43–1.17	0.18
Under emergency medicine	3.33	1.85–5.98	<0.001*
Age group (for every increase of 10 years)	0.83	0.73–0.95	0.005*
Haemodynamic instability (SBP <90mmHg or lactate >4	1.33	0.79–2.23	0.29
Arrival by ambulance	1.60	0.94–2.72	0.08
Three or more red flags	1.59	0.97–2.61	0.07
Final diagnosis	1.01	0.93–1.11	0.76

SBP = systolic blood pressure

Table 4: Odds of sepsis resuscitation bundle delivery within 3 hours, before and after the introduction of the Raise the Flag sepsis quality programme, in 385 patients with infection and high-risk clinical findings presenting to Waikato Hospital, New Zealand from 2018 to 2021.

Sepsis bundle completion within 3 hours			
	Yes	**No**	**Total**
Group 1: pre-implementation	58 (49.6%)	59 (50.4%)	117
Group 2: post-implementation	95 (63.8%)	54 (36.2%)	149
Group 3: maintenance	58 (48.7%)	61 (51.3%)	119
Unadjusted analysis			
	OR	95% CI	p-value
Group 2 vs Group1	1.79	1.09–2.95	0.02*
Group 3 vs Group1	1.07	0.64–1.78	0.80
Multivariate analysis*			
	OR	95% CI	p-value
Group 2 vs Group1*	2.20	1.27–3.79	0.005*
Group 3 vs Group 1*	1.22	0.89–1.66	0.21

OR = odds ratio; CI = confidence interval
*Adjusted for care under emergency department at time zero, 10-year age group, final diagnosis, ethnicity, haemodynamic instability (lactate ≥4 or systolic blood pressure <90mmHg), arrival by ambulance and three or more red flags.

Discussion

A comprehensive, hospital-wide sepsis initiative was associated with improvements in delivery of a sepsis resuscitation bundle at our hospital. This improvement was not sustained at 18 to 30 months. In assessment of secondary and *post hoc* end points, important findings were revealed with respect to clinician and system performance. Delivery of treatment by an emergency medicine team increased the odds of sepsis bundle delivery (aOR 3.33, 95% CI 1.85–5.98, p<0.001). Increasing age significantly reduced sepsis bundle completion, despite excluding treatment ineligible patients and adjusting for both haemodynamic instability and Charlson Comorbidity Index (aOR 0.83 for every 10 years of age, 95% CI 0.73–0.95, p=0.005). The odds of being admitted to ICU (the only area in our hospital we deliver vasoactive medications) increased in the combined post-implementation groups (aOR 2.81, 95% CI 1.13–6.97, p=0.026). We suggest that the increased rates of admission to ICU show that, despite a drift to baseline in terms of immediate sepsis bundle delivery, the Raise the Flag programme had wider impacts that improved sepsis care beyond 2019.

The strength of our study is the description of, and adjustment for, confounding factors. This enabled comparison between groups that were not matched in important variables and allowed us to investigate the factors that influence delivery of the bundle to target ongoing interventions. For example, the Red Flag Sepsis Screening Tool was updated in 2022 to include Māori ethnicity as an "amber flag" to highlight excess risk in this group. The major limitation of our study is the before and after design. Data for Group 3 were

collected during the COVID-19 pandemic and may have been particularly affected by residual confounding. Whether the lower rates of haemodynamic instability in the 2021 cohort is a sampling phenomenon or a real effect is not clear. During this period, New Zealand had restrictions on large gatherings and encouraged the use of masks in public. Widespread community transmission of COVID-19 didn't occur until early 2022. COVID-19 containment measures have been shown to reduce blood stream infections with organisms transmitted by droplet spread, such as *Streptococcus pyogenes*, overseas.[9,10] Surveillance data show that the rates of both invasive pneumococcal disease and invasive Group A Streptococcal disease were lower in 2020 and 2021 in New Zealand compared to previous years.[11,12] It is possible that both behavioural change and a change in the microbiology of sepsis had an impact on the presentation of sepsis, and more research is required in this area.

The results of this study are consistent with the results of similar programmes in New South Wales and world-wide, which show improvement in the delivery of sepsis care after their implementation.[3,13,14] Fifty-six percent of our patients received the sepsis bundle in 3 hours, which compares well with the literature referenced.[13–15] The most successful sepsis quality improvement projects combine process change and educational activities, dedicated sepsis teams and supportive environmental contexts and resources.[15,17] The reduction in bundle delivery in Group 3 coincides with the end of direct feedback to clinical teams and suggests that feedback and education must be sustained over time to embed the change in routine practice.

The 9-year younger mean age of patients of Māori or Pasifika ethnicity compared to the study population average is consistent with existing evidence that sepsis is both a result and a potentiator of health inequity in New Zealand. We did not find that ethnicity was associated with sepsis bundle delivery; however, the crude and adjusted ORs were below 1, and this sample size would not detect a small difference in bundle delivery. It would be naïve to think that sepsis interventions are unaffected by the various forms of bias and systemic racism resulting in variation in practice described in other conditions, and this will continue to be monitored at our institution.[18,19]

We have shown that age is associated with reduced odds of receiving the sepsis resuscitation bundle (aOR for every 10-year increase in age 0.83, 95% CI 0.73–0.95, p=0.005). In a previous report, we have shown that the NZSI identifies more neurologic and renal organ failure with age, and less respiratory failure.[2] Normothermia and hypothermia are more common with age. This may translate to differences in the clinical cues used to prompt action. However, this study made use of red flags that should have triggered action regardless of age. Delay of over 3 hours in the administration of antimicrobials in sepsis is associated with increased risk of death in observational studies, is inconsistent with best practice guidelines and would not be considered appropriate for treatment-eligible adults.[20–22] Given the higher mortality in older patients, there may be more to gain in this group from prompt antimicrobial and haemodynamic management.

In conclusion, a system-wide sepsis programme at our hospital produced changes in early sepsis management and revealed evidence of differential care based on age. Embedding and sustaining change in a complex system requires ongoing education and support, as well as optimisation of environmental contexts and resources to enable best practice. We regard an appropriate increase in ICU utilisation as an ongoing success and continue to investigate whether the wider impacts of the programme included effects on mortality and hospital length of stay.

COMPETING INTERESTS
Dr Paul Huggan is a founding member of the New Zealand Sepsis Trust.

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Who Australasians trusted during COVID-19: lessons from the pandemic response

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ABSTRACT

AIM: Public trust in authoritative information sources is a key element of a successful public health response to a pandemic. This study investigated which sources of COVID-19 advice were most trusted by a primarily New Zealand-based cohort and considers implications for policy and practice regarding future pandemics.

METHOD: Data were from a COVID-19 vaccine intention survey presented to Australia- and New Zealand-based members of the longitudinal Dunedin Study (n=832) between ages 48 and 49, immediately before vaccines became available for the general population within New Zealand. We assessed participants' trust in specific sources of COVID-19 advice and investigated whether the pattern of responses differed by sex, socio-economic status (SES) or education.

RESULTS: Doctors and healthcare providers were the most trusted source of COVID-19 advice, over and above other institutional sources. This pattern was consistent across sex, SES and education. Institutional experts were trusted significantly more by those with higher SES compared to those with lower SES, and by those with formal qualifications compared to those without formal qualifications.

CONCLUSION: Our findings suggest that it is important to empower healthcare providers early in a pandemic to share advice with the public alongside other trusted sources, such as the government.

Global research shows that trust is important for public compliance with protective measures during a pandemic,[1–3] including the recent COVID-19 pandemic.[4,5] For example, international research indicates that greater trust in government was associated with better adherence to COVID-19 guidelines,[2,5] reduced COVID-19 death rates[4] and higher rates of vaccination.[5] Evidence suggests that trust in scientists is particularly important for compliance with public health measures and facilitates positive attitudes toward vaccination.[3] In the face of a novel health crisis, trusted information from others is crucial for guiding individuals' behaviour. However, trust in unreliable sources could be damaging to a pandemic response;[2] therefore, it is important to understand which sources are most trusted by the public. Researchers often distinguish between trust in institutions, known as institutional trust,[4] and trust in the general public, known as social trust.[6] In this study, we assessed trust in both institutional sources and social sources.

Research from the United States indicates that the relationship between trust and compliance with COVID-19 protective measures depends, at least in part, on individual factors.[2] Individual characteristics associated with historical experiences of discrimination or disadvantage could lead to institutional mistrust, including, for example, women, people with low levels of education, or people experiencing socio-economic deprivation.[7] Findings on the relationship between sex and trust are mixed,[8,9] but the majority of research suggests that those with a higher socio-economic status (SES)[10–12] or greater education[12–14] display higher levels of trust than those with a lower SES or lower education. Furthermore, greater mental health issues, adverse childhood experiences and particular personality traits, including greater negative emotionality, are related to lower levels of trust.[12]

Given the centrality of trust for a successful pandemic response,[1–6] it is important to understand which information sources are most trusted by individuals, and therefore which sources of information are best suited to provide the public with pandemic advice. International research shows that individuals trust pandemic-related information from institutional sources, such as scientists and governments, more than other

sources,[15] but more information is needed on which sources are most trusted in the New Zealand and Australian contexts. The purpose of this study was to investigate which sources of COVID-19 information are most trusted by individuals living in Australasia and to examine differences by sex, SES and education. Members of the Dunedin Multidisciplinary Health and Development Study ("The Dunedin Study") living in New Zealand and Australia were surveyed between April and July of 2021 on their levels of trust in different sources of COVID-19 advice. At the time of the survey, COVID-19 had been globally pervasive for over a year and participants were likely to have been exposed to COVID-19 information over that time. Data were collected immediately before the New Zealand public became eligible for vaccinations. Based on previous research demonstrating the importance of institutional trust for a successful pandemic response,[1–6] we expected participants to have high trust in perceived experts, such as healthcare providers, scientists, and the government. Based on past research suggesting that historically disadvantaged characteristics are associated with higher distrust,[8–11,13,14] we expected individuals with these characteristics to display less trust overall.

