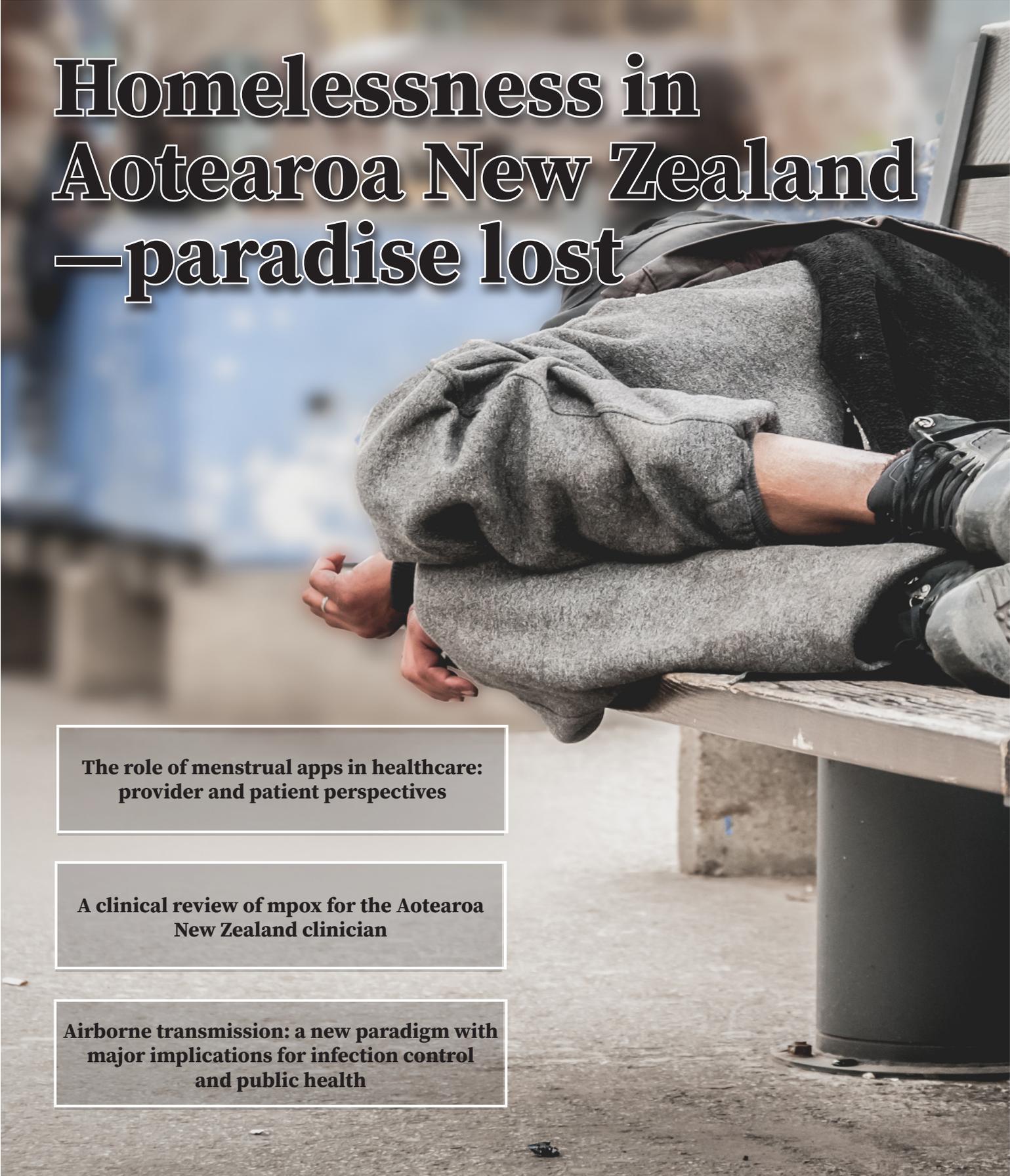


The
**New Zealand
Medical Journal**
Te ara tika o te hauora hapori

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Homelessness in Aotearoa New Zealand —paradise lost

A photograph of a person sleeping on a wooden bench outdoors. The person is wearing a grey hoodie and dark pants. The background is blurred, showing an urban setting.

**The role of menstrual apps in healthcare:
provider and patient perspectives**

**A clinical review of mpox for the Aotearoa
New Zealand clinician**

**Airborne transmission: a new paradigm with
major implications for infection control
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MEDICAL ASSOCIATION
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Summaries

Feasibility study of brief Group Transdiagnostic Cognitive Behavioural Treatment delivered via Zoom for anxiety and depression in primary care

Ben Beaglehole, Jenny Jordan, Chris Frampton, Alison Alexander, Angela Spencer, Cameron Lacey, Richard John Porter, Caroline J Bell

Our study assesses whether it is feasible to deliver Transdiagnostic Cognitive Behavioural Therapy (TCBT) using Zoom for patients with anxiety and depression in primary care. TCBT targets the common factors shared between anxiety and depression and is appealing because many people have mixed symptoms of anxiety and depression as opposed to a single disorder. We used Zoom to deliver therapy because of the challenges of face-to-face therapy during the COVID-19 pandemic. We recruited participants successfully to the study suggesting that this option is appealing to patients. Clinical measures of anxiety and depression were improved following treatment suggesting promise for this treatment as an intervention for anxiety and depression in primary care.

Resident medical officers' redeployment experiences in the Adult Emergency Department during the COVID-19 pandemic at Te Toka Tumai | Auckland Hospital

Peter G Jones, Bryony P T Nicholls

In times of crisis, Resident Medical Officers (junior doctors training to be specialists) may be redeployed from their usual duties to the Emergency Department. We wanted to know their views on how this impacted their relationship with the emergency department team and their training. We found that most junior doctors would be willing to be redeployed, with positive impacts on their education and training, with a better understanding of emergency department processes. A welcoming and supportive environment helped ensure a positive experience of redeployment. More junior doctor input into the planning for redeployment, a single point of contact between redeployed doctors and hospital administrators and a structured orientation to the emergency department would have improved the redeployment process.

An exploratory qualitative enquiry into workers' experiences of leptospirosis and post-leptospirosis in Aotearoa New Zealand

Jackie Benschop, Shaan Mocke, Julie M Collins-Emerson, Jane Lennan, Jenny F Weston

Our pilot study described six people who reported post-leptospirosis symptoms (PLS). We used face-to-face, semi-structured interviews to capture their experiences and to gain understanding of the impact and burden of PLS. The participants were male, had been employed in slaughter plants (n=2) or farming (n=4) when they first contracted leptospirosis and claimed to have been suffering from PLS for 1–35 years. Symptoms included exhaustion, brain fog and mood swings, and participants' lifestyles and relationships were severely affected. Leptospirosis may have severe long-term consequences for patients, their families, and their communities.

The role of menstrual apps in healthcare: provider and patient perspectives

Bryndl E Hohmann-Marriott, Tiffany Williams, Jane E Girling

Healthcare providers, patients, and app users described how period tracking apps could play a role in healthcare. Using an app to keep a record of cycle dates and symptoms can help improve communication between patients and providers, but there is concern about the apps giving inaccurate information and misusing data. At present, apps do not seem suited for helping to manage menstrual cycle disorders.

Usability survey of an inpatient electronic clinical communication platform at a large New Zealand tertiary hospital

Yassar Alamri, Nick Cross, Charlene Tan-Smith, Saxon Connor

The current study revealed good usability of Cortex. The user experience was equivalent among the various professions of the study's participants (doctors, nurses, and allied health staff). The present study provides a useful benchmark for Cortex at a point-of-time, and it sets up potential to periodically repeat this survey to see how new functionality has added to (or detracted from) its usability.

A clinical review of monkeypox for the Aotearoa New Zealand clinician

Teena Mathew, Eamon Duffy, Erasmus Smit, Jay Harrower, Jeannie Oliphant, Noah Bunkley, R Joan H Ingram, Rupert Handy, Annabelle Donaldson

Mpox or previously known as monkeypox infection has been reported in Aotearoa New Zealand since July 2022 as part of the global outbreak mainly among individual identifying as gay, bisexual or other men who have sex with men. We hope this article will raise awareness of mpox infection among New Zealand clinicians. Mpox is not a new infection but the 2022 outbreak was being reported in countries where it is not usually present. Another interesting feature of the 2022 outbreak was the atypical clinical features which were not described previously. Globally the numbers are falling due to preventive activities including vaccination.

Airborne transmission: a new paradigm with major implications for infection control and public health

Anna Stevenson, Joshua Freeman, Mark Jermy, Jason Chen

At the start of the COVID-19 pandemic precautions against infection were based on the understanding that the virus would transmit largely by droplet spread. Evidence is now overwhelming that the Sars-CoV-2 virus and many other pathogens (like RSV, Measles, and Influenza) are primarily spread through the air. To reduce transmission of airborne infectious illnesses we must improve our ventilation systems and ensure that people in public buildings are provided with clean air to breathe. Where ventilation upgrades are not possible, or may be delayed, the use of masking, HEPA filters and UVC technology may help to ensure the safety of vulnerable populations, especially unvaccinated groups in our community such as young children.

Homeless in Aotearoa New Zealand —paradise lost

Frank Frizelle

Homelessness is one thing I have been fortunate to avoid so far in my life. I have had little to do with homeless people until recently, other than walking past them in shop doorways and seeing them when they have been often admitted acutely, with various ailments, under my care in the past (especially in the middle of winter). Most have been keen to get out of hospital as fast as possible and I have often thought, after talking with them, how lucky I was—and thought to myself, after listening to what has happened to them, “there but through the grace of God go I”.

More recently I have been forced to re-examine the issues that homeless people are living with and society’s reactions to them, after a group of homeless men and women moved onto a section I own in central Christchurch. For over 9 months the local council and police did a good job providing support for these people and were tolerant of their presence. These homeless people developed a garden and had pet ducks, however, had no toilet facilities or running water. While they generally kept to themselves and lived in a sort of symbiotic relationship with the community, at times they partied and upset some local residents. As a result, eventually a few residents complained about this group to the Council and to the media. They were noticed, and the inevitable rules and regulations of society took over.

This meant that these homeless people had to move off the previously unused, vacant section, and back into areas such as shopping streets, doorways and the local parks, where none of the council requirements that forced them away were going to be met. What did surprise me was how intolerant a few well-off people are to the homeless, and the way the media tried to distort the story and continued to support urban myths about the homeless.

There is increasing literature about homelessness in New Zealand and some key points are worth reflecting on.

Homelessness is common and increasing. The 2018 Census identified 102,123 people as severely housing deprived, which is nearly 2.2% of the population. This figure includes people living in

“Uninhabitable housing”, a statistic measured for the first time in the 2018 Census. If one excludes the “Uninhabitable housing” category, 41,724 people (or nearly 0.9% of the population) were identified as severely housing deprived. Compared with 2013, the rate of severe housing deprivation in 2018 had increased by 0.9% per 10,000 people, an increase of about 4,400 people.¹

There is considerable geographical variation in homelessness within New Zealand. The highest rates of severe housing deprivation were found in Northland, Gisborne and Auckland; the lowest in Canterbury, Taranaki and Southland.¹

Māori and young people are the most affected groups (see Figures 3 and 4).

The average life expectancy of those chronically homeless is significantly reduced. One study found the average life span of a homeless person was shorter by approximately 17.5 years than that recorded for the general population. The average age at death of a homeless male was 56.27 years old (SD 10.38), and 52.00 years old (SD 9.85) for a homeless female. Other studies have found greater impact, with one suggesting the life expectancy of a chronically homeless male is 48 years.⁶

There are high rates of mental illness and substance abuse amongst the homeless. Epidemiological studies have consistently found that at least 25–30% of homeless persons have a severe mental illness such as schizophrenia and substance abuse. At the same time, the deleterious effects of homelessness on mental health have been established by research going back decades. There is a bi-directional relationship between mental ill health and homelessness.⁷

For many homeless, this is a temporary distressing issue; however, there is a small percentage of homeless people for whom this is a long-term issue. Many homeless are Māori and Pasifika peoples, and people with mental illness and substance abuse issues that are made worse by homelessness. The impact of homelessness on life expectancy is significant. Managing homelessness by moving people on as misbehaving youths is not the answer. After these recent severe storms there may be an increase in homelessness in the regions, despite whatever initial support is

put in place. Though in this post-COVID lockdown period, society appears to have become less tolerant and considerate. Compassion, and tolerance are required, and the understanding that no

one wants to be homeless—and that while it is as much a medical issue as it is social, it should not be considered criminal.

Figure 1: Compared with other countries New Zealand has high rates of homelessness.²

Table HC 3.1.1a: Estimated number of homeless people, 2020 or latest year available

	Year	Number of homeless	Homeless as % of total population ¹	Figures include more than persons 1) living rough, 2) living in emergency accommodation, and 3) living in accommodation for the homeless?
Australia	2016	116,427	0.48%	Yes
Austria	2019	22,580	0.25%	Yes
Brazil	2015	101,854	0.05%	Not provided
Canada (2)	2016	129,127	0.36%	No
Chile	2019	14,013	0.07%	No
Colombia	2019	13,252	0.03%	Yes
Costa Rica	2020	3,387	0.07%	Not provided
Croatia	2013	462	0.01%	No
Czech Republic (3)	2019	23,830	0.22%	Yes*
Denmark	2019	6,431	0.11%	Yes
Estonia	2011	864	0.06%	No
Finland	2018	5,482	0.10%	Yes
France	2012	141,500	0.22%	No
Germany (4)	2018	337,000	0.41%	Yes
Greece	2009	21,216	0.19%	Yes
Hungary	2014	10,068	0.10%	Yes
Iceland	2017	349	0.10%	Yes
Ireland	2020	5,873	0.12%	No
Israel	2020	3,471	0.04%	Yes
Italy (5)	2014	50,724	0.08%	No
Japan	2020	3,992	0.00%	No
Latvia	2017	6,877	0.35%	No
Lithuania	2011	857	0.03%	No
Luxembourg (6)	2014	2,059	0.37%	Yes
Mexico	2010	40,911	0.04%	Not provided
The Netherlands	2018	39,300	0.23%	Yes
New Zealand	2018	41,644	0.86%	Yes
Norway	2016	3,909	0.07%	Yes
Poland	2019	30,330	0.08%	Yes
Portugal	2019	7,107	0.07%	No
Slovak Republic	2011	23,483	0.44%	Yes
Slovenia	2019	3,799	0.18%	No
Spain	2013	22,938	0.05%	No
Sweden	2017	33,250	0.33%	Yes
United States (7)	2020	580,466	0.18%	No
United Kingdom: (8)				
England	2020 (Q1-Q4)	(289,800 households)	(1.25% households)	Yes, but limited to certain priority categories; includes households threatened with homelessness
Northern Ireland	2020 (July-Dec)	(7,989 households)	(1.10% households)	Yes, but limited to certain priority categories; includes households threatened with homelessness and people living in temporary accommodation
Scotland	2020 (April-Sept)	(27,796 households)	(1.14% households)	Yes; includes households threatened with homelessness and people living in temporary accommodation as of 30 Sept
Wales	2019-20	(22,392 households)	(1.66% households)	Yes, but limited to certain priority categories; includes households threatened with homelessness (Section 66) and people living in temporary accommodation (Section 73)

Figure 2: Most homeless people are only transitionally homeless, though about 5% are chronically homeless.³

