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Trial removal of indwelling urinary catheters in stroke patients: a clinical audit at North Shore Hospital

Dushiyanthi Rasanathan, Xu Wang

We performed an audit that identified stroke patients admitted to North Shore Hospital between 26 November 2018–24 May 2019, who had a urinary catheter inserted during their time in hospital. We looked at the reasons for catheter insertion, how many days patients had catheters in before trial of removal and whether these patients developed a urinary tract infection. Conclusions from this audit include the need to consider whether the decision to insert a catheter is appropriate, and the importance of removing catheters as soon as possible to reduce risk of infection. Urinary catheters and associated infection can affect stroke patients' hospitalisation time and recovery.

A persuasive approach to antimicrobial stewardship in Christchurch hospitals produced a sustained decrease in intravenous clarithromycin dosing and expenditure via a switch to azithromycin orally

Sharon J Gardiner, Sarah CL Metcalf, Anja Werno, Matthew P Doogue, Stephen T Chambers, on behalf of the Canterbury District Health Board Antimicrobial Stewardship Committee

Optimising use of available antibiotic medicines (antibiotic stewardship) helps reduce antibiotic resistance. Giving antibiotics by the oral rather than intravenous (IV) route can help avoid problems like infection caused by the IV line. We used strategies like leadership and pharmacy support, and education, to encourage our prescribers to avoid the IV route for treatment of community-acquired pneumonia where appropriate. This produced a sustained decrease in use of clarithromycin IV (by 72%) and cost savings of around $100,000 per annum.

On the use of a new monocular-indirect ophthalmoscope for retinal photography in a primary care setting

Aqeeda Singh, Kirsten Cheyne, Graham Wilson, Mary Jane Sime, Sheng Chiong Hong

The oDocs Nun is a newly released smartphone-based ophthalmoscope, which can be used to capture images of the back of the eye. This study aimed to subjectively assess the quality of the images captured with it in order to determine the feasibility of its use in a clinical environment. Twenty-eight general practitioners (GPs) captured and uploaded 357 photographs, which were then rated by two ophthalmologists and two optometrists. Overall, it was found that the oDocs Nun is a promising tool which GPs can use in the primary care setting.

Admission to ICU "solely for possible organ donation"—audit of current New Zealand practice

Stephen Streat, Annette Flanagan, Joanne Ritchie

There are a small number of patients (49 over a recent two-year period) with likely fatal acute illness who are admitted to ICUs in New Zealand "solely for possible organ donation", commonly after a preliminary discussion with their family about donation. Around 40% (20/49) of these patients donated organs after their death in the ICU. These organs were transplanted into 58 recipients, 14% of the 417 recipients of organs from deceased donors over the two-year period. Organ Donation New Zealand is supporting expansion of this practice within recommended best practice guidelines.

Inherited thrombophilia testing in a large tertiary hospital in New Zealand: implementation of a Choosing Wisely protocol to reduce unnecessary testing and costs

Myra Ruka, Helen Moore, Denis O'Keeffe

Inherited thrombophilia testing should only be performed in a small subset of patients who are likely to derive benefit. Internationally and nationally, testing patterns reflect an overuse of this test due to testing patients that do not fulfil clinical criteria for testing. An audit on Waikato Hospital Laboratory testing patterns over a one-month period revealed only 1 of 94 tests complied with British Society of Haematology guidelines testing criteria. A multimodal choosing wisely programme was implemented into Waikato Hospital laboratory with a subsequent reduction in test requests, tests performed and cost of testing.

Sleep habits of intermediate-aged students: roles for the students, parents and educators

Kate Ford, Paul T Kelly, Rebecca Williamson, Michael Hlavac

In this group of students, most achieved a sleep duration within the advised Ministry of Education and Sleep Health Foundation guidelines. Students that used an electronic device before bedtime were more likely to achieve less sleep than non-device users. Further, students whose parent chose their bedtime went to sleep earlier and achieve more sleep compared to students that chose their own bedtime. Therefore, parental guidance with regard to bedtimes and reduction in device usage before sleep are two factors that may improve sleep in this group.

Transition of the medical model of care at Ashburton hospital over 10 years: the perspective of rural generalists

Steve Withington, Sampsa Kiuru, Scott Wilson, John Lyons, Alexander Feberwee, Janine Lander

Over a 10-year period from 2008 to 2017, Ashburton Hospital's medical staffing system has changed through a gradual, planned replacement of surgeons, anaesthetists and physicians by generalist rural hospital doctors who now manage all people presenting to the hospital. The transition was driven largely by problems with specialist medical staff recruitment and replacement, which is common to rural hospitals in New Zealand and elsewhere, but was made possible by a new qualification in rural hospital medicine, and a group of doctors working Ashburton willing to take up this training. Following this transition, the hospital only offers a very limited range of surgical services on site, but nevertheless assesses and treats a much larger number of acute patients than before, while keeping admissions and overall medical staffing constant, and with only a small increase in transfers to Christchurch, similar to the population increase over the period. This represents a successful transition of medical model of care in Ashburton hospital and its challenges and lessons learned may be of benefit to other rural hospitals in New Zealand.

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Neoliberalism: what it is, how it affects health and what to do about it

Pauline Barnett, Philip Bagshaw

Neoliberalism is about getting government out of providing most services, and letting private enterprise and markets take over through competition, including the creation of a 'fake market' for public healthcare services. It is supposed to give individuals more choice. However, it has favoured the 'haves' at the expense of the 'have nots' in levels of income and health in New Zealand. Some of the worst effects of neoliberalism have been reduced but it still remains buried in our psyche and in some of the ways our society functions. To root it out in healthcare we need bold new initiatives with greater investment of money, particularly where it is needed most, and an emphasis on equity of health for all citizens.

A consensus statement on the use of angiotensin receptor blockers and angiotensin converting enzyme inhibitors in relation to COVID-19 (corona virus disease 2019)

Hari Talreja, Jasmine Tan, Matt Dawes, Sharen Supershad, Kannaiyan Rabindranath, James Fisher, Sajed Valappil, Veronica van der Merwe, Lisa Wong, Walter van der Merwe, Julian Paton

Some patients have been expressing concerns to doctors after the idea started circulating on social media that two common hypertension (high blood pressure) drugs could lead to more severe cases of COVID-19. However, a high-powered group of doctors and scientists in Aotearoa New Zealand have scrutinised the evidence for this theory and determined it is inconclusive and should be disregarded.

Here we go again? A new pandemic of the 21st century

Geoffrey Rice

As the COVID-19 pandemic has worsened rapidly over the past few weeks, comparisons have been made with the great influenza pandemic of 1918, with people asking "Are we about to see a repeat of that global disaster?" History doesn't actually repeat: it only appears to. Different circumstances will produce different outcomes in different places, even from the same infectious disease.

Here in New Zealand we have been better prepared than most countries for a pandemic, with a comprehensive and recently updated plan for influenza. So far the government and Ministry of Health have been guided by that plan, and have mounted a measured step-by-step response, aimed at 'flattening the curve' of cases. Some of us had been asking for an earlier school closure, but as soon as there was clear evidence of community spread the authorities announced a Level 3 emergency and moved within 48 hours to a complete Level 4 lockdown. One of the big lessons of 1918 had been applied: respond quickly or it will run away out of control.

Some countries had not learned that lesson. The forecasts for the UK and North America are grim, because they failed to take the threat seriously enough or respond early enough. A week is a long time in a pandemic, as Wellington discovered in November 1918, when delay proved dangerous and resulted in a death rate nearly twice that of Christchurch.

So far New Zealand appears to have mainly done the right things, and in a reasonably timely fashion. Our leadership so far has been superb. But our pandemic planning was done mainly with influenza in mind, and here we are confronted by a novel coronavirus. In the race to find a vaccine the scientific world is quickly finding out a lot more about the virus itself, but we don't really know as yet how this particular virus will behave as it passes through large populations. COVID-19 is highly infectious, with high case fatality for the elderly.

The 1918 A/H1N1 influenza pandemic saw three distinct waves across 18 months. The first wave was quite mild, a doctor's delight: "many people sick, not many dying". But the second wave later in the year was much more severe and killed an estimated 50 million people. The third wave in 1919 was less severe, and did not affect all countries equally. Australia came through with a very low death rate, whereas some regions in Japan suffered losses almost as bad as in 1918.

Will this COVID-19 pandemic be all over in one wave, or will it recur? The 1889–94 'Russian' flu pandemic kept coming back in successive waves, but with declining death rates and a low overall mortality of only about one million. We are in uncharted waters with COVID-19. Computer modelling has been exceptionally helpful in predicting the short-term curve, based on normal epidemiological patterns, the reproduction rate of the virus, and the effect of mitigation measures. We can only hope that this virus stays stable and does not start transmuting into anything nastier.

In some respects COVID-19 is already much nastier than flu for the elderly. The 1918 virus tended to produce secondary infections of bacterial pneumonia, and most people had a fighting chance of recovering from that, but COVID-19 seems to penetrate much deeper into the lungs, causing destructive viral pneumonia. As patients become breathless, they lack oxygen, and need mechanical respiration in order to survive.

We have all been shocked by the scenes in hospitals in Northern Italy, where predominantly elderly patients have been dying

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in large numbers. In Spain old folks have been left to die alone. Though India has at last moved to a lockdown, it remains to be seen how that vast population will cope with rapidly escalating infection rates, and the possibilities for much of Africa are almost too terrible to think about. Nick Wilson's modelling now warns that if the present strategy fails New Zealand could be facing a very severe outcome, with 8,000 to 14,000 deaths. But China has shown that drastic measures can eliminate the infection.

Whether this pandemic comes to be called 'the Exodus of the Elderly' or 'the Pensioners' Plague' is up to some future historian to decide, but one thing is starkly clear at this point. If present measures fail, this could be the most severe test our hospital system has ever had to face. Doctors and nurses, ambulance paramedics and rescue helicopter staff are our front-line fighters, supported by an army of orderlies, aides, carers and other staff. Retired medical personnel are now coming forward, as in the UK, to bolster the response. In 1918 many doctors and nurses caught the flu, and over 50 of them died.

In Italy and Spain people have been clapping to show their appreciation for the desperate efforts of hospital staff. We must work harder to ensure that things don't get that bad here, but whatever happens we will certainly owe our medical sector enormous gratitude. 'Elimination' is now the goal and staying at home is the best way the rest of us can help to 'break the chain' and ensure that our hospital system does not collapse under the strain. Yet that also reduces herd immunity, and increases the prospect of reinfection if elimination fails, before a vaccine becomes available. This may only be the start of a prolonged crisis, in which our resilience and ingenuity as a nation is put to the test.

'Kia kaha'. We are all in this together.

Dr Rice is Emeritus Professor of History at the University of Canterbury and author of Black November: the 1918 Influenza Pandemic in New Zealand *(second edition, 2005),* Black Flu 1918: the story of New Zealand's worst public health disaster *(2017) and* That Terrible Time: Eye-witness Accounts of the 1918 Influenza Pandemic in New Zealand *(2018).*

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New Zealand's elimination strategy for the COVID-19 pandemic and what is required to make it work

Michael G Baker, Amanda Kvalsvig, Ayesha J Verrall, Lucy Telfar-Barnard, Nick Wilson

In this editorial we summarise the threat posed by the COVID-19 pandemic, the justification for the elimination strategy adopted by New Zealand, and some of the actions required to maximise the chances of success.

What is the size and nature of the threat?

The COVID-19 pandemic, caused by the SARS-CoV-2 virus, has shown a relentless ability to infect the world's population. The virus is highly infectious, with each case typically infecting 2–3 others (a reproduction number [Ro] of about 2.5). Consequently, it has the potential to infect about 60% (crudely estimated as 1-1/Ro) of the world's population during the next 1–2 years as pandemic waves work their way around the planet.

There are many measures of health impact, but case-fatality risk (CFR) is one of the most important. A reasonable working estimate is a 1% CFR for the population as a whole, with risk increasing markedly for those aged 60+ years and those with comorbidities.[1] The more useful measure is the infection fatality ratio, which is based on the total proportion of the population infected and can usually only be estimated retrospectively by serological surveys. Modellers have now cleverly calculated this for China, producing an estimate of 0.66% (0.39–1.33).[2] Putting these numbers together suggests this pandemic could kill 0.4% of the world's population (about 30 million people).

In New Zealand, we have used disease modelling to improve on these estimates, because modelling can take account of a lot more factors than basic data, including the fact that populations take measures to protect themselves.[3] Under one of the more likely scenarios if the country's current elimination strategy fails, New Zealand could expect approximately 14,400 deaths.[3] In addition, large numbers of people who are ill and hospitalised could swamp health services at all levels and prevent the delivery of elective services and preventive care.

A poorly controlled pandemic will greatly increase health inequities. Like seasonal influenza in New Zealand, risk is particularly concentrated in older people and those with severe comorbidities.[4] Therefore Māori and Pacific peoples could be more vulnerable, as seen in past influenza pandemics.[5]

What are the strategic options?

Pandemic planning in New Zealand, as in most countries, has been dominated by measures to manage influenza pandemics. For good reason, given experience with the 1918 influenza pandemic.[6] With the rising threat of the COVID-19 pandemic in January, New Zealand used its existing national influenza pandemic plan as a basis for its response.[7] This planning is appropriately based on a mitigation model, and focuses on delaying the arrival of influenza, and a range of measures to 'flatten the curve' of the pandemic. There is no expectation that any measures can halt an influenza pandemic (short of complete border closures, termed 'protective sequestration', which has protected Pacific Islands in the past[8]).

We are now seeing this mitigation approach being applied in countries across Europe, North America and Australia where the COVID-19 pandemic is spreading

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widely. A variation of this approach is the suppression strategy, where the curve is flattened to the point where there are relatively few cases. This approach is likely to require a prolonged 'lockdown' response which may last for months until an effective vaccine or antivirals are available.[9] Attempts at the suppression approach are increasingly replacing mitigation as the pandemic overwhelms healthcare systems.

But COVID-19 is not pandemic influenza.[10] The potential to contain it has not been adequately appreciated. This difference is largely a function of the biology and epidemiology of this infection. COVID-19 infection has a longer incubation period (median of 5–6 days) than influenza (1–3 days). This feature provides an opportunity for case identification and isolation and tracing and quarantining of contacts to succeed, but probably only if done swiftly and effectively.[11]

The strongest evidence that containment, on the path to elimination, works comes from the remarkable success of China in reversing a large pandemic.[12] Of particular relevance to New Zealand are the examples of smaller Asian jurisdictions, notably Hong Kong, Singapore,[13] South Korea[14] and Taiwan.[15]

New Zealand had a brief time-window to refine its plan before the pandemic arrived with the first COVID-19 case on 28 February.[16] At the time of writing, there were just over 800 identified cases, almost entirely in people who had recently returned from overseas or their contacts. However, there were several cases of community transmission, which was likely to be more widespread than numbers indicated because the initially limited diagnostic testing capacity was focused on people with a travel history.

New Zealand therefore had a major choice. A more familiar mitigation strategy or a more ambitious elimination approach. Technically, elimination is the eradication of an infectious disease at a country or regional level, with the term eradication reserved for global extinction of an organism. Disease elimination has been applied to a wide range of human and animal infectious diseases, though an effective vaccine is often required.[17]

By mid-March there was growing support for an elimination strategy.[18] The Government introduced a four-tier response system on 21 March and the country was placed on 'level 2' response (which involved limitations on mass gatherings and encouraging increased physical distancing). The country then escalated rapidly to 'level 4' (widely described as a 'lockdown' involving closing all schools, non-essential workplaces, social gatherings and severe travel restrictions) which came into force on the evening of 25 March 2020. A national emergency was also declared, giving authorities additional powers to enforce control measures.

This elimination strategy is a major departure from pandemic influenza mitigation. With the mitigation strategy, the response is increased as the pandemic progresses and more demanding interventions such as school closures are introduced later to 'flatten the curve.' Elimination partly reverses the order by introducing strong measures at the start in an effort to prevent introduction and local transmission of an exotic pathogen such as COVID-19. This approach has a strong focus on border control, which is obviously easier to apply for island states. It also emphasises case isolation and quarantine of contacts to 'stamp out' chains of transmission. If these measures fail and there is evidence of community transmission, it then requires a major response (physical distancing, travel restrictions and potentially mass quarantines or 'lockdowns') to extinguish chains of transmission.

Benefits and risks

The elimination strategy has benefits over mitigation: if started early it will result in fewer cases of illness and death. If successful it also offers a clear exit path with a careful return to regular activities with resulting social and economic benefits for New Zealand. The elimination strategy can also support Pacific Island neighbours to remain free of this virus once they relax current border controls.

The elimination strategy also has risks and these may be substantial. To make elimination work, New Zealand had no feasible alternative but to escalate its response to a national 'lockdown', mainly to give it time to ramp up key control measures.[18] A full national 'lockdown' was probably also

needed to ensure the population would swiftly transition to the physical distancing behaviours needed to limit spread and extinguish chains of transmission. New Zealand disease control planning was not greatly influenced by the SARS pandemic, which many countries in Asia experienced, and public awareness of concepts like quarantine and isolation have probably been poor.[19]

The lockdown does, however, have large social and economic costs, and is likely to be particularly tough for those with the fewest resources. The Government response includes a range of interventions to support these groups, including a major economic support package and restrictions on rent increases.

What we need to do to make elimination work

Elimination is a well-recognised strategy for infectious disease control, and New Zealand can draw on public health experience of eliminating a range of human and animal infectious diseases. In particular there are lessons to be learned from the measles and rubella elimination strategy,[17,20] albeit with the difference that we do not yet have an effective vaccine for COVID-19. Past experience has taught us that there are three factors that are critical to elimination success: 1) high-performing epidemiological and laboratory surveillance systems; 2) an effective and equitable public health system that can ensure uniformly high delivery of interventions to all populations, including marginalised groups (in this instance intervention is focused on diagnosis, isolation of cases and quarantine of contacts rather than vaccine); and 3) the ability to sustain the national programme and update strategies to address emerging issues.

The essential elements of an elimination strategy for COVID-19 are likely to include:

1. Border controls with high-quality quarantine of incoming travellers;
2. Rapid case detection identified by widespread testing, followed by rapid case isolation, with swift contact tracing and quarantine for contacts;
3. Intensive hygiene promotion (cough etiquette and hand washing) and provision of hand hygiene facilities in public settings;
4. Intensive physical distancing, currently implemented as a lockdown (level 4 alert) that includes school and workplace closure, movement and travel restrictions, and stringent measures to reduce contact in public spaces, with potential to relax these measures if elimination is working;
5. A well-coordinated communication strategy to inform the public about control measures and about what to do if they become unwell, and to reinforce important health promotion messages.

Given how infectious the SARS-CoV-2 virus is, multiple measures will need to be taken to ensure all of these control interventions are working in an optimal way. For example, there is good evidence for the use of mobile phone technology to speed up the effectiveness of contact tracing and quarantine.[21] Greater use of face masks may also be needed to reduce the risk of virus transmission by people during the pre-symptomatic phase of their infections.[22]

At the same time as the above pandemic control measures are implemented, steps need to be taken to reduce impacts of the pandemic on the health system and healthcare workers if successfully achieving elimination is prolonged. Preparation of hospitals is already underway with enhanced infection control measures and sourcing of staff and equipment to increase surge capacity. In particular, health services are working actively to expand intensive care unit (ICU) and ventilator spaces in case there is a need to treat large numbers of patients with respiratory failure.

The control measures will also require a rapid and potentially large expansion of other workforce and support systems (eg, information systems for case and contact management).

The exit path will need to be based on demonstrable high-performing border controls and case and contact follow-up, along with sufficient testing and surveillance to detect a low risk of COVID-19 circulation in the population. Under these circumstances, the 'lockdown' can be gradually relaxed, potentially on a regional basis.

What to do if the elimination strategy fails?

Success with the elimination strategy is far from certain in New Zealand. In the meantime, the country will need to keep accelerating its preparations for a potential shift to the suppression or the mitigation strategy. These preparations could vastly reduce the mortality burden of vulnerable populations (particularly older people and those with chronic conditions[23]). In particular, there could be a 'safe haven' programme to protect such populations in their own homes, institutions and communities. These could be rolled out by city, region and nationally, based on the spread of the pandemic within the country.

Conclusions

New Zealand society has made a large 'upfront' sacrifice in pursuing an elimination strategy. Its actions in the coming weeks will decide if this goal can be achieved. To justify this sacrifice we need to put maximum effort into giving this intervention the best possible chance of success. These are uncharted waters for public health.

The strategy will need to be fine-tuned and enhanced in multiple ways as we learn more about how COVID-19 behaves in the New Zealand setting. To achieve that, we will need to make maximum use of the many science disciplines and technologies we have available to inform and guide our response in innovative ways. The COVID-19 pandemic has also forcefully demonstrated the need for ongoing provision of effective public health infrastructure and resources to ensure that New Zealand is able to protect its population during a severe public health emergency.[24]

Competing interests:
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Trial removal of indwelling urinary catheters in stroke patients: a clinical audit at North Shore Hospital

Dushiyanthi Rasanathan, Xu Wang

ABSTRACT

BACKGROUND: This is a baseline clinical audit looking at indwelling urinary catheter (IDC) use and trial removal of catheter (TROC) in stroke patients. We collected data on stroke patients admitted to North Shore Hospital between 26 November 2018–24 May 2019, who underwent insertion of an IDC as an inpatient. A minority of patients had TROC within the recommended guideline period. A high incidence of urinary tract infection (UTI) was found in this patient population. Insufficient documentation and inappropriate indications for IDC insertion were features noted during this audit. Daily electronic reminders and prompting by all members of the rehabilitation team concerning TROC are important to reduce catheter days and reduce UTI rates.

AIMS: To identify if the trial removal of indwelling urinary catheters (TROC) in stroke patients complies with the 2016 American Heart Association/American Stroke Association (AHA/ASA) AHSA guidelines, and to identify any precipitating factors that prevent compliance with the guidelines.

METHODS: We performed a clinical baseline audit that identified patients who were admitted to the acute stroke ward at North Shore Hospital with a diagnosis of stroke from 26 November 2018–24 May 2019 and had an indwelling urinary catheter (IDC) inserted during their admission. The audit consisted of both retrospective and prospective components. Data was collected on patient demographics, the documented indication for IDC insertion, total number of catheter days, the incidence of UTIs and the outcomes after catheter removal.

RESULTS: A total of 49 patients were included. 4.1% of patients had catheters removed within 24 hours (95% confidence interval: 0.011–0.137). The average number of catheter days before removal of IDC was approximately five days. 24.5% of our patient sample went on to develop a urinary tract infection.

CONCLUSIONS: Insufficient documentation and inappropriate indications for IDC insertion were features noted during this audit. Daily electronic reminders and prompting concerning TROC are important to reduce catheter days and reduce infection rates. Indwelling catheters and associated infections impact the length of hospitalisation, mortality and morbidity of stroke patients.

Indwelling urinary catheters (IDCs) are commonly used in stroke patients; yet they also present unique challenges for this population. It is vital that IDCs are used only when necessary and removed when appropriate to prevent the development of complications. As such, we wanted to investigate whether IDCs were removed within a stated guideline period for stroke patients admitted to the acute stroke ward at North Shore Hospital, Auckland, New Zealand.

To distinguish IDCs from the various other types of urinary catheters, an IDC is defined as a draining tube inserted into the urinary bladder through the urethra. It is connected to a closed collection system. Alternative forms of urinary catheters include intermittent catheterisation, external catheters and suprapubic catheters.[1] An IDC is the most common form of urinary catheterisation.[1]

The indications for appropriate urinary catheterisation include acute urinary retention, bladder outlet obstruction and to improve comfort during end of life cares.[1] Inappropriate indications for IDC insertion include urinary incontinence, monitoring of urine output without a critical need and using catheters to obtain urine samples for diagnostic testing, despite a patient being able to voluntarily void.[1] Priority recommendations for appropriate IDC use include inserting catheters only for appropriate indications and to leave them in place only as long as needed.[2] It is estimated that approximately one quarter of catheterisations are unnecessary.[3]

Stroke patients have a number of risk factors that predispose them to acute urinary retention and thereby requiring urinary catheterisation. Urinary retention, urgency, frequency and incontinence occur in approximately 29–58% of patients after stroke.[2] Bladder dysfunction following a stroke is classically due to interference in the central nervous system control and the coordination of voiding reflexes. Psychological mechanisms can also contribute to these problems. The potential loss of privacy with bladder functioning after a stroke can interfere with normal bladder patterns and subsequently lead to urinary retention, as psychological factors may prevent easy evacuation.[2] Speech dysfunction and alterations in mental status also impair the ability to communicate a voiding problem, which can also induce urinary retention.[4] The impact on continence and dignity that a stroke can cause is an important focus for all members of the stroke rehabilitation team.[3]

Urinary tract infections (UTIs) are the most common form of hospital-acquired infection and are estimated to account for more than 30% of all infections in hospitals.[1] An estimated 80% of UTIs in hospitals are attributable to an IDC.[5] A UTI is the most important adverse outcome of urinary catheter use. Bacteraemia and sepsis can develop in a small proportion of infected patients.[6] As early as the first day after catheterisation, a biofilm develops on both extraluminal and intraluminal surfaces of the catheter, increasing the capability of micro-organisms to adhere to the surfaces and promoting colonisation. This is an important factor in the pathogenesis of many catheter-associated UTIs (CAUTIs).[2] CAUTIs may be caused by exogenous contamination from the hands and equipment of health professionals. Endogenous contamination can occur from nearby internal colonisation of bacteria in a patient.[7] The duration of catheterisation is the most important risk factor for the development of infection.[5] In the general medical population, the risk of UTI is 3–10% per day of catheterisation.[7] The longer an IDC is in place, the greater the likelihood of bacteria and UTI.[6]

A UTI can result in further medical complications for patients who have had a stroke. Stroke patients are particularly prone to developing UTIs due to immunosuppression, bladder dysfunction and increased use of urinary catheters.[3] Studies suggest that ischaemia in the brain may lead to a systemic immunodepression that predisposes patients to infection.[2] A UTI can cause electrolyte disturbances, hypoxia and fevers. These can have a detrimental effect upon the vitality of neurons within the ischaemic penumbra; the area of reversible injured brain tissue around the ischaemic core, thus delaying the recovery of the brain. Fever can alter the blood-brain barrier permeability, increase cerebral metabolic demands and promote acidosis, as well as the release of excitatory amino acids.[5] Fever and the systemic inflammatory response associated with UTIs can thus impair stroke recovery. A population-based study found that the length of inpatient stay was extended by an average of 41% in patients with ischaemic stroke who developed a UTI.[2] Infection is also a risk factor for delirium, which worsens neurological state and adversely affects the length of admission and mortality in stroke patients.[7]

UTI in a stroke patient can impair the process of rehabilitation.[6] UTI and catheter use can prolong the period of immobility for patients as systemic illness, intravenous antibiotics and urinary catheters make it more difficult to begin intensive physical therapy.[2] UTIs are related to undesirable outcomes, including deterioration in neurological state, increased length of hospitalisation and long-term disability.[5] Infections and other adverse effects associated with IDCs therefore lead to increases in patient discomfort, morbidity, mortality and amplifies the economic burden of care.[7] Thus it is vital that IDCs are only used when necessary, and that they are removed as soon as possible.

Aim and objectives

The aim of this audit is to identify if the practice of trial removal of indwelling urinary catheter (TROC) complies with the 2016 American Heart Association/American Stroke Association (AHA/ASA) AHSA guidelines, and to identify any precipitating factors that prevent compliance with the guidelines.

Criteria and standards

Criterion	Standard	Class	Evidence base
Removal of the urinary catheter within 24 hours of insertion, after admission for acute stroke is recommended.	100%	Class I (Benefit>>>risk) Procedure/ treatment SHOULD be performed	Level B

This audit used the 2016 American Heart Association/American Stroke Association (AHA/ASA) Guidelines for Adult Stroke Rehabilitation and Recovery, which states that TROC should be attempted within 24 hours after insertion.[8] The NICE accredited 'National Clinical Guidelines for Stroke' published in 2016 were also consulted, which recommended that people with stroke should not have an IDC inserted unless indicated to relieve urinary retention or when fluid balance is critical.[7]

Methodology

This is a baseline audit that identified patients admitted to the acute stroke ward at North Shore Hospital with a radiological or clinical diagnosis of stroke from 26 November 2018–24 May 2019. The audit consisted of both retrospective and prospective components. The retrospective component covered the period between 26 November 2018–24 February 2019. The nursing handover software program 'Trendcare' was used to identify patients during this period who were admitted to the ward with a stroke and had an IDC inserted during their admission. The prospective aspect of the audit was conducted from 25 February–24 May 2019. This aspect of the audit identified all new patients admitted with a stroke and followed up patients who had an IDC inserted. Patients who had symptoms of UTI and had a mid-stream urine sample indicative of infection were considered to have developed a UTI.

Data was collected from clinical notes, Trendcare and discharge summaries and entered into a Microsoft Excel spreadsheet. The data collected included:

- patient demographics
- the nature of stroke
- date and documented indication of catheter insertion
- number of catheter days (the number of days the patient had a catheter in-situ)
- whether patients went on to develop a UTI
- outcomes of catheter removal
- patient discharge destination

Minor statistical analysis was also conducted using a spreadsheet and associated statistical functions. A 95% confidence interval for the average number of catheter days for our patient sample was estimated using a t-test based method.

Results

A total of 49 patients had an IDC inserted during their admission for stroke during the six-month audit period (n=49).

Table 1: Documented indications for IDC insertion for stroke patients during the audit period.

Documented indication for catheterisation	N/49 (%)
Urinary retention	24 (49.0)
Monitoring for acutely unwell/unstable patient	5 (10.2)
Incontinence	4 (8.2)
Comfort cares	3 (6.1)
Immobility	2 (4.1)
Urgency	1 (2.0)
Not documented/unknown cause	10 (20.4)

Catheter removal within 24 hours happened in only 2 of 49, 4.1% (95% CI 1.1–13.7) of patients. The average number of catheter days for our patient sample before TROC was approximately five days. The mean time to catheter removal was 5 (5.1) days, with a standard deviation of 4.4. The 95% confidence interval for the average number of catheter days before TROC is between 3.5–6.7 days. Because this confidence interval does not include the number 1, indicative of 24 hours, the analysis is significant in showing that we are not TROCing patients according to the AHA/ASA guidelines recommendation of 24 hours.