Method

Participants

Participants were members of The Dunedin Study, a longitudinal investigation of health and behaviour in a representative birth cohort born between 1 April 1972 and 31 March 1973 in Dunedin, New Zealand. This cohort has previously been described in extensive detail.[16] Data have been collected at birth and each participant came to the research unit for private interviews and examinations at ages 3, 5, 7, 9, 11, 13, 15, 18, 21, 26, 32, 38 and most recently at age 45, when 94% of Study members still alive in 2019 participated. In April–July 2021, we invited the 942 living Study members residing in New Zealand and Australia to report their vaccine intentions in a rapid survey, obtaining an 88% response rate (n=832). The Dunedin Study was approved by the Health and Disability Ethics Committee, Manatū Hauora – Ministry of Health, New Zealand. Study members gave informed consent before participating.

Trust in sources of COVID-19 advice

To understand which sources could be best suited to provide the public with pandemic advice, Study members living in New Zealand and Australia were invited to complete a survey of their COVID-19 vaccine intentions between April and July of 2021, at ages 48–49.[12] Of the 942 Study members contacted, 832 (88%) agreed to take part. As part of this survey, participants were asked to indicate (yes/maybe/no) whether they trusted COVID-19 advice from each of 14 different sources (see Appendices). Given that some participants were based in Australia, we did not include New Zealand-based public servants and politicians (at the time, Director-General of Health Ashley Bloomfield, Prime Minister Jacinda Ardern and Minister for COVID-19 Chris Hipkins) in our analysis, as participants based overseas were instructed to respond differently to these sources (see Appendices).

Variables

Education level

Education level was measured as the highest level of educational attainment completed by Dunedin Study members at the time of the age-45 assessment. In our analysis, we compared those with formal qualifications (at least a high school qualification) to those with no formal qualifications (no high school qualifications by age 45).

Socio-economic status

Socio-economic status was measured at age 45 using standard New Zealand occupation-based indices,[17,18] which use a six-interval classification system (e.g., a doctor scores 1 and a labourer scores 6). Scores of 1 or 2 were allocated to high SES group; those scoring 3 or 4 were allocated to the medium SES group and those scoring 5 or 6 were allocated to the low SES group.

Sex

Sex was measured as the biological sex recorded at birth.

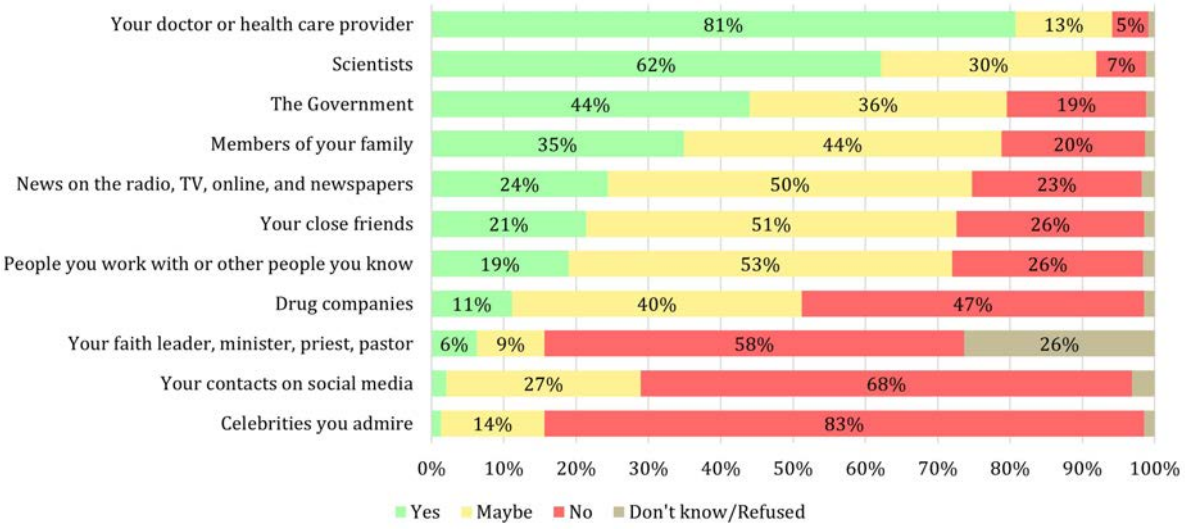
Data analysis

Stata SE v17 was used for all statistical analyses and a significance threshold of p<.05 was chosen. First, we calculated the percentage of respondents that trusted each source of COVID-19 advice (indicated "yes"). We then used two sample proportion tests (z-tests) to test for statistically significant differences in trust between the sources. We compared the level of trust in COVID-19 advice from doctors/healthcare providers and the government

Table 1: Participant characteristics (*n*=831).

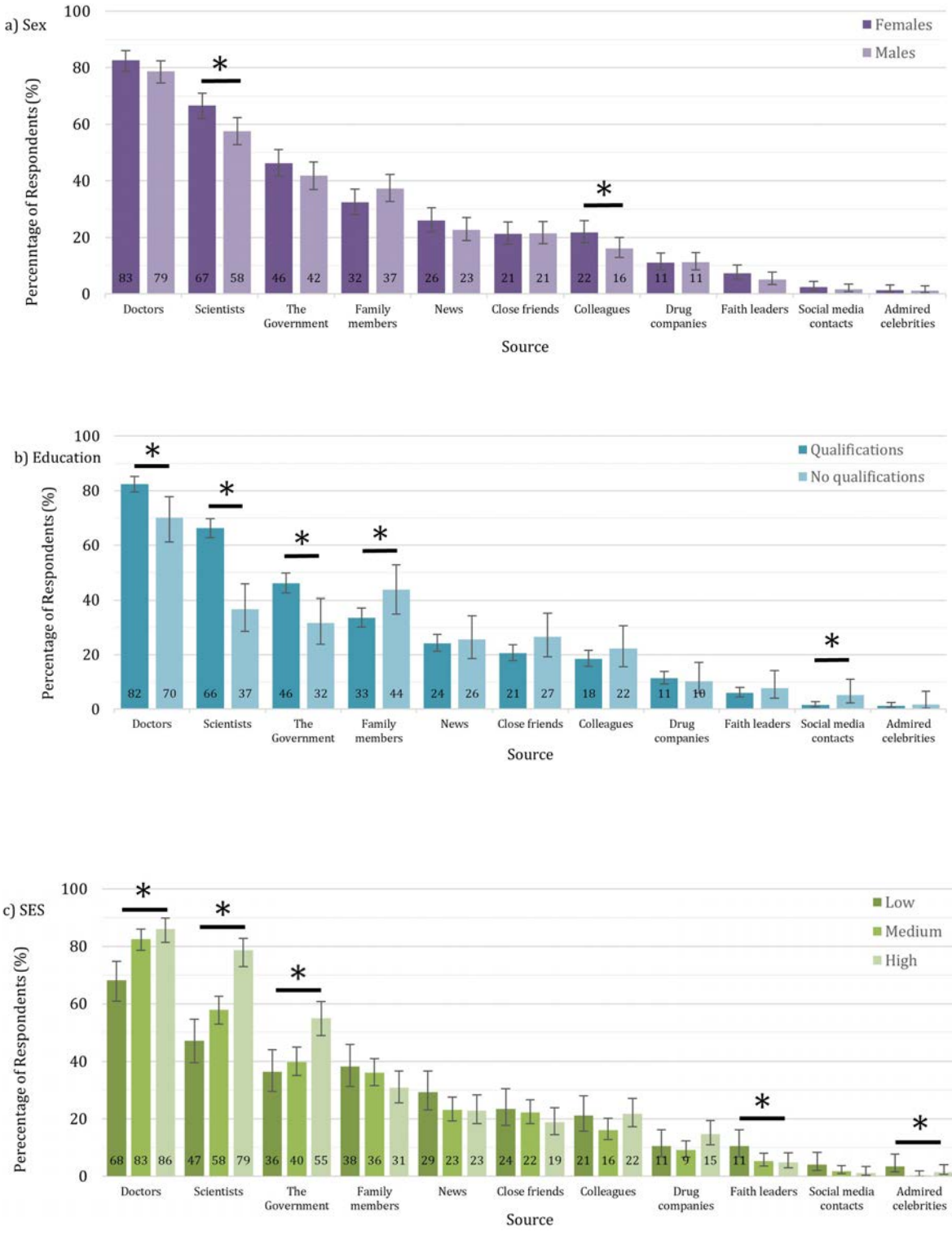
Characteristic	*n*	%
Sex		
Female	422	51%
Male	409	49%
Education level		
Formal qualifications	714	86%
No formal qualifications	117	14%
SES		
Low	166	20%
Medium	399	48%
High	266	32%

Figure 1: Percentage of respondents that trusted different sources of COVID-19 advice.



Note: data labels below 4% are not shown.

Figure 2a, b, c: The percentage of respondents that trust each source by sex, education and SES.



Note: data labels below 9% are not shown.
*Significant differences (p<.05) between subgroups are marked by an asterisk.

to trust in other sources (restricted to the sources trusted by more than 20% of respondents). We then used Chi-squared tests to assess whether the proportion of respondents that trusted each source differed significantly across sex, education or socio-economic status. Finally, we conducted sensitivity analyses for those living in New Zealand only, to assess whether findings differed between these individuals and those based in both New Zealand and Australia (see Appendices).

Results

Participant characteristics are displayed in Table 1, excluding one individual with no education level information. All were aged 48 or 49.

Overall trust in each source

Figure 1 shows the percentage of participants who said "yes," they trusted that source for COVID-19 advice. The most trusted sources of COVID-19 advice were doctors/healthcare providers (81%), followed by scientists (63%), the government (44%) and family members (35%). The least trusted sources of COVID-19 advice were admired celebrities (1%), social media contacts (2%) and faith leaders (6%).

Statistical comparisons between trusted sources

Compared with doctors/healthcare providers, a significantly lower percentage of participants trusted scientists (19%, $p<.001$), the government (37%, $p<.001$), family members (46%, $p<.001$), news organisations (56%, $p<.001$) and close friends (59%, $p<.001$). Compared with the government, a significantly higher percentage of participants trusted scientists (18%, $p<.001$), whereas a significantly lower percentage of participants trusted their family members (9%, $p<.001$), news organisations (20%, $p<.001$) or their close friends (23%, $p<.001$).