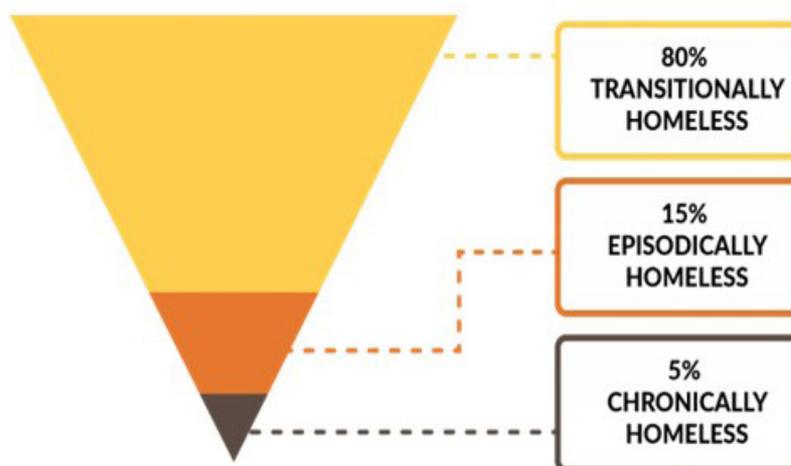


Figure 3: The severely housing deprived population was disproportionately young, with nearly 50% aged under 25 years.⁴

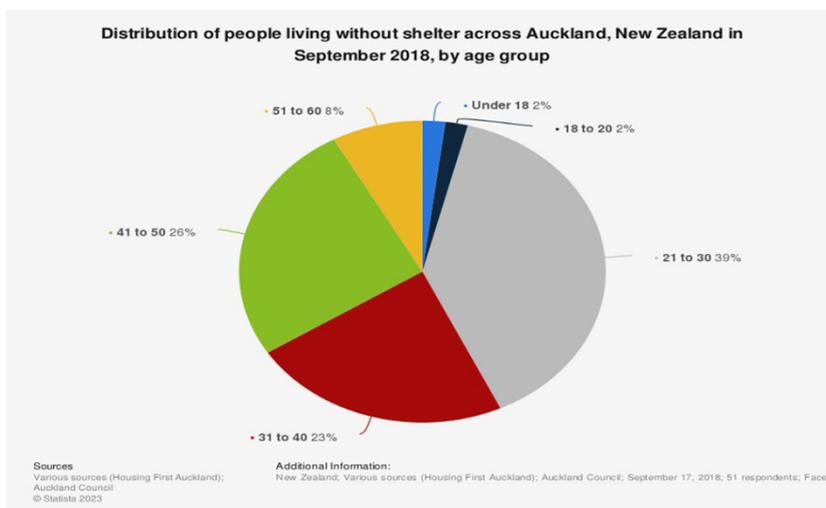
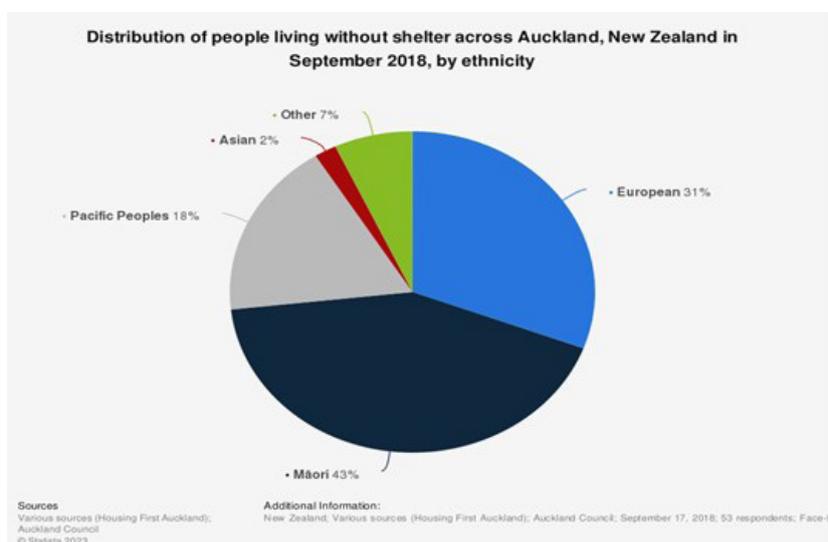


Figure 4: Rates of severe housing deprivation are highest among Pasifika and Māori young people.⁵



COMPETING INTERESTS

Frank Frizelle is the Editor in Chief of the *New Zealand Medical Journal*.

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Feasibility study of brief Group Transdiagnostic Cognitive Behavioural Treatment delivered via Zoom for anxiety and depression in primary care

Ben Beaglehole, Jenny Jordan, Chris Frampton, Alison Alexander, Angela Spencer, Cameron Lacey, Richard John Porter, Caroline J Bell

ABSTRACT

AIM: To report the feasibility of delivering and the effectiveness of brief Group Transdiagnostic Cognitive Behavioural Therapy (TCBT) via Zoom for anxiety and/or depression in primary care.

METHODS: Participants were eligible for this open-label study if their primary care clinician recommended brief psychological intervention for clinically diagnosed anxiety and/or depression. Group TCBT included an individual assessment followed by four x 2-hour manualised therapy sessions. Primary outcome measures assessed recruitment, adherence to treatment and reliable recovery measured using the PHQ-9 and GAD-7.

RESULTS: Twenty-two participants received TCBT over three groups. Recruitment and adherence to TCBT met feasibility thresholds for delivering group TCBT via Zoom. Improvements in the PHQ-9, GAD-7 and reliable recovery were present 3 and 6 months following treatment commencement.

CONCLUSION: Brief TCBT delivered using Zoom is a feasible treatment for anxiety and depression diagnosed in primary care. Definitive RCTs are required to provide confirmatory evidence of efficacy for brief group TCBT in this setting.

Anxiety and depression are common and burdensome mental illnesses in the community.¹⁻³ Standard treatment for anxiety and depression consists of psychological interventions and medications.^{4,5} In New Zealand, psychological interventions are most delivered in individual form by Brief Intervention Counsellors over 4-6 sessions.

Individual disorder-specific Cognitive Behavioural Treatment (CBT) may not be the most effective or efficient model of treatment for patients with mixed anxiety and depression. Transdiagnostic Cognitive Behavioural Treatment (TCBT) (targeting depression and a range of anxiety disorders) is an effective treatment that targets the common factors and processes underlying anxiety and depressive symptoms.⁶⁻⁸ Previous trials evaluating TCBT have been internet-based or face-to-face in individual or group form.⁹ Treatment lengths have typically been 10-18 sessions,⁹⁻¹² although a large TCBT study evaluated brief (seven session) group TCBT for emotional disorders in primary care.¹³ This study

reported sustained improvements for anxiety, depression, somatisation and reliable recovery for those receiving TCBT compared to treatment with general practitioners (GPs), but the treatment intervention was longer than is typically provided in the New Zealand context and the study did not include an active therapy control.

Greater availability of evidence-based psychological interventions is required in New Zealand and Australia to address mild to moderate mental illness in primary care.^{14,15} In New Zealand, there is also a strong imperative for culturally appropriate interventions due to entrenched health disparities for the Indigenous Māori population.¹⁶ In the context of the COVID-19 pandemic, there is also a need for innovative healthcare provision solutions. Greater use of video conferencing and telehealth facilities may be required in the future.¹⁷

We planned a study evaluating a four session TCBT intervention to match the length of therapy typically provided by community counsellors in New Zealand. We commenced a Randomised Controlled Trial (RCT) to evaluate the feasibility

of evaluating brief group TCBT for adults with anxiety and/or depression in primary care. At an early stage, it was clear that recruitment to the study would not meet the rate we had specified in our primary outcomes to be feasible. In addition, the COVID-19 pandemic meant that further recruitment to face-to face groups was untenable. We therefore redesigned the study to evaluate the feasibility of delivering open-label group TCBT using the video conference platform Zoom. This paper reports findings from the redesigned open-label Zoom study evaluating brief group TCBT for patients with anxiety and depression in primary care.

Methods

Ethics approval was granted by the Northern B Health and Disability Ethics Committee. Approval number: 19/NTB/143/AM03. The trial was prospectively registered with the Australian New Zealand Clinical Trials Registry (ANZCTR). Registration number: 12619001563156. UTN: U1111-1235-5047. This work was funded by the Health Research Council of New Zealand (reference number: 19/670).

Eligibility criteria

Patients aged 18 or older referred for brief psychological assistance with anxiety and/or depression in primary care. Entry to the study was based on the clinical judgement of primary care clinicians that brief psychological input for anxiety and/or depression was required (as opposed to formal diagnostic assessment or meeting diagnostic threshold on clinical rating scales).

Exclusion criteria

Patients not eligible included those for whom alcohol and drugs were identified as the main clinical issue, those for whom a referral to specialty services was required to manage moderate-severe illness or high levels of risk and those with significant cognitive problems or language barriers that meant psychological interventions and completion of rating scales was not possible unless in modified form. If participants were unable to access the internet for Zoom purposes they were also ineligible for the study.

Recruitment

We met with key primary care clinical staff to ask them to consider referring their patients for brief group TCBT delivered by Zoom (as opposed to offering usual individual input) if they consid-

ered that brief psychological interventions were indicated for anxiety and depression. We accepted referrals from GPs and other primary care practitioners including brief intervention counsellors and allied health professionals providing brief general health interventions. Potential patients were aware they were being referred for group online TCBT for anxiety and depression. Following referral, potential participants were contacted by one of the group facilitators who provided study information and asked if they wish to participate further. Further information was then sent by mail or email and a study baseline assessment was booked with one of the group facilitators. Informed consent and baseline questionnaires were completed using REDCap, a secure, web-based electronic data tool hosted at the University of Otago.¹⁸ The baseline assessment was completed on Zoom to allow any technological issues to be resolved prior to group commencement.

Intervention

Participants received an initial 1-hour assessment followed by four x 2-hour group transdiagnostic treatments. The 1-hour assessment clarified the core presenting problem, screened for anxiety and depression symptoms, checked for any risk issues and completed interim goal setting. All sessions were delivered via Zoom.

Group facilitators followed a treatment manual developed specifically for this group by Ms Alison Alexander and Associate Professor Jennifer Jordan. Ms Alexander and Associate Professor Jordan are clinical psychologists with extensive experience in transdiagnostic treatments for anxiety and depression. Ms Alexander or Associate Professor Jordan and Ms Angie Spencer led the groups. Ms Spencer is a registered nurse with postgraduate CBT qualifications who was employed as a brief intervention counsellor. Ms Spencer completed a 1-day training programme about this TCBT programme prior to group commencement.

Group content included the following: socialisation to the group, goal setting and motivation, introduction to the TCBT model, understanding the function of emotion, emotion-driven behaviours and the role of avoidance, behavioural activation, learning to observe emotions and thoughts (mindfulness exercises), thinking biases and thought restructuring, behavioural experiments, awareness of and tolerating physiological sensations (including interoceptive exposures) and relapse prevention. Table 1 outlines the course content according to session. The content was delivered

using a PowerPoint lecture framework complemented by discussion, small and whole group exercises and behavioural experiments. Zoom breakout rooms were used for behavioural experiments and to facilitate interaction. Catch-up sessions were offered to participants if they were unable to attend one of the group sessions. The treatment manual was sent to group participants in paper form at the beginning of therapy and was used as a therapy workbook. Access to the manual will be considered on request to the corresponding author. Table 1 provides more details on the content and timing of the therapy sessions.

Each session ends with setting up homework, including that specific to individual goals. Session 2–4 begin with a review of how the group fared with their homework.

Outcome measures

The primary outcomes were measures evaluating the feasibility of recruiting and successfully delivering brief group TCBT using Zoom for anxiety and depression in primary care:

1. If fewer than 50% of patients approached by study staff agreed to participate, the group treatment would be deemed unfeasible.
2. If more than 50% of patients failed to complete at least 3/4 treatment sessions, the group treatment would be deemed unfeasible.
3. To measure whether online group TCBT resulted in reliable recovery at 3 and 6 months following treatment commencement. Reliable recovery was measured by scoring above clinical cut-off for PHQ-9 (≥ 10) and GAD-7 (≥ 8) at baseline assessment, scoring below clinical cut-off for PHQ-9 and GAD-7 at the follow-up time point and showing reliable improvement over treatment (pre-post change in PHQ-9 > 5.2 and GAD-7 > 3.53).¹⁹ The PHQ-9 is a reliable, valid self-administered measure of depression²⁰ and the GAD-7 is a valid and efficient self-report measure for the assessment of generalised anxiety disorder.²¹

Secondary outcome measures were:

1. Acceptability of study intervention and design for Māori measured by: recruitment, treatment completion, drop-out rates and satisfaction ratings.

2. If fewer than 75% completed psychological measures (PHQ-9 and GAD-7) at the 3 time points (baseline, 3 and 6 months) the study would be deemed unfeasible.

Additional assessment

We also included treatment credibility, session rating scale and treatment satisfaction questions at the end of TCBT. We anticipate reporting this data in a subsequent publication that also provides a more detailed account of the development of the brief TCBT manual, which we feel is beyond the scope of this initial paper.

Statistical analysis

Socio-demographic characteristics, baseline PHQ and GAD levels of the study populations and the feasibility measures are reported using standard descriptive statistics including means, standard deviations, medians, interquartile ranges and frequencies and percentages.

The mean change for PHQ-9, GAD-7 from baseline and reliable recovery rates are reported. These changes were calculated from all available data with no imputation of missing data due to the feasibility goals and small sample sizes.

Results

Table 2 outlines the baseline socio-demographic characteristics and clinical rating scales for the study population. Twenty-two participants were allocated to receive Zoom group TCBT (provided over three groups). Sixty-eight percent were female. The majority of the study population were of NZ European ethnicity. The mean score for the PHQ-9 was 16.7 (SD 5.8), consistent with moderately severe depression. The mean GAD-7 score was 13.3 (4.9), consistent with moderate anxiety.

All referrals to the open-label study agreed to participate, although two patients withdrew prior to therapy commencement. This 100% recruitment rate met our primary outcome recruitment criterion. 20/24 participants (83%) completed at least three of the four treatment sessions, meaning the treatment engagement feasibility criterion was met. A total of 4 catch-up sessions (between three participants) were offered and used during the three open-label groups. The overall completion rate for psychological measures at baseline, 3 months and 6 months was 80%, meeting the primary outcome criterion.

Māori participation in the study was low and

Table 1: Group TCBT content.

Session	Content
Assessment	Clarification of core presenting problem and screening for anxiety and depression Risk assessment Interim goal setting
1	Socialisation to the group Introduction to the TCBT model Understanding the function of emotion Behavioural activation Motivation, goal setting and graded hierarchies
2	Thinking biases and cognitive restructuring Behavioural experiments Awareness of and tolerating physiological sensations (including interoceptive exposures)
3	Attention focus and behavioural experiments Learning to observe emotions and thoughts Mindfulness exercises
4	Review and further behavioural experiments Relapse prevention Wellbeing plan and being your own therapist

findings are not reported separately for Māori to prevent identification of participants.

Table 3 reports the change in PHQ-9 and GAD-7 scores compared to baseline. PHQ-9 and GAD-7 scores improved compared to baseline at all time intervals. Table 3 also reports the reliable recovery rates at 3 and 6 months. Thirty-six percent of the study population met the reliable recovery criteria at 3 months and 42.9% met the criteria at 6 months.

Discussion

We evaluated brief group TCBT delivered by Zoom for anxiety and depression in primary care. Our initial face-to-face RCT failed to meet pre-specified recruitment criteria and the COVID-19 pandemic intervened, which meant we redesigned our study to evaluate brief group TCBT delivered by Zoom. Despite modifying the study design and switching the delivery of therapy to Zoom, we believe there are key findings that inform this area of research.

The redesigned study recruited at a higher rate than the RCT. Potential participants were only passed on to study staff for further contact if they expressed an interest in receiving group TCBT following discussion with their primary care physician. Referrals to the study were dominated by a small number of referrers as opposed to being spread widely over the primary care network. This suggests that enthusiastic staff and allegiances with referrers are critical in the referral process.