UTI developed in 12/49 (24.5%) of patients. 29.0% of patients who were TROCd (9/31 patients) were considered to have a failed TROC and underwent reinsertion of an IDC. 32.7% of patients who had an IDC inserted went on to their discharge destination with their IDC in situ. This encompassed 16 patients out of the 49 patients who had an IDC inserted. Discharge destinations were most commonly rehabilitation wards or a private hospital.

Discussion

This audit generated a number of noteworthy conclusions. The most critical of which highlighted that our average period of catheter days before TROC on the stroke ward does not meet the recommended period of 24 hours, as per the AHA/ASA guidelines. A minor portion of our patients with IDC had TROC within 24 hours (4.1%). Of the patients who had an IDC inserted during their time as an inpatient, 24.5% went on to develop UTIs. Concerningly, 29% of patients had failed TROCs. This raises a number of questions regarding exactly when it is appropriate to TROC a patient.

Waitemata District Health Board's guidelines concerning catheter management denote how a patient's risk factors for an unsuccessful TROC include difficulty voiding prior to ICD insertion, chronic retention, diabetes mellitus, Parkinson's disease and difficulty with catheter insertion.[10] Situational risk factors for unsuccessful TROC include having unrelieved pain, having had anticholinergic drugs such as Oxybutynin in the last 10 hours, recent surgery, constipation and ongoing haematuria with clots. Removing an IDC for a patient who cannot empty their bladder increases their overall number of catheter days, as catheters need to be re-inserted and monitored.[11]

A key feature noted during this audit was the issue of insufficient documentation of the indications for IDC insertion. Waitemata DHB uses specifically designed IDC insertion stickers for health professionals to complete in clinical notes. 20.4% of the patients' notes in this audit did not have any documented indication for IDC. Several also stated an inappropriate reason for catheterisation, including urinary incontinence, agitation and patient discomfort. This appears to be a universal issue as the literature commonly notes inappropriate documentation of the indications for an IDC and the use of limited clinical reasoning to determine if an IDC is required for a patient.[11] Understandably, there are circumstances where IDCs are used for patient comfort and nursing convenience. These include IDC insertion for terminally ill patients which can ease the inconvenience, pain and hygiene difficulties related to uncontrolled voiding. A competing pressure also exists on nurses to mitigate the development of hospital-acquired pressure ulcers. This can lead to the perception that urinary catheters reduce the risk of skin breakdown, despite IDCs rarely being appropriate for patients with incontinence and sacral wounds.[12] Completion of these IDC stickers in the clinical notes can however, encourage appropriate clinical reasoning for the appropriateness of IDC insertion. They can also serve to remind the multidisciplinary team to question when a catheter is no longer indicated and consider removal.

Another notable factor that contributed to the increase in catheter days for our patients was the practice of TROC on the wards between 6–7am. There were several instances where a TROC was requested on the previous day, with no subsequent TROC occurring the next day. The TROC would then be completed the following day as the time period for TROC had passed. There were also numerous patients for whom a TROC was decided during the morning ward round, around 0830 for example, who were only TROCd the following day at 0600. This rendered the patients with another catheter day and thus with a proportional increase in risk of infection. Coleman Gross' study did not show a difference in voiding based on

whether the catheter was removed at 7am or at 10pm in their sample of stroke rehabilitation patients.[10] Aiming for the removal of IDC between midnight and midday is preferable as it entails time for adequate assessment during the day and the availability of trained staff to re-catheterise if needed. The TROC period of 0600–0700 often results in another catheter day for patients, when it may have been possible to TROC them later in the morning, while there is still time to monitor patients with sufficient numbers of staff.

As UTIs are such a significant cause of healthcare infection, other measures to reduce infection, aside from limiting catheter use and removing catheters as soon as possible, should be briefly considered. Intervention strategies that have been previously described in the literature include prophylactic antibiotics, anti-septic impregnated catheters and quality improvement interventions to reduce inappropriate catheterisation.[2] Stat dose peri-catheterisation antibiotic prophylaxis is generally only indicated in high-risk patients, including those with recent artificial joint replacements, mechanical heart valves, previous infective endocarditis, recurrent UTIs, immunosuppressed patients and patients who have needed recurrent attempts to insert the catheter. Low-quality evidence has suggested little to no benefit in antimicrobial prophylaxis for patients undergoing urinary catheterisation.[1] A recent literature review showed many of the studies addressing strategies to prevent CAUTI were not of sufficient quality to allow conclusions to be formed regarding these interventions.[1] The literature is consistent in that limiting catheter use and minimising the duration of catheterisation are the primary strategies for CAUTI prevention.[5]

The most significant feature noted during this audit and also reflected in the literature is the importance of the medical team being aware of IDCs in their patients. Within the rotating members of a medical team, physicians may not even recognise which patients have IDCs.[14] Catheters are often used and managed inappropriately, and doctors are often unaware that urinary catheterisation has been excessively prolonged in patients until a catheter-related complication occurs.[9] Unlike an intravenous luer which is removed when a patient is deemed ready for purely oral fluids and medications, the only way to determine if a patient can empty their bladder successfully after using an IDC is to remove the catheter itself.[11] Furthermore, the presence of a urinary catheter is not always documented in clinical notes. This audit used the nursing handover software 'Trendcare' because it was the only clinical software that specifically mentions which patients on the ward had IDCs. This software is not used by members of the medical team. This highlights the limited involvement that the medical teams can have with the management of IDCs.

To reduce the number of catheter days for patients, Meddings et al describes the lifecycle of the urinary catheter and the four steps or checkpoints in order to remove a catheter. Firstly, the physician must recognise that their patient has an IDC. Secondly, the physician identifies that the IDC is no longer needed or indicated. Thirdly the clinician documents or instructs the need to TROC. Finally, the TROC occurs.[12] These four steps all take time, potentially rendering a patient with an increasing number of catheter days. These four steps also provide points of intervention to fast-track this process. The removal of urinary catheters should be assessed on a daily basis.[10]

The literature highlights the importance of ongoing reminders, both electronically and by nursing and MDT staff to the medical team with regards to the appropriate time for TROC. Interventions trialled previously include stop orders directed at physicians, requiring an order to be renewed or discontinued on the basis of review at regular intervals.[12] A notification on our Clinical Portal system, for example on the 'Inpatient Snapshot' page which is reviewed at least daily by the medical team, stating that the patient has an IDC could be an effective reminder to TROC when appropriate. Parry et al staged an intervention at Stamford Hospital, Connecticut whereby nurses led the prompting and auditing for TROC, with use of a nurse-directed urinary catheter removal protocol. This was an extremely successful intervention which saw a 50% reduction in catheter use and a 70% reduction in CAUTIs throughout the hospital. It highlighted the importance of a multidisciplinary approach to the management of IDCs. The intervention caused a culture

change for the facility, enhancing teamwork and ownership among disciplines involved in the care of patients with IDCs.[15]

The limitations of this audit include the small sample size of the audit, limiting the propensity for greater statistical analysis due to the potential for significant random error. A longer audit period would enable the inclusion of more patients, increasing the possibilities for more extensive statistical analysis. There was also limited information on the patients' follow up urinary patterns, including whether patients required another IDC at their discharge destination. Furthermore, the patients who were discharged with a catheter in situ were not followed up in terms of TROC and UTI outcomes. The measurement of catheter days in the retrospective component of our audit was also dependent on the accuracy of nursing documentation in the Trendcare program.

The main goals in the acute stroke unit include commencing early rehabilitation, as well as the prevention, diagnosis and management of stroke complications.[3] There is limited high-quality data on the frequency, type, duration and indications for urinary catheter use in stroke patients. This is attributable to poor clinical documentation and because the topic has previously received little focus. Preventing UTI after stroke can reduce length of hospitalisation and decrease the cost of care.[2] The simple measures of eliminating the use and duration of unnecessary IDCs have the potential to decrease the incidence of UTI, reduce the time to mobilisation, improve patient comfort and ultimately result in improved outcomes for our stroke patients.

Conclusion and recommendations

- 4.1% of the sample had their IDCs removed within the recommended 24 hours. The analysis is significant in showing that we are not removing catheters in patients according to the AHA/ASA guidelines recommendation of 24 hours.
- The average number of catheter days for our patient sample before removal of IDC was approximately five days.
- 24.5% of our patient sample went on to develop a urinary tract infection. This is concerning for the adverse impact that infections have upon the rehabilitation process of stroke patients.
- Consider if a patient has an appropriate clinical indication for urinary catheterisation and document this, before inserting an IDC.
- Daily electronic reminders and prompting by all members of rehabilitation team concerning TROC are important to reduce catheter days and reduce infection rates.
- Limited literature exists concerning IDC removal in stroke patients. There is significant scope for further research.
- Recommendations for re-audit include having a longer time-period to capture a greater sample size. A re-audit in one year's time is recommended to examine the rates of TROC within the guidelines, the rates of UTI and the rates of failed TROC in comparison to this baseline audit.

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Nil.

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A persuasive approach to antimicrobial stewardship in Christchurch hospitals produced a sustained decrease in intravenous clarithromycin dosing and expenditure via a switch to azithromycin orally

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ABSTRACT

AIMS: To assess a persuasive multimodel approach to decreasing unnecessary intravenous (IV) clarithromycin use for community-acquired pneumonia (CAP) in Canterbury District Health Board (CDHB) hospitals.

METHODS: In December 2013, CDHB guidelines for empiric treatment of CAP changed to prioritise oral azithromycin over IV clarithromycin. The multimodel approach we used to implement this change included obtaining stakeholder agreement, improved guidelines access, education and pharmacist support. The impact of the intervention was evaluated by comparing macrolide usage and expenditure for the four years pre- and post-intervention.

RESULTS: Mean annual clarithromycin IV use decreased by 72% from 6.4 to 1.8 defined daily doses (DDDs) per 1,000 occupied bed days (OBDs) post-intervention, while oral azithromycin increased by 833% (4.2 to 39.2 DDDs per 1,000 OBDs). Concurrently, oral clarithromycin use decreased by 91% (32.9 to 2.9 DDDs per 1,000 OBDs), and roxithromycin by 71% (17.0 to 5.0 DDDs per 1,000 OBDs). Mean annual total macrolide use decreased by 21% (68.2 to 53.9 DDDs per 1,000 OBDs), while expenditure decreased by 69% mainly through avoided IV administration.

CONCLUSIONS: A persuasive multimodel approach to support adoption of CAP guidelines produced a sustained decrease in IV clarithromycin use, which may have clinical benefits such as reduced occurrence of catheter-related complications.

Maximising the use of oral rather than intravenous (IV) antimicrobial agents is one of the safest and most cost-effective interventions available in antimicrobial stewardship (AMS), provided that an effective concentration reaches the site of infection with oral dosing. Advantages of the oral route include avoidance of IV line-related infections, increased patient mobility, reduced nursing time and earlier discharge from hospital.[1] Our unpublished internal audit (2011) of community-acquired pneumonia (CAP) management showed that many clinically stable patients unnecessarily received a macrolide via the IV route. Possible reasons for this include delays in clinical

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reassessment of patient progress, lack of clinical confidence in oral formulations, fear about patient complaints and medical team dynamics.[2,3] Local prescribers were particularly concerned that the oral regimen for CAP should be highly effective for treating Legionnaires' disease because of the high rates of *Legionella longbeachae* infection in the region.[4,5]

In 2013 our AMS committee recommended that the Canterbury District Health Board (CDHB) hospital guidelines for management of CAP include oral azithromycin (rather than oral roxithromycin or 'defaulting' to IV clarithromycin) when an agent active against *Legionella* spp., was indicated. The ability to prescribe azithromycin for inpatient management of CAP had been facilitated by the Pharmaceutical Management Agency ('PHARMAC') funding azithromycin in the community (five days' maximum per prescription for any indication) in December 2012 (improving accessibility and reducing cost), as well as in hospital. Clarithromycin IV was retained in the guideline for patients with severe disease and those unable to take medicines orally (Table 1). The committee gave the task of leading this change to a newly appointed AMS pharmacist. Key stakeholders including senior respiratory, general medicine and emergency medicine physicians agreed to the changes prior to release of the guidelines in December 2013. Here, we describe the collection of persuasive strategies used to facilitate adoption of the new CAP guidelines in our hospitals, together with an evaluation of the impact of this initiative on macrolide usage and expenditure.

Table 1: Empirical antimicrobial guideline for community-acquired pneumonia (CAP) in Canterbury District Health Board (CDHB) hospitals (2013), with key changes from the previous version identified.

CAP severity	New guideline (published December 2013)	Key changes from previous version
Mild (CURB-65 0-1)	amoxicillin PO 500mg three times daily *or* azithromycin PO 500mg once daily[a]	azithromycin replaced roxithromycin
Moderate (CURB-65 2)	amoxicillin IV 1g every 8 hours *Add, if risk factors for Legionella spp.,* azithromycin PO 500mg once daily[a] *or* doxycycline PO 200mg once daily	oral azithromycin or doxycycline replaced IV clarithromycin
Severe (CURB-65 3-4)	amoxicillin+clavulanate IV 1.2g every 8 hours *and either* clarithromycin IV 500mg every 12 hours *or* azithromycin PO 500mg once daily	new recommendation to give only one or two clarithromycin IV doses before changing to oral azithromycin
Extremely severe[b] (CURB-65 5)	ceftriaxone IV 2g every 12 hours *and* gentamicin IV every 24 hours *and* clarithromycin IV 500mg every 12 hours	

CURB-65 pneumonia severity score, which predicts mortality based on assignment of points for **C**onfusion, **U**rea concentration, **R**espiratory rate, **B**lood pressure and age (65 years or older).[20]
IV, intravenous; PO, per os.
a. Acceptable alternative azithromycin regimen for mild to moderate CAP was 500mg initially then 250mg once each day for four days (both regimens comprised 1,500mg per course).
b. CDHB guidelines for immunocompetent patients with severe CAP treated in the intensive care unit differ and comprised ciprofloxacin IV plus amoxicillin+clavulanic IV.

Methods

Setting

CDHB provides government-funded healthcare services for a population of ~570,000 people in Canterbury, New Zealand.[6] The Christchurch Hospital campus, which is the largest CDHB facility at ~800 beds,[7] offers a full range of inpatient and outpatient services, and receives more than 95% of acute admissions for CDHB.

The CDHB hospital AMS committee has multidisciplinary (pharmacists, junior and senior doctors, nurses and laboratory scientists) membership from services that include Infectious Diseases, Pharmacy, Clinical Microbiology and Clinical Pharmacology. One of its core functions is to produce hospital guidelines for management of common infections. The committee primarily uses persuasive rather than restrictive approaches to influence antimicrobial prescribing. Persuasive measures include local consensus building processes and discussion with opinion leaders during guideline development as well as multimodal clinician education and verbal reminders from pharmacists.[8] There were some restrictive interventions in place prior to the intervention. These were selective laboratory reporting of susceptibilities to respiratory pathogens,[8] with some external antimicrobial restrictions applied by PHARMAC[9]. For example, levofloxacin is not publicly funded at all in New Zealand while moxifloxacin is only funded for specific subsets of patients with CAP such as those with multiresistant *Streptococcus pneumoniae*.

Multimodel approach to facilitate guidelines adoption

1. Guideline access: Access to CDHB antimicrobial guidelines was improved via a new easily searchable electronic format that replaced the existing Portable Document Format (PDF) and was accessible on mobile devices (tablets and phones) as well as computers.[10] Hardcopies (book and poster) of the guideline were also available in clinical areas.
2. Education: Verbal education sessions for medical, nursing and pharmacy staff were conducted by the AMS pharmacist. These comprised ~20 brief (10 minute) teaching sessions to staff in key clinical areas, such as the general medical wards and the emergency department. The presentations outlined the guideline changes as well as the relative advantages and disadvantages of IV clarithromycin versus oral azithromycin including consideration of IV catheter-related complications, drug interactions, dosing regimen and cost. An infectious diseases physician participated in the education sessions when the audience included senior medical doctors. Written information to support key messages comprised bulletins (single-sided A4 documents) disseminated electronically to clinical staff at baseline (December 2013) and at four months into the initiative (April 2014) highlighting the initial progress made, along with a poster placed in clinical areas.
3. Access to macrolides: Clarithromycin IV vials were removed from most wards except from locations such as the emergency department that need rapid access for acutely unwell patients. The intent was to have most requests for clarithromycin IV screened against the guidelines by the pharmacy department for appropriateness prior to supply. Prescriptions that appeared inconsistent with the guidelines would be discussed with the prescribing medical team, but clarithromycin IV could still be dispensed even if the intended use was not compliant with guidelines. Access to azithromycin 250mg tablets was assisted by adding it to clinical areas as a 'stock' item.
4. Ongoing support by healthcare providers: The specialist AMS pharmacist led this initiative, supported by infectious diseases physician champions who also worked in general medicine, likely assisting with changing practice. Additionally, pharmacy staff in clinical areas and the dispensary actively supported this initiative by engaging with prescribers when clarithromycin IV use appeared inconsistent with the guidelines, and by promoting an early switch to oral azithromycin.

Macrolide usage and expenditure

Data on adult inpatient macrolide usage and expenditure at the four main CDHB hospitals—Christchurch, Christchurch Women's, Burwood and the Princess Margaret—were extracted from hospital pharmacy dispensing software (ePharmacy, v1.7, DXC Technology, VA, US) into Microsoft Excel™. The time periods evaluated were the four years before (2010–2013) and after (2014–2017) the guideline change. Data for adult inpatients were included. Paediatric and psychiatric inpatients, and all outpatient areas were excluded. All dosage formulations (IV, and solids and liquids for oral administration) of macrolides used at CDHB hospitals were included (Table 2). Usage was expressed as defined daily doses (DDDs) per 1,000 occupied bed days (OBDs) for the individual macrolides, and for all macrolides combined.[11]

Table 2: Mean annual macrolide usage and expenditure for adult inpatients in Canterbury District Health Board (CDHB) hospitals for the four years before (2010–2013) and after (2014–2017) the changes in empiric antimicrobial guidelines for community-acquired pneumonia (CAP). Oral formulations (tablets and suspension) for each macrolide are combined, as relevant.

Formulations in use at CDHB hospitals		**DDDs per 1,000 OBDs (mean usage per year)**			**Expenditure (unadjusted mean cost in $NZ per year)**		
Form	**Strength (cost per unit*)**	**2010–2013**	**2014–2017**	**% Change**	**2010–2013**	**2014–2017**	**% Change**
Azithromycin							
Tab Susp	250mg ($0.30–$0.35) 500mg ($0.53–$3.12)[a] 200mg/5mL ($6.60–$12.50)[b]	4.2	39.2	↑ 833%	$1,035	$4,133	↑ 300%
Clarithromycin							
Vial	500mg ($12.04–$30.00)[c]	6.4	1.8	↓ 72%	$106,734	$23,967	↓ 78%
Tablet Susp	250mg ($0.28–$0.58)[d] 500mg ($0.74–$1.75)[e] 125mg/5mL ($23.12) 250mg/5mL ($23.12)	32.9	2.9	↓ 91%	$12,018	$710	↓ 94%
Erythromycin**							
Vial	1g ($10.99–$16.00)[f]	2.5	2.5	↔	$8,243	$10,559	↑ 28%
Tablet Susp	250mg ($0.23) 400mg ($0.18) 500mg ($0.47) 200mg/5mL ($4.57–$5.18) 400mg/5mL ($6.04–$6.99)	5.1	2.6	↓ 49%	$1,438	$748	↓ 48%
Roxithromycin							
Tablet	150mg ($0.15–$0.19) 300mg ($0.29–$0.35)	17.0	5.0	↓ 71%	$1,706	$409	↓ 76%
Total		**68.2**	**53.9**	**↓ 21%**	**$131,175**	**$40,526**	**↓ 69%**

DDD, defined daily doses; OBDs, occupied bed days; Susp, suspension; $NZ, New Zealand dollars.
*Prices were CDHB hospital pharmacy acquisition costs (unpublished) per unit [tablet, vial or bottle (liquid)] until March 2013 when Pharmaceutical Management Agency (PHARMAC) subsidy prices were used.[9] Dates for a price change greater than 20% were as follows: a: decrease from $3.12 to $0.63 February 2013, and to $0.53 July 2015; b: increase from $6.60 to $12.50 per 15mL August 2015; c: decrease from $30.00 to $20.40 July 2015, and to $12.04 December 2017; d: decrease from $0.58 to $0.28 June 2014; e: decrease from $1.75 to $0.82 February 2012, and to $0.74 July 2014; f: increase from $10.99 to $16.00 March 2013.
**Erythromycin salts were lactobionate (IV), stearate (250mg, 500mg) and ethylsuccinate (400mg, 200mg/5mL, 400mg/5mL).

Expenditure was determined in New Zealand dollars ($NZ) using the pharmacy purchasing price per unit until 1 March 2013, after which PHARMAC subsidy prices were used.[9] Costs of consumables for IV administration were set as $NZ8.49 per dose for a giving set (Alaris secondary set, CareFusion, Switzerland), plus two sodium chloride 0.9% infusion bags for the dose (250mL) and for the post-dose flush (100mL). Other direct costs such as those of water for injection, syringes and needles for reconstitution, and indirect costs such as nursing time were not included.

Results

Macrolide usage and expenditure

Mean annual macrolide usage for the four years before and after commencement of this initiative are shown in Figure 1 and Table 2. Overall mean annual macrolide use, as DDDs per 1,000 OBDs, decreased by 21% post-initiative due to reductions in use of clarithromycin IV (by 72%), along with decreases in use of oral clarithromycin (by 91%), erythromycin (by 49%) and roxithromycin (by 71%). These reductions were offset by a substantial increase in use of azithromycin (by 833%). The mean number of IV clarithromycin doses used (not standardised against OBDs) annually was 3,601 pre-initiative and 985 post-initiative. This equated to approximately 2,617 avoided IV clarithromycin doses each year. There was no change in the mean annual usage of erythromycin IV, which is the other IV macrolide in use at CDHB hospitals.

Mean annual expenditure for the four years pre- and post-initiative are shown in Figure 2 and Table 2. Overall, mean expenditure on macrolides decreased by 69% ($NZ90,649) from $NZ131,175 per annum before the initiative to $NZ40,526 per annum after the initiative. Most of this resulted from savings attached to avoided use of clarithromycin IV and orally ($NZ82,767 and $NZ11,308 saved annually, respectively), and was offset by a small increase in costs associated with azithromycin orally ($NZ3,098). The annual savings ($NZ82,767) from avoided use of clarithromycin IV were greater ($NZ104,000) if giving sets and infusion bags are also considered (data not shown).

Figure 1: Macrolide usage per quarter in adult inpatients at four CDHB hospitals (2010–2017). Data presented as individual (combined oral formulations, and IV vials) and total macrolides, as defined daily doses (DDDs) per 1,000 occupied bed days (OBDs). Erythromycin not shown.

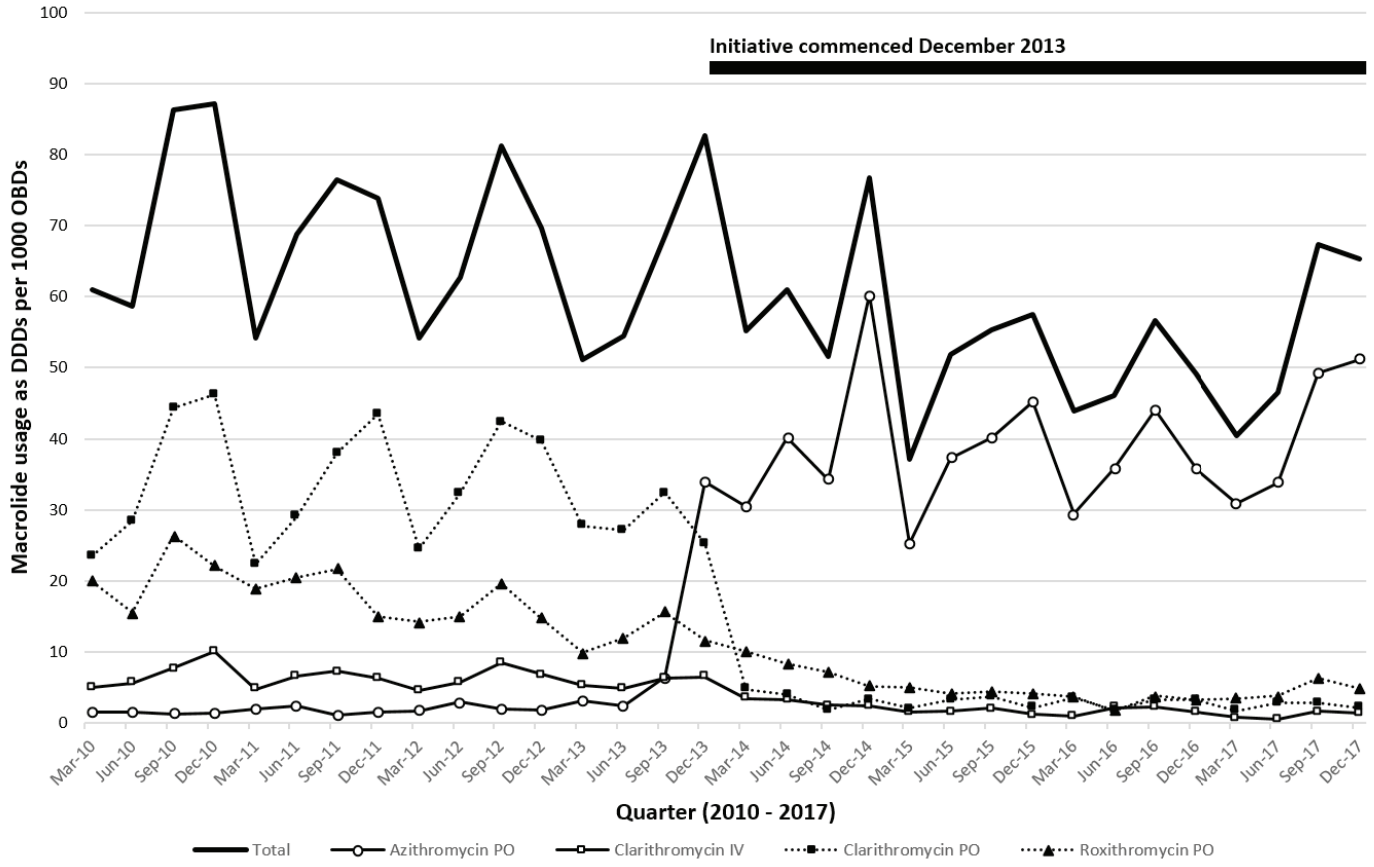
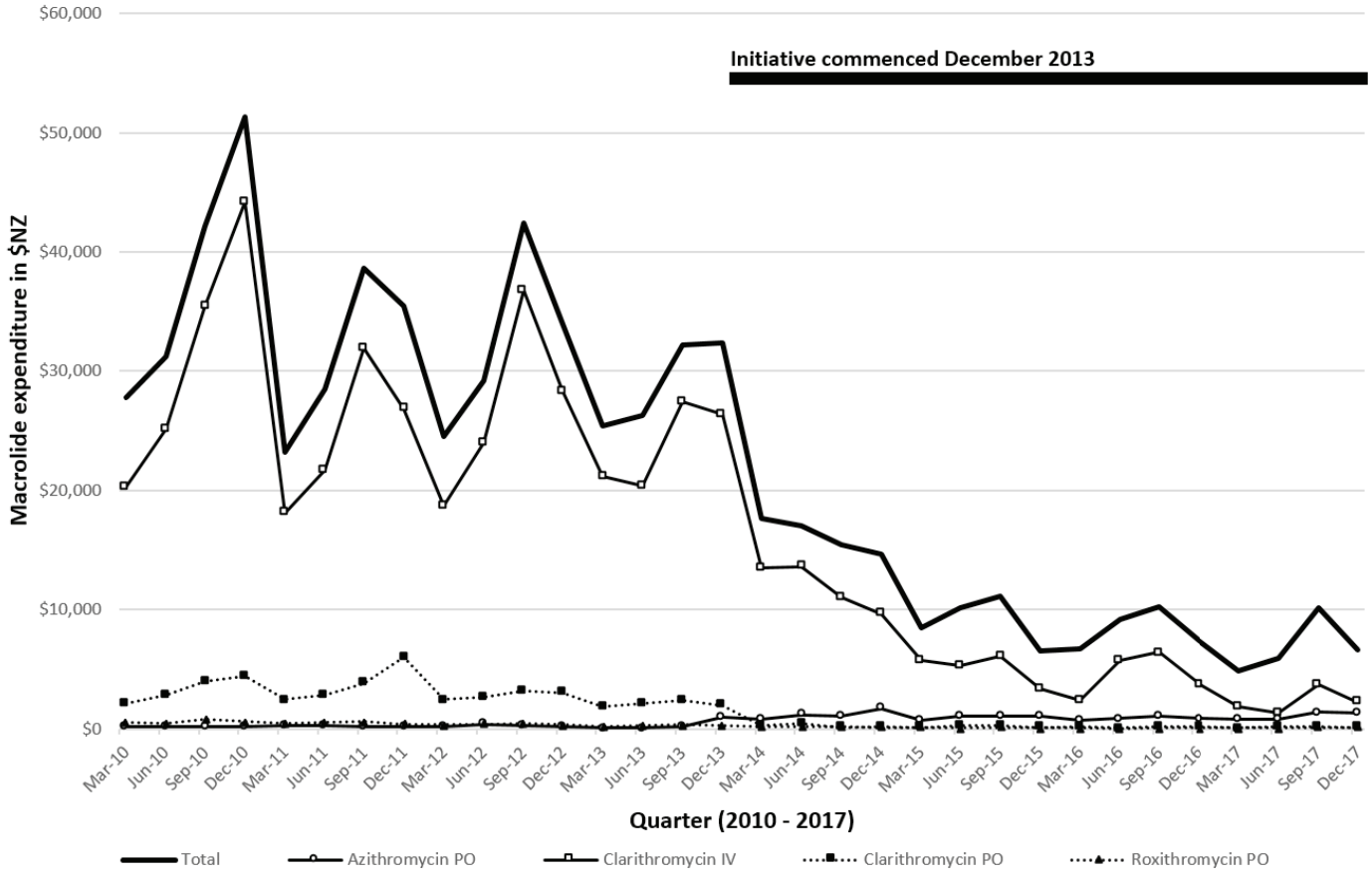


Figure 2: Macrolide expenditure per quarter in adult inpatients at four CDHB hospitals (2010–2017). Data presented as individual (combined oral formulations, and IV vials) and total macrolides, in New Zealand dollars. Erythromycin not shown.