Demographic differences

Overall, females and males had similar levels of trust in each source, although females trusted scientists ($p=.007$) and colleagues ($p=.036$) significantly more than males (Figure 2a). Those with formal qualifications and those without formal qualifications had similar levels of trust for most sources (Figure 2b). However, those with formal qualifications trusted doctors/healthcare providers ($p=.002$), scientists ($p<.001$) and the government ($p=.004$) significantly more than those without formal qualifications, and family members ($p=.033$) and social media contacts ($p=.011$) significantly less. For most sources, no significant differences in levels of trust across different SES categories were observed (Figure 2c). However, respondents with higher SES trusted doctors/healthcare providers ($p<.001$), scientists ($p<.001$) and the government ($p<.001$) significantly more than those with lower SES, and those with lower SES trusted faith leaders ($p=.032$) and admired celebrities ($p=.007$) significantly more than those with higher SES. Notably, doctors/healthcare providers were the most trusted source of COVID-19 advice regardless of any demographic differences.

Discussion

Overall trust

In this survey of a large population-based cohort of middle-aged adults living in New Zealand and Australia conducted between April and July 2021, the majority of respondents trusted perceived experts (doctors/healthcare providers and scientists) for COVID-19 information. The next most trusted sources of information were the government and family members. These findings support the idea that perceived expertise and, to a lesser extent, personal connection, are important predictors of trust. Indeed, sources with greater personal connection, such as family and friends, were more trusted than sources with less personal connection, such as drug companies. Research suggests that expertise, particularly perceived expertise,[7] is important for facilitating trust in advice,[19] especially in times of uncertainty.[20] Doctors/healthcare providers, who have both perceived expertise and (oftentimes) personal connection, were the most trusted source of COVID-19 advice. Furthermore, several characteristics associated with personal connection, including empathy, honesty and reciprocal trust have been shown to be important qualities within information sources to facilitate the development of trust.[7,19,20]

Demographic differences

Females and males had similar levels of trust in each source and a similar pattern of most to least trusted sources. However, females were more likely than males to trust scientists or colleagues to provide them with COVID-19 advice. Across most sources, the pattern of most to least trusted sources was similar by education level and SES. However, there were some differences for specific sources. We found that those with higher levels

of education had greater trust in institutions and experts than those with lower levels of education. In contrast, those with lower levels of education trusted friends and family more than those with higher levels of education. These findings are consistent with research suggesting that greater education is related to greater trust in others, particularly in institutional sources.[13,14] We also found that those with higher SES had greater trust in institutions and experts than those with lower SES. In contrast, those with lower SES trusted faith leaders and admired celebrities more than those with higher SES. These findings are consistent with research suggesting that higher SES is related to greater trust in others, particularly in institutional sources.[10,11] Our findings suggest that sex, education levels and SES should be important considerations when developing public health information programmes, particularly when deciding which sources of pandemic advice are best suited to share information. The comparative distrust of institutions displayed by individuals with lower SES and education levels could be explained by the historical disadvantages they have faced. Disadvantaged groups are often exposed to negative experiences with institutions, such as healthcare facilities and governmental organisations, which could reduce trust in these institutions.[7] Another explanation for the relationship between education and trust is that education provides relevant information and improves information-seeking abilities,[21] which could enable people to be better informed regarding things like vaccines and better able to comprehend new information, thus improving trust in institutions.[22] This theory could also explain why less educated individuals display more trust in friends and family than more educated individuals—they may feel as though they cannot trust information from formal institutions and may seek information elsewhere.[13]

Implications for policy and practice

New Zealand's COVID-19 response initially relied on the centralised roll-out of information and advice from the Government, particularly regarding vaccines, with a gradual evolution to include general practitioners and community leaders.[23] Community leaders in New Zealand have argued that this slow decentralisation disproportionately affected Māori and Pasifika populations, highlighting socio-economic inequities in New Zealand.[24] We found that doctors/healthcare providers were the most trusted source of COVID-19 advice among our respondents. Additionally, scientists were the second most trusted source of COVID-19 advice among our respondents. Therefore, our findings suggest that doctors/healthcare providers and scientists should be empowered by the government to communicate with the public directly.

We found that levels of trust differed significantly by sex, education and SES. This suggests that subgroup differences are important to consider when deciding which sources of advice are best suited to share relevant pandemic information with the public. We found that doctors/healthcare providers were the most broadly trusted source regardless of any subgroup differences. This suggests that doctors/healthcare providers are an important source of information for all communities, including more marginalised ones, and that marginalised communities could be targeted with pro-vaccine messaging through doctors/healthcare providers.[12] Indeed, vaccine uptake within New Zealand was relatively slow, particularly in Māori and Pasifika communities, and it has been speculated that this was a result of low trust in the government and other sources of pandemic advice.[24] Māori and Pasifika groups have experienced ongoing systematic marginalisation and discrimination by the health and legal systems within New Zealand, which may have led to lower trust, particularly in institutions.[25,26] Indeed, Māori have experienced higher infection rates, hospitalisation rates and death rates than Pākehā in previous pandemics.[27] Furthermore, our findings may have implications for other public health initiatives, including screening programmes, general infection-minimisation behaviours, and encouragement of healthy behaviours such as physical exercise and responsible alcohol consumption. Specifically, our findings could suggest that public health initiatives utilise the most trusted sources of advice to share relevant information to improve public compliance.

Strengths and limitations

This study provides insight into trust in different sources of advice from a key time in New Zealand's pandemic response, immediately before vaccines became available to the general public. Furthermore, The Dunedin Study is a longitudinal, population-based study that allows for the development of high trust and honest self-reporting, and the inclusion of individuals who would not typically respond to a vaccine

intention survey.[28] We also completed sensitivity analyses to test whether findings differed between the individuals based in New Zealand only, and those based in both New Zealand and Australia. We found few differences, allowing us to interpret the findings from a larger sample of Australia- and New Zealand-based individuals in the context of the New Zealand COVID-19 response.

However, our participants have been involved in a successful and enduring longitudinal study,[16] so may be more trusting of scientists than the wider population. Additionally, this study was conducted in middle-aged, predominantly New Zealand European individuals at a specific time during the COVID-19 pandemic, so may not generalise to other age groups, ethnicities or timeframes. For example, New Zealanders display higher trust compared with other OECD countries.[25,26] Furthermore, Māori and Pasifika individuals, who experienced significant health inequities related to COVID-19,[24] tend to display lower trust than the general New Zealand population, likely due to the ongoing impacts of colonisation.[25,26] Therefore, it is possible that our findings reflect higher levels of trust, particularly in institutions, than would be expected from a sample that included more Māori and Pasifika individuals. Finally, our findings reflect patterns of trust at a particular point in time: after the initial COVID-19 response when institutional trust in New Zealand peaked,[25,29] but before the spread of misinformation and disinformation in late 2021, which may have led to a shift away from vaccine hesitancy and towards vaccine resistance.[30] Although institutional trust within New Zealand fluctuated according to the particular socio-cultural context at the time,[25,29] our findings provide useful insight into the period when New Zealanders were making decisions on whether or not to get vaccinated against COVID-19.[12] Future research along similar lines is needed in different samples to improve understanding of the generalisability of findings. In particular, future research could specifically investigate patterns of trust in Māori, Pasifika and other marginalised populations.

Conclusion

Doctors and healthcare providers were consistently the most trusted source of COVID-19 advice, regardless of sex, education or socio-economic status. Given the importance of trust for a successful pandemic response,[1–5] particularly regarding public compliance with health measures and restrictions,[2,3,5] our findings indicate that healthcare providers should be empowered alongside government agencies and other trusted sources, such as scientists, to share information and advice during future pandemics to promote a successful response.

COMPETING INTERESTS
We have no conflicts of interest to declare.

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Appendices

Appendix 1: Vaccine intention survey

3. Below is a list of sources where people go to get information about COVID-19. We'd like to know which ones you trust.

Do you trust COVID-19 advice from:

(a) Your doctor or healthcare provider	(0) No	(1) Maybe	(2) Yes
(b) Your faith leader, minister, priest, pastor	(0) No	(1) Maybe	(2) Yes
(c) Your close friends	(0) No	(1) Maybe	(2) Yes
(d) Members of your family	(0) No	(1) Maybe	(2) Yes
(e) People you work with or other people you know	(0) No	(1) Maybe	(2) Yes
(f) News on the radio, TV, online and newspapers	(0) No	(1) Maybe	(2) Yes
(g) Celebrities you admire	(0) No	(1) Maybe	(2) Yes
(h) Your contacts on social media	(0) No	(1) Maybe	(2) Yes
(i) Drug companies	(0) No	(1) Maybe	(2) Yes
(j) Scientists	(0) No	(1) Maybe	(2) Yes
(k) The government	(0) No	(1) Maybe	(2) Yes
(l) Dr Ashley Bloomfield Director-General of the New Zealand Ministry of Health (If overseas, the most prominent health leader)	(0) No	(1) Maybe	(2) Yes
(m) Prime Minister Jacinda Ardern (If overseas, the prime minister or president in the country where you live)	(0) No	(1) Maybe	(2) Yes
(n) Chris Hipkins, Minister for COVID-19 (If overseas, please leave blank)	(0) No	(1) Maybe	(2) Yes

Appendix 2: Sensitivity analyses: New Zealand-based Study members

This analysis included the 670 Dunedin Study members who participated in the COVID-19 survey and were living in New Zealand at the time of data collection. Participant characteristics are displayed in Appendix Table 1, excluding one individual with no SES information. All were aged 48 or 49. These participant characteristics were similar to those in the main analyses.

Overall trust in each source

Appendix Figure 1 shows the percentage of New Zealand-based participants who said "yes," they trusted that source for COVID-19 advice. Consistent with the results from the main analyses, the most trusted sources of COVID-19 advice were healthcare providers (82%), followed by scientists (62%), the government (46%) and family members (36%). The least trusted sources of COVID-19 advice were still admired celebrities (2%), followed by social media contacts (2%) and faith leaders (6%).

Statistical comparisons between trusted sources

Consistent with the results from the main analyses, compared with healthcare providers, a significantly lower percentage of participants trusted scientists (21%, $p<.001$), the government (36%, $p<.001$), family members (47%, $p<.001$), news (57%, $p<.001$) and close friends (60%, $p<.001$). Compared with the government, a significantly higher percentage of participants trusted scientists (16%, $p<.001$), whereas a significantly lower proportion of participants still trusted their family members (10%, $p<.001$), news organisations (21%, $p<.001$) or their close friends (24%, $p<.001$).