The mean baseline measures of the study population were consistent with moderately severe depression²⁰ and moderate anxiety.²¹ Attendance at the groups and completion of the outcome measures following treatment met pre-specified criteria. The high level of attendance accompanied by improvements in the clinical rating scales suggests that participants found attending the groups beneficial. Groups were undertaken during office hours. However, as they occurred during the acute phase of the COVID-19 pandemic, this may have resulted in

Table 2: Socio-demographic characteristics of the study population.

Characteristic	TCBT groups (n=22)
Mean age (SD)	36.6 (14.6)
Mean PHQ-9 baseline (SD)	16.7 (5.8)
Mean GAD-7 baseline (SD)	13.3 (4.9)
Female (%)	15 (68.2)
Ethnicity (%)	
NZ European	13 (59.1)
Māori and other ethnicity	9 (40.9)
Relationship status (%)	
Single	14 (63.6)
Married/de facto	6 (27.3)
Widowed/separated/divorced	2 (9.0)
Median education years (IQR)	
Secondary school	5.0 (3.0–5.0)
Tertiary level	3.0 (1.0–4.0)
Employment status (%)	
Paid employment	8 (36.4)
Job seeking	3 (13.6)
Other	11 (50.0)

Table 3: Clinical outcome measures.

Outcome	TCBT groups
Mean change PHQ-9 from baseline at 3 months (SD)	7.8 (4.2) (n=14)
Mean change PHQ-9 from baseline at 6 months (SD)	7.6 (6.1) (n=15)
Mean change GAD-7 from baseline at 3 months (SD)	7.1 (5.2) (n=14)
Mean change GAD-7 from baseline at 6 months (SD)	6.5 (6.4) (n=15)
N reliable recovery 3 months (%)	5 (35.7)
N reliable recovery 6 months (%)	6 (42.9)

greater ease of attendance for participants. Therapists were able to deliver planned content using Zoom, although some interpersonal aspects and behavioural experiments are likely to have been experienced differently by participants compared to face-to-face delivery.

Group TCBT was associated with improvements in the PHQ-9 and GAD-7 scales that were sustained over the follow-up period. This suggests that brief group TCBT is helpful for patients with anxiety and depression in primary care. We measured reliable recovery to include a robust measure of recovery and improvement over time.¹⁹ The reliable recovery rates were 35.7% and 42.9% at 3- and 6-month follow-up periods. These are comparable with reliable recovery rates measured at the end of therapy in the United Kingdom. The large scale Improving Access to Psychological Therapies (IAPT) service reported reliable recovery rates of 42.85% and 44.44% in 2014/2015 and 2015/2016 respectively.¹⁷

We believe there are therapeutic benefits offered by group interventions (over and above individual treatments) such as group bonding and the potential for within-group behavioural experiments that may be particularly helpful for some individuals with anxiety and depression.²² Group treatment protocols also have the potential to deliver more therapeutic content despite using less staff time. These efficiency gains should be appealing for patients and organisations pro-

viding care. We suggest that if face-to-face group treatments are planned, they are best delivered from large urban centres to ensure sufficient numbers for timely recruitment to groups. However, Zoom and other video conferencing platforms appear to offer an appealing alternative for New Zealand and Australia that service large rural populations. The delivery of brief group TCBT via Zoom is also appealing in the context of pandemics that may place restrictions on and uncertainty over group gatherings.

Limitations

We relied on clinical judgement to determine anxiety and depression requiring therapy for study entry and psychological rating scales (PHQ-9 and GAD-7) to track progress as opposed to undertaking structured diagnostic interviews. Māori participation in the study was low. This suggests that systemic factors influencing referral may be present or that our treatment intervention may not be appealing for Māori (although the study was not powered to determine if this is the case).

In conclusion, we believe that brief group TCBT delivered via Zoom for anxiety and depression in primary care offers promise. Definitive studies are required to compare brief group TCBT with treatment as usual. We also believe there are benefits to further studies comparing face-to-face group TCBT with that delivered by video conferencing.

COMPETING INTERESTS

The authors have no competing interests to declare relating to this research.

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Resident medical officers' redeployment experiences in the Adult Emergency Department during the COVID-19 pandemic at Te Toka Tumai | Auckland Hospital

Peter G Jones, Bryony P T Nicholls

ABSTRACT

BACKGROUND: Te Toka Tumai Auckland Hospital enacted a multi-faceted plan in response to widespread community transmission of the Omicron variant of SARS-CoV-2 in 2022.¹ This included redeploying a number of resident medical officers (RMOs) from other specialties to assist emergency medicine and general medicine services within the adult emergency department (AED). The purpose of this report is to evaluate the experience of the redeployed RMOs and identify ways to improve the redeployment process in the future.

METHODS: An anonymous survey was sent out to the nineteen RMOs who were redeployed. Nine of 18 eligible RMOs responded (50%), with both quantitative and qualitative feedback collated. The quantitative data were descriptively compared, and a thematic analysis was performed.

RESULTS: RMOs provided a range of responses about the redeployment experience, with 56% willing to be redeployed to the AED in a future crisis. Impact on training was the most commonly reported negative experience. Positive redeployment experiences related to feeling welcomed and appreciated, and to having the opportunity to enhance acute clinical skills. Areas for improvement included structured orientation, RMO input and consent in the redeployment planning process, and having a single point of communication between the RMOs being redeployed and the administration.

CONCLUSION: The report identified areas of strength and areas for improvement in the redeployment process. Despite a small sample size, useful insights into the RMOs' experiences of being redeployed to acute medical services in the AED were gained.

In mid-January 2022, the community spread of the Omicron variant of SARS-COV-2 was detected within Aotearoa New Zealand.¹ Shortly after this, Te Toka Tumai Auckland Hospital enacted a hospital wide redeployment process during March and early April 2022. Eighteen resident medical officers (RMOs) were redeployed to assist with the acute medical services (emergency medicine and general medicine) within the adult emergency department (AED).

The aim of this report is to evaluate the RMOs' experiences of being redeployed and identify areas for improvement using a feedback mechanism incorporating quantitative and qualitative data.

Methods

Participants

Eligible participants consisted of RMOs who were redeployed to acute medical services working in the AED within Te Toka Tumai Auckland Hospital. One of the 19 respondents, redeployed to

general medicine, was excluded as they identified in their response they were exclusively redeployed to a different department. Of the nine eligible participants (50%) who engaged in the feedback process, 67% (six RMOs) were redeployed from the perioperative/anaesthetics department, 22% (two RMOs) from general medicine and specialty medicine departments and 11% (one RMO) from general surgery. Fifty-six percent (five RMOs) of respondents were registrars, 22% (two RMOs) were senior house officers, and 22% (two RMOs) were house officers. Sixty-seven percent (six RMOs) of eligible respondents were allocated to the emergency medicine service, and 33% (three RMOs) were allocated to the general medicine service within the adult emergency department for the purposes of redeployment.

Procedure/instrumentation

Eligible participants were identified by lists provided by the rostering team within the RMO Support Unit and the Chief Resident of perioperative

medicine. Participants were emailed a link to a Microsoft Forms survey and advised that survey completion was anonymous and voluntary, and that completion of the survey would not impact current or future employment with the organisation. Individual staff responses were not able to be identified.

The report proposal was approved by the senior management team of Te Toka Tumai Auckland Hospital. The feedback survey was drafted de novo and modified after consultation with the Director of Emergency Medicine Research, the staff of the AED and other stakeholders including the Chief Medical Officer, the Clinical Director of the AED, the Director of Provider Services, the Director of Prevocational Training, and the Project Manager of Pathways and Outcomes.

As an anonymised, voluntary audit of redeployed staff to help understand how to improve the redeployment process, ethical approval was not required or sought.

Likert scales were used in the questionnaires ranging from positive to negative responses relating to six categories including overall redeployment experience, impact on relationship with emergency medicine and general medicine teams, understanding of the importance of efficient patient flow, impact on training and education, and willingness to assist in future redeployment.

The questionnaires also included free text questions based on positive and negative aspects of the redeployment experience, suggested improvements, and opportunity for general comments (Appendices 1 and 2).

Data analysis

Quantitative data analysis was performed using Microsoft Excel. The Likert scales were scored from 1 (very negative) to 5 (very positive) and mean scores with 95% confidence intervals (CIs) calculated. The qualitative data were categorised into themes and a thematic analysis was performed based on the standardised approach developed by Braun and Clarke.²

Results

Quantitative results

Overall experience

Five RMOs (56%) felt neutrally about the overall experience of being redeployed, while 44% (four RMOs) found the experience positive (33% very positive, 11% somewhat positive). Those RMOs redeployed to work with the emergency medicine

service were more inclined to have a positive experience (with 67%, or four of the six RMOs, giving a very positive or somewhat positive response) compared to those allocated to general medicine (rated as neutral by 100% of this RMO subgroup).

Impact on relationship with the emergency medicine team

Six RMOs (67% of all respondents) reported their relationship with the adult emergency medicine team was impacted positively as a result of the redeployment process (five RMOs very positively, and one RMO somewhat positively). Three RMOs (33%) felt there was no impact. Of note, 83% (five out of six RMOs) of those who were redeployed to work specifically with the emergency medicine team felt the redeployment process had a very positive impact on their relationship with the emergency medicine team, whereas 67% (two out of three RMOs) from the subgroup redeployed to work with the general medicine team felt there was no impact made on their relationship with the emergency medicine team, and 33% (one RMO) felt there was a somewhat positive impact. There were similar results from this subgroup regarding the impact on their relationship with the general medicine team, with 67% (two RMOs) experiencing a somewhat positive impact, and 33% (one RMO) reporting no impact.

Impact on understanding of importance of efficient patient flow

Overall, 33% of the total respondents (three RMOs) identified that they gained somewhat more understanding of the importance of efficient patient flow as a result of the redeployment experience, and 67% (six RMOs) reported no difference. The responses between the two RMO subgroups were similar.

Impact on training

Overall, RMOs mostly reported a negative or neutral impact on training as a result of the redeployment process with 44% of the total respondents scoring somewhat negatively (three RMOs working in anaesthetics and one RMO working in general medicine pre-deployment), 33% (three RMOs) reporting no impact on training and 22% (two RMOs) reporting a very positive impact on training. It is unclear to what extent cancellation of elective surgeries contributed to the negative experiences of the RMOs redeployed from anaesthetics. The RMOs who reported a very positive impact on training were redeployed to work with the emergency medicine team.

Impact on general learning and education

The majority of overall RMOs (56%, five RMOs) reported no impact on their general learning and education, 33% (three RMOs) felt there was either a very positive or somewhat positive impact, and 11% (one RMO) identified a somewhat negative impact on their general learning and education as a result of redeployment. More RMOs who were redeployed to work with the emergency medicine team reported either a very positive or somewhat positive impact on general learning and education (50%, three out of six RMOs) compared with the subgroup of RMOs allocated to work with the general medicine team (0%).

Willingness to assist with the adult emergency department in future crisis situations

Overall, 56% (five RMOs) indicated they would be very or somewhat willing to assist with redeployment should a future need arise, 33% (three RMOs) provided a neutral response and 11% (one RMO) felt somewhat not willing.

Qualitative results

The qualitative data are represented in Table 2.

Qualitative data were categorised by positive and negative aspects of the redeployment processes, and areas for improvement with subthemes in each of these three categories.

Themes within the positive aspects of redeployment included: feeling welcomed, feeling appreciated, resource provision, enhancement of clinical skills and knowledge, insight into other services' workloads, and balance with non-ED work.

Themes within the negative aspects of redeployment included: impact on training, disruption to usual routine, witnessed doctor-patient interactions, high acuity/service demands, under-utilisation of clinical skills/scope of practice, and lack of familiarity/orientation to environment and role.

Themes within areas for improvement included: RMO input into the redeployment process, resource provision/orientation, and communication.

Positive aspects of the redeployment process

The RMO group who was redeployed to work with the emergency medicine team provided feedback in subthemes of feeling *welcomed* and *appreciated* (including: "*Great team, welcoming environment*"; "*The team were all very supportive and approachable*"; and "*SMO very appreciative of the help, enjoyed working with the team*"). Both RMO groups gave feedback that referenced the subtheme of enhancement of clinical skills

and knowledge (for example "*there was a good variety of cases. Opportunities to practice procedural skills*", "*refreshed some clinical knowledge*" and "*Opportunity to learn some general medicine and clerk patients in*"). One of the RMOs allocated to the emergency medicine team feedback about resource provision ("*I was emailed an orientation document (don't know how widely it was distributed but it definitely helped for door codes)*"). The sub-theme of balance with non-emergency department work was identified with the feedback: "*I liked how it was only 2 shifts a week with the rest of my time in anaesthesia as opposed to a full week of it*".

The feedback highlights the importance of a welcoming and appreciative attitude towards external staff in contributing to their redeployment experience being perceived as positive, and the educational opportunities to redeployed RMOs. The feedback about part time redeployment to the emergency department being a positive aspect is valuable for planning future redeployment rosters.

Negative aspects of the redeployment process

The most commonly reported negative experience related to impact on training time including "*loss of training time*", "*interrupted anaesthetics placement*" and "*missing out on opportunities in theatre/anaesthetics*". This feedback was raised equally in both RMO groups.

Other subthemes from negative feedback included disruption to usual routine (such as "*interrupted work/life by changing roster at last minute*"); underutilisation of clinical skills/scope of practice (including "*often being used as a means to putting IVL that were not challenging*"); the acuity of the ED ("*busy environment*"); witnessed doctor-patient interactions ("*not isolated to ED, but it was disappointing to hear/see some members of senior staff struggling to accommodate the basic needs of our trans community, e.g., incorrect pronoun use, casting assumptions, speaking openly in an unkind manner about frequent presenters*"); and lack of familiarity/orientation to environment and role (such as "*minimal orientation to how the general medicine admitting service functions*").

These data provide helpful information on how to enhance the experience should there be a future requirement for redeployment, especially in relation to providing effective orientation and resources for staff who are new to an area or specialty. The negative commentary relating to witnessed doctor-patient interactions serves as a reminder of the importance of upholding professionalism, compassion and appropriate rolemodelling.

Table 1: Quantitative results.

Question	Redeployed to EM (n=6) mean (95%CI)	Redeployed to GM (n=3) mean (95%CI)	All redeployed staff (n=9) mean (95%CI)
Overall experience	4.2 (3.1, 5.2)	3.0 (3.0,3.0)	3.8 (3.0, 4.5)
Relationship with EM	4.7 (3.8, 5.5)	3.3 (1.9, 4.8)	4.2 (3.5, 5.0)
Relationship with GM	-	3.7 (2.2, 5.1)	-
Understanding of flow	3.3 (2.5, 4.2)	3.3 (1.9, 4.8)	3.3 (2.6, 4.1)
Specialty training	3.3 (1.9, 4.8)	2.3 (0.9, 3.8)	3.0 (2.0, 3.9)
General Education	3.7 (2.4, 4.9)	3.0 (3.0, 3.0)	3.4 (2.7, 4.2)
Willing to assist again	3.8 (2.4, 5.2)	3.7 (2.2, 5.1)	3.8 (2.9, 4.6)

Abbreviations: EM = emergency medicine, GM = general medicine.

Notes: All questions scored from 1 to 5, with 1 being very negative and 5 being very positive.

Table 2: Qualitative data about the redeployment process.