Discussion

This initiative demonstrates that a collection of persuasive measures can produce immediate and sustained changes in antimicrobial prescribing practice with substantial cost savings. In this case, a multipronged campaign focusing on oral azithromycin as the preferred macrolide for CAP resulted in a ~70% decrease in use of both clarithromycin IV and roxithromycin PO. With the mass shifts away from use of other macrolides at CDHB use of azithromycin increased by ~800% because of the low starting point. The large decrease (~90%) in use of oral clarithromycin was likely because it had been used as the logical follow-on to clarithromycin IV.

This initiative had strong support from medical staff who were confident in the efficacy of azithromycin in Legionnaires' disease.[12] Routine polymerase chain reaction testing of lower respiratory specimens for *Legionella* spp., commenced in 2010, which was prior to our initiative.[5]

While not directly involved in the macrolide initiative, our guideline changes for CURB-2 pneumonia also included doxycycline as an alternative to oral azithromycin when cover against *Legionella* spp., was required. Doxycycline usage (reported briefly for completeness) increased from around 16–17 per 1,000 OBDs pre-initiative to around 20–23 DDDs per 1,000 OBDs post-intiative. However, we recently changed our CAP guidelines to cease recommending doxycycline for *Legionella* spp., as local research suggested it may be ineffective.[13]

The readily quantifiable benefits of our initiative were mainly through avoided IV doses (~2,600 annually). The direct cost savings (drug plus some consumables) of ~$NZ90,000 point to the ability of AMS programmes to generate financial savings, potentially covering any investment in resourcing.[14] The clinical benefits of appropriate avoided IV antimicrobial administration include reduced complications from IV access, shorter hospital length

of stay and a lower need for outpatient parenteral antimicrobial therapy.[1] A further benefit of the shift away from clarithromycin (IV and PO) is that azithromycin does not inhibit drug metabolism by cytochrome P450 3A appreciably, and thus carries a much lower potential for adverse drug interactions.[15] We have not made any estimate of the administration, health or cost benefits of this initiative, other than those related directly to drug expenditure. However, it is probable that these extend beyond those presented here.

We cannot determine the relevant weightings of the various components of our multimodel initiative (specialist AMS pharmacist, physician champions, stakeholder support, multifaceted and repeated education strategies, and ongoing pharmacy involvement) in terms of their contribution to its overall success. However, it was largely a 'front-loaded' approach that was completed within six months. One factor that we believe was integral to its success was obtaining the support of senior clinicians from relevant specialties prior to implementation, and ensuring that there were multiple opportunities (verbal education sessions plus memos, bulletins, posters) for senior clinicians not involved in the initial guideline development to become aware of the changes. This recognises the role of 'prescribing etiquette' (related to medical hierarchy) in antimicrobial prescribing behaviours within clinical teams, and the ability of healthcare leaders to influence the success of a quality improvement initiative.[3] The improved efficacy of azithromycin compared with other macrolides has been affirmed since then which may contribute to the sustained acceptance of the regimen.[16]

The limitations of this work relate primarily to the rather blunt mechanism for assessing macrolide usage and patient outcomes. First, our data on macrolide usage were extracted from CDHB hospital pharmacy dispensing software, which is a composite of dispensings to individual patients and to clinical areas. The assumption that dispensings to clinical areas (eg, wards) match patient usage is often applied in hospital settings,[17] but is clearly several steps away from administrations to patients. Second, we assumed that CAP was the dominant indication for macrolide use in hospitalised patients at CDHB. This seems likely from the bulk shifts in macrolide usage associated with our initiative, but some other infective (eg, atypical mycobacterial infections) and non-infective (eg, prokinetic and anti-inflammatory effects) indications will also be in play. Third, an external restrictive element for access to clarithromycin IV was applied on 1 July 2013, with PHARMAC restricting clarithromycin IV to second-line treatment of CAP until 1 June 2015.[18] While these restrictions added a useful 'argument' to drive a change in prescribing, the shift in macrolide prescribing coincided with our initiative rather than with initiation of the restrictions. Finally, this and other persuasive initiatives at CDHB[19] may have been successful, in part, because of a long history of prioritising a collegial approach over removing the prescriber's autonomy with enforced antimicrobial restrictions. On this basis, it should be noted that while restrictive interventions may produce a swifter change in antimicrobial prescribing, both persuasive and restrictive approaches produce a comparable effect at 12 months.[8]

In conclusion, we demonstrated that a multipronged initiative designed to improve adoption of antimicrobial guidelines can produce a substantial and sustained change in prescribing. In particular, we did not use formal behaviour change techniques such as audit and feedback to individual teams or prescribers. Rather, the aim was to create an enabling environment with which to change clinical practice.

Competing interests:
Dr Werno reports that she is a Member of the Anti-Infective subcommittee, Pharmacology and Therapeutics Advisory Committee (PTAC), PHARMAC (www.pharmac.health.nz).

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On the use of a new monocular-indirect ophthalmoscope for retinal photography in a primary care setting

Aqeeda Singh, Kirsten Cheyne, Graham Wilson, Mary Jane Sime, Sheng Chiong Hong

ABSTRACT

AIM: There is consensus among general practitioners regarding the difficulty of direct ophthalmoscopy. Hence, there is increasing interest in smartphone-based ophthalmoscopes; the New Zealand-made oDocs Nun ophthalmoscope is one such device, released in November 2018. This study aims to subjectively assess the quality of the images captured with it in order to determine the feasibility of its use in a primary care setting.

METHOD: Twenty-eight general practitioners (GPs) from different practices throughout New Zealand agreed to participate in this prospective observational study and were sent an oDocs Nun ophthalmoscope. Using the device, clinicians took retinal photographs of patients who presented with visual complaints and uploaded one image per eye onto a database. Three hundred and fifty-seven photographs were collated and rated by four professionals (two ophthalmologists and two optometrists) on the basis of image quality and the anatomical features visible.

RESULTS: On a Likert scale from 1 (poor quality) to 4 (very good quality), the median and mode values for each professional's rating of all photographs were both 2. On average, 94.5% of the photographs were deemed to have visible optic discs and 50.0% to have visible maculae adequate for detecting an abnormality. Pairwise comparison showed 93.7% agreement among the four professionals for optic disc visibility, and 74.2% agreement for macula visibility.

CONCLUSION: The oDocs Nun is a promising tool which GPs could use to circumvent the challenges associated with direct ophthalmoscopy. With appropriate training to ensure proficiency, it may have a valuable role in telemedicine and tele-referral.

In 1851, Professor von Helmholtz revolutionised the ophthalmoscope, an instrument which is an indispensable tool for examination of the human retina.[1,2] It is a small-scale Galilean telescope, where the patient's refractive media, namely the cornea and the lens, act as the objective lens and the pin hole acts as the eye piece; the result is a magnified image of the retina but with a significantly reduced field of view.[3,4] The modern direct ophthalmoscope, such as those manufactured by Welch Allyn (Hill-Rom Services Inc, Alabama, US) and Heine (HEINE Optotechnik, Herrsching, Germany) are based on the above optical principle. It is widely agreed among primary care clinicians that the modern direct ophthalmoscope is difficult to use and requires a certain level of proficiency.[5,6] Direct ophthalmoscopy is an old technique with multiple inadequacies, which are contributing to its demise, such as its limited field of view, extreme proximity to the patient, and the steep learning curve required to use it accurately. These factors have made the direct ophthalmoscope a poorly designed instrument for

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mass-uses; for example, emergency ocular telemedicine or the diabetic retinopathy screening programme.[5,7,8]

To address the aforementioned challenges of using the direct ophthalmoscope, Welch Allyn launched the PanOptic ophthalmoscope in the early 2000s. The product is generally well received by the clinical community; the device offers a wider field of view and allows a smartphone adapter to be attached to acquire retinal photographs.[9] However, the maximum field of view in dilated eyes is only 25° and is deemed to be inadequate for detecting some retinal diseases, such as diabetic retinopathy, age-related macular degeneration, retinopathy of prematurity, and peripheral retinal tear or detachment.[10–12] The company also launched an iPhone (Apple Inc, California, US) adapter called iExaminer that would allow clinicians to acquire images of the retina. Since then, there have been at least three known regulatory-approved smartphone ophthalmoscopes launched by different companies. Peek Retina (Peek Vision Inc, UK) and D-Eye (D-Eye Care, Italy) are smartphone ophthalmoscopes based on the same principles of direct ophthalmoscopes. These devices are also limited by their narrow field of view ranging from 10° to 20° field of view.[13] Volk (Volk Inc, US) released a smartphone-based ophthalmoscope (Volk iNview) with a larger field of view (45°); however, there is limited clinical evidence of its quality and actual performance.[14,15] Furthermore, the device is designed to fit only the older generations of iPhone devices.

A new ophthalmoscope, based on the principle of indirect monocular ophthalmoscopy, has been released by oDocs Eye Care (oDocs Eye Care Limited, New Zealand).[16] The company claims that the device is capable of acquiring high-quality retinal photographs with a field of view of up to 40° in eyes with a 6mm pupil and above, or 15° in non-mydriatic pupils as small as 2mm. Unlike the other smartphone ophthalmoscopes, the oDocs nun ophthalmoscope's phone adapter is compatible with a wider range of smartphones including those from Android (Alphabet Inc, US) and Apple. The device can be used in conjunction with a smartphone for retinal image and video acquisition for clinical photo-documentation and telemedicine.

The rationale of this study is to subjectively determine the quality of retinal photographs acquired with the oDocs nun ophthalmoscope in a primary care setting by general practitioners (GPs), and see if anatomical regions of the human retina are identifiable in those photographs. It aims to assess if the oDocs Nun is a feasible tool to capture retinal images in a real-world clinical setting where patients present with ophthalmic problems, with implications for telemedicine and tele-referral.

Methods

This was a prospective and observational study designed to subjectively assess the quality of the retinal photographs acquired through the oDocs nun ophthalmoscope in a primary care setting. The study was approved by the University of Otago Human Ethics Committee. Māori consultation was carried out with Ngāi Tahu and Ngati Porou.

Participants and study members

A research participation invitation was sent to 52 general practices throughout New Zealand. A total of 28 general practitioners agreed to participate in the study. At the time of the study, the physicians were all practising and registered with the Royal New Zealand College of General Practitioners.

Study members were recruited from patients who presented to the primary care practices with visual complaints. Patients who fulfilled the study criteria were given the opportunity to participate in this study. The study criteria are listed in Table 1.

Clinical protocol

The participating clinicians received standard training protocol, which included reading the user manual of the device, watching a two-minute training video, and practices on fake eyes. The clinicians were allowed to practise the skill once they felt confident and competent in using the ophthalmoscope.

Patients who were accepted into the study had the symptomatic eye dilated with tropicamide 1%. The clinician instilled one drop of tropicamide 1% into the patient's eye. The patients were then asked to wait in the waiting room for at least 20 minutes. The clinician then used the video function of the phone to acquire a live video of the retina

Table 1: Inclusion and exclusion criteria for study participants.

Inclusion criteria	Exclusion criteria
1.1 Patient with visual symptoms as below: Visual disturbances (blurry vision, loss of vision or visual field) Other symptoms: Photopsia, floaters, aniseikonia, distortion Ocular pain	2.1 Patient with media opacities such as clinically significant cataract, corneal ulcers or scars.
1.2 Patients aged between 18 and 85 years old.	2.2 Patient incapable of giving informed consent.
1.3 Patients with clinical indications for pharmacological dilated retinal examination (as per criteria 1.1).	2.3 Patient with contraindications for pharmacological dilation. These include known history of narrow angle, angle closure glaucoma, and adverse drug reaction to tropicamide.
1.4 Patients capable of following orders for verbal commands such as direction of gaze.	2.4 Patient physically or mentally incapable of following commands. These include patients with photophobia and blepharospasm.

from which still photographs were extracted for analysis.

The clinician chose only one still image per eye to upload. The image selected was requested to be of the highest image quality, showing the widest field of view, and including the posterior pole of the human retina covering both the optic disc and the macula.

Smartphones and depository of the photographs

The smartphones used in the study were either iPhone 7 or iPhone 8. The photographs were stored on password-protected smartphones and transferred to a password-protected hard drive at the conclusion of the study.

Data protection and storage

Transfer of data between the GPs and researchers was done with encrypted technology. Clinicians uploaded the selected photographs onto Microsoft Azure (Microsoft Corp, US), an end-to-end encryption storage platform. Microsoft Azure supports HIPAA compliance, which can be regarded as equivalent to the New Zealand HIPC requirement.[17,18]

Photographs used were anonymised. Information such as name, date of birth, gender and age were collected for epidemiological purposes but will not be linked or made publicly available. Protocols for data management and collection were compliant to the Health Information Privacy Code 1994.

Rating of the photographs

Four experienced ophthalmic professionals (two general ophthalmologists and two optometrists) were involved with rating each of the photographs collected, which were presented in the form of a questionnaire. Two factors were rated for each photograph in the questionnaire: photograph quality and the presence of anatomical features, namely the optic disc and macula. All professionals were blinded from each other's responses. The photographs were presented to the professionals on a digital computer screen with a minimum resolution of 1080 pixels by 720 pixels.

The four professionals first rated the quality of each photograph using a Likert scale ranging from 1 to 4. The score translations were:

1. Poor quality and unacceptable
2. Average quality and acceptable
3. Good quality
4. Very good quality

The terms 'acceptable' and 'unacceptable' referred to the adequacy of the quality of the images to detect an abnormality.

The four professionals then rated if the anatomical features of the retina, namely the optic disc and macula, were visible in each image and adequate for detecting an abnormality, with binary responses of 'yes' or 'no'.

Statistical analysis

The end results were collated on a spreadsheet and Microsoft Excel (Microsoft Corp., Albuquerque, NM, US) was used for statistical analysis. Statistical measures such as median and mode were calculated for image quality, and percentages were calculated for identifiable anatomical features. For both factors, inter-professional agreement was calculated as a percentage. This was done using pairwise comparisons, which involved taking the number of times a professional was in agreement with another professional over the total number of pairwise comparisons.

Results

Patient demographics

A total of 339 participants were recruited during the study period. Eighteen patients had bilateral retinal photographs and the rest of the participants had only one eye examined with the oDocs Nun ophthalmoscope. A total of 357 retinal photographs were acquired with the device. The mean age of the participants was 68.2 years old and the median age was 71 years old. One hundred and ninety-four (57.2%) of the participants were female and 145 (42.8%) were male.

Photograph quality: the quality of most photographs was rated as at least average and acceptable by the ophthalmic professionals.

On a Likert scale from 1 (poor quality and unacceptable) to 4 (very good quality), the median and mode values for each professional's rating of all photographs were either 2 or 3. The detailed medians and modes are given in Table 2. Across the four professionals, on average, 7.1% of the images were rated as 1, 46.3% were rated as 2, 37.9% were rated as 3 and 8.7% were rated as 4. Pairwise comparison showed that there was 44.6% agreement between all four professionals regarding these ratings.

Table 2: Median and mode values for each professional's rating of all photographs for photograph quality.

	Median	Mode
Professional 1	3	3
Professional 2	2	2
Professional 3	2	2
Professional 4	2	2
Overall	2	2

Figure 1: Graph depicting the individual percentages of each professional for the proportion of photographs having a visible optic disc adequate for detecting an abnormality.

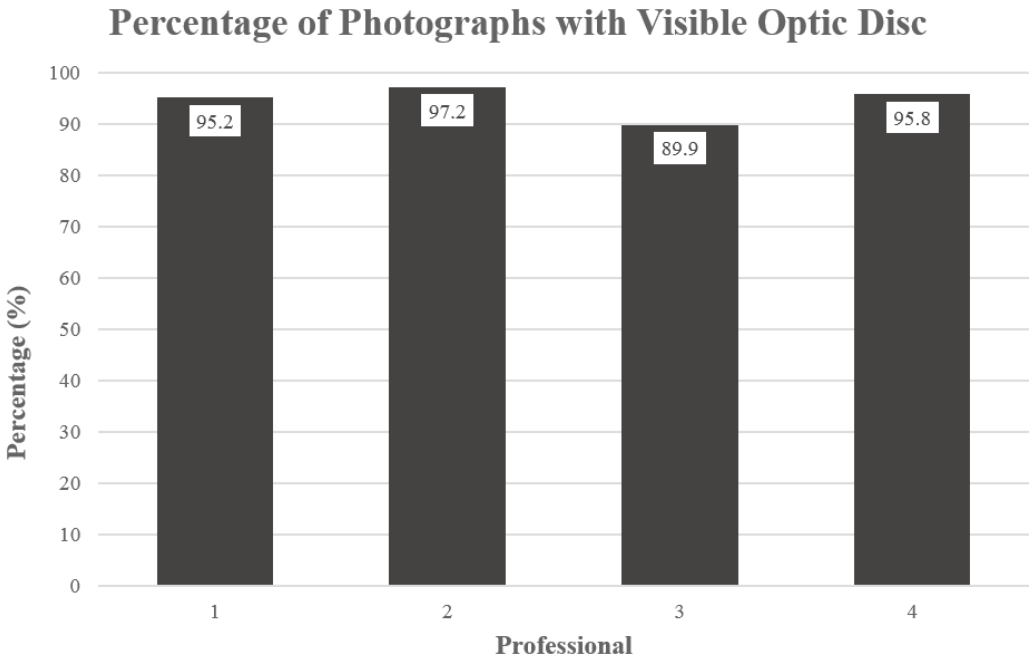

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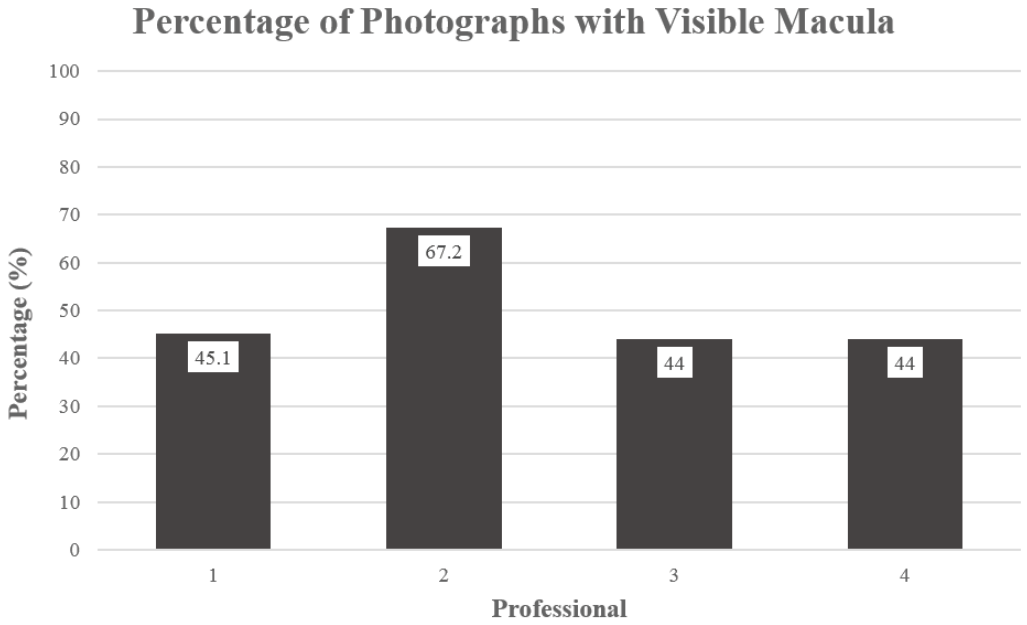
Figure 2: Graph depicting the individual percentages of each professional for the proportion of photographs having a visible macula adequate for detecting an abnormality.



Optic disc: all professionals agreed that the majority of the photographs had a visible optic disc adequate for detecting an abnormality.

Professionals' ratings of the percentage of photographs in which there was a visible optic disc adequate for detecting an abnormality ranged from 89.9% to 97.2%, with the average being 94.5% (see Figure 1). Pairwise comparison showed an inter-professional agreement of 74.2%. Out of the 357 images, there were only three images that all four professionals agreed did not adequately show the optic disc.

Macula: on average, at least half of the photographs were deemed to have a visible macula adequate for detecting an abnormality.

Professionals' ratings of the percentage of photographs in which there was a visible macula adequate for detecting an abnormality ranged from 44.0% to 67.2%, with the average being 50.0% (see Figure 2). Pairwise comparison showed an inter-professional agreement of 74.2%.

Discussion

This study has successfully demonstrated that the oDocs Nun is a promising tool which could be used to circumvent the challenges associated with direct ophthalmoscopy. Despite only 8.7% of photographs being rated as 4 (very good quality), there was sufficient agreement among all four ophthalmic professionals that the quality of most of the retinal photographs taken by GPs using the oDocs Nun was acceptable. This was supported by the high inter-professional agreement that the majority of the photographs had an image of the optic disc that was sufficient to detect any abnormalities. However, there was also agreement among the four professionals that only half of the photographs had an adequate image of the macula to detect an abnormality. Although there is rising popularity of indirect ophthalmoscopes, GPs are still more accustomed to using the direct ophthalmoscope despite its various drawbacks. [19,20] As a result, there is need for a longer training time before the user becomes proficient at utilising unfamiliar equipment such as the oDocs Nun. Nevertheless, the success of the oDocs Nun in capturing many images that professionals rated as being of acceptable quality for identifying an abnormality indicates the potential of this instrument to be used as an ophthalmoscope in the primary care setting.

As previously mentioned, the oDocs Nun is a new device based on the principle of indirect monocular ophthalmoscopy; compared to the direct ophthalmoscope, it has a wider angle of view (40°),[21] as well as potential greater ease and comfort of use due to having reduced patient proximity.[8]

Moreover, compared to other smartphone retinal imaging devices mentioned earlier which are simple direct ophthalmoscopes, the oDocs Nun has a wider field of view, and has coaxial illumination.[24] Beyond this, the oDocs Nun could potentially have a significant role in the field of telemedicine. Telemedicine refers to the practice of remote medicine through technological means, which includes remote consultation, treatment, surgery and monitoring.[22,23] Teleophthalmology is a branch of telemedicine which involves delivering eye care through either a store-and-forward method or real-time communication.[24] There is robust evidence to support that teleophthalmology is suitable for things such as screening for diabetic retinopathy.[25,26] In this, teleophthalmology essentially involves a trained individual, such as a GP, using a device which can produce adequate photographs of the retina that can be sent to ophthalmologists for further evaluation; the oDocs Nun could therefore potentially become an integral part of teleophthalmology and emergency teleophthalmology.[27] Ethical issues revolving around patient security and privacy are no longer hindrances as there are multiple platforms now built with legal compliance; there is also global progress towards creating paperless automated digital workflows in hospitals.[28,29] Fundamentally, the advancement of the field of teleophthalmology with novel devices such as the oDocs Nun enables many advantages: short examination time, electronic medical photographs, the ability of non-ophthalmologists to screen for diseases, and a decreased need for further resources, especially in rural or deprived areas, for example.[26,27]

There are various limitations of this study as well as areas which may be improved for future research. Firstly, the questionnaire for the four professionals used subjective terms in the questions, which were dependent on the interpretation of the professionals. This may have introduced systematic errors if the definitions of the terms were different for each professional. Regarding image quality, although all professionals rated the majority of the photographs as above average and acceptable, there was low inter-professional agreement of only 44.6%. This may have been due to there being four points on the Likert scale; as mentioned above, only 15.8% of the responses were either 1 or 4. This indicates that only two options for image quality (acceptable vs unacceptable for detection of an abnormality) may have been needed in the questionnaire, which could have significantly increased the inter-professional agreement. Secondly, there were no measures taken to determine intra-professional reliability; for future research, it would be advantageous to randomly select some images to be reassessed by the same professional. Moreover, the GPs may have needed more extensive training or longer time to become accustomed to using the oDocs Nun before uploading an image; greater practice with the device for all GPs may have increased the number of photographs with an adequate image of the macula.

This study has indicated that the oDocs Nun is a suitable device that GPs can use in the primary care setting, which sidesteps the challenges associated with the direct ophthalmoscope. Previous studies have also indicated the preference for indirect ophthalmoscopes by health practitioners;[21,30–32] utilisation of devices such as the oDocs Nun could improve the implementation of complete eye examinations by GPs. Although mydriasis was used in this study, the oDocs Nun is suitable for non-mydriatic pupils, hence saves time during consultations. The oDocs Nun also may have a role in screening programmes because of its ease of use and potential application of telemedicine. Moreover, it is a device which could also be used to teach ophthalmological techniques to medical students because of its ease of use.

In conclusion, it was found that the oDocs Nun is a new and promising indirect ophthalmoscope. Overall, most photographs were rated by professionals to be of acceptable quality; 94.5% of photographs were deemed to a visible optic disc and 50.0% had visible maculae which were adequate for detecting an abnormality. As compared with other similar devices, the oDocs Nun offers a wider field of view, co-axial illumination and image acquisition capabilities when used in conjunction with a smartphone. The device has potential roles in telemedicine, screening programmes, and student learning, and it may successfully reduce the obstacles GPs face in ophthalmic consultations related to the direct ophthalmoscope.

Competing interests:
Dr Sime and Dr Hong report non-financial support from oDocs Eye Care Ltd outside the submitted work. In addition, Dr Hong has a patent Co-axial illumination issued.

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Admission to ICU "solely for possible organ donation"—audit of current New Zealand practice

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ABSTRACT

AIM: Admission of patients with likely fatal illness to ICU "solely for possible organ donation" has been a long-standing practice in New Zealand. This is advocated as a means of increasing the availability of organs for transplant. We sought to determine the extent and characteristics of current clinical practice.

METHOD: We identified patients admitted "solely for possible organ donation" from a total of 2,686 patients who died in the 24 public hospital ICUs in New Zealand between 1 July 2017 and 30 June 2019. We determined their characteristics, resource utilisation and organ and tissue donation outcomes.

RESULTS: There were 49 patients (F26, M23; age range 9 days to 79 years, median 57 years, European 36, Māori 11, Pacific 1, Asian 1). On 26 occasions (57%) ICU admission was preceded by a "preliminary family discussion about donation". Eighteen of the 24 ICUs admitted at least one patient (range 1 to 13, median 2) over the two-year period. All 49 patients had evidence of catastrophic brain damage at the time of ICU admission; they used a total of 60 ICU days, including 15.5 days for one patient who was actively treated after spontaneous improvement. Death occurred between 5 minutes and 15 days, median 18.7 hours after ICU admission; all but one death occurred by 82 hours. Distribution of ICU stay was similar for the 20 patients who donated and for those 29 who did not. Brain death developed in 22 patients, 20 of whom donated 63 organs, 15% of the total 430 organs donated by all deceased donors over the period. Organs from 20 donors were transplanted into 58 recipients, 14% of the total 417 recipients of deceased-donor organs over the period. Nine of the 49 patients also donated tissues for transplantation.

CONCLUSION: There are already a small number of patients being admitted to ICUs in New Zealand "solely for possible organ donation", the majority following prior family discussion of donation. These patients occupy a small number of ICU bed-days and contribute ~15% of the deceased donation activity. Organ Donation New Zealand has developed and recently promulgated recommended best practice guidelines for clinicians in the ICU and emergency departments and is supporting expansion of the practice within the scope of these guidelines.

The practice of admitting patients with likely fatal acute illness to ICU "solely for possible organ donation" is increasingly being advocated for as a potential source of additional organs for transplantation. This practice has a comparatively favourable cost-utility when compared to ICU admission for other indications.[1] Some intensive care clinicians have expressed concerns about the boundaries of moral rectitude of this practice, its impact on the families of dying patients and the effect that it might have on the ability of the ICU to provide for the needs of other critically ill patients. In 2014 Organ Donation New Zealand (ODNZ), in collaboration with clinicians in intensive care medicine and emergency medicine, began developing best practice clinical guidelines on this practice. In 2017 ODNZ began prospectively collecting additional data about the practice as part of our confidential national registry of deaths in public hospital ICUs. In June 2019 our best practice guidelines[2] were released to clinicians. More recently the Australian and New Zealand Intensive Care Society

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(ANZICS) recommended that "intensivists, in collaboration with donation staff, should develop local pathways so that patients with potential for organ donation who are near the end of life in other hospital departments or remote centres are referred to an intensive care unit for exploration of the possibility of organ donation."[3] The ODNZ best practice guidelines are consistent with this recommendation.

We sought to determine the existing extent of the practice in New Zealand including the incidence, patient circumstances, use of ICU resource, organ (and tissue) donation outcomes and the extent to which these donation outcomes contributed to transplantation. We used these data along with other reported sources[1,4] to make estimates of the costs and benefits of the practice and place these in a broader context.

Method

ODNZ has maintained a confidential voluntary registry of all deaths in the 24 New Zealand public hospital ICUs since 2008. The registry is used by ODNZ as part of a comprehensive quality improvement programme to ensure that opportunities for deceased organ (and tissue) donation are recognised and appropriately supported. The registry is hosted by a private provider and includes detailed clinical information relevant to possible organ donation. Data are entered online, soon after a patient's death by authorised nurses with individual passwords in every ICU ('ICU Donation Link Nurses'). Each patient is assigned a unique identifier by the data hosting company for the purposes of communication between the ICUs and ODNZ. Data are anonymised, encrypted, securely maintained and made available to ODNZ. Two additional data elements have been collected since July 2017: "Was the patient admitted to ICU solely for possible organ donation?" and "Did a preliminary family discussion about donation take place before ICU admission?"