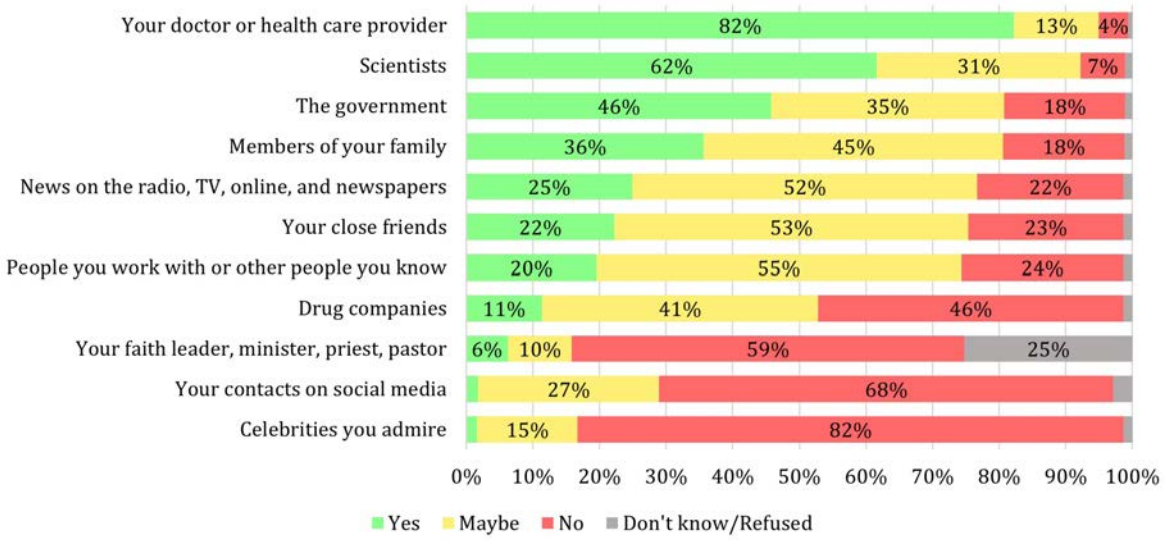
Demographic differences (sensitivity analyses)

Consistent with the results from the main analyses, females trusted scientists significantly more than males ($p=.01$), but the observed difference between female and male trust in colleagues no longer reached statistical significance ($p=.113$), as shown in Appendix Figure 2a. Those with formal qualifications trusted doctors/healthcare providers ($p=.009$), scientists ($p<.001$) and the government ($p=.003$) significantly more than those without formal qualifications, and family members ($p=.02$) and social media contacts ($p=.009$) significantly less (Appendix Figure 2b). Respondents with higher SES trusted doctors/healthcare providers ($p<.001$), scientists ($p<.001$) and the government ($p=.002$) significantly more than those with lower SES, and those with lower SES still trusted faith leaders ($p=.037$) and admired celebrities ($p=.007$) significantly more than those with higher SES (Appendix Figure 2c). As opposed to the main analyses with all respondents, those with higher SES trusted drug companies significantly more than those with lower SES ($p=.037$) and those with lower SES trusted social media contacts significantly more than those with higher SES ($p=.005$).

Appendix Table 1: Participant characteristics for New Zealand-based respondents (*n*=669).

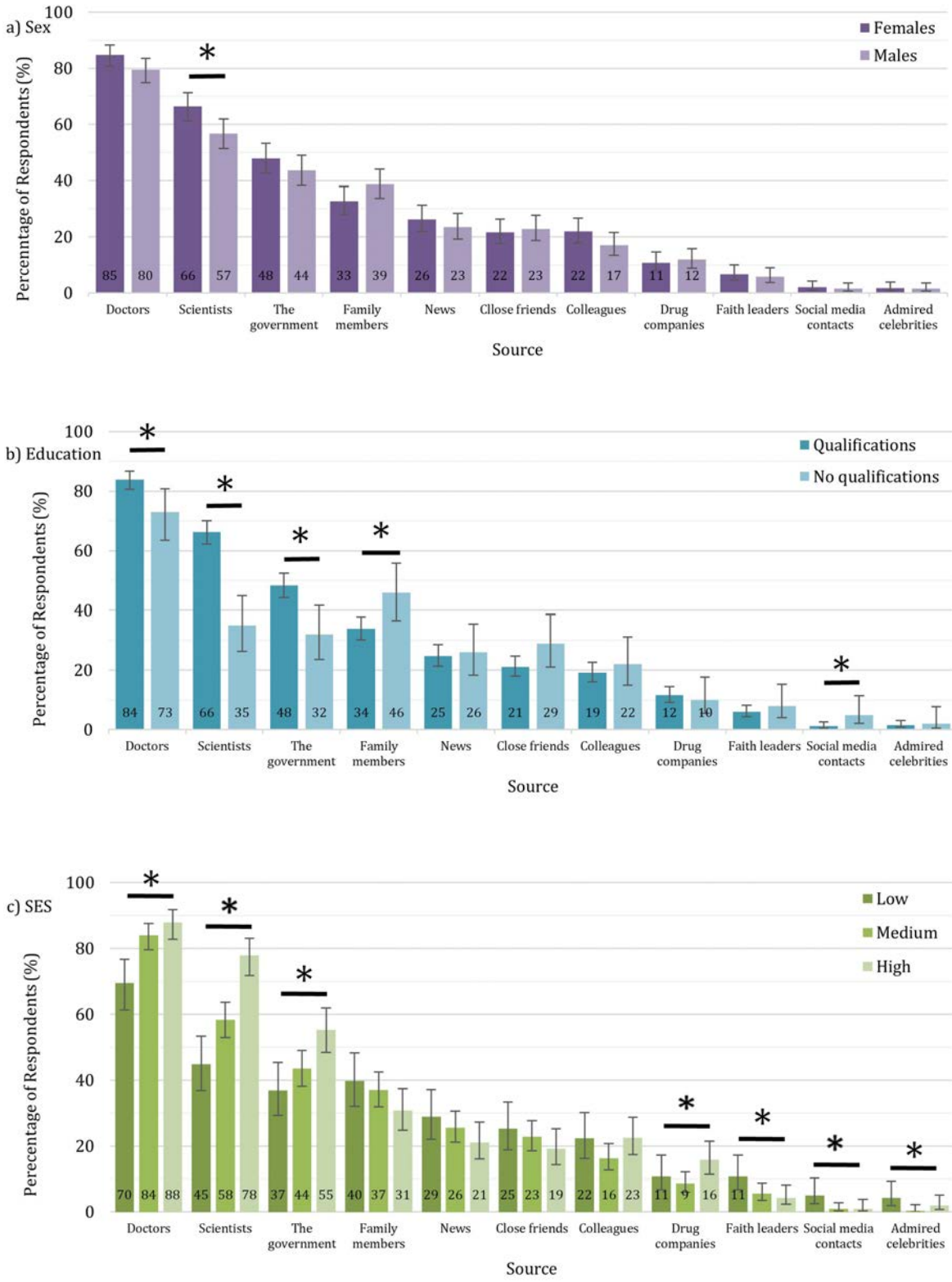
Characteristic	*n*	%
Sex		
Female	342	51%
Male	327	49%
Education level		
Formal qualifications	569	85%
No formal qualifications	100	15%
SES		
Low	138	21%
Medium	323	48%
High	208	31%

Appendix Figure 1: The proportion of New Zealand-based respondents that trust different sources of COVID-19 advice.



Note: data labels below 4% are not shown.

Appendix Figure 2a, b, c: The proportion of New Zealand-based respondents that trust each source by sex, education and SES.



Note: data labels below 9% are not shown.
*Significant differences between subgroups of $p<.05$ are marked by an asterisk.

Robot-assisted general surgery in Aotearoa New Zealand

Phillip P Chao, Jonathan B Koea, Andrew G Hill, David Resoli, Sanket Srinivasa

ABSTRACT

Robot-assisted surgery refers to a surgeon controlling a robotic device that performs an operation. This viewpoint explores the current state of robot-assisted surgery in Aotearoa New Zealand using the da Vinci Surgical System (Intuitive Surgical, Sunnyvale, California, United States), the only currently available robotic surgical system for general surgery in the country. We describe the contemporary progress in Aotearoa New Zealand compared to Australia and globally, and present emerging high-level evidence from randomised controlled trials regarding the utility of the robot-assisted approach for general surgery procedures. From the available evidence, we suggest that the value of robot-assisted general surgery in the public healthcare system arises from its emerging clinical benefits for complex procedures and its potential to engender equitable access and outcomes, particularly for Māori and Pacific peoples, improve education and training and contribute towards quality assurance and workforce development. Therefore, its implementation aligns with the New Zealand Health Strategy's long-term goals and priority areas to achieve pae ora, a healthy future for all.

Robot-assisted surgery (RAS) refers to a surgeon controlling a robotic device that performs an operation. In its simplest iteration, it is an extension of surgical instruments and is not autonomous as it remains under the complete control of the operating surgeon. The first approved robotic surgical system (RSS) for clinical use in general surgery was a robot-assisted camera holder for laparoscopic surgery in 1993.[1] The da Vinci Surgical System (dVSS) (Intuitive Surgical, Sunnyvale, California, United States [US]) received approval from the US Food and Drug Administration (FDA) in 2000 and has been the dominant RSS used in general and abdominal surgery.[1]

Robotic surgical systems for general surgery in Aotearoa New Zealand

There are various other RSS for general surgery available,[1] such as the Hugo (Medtronic, Dublin, Ireland) and Versius (CMR Surgical, Cambridge, United Kingdom) in Australia; however, to the best of our knowledge, these are not yet currently available in Aotearoa New Zealand. The first surgery using the dVSS in Aotearoa New Zealand was robot-assisted radical prostatectomy performed in 2007,[2] and there are currently seven dVSS in operation in the country. North Shore Hospital is the only public hospital with a dVSS, and its first robot-assisted general surgery procedure was performed in late 2022.

The RAS-specific code was only introduced to the National Minimum Dataset for hospital events in 2019, and despite its implementation it has been variably applied (communications with National Collections and Reporting, Manatū Hauora – Ministry of Health). Therefore, the data presented here utilise anonymous procedure-only information from the Aotearoa New Zealand distributor of the dVSS (Device Technologies, Auckland, New Zealand) akin to other published work in this area.[3,4]

A total of 4,709 operations using the dVSS have occurred in private hospitals in Aotearoa New Zealand from 2007–2022. The number per year increased almost sevenfold, from 110 in 2008 to 743 in 2022 (Figure 1). For an initial 7 years, from 2007–2013, the dVSS was solely used for urological surgery, until the first cases of gynaecology and general surgery were recorded in 2014, and head and neck in 2016.