Overarching theme: positive aspects of the redeployment process		
Subtheme	Quotes: EM group	Quotes: GM group
Welcomed	<p>“Great team, welcoming environment”</p> <p>“I was welcomed very warmly”</p> <p>“The team were all very supportive and approachable”</p>	
Appreciated	<p>“SMO very appreciative of the help, enjoyed working with the team”</p>	
Resource provision	<p>“I was emailed an orientation document (don’t know how widely it was distributed but it definitely helped for door codes)”</p>	
Enhancement of clinical skills and knowledge	<p>“There was a good variety of cases. Opportunities to practice procedural skills”</p> <p>“Good practice at history taking and examination. Not done too much of that since medical school”</p>	<p>“Refreshed some clinical knowledge”</p> <p>“Opportunity to learn some general medicine and clerk patients in”</p>
Insight into other services’ workloads		<p>“Gaining an insight into what general medical and AED colleagues do”</p>
Balance with non-emergency department work	<p>“I liked how it was only 2 shifts a week with the rest of my time in anaesthesia as opposed to a full week of it”</p>	

Table 2 (continued): Qualitative data about the redeployment process.

Overarching theme: negative aspects of the redeployment process		
Subtheme	Quotes: EM group	Quotes: GM group
Impact on training	<p><i>“Impact on training, working an altered roster, more evenings”</i></p> <p><i>“Interrupted anaesthetics placement”</i></p> <p><i>“Didn’t get to do anaesthetics”</i></p>	<p><i>“Loss of training time”</i></p> <p><i>“Missing out on opportunities in theatre/ anaesthetics”</i></p> <p><i>“Loss of clinical time and missing out on volume of practise”</i></p>
Disruption to usual routine	<i>“Interrupted work/ life by changing roster at last minute”</i>	
Witnessed interactions with patients	<i>“Not isolated to ED, but it was disappointing to hear/see some members of senior staff struggling to accomodate the basic needs of our trans community, e.g., incorrect pronoun use, casting assumptions, speaking openly in an unkind manner about frequent presenters”</i>	
High acuity/ service demands	<i>“Busy environment”</i>	
Underutilisation of clinical skills / scope of practice		<i>“Often being used as a means to putting IVL that were not challenging, but rather because CDU staffed saw as a means to bypass appropriate channels for requesting procedural assistance from the Anaesthetic department”</i>
Lack of familiarity with environment and position / Orientation to service		<i>“Minimal orientation to how the general Medicine admitting service functions”</i>
Overarching theme: areas for improvement		
Subtheme	Quotes: EM group	Quotes: GM group
RMO input into the redeployment process	<i>“Ask staff if they’re willing to volunteer before forcing redeployment”</i>	
Resource provision/ orientation	<i>“Every service should have a redeployment orientation one pager”</i>	<i>“Orientation to how the departments functions and useful documents pertaining to work in AED”</i>

Table 2 (continued): Qualitative data about the redeployment process.

Overarching theme: areas for improvement		
Subtheme	Quotes: EM group	Quotes: GM group
Communication	<p><i>"I wish there was on central person that we could have liaised with about the whole redeployment process. Someone that was connected to the appropriate senior leadership within each affected department. Because the communication in general was frankly awful ... was patchy at best, radio silent at worst. I had no idea if the redeployment was approved by my own department, because there were some instances where we thought we had over allocations in our after hours shifts but due to sick calls that weren't communicated we'd actually end up short. It's uncomfortable being redeployed not knowing if my own service was going to be left short. I think ... could play a role in identifying who might be suitable for redeployment but I think the actual coordination should be overseen by e.g., one of the educational fellows who is trusted and known to the RMOs. Also, zoom meetings in the middle of the work day are a pretty inconvenient way of trying to disseminate information. Emails or brief phone calls are probably better"</i></p>	

Abbreviations: EM = emergency medicine; ED = emergency department; GM = general medicine; CDU = clinical decision unit; IVL = intravenous lines; RMO = resident medical officer.

Areas for improvement in the redeployment process

Resource provision and orientation was another main subtheme in the category of areas for improvement and was raised by both RMO groups. Examples include “every service should have a redeployment orientation one pager”, and “orientation to how the departments functions and useful documents pertaining to work in AED”. One RMO provided a suggestion to have RMO input into the redeployment process (“ask staff if they’re willing to volunteer before forcing redeployment”).

Feedback in the subtheme of communication was provided, such as:

“I wish there was on central person that we could have liaised with about the whole redeployment process. Someone that was connected to the appropriate senior leadership within each affected department. Because the communication in general was frankly awful ... patchy at best, radio silent at worst ... I think the actual coordination should be overseen by e.g., one of the educational fellows who is trusted and known to the RMOs. Also, zoom meetings in the middle of the work day are a pretty inconvenient way of trying to disseminate information. Emails or brief phone calls are probably better.”

From this data, it would appear there is value in developing resources to assist with orientation of redeployed staff, including an outline of how a service works during a period of redeployment, who to report to, expected scope of practice, and relevant hints and tips. This may enhance both efficiency in work and staff satisfaction/wellbeing.

Discussion

All of the RMOs responding to the survey either felt positively or neutrally about the redeployment experience and over half reported that they would be willing to assist the AED should a crisis recur in the future. Staff related factors were highlighted as contributing to positive experiences in both the quantitative and qualitative data, with the latter focusing on a sense of being welcomed and appreciated. Both RMO groups positively highlighted the opportunity to enhance their clinical skills and knowledge through exposure to working in the ED.

There are a number of prior studies exploring

the impact of the COVID-19 pandemic on junior doctor training, mostly involving surgical trainees. However, the specific impact of redeployment over general impact of the pandemic such as reduction of elective surgeries and reduced hands-on clinical teaching, was not often clarified in these studies. A scoping review of the impact of the pandemic on junior doctor education and training found eight studies mentioning redeployment, with around a quarter of junior doctors being redeployed (range 1–35%).³ Although the majority of trainees reported negative impacts of the pandemic on training, the impact of redeployment was only specifically mentioned in one of the included studies.⁴ In that study of 756 surgical residents, 112 had been redeployed (2/3 to a non-surgical specialty). Approximately half of the redeployed residents believed the redeployment had a positive impact on training while a third believed the impact was negative, the remainder being neutral.⁴ The varying impacts of redeployment on training was also found in a study of orthopaedic trainees, which reported an even split between positive and negative experiences. Half of the respondents reported receiving no training or orientation in the new area and one trainee was not comfortable running a minor injuries unit without supervision, while another reported a good experience under a welcoming medical team.⁵ Another survey of 60 junior doctors in training found that the 30% who were redeployed (mostly to general medicine or critical care) all had direct consultant supervision and were more likely to believe that their clinical skills, knowledge base and patient engagement were positively impacted than those who were not redeployed. Surgical skills training was impacted negatively in both groups, but more so in the redeployed group in that study.⁶ A consistent theme in studies exploring junior doctor experience with redeployment is that being redeployed creates stress and anxiety in the redeployed staff, which can be lessened by adequate supervision, good communication, support and a welcoming attitude by the receiving department—this is consistent with our findings.⁷⁻⁸

- Based on our findings and those reported in prior literature, there are several concepts that may enhance a future redeployment process, namely:
Providing RMOs with a standardised orientation document outlining expectations of clinical work and scope of practice in a

redeployed position as well as departmental aspects (such as access codes).

- Creating a resource to provide redeployed RMOs outlining general processes within a service, and hints and tips on how to achieve common work tasks within a particular service (a “cheat sheet”). Of note, there is a hospital-wide orientation handbook for interns (postgraduate year one and two doctors) provided at the beginning of each year which outlines the main components and tasks of working in each specialty (including emergency medicine). It is unknown whether this was provided to redeployed RMOs.
- Rostering RMOs to part time redeployment, with a limited number of shifts per week. This would allow for some ongoing exposure and consistency with usual clinical work and would lessen the impact on training.
- Involving RMOs in the redeployment planning process and seeking their agreement to redeployment in the first instance.
- Identifying a key staff member to act as a communication liaison between the redeployed RMOs and departments. Feedback indicated a preference for email and phone-based communication, as opposed to via Zoom updates.

- Given several RMOs reflected positively about the exposure to the type of patient cases and workload in the adult ED, this could be highlighted in advertising for future redeployment recruitment processes.

Limitations

As a single site survey with a limited number of potential respondents generalising our findings may be problematic, although our response rate was relatively high for such a survey. Given there was no comparison group of trainees who were not redeployed at the time of the survey, the impact of redeployment vs the impact of the overall pandemic response on trainees’ beliefs about their training could not be determined. The small sample size limited the quantitative analysis to descriptive only.

Conclusion

The redeployment process used had both positive and negative impacts on the training of redeployed RMOs. Their experiences provide useful data to inform any future plans for redeployment in response to staffing and workload crises within Te Whatu Ora – Health New Zealand hospitals and have the potential to improve RMO training generally.

COMPETING INTERESTS

Nil.

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Appendices

Appendix 1: Survey for RMOs redeployed within the AED to Emergency Medicine, and for RMOs redeployed within the AED to General Medicine.

1. What department were you working in when you were redeployed to AED?

[Enter your answer]

2. What is your current level of training?

- House officer
- Senior House Officer
- Registrar

3. Are you enrolled in a vocational training programme?

- Yes
- No

4. Please rate your overall experience during redeployment to AED

- Very negative
- Somewhat negative
- Neutral
- Somewhat positive
- Very positive

5. How did working in AED impact your relationship with the General Medicine team?

- Very negatively
- Somewhat negatively
- No impact
- Somewhat positively
- Very positively

6. How did working in AED impact your relationship with the Emergency Medicine team?

- Very negatively
- Somewhat negatively
- No impact
- Somewhat positively
- Very positively

7. How did working in AED impact your understanding of the importance of efficient patient flow?

- A lot less understanding
- Somewhat less understanding
- No difference

- Somewhat more understanding
- A lot more understanding

8. How did working in AED impact your training?

- Very negatively
- Somewhat negatively
- No impact
- Somewhat positively
- Very positively

9. How did working in AED impact your general learning/education?

- Very negatively
- Somewhat negatively
- No impact
- Somewhat positively
- Very positively

10. Would you be willing to assist General Medicine/AED again to help in crisis situations in the future?

- Not willing at all
- Somewhat not willing
- Neutral
- Somewhat willing
- Very willing

11. What were the positive aspects of being redeployed to AED?

[Enter your answer]

12. What were the negative aspects of being redeployed to AED?

[Enter your answer]

13. How could the redeployment process be improved if we had to use it again?

[Enter your answer]

14. Any other comments?

[Enter your answer]

An exploratory qualitative enquiry into workers' experiences of leptospirosis and post-leptospirosis in Aotearoa New Zealand

Jackie Benschop, Shaan Mocke, Julie M Collins-Emerson, Jane Lennan, Jenny F Weston

ABSTRACT

AIMS: This pilot study describes the experiences of six people who reported post-leptospirosis symptoms. Our aim was to perform an exploratory qualitative study to document participants' experiences and to identify themes to gain understanding of the impact and burden experienced.

METHODS: Participants self-recruited, meaning they had directly contacted the first author prior to the study commencing and had offered to tell their stories. Face-to-face semi-structured interviews were conducted in January 2016 and summative content analysis was used to distil themes.

RESULTS: The participants were male, had been employed in livestock slaughter plants (n=2) or farming (n=4) when they first contracted leptospirosis and claimed they had been suffering from post-leptospirosis symptoms for 1–35 years. Symptoms included exhaustion, brain fog and mood swings, and participants' lifestyles and relationships were severely affected. Participants and their partners reported poor awareness and knowledge of leptospirosis when they sought help, and that employers and the Accident Compensation Corporation (ACC) were dismissive of post-leptospirosis symptoms. Participants also reported some positive experiences and had advice to share.

CONCLUSION: Leptospirosis may have severe long-term consequences for patients, their families and their communities. We recommend that the aetiology, pathogenesis and burden of the persistence of leptospirosis symptoms become topics for future research.

Leptospirosis is a globally important, zoonotic bacterial disease with an estimated 1.03 million cases and 58,900 deaths annually, with tropical regions incurring the highest burdens.¹ Humans are infected from contact with animal urine or from contaminated water; contact with rodents and floodwater are recognised risk factors globally.² Patients with acute leptospirosis episodes (ALEs) have diverse symptoms, ranging from undifferentiated fever to fatal disease.³ The clinical presentation is nonspecific, so diagnosis relies on attending clinicians being aware that leptospirosis could be a differential diagnosis followed by laboratory confirmation. Beyond the severe acute illness there are reports of post-leptospirosis symptoms (PLS) including malaise, fatigue and myalgia in the Netherlands;⁴ uveitis in South India;⁵ and chronic kidney disease and depression in patient cohorts in Taiwan.^{6,7} In these studies, post-leptospirosis was variably defined from as little as 2 months after the acute episode up to 24 months. Goris et al. reported the duration of symptoms as 24 months or lon-

ger for 21% (12/57) of patients. The mechanisms underlying PLS may include persistent infection with *Leptospira*,⁸ post-infective fatigue syndrome⁹ or autoimmune conditions.¹⁰ Current reports on long COVID bring the importance of documenting the long-term sequelae of infectious diseases in greater focus.¹¹ Choutka et al., in their 2022 review, coined the phrase post-acute infection syndromes (PAISs) to encompass viral, bacterial and protozoal infections where there is an unexplained failure to recover from the acute infection.¹² These authors recognise the overlap of the clinical features of PAISs with myalgic encephalomyelitis/chronic fatigue syndrome, suggesting a common etiopathogenesis.

Leptospirosis is also prevalent in countries with pastoral livestock industries like Aotearoa New Zealand (Aotearoa), as livestock contact is a recognised risk factor. Men working in agricultural industries, including meat workers and farm workers, are most reported as cases.¹³ Serological diagnosis has been considered a gold standard¹⁴ and predominates, however, PCR diagnosis is

playing an increasing role. Serovars Hardjo-bovis, Ballum (both *Leptospira borgpetersenii*) and serovar Pomona (*Leptospira interrogans*) are most reported in Aotearoa. These reflect the restricted number of pathogenic *Leptospira* serovars known to be endemic in Aotearoa, all of which have arrived with domestic and wild mammals imported from the early 1800s.¹⁵

Leptospirosis is included in the list of occupational diseases recognised by the Accident Compensation Corporation (ACC), a Crown entity that administers a no-fault insurance scheme for injury by accident. People who develop leptospirosis resulting from their employment are eligible for cover, provided they satisfy the statutory and clinical criteria set by ACC. Over half of notified leptospirosis cases in Aotearoa are hospitalised¹⁶ and approximately one quarter of these are admitted to intensive care.¹⁷ The estimated annual cost of ALEs in Aotearoa is \$4.42 million USD (95% PI 2.04–8.62) due to absence from work and disease treatment,¹⁸ but this does not address the estimated 15-fold under-reporting of cases or the ongoing effects of PLS. While there is a paucity of documented information about PLS in Aotearoa and it is poorly recognised by ACC, there is high awareness of PLS in rural communities.

Our research programme in leptospirosis over the last 15 years has led to informal discussions with patients, physicians and workers and has identified two syndromes in approximately 30% of ALE patients: 1) “those who never came right”, who suffer fatigue, poor concentration and general malaise since their ALE, and 2) a headache/fever/myalgia triad that is intermittent for a variable period post-ALE. A 2009 case series reviewed 12 cases of chronic fatigue syndrome with a direct temporal link to a previous ALE contracted in Australasia. The 10 men and 2 women were meat processors (n=9) and farm workers (n=3), and the duration of their fatigue ranged from 6 months to 6 years at the time of last follow-up.¹⁹ Three quarters of these (9/12) were 41 years of age or younger at the time of their ALE. All suffered disruption to their personal lives and work because of leptospirosis and its sequelae.

An earlier study was undertaken using semi-structured interviews and inductive analyses to explore the consequences for 10 New Zealand workers who had occupationally acquired leptospirosis.²⁰ These comprised nine men and one woman working in meat processing (n=8), farming (n=1) and truck driving (n=1) with 30% (3/10) under 40 years of age. Although

PLS was not a focus of this work, ongoing fatigue was reported by all participants. Most reported at least one of the following long-term symptoms (up to 8 years post-ALE): migraines, irritability, depression, kidney problems, backache and sensitivity to light. Both immediate and longer term social (strained relationships), economic (lost income) and psychological consequences (fear of returning to work) were reported.