ODNZ maintains a separate confidential registry of all deceased organ donors since 1993. This includes which organs from each donor were actually transplanted.

This study was a two-year (1 July 2017 to 30 June 2019) retrospective audit of these two registries, which sought to establish the current extent and nature of the clinical practice of admitting critically ill patients to ICU "solely for possible organ donation". Data of interest were analysed within an Excel® spreadsheet which included demographics, clinical details, whether a preliminary family discussion about donation had taken place before ICU admission, the ICU length of stay, organ (and tissue) donation outcomes, and the organs and tissues actually transplanted. The extent of donation from these actual donors was reported in the context of donation from all other deceased donors over the same time period. Estimates of the costs and benefits of the practice of admission "solely for possible organ donation" were made from these data and other reported sources. Simple parametric statistics were used as appropriate.

Results

There were a total 2,686 deaths in the 24 public hospital ICUs over the two-year study period (1 July 2017 to 30 June 2019), including 49 deaths of patients who had been admitted to ICU "solely for possible organ donation". On 26/49 occasions (57%) the ICU admission occurred after a "preliminary family discussion about donation". Table 1 shows demographic and clinical details of the 49 patients, and Table 2 shows the cause of death for those who did [n=22] and did not [n=27] become brain dead.

Table 1: Gender, age and ethnicity of 49 patients admitted to ICU "solely for possible organ donation".

Gender	26 F, 23 M
Age	Range 9 days to 79 years, median 57 years
Ethnicity	European 36, Māori 11, Pacific 1, Asian 1

Sixteen of the 24 ICUs had admitted at least one patient (range 1 to 13, median 2). Prior "preliminary family discussion about donation" was no more common in the three ICUs who admitted six or more such patients than in the other 13 ICUs (15/27 vs 11/22, Fishers exact test value = 0.9, NS). The 49 patients used a total of 60 ICU days, including 15.5 days for one patient who was actively treated after spontaneous

Table 2: Cause of death in 49 patients admitted to ICU "solely for possible organ donation".

	Brain dead [n=22]	Not brain dead [n=27]	Total [n=49]
Intracerebral haemorrhage	5	10	15
Subarachnoid haemorrhage	6	8	14
Traumatic brain injury	6	5	11
Hypoxic-ischaemic encephalopathy	0	3	3
Spontaneous subdural haemorrhage	2	1	3
Cerebral infarct	2	0	2
Brain tumour	1	0	1

improvement before deteriorating due to late re-bleeding from a cerebral artery aneurysm. Death occurred between five minutes and 15 days, median 18.7 hours after ICU admission; all but one death occurred by 82 hours. Distribution of ICU stay was similar for the 20 patients who donated and for those 29 who did not. Brain death was determined to have developed in 22 patients, 20 of whom donated organs. Table 3 shows the organs donated and transplanted from these donors, along with organs transplanted from all other deceased donors over the same two years.

These 20 donors (15% of the 136 total deceased donors over the period) donated 63 organs, 15% of the total 430 organs donated by deceased-donors. The 63 organs were transplanted into 58 recipients, 14% of the 417 recipients of organs from deceased-donors. Nine patients, including four who donated organs, also donated tissues (eight donated eyes and two donated heart valves).

Discussion

This is the first study to accurately quantify the existing practice in New Zealand of admitting patients to the ICU "solely for possible organ donation". The practice is established in New Zealand, with two thirds of the ICUs having admitted at least one patient solely for possible organ donation over the two years of the study. There is considerable variability between ICUs in the frequency with which this occurs. This is likely to reflect both hospital size and services, and also aspects of both ICU and ED culture and communication around patients at the end of life. There is also variability in the frequency in which ICU admission is preceded by a preliminary discussion of organ donation, although such discussion did occur on 57% of occasions.

Admission policies in New Zealand ICUs, in line with worldwide consensus recommendations,[5] prioritise admission

Table 3: Organs donated and transplanted from donors admitted solely for possible organ donation, and from all other deceased donors, together with the number of corresponding transplanted recipients* over two years 1 July 2017 to 30 June 2019.

	"Admitted for possible organ donation" (DBD, n=20)	All other donors (DBD 101, DCD 15)	Total
Hearts	8	33	41
Lungs	7	48 (DCD 4)	55
Livers	16	79 (DCD 1)	95
Kidneys	31	199 (DCD 25)	230
Pancreas	1	8	9
Organs	63	367	430
Recipients*	58	359	417

*Note: Some recipients received multiple organ transplants.

to patients who are most likely to derive benefit from that admission. These patients have a potentially reversible acute illness which is too severe to be managed in a ward setting, and not so severe that death is extremely likely irrespective of ICU admission. In that context however, there are some situations where end-of-life care is probably best provided in an ICU setting (eg, lethal-extent burn injury). Sometimes space, time, privacy and personnel may not be available to provide for the end-of-life care needs of a ventilated patient or their family in the emergency department and ICU may have the necessary capabilities. These issues are complex and vary between hospitals, reflecting locally available hospital resources and the services that the ICU provides to each hospital. A combined Australian and New Zealand report[6] from a large but incomplete set of ICUs found that 3,700 (0.4% of the total 1,024,203 patients admitted to the 177 ICUs over a 10-year period between 1 January 2007 and 31 December 2016) were admitted for "palliative care of a dying patient" and that these 3,700 patients had a mortality of 86.6%. We have tried to exclude patients admitted to ICUs for these reasons from this report, by restricting inclusion to patients "admitted to ICU solely for possible organ donation", implying that they would not have been admitted for any other reason.

It is possible that there might have been other patients who were also "admitted solely for possible organ donation" who did not die in the ICU (and therefore would not appear in the ODNZ registry of ICU deaths). These are likely to be very few, although there was one patient in this study who did improve and receive active treatment for 15 days before dying of a late complication. The Australasian report[6] found that 1,115 (0.1% of the total ICU admissions) were admitted for "potential organ donation" and that these 1,115 patients had a mortality of 95.9%. Donation outcomes were not reported for this cohort.

All except one of the 49 patients in this study died in the ICU within a few days; 22/49 (45%) of them became brain dead; with a similar time to death as those 29 who did not become brain dead. Assuming a representative cost of an ICU day in New Zealand at $NZD5,500,[4] the total cost of the ICU stay of all 49 patients would be $330,000 ($6,735 per admitted patient) or $244,750 for 48 patients ($5,099 per patient) if the actively treated patient is excluded. Attributing these costs to the 58 recipients of donated organs would result in an additional cost per recipient of $5,690 [all 49 ICU admissions] or $4,220 [48 ICU admissions not actively treated]. This is approximately 2.5% of the cost of an (adult) liver transplant or 6% of the cost of a renal transplant (Professor Stephen Munn, personal communication). ICU admission solely for possible organ donation does not currently result in any additional reimbursement to ICUs and can be seen as of lesser priority than admission of a critically ill patient for active treatment. This view is particularly held if ICUs resources, including staff with specific expertise in organ donation are limited or unavailable. The contribution of this ICU admission practice to national transplantation activity is already significant (~15%), similar to what was found in seven hospitals in the Netherlands in 2013–2014 where 8/72 (11%) of donors had been admitted to ICU solely for possible donation.[7] Very recently these researchers have shown a decrease in such potential donors not being referred from the ED following implementation of a protocol to support the practice.[8] In that report of 55 patients admitted to ICU solely for possible organ donation (clinically similar to the 49 patients in this report), there were 20 actual donors (26% of the 69 total donors in the participating hospitals). In a nested-cohort report within the Australasian study[6] of 177 ICUs, 116 of the 1,115 (10.4%) patients admitted "for potential organ donation" over a 10-year period were from a single large Australian tertiary centre. In that centre, donation was discussed with families before ICU admission on 59/116 occasions (51%), brain death was determined in 75 patients (65%) and there were 61 donors (63%), broadly similar to the national New Zealand findings in this study.

The mean number of organs transplanted per donor in this study was 3.15, similar to the 3.33 organs per donor transplanted from the other 101 DBD donors over the two-year period. There were no DCD donors from among the patients admitted solely for possible organ donation; there were 15 DCD

donors over the period from whom a mean of 2.0 organs per donor were transplanted.

The extent of benefit attributable to organ transplantation, as measured by Quality Adjusted Life Years (QALYs) has been calculated from transplant recipient data published between 2002 and 2014.[1] Derived QALYS were 8.9 for liver, 8.8 for heart, 2.8 for lungs, 2.6 for kidney and 2.1 for pancreas transplantation. These values will be conservative, as long-term survival for transplant recipients is generally continuing to improve. Applying these values of QALYs to the organs donated by the 20 DBD donors in this report results in a total of 313.5 QALYs from 63 organs. Assuming that the QALY effects of multiple organ transplants would not be strictly additive, we have conservatively reduced the number of QALYs to 58/63 of its value, ie, to 308.4 QALYs or 15.4 QALYs per DBD donor. The theoretical analysis by Nunnink[1] estimated the maximum number of QALYs at 30.6 "when all possible organs were medically suitable for transplantation" (heart, lungs, liver, kidneys and pancreas), implying five or more transplant recipients per DBD donor, compared with the actual value of 2.9 recipients per donor that we found in this report.

An estimate of cost per QALY, (where cost is based only on ICU length of stay for the 49 patients admitted to ICU solely for possible organ donation), is therefore not more than $1,070. Such a value represents very high cost-utility for a healthcare intervention. For example, care in a stroke unit rather than a general ward setting costs $7,960/QALY,[9,10] water fluoridation between $12,821 and $20,000/QALY,[11] population-based screening for abdominal aortic aneurysms $15,300/QALY[9,12] and stockpiling of antivirals in anticipation of a future influenza epidemic $33,200/QALY.[9,13]

Guidelines for best practice in New Zealand[2] have been developed by ODNZ by a process of wide consultation among clinicians in ICUs and emergency departments with principle-based consensus. They are in accord with the relevant position statement of the Australian and New Zealand Intensive Care Society.[3] ODNZ recommends that if the only reason for ICU admission is "solely for possible organ donation" and would otherwise not take place, such admission should be preceded by an explicit discussion of the reasons for it with the family, if that is possible.

Summary and conclusion

This study provides a national 'baseline measure' of admission to ICU solely for possible organ donation. This practice currently contributes ~15% to transplantation activity. ODNZ now has an ongoing program to encourage expansion of this practice, within the bounds of what is considered best practice and is acceptable to families and clinicians.

Competing interests:
Nil.

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Inherited thrombophilia testing in a large tertiary hospital in New Zealand: implementation of a Choosing Wisely protocol to reduce unnecessary testing and costs

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ABSTRACT

AIM: To evaluate the practice of inherited thrombophilia testing at Waikato Hospital Laboratory, benchmarked against the British Society of Haematology (BSH) guidelines with the plan to reduce unnecessary testing.

METHODS: We retrospectively reviewed data on all inherited thrombophilia tests performed in the Waikato Hospital Laboratory during August 2015. We then established a local Choosing Wisely guideline for testing. A clinical and laboratory programme was developed to facilitate the implementation of this guideline. Ordering practices were re-evaluated six months after the implementation of the Choosing Wisely programme.

RESULTS: Of the 94 requests received in August 2015, only one complied with BSH guidelines. Most abnormal results did not change the clinical management of patients. In the first six months following the implementation of our intervention, there was a significant reduction of tests performed with an estimated savings of $118,000.

CONCLUSIONS: The majority of inherited thrombophilia tests performed in our laboratory did not comply with BSH guidelines. A multimodal inherited thrombophilia Choosing Wisely programme was successful in reducing unnecessary testing. A laboratory protocol that required screening of every inherited thrombophilia request by a haematologist was necessary for the success of this programme.

Venous thromboembolism (VTE) represents a significant cause of morbidity and mortality in New Zealand.[1] Inherited thrombophilia is associated with an increased risk of VTE. The most common inherited thrombophilias include deficiencies in naturally occurring anticoagulants such as antithrombin (AT), protein C (PC) and protein S (PS) as well as gene polymorphisms for factor V Leiden (FVL) and prothrombin gene, G20210A (PGM).[2–4] These are all included in the inherited thrombophilia screening panel at Waikato Hospital Laboratory in Hamilton, New Zealand. However, testing for an inherited thrombophilia is controversial.

There is little evidence demonstrating the clinical utility of inherited thrombophilia testing in the majority of patients with a VTE.[5–7] Testing does not reduce the recurrence of venous thrombosis.[8–10] Also, if testing is performed in unselected patients at the incorrect time, you run the risk of attaining false-positive results.

Some inherited thrombophilia assays are affected by medications, acute thrombosis, pregnancy and liver failure. False-positive results can lead to overtreatment, complications from unnecessary treatment and the social, psychological and financial costs that arise from being labelled with an incorrect diagnosis. Testing patterns both internationally and nationally are renowned for being indiscriminate and reflect a lack of awareness of the futility of testing and the risk of harm arising from testing in unselected patients.[8,11–14]

Many guidelines have been published to reduce unselective testing. The British Society for Haematology (formerly British Committee for the Society of Haematology BCSH) has produced the most comprehensive restrictive guidelines that recommend testing in a few selected cases and only when the results will change clinical management.[7] Other guidelines include the American Society of Haematology (ASH) Choosing Wisely,[15] American College of Chest Physicians,[16] NICE guidelines[17] and National Laboratory guidelines in New Zealand.[18]

The National Laboratory guidelines for inherited thrombophilia testing was employed at Waikato Hospital prior to this study. An automatic laboratory reflex was implemented in 2005 that prevented repeat molecular testing for FVL and PGM. All other inherited thrombophilia screening tests, both initial and repeat requests were performed without a formal review of clinical indications for testing and compliance with the laboratory guideline.

Waikato Hospital Laboratory serves a large geographic catchment area with a population of approximately 765,500 people. The Hospital haemostasis laboratory draws requests from the hospital and community laboratories in Hamilton, Thames, Coromandel, Tauranga, Rotorua, Tokoroa, Te Kuiti, Taumarunui and Taupo. Approximately 1,200 inherited thrombophilia tests were being performed annually. In 2015–2016, a Choosing Wisely programme for laboratory testing was developed at Waikato Hospital. Inherited thrombophilia testing is on the 'Choosing Wisely' list endorsed by many speciality societies, including the American Society for Haematology.[15]

This study aimed to assess inherited thrombophilia testing practice at Waikato Hospital Laboratory and benchmark this against BSH guidelines. We aimed to reduce indiscriminate testing in our laboratory by implementing a multimodal inherited thrombophilia Choosing Wisely programme for hospital and community clinicians. Requesting and testing patterns were reassessed after implementation of the programme.

Methodology

Study design and data sources

We retrospectively reviewed all inherited thrombophilia tests performed at Waikato Hospital Laboratory during August 2015.

We assessed an electronic version of the original request form to identify clinical details provided, such as indications for testing and requestor details. We then extracted data such as patient age, gender, inherited thrombophilia tests requested and results of tests from the electronic medical records. If clinical details were lacking on the request form, clinical notes were reviewed, or the requestor was contacted to assess indication and eligibility for testing. When possible, a written note review was performed to gather further clinical data. Microsoft Excel 2008 was utilised to record and collate data.

Assessing the appropriateness of requests

The BSH inherited thrombophilia testing guideline was the standard against which this audit was undertaken (Table 1).[7]

The clinical utility of an abnormal result was defined as an abnormal result that changed clinical management, such as duration of anticoagulation or thromboprophylaxis. Costs associated with unnecessary inherited thrombophilia testing were calculated based on the cost of all tests performed that did not meet BSH criteria for testing in one month. The cost of a screening panel for inherited thrombophilia testing at Waikato hospital laboratory is $247.

A multimodal intervention was designed and implemented to reduce inappropriate testing. The intervention included establishing a local inherited thrombophilia Choosing Wisely guideline in collaboration

Table 1: BSH criteria for inherited thrombophilia testing.

Testing Indicated in the following clinical contexts: (level of evidence)	Testing MAY be indicated in the following clinical contexts: (level of evidence)
Neonates and children with purpura fulminans should be tested for protein C and protein S deficiency (1B).	Case finding of asymptomatic relatives with high-risk thrombophilia, such as antithrombin, protein C or protein S in thrombosis-prone families (1B).
Patients with skin necrosis in association with Vit K antagonists should be tested for protein S and protein C deficiency (2B)	Asymptomatic pregnant women with a strong first-degree family history of unprovoked VTE or VTE provoked by pregnancy or combined oral contraception exposure or a minor risk factor (2C). (indication for testing would increase if the first-degree relative had a known thrombophilia)
Patients with VTE and <40yrs old and must have a history of thrombosis-prone family members (>2) (C).	

with the Waikato Hospital Laboratory and Waikato Hospital Departments of Haematology, General Medicine, Obstetrics and Neurology. The BSH, National Laboratory Test Referral and RCOG Green-top guidelines[7,18,19] along with the guiding principles of 'Choosing Wisely' and outcomes from meetings with the above stakeholders influenced the final guideline design (Tables 2 and 3). Testing for patients with obstetric indications continued as there were large randomised control trials underway.

Communication with key stakeholders in the hospital was vital for organisational and clinician buy-in for the new testing protocol. The findings from the first phase of our study were presented at the Waikato Hospital medical presentations and grand round. The new guidelines were then disseminated to all general practitioners in our region, informing them of the need for testing in selective patients and the implementation for the new testing protocol in July 2016 (See supplementary article).

Table 2: Waikato Hematology Laboratory criteria for inherited thrombophilia testing, 2016.

• Idiopathic venous thromboembolism in young patients (<45 years).
• Warfarin-induced skin necrosis (patients should be tested for protein C deficiency and protein S deficiency one month after stopping vitamin K antagonist therapy if this can safely be discontinued).
• Children presenting with purpura fulminans (test for protein C and protein S deficiency).
• Siblings of patients with homozygous FVL, homozygous PT20210A or compound heterozygotes for these mutations.
• Thrombosis in unusual sites (eg, cerebral, mesenteric, portal). Cryptogenic stroke in the young (<50yrs) will be performed after exclusion of other causes.
• Recurrent miscarriage, IUGR, IUD.
In all other situations, testing should only be undertaken after consultation with a haematologist or as part of a clinical trial.

Table 3: Waikato Haematology Laboratory Guidelines for inherited thrombophilia testing, 2016.

• Request forms MUST provide clinical details of which criteria for testing the patient meets, or the sample will not be tested. The sample will be held for 14 days and will be tested if the requesting clinician subsequently provides appropriate clinical details.
• In the absence of meeting one of the testing criteria and testing is still thought to be appropriate, the requestor must discuss with a clinical haematologist and requestor name clearly identified on the request form along with clinical details.
• Where low levels of antithrombin III, protein C or S are found, a repeat sample will be requested to confirm the abnormal finding.
• Patients will only be tested for FVL and prothrombin gene mutation once in their lifetime. **Context and timing of tests :**
Wherever possible, thrombophilia testing should be avoided in the following settings as one or more of the laboratory tests may give false-positive results: • In people taking hormone replacement therapy (oestrogen) • Acute thrombosis • During warfarin therapy or other vitamin K antagonists, DOAC or heparin therapy • During pregnancy and for eight weeks post-partum

A laboratory programme using the existing laboratory information service (LIS) was set up specifically for inherited thrombophilia testing. The capacity to add on tests for an acquired thrombophilia or to complete a thrombophilia screen was embedded into this program. From 4 July 2016, all thrombophilia requests were reviewed by a haematologist working in the laboratory. Any request that did not fulfil criteria for testing and requests lacking necessary clinical details were declined. The capacity to ask the requestor for more clinical information and communicate the reasons for declining a test was embedded in the LIS program. The requestor of a test that was declined was sent an electronic link to the new Waikato Hospital Laboratory inherited thrombophilia Choosing Wisely guidelines along with contact details for the laboratory haematologist if a further discussion was required. Declined samples were held for 14 days.

A re-audit of inherited thrombophilia testing patterns was performed six months after implementation of the Choosing Wisely programme from July 2016–December 2016.

Results

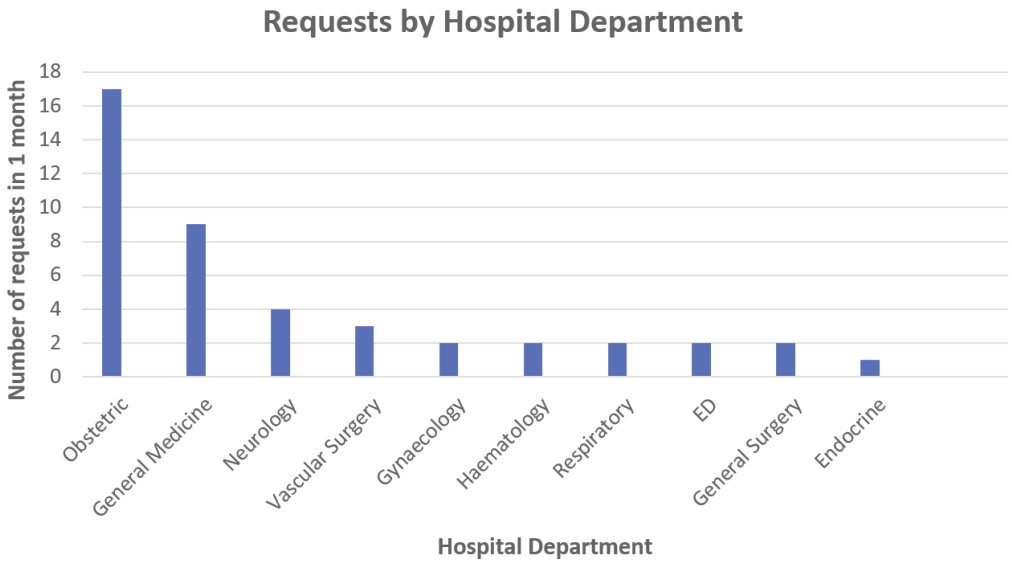
A total of 94 inherited thrombophilia requests were performed in August 2015. Most requests were for female patients (75%, n=70). The median age was 38 years for females and 52 years for males. A significant number of request forms lacked clinical information or indication for testing (21%, n=20).

There was only one inherited thrombophilia request that complied with BSH guidelines. This patient was young (<45 years) had a VTE and a sibling with a history of VTE during pregnancy and known to be compound heterozygote FVL/Prothrombin gene mutation.

There was an equal distribution of requests for inherited thrombophilia tests generated from hospital and community clinicians 46% and 48% respectively.

Within the hospital, the obstetric and general medical departments generated the majority of requests (Figure 1). Personal and Family history of VTE and obstetric complications comprised the majority of indications for testing (Figure 2). There were a few requests for patients with bleeding issues.

Figure 1: Inherited thrombophilia requests by hospital department.



Clinical utility of abnormal results

A total of 21 patients had abnormal results. Of these, 76% (n=16) results would not have changed clinical management (Table 4).

The clinical utility of test results was uncertain in 3 of 21 patients with abnormal results. These included two patients with low protein S levels tested at the time of pregnancy loss with no repeat level performed eight weeks post event. The third patient was tested for a presumed pulmonary embolus (PE). No PE was identified on CTPA, there was no personal or family history of thrombophilia, but the patient had a low AT III level.

Figure 2: Indications for testing identified on 74/94 laboratory request forms, 16/94 had no indication for testing on the request form but were identified following clinical note review or discussion with the requestor. "Bleeding and others" include easy bruising, epistaxis and menorrhagia.

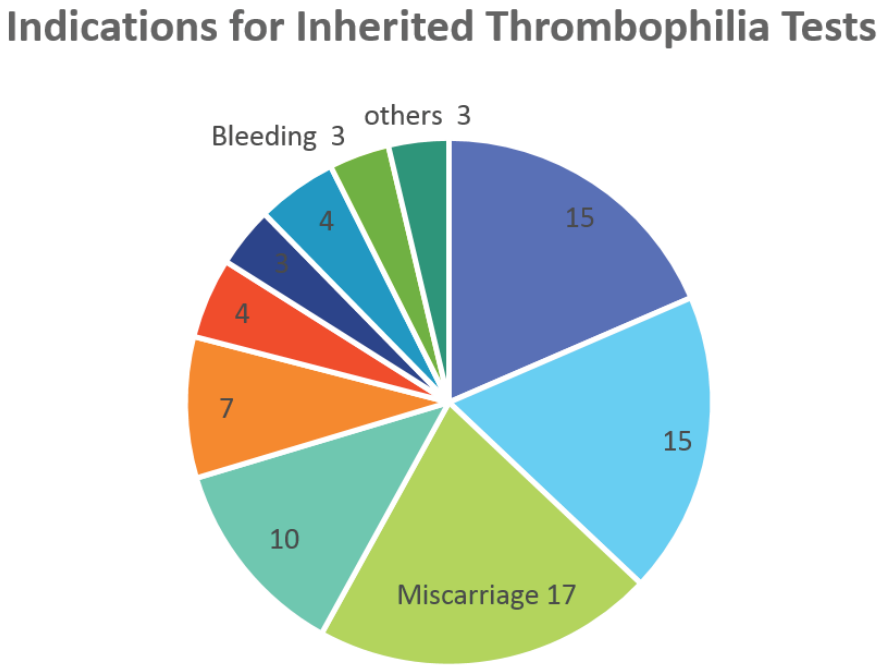


Table 4: Abnormal results would not change clinical management.

Inappropriate testing
Five patients tested at the time of pregnancy loss resulting in a decreased PS level. (A)
All five were normal on repeat testing eight weeks later.
One patient tested for DVT during pregnancy resulting in low PS and AT levels. (A)
Repeat testing eight weeks post-partum showed normal PS and AT levels.
One low protein S and protein C while on warfarin therapy. (A)
Three heterozygous for FVL tested before commencing the combined oral contraceptive pill (COCP). All would require alternative contraception regardless of results due to a strong family history of VTE. (B)
Four patients >60 yrs. Tested for unprovoked VTE, found to be heterozygous for FVL. No personal or family history of thrombophilia. (B)
Two patients with an established diagnosis of prot S deficiency were retested. (C)

Inappropriate timing of tests (A), inappropriate indication for testing (B), repeated test despite having an established diagnosis (C).

Two patients had abnormal results that would have changed clinical management. One patient with compound heterozygosity FVL/prothrombin gene mutation and a family history of thrombophilia. The other patient was tested for a recurrent miscarriage and found to be heterozygous for FVL mutation with a true protein S deficiency. Both complied with criteria for testing where clinical management would or may be influenced by the result.

The cost for unnecessary inherited thrombophilia tests for the month of August 2015 was $23,282. A total of 1,233 tests were performed in the 12-month period from Sept 2014–Aug 2015. The estimated cost of unnecessary tests in that 12-month period is around $300,000.

Six months after the implementation of the new guidelines, the overall number of requests for testing had decreased, and the number of requested tests that were performed reduced significantly (Figure 3). Overall, 376 requests were received, of which 138 fulfilled criteria for testing. Only 312 of the 376 requests had adequate clinical information provided on the initial request. Sixty-four requestors were asked for additional clinical information.

The majority of requests performed were for obstetric complications, 66% (n=91). DVT and VTE in those <45 yrs old comprised 20% of requests (n=28). Cryptogenic stroke in the young patient made up 8% of requests (n=11). Test results are detailed in Table 5.

Figure 3: AT III testing volumes at Waikato Hospital—used as a marker for inherited thrombophilia screening volumes.

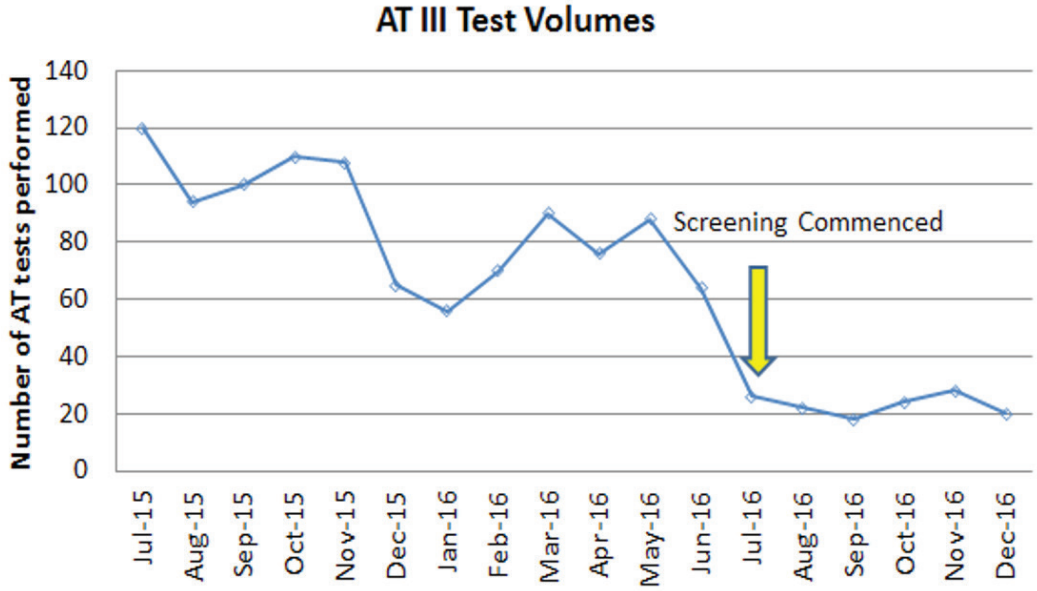


Table 5: Test results by indication.

Obstetric complications	**n (%)**
Normal	91 (53)
Low protein S (tested at the time of pregnancy loss)	33 (36)
Heterozygous FVL	5 (6)
DVT/PE, <45 yrs old with a family history of VTE	
Normal	18 (64)
Heterozygous FVL	5 (19)
Low AT	2 (7)
Low PC	2 (7)
Heterozygous prothrombin gene mutation	1 (3)
Neurology- cryptogenic stroke	
Normal	10 (91)
Low PC	1 (9)
Others	
Normal	8 (100)

The total cost of inherited thrombophilia testing in selected patients for the first six months since programme implementation was $34,914, with an estimated savings of $120,000.