The numbers of procedures and proportions in each of the defined categories are shown in Table 1, along with the five most frequently performed surgical procedures overall and their proportions in their respective category.

Among the 16 recorded general surgery procedures are rectopexy, cholecystectomy, distal pancreatectomy, liver resection, liver cystectomy and ventral/incisional hernia repair.

RAS with the dVSS in Australia and globally

In Australia, the dVSS was the only robotic platform to perform soft tissue operations until the

limited entry of other platforms in 2018.[3] Using the same data source,[4] Table 2 compares the number of cases and systems available in Australia and Aotearoa New Zealand from 2015 to 2020. There was a similar rate of annual increase in the number of cases between the countries. In 2020, Australia had over double the number of dVSS per capita (2.6 vs 1.0 per 1 million) but performed almost five times the number of cases per capita (543 vs 109 per 1 million) as a result of the almost twice as many cases performed per RSS (208 vs 111).

Australia has seen a decreasing proportion of urology cases due to the expansion to other specialities, with urology accounting for 68% and gynaecology for 15% of cases in 2020, compared with 88% and 10% in Aotearoa New Zealand, respectively.[4,5] No detailed analysis of the numbers and types of all general surgery cases in Australia has been published, except pertaining to robot-assisted colorectal surgery.[3] There were 6,110 robot-assisted general surgery cases using the dVSS in Australia between 2010 and 2019 with colorectal procedures accounting for 57.6%.[3]

World-wide, there were over 1.8 million procedures done utilising over 7,500 dVSS in 2022, with general surgery being the most rapidly growing and largest category—comprising almost half of all procedures—followed by urology and then gynaecology.[6]

Figure 1: Trend of robot-assisted surgery utilising the da Vinci Surgical System in Aotearoa New Zealand private hospitals from 2007–2022.

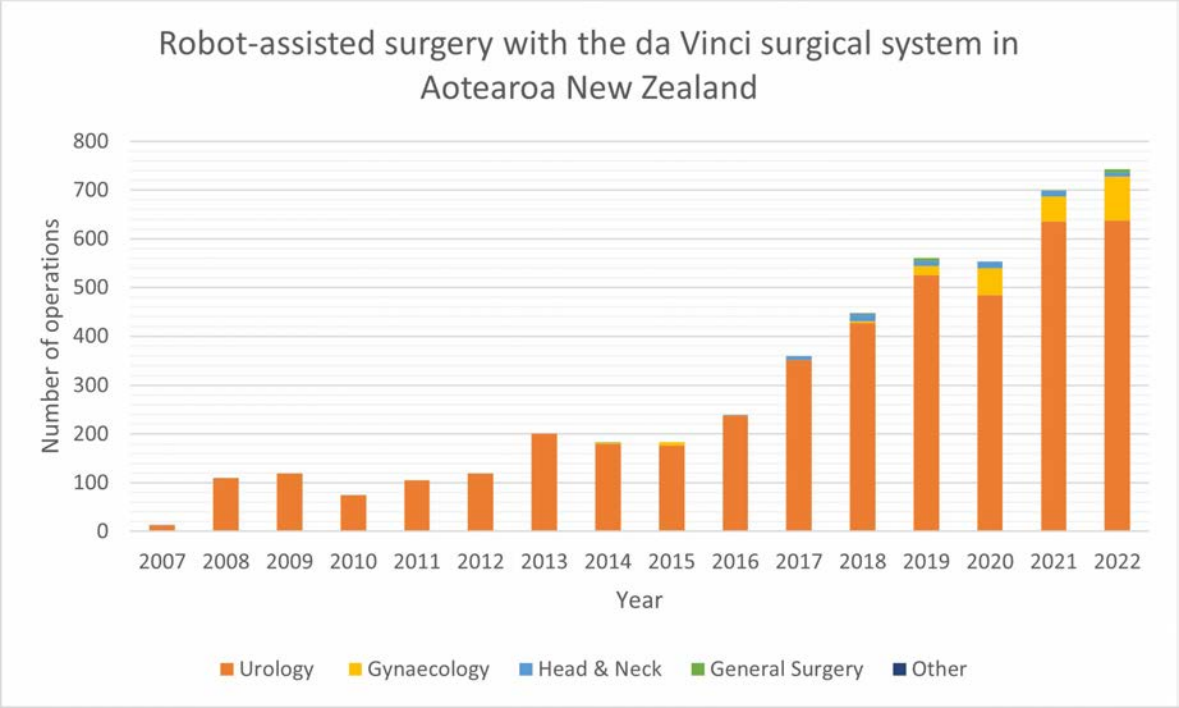


Table 1: Total number and proportion of robot-assisted surgeries utilising the da Vinci Surgical System in Aotearoa New Zealand, and the overall five most prevalent procedures.

Category	Numbers (% of total)		Most prevalent procedures	Numbers (% of category)
Urology	4,398 (93.4)		Prostatectomy	4,178 (95.0)
Gynaecology	227 (4.8)		Partial nephrectomy	161 (3.7)
Head and neck	67 (1.4)		Hysterectomy	152 (70.0)
General surgery	16 (0.3)		Tongue base resection	38 (56.7)
			Radical tonsillectomy	28 (41.8)

Table 2: Annual total number of cases using the da Vinci Surgical System and number of systems in operation in Australia and Aotearoa New Zealand.

Year	Cases, Australia	Cases, Aotearoa New Zealand	Systems, Australia	Systems, Aotearoa New Zealand
2015	6,726	183	34	2
2016	7,441	240	44	3
2017	8,818	359	48	3
2018	10,976	447	59	3
2019	13,625	560	65	4
2020	13,931	553	67	5

Status and current evidence on robot-assisted general surgery

The robot-assisted approach has been applied for almost all procedures in general surgery (colorectal,[7] oesophagogastric,[8] hepatopancreatobiliary,[9] breast,[10] endocrine,[11] hernia[12] and transplant[13]). The diversity of procedures in general surgery and the well-established role of laparoscopy as a minimal access technique for common procedures have resulted in RAS only comprising a relatively small proportion of all general surgery procedures despite the significant rate of growth. For example, in the US state of Michigan, the proportion of RAS for general surgery increased from 1.8% in 2012 to 15.1% in 2018, with RAS comprising 7.5% of all cholecystectomies in 2018.[14] At US community hospitals, which make up almost 90% of all general surgical RAS using the dVSS, it is estimated that about two general surgery procedures were done per dVSS per week in 2021.[15]

While the feasibility, safety and efficacy of RAS for numerous general surgery procedures have been demonstrated, contemporary evidence comparing its efficacy against the next best alternative (laparoscopic or open surgery) in randomised controlled trials (RCTs) is only recently emerging.[16] These suggest the value of robotic assistance for surgical procedures manifests in complex procedures, wherein conventional laparoscopy as the other alternative to the minimally invasive approach is technically challenging or inexpedient. For example, in the largest (n=1,171) and most recent multi-centre (11 hospitals) RCT, total mesorectal excision for rectal cancer using RAS compared with laparoscopic surgery resulted in significantly reduced intra- (5.5% vs 8.7%) and post-operative (16.2% vs 23.1%) complications, fewer conversions to open surgery (1.7% vs 3.9%), shorter length of stay (7 vs 8 days) and better oncological quality of resection.[7] Similar improvements in post-operative complications (13.2% vs 23.7%), open conversion (0% vs 2.9%) and post-operative length of stay (5 vs 7 days) have been observed in RAS compared with laparoscopy for abdominoperineal resections for low rectal cancer in a single-centre RCT (n=347), with additional improvements in 30-day readmission rate (2.3% vs 6.9%) and in urinary and sexual function without a difference in long-term oncological outcomes.[17] A lower rate of post-operative complications was also observed in gastric cancer comparing RAS with laparoscopy for gastrectomy (8.5% vs 19.3%, two-centre RCT, n=236)[18] and distal gastrectomy (9.2% and 17.6%, single-centre RCT, n=283).[19] Further RCTs comparing RAS with thoracolaparoscopic oesophagectomy for oesophageal cancer[8,20] and RAS with open pancreaticoduodenectomy for pancreatic and periampullary tumours[21,22] are ongoing.

Well-designed and conducted multi-centre RCTs provide the highest level of evidence regarding the efficacy of surgical therapeutic interventions.[23] Such trials are difficult to complete, with numerous challenges well described.[24] Although many established surgical procedures are not underpinned by multi-centre RCTs (for example, appendicectomy for uncomplicated acute appendicitis[25] and laparoscopic cholecystectomy[26]), its value has been highlighted by a multi-centre RCT comparing minimally invasive to open radical hysterectomy for early cervical cancer.[27] Those results in

gynaecologic oncology contravened the other retrospective and non-randomised evidence at the time to show an increased risk of death and recurrence with minimally invasive radical hysterectomy. The decreased overall survival in cervical cancer associated with RAS compared to open radical hysterectomy has since been corroborated in a recent systematic review and meta-analysis of matched or adjusted studies.[28]

In addition to the general considerations of the applicability of trial populations (e.g., rates of obesity and comorbidities), a special consideration of trials involving surgical procedures is that the results are significantly influenced by the surgeons' performance of the procedure.[29] The concept of a learning curve for surgical procedures is well recognised, but how to define and measure it for a specific procedure is variably established, let alone for a specific surgeon.[30] When comparing new surgical procedures with an established alternative there is a risk that trials earlier in the learning curve may not represent its true effectiveness, as was the case for laparoscopic inguinal hernia repair.[31]

The current literature reveals a significant monetary cost associated with RAS, especially in the context of a monopolistic RSS vendor.[16] Despite the recent and future introduction of numerous other RSS vendors to the market[1] it is extremely unlikely that the direct costs of RAS will be lower than laparoscopic or open surgery due to the requirement of extra equipment to enable robotic assistance. It is very seldom that an advancement in technology, whether in telecommunications, homeware or medical devices, is associated with a reduction in direct equipment costs. Hence, RAS must demonstrate robust clinical benefits to be determined cost effective. Evidence from multi-centre RCTs suggested no clinical benefits for less complex procedures such as inguinal[12] and simple ventral hernia[32] repair compared with laparoscopy, and instead demonstrated increased operative time, healthcare costs and surgeon frustration.