Globally, there is little information about the persistence of leptospirosis symptoms and whether some serovars are more likely to result in PLS. In Aotearoa, PLS is currently poorly, or not at all, recognised by ACC, thus documentation of patient experience with PLS will raise awareness of the condition and may also identify opportunities to improve systems and quality of care.²¹ The aim of this pilot study was to perform an exploratory qualitative study with participants who were suffering from PLS to document their experiences.

Methods

Seven people who had previously been in contact with the first author to discuss their persistent symptoms of leptospirosis and who had expressly said that they would like to tell their stories were eligible to participate in this study. They were telephoned in late 2015 and were asked if they were willing to be involved in the study. Each participant who agreed to further contact was mailed or emailed a consent form, information sheet and an introductory questionnaire capturing demographic information, details of their leptospirosis infection or infections and their persistent leptospirosis. The introductory questionnaire was used to guide the subsequent semi-structured interview; it also specifically asked if the patients were aware of their serology (MAT titre) results. This is a paired blood test for leptospirosis, for which a diagnostic for confirmed leptospirosis is ≥ 400 or a four-fold rise in titre.²² MAT results also give evidence of the likely infecting serovar. Serovar information has not been gathered in the context of persistent symptoms of leptospirosis in New Zealand previously.

Semi-structured interviews were conducted face-to-face by S.M. in locations chosen by the participants. For three of the interviews, a study supervisor accompanied the interviewer but was not involved in the actual interview process. Questionnaire development was led by a clinical psychologist (J.L.) who had experience counselling people with chronic conditions. The

questionnaire and the structure of the interview were piloted on two individuals; the first being an employee at Massey University who had been diagnosed with leptospirosis at least 20 years ago and was suffering persistent symptoms. The second was an experienced farm animal veterinarian with good knowledge of the disease in animals and people.

All participants were offered the opportunity to have a support person with them for the interview, and a follow-up visit with their general practitioner was offered if they wished to know more about their condition or required further support after the interview. Interviews were recorded and a descriptive approach was used to analyse transcripts. Specifically, summative content analysis²³ was performed by two researchers (S.M. and J.W.) examining the text looking for recurring themes. Quotes from participants were included to support researcher inferences and provide evidence for the basis of the themes distilled from the interviews.

Prior to undertaking this research, the project was evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The project was recorded on the Low-Risk Database, which is reported in the Annual Report of the Massey University Human Ethics Committees.

Results

All seven men who were approached initially agreed to be involved, although one of the participants withdrew from the study prior to the interviews commencing. During January 2016, the remaining six participants were interviewed either at their homes (n=4, Northland, Manawatū-Whanganui, Hawke's Bay), a café (n=1, Hawke's Bay) or at Massey University (n=1).

The participants were all male and ranged in age from 41 to 61 years old (Table 1). Five participants were in a long-term relationship and were interviewed with their partners. The other participant was interviewed on his own. Three of the participants had dependent children at home. One was in the same occupation as when first diagnosed with leptospirosis, two were currently unable to work and were at home full time and the other three were employed in part-time work. Four of the participants were hospitalised when they were initially diagnosed with leptospirosis. Laboratory test results for two of the participants (1 and 3) were viewed by the researchers. Participants reported infection with serovars Hard-

jo-bovis (n=3), Pomona (n=2) and one each of Copenhageni and Ballum.

Individual participant summaries

Participant 1

This farmer was married with two young children when he was first ill with leptospirosis in 2011. Reported symptoms were fever and chills, headache, myalgia and extreme lethargy. He believed that he was developing "the flu" and spent 2 days in bed before seeing his local general practitioner. The following day, he presented at the local hospital where he was admitted due to dehydration. He was treated with fluids and intravenous antibiotics. Although his initial screening test for leptospirosis was negative, he was treated empirically for leptospirosis and medical records showed a second serum sample collected 2 weeks later had a MAT titre for Hardjo-bovis of 800. He reported being unable to work for the next 4 years due to fatigue, recurrent headaches, photophobia and myalgia (particularly in the legs and feet). He also reported mood swings. He was interviewed with his wife at Massey University, Palmerston North.

Participant 2

This participant reported fatigue, weight loss, back pain, myalgia (mainly in the legs) and proteinuria when first ill. He reported being treated with antibiotics for 9 months and not being hospitalised. In addition to the initial presentation, the patient reported further episodes of acute clinical disease in 2007 and 2010. The medical records for this patient were not available but he recalls testing in 2010 showed evidence of previous infection with Copenhageni and Hardjo-bovis. This patient reported that his situation over many years had been depressing and that he also suffered mood swings. The interview occurred at his home.

Participant 3

Acute leptospirosis symptoms were fever, vomiting, and back and loin pain for this participant. He was married with several dependent children when first ill. He was hospitalised where he was confirmed to be infected with Pomona (MAT titre 400). During his 9 days in hospital, he was diagnosed with hypotension, impaired renal function, pulmonary oedema and coagulopathy. At the time of interview, he had been unwell for 12 months with severe fatigue. He was one of three workers hospitalised in an outbreak of leptospirosis on a dairy farm in early 2015.²⁴ Cattle and pigs on the

farm had serological evidence of recent infection with both Pomona and Hardjo-bovis, however, there was no evidence of clinical disease among the animals.²⁵ Ongoing symptoms included severe lethargy, headaches and visual disturbances. This participant had been unable to work since the initial illness. He was interviewed at home with his wife.

Participant 4

When first ill this participant's symptoms were fatigue, tremors and photophobia. He spent 6 nights in hospital, 4 of them in intensive care. At discharge he was still suffering from impaired renal and hepatic function. He was confirmed to be suffering from leptospirosis due to Ballum 8 weeks after discharge. However, the medical records for this patient were not available. He had not been able to return to work and still suffered from fatigue and headaches. He reported needing to sleep for about 16 hours per day, and that he had no strength or stamina. The interview was at home with his wife.

Participant 5

This participant was working at a sheep slaughter plant when he first became ill with fever, vomiting, lower back pain and severe headaches. Although leptospirosis was suspected at the time, it was not confirmed. He was hospitalised and then transferred to a tertiary hospital for dialysis. He was in hospital for about 3 weeks in total, and unable to work for at least 2 months. His persistent symptoms consisted of severe headaches. In 2010, he became ill again with similar symptoms to the 1986 episode, including severe headaches, generalised muscle pain, fatigue and fever. Dilated cardiomyopathy was diagnosed in 2015, reportedly due to a "virus" that damaged the heart over a period. He is now unable to work in a physically demanding environment and is employed in office work. The medical records for this patient were not available. He was interviewed at a café in his hometown with his wife.

This patient's father-in-law, daughter-in-law and several friends had also contracted leptospirosis through occupational exposure.

Participant 6

This worker first became ill while working in a deer slaughter plant. He reported extreme fatigue, fever, polyuria, photophobia, hyperacusis and tremors, and was noted by workmates to be jaundiced. This episode of disease was eventually confirmed by serology to be due to Hardjo-bo-

vis. The medical records for this patient were not available. This patient was not hospitalised and was not treated with antibiotics for this episode of disease. He had a recurrence of acute disease in 2010, which was due to Pomona. After the initial episode of disease, he reported suffering symptoms for more than 10 years, which consisted of headaches (reported to be like migraines and occurring several times per month), photophobia, fatigue, myalgia (legs and back) and diarrhoea. He was interviewed at home with his wife.

Summative content analysis

The following themes were distilled from the interviews with the participants (and their partners in some instances).

These were hard-working men severely affected by the acute disease

All participants were working in physically demanding occupations prior to contracting leptospirosis. Their healthy lives, hard work and engagement with their communities were a source of pride and happiness.

It was full on, but I was loving it at that stage. You know I was pretty busy, with what I was doing, sports, different community things I was involved in. – 2

Participants reported classic symptoms of acute leptospirosis, especially rigours, myalgia, fever and extreme exhaustion. The sudden onset of symptoms was frightening to participants and their partners. Often men continued to work while feeling unwell.

He said to me "Well my muscles are sore, so sore", and I thought it must be from bringing all the hay in, so normal. And pretty much 24 hours from then, on the Thursday, I was in town, and there was this funny message on the phone, get home quick, help! So I came home and found him passed out on the lawn, totally incoherent. – Partner of 3

It started with the chill in my back. And that must've been 2 to 3 hours before knock off. So I thought I would just hang in there, and do my evening shift clean up at the end of the day, and then I would sort it out when I got home. I just made it to

Table 1: Features of participants in a case series of persistent leptospirosis symptoms.

Participant identifier	Age at first onset of acute disease (years)	Ethnicity	Year at first onset of acute disease	Serovar(s)	Occupation at time of first onset of acute disease	Age when interviewed for this study (years)	Duration of post-leptospirosis symptoms (years)
1	41	European	2011	Hardjo-bovis	Farmer (sheep, cattle, some slaughter)	45	4
2	23	European	1978	Hardjo-bovis Copenhageni	Farmer (dairy and contracting)	60	35
3	47	European	2015	Pomona	Farmer (dairy)	48	1
4	55	European	2010	Ballum	Farmer (beef)	61	6
5	21	Māori/ Rarotongan	1986	Not reported	Meat worker	50	29
6	22	European	1996	Hardjo-bovis Pomona	Meat worker	41	10

the end of my shift, cleaning, and the pain was intensifying in my lower back. When I got home it came on over 5 or 6 hours, before I hit rock bottom. Yeah, massive headaches, migraines. And it felt like I had the flu, but about 10 times worse. – 5

Yes it happened at work, my mate said to me, I had really yellow eyes, I had no energy, and it just got worse. I finished the day out, but, um, over the next few days, it was really downhill. I was sweating and shaking, I had no balance, yeah, I was in a bad way. Any light, noises, loud noises, light specially, couldn't tolerate it. – 6

Participants and their partners felt that medical staff who attended them during their acute episode had poor awareness, recognition and knowledge of leptospirosis

Participants reported that they were dismissed as having “the flu” or a virus. They had to suggest leptospirosis as a possible diagnosis to medical staff and they had to argue for a blood test or antibiotic treatment.

We went to the doctor and got a blood test done. And we had to argue that, for lepto, didn't we? – 1

And the doctor we saw, she said he has a virus, he must toughen up. – Partner of 3

And I said, was it lepto... And he said, what's lepto? And that's when you think, oh shit. – 4

Post-leptospirosis symptoms were severely debilitating

Participants were exhausted, lost weight and they had aching muscles, brain fog and mood swings. Uncertainty about when or if they would recover fully, a sense of frustration and loss of self were apparent.

I get really achy legs. If my legs are too achy and sore, that's an early sign. I got sore eyes from bright light ... for the first 2 months out of hospital, even wore sunglasses around the house. I couldn't stand any bright light. It drove me nuts. – 1

Well by that stage I was just so exhausted and bugged. For that first probably 12 months, I was just a write off. – 1

Mood swings and depressions, mood swings are, that's actually a really hard one... I mean, you do get pissed off. That level of frustration is so high. Or are you that pissed off that you can't do anything? It is frustration, I think frustration is probably a symptom that needs to be clearly put in there. – 2

I have brain issues, from ongoing effects, especially when I get tired, it shuts down ... fuzzy thinking, fuzzy eyes, need to sit down, time for a break. You have no strength, and no stamina. You try to avoid walking every step, but then, after two months, you virtually have to train yourself to walk again. There was no way I could run, I was still falling over. Lepto eats you, and continues to eat you, until you have got nothing left. – 4

Even kind of now, I get really bad migraines, hey, really shocking migraines. I've got to go into a dark room for these headaches. I call them the dark room headaches. Probably about three times a month. The headaches are severe, very severe. – 6

Participants and their partners felt that the medical staff were poorly aware of PLS

This ranged from not believing that the patients were genuinely unwell or required any specific treatment, to a delay in requesting diagnostic tests or prescribing antibiotics, to not considering leptospirosis as a differential diagnosis.

Then one of the doctors said, these results on my blood screening were coming down and it was all in my head. – 1

[After an MRI] everything was perfect, and the other tests were perfect, walking okay etc. It was this neurologist at the private hospital that we saw, he said it was all in his head, just a waste of time. – Partner of 3

One time he had antibiotics, the other not,

the first time he had nothing. I just had to look after him at home. – Partner of 6

Participants' lifestyles and relationships were detrimentally affected by PLS

Participants reported the loss of careers and the ability to enjoy sport, they were short-tempered with their children and their partners had to pick up the farm work. Important relationships were affected, and participants recognised the stress that family members felt.

Work just stopped. It wrecked my career, it changed it—it stopped what we were doing, put it on hold. [Wife] went back to work full time. I looked after the kids. – 1

Given my time again, heaven forbid, the wrap-around thing would need to include support for the people supporting the patient ... okay, you've got lepto, yes some antibiotics, go away but I want to see your family tomorrow, I want them in one room, I want to talk to them. The patient is fine, they've just got lepto. But you've got a wife thinking where's the next paycheque coming from, the kids are thinking Dad is not much fun anymore, the volume goes up and up and up, and no one is listening. And the whole thing can become actually, turn to shit, pretty quickly. – 2

And I can't do half the things I used to do with the kids. That's the worst thing about it. And I get very short fused, when I start going down. The kids just vanish, because I lose it. – 3

He does lose his rag a lot quicker than he used to—still does, I don't think that will change. – Partner of 4

I used to love golf. I still have not been able to achieve an 18-hole round, it was 2 years before I could swing the club. Oh, you would come to grips with it, but reluctantly you did accept. So I would go out, with intentions of going to have a game of golf, but after two holes I would be exhausted. – 4

Participants felt their employers and ACC were dismissive of PLS

Employers did not engage with the issue, or they tried to shift the blame to the employee. Sick leave entitlements were insufficient. Participants faced multiple barriers to a positive ACC experience: delay, lack of consistency, requirements to work very short hours and feeling that they were being labelled as a “bludger”.

ACC were just absolutely hopeless. I think I ended up with about 13 different case managers. I'd go there, and then get sent here, then make calls, and then I'd say I'm buggered and just go home, and sleep for a couple of days. I had to go to work 1 hour a day, and they were going to get me back into work. But it was like, who wants to hire someone for 1 hour a day, and I was going to travel for that, and to drive, I had to drive half an hour to get to work for 1 hour a day. And if I was tired and couldn't do it, the driving was bloody hard on me. – 1

And I rang his employer and told them that he wasn't well and they suspect it is lepto. And he said he shears sheep and does some home kill, that's where he got it from, not from our cows. And then the third worker got it, three of them from the same farm. – Partner of 3

They wanted me back at work straight away. And then I went downhill again. They were only going to pay me a week sick leave and I had been there 3 years without a day's leave! Then they said OK, maybe you can have 3 weeks' sick leave—after all I had done for them! And then they put the screws on me to say, well ... they avoid me in town ... they want to hide it all under the carpet. – 3

It took 13 weeks for ACC to sort out our payments. Family of four, it was tough. – 3

I realised we may be entitled to ACC. So I rang ACC, they explained it to me, and they said they can't initiate it. It has to go through your doctor. So we went to the doctor, and the reaction was less than desirable. Basically saying you

are a bludger, you know, that kind of feedback we got. It was just like, then he went on his computer and said oh, there is something there for that. But we already had that first impression that we were bludgers for ACC support. – 4

Participants had valuable experiences to share

Participants advised others to protect themselves from risk such as making sure the livestock they were working with were vaccinated. They emphasised recognising the symptoms, acting quickly and resting well as part of the path to recovery.