Discussion

The BSH provides comprehensive guidelines for selective inherited thrombophilia testing. Our laboratory fell well below the recommended guidelines for testing with only 1 of 94 requests complying with the BSH criteria for testing. This pattern of inappropriate ordering practice is seen elsewhere in New Zealand[8] and internationally.[2,10,20] A retrospective study in a large tertiary haemostasis referral laboratory, Westmead NSW, Australia found that less than 20% of requests for inherited thrombophilia were appropriate for testing.[20]

In our study, the majority of test requests were for female patients (75%, n=70) with a median age of 38 years, reflecting the perceived value of testing in the context of obstetric complications and testing to inform suitability for the COCP. To date, guidelines recommend against inherited thrombophilia testing to guide decisions around commencing the COCP. A family history of thrombophilia in the context of oestrogen exposure is a reliable criterion for avoiding the COCP. However, a recent large study of women taking the COCP demonstrated a similar prevalence of an inherited thrombophilia among those with and those without a family history of VTE.[21] This may result in a change in testing practice in future, but further validation studies are required. The role of testing prenatally in asymptomatic women with a family history for inherited thrombophilia is on the BSH criteria for testing where results may change clinical management.[7] The Royal Australian and New Zealand College of Obstetricians follow the RCOG UK green top guidelines which recommend testing in this context.[19] The RCOG guidelines for recurrent miscarriage also recommend testing in women with second-trimester miscarriage. After consultation with the obstetric department at Waikato Hospital, the decision was made to test in asymptomatic women with a family history for thrombophilia and obstetric complications such as recurrent miscarriage, second-trimester fetal loss, IUGR and IUD. For obstetric complications, a strong recommendation was made to test at least 6–8 weeks post-event to remove the ambiguity of interpreting abnormal protein S levels. A local database of all obstetric requests performed since the implementation of the programme has been created with the plan to evaluate the clinical utility of testing for those patients.

An important and reassuring finding from this study was that no clinically significant abnormal results were missed when applying the BSH criteria to the cohort. Overall there were 21 patients with abnormal results. Two of 21 patients had clinically significant abnormal results, one patient who fulfilled criteria for testing and another who fulfilled BSH criteria where testing may be indicated. The majority of abnormal results (76%, n=16) would not have changed clinical management. A significant number of false-positive results were due to the inappropriate timing of tests. Interpretation of tests performed during pregnancy loss, the acute phase of a VTE or while on warfarin therapy is problematic, even more so if the clinician reviewing the patient's results does not have expertise in haemostasis and thrombosis. These findings highlighted the need to emphasise the appropriate timing of testing when designing our local protocol.[11]

The Waikato Hospital Laboratory inherited thrombophilia Choosing Wisely guidelines were developed in collaboration with various departments in the hospital. There is a paucity of large randomised controlled trials to guide testing decisions in many circumstances. The collaboration provided an opportunity to discuss clinical areas where the utility of testing is uncertain and arrive at a consensus for testing. The BSH, National Laboratory Test Referral and RCOG Green-top guidelines, along with the guiding principles of 'Choosing Wisely' influenced the final guideline design. We developed a guideline that was selective, restrictive and reduced harm but allowed for testing in situations where there is no clear evidence for or against testing.

Implementation of the guidelines required a multimodal approach covering the organisational, clinical and laboratory arms of testing. When implementing the laboratory arm for this inherited thrombophilia programme, we had underestimated the ongoing need for fine tuning the LIS programme so that it was fit for purpose. Optimising the capacity to individualise test approval and feedback to requestors took six months.

The results from our initial audit showed that education and wide dissemination of guidelines alone do not ensure a change in requesting behaviour. The decision to have all requests screened by a haematologist was a necessary measure to support a change in behaviour. This process of screening is time-consuming and requires ongoing dedication and commitment from the haematologists working in the laboratory. There was a significant reduction in testing overall within the first six months of protocol implementation with 376 requests overall. This suggests clinicians were more mindful of appropriate test ordering practices. However, the majority of requests received did not meet the criteria for testing (63% n=238) and reflected the need for ongoing clinical education around appropriate ordering practices.

In future, electronic laboratory requesting would circumvent the issue of insufficient clinical details provided on request forms and the labour-intensive screening of all requests by a laboratory haematologist. Algorithms and embedded decision-making tools, indicating criteria for testing and appropriate timing of testing would help clinician decision making at the time of ordering the test.

Thrombophilia testing is expensive. Studies repeatedly demonstrate the unnecessary financial costs associated with indiscriminate testing.[22] The estimated annual cost for unnecessary testing at Waikato Hospital Laboratory was $306,208.65. This estimate does not account for the costs associated with retesting abnormal results, carrying an incorrect diagnosis such as long-term anticoagulation and cost of complications arising from bleeding and overtreatment.

Limitations of this study

There are some limitations to this study. The small sample size and duration period of assessing inherited thrombophilia testing in the first and second phase of the study are significant limitations. In recognition of this, the study data was supplemented by looking at trends of AT testing over 12 months to ensure the testing behaviour in August 2015 was typical for the 12 months prior.

A retrospective design means that collection of data relying solely on adequate documentation introduces information bias. Compliance of inherited thrombophilia requests with BSH may have been underrepresented due to this bias rather than a

true finding. There is also a potential for investigator error and bias when collecting the data from electronic records and written clinical notes.

The strengths of this study included the assessment of consecutive thrombophilia requests and clinical note review to gain detailed clinical information and outcomes. In addition, the collaborative design of the new guideline and multimodal implementation programme facilitated clinician buy-in and early adoption of the Choosing Wisely programme. The benefits of implementing this laboratory programme have been far-reaching beyond our laboratory. Subsequent to presenting the findings of this study at the 2017 New Zealand branch meeting of the HSANZ (Haematology Society of Australia and New Zealand) another reference haematology laboratory in New Zealand has decided to implement an inherited thrombophilia programme based on our laboratory model of selective testing.

Conclusion

Our retrospective study demonstrated indiscriminate patterns of inherited thrombophilia testing in the Waikato region. There was a reduction in requests and costs following the implementation of multimodal Choosing Wisely programme. The critical success factor for the implementation of this programme was having all requests reviewed by a laboratory haematologist and restricting access to testing. Although time-consuming, this was a necessary measure to support appropriate testing in our laboratory. We expect in future; inherited thrombophilia testing will be more selective and performed only on patients who are likely to derive benefit from testing.

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Appendix

June 2016

Inherited Thrombophilia Testing

SUMMARY OF CHANGES

From 4th July 2016, inherited thrombophilia testing performed at Waikato Hospital, for the Waikato & BOP region, will only be performed in the following clinical situations:

- Idiopathic venous thrombo-embolism in young patients (<45 years)
- Warfarin-induced skin necrosis (Patients should be tested for protein C deficiency and protein S deficiency one month after stopping vitamin K antagonist therapy if this can safely be discontinued.)
- Children presenting with purpura fulminans (Test for protein C and protein S deficiency).
- Siblings of patients with homozygous FVL, homozygous PT20210A or compound heterozygotes for these mutations
- Thrombosis in unusual sites (e.g. cerebral, mesenteric, portal).

In all other situations testing should only be undertaken after consultation with a Haematologist or as part of a clinical trial.

Samples MUST provide clinical details of which criteria for testing the patient meets or the sample will not be tested.

In the absence of meeting one of the testing criteria and testing is still thought to be appropriate, it must be discussed first with a clinical haematologist and their name clearly identified on the request form along with clinical details.

Wherever possible, thrombophilia testing should be avoided in the following settings as one or more of the laboratory tests may give misleading results:

- In people taking hormone replacement therapy (oestrogen)
- Acute thrombosis
- During warfarin or other vitamin K antagonist or DOAC or any heparin therapy
- During pregnancy and for 8 weeks post-partum

Situations where testing is NOT indicated:

- Recurrent VTE
- Recurrent VTE despite adequate therapeutic anticoagulation
- VTE in the context of a family history of unprovoked VTE in a first degree relative
- VTE in association with a history of thrombophlebitis
- Arterial thrombosis (Lupus testing is indicated in this setting)
- Women with a history of miscarriage, pre-eclampsia, abruption or intrauterine growth restriction (Lupus testing is indicated in this setting).
- Prior to use of combined oral contraceptives in patients with a family history of VTE (Current British guidelines recommend avoidance of the combined oral contraceptive pill in women with a history of VTE in a first degree relative regardless of the thrombophilia results)
- In unselected women considering the use of the combined oral contraceptive pill.

Dr Helen Moore
Laboratory Haematologist, Waikato Hospital

See overleaf for more information and background:

CLINICAL UPDATE

Background

The currently recognised conditions resulting in heritable thrombophilia are:-

1. Antithrombin III deficiency
2. Protein C deficiency
3. Protein S deficiency
4. Factor V Leiden (FVL)
5. Prothrombin G20210A mutation (PT20210A)
6. Dysfibrinogenaemia
7. Inherited antiphospholipid syndrome

Patients with deficiencies of the naturally occurring anticoagulants (antithrombin, protein C and protein S) in thrombosis-prone families have a severe thrombophilic tendency with a relative risk for venous thromboembolism (VTE) of approximately 10-20 fold compared to unaffected people. This compares to a relative risk of approximately 3-5 fold for people who are heterozygotes for FVL or PT20210A.

People who are homozygous for FVL or PT20210A or double heterozygotes for these conditions are rarely seen but appear to have a particularly high risk of VTE, with a relative risk rate estimated at approximately 50-80 fold.

The dysfibrinogenaemias and inherited antiphospholipid syndrome are extremely rare and should be discussed with a haematologist prior to ordering any further tests.

Testing for Inherited Thrombophilia

Waikato hospital laboratory recently performed an audit on inherited thrombophilia testing requests performed in a month and bench marked them against international and national standards for performing these tests. (1-3). Results showed that testing for inherited thrombophilia was not being performed wisely or in accordance with these guidelines with only 1/97 tests being performed appropriately.

As a result of this, **from Monday 4th July** testing for inherited thrombophilia will only be permitted in the following situations based on the national NZ laboratory testing guidelines and Waikato DHB laboratory testing guidelines. (3-5)

Testing Indications for inherited thrombophilia:

- Idiopathic venous thrombo-embolism in young patients (<45 years)
- Warfarin-induced skin necrosis (Patients should be tested for protein C deficiency and protein S deficiency one month after stopping vitamin K antagonist therapy if this can safely be discontinued.)
- Children presenting with purpura fulminans (they should be tested for protein C and protein S deficiency).
- Siblings of patients with homozygous FVL, homozygous PT20210A or compound heterozygotes for these mutations (they will be offered testing for FVL and PT20210A as they have at least a 1 in 4 chance of being similarly affected by these severe thrombotic disorders).
- Thrombosis in unusual sites (e.g. cerebral, mesenteric, portal).

In all other situations testing should only be undertaken after consultation with a Haematologist or as part of a clinical trial.

Situations where testing is NOT indicated:

- Recurrent VTE
- Recurrent VTE despite adequate therapeutic anticoagulation
- VTE in the context of a family history of unprovoked VTE in a first degree relative
- VTE in association with a history of thrombophlebitis
- Arterial thrombosis (Lupus testing is indicated in this setting)
- Women with a history of miscarriage, pre-eclampsia, abruption or intrauterine growth restriction (Lupus testing is indicated in this setting).
- Prior to use of combined oral contraceptives in patients with a family history of VTE (Current British guidelines recommend avoidance of the combined oral contraceptive pill in women with a history of VTE in a first degree relative regardless of the thrombophilia results)
- In unselected women considering the use of the combined oral contraceptive pill

Patient counselling
Testing for heritable thrombophilia may reveal the presence of a genetically determined disorder and patients should be counselled appropriately before testing is performed.
Patients should also be advised that testing for heritable thrombophilia may affect their insurance risk and that their access to insurance policies may be changed, regardless of the result of the test result.

Genetic Testing
Index case sequencing (if initial testing has been negative) should only occur at the request of a haematologist.

Requesting an inherited thrombophilia panel from Monday 4th July

The tests comprising an inherited thrombophilia screen are:

- Antithrombin III
- Protein S and C
- Factor V Leiden (FVL); this is a molecular test
- PT20210A (prothrombin gene): this is a molecular test

Testing for antiphospholipid antibodies such as Lupus anticoagulant, IgG anticardiolipin antibodies and beta glycoprotein antibodies is more likely to be informative in cases of arterial thrombosis or in women with pregnancy loss, intrauterine growth restriction, pre-eclampsia and abruption.

Wherever possible, thrombophilia testing should be avoided in the following settings as one or more of the laboratory tests may give misleading results:

- In people taking hormone replacement therapy (oestrogen)
- Acute thrombosis
- During warfarin or other vitamin K antagonist therapy
- During treatment with any form of heparin
- During pregnancy and for 8 weeks post-partum

Testing will only be performed on samples accompanied by appropriate clinical details stating which of the above indications for testing the patient meets.

In the absence of meeting one of the recognised indications, the sample will not be tested unless it has been discussed with a clinical haematologist and this has been clearly documented on the request form.

Samples arriving in the laboratory without appropriate clinical details will not be tested but the sample will be held for 14 days and will be tested if the requesting clinician subsequently provides appropriate clinical details.

Where low levels of antithrombin III, protein C or S are found, a repeat sample will be requested to confirm the abnormal finding.

Patients will only be tested for FVL and prothrombin gene mutation once in their lifetime.

Conclusion

It is hoped by these measures that testing inappropriately for inherited thrombophilia where the result of testing does not alter subsequent management of many patients will be significantly reduced and will bring the Waikato region in line with other areas of New Zealand that have already adopted these practices.

Please contact the haematology laboratory at Waikato Hospital on 07 8398606 for more information if required.

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Laboratory Haematologist, Waikato Hospital

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CLINICAL UPDATE

Competing interests:
Nil.

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URL:
www.nzma.org.nz/journal-articles/inherited-thrombophilia-testing-practice-in-a-large-tertiary-hospital-in-new-zealand-implementation-of-a-choosing-wisely-protocol-to-reduce-unnecessary-testing-and-costs

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Sleep habits of intermediate-aged students: roles for the students, parents and educators

Kate Ford, Paul T Kelly, Rebecca Williamson, Michael Hlavac

ABSTRACT

AIM: Obtain an overview of the current sleep habits and sleep hygiene practices in a group of intermediate-aged students, and establish whether these students achieve adequate sleep according to the New Zealand education and health guidelines.

METHODS: A standardised sleep health questionnaire and seven-day sleep diary were completed by 163 participants (aged 11–13; 62% female) from a cross-section of five Christchurch schools.

RESULTS: In this group, 71% of students reported 9–11 hours of sleep per night (averaged over seven days). Total sleep time was independent of gender and the day of the week. Bedtimes and wake-times were earlier from Monday–Thursday compared to the weekend ($p<0.0001$). Fifty-nine percent of students used a device in the hour before bed. Pre-bedtime device users were more likely to achieve less sleep than non-device users ($p<0.001$). The majority of students (66%) did not choose their bedtime.

CONCLUSIONS: In this group of students, the majority achieved a sleep duration within the advised Ministry of Education and Sleep Health Foundation guidelines, despite non-recommended sleep hygiene practices in the pre-bed routine. Parental guidance, with respect to bed times and reduction in device usage before sleep are two factors that could be employed to improve sleep in this group.

The foundations for health include proper nutrition, regular exercise and good sleep quality.[1] Sleep quality is often overlooked as a contributory factor to poor health. Disrupted and inadequate sleep is considered by some to be a modern societal problem which has arisen from urbanisation, increased access to technology, creation of social media and an engaging 24/7 lifestyle.[2] From a public health perspective, the cost of inadequate sleep is widespread from greater risk of motor vehicle accidents to mental illness.[3] In Australia, inadequate sleep is highly prevalent with an estimated economic cost of $66.3 billion (AUD) per year.[4] Accordingly, the Australian Sleep Health Foundation are advocating the importance of good sleep hygiene practices and implementing preventative measures to promote sleep health.

There is a perception that school-aged children are at the greatest risk of disrupted sleep.[5] Poor sleep hygiene practices including irregular sleep schedules, variable bedtime routines, the use of electronic devices and social media engagement pre-bedtime, are associated with sleep problems in children.[6] This could also be a reflection of discrepancies between parental enforcement of bedtimes on weeknights compared to the weekend.[7] In children, inadequate sleep has been associated with poor immune functioning, greater risk of obesity, disrupted memory consolidation, impairment of academic performance and risk of mood disorders.[8–11] Both the Sleep Health Foundation and the National Sleep Foundation's multidisciplinary expert panel recommended a sleep duration of 9–11 hours for school-aged children between the

ages of 6–13 years.[12,13] Subsequently, the New Zealand Ministry of Education released guidelines advocating for "quality uninterrupted sleep of 9–11 hours per night for those aged 5–13 years, with consistent bed and wake-up times" and "no more than two hours per day of recreational screen time".[14]

To the authors' knowledge, there is no structured education pertaining to sleep health mandated in the New Zealand curriculum. Thus, there is a possible health education gap, and a loss of education opportunity in this group of students. There is evidence of increasing use of social media between the ages of 11–13 years, which may have a downstream effect of increased susceptibility to poor sleep.[15] Previous research has examined the sleep duration of seven year-old New Zealand children and the sleep hygiene practices in 15–17 year-old New Zealand adolescents.[16,17] However, there is limited data on the bedtime routines and sleep practices of New Zealand intermediate-aged students. The purpose of this study is to obtain an overview of the current sleep habits and sleep hygiene practices in a group of intermediate-aged students during a normal term week and weekend. Furthermore, we want to establish whether this student cohort achieve the Ministry of Education guidelines pertaining to sleep health. The authors wished to ascertain whether or not inadequate sleep was common in this cohort.

Method

Study design

Cross-sectional, observational study of the sleep practices and knowledge of sleep health in a sample of intermediate-aged students.

Setting

Participants were recruited from intermediate classes in Christchurch, New Zealand in November 2018. Intermediate classes consisted of students in year 7 and 8 (aged 11–13 years). The Christchurch schools were inclusive of two state schools, two Catholic schools and a kura kaupapa, with decile ratings ranging from 3–10.

Data collection

More than 20 Christchurch schools were invited to participate. Given the busy time of the school year, only five schools agreed to participate and were included in the study. From the collective sample of 328 recruited students, consent forms were returned by 163 participants, an overall 50% response rate.

Education seminars were given at each school just prior to the data collection. These seminars consisted of a demonstration of the correct way to complete the seven-day sleep diary and standardised sleep health questionnaire, and a brief presentation outlining the importance of good-quality sleep and sleep hygiene practices. A time frame of seven consecutive days was arranged with each teacher for the sleep diaries to be completed with oversight in their classroom and consistency across students within and between schools. The teachers were also given an educators survey to complete; however, the low response rate produced an insufficient sample size to present these findings. After the week allocated for the study, the student questionnaires and sleep diaries, teacher surveys and consent forms were collected from the school.

Research measures

Demographic information

Age, educational year, gender and ethnicity were taken from the student questionnaires. Ethnicity data was recorded according to the New Zealand Ministry of Health Level l Ethnic Group code descriptions.

The sleep health questionnaire

Table 1 summarises the study questions.

Table 1: Study questions and sleep diary.

Once answered questions									**Answer**
When I am at school, I fall asleep									Yes/No
At school, there are times when a realise that I have fallen asleep									Yes/No
Do you have a bedroom of your own?									Yes/No
Are you allowed to decide for yourself what time you go to bed?									Yes/No
Would you prefer to go to bed at another hour?									Yes/No
Check the activities in the hour before bedtime (answered daily)									
Homework	Read	Eating	Soda	Device	Sport	TV	Gaming	Talk	Music
Standardised seven-day sleep diary with 30 minute graduations. Subjects shaded the total times that they were asleep for each day of the week.									
Daily questions on how the subjects slept									
Did you have trouble falling asleep?									Yes/No
Did you wake during the night?									Yes/No
What woke you during the night?									
Did you feel sleepy in the morning?									Yes/No

Statistical analysis

A Friedman test was used to assess differences between the days of the week, for sleep onset time, sleep offset time and total sleep time. The Wilcoxon test was used to compare the sleep onset time and sleep offset time between two paired days of the week. As there was a non-significant difference between Monday to Thursday and Friday to Sunday, the authors used these groups to define weekdays and the weekend. This test was also used to compare the sleep onset time, sleep offset time and total sleep time on weekdays (defined as Monday–Thursday) versus weekend days (defined as Friday–Sunday). The Mann-Whitney test was used to compare boys and girls for sleep onset time, sleep offset time and total sleep time, and sleep length differences between device users versus non-device users. This test was also used to compare the sleep onset time, sleep offset time and total sleep time between children that chose their bedtime versus children whose parents chose their bedtime.

Fisher's exact test was used to determine the effect of pre-bedtime device use on short sleepers (<9 hours) versus normal sleepers (>9 hours). Fisher's exact test was also used to look at the effect of short and normal sleep versus feeling sleepy in the morning.

Results

From a total of 328 recruited students, 163 (50%) completed and returned the consent form, sleep health questionnaire and seven-day sleep diary. Participants were aged 11–13 years (mean=12, SD= 0.1) with 37% male and 62% female. Age information was missing for one child (1%) and gender was missing for one other (1%). The sample was 81% European, 10% Māori, 7% Asian, 1% Pacific peoples and 1% Middle Eastern/Latin American/African.

When averaged over the week, in the hour before bedtime (Figure 1) the majority of students (59±2%) used a device, and to a lesser degree watched TV (48±2%), ate food (47±5%) and/or read a book (41±6%). Despite this finding, only a relatively small number reported trouble falling asleep (25±7%) and waking during the night (20±7%). However, the majority reported feeling sleepy in the morning (53±9%). When asked as a one-off question, only 3% of the students reported falling asleep at school.

There was a statistically significant difference ($p<0.0001$) between sleep onset time and sleep offset time on weekdays (Monday–Thursday) compared to the weekend (Friday-Sunday) (see Figure 2).

Figure 1: Activities one hour before bedtime; daily average over the week (mean ± SD).

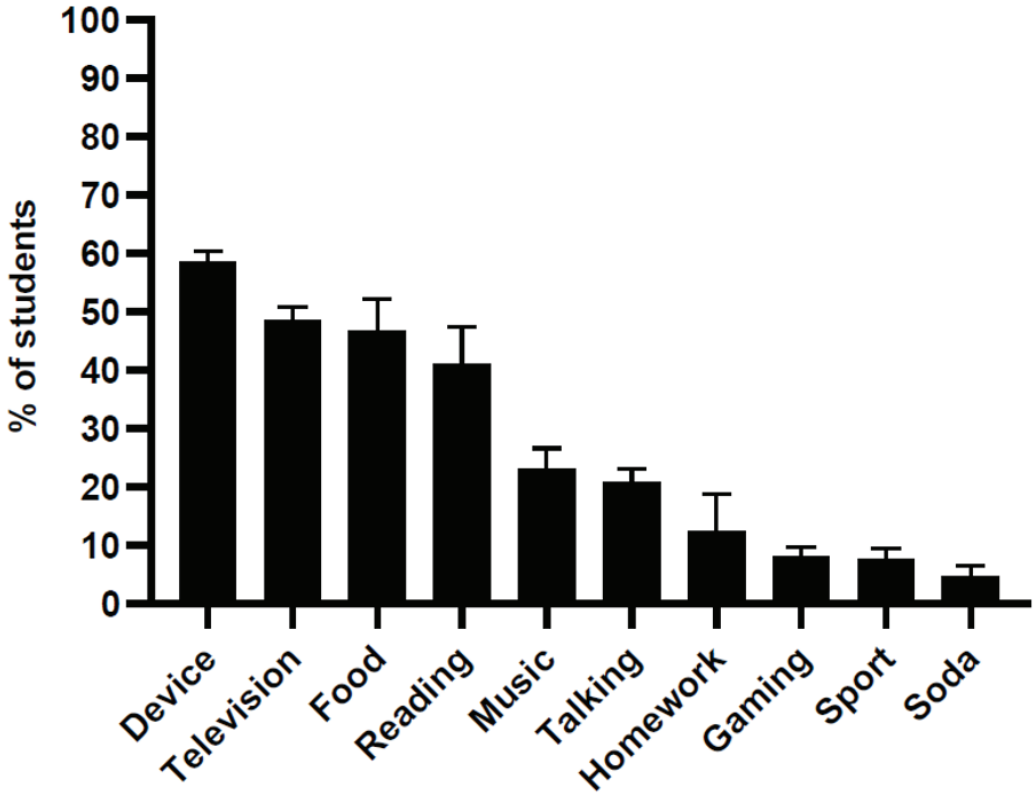


Figure 2: Sleep diary (sleep onset and sleep offset in 24-hour time on the y axis).

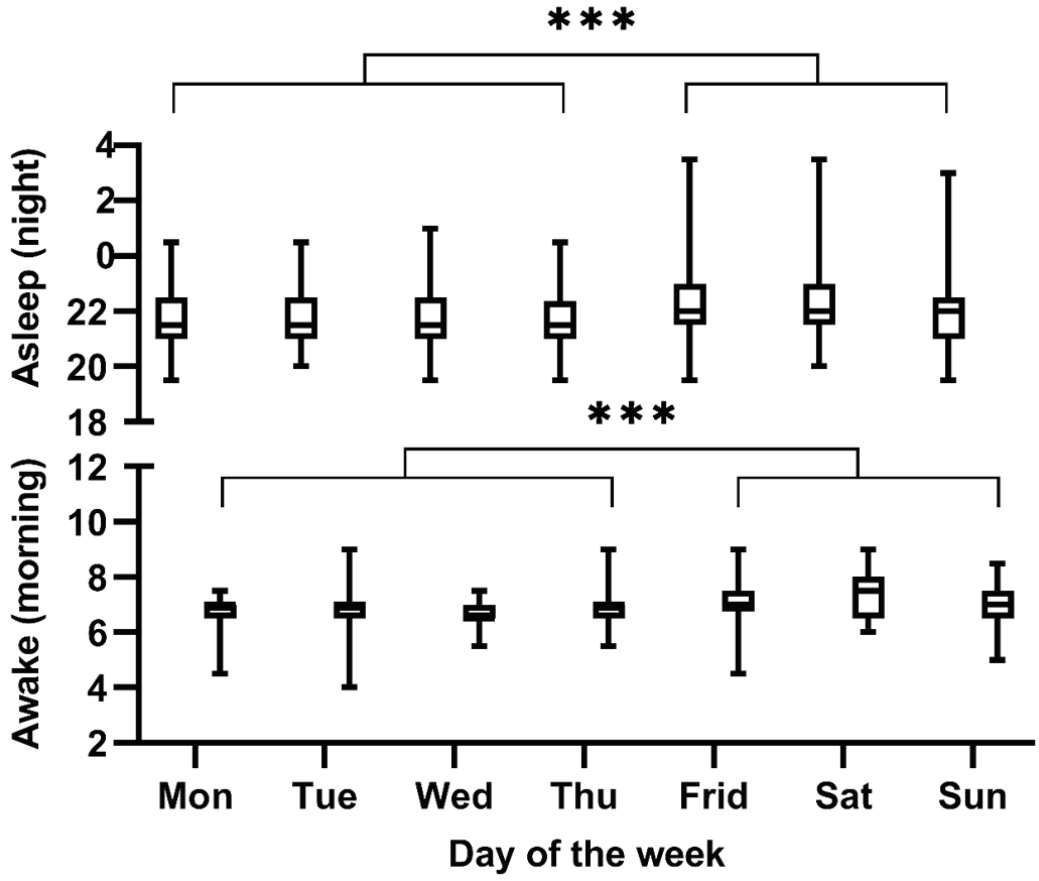
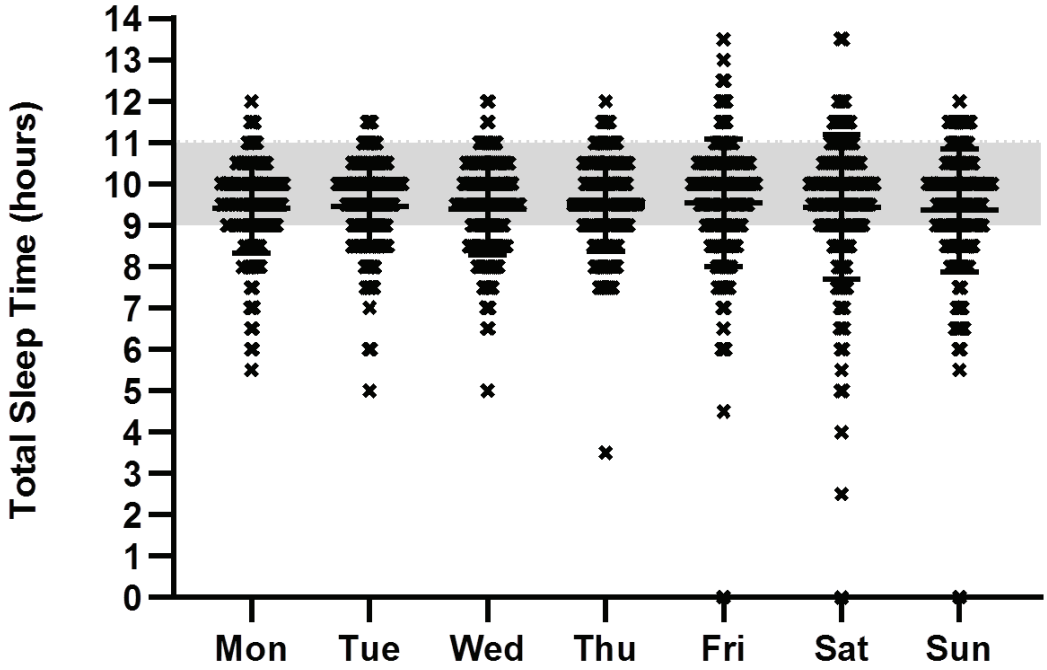


Figure 3: Total sleep time (TST). Shaded area is the Ministry of Education guidelines.