Cost effectiveness is an important consideration encompassed in assessing the value of an intervention. All healthcare systems, including our own, will continue to face multiple demands in weighing up investment opportunity costs. In addition to the possible clinical benefits pertaining to complex surgical procedures previously evidenced, we believe the value of RAS in the public healthcare system will manifest through engendering equitable access, quality improvement and workforce development to futureproof surgical care for our population.

The value of robot-assisted general surgery in the Aotearoa New Zealand context

As new RSS vendors enter the market, it is salient to note that Aotearoa New Zealand does not have a pre-market approval process for medical devices under the *Medicine Act 1981*. RSS are multi-speciality technology that facilitate diverse procedures and indications. Specialists must consider the value of a specific procedure for a specific patient in their hands with the best available evidence. For instance, robot-assisted cholecystectomy may provide superior outcomes for certain indications (e.g., Mirizzi syndrome) and populations (e.g., chronic liver disease), which are not amenable to RCTs, by an experienced RAS surgeon.[33] Therefore, the assessment of the value of RSS for the health system is perhaps more complex than a particular medical device designed for a specifically defined indication.

Value assessments must also incorporate a focus on equity rather than a singular focus on cost effectiveness, as interventions that reduce inequity of health outcomes may cost more but be more valuable. Private healthcare in Aotearoa New Zealand is following regional and global trends in RAS, with an established practice in urology and a nascent practice in gynaecology. Most recent available figures show robot-assisted radical prostatectomy for prostate cancer comprised 28% of all radical prostatectomies in Aotearoa New Zealand for the 2019/2020 year, compared to only 11% in 2010/2011.[34] General surgery in Aotearoa New Zealand appears to be on the precipice, and international experience suggests that it is not only the fastest-growing category but also the highest volume. Until recently, access to RAS has only been available via private healthcare through the ability to pay and through having private health insurance. That inevitability results in disparities in access by wealth, and only 38% of the population report being covered by private health insurance.[35] This disproportionally affects Māori and Pacific peoples, who have an average annual household equivalised disposable income of 16–21% ($9,000–$12,000) less than NZ Europeans[36] and lower rates of private health insurance—22% of Māori and 17% of Pacific peoples compared to 40% of NZ European/Other.[35] The implementation of robot-assisted general surgery in the public

healthcare system at the current opportunity, when it is not prevalent in private healthcare, may mitigate against disparities in access seen in other specialities.

Robot-assisted general surgery may also promote health equity by improving outcomes related to patient and disease-specific factors. For example, one of the Te Aho o Te Kahu quality improvement indicators for rectal cancer is the rate of abdominoperineal resection, which is associated with the rate of permanent stomas.[37] Māori have a higher rate than NZ European/Other (25.5% vs 21.9%),[37] and evidence from the most recent multi-centre RCT comparing RAS to laparoscopy for middle and low rectal cancer suggests a significantly lower rate for RAS (16.9% vs 22.7%).[7] In addition, the benefits of RAS for gastric cancer[18,19] are particularly relevant for Māori, for whom it is the fourth most common cause of cancer death, and, compared with NZ European/Other, have a higher age–sex-standardised incidence and are more likely to be diagnosed with local and regional disease amenable to surgery.[38,39] Thus, the implementation of robot-assisted general surgery in public hospitals aligns with the New Zealand Health Strategy's vision of pae ora, a healthy future for all, in "*harnessing the benefits of innovation, technology and practice that improves how care is delivered, reduces variation and tackles inequity in outcomes. … and support[ing] access for the most under-served communities*".[40]

What role Pharmac may have in determining the availability of RSS in public hospitals as it establishes a national list of all hospital medical devices by 2025 is yet to be defined. Traditional health technology assessments have been shown to be inadequate when exploring the context of application, such as patient-related and socio-organisational factors.[41] Therefore, there is also an imperative for clinicians to lead and be involved in the evaluation to generate evidence specific to the Aotearoa New Zealand context. Such are the limitations of the currently presented and available data, devoid of clinical characteristics.

There are also benefits that extend to education, training and quality assurance, some of which did not exist with open or laparoscopic surgery. It has been shown that early surgical trainees perform more competently with RAS than with laparoscopic surgery,[42] and for surgeons performing complex oncological surgery the RAS learning curve may be less than open surgery for achieving adequate cancer control.[43] This is germane to the Aotearoa New Zealand context due to our relatively small population; we could be considered a low-volume country for many complex surgical procedures.[44] The advances in simulation, proficiency-based curricula coupled with artificial intelligence and novel feedback mechanisms have improved safety and outcome for patients.[45–47] This has particular implications for Aotearoa New Zealand's public healthcare system, where patients do not usually have a choice of hospital or surgeon, and consumers have emphasised the importance of ensuring professional competence that is publicly demonstrated.[48]

Furthermore, the provision of RAS in public hospitals is a prudent strategic investment in developing a skilled workforce capable of delivering high-quality care, a priority area in the New Zealand Health Strategy.[40] As the evidence on RAS matures it is likely that Aotearoa New Zealand will follow the trends of other advanced economies overseas that are increasingly utilising RAS for complex surgical oncology.[3,49,50] General surgery training predominantly takes place in public hospitals, where the only accredited training attachments are based. RAS in public hospitals provides equitable opportunities to upskill current advanced trainees for competitive overseas fellowships at academic centres, where RAS is increasingly used. It will also support the recruitment and retention of returning specialists to the public health system, where they may apply their expertise in advanced therapies for the benefit of our local populations and contribute to the education of colleagues, including trainees. This will build capacity to integrate RAS into the training curriculum and ultimately develop self-sufficient pathways for local trainees in the Aotearoa New Zealand context. At Te Whatu Ora – Health New Zealand's Waitematā District we partnered with several stakeholders to deliver free minimally invasive surgery workshops for surgeons and trainees that involved laparoscopic box trainers, ex-vivo animal organ simulation and RAS training, including the use of virtual reality.

Frameworks in place to support ethical implementation in Aotearoa New Zealand

In addition to equity of access and outcomes discussed above, the adoption of RAS necessitates other ethical considerations regarding informed consent, biases and managing conflicts of interest, including advertising. Aotearoa New Zealand law (*Health and Disability Commissioner Act 1994* and

the *Health and Disability Commissioner [Code of Health and Disability Services Consumers' Rights] Regulations 1996*) and the Commissioner's decisions provide clear guidance on informed consent for innovative procedures.[51–53] Several cognitive and emotional biases exist when handling medical technology.[54] It is important to be aware of biases as they can influence clinical practice and patient outcomes.[55,56] An essential component of addressing biases is mitigating the effect of conflicts of interest.[57] The Royal Australasian College of Surgeons provides practical guidance in a position paper on interactions with the medical industry.[58] Te Kaunihera Rata o Aotearoa | Medical Council of New Zealand have a statement on advertising that sets a standard supported by the *Fair Trading Act 1986*.[59]

At Te Whatu Ora – Waitematā District we have established a transdisciplinary committee of multi-speciality clinicians, hospital management and non-clinical representation that guides the implementation of RAS in line with suggested evidence-based practice.[60] We have also developed an independent credentialing process that recognises individual surgeon performance is context specific and is not necessarily portable from one setting to another.[61]

Conclusion

The introduction of RAS to general surgery in Aotearoa New Zealand has some parallels to the introduction of laparoscopy over two decades ago.[62] Current evidence suggests that its value for patients is realised in complex procedures, and its value for the health system may be multifaceted. To achieve optimal outcomes, educational and quality improvement initiatives should be embedded in clinical implementation. Aotearoa New Zealand is well placed with legal, ethical and professional frameworks to support evidence-based dissemination. Clinicians from multiple specialities within general surgery, along with patients, should be involved in defining the future role of robot-assisted general surgery in Aotearoa New Zealand.

COMPETING INTERESTS
The authors declare no conflicts of interest. None of the authors have received any payment from Intuitive Surgical, Device Technologies or any of their subsidiaries.

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A case of imported rabies in Aotearoa New Zealand

Hamish Wright, Andrew Fox-Lewis

Rabies is a zoonotic encephalitis caused by viral species within the *Lyssavirus* genus.[1] Rabies virus (RABV; species *Lyssavirus rabies*) transmitted from dog bites is the most common cause of human rabies.[1] Rabies is not endemic in Aotearoa New Zealand,[2] and here we describe Aotearoa New Zealand's first recorded case.[3]

Case report

A 48-year-old Filipino man presented to hospital with fever, vomiting and inability to swallow food or fluids (day 3 post-symptom onset). There was no history of an animal bite from the patient (while lucid), or his wife. He worked on a commercial cargo ship and had not disembarked since boarding in the Philippines over 7 months earlier. There were reportedly no animals on board. He had a background of type 2 diabetes mellitus, for which he took metformin and gliclazide.

On examination on the day of presentation (day 3 of illness), he was febrile (38.6°C) and anxious. Initial blood tests showed a neutrophilia and normal C-reactive protein. On day 4 he became increasingly agitated and paranoid, necessitating sedation and intubation for ongoing management. Initial CT and MRI brain imaging were unremarkable (Figure 1). CSF analysis demonstrated a lymphocytic pleocytosis. Routine CSF microbiological investigations and autoimmune encephalitis screen were negative. He received empirical broad-spectrum antimicrobials to cover bacterial meningitis and viral encephalitis, and a 5-day course of methylprednisolone (1g/day) for a possible autoimmune cause. On day 5 he developed significant autonomic instability with alternating tachypnoea and apnoea, and episodes of extreme hypertension interspersed with hypotension.

Urine, serum and CSF collected on day 8 were tested with a pan-*Lyssavirus* genus reverse transcription real-time PCR, which was negative. Day 10 serum was negative for RABV IgG. The patient became progressively obtunded from day 14, with marked hypersalivation (saliva losses exceeding 1L/day). Day 15 serum demonstrated RABV IgG seroconversion. Three saliva samples and a nuchal (nape of neck) skin biopsy collected on days 16–17 all tested positive for *Lyssavirus* genus RNA by PCR. The detected *Lyssavirus* was confirmed as RABV by sequencing (Figure 2). His obtundation progressed to absent respiratory drive and multi-organ failure, and he died on day 23 post-symptom onset. The patient was managed with infection prevention and control (IPC) standard precautions, with appropriate personal protective equipment (PPE) used when staff were at risk of contact with infectious bodily fluids.