Tell them not to work on an unvaccinated dairy farm. That information needs to be put out to workers. It's not worth it, it's 4 years and I'm just starting to get back into work. The boss doesn't care, the boss just gets someone else in. You worked well, and then you got crook. You are just a number. I don't mean that negatively, but that's just the way it is. – 1

My biggest thing, and I tell other farming families, all of a sudden you're feeling crook, stinking headaches and you can't stand the light: lepto, get the drugs. That's the one thing that annoys me, that I didn't do something sooner. – 1

I would tell them to get it sorted, get antibiotics, take it easy, and fluids. – 6

Participants had some positive experiences due to PLS

Participants reported rising to a challenge, growth in confidence, time with family and embracing different community roles as a counterpoint to feelings of resignation and needing to keep going. Among meat industry employees there was a sense of improvement in relation to how the workplace responded to leptospirosis over time.

On the positives, I'm on the school board now, and I'm up at the school, because I was at home a lot, I ended up joining a few committees, and chairman of another outfit. I get to spend a lot more time with the kids, I'm a lot more involved with the community, and I'm a

lot more confident, I am more confident at big gatherings to say something. – 1

What has kept me going ... [silence] I think it's psychological in the terms of, well, I want to get well. And there's always going to be a tomorrow, and tomorrow might be the day that I get well. There is that aspect to it. It's almost become a little personal thing, a challenge. – 2

I live for my kids, my family, our kids, I just wish I could do more with them. I suppose one way I've been able to spend a couple of hours at school with them, helping the school, helping the kids at school for a couple of hours. – 3

It's different now, [at meat works company] now we have glasses, goggles, smock, everything, helmets, visors. It's pretty good now. – 6

Discussion

This small pilot study has identified that leptospirosis contracted in the workplace can have severe long-term consequences for patients, their families and their communities. Patients and their partners felt unheard by medical staff, employers and compensation authorities. Our findings in relation to leptospirosis add support to previous work performed in Aotearoa^{19,20} and in the Netherlands,⁴ where it was identified that symptoms can persist long after the acute episode and these are associated with significant disruption to personal and work lives.

Participants experienced dramatic change in their lifestyles with only two of six returning to their pre-leptospirosis careers. While most workers who experience work-related illness or injury successfully reintegrate into the workforce,²⁶ our participants experienced complex employment patterns after their leptospirosis diagnosis and two were not working at the time of their interview. Workers in primary industries consider themselves staunch and stoic²⁷ and particularly within the farming community of Aotearoa the dominant stereotype is to be independent and self-sufficient.²⁸ That these men had little previous experience of illness and were working within the agricultural sector may have exacerbated feelings of anger and frustration at the disease, themselves and sometimes their families.²⁹

Globally the burden and impact of work-related diseases and injuries are severely underestimated³⁰ and specifically work-related chronic diseases have challenges associated with their recognition. Our participants felt their illness was inadequately recognised, investigated and treated and as a result felt dismissed by medical staff. This occurred when they sought help with both acute and persistent leptospirosis. Inadequate investigation may stem from a lack of recognition of leptospirosis by the attending medical practitioner. Awareness of leptospirosis in Aotearoa medical communities was identified as an issue in the results of analysis of semi-structured interviews with nine key influencers from agricultural industries.³¹ Often participants or their partners needed to suggest leptospirosis as a differential diagnosis and then also suggest that a test needed to be performed. Inadequate investigation due to a lack of commonly agreed diagnostic terminology is a key factor in the poor recognition of chronic work-associated disease.³²

Difficulties with investigating acute leptospirosis are further compounded by limitations in current testing protocols that make diagnosis difficult, even when leptospirosis is suspected and appropriate diagnostic samples are taken. A 2014 study identified that about a quarter of farm workers and meat workers presenting to general practice with flu-like symptoms will have leptospirosis, but even when the disease is suspected, they will not be diagnosed unless appropriately tested.³³ Reliance on paired blood sampling means that a large proportion of cases (84%) are not followed up and the diagnosis is never confirmed, nor included in surveillance notifications³⁴ We recommend ordering multiple laboratory tests during the acute episode to increase the likelihood of making a diagnosis. If acute leptospirosis is not diagnosed, or diagnosis is delayed, this potentially puts other workers in the same contaminated working environment at risk. It is possible to mitigate the risk of others contracting leptospirosis by taking swift corrective action, such as reducing contact with animal urine, increasing hygiene measures and treating infected animals with antibiotics.²⁴ Equally concerning, and more so for the patient, if an initial diagnosis is not made there will be no medical record to link to subsequent symptoms.

Although participants reported having to ask for antibiotics, sometimes repeatedly, we have found that antibiotics are almost always prescribed when leptospirosis is suspected in Aotearoa. Thirty-nine of 41 patients suspected

of leptospirosis were prescribed antibiotics in a 2014 study,³³ and antibiotics are recommended clinical management for leptospirosis globally.³ Thus, not being prescribed antibiotics is likely to be largely due to a clinician's lack of awareness of the disease rather than unwillingness to prescribe antibiotics for suspected leptospirosis. A key unknown is whether the timing of antibiotic treatment influences subsequent PLS. While current guidelines of not prescribing antibiotics when viral infections are suspected are useful in the toolbox of approaches to prevent antibiotic resistance,³⁵ it is also important to consider the impact of that guideline when bacterial disease is challenging to diagnose. We recommend that the current practice of treating on suspicion of leptospirosis continues.

In general, the impact of chronic disease on the families of patients is also often unrecognised.³⁶ Participants' partners had major life changes including having to start work, moving to full-time work or taking up more responsibilities on the farm. In a mixed-methods research project involving case studies of injured or ill employees, the "hidden" costs borne by family and friends of the employees were discussed.³⁷ These included loss of closeness between partners and between parents and children, and spouses changing their work patterns. Being aware of and mitigating the effects of PLS on patients' families will support patient recovery. Participants reported excellent family support and shared positive experiences including spending time with family, being more active in the community and facing the challenge of recovery.

Participants' experiences with ACC were poor. A qualitative review into the cover decisions for work-related leptospirosis claims in Aotearoa identified that the crucial decisions affecting the claim outcomes were made by treatment providers and insurance claim assessors largely outside of the patient's purview.³⁸ Each claim is assessed against two main requirements: having a confirmed diagnosis and having an appropriate exposure. While the criteria for the exposure are set in legislation, the diagnostic criteria may vary depending on factors like physician experience, laboratory test preference, and patient and employer compliance. A 2009 report analysing concepts of work-related harm found that the key to improving diagnoses was establishing systems to ensure that ACC claims are investigated by people with the appropriate expertise, as well as improving the occupational medicine

training of general practitioners.³²

The serovars reported by our study participants broadly reflect the general distribution of serovars in leptospirosis patients over the period these participants first became ill with leptospirosis.^{13,39} A Dutch survey based on active case-finding reported an association between infecting serovar and likelihood of PLS, however, the time after the acute episode was shorter than in our study (2 months) and the infecting serovars in Dutch patients were not an exact match for those in patients from Aotearoa.⁴ If infection with a particular serovar was a flag for persistence this could inform clinical decision making e.g., in managing patient expectations for recovery and in providing a broad support package of care around these patients. We recommend further investigations into this association.

Participants attributed their ongoing symptoms to their earlier diagnoses of leptospirosis, in some cases decades ago. However, how much of the ongoing expression is due to a constellation of predisposing, precipitating and perpetuating biopsychosocial factors, rather than a direct medical cause needs to be considered.⁴⁰ This enters an area of interface between medicine, psychiatry and psychology and includes the need to consider somatic symptoms and related disorders (DSM 5). In these conditions, symptoms typically persist after the normal expected trajectory of recovery from disease or injury and are medically unexplained. This area is poorly understood and the subject of ongoing research. Further, our participants “self-recruited” by reaching out to the lead author because of her research portfolio. They were seeking understanding and wanted to tell their stories and to be heard—and their stories relied on self-report and memory. While this bias needs to be considered, our findings are supported by international work and by interim findings from a current Aotearoa leptospirosis case control and case series study.⁴¹ In this study 96 patients diagnosed with leptospirosis from September 2019 until December 2021 were enrolled. To date, one half (42/81) of these remained fatigued at least 9 months after disease onset and 20% had persistence of myalgia or headache. Twenty-five reported new symptoms they felt were due to their leptospirosis. These included urinary, renal

and neurological concerns. All 13 participants who had a detailed semi-structured interview commented on their long duration of illness.

A further limitation we have considered is that the symptoms reported (exhaustion, weight loss, myalgia, brain fog and mood swings) occur in the general population. We have used data from the 2015–2016 New Zealand Health Survey to make a comparison.⁴² Although we cannot perfectly match the symptoms and acknowledging our sample size (n=6) is small, we are confident that among the study population their symptoms occur more commonly than in the general population. For example, most adults completing the NZHS rate their own (88%) health as good, very good or excellent.

Another potential limitation of our study is that initial putative infecting serovar information was sighted by the researcher for only two of six patients and that there were no clinical notes sought. Further, we did look for biological markers of persistent infection or auto-immunity. However, as our aim was to perform an exploratory qualitative study to document patients’ experiences of PLS, we were not attempting to link experience with any documented clinical information.

Future research avenues include completing the initial follow-up for all of our current 96-patient cohort and continuing their follow-up for at least 5 years. This will elucidate the duration, severity and impact of PLS for the first time. Gaps in knowledge and awareness of leptospirosis were identified in this pilot study and future work to understand these gaps and to further knowledge and awareness is important. This includes disseminating the results of this study beyond traditional medical outlets to health psychologists, workplace insurers, occupational physicians and rural support groups.

Conclusion

Leptospirosis may have severe long-term consequences for patients, their families and their communities. We recommend that knowledge and awareness gaps in diagnosing the acute disease are addressed and that questions around aetiology, pathophysiology, biopsychosocial factors and burden be the topics of future research.

COMPETING INTERESTS

Nil.

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The role of menstrual apps in healthcare: provider and patient perspectives

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ABSTRACT

AIM: This study aimed to understand the role that menstrual apps (“period tracking apps” or “fertility apps”) could perform in healthcare.

METHODS: Expert stakeholders including healthcare providers, app users, and patients offered perspectives on potential benefits, concerns, and role of apps in healthcare. Responses from an online qualitative survey ($N=144$) and three online focus groups ($N=10$) were analysed using reflexive thematic analysis.

RESULTS: The role of menstrual apps in healthcare could include keeping a record of cycle dates and symptoms and assisting in the management of menstrual disorders, diseases and conditions linked to the menstrual cycle such as endometriosis, PCOS, infertility, and perimenopause. Respondents are using app calendars and symptom tracking to improve communication between healthcare providers and patients, while also expressing concerns about inaccuracies and other uses of data. Respondents wished for assistance in managing their health, while noting that apps currently are limited and suggesting that apps need to be better suited to Aotearoa New Zealand specific menstrual disorders, diseases and life stages.

CONCLUSIONS: Menstrual apps may have a role in healthcare, but further research needs to develop and evaluate app functions and accuracy as well as providing education and guidelines for whether and when apps are appropriate for healthcare.

Digital mobile applications (apps) for tracking menstrual cycles, also known as “period tracking apps” and “fertility apps”, are a widely used and rapidly growing area of mobile health and digital health, with over 500 million downloads worldwide.¹ These menstrual apps position themselves as contributing to health and wellbeing. Some types of information collected by menstrual apps, including last menstrual cycle (LMC) and menstrual symptoms, are used in healthcare for diagnosis of menstrual disorders and diseases linked to the menstrual cycle, such as abnormal uterine bleeding.^{2,3} Most menstrual apps offer features that purport to assist fertility and conception such as predictions of ovulation timing and the “fertile window”.^{4,5} Some offer their users screening and clinical advice for endometriosis, polycystic ovary syndrome (PCOS), and menopause.^{6,7} While we do know that menstruators are using these functions in their apps,^{8,9} including menstruators in Aotearoa New Zealand and those with menstrual disorders,^{10,11} it is unknown whether healthcare providers or patients rely on apps as a record of menstrual cycles or other information.

Menstrual tracking apps offer benefits but also risks

To perform their functions, most menstrual tracking apps require users to input informa-

tion at signup (e.g., typical cycle length) and users are requested to input ongoing information about dates of menstruation.¹² Apps may also allow users to track a variety of symptoms (e.g., amount of bleeding, pain, mood). Apps will usually have an interface showing users the past dates and symptoms they have logged, arranged by calendar and/or cycle.¹² Most apps have algorithms that produce predictions and suggestions for users. This process is not transparent, as algorithms are treated as commercially sensitive and not revealed.⁴ There appear to be two types of predictive algorithm used by apps:⁵ (1) period tracking algorithms, which take user-input dates of menstruation along with standardised information about menstrual cycles and ovulation timing, and (2) fertility algorithms, which incorporate user-input menstruation dates along with one or more user-input physiological indicators of ovulation (e.g., temperature, urine test, cervical fluid). Both types of predictive algorithms offer estimates of date of next menstruation and date of ovulation,^{4,5,13} although these estimates have questionable accuracy.^{4,13,14} Another issue is that the information collected and created by apps may be leaked, sold and shared, revealing sensitive personal information to marketers, law enforcement, and others.¹⁵

Symptoms related to menstrual cycles have substantial effects

Menstrual disorders and diseases are of substantial concern in Aotearoa New Zealand and worldwide. Endometriosis, an inflammatory disease where tissue resembling the endometrium is present outside the uterus,¹⁶ affects approximately 11% of reproductive-age women and can cause severe and chronic pain, organ damage and infertility.^{17,18} PCOS, a chronic condition defined by androgen excess and ovarian dysfunction, is one of the most common endocrine and metabolic disorders among women and is also linked with infertility.¹⁹ Infertility, when pregnancy is not established after 12 months of regular unprotected sexual intercourse or where a person's capacity to reproduce is impaired,²⁰ can have multiple causes and is experienced by up to 26% of women in Aotearoa New Zealand who attempt to become pregnant.²¹ Everyone with cycles will eventually experience the cessation of their cycles at menopause, with the years leading up to menopause frequently associated with debilitating symptoms.²² For all of these menstrual disorders, symptoms are frequently unrecognised or misdiagnosed, with research consistently finding that the concerns and experiences of women and reproductive health patients are dismissed.^{23,24} Diagnoses often take considerable time; for instance, recent data from Aotearoa New Zealand suggests a diagnostic delay of 8.7 years for endometriosis.²³ Delays in diagnosis lead to increased severity, prolonged pain, decreased quality of life and psychosocial distress.²⁵ Further, the economic burden from healthcare costs and loss of productivity is substantive at both individual and population levels.^{26,27} To more effectively diagnose, treat and manage menstrual disorders and diseases, patients are pleading for better options.²⁶

Aim and research question

Menstrual disorders and diseases linked to the menstrual cycle could potentially be addressed by digital health applications; however, an understanding of potential possibilities and limitations is lacking. Our study aims to understand menstrual tracking apps and menstrual disorders and diseases in Aotearoa New Zealand, and begins by asking the question: how do expert stakeholders, including healthcare providers, app users and patients, view the role of menstrual apps in healthcare?

Methods

Study design

Our study involved an online qualitative survey followed by online focus groups. Ethical approval for the study was granted by the University Human Ethics Committee (reference: #D21/418).

Recruitment

The study aimed to engage experts and stakeholders with an interest in menstrual tracking applications and menstrual disorders and diseases including endometriosis, PCOS, infertility, and menopause, namely healthcare providers, patients, app users, app developers or regulators, and researchers. A purposive sampling technique was used to recruit participants. First, a list of individuals and organisations who fit the study aim was generated by the research team. The researchers then sent email invitations, which organisations shared with their members via newsletters or social media. All invitations included links to study information and the online survey. At the end of the online survey there was a link to a separate form (to ensure anonymity of survey responses) where respondents could register interest in participating in a focus group. Respondents were considered eligible to participate in this study if they were aged 18 years or older and gave consent based on the participant information provided.