Between boys and girls, there was a statistically significant difference ($p<0.05$) for sleep offset time and a non-significant difference ($p=0.0871$) for sleep onset time. The average sleep onset time was earlier on weekdays (21:48±62 minutes) than the weekend (22:12±78 minutes). The average sleep offset time was earlier on weekdays (06:54±37 minutes) than the weekend (07:18±53 minutes). For children with parent-implemented bedtimes, the average sleep onset time was earlier compared to children that chose their bedtime (21:48±59 minutes versus 22:15±50 minutes: $p<0.001$). Children with parent-implemented bedtimes were also more likely to have a longer sleep (9.6±1 hour versus 9.2±0.87 hours: $p<0.05$). Total sleep time was independent of gender ($p=0.503$) and the day of the week ($p=0.56$), with an average daily sleep time of 9.4±1.3 hours and 71.6% meeting the recommended guidelines (see Figure 3). On each weekend night, one student reported achieving zero hours of sleep and this student was different each time.

Participants that used a device before bed were more likely to have a shorter sleep (9.2±1.3 hours versus 9.8±1.3 hours: $p<0.001$). Pre-bed device users were also more likely to report that they felt sleepy the following morning ($p<0.01$). However, this effect was isolated to device use, as watching television before bed had no significant effect on sleep length ($p=0.834$).

Almost all of the students (96%) reported that they do not fall asleep at school. The majority of students (85%) have a bedroom of their own. Most students (66%) do not determine their own bedtime and approximately 50% would prefer to go to bed at another hour.

Discussion

The aim of this study was to obtain an overview of the current sleep habits and sleep hygiene practices in a group of intermediate-aged students, and establish whether these students achieve adequate sleep according to the New Zealand education and health guidelines. In this group of students, adequate sleep was achieved by most, despite a large proportion of the cohort using a device or watching television in the hour before bedtime. Importantly, students that used a device before bed were more likely to achieve less sleep and feel sleepier compared to those that did not. Of interest is that sleep onset time and sleep offset time was earlier during weekdays than the weekend; however, total sleep time was independent of the day of the week. Most students reported that they did not choose their own bedtime.

It is noteworthy that a significant number of intermediate-aged students achieved sleep within the Ministry of Education, the Sleep Health Foundation and the National Sleep Foundation guidelines of 9–11 hours per night. Specifically, between 70–77% of the students achieved these recommended guidelines each night, over the seven-day period. Consistent with previous research in seven year-old New Zealand children, the average total sleep time was within the guidelines of 9–11 hours, for those aged 5–13 years.[14,16] However, approximately one in four students did not achieve sleep within these recommended guidelines. In addition, reduced sleep was most prominent in the weekend with around 6% of the students achieving less than seven hours of sleep, including a small number of students reporting not sleeping at all. Therefore, while the average across the week of 72% of students reporting adequate sleep is reassuring, it is far from the goal of every child achieving sleep within the recommended guidelines.

Previous researchers have established that the use of electronic devices pre-bedtime has a negative impact on sleep in adolescence.[18,19] Accordingly, sleep hygiene practices recommended by the Sleep Health Foundation include avoiding electronic devices before bedtime.[20] Moreover, device use before bed has been associated with obesity, reduced levels of physical activity and a poor diet.[21] Recently, a relationship has been found between device use within one hour of bedtime and inadequate sleep duration and a lower health-related quality of life.[22] Consistent with previous research in 15–17 year-old New Zealand adolescents, the results in the present study support a reduced sleep duration on the nights where devices were used in the hour before bed.[17] Hence, bedtime device use has implications for physical and mental health, in addition to the consequences associated with poor sleep. This suggests the need for parental guidance and moderation of the use and availability of electronic devices before bed.

The present findings confirm that there is a need for sleep health education in New Zealand schools. Educating children on the importance of sleep health will promote the notion of prioritising time for good-quality sleep and prevent sleep problems linked to poor sleep hygiene.[23] Accordingly, we propose a set of recommendations for students, parents and educators. Firstly, all school-aged children should receive sleep health education within the New Zealand curriculum. At present, the Ministry of Education guidelines advocate for a consistent sleep schedule and good quality sleep. However, there are no further guidelines for sleep health or sleep hygiene practices. Intermediate-aged students' lack of instruction of good sleep-hygiene practices is a missed educational opportunity in the New Zealand curriculum. Therefore, the educational guidelines should be updated to incorporate instruction of good sleep hygiene, knowledge of sleep health and completion of a sleep diary to encourage self-awareness of their sleeping habits.

Of note, most students did not choose their own bedtime, with half preferring to go to bed at a different hour. The students that chose their own bedtime went to bed almost half an hour later and had a shorter sleep duration than students whose parents chose their bedtime. Therefore, adequate sleep was achieved in this group due to parental enforcement of bedtimes. As such, the aforementioned gap in sleep health education may not affect many students until there is a decline in parental involvement and an increase in independence during late adolescence. Based on this premise, parents were a mediating factor as they provided guidance for bedtimes which ensured that most students achieved adequate sleep. Therefore, we recommend that parents initially implement bedtimes for this age group and then teach and monitor their children as they take increasingly more responsibility during adolescence. Previous research reported that parent knowledge about good sleep habits was poor, therefore, children's sleep may also benefit by providing parents with sleep health education.[24] Due to the impact of pre-bedtime device use, we also recommend that parents monitor the use of electronic devices before bed, where possible.

Teachers may be in a better position to assume the responsibility of teaching children about sleep, through mandated sleep health education. Of the four teachers that returned surveys, most were unaware of the current Ministry of Education guidelines pertaining to sleep health and did not

teach their students sleep hygiene practices. Therefore, we recommend providing teachers with their own education regarding sleep health and sleep hygiene practices. This is crucial to inform and guide their teaching of the Ministry of Education guidelines to their students.

While the present study was the first to our knowledge examining sleep duration and sleep hygiene in a local group of intermediate-aged students, it was not without limitations. The main limitation of our study is the reliance on self-report by the students, which may lead to an overestimation of total sleep onset time and an underestimation of night wakings.[25] However, this method of reporting provided the students with awareness of their own sleeping patterns and the ability to self-monitor their own sleep health. Future research could examine whether similar findings are replicated using an objective measure accessible outside of a clinical setting, for example, an activity tracker. Also, while the intention of the education session was training focused on how to complete the sleep diaries and questionnaires, there was a small component of sleep health education to improve the data accuracy. In addition, the study population was local to Christchurch, New Zealand, there was an uneven distribution of boys and girls, and 135 of the 163 students (83%) were from a decile 9 or 10 school. Therefore, these findings may not generalise to the New Zealand population. Further limitations were a relatively small number of students (*n*=163), a 50% response rate from the 328 recruited participants and a short sampling time frame of seven days.

In conclusion, sleep health education should be prioritised in the New Zealand curriculum in order for adequate sleep to be achieved by every student. Providing this education prior to the teenage years may help students to achieve good-quality sleep as they become more independent. Alongside education, there is a need for consistent information pertaining to sleep health that can be resourced by children, parents and teachers. While parents provided guidance with regard to bedtimes, it is recommended that they moderate the use and availability of devices before bed. Education of sleep health and sleep hygiene practices from childhood is the key to preventing lifelong consequences associated with poor-quality sleep.

Competing interests:
Nil.

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Transition of the medical model of care at Ashburton hospital over 10 years: the perspective of rural generalists

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ABSTRACT

Rural hospitals in New Zealand face difficult workforce challenges to maintain services and quality outcomes. Ashburton Hospital has undergone a 10-year transition from a secondary specialist to a rural generalist medical model of care. Current senior medical staff (rural hospital medicine fellows) here explore their experience of the process and outcomes of this transition. Key drivers for change included commitment and support from management, senior medical staff and the local community, the new rural hospital medicine qualification and a core group of doctors willing to train in it. Challenges included the need to adapt rapidly to even a single doctor's departure, initial lack of credibility of the new qualification, and choice between a single or two-tier system of medical rostering. While acute and elective surgical services were lost, acute medical and rehabilitation services were maintained or increased. Presentations to the acute assessment unit, including high acuity cases, have more than doubled over the period described. Workforce stability has been enhanced and commitment to training contributes to future workforce sustainability. Long-term shared strategic commitment to transition was a key factor in successfully traversing challenges faced. Rural and provincial communities should consider rural generalism as a medical model to sustain and further develop their local hospital services.

The World Health Organization (WHO) has identified lack of rural health workforce as a major barrier to universal and equitable health coverage.[1] Rural hospitals throughout New Zealand and internationally face difficult challenges related to workforce retention and recruitment.[2–5] Moreover, there has been a tendency within health services to focus on specialised, urban-based services in terms of policy, funding, reporting expectations and service planning. Internationally, rural hospital viability has been under threat from declining rural population and economic activity,[6] and a reduction of rural health infrastructure and centralisation of services.[4] When public hospitals were corporatised as Crown Health Enterprises, many New Zealand rural hospitals were closed as they were considered to be inefficient and expensive.[6] Unsurprisingly, rural communities resisted changes to their healthcare services. Closure of the sole rural community hospital has been shown to be associated with increased local unemployment and reduction in per capita income,[7] decreased access to healthcare for the population[8] and increased travel time to health services.[9]

In response to health service centralisation, serious workforce shortages and high use of locums without formal qualifications or vocational training, the Medical Council of New Zealand (MCNZ) recognised a new rural scope of practice in 2008. The Division of Rural Hospital Medicine (DRHM) was created within the Royal New Zealand College of General Practitioners (RNZCGP).[2] Since rural hospital medicine (RHM) was

recognised as a specialist vocation, New Zealand rural hospital workforce levels have improved.[10] 'Rural generalism' is often represented as a broad extension of community medical practice in remote rural areas to include, for example, some aspects of traditionally 'specialist' hospital practice, in keeping with the Cairns Declaration.[11] Nevertheless, as Atmore notes, the term 'generalism' is not necessarily 'settings-bound', neither confined to medical professionals, nor to general practitioners (GPs) alone.[5,12] For the purposes of this paper, the focus will be on rural hospital practice, where broad medical responsibility for all patients presenting to a rural hospital is regarded as a subset of a broader concept of rural generalism.

Ashburton Hospital is the sole community hospital providing care for the whole rural Ashburton District. Its tertiary referral centre is Christchurch Public Hospital, 88km North by road. Over the 10 years from 2008 to 2017 Ashburton Hospital changed its medical model of care from a secondary specialist to a rural generalist model, with a senior medical workforce populated solely by RHM fellows. The authors all have current Ashburton Hospital appointments and are RHM fellows, who had participated in the transition, working before, during and after the changes in a variety of roles, including as clinical directors. They collectively documented differences in the medical model of care before and after transition, based on their experiences, records and communications with other stakeholders, and here present their viewpoint on milestones in transition of the model of care, drivers for change, challenges faced in the process and lessons learned. Changes in hospital indices of capacity and outcome were obtained from hospital documents and DHB databases to compare the situation pre- and post-transition.

Medical model in 2008

In 2008 the specialist medical model had included an acute and elective general surgical roster led by three general surgeons and supported by four anaesthetists (three FTE). Four general physicians looked after acute medical and rehabilitation admissions, and ran outpatient clinics. An experienced and relatively stable medical officers on special scale (MOSS) workforce had replaced all resident medical officer (RMO) positions, and a two-tier roster was maintained, with admissions under the surgeon or physician on-call. Limited paediatric cover was provided and all but the mildest of paediatric cases requiring admission were transferred to Christchurch. Maternity services were midwife-led, focused on primary birthing of uncomplicated pregnancies, with occasional urgent Caesarean section operations performed by one hospital surgeon. Subspecialty outpatient clinics operated with the support of Christchurch visiting specialists.

Medical model in 2017

By 2017, the SMO workforce had evolved to eight part- or full-time vocationally registered RHM fellows, with six FTE in total, working a 1:5 acute roster, taking all medical, non-operative surgical and paediatric admissions during that period. The second tier of the roster was made up of a team of eight RMOs, ranging from PGY2 house officers completing their three-month 'community rotation' in Ashburton, to RHM trainees and other general registrars at post-graduate year (PGY) 3–5 level. After-hours one RMO on duty and one RHM SMO on call covered the hospital and acute assessment unit (AAU), and an RMO night shift was in place. Three inpatient teams consisting of two to three RHM SMOs, one registrar and one other RMO provided continuity of care from admission to discharge. No acute or elective surgery was conducted, but elective endoscopy services were maintained. Maternity services continued to be midwife-led and focused on uncomplicated deliveries, with no on-site acute Caesarean section service available. Maternal and neonatal resuscitation support was provided by the rural generalist team. Outpatient specialist surgical services were unchanged. A timeline showing milestones in transition is shown in Table 1.

Table 1: Milestones in changes in medical staffing and model of care.

2008	Surgeons - three FTE; Physicians - four FTE, Anaesthetists - three FTE; MOSSs - five FTE. Rural hospital medicine recognised by MCNZ as a separate vocational scope. Three MOSSs and one SMO commit to further training in order to meet criteria for RHM vocational registration and DRHM fellowship.
2008–9	One surgeon retired, replaced by surgeon on joint appointment with Christchurch.
2010–11	Decision made to cease acute surgery over time, and maintain an elective surgical service only. Departure of two physicians, and intermittent locum cover. Strategic conversations held about replacement with specialists or generalists.
2011–12	Elective surgery ceased as operating theatres deemed unsafe in the wake of the Feb 2011 earthquake and changes to building code. Retirement of one anaesthetist and subsequent loss of anaesthetic service. Continuation of endoscopy and outpatient surgical clinics. Inpatient medical cover shared between physicians and MOSSs. Hybrid generalist roster with 1:5 call. Three MOSSs receive RHM fellowship.
2012–14	Two more RHM fellows appointed to replace departing physicians. Two-tier system with MOSSs and SMOs. Discussion regarding single vs two tier service. RHM fellows - 5.3 FTE; MOSSs & RHM trainees - seven FTE. Five MOSSs on RHM training scheme.
2015	Proposal to disestablish MOSS grade and replace with RMOs on MECA-compliant roster. Shift in focus from service delivery to clinical training and education.
2016–17	New model of care fully staffed and functioning: RHM SMOs - six FTE; RMOs - eight FTE.

Drivers for change

Key local drivers for the medical model change are listed in Table 2, both 'negative' drivers which essentially forced change (1–5), and 'positive' drivers which facilitated a change in the direction of rural generalism (6–9). The age of the workforce was a particularly pressing issue in surgery where all three surgeons were near retirement, and the retirement of one made sustaining acute surgical services difficult. A replacement was found, however pending retirements for the two others, the requirement for general surgical skills, and the narrowing scope of operations, made both acute and elective surgery less viable and the former was intentionally phased out. Anaesthetics was similarly vulnerable following the resignation of one SMO upon whom credentialing support depended. The February 2011 Canterbury earthquake compounded recruitment challenges as changes in the building code led to the existing operating theatres being permanently closed for structural reasons. There was also uncertainty of timelines for rebuilding and ongoing consultation around the scope of future surgical services. Replacement of general physicians also proved difficult, and provisions in the RMO's 2002 Multi-Employer Collective Agreement (MECA), had earlier discontinued regular, guaranteed RMO support from Christchurch. In response to staff shortages, Medical Officers of Special Scale (MOSSs) were employed on contract or as locums to cover positions previously held by both specialist SMOs as well as RMOs. In the transitional situation of Ashburton, some MOSSs were employed in positions supervising other MOSSs.

Positive drivers for change included the opportunity presented by the new pathway to Fellowship in RHM, and the interest shown by several medical officers to undergo this training. This was augmented by strategic commitment of the hospital management towards a generalist medical model, and support of existing specialist SMOs for the training. Another key positive factor was a very engaged local community, with strong philanthropic organisations, who helped fund new developments, including extensive rebuilding required post-earthquake.

Table 2: Drivers for medical model change.

1.	Aging/retiring SMO* workforce
2.	Difficulty recruiting replacement general surgeons, physicians, anaesthetists
3.	Dependence on individual specialists for credentialing leading to vulnerability on retirement/ resignation
4.	Difficulty recruiting RMOs** and increasing reliance on locum staff at MOSS*** level
5.	2011 Canterbury earthquake(s) with consequent closure of operating theatres
6.	Opportunity of RHM training & qualification providing a pathway for new generalist SMOs
7.	Strong community support to maintain a strong, sustainable hospital service
8.	Willingness of existing specialist SMOs to support transition
9.	Management support for transition

*SMOs or Senior Medical Officers operate unsupervised in hospital settings. They are usually vocationally registered with the MCNZ, but they may have only general registration, particularly in some rural hospitals.
**RMOs or Resident Medical Officers work under supervision in hospitals, have general registration, and many commence formal training in a vocational specialty.
***MOSSs or Medical Officers on Special Scale are not uncommonly employed and/or remunerated as SMOs in New Zealand rural hospitals, working fully or largely independently. They are usually generally registered and not in a vocational training programme.

Challenges of transition

Key challenges arising during the transition are outlined in Table 3. A cascade in workforce issues, where a single loss of personnel affected the sustainable staffing and therefore viability of an entire service, was experienced on more than one occasion. These changes were often unexpected and necessitated rapid changes in service delivery, sometimes without a significant transition period. The qualification in RHM was new and largely unproven in the early stages of transition, which led to questions of credibility among some health professionals and uncertainty of future senior employment opportunities for trainees. Some stakeholders within and outside the hospital saw the move to generalism as a significant reduction in standards of care, with the loss of services such as acute surgery and emergency Caesarean sections creating considerable unease. In response, focused training on anticipated clinical needs was undertaken, which has resulted in the development of considerable skill and experience in emergency procedures, for example fracture manipulations under procedural sedation. The operating theatre has been rebuilt with community support, which will facilitate elective surgery to return in future, alongside its current utilisation for endoscopic and minor gynaecological procedures.

Hybrid rostering, where some on call shifts were covered by generalists and some by physicians who needed support from generalist colleagues to cover for certain emergency situations (including paediatrics and trauma), led to a temporary increase in cost, both financial and in terms of rostering demands. A particular issue of controversy was whether to maintain the RHM SMO/RMO two-tier structure and focus on training, or to adopt a single-tier RHM system which moves focus towards service delivery. Alongside the medical staffing challenges, the departure of key managers at critical junctures made it difficult to sustain commitment to the future vision of the service.

Table 3: Challenges identified.

1.	Cascade of workforce issues, with one staff member departure affecting a whole service
2.	Cost of maintaining support of non-generalists on generalist roster
3.	Uncertainty of available positions and staff at RHM SMO level
4.	Credibility of the RHM qualification
5.	Departure of key managers
6.	Single tier vs two tier system
7.	Patient care: no Caesarean section or urgent surgery availability

Table 4: Available physical and human resources.

	2008	2017	Change
FTE medical staff:			
Total	15	14	-1 (-7%)
SMO	10	6	-4 (-40%)
RMO/MOSS	5	8	+3 (+60%)
Number of beds:			
Total	76	53	-23 (-30%)
Acute medical	21	21	0
Surgical	25	0	-25 (-100%)
Rehab	15	19	+4 (+27%)
Maternity	6	5	-1 (-17%)
Acute assessment unit	9	8	-1 (-11%)

*Figures derived from hospital management records from 2008 and 2017, and clinical staff consultation.

Changes in overall hospital indices and outcomes

In terms of human and physical resource change, outlined in Table 4, most notable was the complete loss of surgical inpatient beds, with only a few day procedures remaining. The rehabilitation ward had four extra beds, and a much greater proportion of long-stay patients, non-weight-bearing as conservative or post-operative orthopaedic management. Acute medical beds, AAU beds and maternity beds have changed little. While overall medical workforce FTE numbers were decreased by one, the proportion of SMOs in relation to RMOs decreased considerably.

Table 5: Output indicators (from CDHB Decision Support Unit).

	2008	2017	Change
Population catchment*	28,420	33,130	+ 4,710 (+16.6%)
Bed days and occupancy			
Acute medical	4,852; 63%	4,839; 63%	-13; 0%
Rehabilitation	3,041; 56%	5,782; 83%	+2,741; +17%
Surgical	456	0	-456
Length of stay			
Total average	2.0	3.1	+1.1 (+55%)
Acute medical ward	3.9	3.2	-0.7 (-18%)
Annual admissions	2,355	2,278	-77 (-3%)
Annual acute presentations			
Total	3,518**	7,236	+3,718 (+106%)
Triage 1+2	262**	659	+397 (+152%)
Acute admissions to Christchurch of Ashburton domiciled patients	278	450	+172 (+62%)
Transfers to Christchurch Hospital	404	454	+50 (+12%)
In hospital deaths	55	69	+14 (+25%)

*Population based on Statistics New Zealand online database figures,13 projected between and beyond the 2006 and 2013 census figures to obtain estimates for 2008 and 2017, based on a constant linear progression.
**Figures from 2010, (earliest year available).

Table 5 shows several indicators of hospital service, comparing 2008 and 2017. Acute medical occupancy was unchanged between the two periods at 63%, while rehabilitation occupancy has risen from 56 to 83%. The total average length of stay has increased from 2.0 to 3.1 days, influenced heavily by the loss of day-stay surgical patients and an increase in rehabilitation patients, in particular the non-weight-bearing patients. A more comparable figure of length of stay is for acute medical patients, where the duration has decreased from an average of 3.9 to 3.2 days. While population increased by 17%, annual admissions decreased slightly from 2,355 to 2,278. However, total emergency presentations to the AAU rose from 3,518 in 2010 (the earliest year that these figures are available) to 7,326 in 2017. Triage 1 and 2 presentations increased from 262 to 659 during the same period. Transfers to Christchurch also increased, but not to the same degree, from 404 in 2008 to 454 in 2017. Direct acute admissions to Christchurch Hospital of people domiciled in Ashburton rose from 278 to 450. While general practitioner (GP) referrals to Christchurch Hospital for specialist care will represent some of this increase, most patients are still referred to Ashburton Hospital. Self-presentations to hospital increased over the period, especially since the end of 2016 when general practice after-hours cover was no longer provided after 8pm (previously 11pm). In addition, GPs no longer covered overnight calls to age-related care facilities. Overall deaths in hospital increased from 55 to 69.

Lessons learned

The primary reason for change to Ashburton Hospital's medical model, was the vulnerability of its medical workforce. Workforce stability has been significantly enhanced with virtually no current reliance on locum medical staff, following the transition. The opportunity for, and promotion of, Ashburton Hospital as a site to undertake 'community attachments' for PGY2 RMOs has aided RMO recruitment, with the RMO roster routinely fully staffed. PGY2 employment has had implications for increased, on-site SMO supervisory requirements. However, this has added to job satisfaction for SMOs and hopefully contributes to the training of a new generation of rural doctors. Transitioning to the RHM model of care in Ashburton allowed for more comprehensive SMO support around-the-clock in some respects than previously. In particular, paediatric management in Ashburton was 'out of scope' for physicians prior to the transition, and it took several years for paediatric admissions to reach acceptance among all hospital staff.

The challenge faced around credibility of the RHM qualification has lessened since nationally, as the qualification is now widely recognised and respected, and governing bodies are more aware of the need for rural exposure in undergraduate and post-graduate training. While some changes in Ashburton Hospital's transition were considered and made following extensive consultation, others occurred suddenly and unavoidably, which often had the ripple effect of further staff losses, uncertainty regarding future workforce and services, and public perception of hospital downgrades. Perhaps the most important lesson learned through this transition process to a rural generalist model is that it takes time, and requires a long-term strategic commitment to change on the part of key stakeholders. It is hoped that some potential resistance to a process of change in the direction of rural generalism can be mitigated by exposure to this and other examples of rural generalist medical models of care in New Zealand hospitals.

Discussion

We believe this has been a demonstrably successful transition from a secondary specialist to a generalist model of care in a New Zealand rural hospital, over an extended period of 10 years. The medical workforce became more stable, and commitment to training in this rural setting promises increased sustainability. The new generalist model serves more acute (including high acuity) patients and a similar number of inpatients compared to the previous model. The decreased length of stay in acute medical inpatients can be seen as a marker for increased efficiency in this setting. This may reflect the benefits of the integrated generalist model, with no specialist 'silos' or compartments, where a

small clinical team provides greater continuity of patient care from admission to discharge. A trend in medicine over the past decade has been for shorter length of stays, but this is unlikely to account for all of the reduction at Ashburton.[14]

This successful transition to a rural generalist model is not an isolated case. There has been a global move in recent years towards enhancing generalism, both in primary care as well as within specialist domains, such as surgery and medicine.[15,16] In a systematic review in 2007, Pashen et al found a rural generalist model to be the most effective and suitable model for delivery of health services to rural Australia.[17] Benefits of a generalist model of care on health services include: enlarged and inclusive scope of practice, holistic approach to patient care, responsiveness to local context and improved patient access to services.[18] Rural community hospitals can provide effective and efficient care equivalent to larger hospitals, with improved patient experiences.[19] In addition, with appropriate training, rural generalists can safely deliver a wide range of low-volume specialised services.[17]

Many of the medical workforce shortage problems described in Ashburton Hospital's transition will be common to other rural health services elsewhere in New Zealand. The DRHM training pathway offers an ongoing pipeline for new SMOs appropriately trained for rural hospitals, that helps address shortages in a generalist model, which has inherent flexibility to adapt to local needs and priorities. The potential for hospitals to recruit registrars who are training for these roles, or RMOs who are doing their foundational 'community' attachments, also represents an opportunity for meeting service provision goals, while decreasing reliance on locums. However, it is important to consider the wider implications of such a two-tier system, including the necessary commitment to supervision and training and potential increase in medical staffing required, alongside anticipated positive outcomes for future workforce sustainability.

Alternative generalist or mixed specialist/generalist models of care are being proposed and/or trialled at various New Zealand rural and provincial hospitals, with differences in drivers and constraints of change, geographical distances from tertiary centres, population size and community needs. Developing the most appropriate model for each rural hospital is a key strategic and shared task for management, senior medical staff, community representatives and other stakeholders in rural areas.

Limitations

This study represents the viewpoint of RHM fellows, with current appointments in Ashburton, based on their experience of the transition and available documents. This is not a systematic sampling of a broad range of clinical and non-clinical informants affected by the transition such as specialists, other RMOs, other hospital staff and managers, GPs and community representatives for their opinions and for data regarding the transition and its outcomes. Statements made about historical movements in staff, their drivers, and significance have not been derived from or checked with all of those staff members, and would have benefitted from a wider consultation process. In addition, only a superficial analysis of output indicators has been possible, and the impact of the transition on the wider hospital community is not clear. Furthermore, the financial implications of a changed medical model of care would require a much more detailed analysis, considering all related inflation adjusted costs in comparison with outputs.

Conclusion

The transition of Ashburton Hospital's medical model of care from a secondary specialist to a rural generalist model over 10 years has been successful. Key indicators of this include moving from high locum dependence to a stable, sustainable RHM SMO and RMO workforce and an efficient use of human and other resources, flexible enough to cope with a changing workload. Key factors in the success have been the new and increasingly recognised RHM qualification, the support of key stakeholders and long-term strategic commitment to change. Challenges faced have been considerable, and lessons learned may help others negotiate similar transitions. The rural generalist hospital model is a viable option to serve rural and provincial communities of New Zealand.

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Neoliberalism: what it is, how it affects health and what to do about it

Pauline Barnett, Philip Bagshaw

ABSTRACT

Since the 1970s, neoliberalism has been the dominant economic and political philosophy among global institutions and some Western governments. Its three main strategies are: privatisation and competitive markets; reduced public expenditure on social services and infrastructure; and deregulation to enhance economic activity and ensure freedom of 'choice'. Generally, these measures have negatively affected the health and wellbeing of communities. In New Zealand, privatisation and competition led to income inequality and an unequal distribution of the 'determinants of health', a burden borne disproportionately by children, the poor, and by Māori and Pacific people. Limiting health expenditure led to inequalities in access to services with restructuring in the 1990s, subverting the service culture of the health system. Failure to regulate for the protection of citizens has undermined health and safety systems, the security of work and collective approaches to health improvement. There has been some retreat from neoliberalism in New Zealand, but we can do more to focus on 'upstream' health initiatives, to recognise that social investment, including adequate funding of services, returns benefits far in excess of any costs, and to make sure that social and cultural equity goals are achieved.

This paper sets out the consequences of neoliberalism for health. Among health workers, including doctors, nurses and managers, there are some with a poor understanding of neoliberalism or who assume that this is the only way to organise our economies and institutions. Neoliberalism has been described as the 'idea that swallowed the world'.[1] We argue that the world also 'swallowed' (uncritically accepted) neoliberalism, and that this should be challenged. We trace the rise of neoliberalism, including its emergence in New Zealand and its implications for health. Finally, we suggest some changes that could mitigate the worst consequences of neoliberalism for health and ensure responsiveness to growing and unmet need.

The rise of neoliberalism

Classical liberalism is an ideology and policy model that emphasises personal and economic freedom and a small role for the state, allowing individuals to pursue their own interests.[2] Originating among eighteenth century philosophers, through the nineteenth century, liberalism was reflected in laissez-faire economic policies that encouraged industrialisation and new models of labour and capital, in short, the modern economy. Classical liberalism relied on the market with minimum interference from the state, either by regulation or taxation. Government's role was to keep order, protect property and create a secure environment for the pursuit of commerce.[2]

The liberal model fell into disfavour in the mid-twentieth century when the upheaval of the Great Depression suggested a greater role for governments in managing economies. Drawing on the economic theories of JM Keynes, Western governments accepted the idea of intervention in economic management and promoting prosperity through welfare states.[3] Early international examples included New Deal policies in the US in the 1930s to address impacts of the Great Depression and comprehensive welfare state legislation in New Zealand in 1938. Over subsequent decades alternative versions of welfare states emerged in Western countries. The three main types are set out in Table 1 (adapted from Schrecker and Bambra,[4] with permission).

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Table 1: Main types of welfare states.