Discussion

When RABV from saliva of an infected animal contacts non-intact skin (via a bite), it enters peripheral motor nerves and travels to the spinal cord (typical incubation period ~20–90 days).[1] Dorsal root ganglia infection produces inflammation, leading to fever, pruritus and paraesthesia (prodromal phase, ~1–2 days).[1] From the spinal cord, RABV rapidly disseminates within the central nervous system (CNS) to produce an acute neurological phase (~1–4 days) with an encephalitic (agitation, hypersalivation, hydrophobia and autonomic dysfunction) or paralytic clinical picture (muscle weakness, paralysis and drowsiness).[1] Development of symptoms is almost invariably followed by death within 1–2 weeks, which may be extended by ICU care.[1]

Following CNS dissemination, the virus spreads outwards via parasympathetic nerves to multiple sites, including skin sensory nerves and salivary glands to facilitate onwards transmission via saliva.[1] Optimal ante-mortem investigations reflect this pathophysiology: saliva specimens (containing excreted virus) and a nuchal skin biopsy (skin nerves close to the CNS) for PCR testing.[1] Our patient evidently lacked prior immunity from rabies immunisation, making paired serology useful in this case for demonstrating RABV IgG seroconversion. Within Aotearoa New Zealand, rabies serology is currently available through Awanui Labs (formerly Labtests), Auckland and Canterbury Health Laboratories, Christchurch.[7,8]

Table 1: Timeline of clinical progress and key investigations.

Clinical progress	Key investigations

• Day 0: **symptom onset** with fever and vomiting.
• Day 2: difficulty swallowing food.
• Day 3: difficulty drinking liquids. Medical attention sought: "For some reason, his throat rejects foods and even water. It's like a gag reflex". Admitted to Whangārei Hospital.
• Day 4: onset of agitation and paranoid ideation. Hydrophobia and oxygen therapy intolerance (possible aerophobia). Intubated and transferred to ICU due to agitation. Empirical meningoencephalitis treatment started (ceftriaxone, clarithromycin and aciclovir).
• Day 5: transferred to Auckland City Hospital ICU. Autonomic dysfunction with abnormal respiration and tachycardia interspersed with bradycardia. Benzylpenicillin and doxycycline added to antimicrobial regimen.
• Day 6: ongoing fevers and autonomic dysfunction with marked hypoxia requiring deep sedation. Abnormal gagging motions, eye rolling and neck flexion movements noted, levetiracetam added.
• Day 7: progressive haemodynamic instability and challenging mechanical ventilation with echocardiography showing severely globally impaired LV. Abnormal jaw and pharyngeal movements. Methylprednisolone IV commenced for possible autoimmune encephalitis (5-day course).
• Day 12: antimicrobials stopped.
• Day 14: hypersalivation noted (over 1L/day saliva losses). Sedation progressively weaned.
• Day 15: resolving autonomic instability.
• Day 17: pupils unreactive.
• Day 19: absent cough reflex, oculocephalic reflex and deep tendon reflexes, with intact corneal reflexes. **Repeat rabies serology positive, demonstrating IgG seroconversion to rabies virus**.
	• Days 3–8
	  • Admission bloods: white cell count 22.5x10^9/L (normal range 4–11), neutrophils 19.6x10^9/L (1.9–7.5), lymphocytes 0.9x10^9/L (1–4), HbA1c mmol/mol 77 (<41), C-reactive protein 2 mg/L (0–5), renal and liver function grossly normal.
	  • Cerebrospinal fluid (CSF) analysis: protein 0.39 g/L (0.15–0.45), glucose 7 mmol/L (2.8–4.4), white cell count 14x10^6/L, neutrophils 1%, monocytes 9%, lymphocytes 90%, CSF PCR panel negative for common viral and bacterial causes of community-acquired meningoencephalitis, bacterial culture no growth, *Mycobacterium tuberculosis* culture no growth after 6 weeks.
	  • Blood cultures and urine culture no growth.
	  • Infectious serology: HIV, syphilis, EBV, CMV, HAV, HBV, HCV, *Rickettsia*, cryptococcal antigen not consistent with recent or acute infection.
	  • Respiratory virus PCR panel and atypical pneumonia PCR panel negative, *Legionella* urinary antigen negative.
	  • Malaria blood films negative, flavivirus PCR of urine and serum negative, *Leptospira* PCR on urine negative.
	  • Autoimmune serology: ANCA and ANA screen negative, anti-neuronal antibodies in serum and CSF negative.
	  • Imaging: chest X-ray no abnormalities detected, CT head, chest and abdomen non-significant, initial MRI rain (day 5) grossly normal, TTE: globally impaired LV systolic function (LVEF 29%).
	• Day 8: *Lyssavirus* genus PCR on urine, serum and CSF negative.
	• Day 10: initial rabies serology (IgG) negative.

Table 1 (continued): Timeline of clinical progress and key investigations.

• Day 20: ***Lyssavirus* genus detected by polymerase chain reaction (PCR) in saliva and nape of neck skin biopsy specimens**, consistent with rabies virus but species to be confirmed. • Day 21: loss of respiratory drive, onset of diabetes insipidus. • Day 23: absent motor responses and cranial nerve reflexes. Family meeting to discuss withdrawal of intensive care supports, and then palliatively extubated in presence of family. **Death** confirmed 10 minutes post-extubation.	• Day 15: repeat **rabies serology (IgG) positive** (resulted day 19). • Days 16–17: ***Lyssavirus* genus PCR on saliva x3 and nape of neck skin biopsy positive**, Australian bat lyssavirus (ABLV) negative (resulted day 20)—later **confirmed as rabies virus** by sequencing, consistent with virus of Philippines origin. • Day 21: MRI brain—repeat MRI showing progressive changes as detailed in Figure 1.

Figure 1: Magnetic resonance imaging (MRI) brain images from the patient.

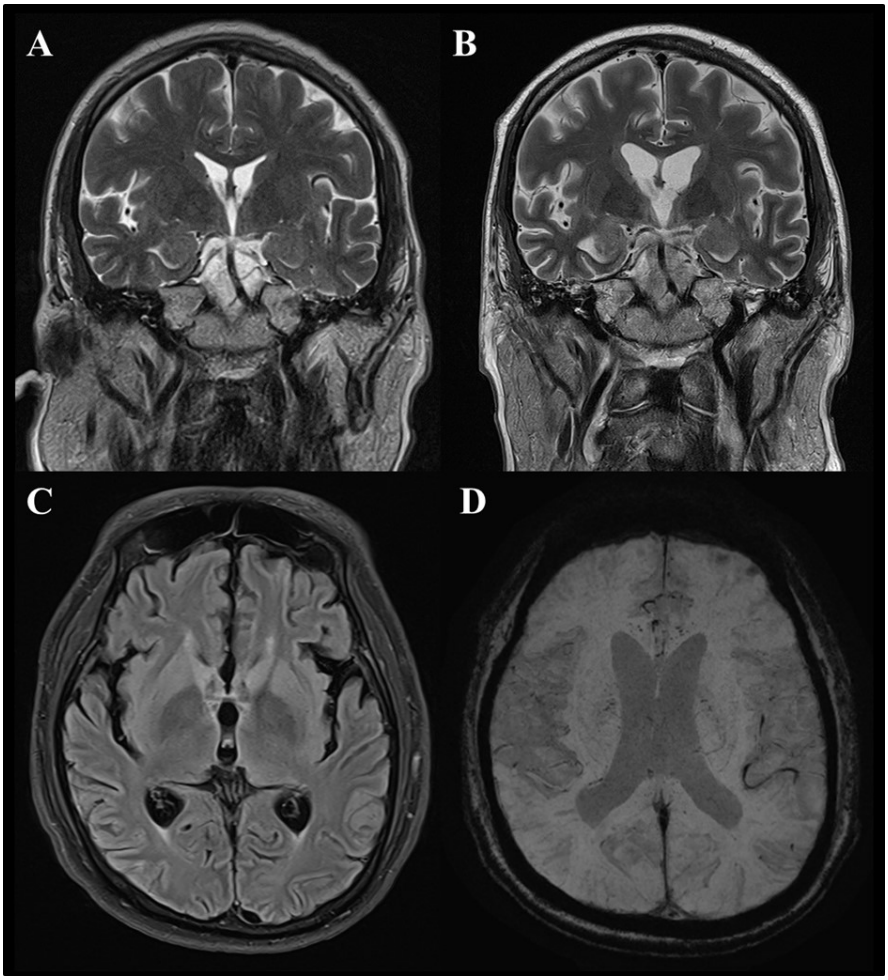
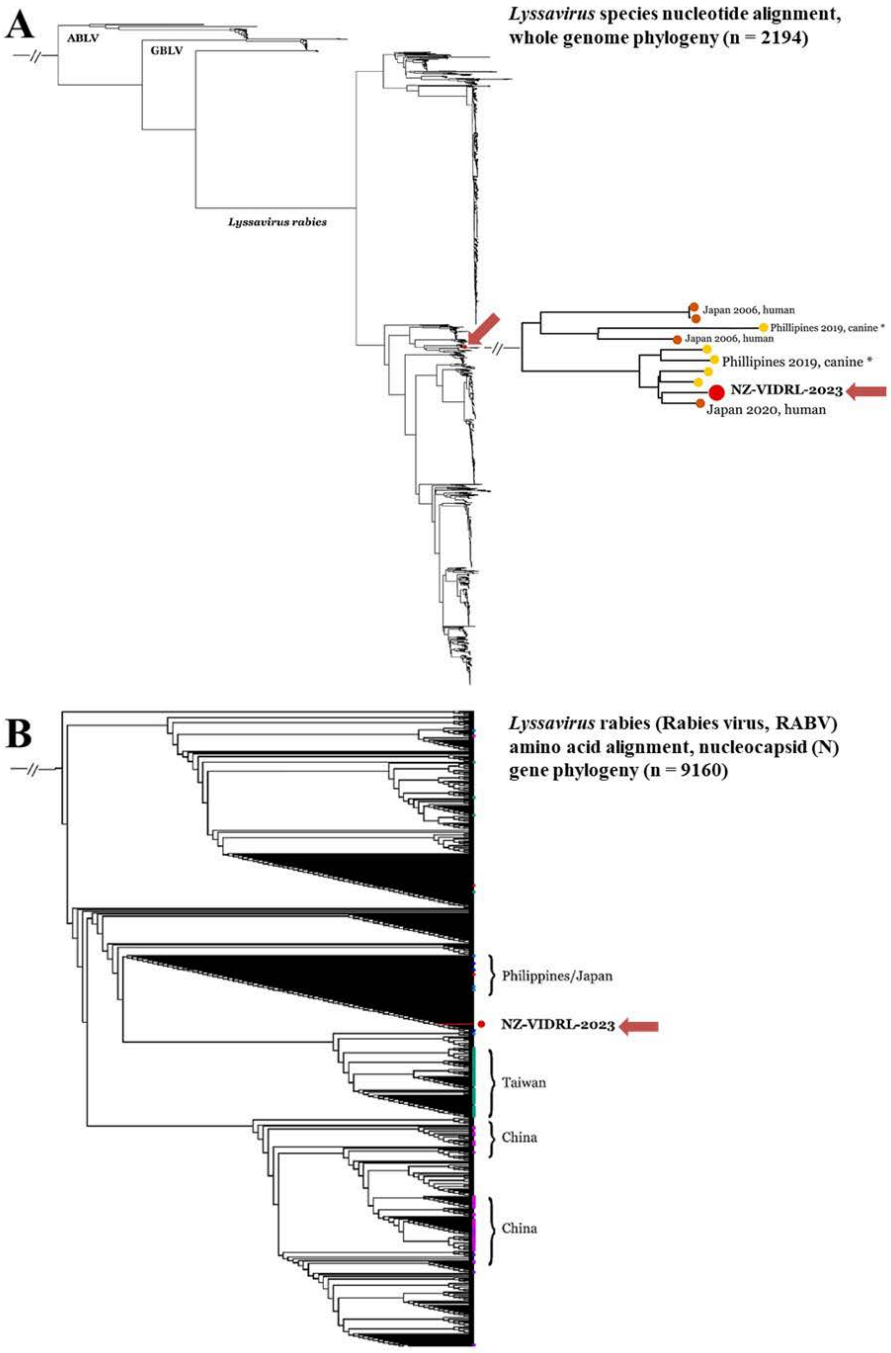