Qualitative survey

The purpose of the survey was to gather initial perspectives from those who may be interested in participating in a focus group, and to give those who could not participate in a focus group the chance to share perspectives. Our online qualitative survey was hosted on Qualtrics and open for four weeks in February 2022. Following participants' consent to participate in the study, the survey asked demographic information and open-ended questions related to menstrual tracking apps. Respondents were able to opt-out of any question. The three key questions focused on 1) perceived benefits; 2) perceived concerns; and 3) the potential role of menstrual apps in healthcare.

Focus groups

Focus groups were held to expand on and enhance understanding of the online survey responses. All interested respondents were invited via email to a focus group held over a two-week period in March/April 2022. Three focus groups

were hosted on Zoom and followed a semi-structured format. Verbal confirmation of consent to participate in the study and permission to audio-record was sought prior to commencement. Preliminary results from the online survey were shared with focus group participants to prompt relevant discussion. Participants received an electronic gift card to acknowledge their contribution.

Analysis

Qualitative survey responses and focus group discussions were analysed using Braun and Clarke's Reflexive Thematic Analysis.²⁸ Our analysis took a critical realist and semantic approach that focused on the explicit and overt content of the responses. We answered our research question by following the six steps of analysis:²⁸ To 1) *familiarise ourselves with the dataset* we read all survey responses and focus group transcripts, then 2) *coded* data using NVivo12.²⁹ The codes were used to 3) *generate initial themes*, which we 4) *developed and reviewed* by discussing with team members, checking against the data, and revising. Finally, we 5) *defined and named themes*, and 6) *wrote up the themes*.

Results

Respondents

We received 144 responses to the online qualitative survey. Just under half (45%) were participating as app users, one-quarter (26%) were healthcare providers, 17% were patients/health advocates, 3% were researchers, and 3% were app developers or regulators. Respondent ages ranged from 19–55 years and 92% identified their gender as female. Ethnicity was identified by 80% as NZ European, 6% as Māori and 1% as Pacific peoples. About half (49%) had ever used a menstrual app, with the most common being Flo and Clue, and 94% reported that they had knowledge and/or experience with one or more of menstruation, endometriosis, PCOS, infertility, and peri/menopause. A table of participant characteristics is included in Table 1.

Of the survey respondents, 37 individuals expressed interest and were invited to participate in a virtual focus group, held on Zoom. A total of 10 participants attended three focus group sessions (Healthcare Providers Group, $n=4$; App Users Group A, $n=3$; App Users Group B, $n=3$).

Role of menstrual apps in healthcare

The analysis began by considering all responses to the survey and focus groups to understand respondents' overall views on the role of men-

strual apps and their medical information in healthcare. We found four main roles described by participants: record-keeping, management, self-knowledge and self-diagnosis. The first two roles were described consistently and had wide agreement, and these will be the focus of the current paper. The more complex and ambiguous roles of self-knowledge and self-diagnosis will be explored in a further article.

Menstrual apps as record-keeping

Analysis of survey responses and focus group discussions relating to the role of apps in record keeping developed three main themes: 1) *Keeping a record of past cycle dates and symptoms*; 2) *Showing cycle dates and symptoms to healthcare providers*; and 3) *Problems with record keeping using apps*. These themes are described in the following text and illustrative quotes are given in Table 2.

Keeping a record of past cycle dates and symptoms was recognised most consistently by respondents as a positive function of menstrual apps. The calendar aspect was mentioned as helpful by all types of participants, including app users and healthcare providers. Participants noted that apps may offer improvements over other methods of cycle histories. Apps are convenient and “*easy to track as it's on my phone, I never did it reliably on the calendar.*” A participant in the healthcare provider focus group made the comparison that “*in the old days, you'd be told to write down things and keep a diary, and I thought it was always very difficult to do. And so now it seems like actually, you could just log that 'I had tummy pain on these days'.*” Participants also described apps as more accurate than memory when taking cycle histories: “*It remembers; I am amazed at how quickly time moves on and how easy it is to forget when your periods were last*”; and particularly for those with irregular cycles: “*I have PCOS so I find it handy to be able to track my periods as sometimes I can go months without having one.*” Further, participants noted that apps offer the option of recording symptoms. Respondents described menstrual apps allowing for “*better habits of tracking to start monitoring holistic symptoms,*” such as supporting users “*to record issues with pain or other symptoms.*” The symptom options in apps may be unsuitable, however. For some users, there were too many options: “*I thought the apps had an overwhelming number of fields, making it more difficult to find the info I was interested in.*” Conversely, other users expressed that they “*need more options i.e., where pain is located.*”

Table 1: Descriptive characteristics of online qualitative survey respondents

		N	%
Expertise			
App user		65	45
Health professional		37	26
Patient or health advocate		24	17
Researcher		5	3
App developer, evaluator and/or regulator		4	3
No response		9	6
Total		144	100
Age			
Range		19–55	
Gender			
Female		132	92
Male		1	1
Another gender		3	2
No response		8	6
Total		144	100
Ethnicity			
NZ European		115	80
Māori		8	6
Pacific peoples		2	1
Asian		2	1
Other/no response		17	12
Total		144	100
Menstrual apps			
Flo		36	51
Clue		21	30
Period Tracker		4	6
Other ¹		10	14
Total		71	49
Knowledge/ Experience	One or more of: menstruation, endometriosis, PCOS, infertility, peri/menopause	136	94

¹Other apps: My Calendar, Period Diary, Balance, Apple Health, Fitbit, Lily, Ava, Daysy, Kindara.

Table 2: Menstrual apps as record-keeping – illustrative quotes from survey respondents.

Theme 1: Recording past cycle dates and symptoms
Convenient to enter and view data
<i>Easy to track as it's on my phone, I never did it reliably on the calendar</i>
<i>Easy to add data to, with you whenever you need it, has information on the app</i>
Accurate record of past cycle dates
<i>Months fly by quickly and keeping a reminder of my cycle is why I use an app</i>
<i>It remembers; I am amazed at how quickly time moves on and how easy it is to forget when your periods were last</i>
<i>Helps keep track of more accurate data re: cycle length etc</i>
<i>They provided a useful record to look back on and compare my (irregular) cycles from month to month</i>
<i>I have PCOS so I find it handy to be able to track my periods as sometimes I can go months without having one</i>
Recording symptoms
<i>Allows for better habits of tracking to start monitoring holistic symptoms</i>
<i>Simple way of monitoring menstruation cycle and the symptoms accompanying it</i>
<i>To record issues with pain or other symptoms</i>
<i>Easy to add symptoms and self-assess severity</i>
<i>Track a large range of symptoms associated with the cycle</i>
<i>I can track anything menstrual cycle, IBS [irritable bowel syndrome] and migraine stuff</i>
<i>Can track symptoms over all cycles (from start of documentation)</i>
Unsuitability of recording symptoms
<i>I thought the apps had an overwhelming number of fields, making it more difficult to find the info I was interested in</i>
<i>Sometimes asks for too much information (like all the associated symptoms of bloating, acne blah blah, I don't care about those)</i>
<i>Need more options, i.e., where pain is located</i>
Theme 2: Showing cycle dates and symptoms to healthcare providers
Calendar history
<i>Help improve communication in consultation</i>
<i>Easy to share the information tracked with specialist</i>
<i>One stop shop for years of records when seeing specialists</i>
<i>If you have any problems there is a good record to share with your health professional</i>
<i>Having a chronological reference of the dates and length of my periods when I need that info for doctors etc</i>
<i>Easy to track symptoms/side effects of periods to take to the GP [general practitioner]/specialists when trying to work out why everything hurts</i>

Table 2 (continued): Menstrual apps as record-keeping – illustrative quotes from survey respondents.

Theme 2: Showing cycle dates and symptoms to healthcare providers
Calendar history
<i>They could provide a longitudinal report of women's health for HCPs [healthcare providers] to draw from instead of simply treating symptoms</i>
<i>As a practitioner myself I find it super helpful to look through the history of the app if a woman presents with inconsistent periods, infertility or even pregnancy that needs to be dated</i>
Credible evidence
<i>As a doctor, it gives me an objective record of a patient's cycles, rather than relying on them to remember their LMP [last menstrual period] or cycle regularity</i>
<i>Having a good way of recording symptoms regularly might help with getting an earlier diagnosis – help get doctors to take people more seriously</i>
<i>Having used a tracking app for years, I could rely on objective data to convince doctors that I need surgery to confirm and remove endometriosis</i>
<i>If patients present this information to a doctor, it could help them get a diagnosis more quickly</i>
<i>If you need to go see a fertility specialist, it's incredibly helpful to have information around usual cycle lengths and symptoms to help them diagnose any issues, rather than uncertain answers</i>
Theme 3: Problems with record keeping using apps
Inaccurate data
<i>When you forgot got track and the data gets mucked up</i>
<i>Trying to remember to actually update it</i>
<i>Targeted to people with normal cycles</i>
<i>Data security and 3rd party use</i>
<i>Huge security issue – what is [the] company doing with my data?</i>
<i>Who else is using the information you input</i>
<i>Information not being secure – and sold to 3rd parties</i>
<i>I guess I don't really know where the data goes</i>
<i>My only concern is having the data wiped or hacked</i>

Table 3: Apps as management – illustrative quotes from survey respondents.

Theme 1: Currently helpful
Helpful
<i>Helpful when facing issues</i>
Tracking symptoms
<i>To record issues with pain or other symptoms</i>
<i>Can track when you experience symptoms</i>
<i>Tracking severity of symptoms</i>
<i>Endo/PCOS – pain locations and weight gain, also a guide/info of symptoms of both</i>
Preparing for symptom onset
<i>A way to track your symptoms leading up to and during [menstruation] so [you] can prepare to manage</i>
<i>Helping woman track periods better – could mean having more information on when periods is due – and can take medications earlier which may help symptoms</i>
<i>Tracking has been really helpful in me identifying and understanding some of the physical premenstrual symptoms I get. As I take [medication] for these symptoms and there is an option to just take these for one premenstrual week it would be good for that</i>
Information and advice
<i>Offer advice on things one can do to lessen the symptoms or to support symptoms</i>
<i>Comfort in reading the associated information and advice</i>
<i>Has forum where other people [are] going through same problems</i>
<i>Also, it shows that you are not alone in this, more often than not, there are a lot of women out there with the same issues</i>
Theme 2: Potentially helpful but need to be more suitable
Potentially helpful
<i>They could ... support a better understanding of future health</i>
<i>Tracking menstruation could help you prepare for life with menopause</i>
<i>They should help to bring those topics into the society</i>
Need to suit place
<i>It's still a bit generic, not NZ [New Zealand] based</i>
<i>Information is ... often not specific to country – mostly American based</i>
Need to suit life stages
<i>It would be great to have an option that is simple for younger girls not interested in fertility</i>
<i>Apps that aren't age appropriate (for teens but not suitable for older women)</i>
<i>I could picture an app that was targeted at 13-year-olds, once they're just starting to get their period, versus an app that's targeted at people wanting to get pregnant</i>

Table 3 (continued): Apps as management – illustrative quotes from survey respondents.

Theme 2: Potentially helpful but need to be more suitable
Need to be more suitable
<i>Current one doesn't work for IVF [in-vitro fertilisation]</i>
<i>When you battle with fertility and a [message] comes up that you may need to consider a pregnancy test, because you are a few days late</i>
<i>They can be very rigid. The one I use is unable to understand why I had a very long cycle immediately after the birth of my baby</i>
<i>I have endometriosis, and there's not much info about it or what women can expect to experience on each day of the cycle if you are an endo sufferer</i>
<i>A lot of them do not adapt very well to things like PCOS, where your period isn't very regular</i>
<i>Not a one-size-fits-all, especially with PCOS</i>
<i>Not too informative or helpful for someone with PCOS like myself</i>
<i>More focused on normal bodies not really with health related i.e, pcos</i>
<i>Everyone might want different things. So surely you need different apps, which is why there are heaps of different apps out there</i>

Showing cycle dates and symptoms to healthcare providers is the second theme when considering the record-keeping role of menstrual apps. Both app users and healthcare providers used app information to “improve communication in consultation.” This was described in general terms as a calendar history, having “a good record to share with your health professional.” This data can be particularly useful in reproductive healthcare: “As a practitioner myself I find it super helpful to look through the history of the app if a woman presents with inconsistent periods, infertility or even pregnancy that needs to be dated.” Calendar histories on apps are further recognised as credible evidence by healthcare providers. Date of last menstrual period (LMP) is used frequently in healthcare: “As a doctor, it gives me an objective record of a patient's cycles, rather than relying on them to remember their LMP or cycle regularity.” App users recognised that the app data is viewed as credible evidence when they present it to their healthcare provider: “Having used a tracking app for years, I could rely on objective data to convince doctors.” Using the app data to “help get doctors to take people more seriously ... might help with getting an earlier diagnosis.”

Problems with record keeping using apps were expressed by study participants in two main areas. Some noted that histories (and predic-

tions) will only be accurate if the app is used correctly and consistently. As a healthcare provider in the focus group noted: “you're only gonna get out of your app, what you put into it as well. So if you're not inputting the right information or enough information, it can't tell you anything.” Survey participants noted that difficulties occur: “When you forget to track and the data gets mucked up.” Apps may be less suitable for use by those with irregular cycles, as they are “targeted to people with normal cycles.” There was also concern about this data being collected by apps. Accidental data loss or leaks were mentioned by a few respondents: “My only concern is having the data wiped or hacked.” Most of respondents' concern was for how the data was being used by the app companies, with some unsure: “I guess I don't really know where the data goes”; and other participants aware that their data and information was being shared but with no transparency about who it was being sold or released to: “Huge security issue- what is [the] company doing with my data?”

Menstrual apps as management

Analysis of survey responses and focus group discussions relating to the role of apps in managing menstrual disorders and diseases showed two main themes: 1) *Currently helpful for man-*

agement; and 2) *Potentially helpful but need to be more suitable*. Descriptions of these themes are given in the following text and illustrative quotes are presented in Table 3.

Apps are *currently helpful for management* in some descriptions offered by survey respondents. There were a few broad statements such as: *“helpful when facing issues.”* Participants described three ways that menstrual apps could help. One way was through tracking symptoms specific to the disease or disorder. Some noted specific symptoms such as pain, others noted tracking options such as timing or severity of symptoms. Another way was tracking cycles to prepare for symptom onset. As one survey respondent described, the app offers *“a way to track your symptoms leading up to and during [menstruation] so [you] can prepare to manage.”* A further way is through providing information and advice. The apps *“offer advice on things one can do to lessen the symptoms or to support symptoms”* as well as having a *“forum where other people [are] going through same problems.”*

A greater number of participants noted that menstrual apps are *potentially helpful but need to be more suitable*. These respondents were more speculative about app benefits, writing about what apps “could” and “should” do. They described apps as unsuitable in several aspects. Apps need to suit Aotearoa New Zealand context. Respondents noted that *“it’s still a bit generic, not NZ based.”* Apps also need to suit age and stage. In particular, there was a call for apps to be better suited to younger users: *“It would be great to have an option that is simple for younger girls not interested in fertility.”* In addition, apps need to suit menstrual disorders and diseases. Many respondents noted that apps were unsuited to those experiencing specific menstrual disorders and diseases along with their symptoms and treatments. App predictions *“do not adapt very well to things like PCOS, where your period isn’t very regular.”* This echoes the theme in the previous section where respondents noted that apps appear to be designed for those with “normal” cycles and are not well-suited to anyone with longer, shorter, or irregular cycles. App notifications may also be unsuitable, such as: *“When you battle with fertility and a [message] comes up that you may need to consider a pregnancy test, because you are a few days late.”*

Summing up these observations, a participant in the healthcare provider focus group noted that *“everyone might want different things. So surely*

you need different apps, which is why there are heaps of different apps out there.”