Social democratic (the 'Nordic' Model)
This includes countries such as Norway, Finland, Sweden, Denmark and Iceland. Income support and social services, including health, are funded predominantly from taxation.
Bismarckian (Social Insurance Model)
This model is typical of continental European countries such as France, Germany, Italy, Netherlands. Income support, social and health services are largely funded through employer and personal contributions with access guaranteed.
Liberal systems
These are typical of the US, UK, Australia and New Zealand. Income support, social and health services are less comprehensive and only partially funded. This has encouraged the emergence of two-tiered systems with significantly greater levels of income inequality and access.
NB There are other ways of classifying welfare states, but the one used here is the most simple and useful.

While welfare states proliferated in the 1940s and 1950s, there was a counter argument that state intervention would lead to totalitarianism. In the 1960s Milton Friedman and others rejected the view that government intervention could lead to improved economic performance. Friedman articulated again the primacy of markets and competition, and a lesser role for the state as the way to improve productivity and efficiency.[3] By the 1970s this thinking had crystallised into the political/economic model known as neoliberalism, with the following key elements:

Economic restructuring, markets and privatisation—increased competition; removal of the state from commercial activity, greater openness to international trade and investment, freedom of movement of capital, labour and goods ('globalisation').

Limiting public expenditure on social services, including healthcare and education, and infrastructure, with debt reduction the major goal (later called 'austerity' policies).

Deregulation and promotion of individual responsibility—limiting government regulation that might inhibit economic activity, despite risks to personal health and safety or the environment; giving priority to individual responsibility and 'choice' over concepts of 'public good' or 'community'.

Led by conservative politicians, a 'great reversal'[3] occurred, with Keynesianism replaced by neoliberalism. Led by Ronald Reagan (US president 1981–89) and Margaret Thatcher (UK prime minister 1979–1990) the 'uptake' of neoliberalism was widespread internationally, and reinforced by financial institutions such as the International Monetary Fund (IMF) and the World Bank. These organisations, throughout the 1980s and 1990s forced unwilling but indebted countries to restructure their economies along neoliberal lines.

Neoliberalism in New Zealand

As a liberal welfare state New Zealand was well-positioned to move along the continuum to neoliberalism. Surprisingly, it was a Labour government, elected in 1984, that thrust neoliberal policies onto an unsuspecting public. Through two terms of government (1984–90) the neoliberal approach, called 'Rogernomics' after Finance Minister Roger Douglas, was introduced quickly and without effective opposition.[5] Minister Douglas himself stated: "Once the program begins to be implemented, don't stop until you have completed it. The fire of opponents is much less accurate if they have to shoot at a moving target".[6]

Neoliberal reform focused on monetary policy and on restructuring the commercial and service activities of the state. The exchange rate was floated, financial markets deregulated and most producer subsidies and import tariffs phased out. Many state commercial activities were corporatised and privatised. The Government reformed the public sector based on a preference for what were perceived to be private models of management, with a preference for private

provision, competition, labour flexibility and contractual arrangements. In deference to its traditional supporters it did not attempt major labour or welfare reform. It did, however, attempt to create a market for healthcare but this was resisted by Labour supporters and health professionals.[5]

The new National government (1990–96) pressed on with neoliberal policies. Severe cuts to welfare occurred in 1991 along with legislation to deregulate and create a more 'efficient' labour market.[7] The aim of health reform policy (1991) was to increase efficiency through privatisation and a competitive market, and opportunities for innovation.[5] The development of not-for-profit (NFP) organisations providing health services to Māori, Pasifika, youth and mentally ill people were important innovations to benefit the community, but otherwise there was a retreat from the excesses of the 1991 policy, first under a coalition government (1997–99) and a Labour government 2000–2009. Nevertheless, as the theory and practice of the New Public Management became consolidated in the 1990s, its business culture became embedded in the health system where it still pervades language and the planning and delivery of services.[8]

The general impacts of neoliberalism

Despite growth in world economic activity from the 1990s onwards, research appraisals of the impact of neoliberalism are mixed. Some say that there is 'much to cheer about',[9] claiming that globalisation removed many people worldwide from poverty and that privatisation of state enterprises increased efficiency and lowered the fiscal burden on governments. Nevertheless, research suggests that there have been poor outcomes for the most vulnerable economies, with most middle- and low-income countries experiencing slower economic growth and reduced progress on social indicators from 1980–2005, compared with previous decades.[10]

There are two areas of exceptionally poor outcomes: income inequalities arising from uncontrolled capital movements (globalisation), and service failure from austerity measures, leading to further inequality.[9] Research into 140 countries from 1970–2014 indicates that increased capital movements and income inequality are positively correlated across all countries.[11] In addition, international lending programmes that required reduced public spending were also associated with increased income inequality. From the 1980s, such 'structural adjustments' were a condition of international loans, forcing countries to reduce public services, with poor social and economic consequences. Research from 1985–2014 indicates that structural adjustment continues to inhibit the ability of governments to plan and provide public services.[12]

In New Zealand, the impacts of the reforms were catastrophic, with over 111,000 jobs lost between 1986 and 1996.[14] The cuts to welfare benefits created extra financial pressures on families with children. Child poverty rose dramatically after the 1991 budget and persisted, with 28% of children in poverty, including 20% in severe poverty in 2015.[14] In 2015 New Zealand, previously considered a low-inequality country, experienced one of the more significant rises in economic inequality in the OECD since the 1980s, similar to that of the US. [15]

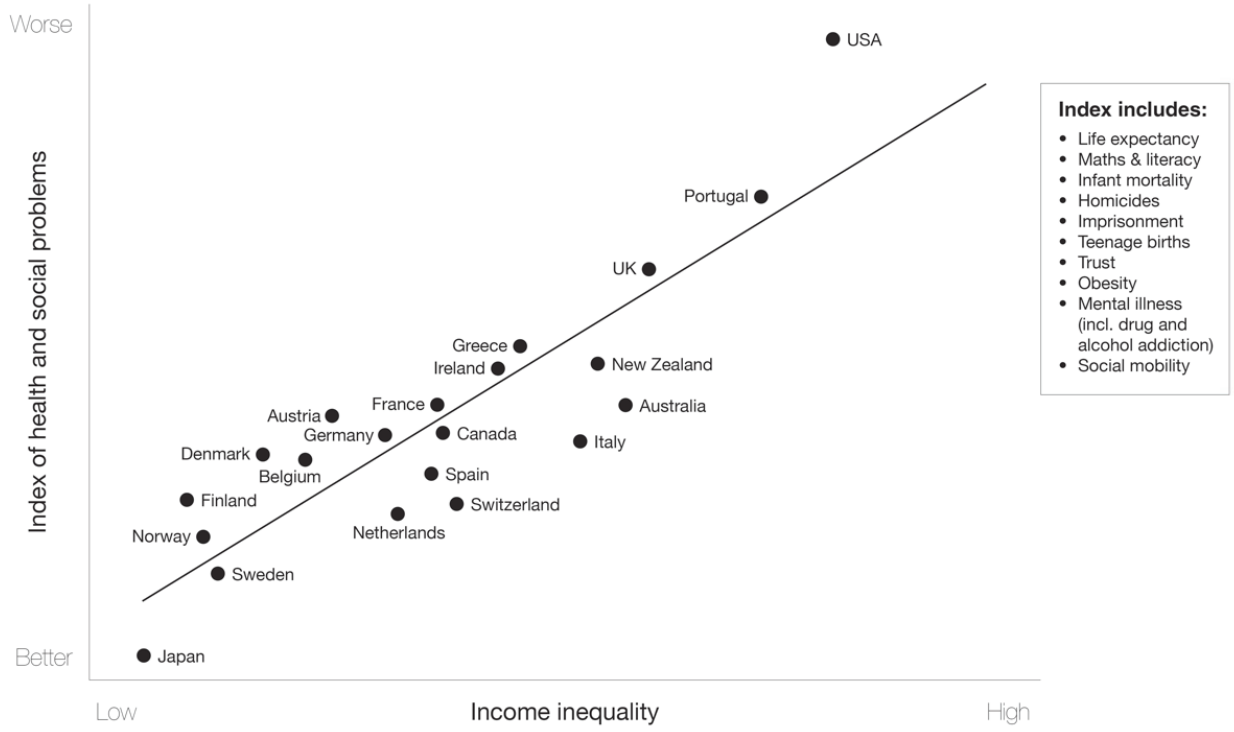
The impact of neoliberalism on health

Inequalities and health

The link between social and economic inequality and ill-health is well established. On virtually all health indicators across countries of all types, health outcomes from the most obvious (such as mortality rates and life expectancy) to the more subtle (mental health problems and chronic disease) are related to levels of inequality.[16] The graph (Figure 1; published with permission) from Wilkinson and Pickett powerfully demonstrates the relationship between increasing income inequality and a rise in the index of health and social problems.

Research worldwide has shown how poor health outcomes are related to deterioration in the social and economic determinants of health, such as income, housing, food security, employment, stress and educational opportunities.[17] Poor social conditions are not accidental, but result from neoliberal policies that affect not only mortality but also morbidities such as obesity, mental health and health risk behaviours. In New

Figure 1: Health and social problems are worse in more unequal countries.



Source: Wilkinson & Pickett, The Spirit Level (2009)

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Zealand these relationships have been demonstrated over decades,[18] with health risks from neoliberalism borne disproportionately by Māori and Pacific people[19] and exacerbated by the experience of cultural loss, colonisation and racism.[20]

Poor health outcomes are 'downstream' effects, but tackling 'upstream' causes requires policies to improve levels of social and economic wellbeing that will help people to live healthy lives. This involves recognising the continuing presence of income and social inequality: in New Zealand in the 1980s someone in the richest 10% earned five times as much as someone in the poorest 10%; now they earn eight times as much.[21]

Austerity policies and health sector reform

Besides the poor economic performance associated with austerity,[10] there is also a negative relationship between austerity and health. First, as already discussed, is the 'social risk effect', or 'risk-shifting'[22] where those already disadvantaged bear the consequences of deterioration in the determinants of health. The second is through the direct impact on health services. For example, after the Global Financial Crisis of 2008, health outcomes for countries where health budgets were reduced compared unfavourably with countries that protected spending on public services.[23] In New Zealand, health service impact is caused by both persistent underinvestment in services, competitive approaches and the marginalisation of health professionals in decision-making.

Underinvestment in health services

Government claims of overfunding in health services in the late 1980s were rejected by professional economists,[24] but the narrative of 'overfunding' was reinforced by self-interested private organisations and neoliberal governments. In fact, there is no indication of unsustainable funding between 2000–2015.[25] Measures of health expenditure for 2009–2018, adjusted for inflation and population change, based on Treasury models, indicated a cumulative decline.[26] The result was an effective reduction in funding for health services.

Persistent district health board deficits are most likely due to chronic underfunding of legitimate and growing needs by an estimated $2.5 billion over the last 10 years.[25,26] A further consequence of underinvestment over several decades is a demoralised workforce that found health workers in understaffed teams and poorly remunerated. Hospital doctors[27] and nurses[28] report stress, burnout and "intense, unrelenting work-loads".

Privatisation, corporatisation and inequalities in access

The 1991 health reforms were implemented specifically to create efficiencies by attempting to 'mimic' a private market in the public sector. This was unsuccessful because of community and professional scepticism. The introduction of 'user pays' for hospital stays in the early 1990s drew public ridicule and was abandoned. There was encouragement of private insurance models, but these received critical opposition.[29] The corporate model failed to improve hospital financial performance and as early 1996 the government's own monitoring agency reported that "the pace of performance improvement seems … to have weakened since the reforms".[30]

By attempting to drive unrealistic financial goals, aggressive management subverted health professional/management relationships, creating mistrust that compromised service quality and culture. This was seen notably in Canterbury where a group of concerned clinicians released a report 'Patients are Dying'. An investigation by the Health and Disability Commissioner (1996) explicitly blamed some patient deaths on systems changes and inadequacies, and led to some tempering of the excesses of the reforms.[31]

While the public health sector was not privatised and remained in public ownership, private sector business practices and culture were embedded in public organisations. The experience of the next two decades reflected continuing underinvestment, the transaction costs of contracting in the 'fake' market and the determination of funders to push financial risk onto local services or the community. For example, NFP community organisations were made to compete against each other in complicated tendering processes. The use of private facilities for contracting out services was encouraged and still persists, despite evidence that this may weaken elements of both public and private sectors.[32]

Despite some retreat from neoliberalism after the year 2000, there has been persistent marginalisation of health professionals through the dominance of rules and guidelines over clinical judgment. Since the late 1990s, for example, the National Waiting Times Project has given priority to rationing criteria over clinical decision-making in allocating elective surgery. These criteria and financial 'thresh-holds' have led, two decades on, to explicit concerns about unmet need.[33,34] Those with means can access private surgery while those without are often unable to access the care they need through public hospitals. In 2018, private hospitals reported performing 50% of all elective procedures (http://www.nzpsha.org.nz). Problems of access, however, go beyond surgical services. In primary care, cost barriers to access originate in the resistance of general practice to participating fully in Welfare State legislation in New Zealand in 1938. The long-term consequences of this are seen in multi-country studies of primary care from 1998–2016 where the proportion of New Zealanders unable to access a GP each year because of cost was on average 21%, second only to that of the US (34%).[35]

Regulation for health protection

Using regulation to improve population health is the cornerstone of public health action. Neoliberal governments often downplay their regulatory responsibilities, citing the paramountcy of 'personal responsibility' and 'personal choice'. In this they find willing partners among commercial interests.

The deregulation of the labour market has impacts for health. Research in both rich and poor countries shows that workers in 'precarious,' 'casual' or 'zero hours' work have poorer health outcomes.[36] The growth of the 'Precariat' is a worldwide phenomenon with up to one-sixth of working age people in New Zealand in this group.[37] The lives of the 'Precariat' are dominated by poor pay and lack of security, with stress a likely health outcome of 'low personal control' over work environments.[36] Similarly, neoliberal deregulation of work

and safety practices create health risks. In New Zealand, a review of the Pike River Mine tragedy in which 29 coal miners died in 2010 indicated serious regulatory failure attributed to neoliberal influences.[38]

In terms of housing, the desire to see business work in an unfettered way led to self-regulation of the construction industry through the Building Act 1991, resulting in poor standards of construction and 40,000 'leaky buildings'. This created health and financial consequences and required re-regulation to raise construction standards. In contrast, research indicates how regulation and interventions to ensure housing insulation can lead to important health benefits by improving energy performance.[39]

In the social sphere, the neoliberal position is that individuals usually make the best 'choices' for themselves, with regulatory approaches characterised as 'nanny state'. The entire apparatus of 'health promotion' appears to have lurched in this individual direction, despite evidence that education alone may not be particularly effective in areas such as alcohol consumption, injury prevention, tobacco control and dietary change.[40] This is another instance of trying to change 'downstream' behaviour instead of working on 'upstream' determinants of health inequalities or taking a responsible approach to providing a regulatory environment that can support behaviour change.

Particularly damaging is the way in which 'personal responsibility' and 'choice' have led to the stigmatisation of the most vulnerable, blaming individuals for their poverty, precarious employment and poor health. Nevertheless, there is optimism in the evidence that regulation and combined regulatory/personal approaches for health gain can be effective.[41]

Reappraisal and moving forward: health funding is an investment, not a cost

As a 'liberal' welfare state (Figure 1), New Zealand was vulnerable to and fell head-first into the neoliberal 'trap', and we have found it difficult to climb out. Neoliberalism persists when it seems so obviously bad for us, perpetuated by the 'haves' who are clearly doing quite well. There is an 'infrastructure of persuasion'[42] that includes relentless messages that embed neoliberalism in our psyche; language exerts a powerful influence as the persistence of the 'nanny state' critique shows.

Clearly there was some retreat from neoliberalism under a Labour government between 2000–2008, but push-back from National occurred from 2009–2016. The present prime minister, Jacinda Ardern has declared that neoliberalism has failed,[43] with the Government moving to strengthen the social determinants of health and raise income levels. Health services have received some modest additional funding to improve primary care access, resource mental health and assist district health boards with capital charges.

To do better, we must reject old-fashioned economic thinking that spending on health or other services is a burdensome cost. In fact, it represents a great investment; producing significant social benefits and promoting economic growth.[41] Risks from government spending in developed countries with little debt (such as New Zealand) are low, and even the IMF now acknowledges the past economic damage from austerity and that investment in public services/works provides both social and economic returns. Research into health spending in 25 European Union countries 1995–2010 indicates that the 'multiplier' effect (ie, the financial benefits) from government spending was 1.61 overall, but health spending achieved a multiplier of 4.9.[44] Therefore, for every dollar invested in health, there is a return of nearly $5 to the economy overall.

A focus on 'upstream' solutions through non-precarious employment and modest income re-distribution to create a 'proportionate universalism' (a balance between targeted and population approaches)[45] can address existing and prevent future inequalities. It will be important to rectify chronic health services underfunding by further increasing allocations, but we also need to address deficiencies within the health system.[46,47] The recent health and disability systems review suggests that some reorganisation is required to address problems of inequity, including poor Māori health outcomes, and lack of leadership, and hints at the need for rationalisation of structures.[46] There is increasing acceptance that there are too many DHBs and that these

add little value. Stronger central policy leadership and support for the integration of all aspects of primary, secondary, NFP community organisations and particularly the long-neglected population health services will be required.

In conclusion, the national (and international) impact of neoliberalism on health and healthcare remains enormous. In order to reverse it in New Zealand, a sea change is needed in philosophy, policy and practice with: (i) the immediate objective of equity of health outcomes for all citizens; (ii) bold re-investment in health and social security; (iii) the explicit rejection of the marginalisation of health professionals in decision-making, and (iv) a move to a more streamlined, ambitious and integrated health system.

Competing interests:
Nil.

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A consensus statement on the use of angiotensin receptor blockers and angiotensin converting enzyme inhibitors in relation to COVID-19 (corona virus disease 2019)

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ABSTRACT

There has been a lot of speculation that patients with coronavirus disease 2019 (COVID-19) who are receiving angiotensin-converting enzyme (ACE) inhibitors or angiotensin receptor blockers (ARBs) may be at increased risk for adverse outcomes. We reviewed the available evidence, and have *not* found this to be the case. We recommend that patients on such medications should continue on them unless there is a clinical indication to stop their use.

There has been an unprecedented interest generated in the medical community and on social media around the interaction of coronavirus (SARS-CoV2) and ACE inhibitors (ACEi) and angiotensin receptor blockers (ARB), and whether these medications increase the risk of COVID-19.

This was triggered by correspondences published in high-impact medical journals, Lancet Respiratory Medicine and BMJ.[1,2] They observed that the COVID-19 patients with comorbidities such as hypertension and diabetes, had more severe symptoms. The authors hypothesised that diabetes and hypertension treatment with ACE2-stimulating drugs increases the risk of developing severe and fatal COVID-19. They suggest that ACEi and ARB can increase ACE2, which is an enzyme used by the virus to gain entry into host cells. Therefore, these drugs could potentially increase the risk of severe infection.

We reviewed the evidence supporting this hypothesis, and would like to make the following observations:

1. The studies from China report higher prevalence of hypertension in those who developed severe COVID-19 disease.[3,4] However, a conclusion cannot be drawn that hypertension results in severe infection as these analyses were unadjusted for confounders such as age, and there was no reported data on ACEi and ARB use in these studies. Another recently published study evaluating cardiovascular implications of COVID-19 did not find any association between use of ACEi/ARB and mortality.[5]
2. Previous animal studies[6] showed that ACEi and ARB increase ACE2 activity. Based on this, Fang et al proposed that this would enhance infectivity of

the SARS CoV2 virus.[1] However, other studies did not find any change in ACE2 mRNA expression in rat heart cells treated with an ACEi[7] and no change in plasma ACE2 activity in the presence of either ACEi or ARBs in humans.[8] Therefore, it is questionable whether these drugs increase either the expression or enzymatic activity of ACE2 in tissues to cause severe viral infection.

3. To the contrary, there is evidence that ACEi might confer protection in some viral pneumonias.[9] Based on this, there are ongoing trials studying the effect of Losartan (an ARB) in patients with COVID-19 in outpatient and inpatient settings.[10,11]

Therefore, given the available evidence, we DO NOT advise patients on ACEi or ARB to change therapy. These commonly used medications confer benefits in patients with cardiovascular disease, kidney disease and diabetes, and should not be changed unless clinically indicated. The current evidence on COVID-19 and hypertension, and ACEi or ARB medication is inadequately adjusted and prone to bias, and therefore remains inconclusive.

Our recommendation to prescribed use of ACEi and ARBs is consistent with the viewpoint of numerous societies from around the world including the American College of Cardiology, American Heart Association, and Heart Failure Society of America, European Society of Cardiology, the International Society for Hypertension, European Renal Association and European Dialysis and Transplant Association.

Competing interests:
Nil.

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Bilateral vertebral artery dissection and cerebellar stroke: a rare complication of massage

William Birkett, Pourya Pouryahya, Alastair D McR Meyer

ABSTRACT

Dissection of a cervical artery is a well-known cause of stroke, especially in younger patients. We describe the case of a 39-year-old male, who presented to our emergency department after a one-day history of headache and vomiting, with associated sudden onset posterior neck pain and cerebellar signs following a massage. Computed tomography angiogram and brain demonstrated bilateral vertebral artery dissection and cerebellar stroke. He was admitted to hospital for monitoring and conservative management with antiplatelet therapy, resulting in a good outcome. This is the first reported case of bilateral vertebral artery dissection and stroke to be associated with massage. This case also suggests, unlike many reports in the literature, that significant vascular pathology can result from massage even without cervical spine manipulation.

In vertebral artery dissection (VAD), a tear occurs in the intimal wall of the vertebral artery. The tear can be either spontaneous or traumatic and allows blood to collect in the wall of the vessel as an intramural haematoma.[1] This can result in either direct haemodynamic compromise of the artery or thromboembolism affecting a downstream vessel.[2] As the vertebral arteries supply the posterior circulation of the brain, a significant consequence of this pathology can be cerebral ischaemia and stroke.[1] Many accounts of VAD have been published supporting the aetiology of this condition as a result of high-velocity forces affecting the cervical spine. Here, we present a case supporting potential aetiology arising from a low-energy intervention to a patient's neck.

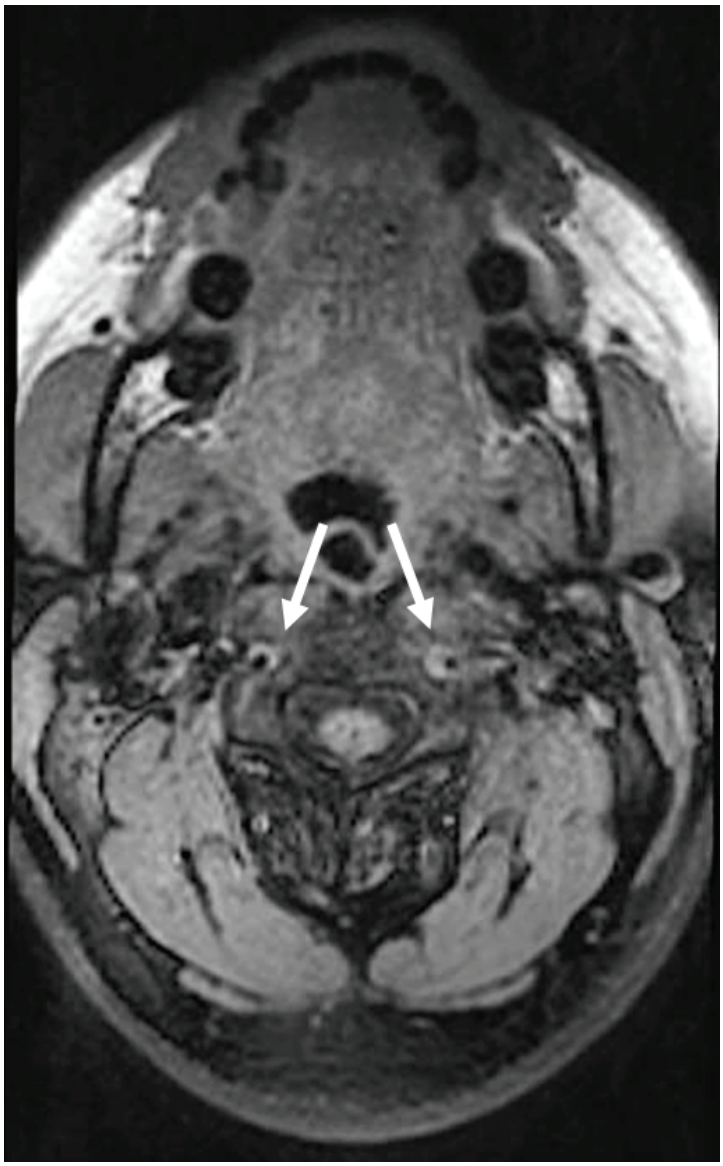
Case report

A 39-year-old male presented to our emergency department (ED) after a one-day history of bitemporal, gradual-onset headache with associated nausea and vomiting. He also complained of posterior neck pain, which had started suddenly during a massage two days prior to presentation. His past medical history consisted only of common migraine; however, this presentation was atypical of his usual migraine attacks. The patient did not report any fevers, photophobia, vertigo, abdominal pain or other gastrointestinal symptoms.

The patient was an ex-smoker, self-employed chef, living independently with his wife and child, with no significant family history. Of note, he regularly received Thai massage.

On physical examination, the patient was apyrexial, with a blood pressure of 150/90mmHg, heart rate of 103bpm, respiratory rate of 18bpm and oxygen saturation of 99% on room air. He was alert and orientated and had no dysarthria. His abdomen was soft and non-tender. He had a full, pain-free, cervical range of motion without any stiffness or midline cervical spine tenderness. The cranial nerve examination was unremarkable and he had normal peripheral tone, power, sensation and deep tendon reflexes. On cerebellar examination, the patient demonstrated left-sided past pointing and an ataxic gait, falling to his left side on ambulation.

Figure 1: MRI neck T1 axial view. Reduced caliber of the vertebral arteries with surrounding T1 hyperintensity (positive crescent sign), consistent with vertebral artery dissection.



Blood results showed an unremarkable urea electrolytes and creatinine (UEC), however a full blood examination (FBE) was notable for a white cell count of $14.7x10^9$/L (normal range 4.0–11.0), with a predominant neutrophilia.

Investigation with computed tomography (CT) angiography demonstrated bilateral dissection of the cervical segments of the vertebral arteries, with complete occlusion of the left vessel, as well as evolving infarction of the left cerebellar hemisphere. These findings were confirmed on magnetic resonance imaging (MRI) of the brain and cervical arteries (Figures 1–3).

The patient was commenced on anti-platelet therapy in ED with aspirin 300mg loading dose. He subsequently was admitted under the stroke unit for medical management, with ongoing daily aspirin (100mg) and atorvastatin (80mg). Following a four-day admission, including intensive physiotherapy, he was discharged home.

At six-month follow-up, the patient had remained symptom-free, with complete recovery of his abnormal neurological findings, allowing him to return to his normal work. Repeat MRI demonstrated significant improvement in the vertebral arteries and appropriate evolution of the stroke.

Figure 2: MRI angiography (maximum intensity projection) of the vertebral arteries. Narrowing of the vertebral artery lumens bilaterally with no flow above dissected segment on left (arrow).

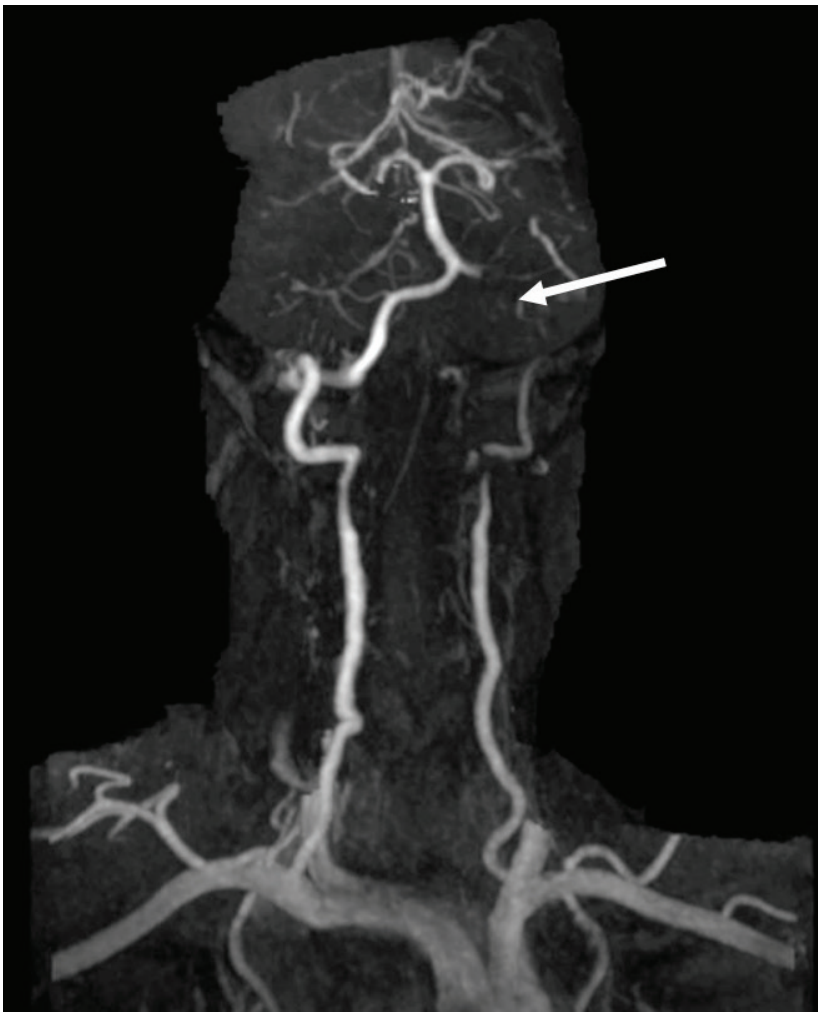
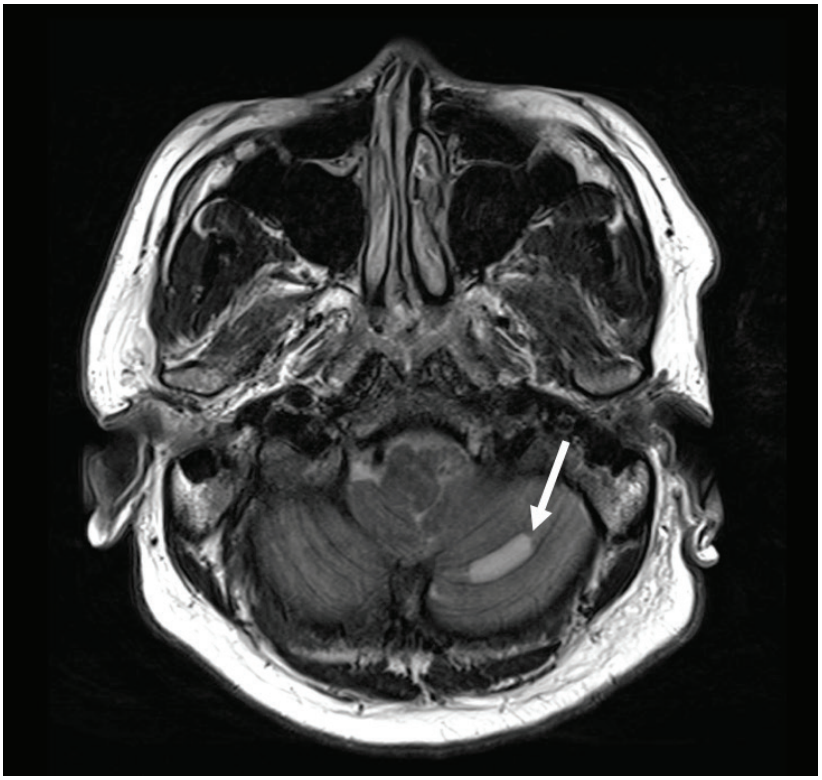


Figure 3: MRI brain T2 TSE TRA, axial-section. Left cerebellar acute infarct.