Figure 1a) Day 5 MRI identified no significant abnormalities.
Figure 1b) Day 21 MRI demonstrated cerebral volume loss with widening of sulcal spaces and increased ventricular size when compared to day 5 MRI.
Figure 1c) Day 21 MRI fluid attenuated inversion recovery (FLAIR) sequence showing mild diffuse increased signal in the cerebral cortex and caudate head, globus pallidus and hypothalamus.
Figure 1d) Day 21 MRI susceptibility weighted imaging (SWI) demonstrating small hypointense foci on at the genu of the corpus callosum consistent with microhaemorrhages. Such changes are described in the literature.[4]

Figure 2: Whole genome phylogenetic tree (a) and N-gene cladogram (b) for the rabies virus isolated from our patient (marked with red dots annotated "NZ-VIDRL-2023" and indicated by red arrows).



The detected *Lyssavirus* was confirmed as RABV, with nucleoprotein (N) gene Sanger sequencing yielding a 100% match to GenBank LC752966.1 *Lyssavirus rabies* 0512 N-gene, and whole genome sequencing of the detected virus giving 100% coverage with GenBank LC619707 Toyohashi strain RABV (also isolated from a Filipino patient, marked with an orange dot annotated "Japan 2020, human").[5]

Note that while the virus detected from this patient is shown as being closely phylogenetically related to RABV strains from Japan and the Philippines, rabies was eliminated from Japan in 1957[5] but remains highly endemic in the Philippines, which has approximately 200–300 human cases annually.[6] The three recent cases diagnosed in Japan in 2006 and 2020 (marked with orange dots) were all acquired in the Philippines, reflecting the common geographic origin of this cluster in the phylogenetic tree.[5]

Key: ABLV, Australian bat lyssavirus (*Lyssavirus australis*); GBLV, Gannoruwa bat lyssavirus (*Lyssavirus gannoruwa*).

Rabies PCR testing is not currently available in Aotearoa New Zealand and can be referred to the Victorian Infectious Diseases Reference Laboratory (VIDRL) in Melbourne, Australia.[9]

The patient developed symptoms after 7 months at sea without shore leave. As demonstrated by this case, the long incubation period, which can extend for several years in rare cases,[10] makes eliciting an animal bite history challenging. This means compatible symptoms and prior travel to a rabies endemic area may be the only clues to the diagnosis. Rabies is highly endemic in the Philippines,[6] and our patient was likely infected there before embarking.

Rabies is transmitted when infectious bodily fluids (saliva, tears, respiratory secretions) or CNS tissue comes into direct contact with non-intact skin or mucous membranes (eyes, nose or mouth).[11] Blood, urine and faeces are deemed non-infectious, and rabies cannot be transmitted via objects/surfaces.[11] Standard precautions should be used for care of all patients,[12] and are considered appropriate for the care of patients with suspected or confirmed rabies.[2,11] This means that staff that are likely to come into contact with infectious bodily fluids should wear gowns, goggles, masks and gloves, particularly when performing activities such as intubation and suctioning.[11] Post-exposure prophylaxis is only warranted following a direct exposure as described above, or when a contact has been bitten by a case.[2] Care of a patient with suspected or confirmed rabies can generate anxiety among attending healthcare workers, especially in non-endemic settings. Anxiety can be managed through staff education regarding which bodily fluids are infectious, reinforcing the value of correct standard precautions for all patients and reassurance that standard precautions are effective in preventing rabies transmission and that there has never been a case of human-to-human rabies transmission from a patient to a healthcare worker (human-to-human transmission has only occurred in the setting of organ/tissue transplantation).[11]

COMPETING INTERESTS
Nil.

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The relation of general practitioner to specialists.

NZMJ, 1923 (*To the Editor*.)

Sir,—I saw a patient a few weeks ago, who gave the following history which I think may be of interest to members of the Association generally:—

Mrs X.Y. was confined of a ten-pound baby in a town in the North Island some four years ago. She was attended by a "surgeon." The baby was unfortunately born dead, as very large babies are always liable to be at a first labour. In consequence of its loss, her mental condition was very much upset, and she could not pass a baby in the street without wanting to run away with it. She was calmed down somewhat by being told that she would soon become pregnant again and have a living baby next time. However, a year or so went by and there was no pregnancy. She again became somewhat upset, and, on the adviice of some friends in England, she expressed a wish to consult me. She was, however, told by her medical adviser that he had examined her, that she was perfectly normal, and that it was quite unnecessary to consult me. Every subsequent effort on her part to come to me was met by the same statement. Another year or so went by, and, as she still did not become pregnant, she expressed a wish to adopt a child. This wish was met with a somewhat similar statement, namely that she would soon become pregnant again, as she was perfectly normal. At last, some three years or so after the first confinement she left the particular town in which she had up to this lived, every effort on her part to obtain the opinion of a specialist, or to adopt a child, having been squashed by the formula that she was capable of becoming pregnant at any moment.

Eventually, after another interval, she got to Christchurch, and came to see me. The following are the physical signs which I wrote down after a first examination without an anæsthetic:—"Patient difficult to examine, uterus retroverted, possibly adherent, wide bi-lateral tear of cervix." Cervical tears have been recognised as definite causes of sterility from the time of *Marion Sims*, or *Emmet*, and so it was obvious that this tear should be cured. Further, an adherent retroversion in all probability means closed tubes and absolute sterility, so that a further examination under an anæsthetic was necessary. The physical signs noted at this further examination were as follows:—"Uterus retroverted, fundus can be brought partially forward but falls back at once owing to adhesions, whole uterus retroposed, broad ligaments shortened and thickened, no cystic condition of tubes or ovaries, deep tear of cervix on one side only."

As the patient had stated that she did not wish any abdominal operation to be done at the time, the uterus was curetted and a trachelorrhaphy performed. So far, I have not as yet discussed the question of further operation, but there is little doubt that she is, at the moment, in a condition of absolute sterility due to closure of the tubes, due in turn to some very mild infection at or subsequent to labour. Even if my diagnosis is incorrect, and the inflammation extra- rather than intra-peritoneal, it makes no material difference so far as the present indications for treatment are concerned. The physical signs of the patient are so definite as to render an exploratory operation essential in the case of a woman who is complaining of sterility.

Now, as I understand medical ethics, a medical man has two duties. His first and chief duty is to his patient—and it is the predominant one. His second duty is to himself. I cannot believe that the medical adviser (of whose identity I am in ignorance) of Mrs. X.Y. has discharged either of his duties. In regard to his patient he has failed very egregiously, because, for some reason, or reasons, he has prevented her from consulting a specialist, and has trusted to assume powers of diagnosis which actually he does not possess. In the case of himself, he has, for no benefit that should have been allowed to weigh with him, exposed himself to loss of reputation. It is impossible for me to hide from the patient or her husband that everything her previous adviser told her, so far as her pelvic organs are concerned, is wrong. Who benefits by this kind of thing? I know three people who do not—the patient, the previous medical adviser, and the specialist who should see the patient. Yet the same thing happens at regular

intervals, when patients come to me and say, "Do not tell my doctor. He would be furious at my consulting you." All of which is rather strange hearing to me who know that "her doctor" is probably just as incapable of diagnosing the condition of pelvic organs as I am of undertaking the treatment of a *Colles'* fracture, and who am not accustomed to this professional antagonism.

Everybody, be he specialist or general practitioner, makes errors of diagnosis. In the case of Mrs X.Y., I should no more expect a general practitioner to diagnose her condition than I should expect myself to diagnose the locality of intra-cranial lesions. The changes in the pelvic organs are far too slight. Even now, knowing them to be there, it is impossible to tell their extent, and if the patient had been somewhat fatter, they would probably have escaped notice altogether. It is not with mistakes in diagnosis that I quarrel, it is with the attitude of mind which enables a man to think that he is entitled to refuse to a patient the advantages which she can get from the opinions of other advisers, and which tries to compel her to limit her opportunities to what can be given by "her doctor."

When I had the honour of addressing the Wellington Conference on "Maternal Mortality," I said : "To imagine that a busy general practitioner can keep himself competent and skilled in all the special branches of modern medicine, is absurd. To deprive the patient, public or private, of the assistance of these special departments helps the quack, discredits the medical profession, wrongs the patient, and, even from a purely selfish point of view, eventually is bound to cause loss rather than gain." Is this a mere truism which every one recognises and acts on, or am I right in thinking that the case of Mrs. X.Y. is only one amongst many?

Yours, etc.,

HENRY JELLETT.