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Discussion

Dissection of a cervical artery is a major cause of stroke in young patients, and is reported to cause up to 25% of strokes in patients under 45 years old.[1] Trauma is the most significant predisposing factor for VAD,[3] which can range from sporting injuries to high-speed motor vehicle accidents. The pathology has also previously been associated with cervical manipulation therapy, as performed by chiropractors.[1] Other risk factors include hypertension, migraine, use of oral contraceptives and connective tissue disorders.[1,3] Our patient had several of these risk factors.

Our review of the PubMed® database using the search terms 'massage' and 'vertebral artery dissection' revealed only two similar cases, reported in China[4] and India.[5] We believe that this is the first reported case of bilateral vertebral artery dissection and stroke to be associated with massage. It is also the first case of VAD associated with massage reported in Australasia.

Massage is a common alternative medicine, which is gaining popularity in New Zealand.[6] National regulation of the industry however remains limited, with no mandatory licensing or registration requirements.[6,7] As a result, some massage therapists may have no qualifications or limited experience.

Our case is notable as unlike most reported cases of VAD, massage typically does not involve the application of high-velocity force to the neck or manipulation of the cervical spine. This suggests that the even application of low-energy therapies to the neck, such as massage or stretching, could result in this vascular pathology, which could potentially be fatal.[1]

For young patients presenting with a syndrome consistent with a posterior circulation stroke, VAD is a significant differential diagnosis, especially in the presence of neck pain or recent trauma. This should include possible low-energy mechanisms of injury including massage. If clinicians are suspicious of this pathology, they should proceed to urgent CT or MRI angiography.[1]

Vertebral artery dissection is typically treated conservatively, with either antiplatelet or anticoagulant therapy. This aims to reduce thrombus propagation and embolism to prevent stroke.[1,8] Thrombolysis can be considered for acute ischaemic stroke, without significant risk of expansion of the intramural haematoma.[8] There are also case reports of successful endovascular stenting to restore perfusion through an occluded vertebral artery.[1]

Conclusion

Vertebral artery dissection is an important cause of stroke in young patients. This case suggests that the application of even low-velocity force to the cervical spine can cause significant vascular injury. Massage is a common alternative therapy, and may be a previously underappreciated contributing factor for this pathology.

Competing interests:
Nil.

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DRESS syndrome due to iodinated contrast medium

Yassar Alamri, Blake Hsu

An 82-year-old woman presented to the emergency department after developing a generalised rash. She had a background of diffuse large B-cell lymphoma, which was successfully treated with a reduced-dose bendamustine-rituximab combination therapy (the last dose of which was six weeks prior to presentation). She had been on her regular medications for at least four months prior to presentation, and denied starting any new medications (including over-the-counter) in the intervening period.

On presentation, she was febrile (temperature 39.1°C) and had an erythematous blanching morbiliform eruption that covered >90% of her body-surface area (Figure 1A and 1B). Her blood tests revealed an acute kidney injury (creatinine 218µmol/L). Her liver functions tests were normal.

A punch biopsy of the skin revealed severe epidermal spongiosis and microvesiculation, with infiltrate of lymphocytic and eosinophilic infiltrates (Figure 2). Peripheral eosinophilia developed on the third day of admission. The peak eosinophil count was $2.9x10^9$ (on the sixth day of admission).

Upon reviewing her history, it was noted that she had undergone a re-staging CT scan four days prior to admission, in which she received iohexol contrast. This was her second exposure to iodinated contrast material (the first of which was at the time of the diagnostic CT scan five months preceding the current presentation). Drug

Figure 1A: Erythroderma covering the patient's torso (a), and limbs (b).

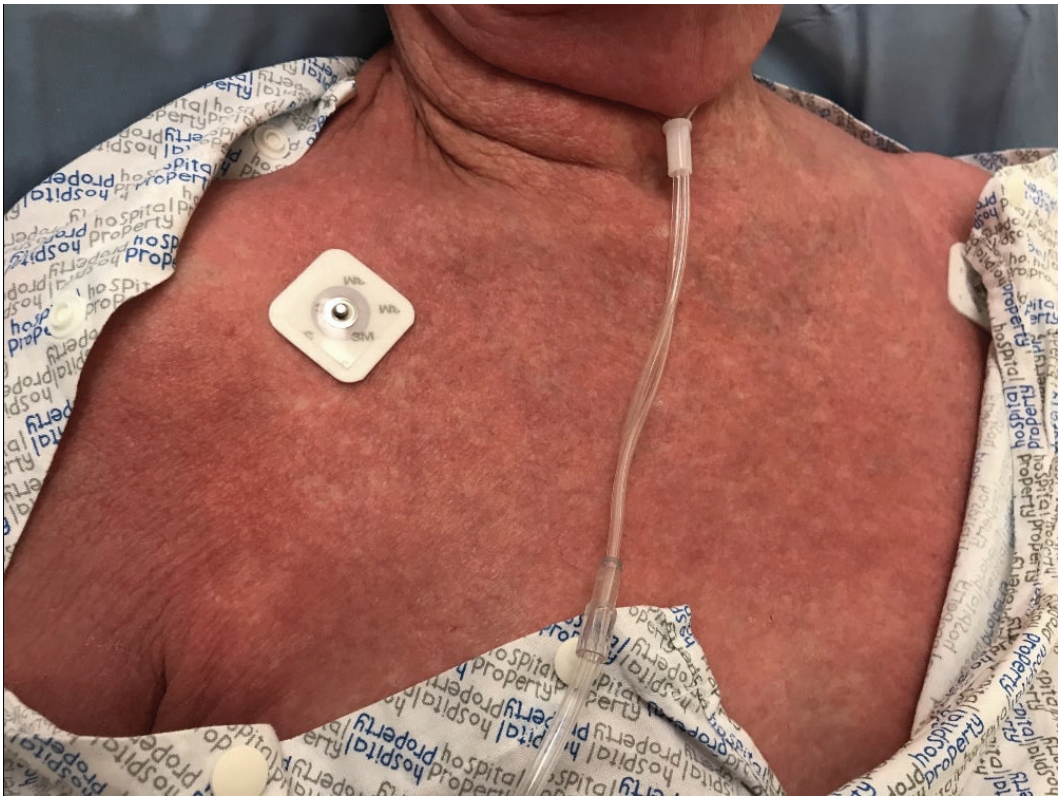

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Figure 1B: Erythroderma covering the patient's torso (a), and limbs (b).

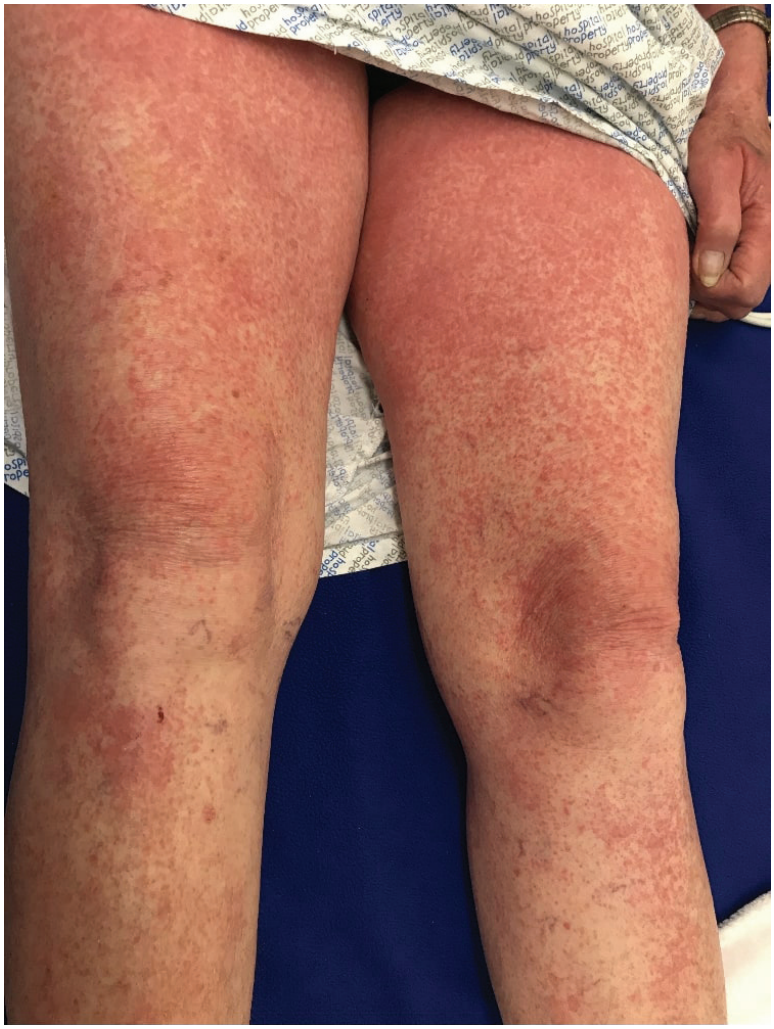
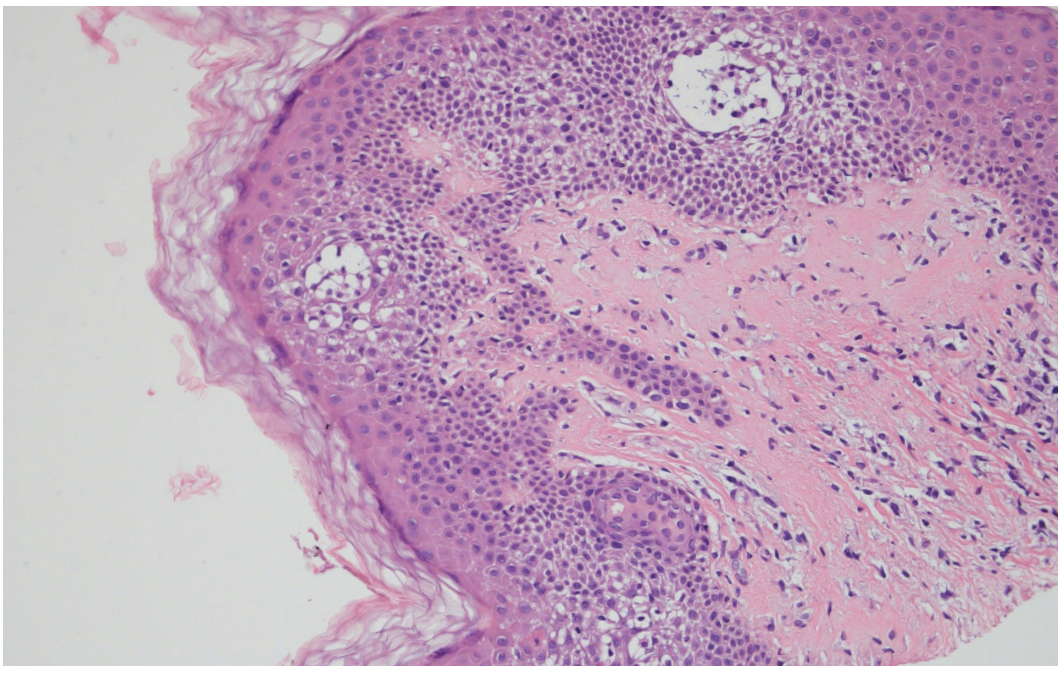


Figure 2: Histological examination of punch biopsy revealed a vesicular spongiotic reaction, with light eosinophilic and lymphocytic infiltrates.



reaction with eosinophilia and systemic symptoms (DRESS) was diagnosed.[1] The patient required a short stay in the intensive care unit for blood pressure support. She made a full recovery, and was discharged after 10 days with a home-based rehabilitation programme. Her rash had completely resolved at follow-up four weeks after her discharge, and she was advised to avoid contrast agents in the future.

DRESS is a rare, but recognised, side-effect of iodinated contrast media exposure.[2] Our patient fulfilled the RegiSCAR diagnostic criteria for DRESS.[3] Due to the vigorous systemic inflammatory response, multi-organ dysfunction may ensue. Reported mortality rates can reach as high as 10%.[4] The cornerstones of treatment is cessation of the implicated causative agent, and supportive care.

Competing interests:
Nil.

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Educational interventions on contraceptive methods in adolescents: face-to-face or virtual?

Victor Moquillaza Alcántara, Angela Yauyo Puquio, Xiomara Marquez Lopez, Pamela Villegas Yaranga

Despite the decline in teenage pregnancy rates it is still a public health problem. Previous reviews have shown that the situation is getting worse in Latin America, where during the last 20 years there have been few interventions that seek to increase the use of family planning methods.[1,2] In countries like Peru, during 2018 the proportion of teenage pregnancy reached 12.6%, although there are regions that come to present 32%.[3]

These high percentages are explained by the factors that predispose their existence, among which is the low knowledge about contraceptive methods, a characteristic that begins in adolescence and remains until adulthood.[4] Studies in Germany have shown that, although adolescents may know the existence of certain contraceptive methods, many do not identify when they should be administered and how they could access them. Also, that the adolescent is in a school of lower academic level or being of immigrant origin were characteristics that are associated with less knowledge.[5]

Faced with this problem, educational interventions have been generated that seek to resolve doubts regarding the use of contraceptive methods; however, many of the studies suggest a face-to-face intervention, which may not present the advantages offered by providing the same knowledge under a virtual system such as a web page. This is aggravated in Andean environments such as those in Latin America, where rural areas are characterised by poor access to health services or institutions where these face-to-face educational interventions are provided, due to the distance between establishments and homes.[6,7]

In Table 1 we show characteristics that could be considered before evaluating the investment of resources in an investigation that poses an educational intervention. In it we can highlight the scope that a virtual intervention can have thanks to the internet, which breaks the temporary limitations (since it does not require a specific schedule) and geographical (because one can access them from anywhere). Although it is also necessary to consider that the web content is restricted to the quality of the expert who validated the content, and this must be updated from time to time.

A recent systematic review where the impact of educational interventions for the use of contraceptives was evaluated reported that only those that include audio or videos manage to reduce the rate of teenage pregnancy over time, likewise, those that also include text messages manage to maintain the continued use of contraceptive methods. On the other hand, those that are face-to-face and use written material only increase knowledge, but do not guarantee its use.[8]

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Table 1: Characteristics of face-to-face and virtual educational interventions.

	Face-to-face	**Virtual**
Requirements	Professionals who go to the place where the intervention and support material (physical or electronic audio-visual) will be generated.	Electronic elements (HTML text, videos or audios) with information validated by a team of experts.
Permanence in time	The support elements can be reused, but the professional must come every time an intervention is generated.	The electronic elements are publicly accessible and possible to be used anywhere.
Investment	The payment to the human resource for each intervention should be considered.	A single payment to the human resource is generated for the advice in the elaboration of the electronic elements, then it is invested only in the maintenance of the hosting.
Benefits	There may be a direct feedback with the exhibitor for any questions.	It can reach any audience in any geographical area due to the internet, likewise no specific time is required to participate.
Limitations	Generating an intervention requires managing the layout of the exhibitors, likewise, its replica only reaches a limited group of people. Finally, modesty can be a barrier to consulting a particular topic.	The content provided will be "current" for the time in which the audio-visual resource was generated. Also, the necessary learning curve, servers and hosting maintenance should be considered.

Therefore, we seek to help researchers or those who design interventions in the field of distance education for the reduction of teenage pregnancy. These interventions can be subsidised by the government through public funds and executed by university research groups; especially in environments where there are barriers to access to education or healthcare, since the internet can be an agile, common and beneficial means for the adolescent population, reaching large masses and therefore being a contribution to the public health of countries.

Competing interests:
Nil.

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Type A aortic dissections: challenges of atypical presentation in remote New Zealand

Varun J Sharma, Minesh Prakash, Francesco Pirone, Brian Chan, Zaw Lin

Clinical vignette

SM, a 62 year-old male of Māori descent, was seen by ambulance for right hemiparesis with no significant medical history. At the scene, he deteriorated into ventricular fibrillation, requiring cardiopulmonary resuscitation and cardioversion, eventually reverting back into sinus rhythm. He was transferred to the Gisborne Hospital with bag-and-mask ventilation and Glasgow Coma Scale of 3.

He was intubated on arrival, maintaining a systolic blood pressure of 80. Investigations showed evidence of coronary (Troponin 45, ST elevation in leads III, aVF with reciprocal changes) and end-organ (eGFR 60, Lactate 2.4, pH 7.24) malperfusion. A widened mediastinum on chest x-ray instigated computed tomography (CT) scans, demonstrating type A aortic dissection (TAAD) extending from the aortic root, across the aortic arch and down the aorta into external iliac arteries. Poor flow was noted in right subclavian, vertebral and common carotid with a right renal artery occlusion. The CT brain was normal. He was accepted and transferred to Waikato District Health Board (WDHB).

On arrival to WDHB, his cardiac (Troponin 7,982, dynamic ST changes), renal (eGFR 37) and neurologic (non-responsive pupils) status deteriorated. The aortic team was convened; at our centre, this is a multidisciplinary meeting of the cardiothoracic and vascular surgical teams, interventional radiology, intensive care unit and anaesthetic department. A decision for repeat CT imaging for neurological prognostication and assessment of coronary ostia was made, demonstrating a large acute right parietal lobe infarct. Given poor neurological prognosis and gross end-organ malperfusion, there was a consensus for palliation after discussion with the family.

Discussion

This case highlights the challenges of emergency management of TAAD in New Zealand. TAADs are time-critical with an immediate mortality rate of 40%, rising 1–2% per hour after onset of symptoms, and a 48-hour mortality rate of up to 70%.[1–5] Tertiary referral centres in New Zealand typically serve large geographical areas; WDHB, for example, serves a region comprising of approximately 900,000 (20% of New Zealand population) people across five district health boards. This represents a logistic challenge, as successful management is predicated on prompt diagnosis and awareness by first-point clinicians and excellent portals of communication with WDHB. Transfer times can be exacerbated by difficult geographical terrain, tortuous road ambulance access and tough air transfer conditions.

There may also be cultural impediments to seeking medical attention. In WDHB's population, 24–40% of the population is of Māori descent, representing approximately 216,000 people or 34% of the Māori Population in New Zealand. There is evidence that the Māori population have a higher predisposition towards TAADs, presenting at a younger age with higher morbidity.[1,6] This is compounded by the possibility of atypical presenting symptoms, with the iRAD registry showing that neurological (17%) and syncopal (9%) symptoms are common,[7] albeit unfounded in the New Zealand population.

Therefore first-point of care clinicians (eg, paramedics, emergency physicians or general practitioners) must be aware of idiosyncrasies of TAAD presentation in New Zealand, and have it as a potential diagnosis for any chest pain or atypical neurological symptoms, and involve the tertiary referral centres as soon possible. The urgent access of radiological imaging through a picture archiving and communication system (PACS) is crucial; there is also scope for a centralised form of medical imaging that can reduce the time to transfer images. A multi-disciplinary aortic team (described above), which is the standard of practice at our centre, is vital:[8] in this case, the concurrent interventional radiology, anaesthetic and intensive care assessment of neurological and end-organ prognosis while the surgical teams were planning operative intervention allowed a timely decision for palliation, avoiding what would have been a futile operative intervention if the patient had been accepted straight for theatre from Gisborne. Trends of TAAD in the Māori population warrant further investigation into the pathophysiology of why this population has a higher incidence and lower survival, and the factors which are impediments to treatment.

Competing interests:
Nil.

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Bullying and harassment in ophthalmology: a trainee survey

Neeranjali S Jain, Hannah K Gill, Hannah M Kersten, Stephanie L Watson, Helen V Danesh-Meyer

Bullying, harassment and gender-based discrimination within the medical workforce in New Zealand has received significant media and academic attention in recent years. Considering this, we completed a survey in which ophthalmology trainees in New Zealand and Australia responded on bullying, discrimination and sexual harassment experiences. It is important to assess the prevalence and extent of discrimination and sexual harassment, as these experiences can significantly limit job satisfaction and career advancement. We wanted to further our understanding of the prevalence of these experiences within the field of ophthalmology.

A 35-question survey was sent to all Australian and New Zealand ophthalmology trainees registered with RANZCO in May 2017 (n=185, 65 female, 120 male). Four questions explored experiences of discrimination and sexual harassment in the workplace, derived from the RACS survey, created by the Australian Surgical Focus Group.[1] The response rate was 31% overall, with 32 responses from female trainees (49%) and 23 from male trainees (19%).

The majority (56%) of trainees had experienced some form of bullying, discrimination, harassment and/or sexual harassment during training, with no significant difference between male and female trainees (43% vs 66%, $p>0.05$). The rates of discrimination, bullying and sexual harassment (21%, 49% and 9% respectively) were similar to those recently described in surgical training in Australia and New Zealand (24%, 54% and 12% respectively).[2]

Male ophthalmologists were cited as more frequent sources of these behaviours than female ophthalmologists (35% vs 12%, $p=0.005$). Other reported sources of these behaviours were other medical consultants (26%), hospital administration staff (24%) and nursing staff (24%).

A frequent form of gender-based discrimination reported was receiving less respect based on gender from medical team members (reported by 40% of women vs 0% of men, $p<0.001$). Women also reported experiencing discrimination for making family-centred choices (57% vs 20% for men, $p>0.05$) and reported child-bearing had slowed their career progression (80% vs 30% of men, $p=0.035$). The gender-based discrimination reported in our study could be a barrier to career progression[3] and could have contributed to the perception reported among two-thirds of women that it was more difficult for women to achieve career success in ophthalmology than men. Limitations of this study include potential response bias associated with a self-reported survey and the low response rate.

These data provide a baseline to measure future progress for initiatives commenced by The Royal Australian and New Zealand College of Ophthalmologists, including education programmes for trainees and consultants, support services and promoting diversity in college leadership roles.[4]

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Competing interests:
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Presidential Address, 1920

By DR. H. LINDO FERGUSON

Dr. Irving (the retiring President) said the profession was accustomed to look on Dunedin as the seat of medical learning, and he congratulated the Otago Division on the number of members it had attracted here. One could not help feeling saddened when one remembered how many old friends would be there no more. It might be invidious to mention names, but he could not help thinking that that grand old veteran, Dr. Batchelor, would have been glad to have been there that night. They might be thankful that so many of the profession had made good and come back to them again. Dr. Colquhoun, who had done so much for the medical profession in New Zealand, was, unfortunately, unable to accept the presidency at the last moment, but his place had been filled by Dr. Ferguson. Dr. Ferguson needed no introduction from him. Anyone who had worked with him knew that he had the welfare of the profession and of the association very much at heart. (Applause.) One of the most important things on the Conference paper was the suggested establishment of a State medical service. Dr. Ferguson, as Dean of the Medical School, looked at the question, he thought, rather differently from those who had graduated many years ago, and he thought it was good that Dr. Ferguson would preside, because he would look at it more from the point of view of the man who was just getting through.

Dr. Ferguson, who was received with applause, remarked that there had been no meeting of the Association in Dunedin for 13 years, and that he was Chairman of the last meeting of the old Association, held in 1896, at which arrangements were made by which they became voluntarily merged in the British Medical Association. It had been his ambition to be the first President of the new Association, but delays and difficulties resulted in the final formation of the Association not being effected till the following year, when another became President. This meeting was important in that it was the first since the war, and war had made an enormous difference to medical work and standards. Things would never be the same again as before the war. In surgery, in medicine, in public health, more strides had been made in four years of war than in 40 years of peace, because extensive experiments and scientific research had been carried out under the stress of great emergency, and with the whole financial resources of the associated Powers behind it. Governments were realising that it paid to spend money in research. ln sanitation our knowledge of public health had increased in leaps and bounds, from the way in which medical men learnt to deal with epidemics in camps. In no war had there been such a small loss from sickness as in the great war now fortunately ended. Never before had there not been greater fatality from sickness than from bullets. If there was one thing he would say they had to learn, it was the value of team work. A single man could not do what a body of men could accomplish.

At the outbreak of war we had an organised territorial force, but practically no organisation for the Medical Corps, and so had to depend upon the civilian men to do it for us. The organisation grew up in the face of great difficulties, and the men responsible for it deserved credit for their work. The civilian medical practitioners who volunteered for service also deserved the gratitude of the community. No doubt mistakes had been made, but the work of the New Zealand Medical Corps was very highly spoken of by those in a position to judge. The Dental Department had earned a name that put in the shade the name of any other department of the forces involved. It was the first time the Dental Association had been associated with their Conference, and he thought it was an innovation of which they might be proud. Referring to the outbreak of the war, Dr. Ferguson, as Dean of the Medical School, said that his teachers then all wanted to shut the school and go to the front. His students, too, were being taken by the Minister of Defence. General Henderson deserved great credit and gratitude for the stand he had taken in

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the matter. He had come down when the students were rampant for war, and pacified them by showing that they would be of more value as medical men to heal wounds than if they went out and tried to inflict them. The result was that they had completely educated over 160 men who they were able to send forward. Touching on the effect of conscription on the profession and the assistance rendered by the British Medical Association in that respect. the speaker said that owing to the tact and consideration shown by General Henderson the scheme worked well, and they were able to send 400 men and yet keep up the work at home. The public and Government were recognising the value of team work, "and as sure as the sun rises tomorrow," said Dr. Ferguson, "we are going to have a State medical service. We have got to face the fact of a State medical service. On the result of your deliberations this week will largely depend what form that medical service will take. If it takes such a form that the profession has a voice in the direction of its future, things will go on all right; but if it is forced on the profession against its will, it will assuredly mean disaster for everyone." He concluded by expressing the hope that beneficial results would follow the Conference.

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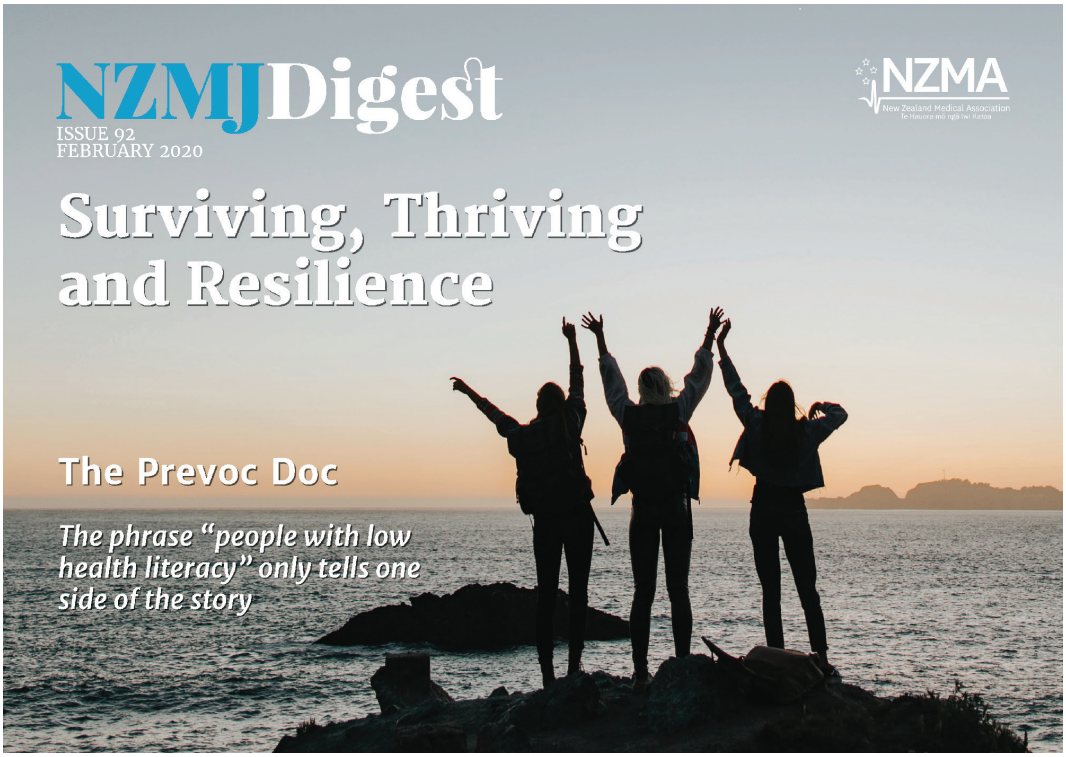

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