Discussion and conclusion

Our study invited expert stakeholders to offer perspectives about the medical information provided by menstrual apps and the possible role of this information in healthcare. These 144 participants included healthcare providers, menstrual app users, and patients with menstrual disorders and diseases linked to the menstrual cycle including endometriosis, PCOS, infertility, and perimenopause. Our analysis of their statements in qualitative surveys and focus groups conceptualised four ways that menstrual apps could play a role in healthcare: as record keeping, management, self-knowledge, and self-diagnosis. This paper focused on the first two of these roles, with the final two roles the focus of a separate paper.

For record-keeping, participants reported that menstrual apps are currently used in healthcare as calendar histories of menstrual cycle dates and symptoms. As these records are viewed as reliable and credible, the overall perspective was that apps can improve communication between healthcare providers and patients. This improved communication may offer a way to address existing delays in recognising and diagnosing menstrual disorders and diseases.^{21,22,23} Concerns remain, however, about potential inaccuracies and misuses of data and information collected and provided by the menstrual apps, highlighting this problematic aspect of apps.^{4,10,13,14}

The participants in our study called for assistance in managing menstrual disorders and diseases. Although they viewed apps as currently able to help to a limited extent, they noted substantial need for more appropriate support. This indicates that, at this point, apps do not appear to be a viable answer to patient calls for more effective treatment and management options.²⁴

This research provided an initial look at the perspectives held by experts and stakeholders about the uses of menstrual apps and their medical information in healthcare. The limits of our small, localised, and self-selected sample and qualitative responses means that we have kept our conclusions focused on demonstrating the existence of menstrual app use in healthcare, conceptualising the possible role of app information, and offering a starting point for developing further research questions.

What we can do now

Our findings suggest that healthcare providers may consider the calendar record on apps as an additional form of menstrual cycle history. These calendars may be able to supplement and corroborate, but not replace, patient experiences. Those who have concerns about their cycles and/or symptoms can create a calendar record to aid communication with healthcare providers. Existing apps could possibly play a role in helping those diagnosed with menstrual disorders and diseases to manage their symptoms (e.g., by preparing for menstrual cycle phases). We advise that any recommendations or suggestions about menstrual apps should disclose that apps may not be suitable for those with nonstandard cycles and may not be applicable to Aotearoa New Zealand. Apps and recommendations also need to be transparent about the potential for harm through apps sending inappropriate and distressing notifications, as well as the potential for patient information being leaked or stolen, used for commercial and advertising purposes, and/or shared with agencies and law enforcement.

What is still needed

App users, patients, and healthcare providers in our study are calling for the development of suitable apps. All apps need to be able to account for variable and irregular cycles. Further, there is a need for apps that support treatment and management of menstrual disorders, diseases and symptoms. Although there may be apps designed for some menstrual disorders and diseases, our participants were not aware of these, indicating a need for more information about any existing apps. Our respondents also sought apps applicable to Aotearoa New Zealand and life course stages. To rely on these apps, patients and healthcare providers must be assured of the accuracy and effectiveness of menstrual app predications and information. Our research suggests that further research should focus on evaluating app functionality, comprehensively assessing how apps are used in healthcare, and establishing education and guidance for patients and providers on whether, when, and how to use menstrual apps in healthcare.

COMPETING INTERESTS

Nil.

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Usability survey of an inpatient electronic clinical communication platform at a large New Zealand tertiary hospital

Yassar Alamri, Nick Cross, Charlene Tan-Smith, Saxon Connor

ABSTRACT

BACKGROUND: Internationally, there is significant published literature indicating low levels of clinical satisfaction with the digital electronic clinical record. Many New Zealand hospitals are currently undergoing a process of digitisation. The aim of the current study was to determine the usability of the inpatient clinical documentation and communication platform known as Cortex approximately one year after full deployment at Christchurch Hospital.

METHODS: Te Whatu Ora – Health New Zealand Waitaha Canterbury staff were invited via their work email to complete an online questionnaire. It was comprised of the System Usability Scale (SUS) survey (industry standard mean scores: 50–69 marginal, and ≥ 70 acceptable) and one additional question about the participant's clinical profession within the organisation.

RESULTS: A total of 144 responses were received during the study period. The median SUS score was 75 with an interquartile range (IQR) of 60–87.5. The median IQR SUS scores did not significantly differ among the different occupation groups: 78 (65–90) for doctors; 70 (57.5–82.5) for nurses; and 73 (55.6–84.4) for allied health staff ($p=0.268$). Additionally, 70 qualitative responses were recorded. Three themes were identified through the analysis of the participants' responses. These were: the need for integration with other electronic systems; implementation issues; and fine-tuning the functionality of Cortex.

CONCLUSIONS: The current study revealed good usability of Cortex. The user experience was equivalent among the various professions of the study's participants (doctors, nurses, and allied health staff). The present study provides a useful benchmark for Cortex at a point-of-time, and it sets up potential to periodically repeat this survey to see how new functionality has added to (or detracted from) its usability.

Many New Zealand hospitals are currently undergoing a process of digitisation.¹ There is no national roll-out of a single vendor electronic clinical record, but each hospital or region of hospitals has been left to adopt a “best-of-breed” approach to digitising the inpatient hospital record.¹ Internationally, there is significant published literature indicating low levels of clinical satisfaction with the digital electronic clinical record.^{2–5}

Te Whatu Ora – Health New Zealand Waitaha Canterbury (HNZ-C) oversees the delivery of healthcare in the Canterbury region of New Zealand. It is made up of seven hospitals, and upwards of 13,000 staff members;⁶ Christchurch Hospital is its largest campus, and also the largest hospital in New Zealand's South Island (bed capacity: 600–650) serving a population upwards of 550,000 people.⁷

Christchurch Hospital has taken a hybrid approach to developing a complete inpatient

clinical record. It has adopted commercially available solutions for observations, radiology and laboratory results, and medications. However, it has elected to co-design with a commercial vendor (Sense Medical Ltd.) a novel mobile iOS solution, Cortex. Cortex is an application that is used to deliver inpatient documentation and inter-professional communication, and to enable viewing other components of the inpatient clinical record (laboratory results, radiology, and observations).

The key principle of this approach was to co-design the solution and functionality with clinical and technical domain experts. It was acknowledged that provision of healthcare occurs within a complex adaptive system, and so a “perfect” final solution could not be articulated at the start of the process. Rather, it was accepted that “experimenting” would be required, and then to amplify functionality that added clinical value, while dampening functionality that did not. The

co-design process involved the description by end-users of the problem they wished to solve. Developers then designed such functionality. The functionality was then deployed often to a small beta group, and further iterations made. This cycle continued until the desired functionality was achieved. Thus, a staged roll-out across the campus was planned after using early adopters (Department of General Surgery, Christchurch Hospital) to iterate and feedback on the product as it was developed. The roll-out process was performed in staged fashion by departments. It involved a small group of multi-profession representatives of the departments to meet on weekly basis over 8-week period. During this period department workflows were discussed and a combination of bespoke or standardised clinical notes designed for each. At the time of writing, the product is now fully deployed across an inpatient tertiary campus (Christchurch Hospital) with the exceptions of the Neonatal Intensive Care Unit (working on a national system), and the Emergency Department (ED) (decided to remain on their current system until a desktop version of Cortex is developed).

The definition of usability has been operationalised to refer to a measure of how effectively a product or application is used to perform the function for which it was designed.⁸ In fact, the International Organisation for Standardisation (ISO) has published criteria, definitions, and standards for usability (e.g., ISO 9241–210).⁹ The System Usability Scale (SUS) is a validated scale created in the 1980s,⁸ and is considered a standard tool for use in usability research (appearing in upwards of 1,500 studies across a wide spectrum of products and industries¹⁰). It is comprised of a 10-item survey for which participants answer each question on a 5-point response scale. The overall score (which involves a complex calculation based upon the participant's responses) ranges from 0 to 100. Interpretation of the scores is provided in Figure 1.¹¹ It is noteworthy that responses from as few as 20 participants yield valid and reliable results.¹⁰

For a publicly funded health system, especially one with frequent budgetary deficits¹² that is required to accommodate an increasingly complex and large volume of patients (due to a system of universal health coverage in New Zealand), the implications of information systems usability are considerable.¹³ With the recent merging of New Zealand's 20 district health

boards (DHBs) into a single national health service (Te Whatu Ora – Health New Zealand),¹⁴ there is an opportunity for broader utilisation of health-related products and applications with high usability, as this may improve the hospital experience for patients and staff alike.¹

The objective of the present study was to determine the usability of the inpatient clinical documentation and communication platform known as Cortex approximately one year after full deployment at Christchurch Hospital. Assessment of its usability may be seen as a way of objectively measuring one facet of the success of the product, as well as identifying areas that needed further enhancement.

Methods

Study setting and participants

For the current study, all HNZ-C staff were invited via their work email to complete an online questionnaire. A link to the survey was also available on the Intranet page. The study ran over a 10-day period (the survey link was included in the daily “Staff Communication Update”). This study is part of a larger project (Studying Usability of Christchurch Electronic health record Systems [SUCCESS]), and was approved by the University of Otago Human Ethics Committee (reference: D22/086).

Study survey

Participants were invited to anonymously complete the study survey online (using Typeform® as the interface). It was comprised of the SUS survey, one question about the participant's clinical profession within the organisation, and a final open-ended question for any additional comments. The survey was only available in the English language. All respondents had consented to participate in the study.

Data analysis

Descriptive statistics were utilised to present the data (expressed as medians and interquartile ranges [IQR], or proportions). Qualitative data were analysed using a general inductive approach which involved coding responses, and grouping codes into common themes via an iterative process. The first author of the research team coded the data; codes were then reviewed and revised by the whole research team.

Results

A total of 144 responses were received during the study-period. Participants were made up of 45 junior doctors (31%), 17 senior doctors (12%), 2 senior medical students (1%), 12 junior nurses (8%), 37 senior nurses (26%), and 32 allied health staff (22%). The median SUS score was 75 with an IQR of 60–87.5. The median IQR SUS scores did not significantly differ among the different occupation groups: 78 (65–90) for doctors; 70 (57.5–82.5) for nurses; and 73 (55.6–84.4) for allied health staff ($p=0.268$).

A total of 70 participants (48.6%) provided qualitative responses. Three themes were identified through the analysis of the participants' responses. These were: the need for integration with other electronic systems, implementation issues, and fine-tuning the functionality of Cortex.

The need for integration with other electronic systems

Several respondents commented on the current poor integration of the various electronic health systems in use at Christchurch Hospital. Many thought that Cortex ought to integrate the data from the other systems/applications.

“Needs to be more integrated with [another application]—Cortex would be a million times more helpful if I could access emergency department notes, clinic letters, etc.” – Participant 15

“It would be easier to use if [3 applications] were linked better. You have to go in and out of the different programmes multiple time in a shift.” – Participant 27

Figure 1: Gradation of system usability scores (adapted with permission from Bangor et al.¹¹).

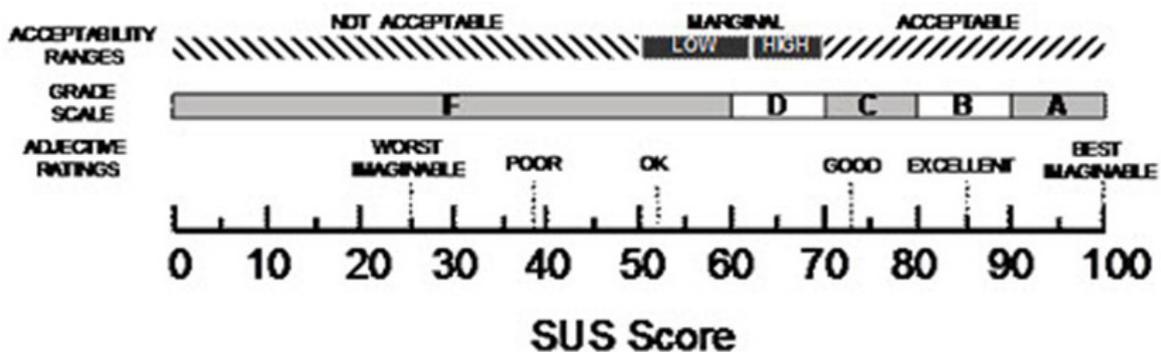
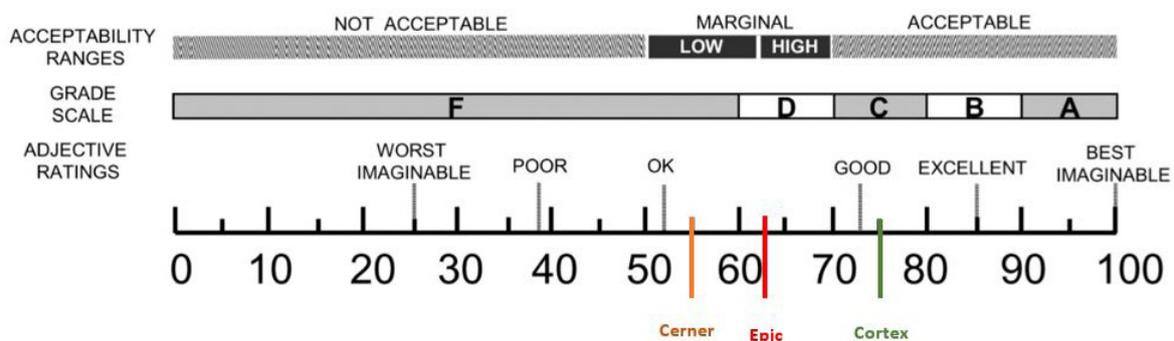


Figure 2: Comparison of usability of electronic health applications using SUS score.



Despite this, many participants found Cortex very useful. Several lamented the fact their departments/ areas do not use Cortex.

“Love Cortex. Desperately needs to be introduced at [a different hospital in Canterbury]” – Participant 69

“It would be great for all ED and other hospitals such as [a different hospital in Canterbury] to be on Cortex, so patient info is all in one system, rather than paper and electronic.” – Participant 44

“Cortex is great! Truly one of the greatest IT developments to happen for [hospital].” – Participant 20

Implementation issues

The second theme, issues with implementing Cortex as the inpatient health system, was highlighted by multiple participants. Such issues included the fact that Cortex currently requires iOS system/Apple Inc. devices, the staggered roll-out of Cortex, and the frequency of soft-ware or clinical note updates.

“I think the biggest deficiency is you can’t write a Cortex note on the computer. It would be a phenomenal system if this was the case.” – Participant 30

“The fact that Cortex requires iOS rather than PC [personal computer] is incredibly frustrating and shortage of hardware to support this leads to poorer patient documentation.” – Participant 16

“Excellent app; [I] like the constant development and improvement.” – Participant 47

“Our department has put in a bunch of work in the last year to be more consistent in our notes. However, due to the staggered roll out of Cortex, this really should have been done at the beginning.” – Participant 7

Fine-tuning the functionality of Cortex

A number of participants expressed frustrations with, or suggested improvements to the functionality of Cortex. These included repetitive information carried over in several notes, asyn-

chronous communications with other team members, and sub-optimal search functionality within the application.

“Just hard to filter previous reviews by allied health many days prior.” – Participant 14

“Cortex is great. Only downside is number of forms on Cortex and inconsistencies with documentation (i.e., progress note, routine note, ward round note, etc) and not all of these coming up as medical notes when searching.” – Participant 27

“I believe that since Cortex has arrived, there is less actual verbal communication with doctors about managing our patients.” – Participant 36

“One of the best features is the ability to message team members and see the responses added to the clinical notes, make it easy to ask for and follow orders.” – Participant 49

“Not very searchable for forms/orders when I don’t know the specific name of the form I’m looking for, and there are lots of forms for one specialty.” – Participant 18

Discussion

The current study revealed a good usability score of the inpatient digital clinical documentation and communication platform, Cortex. A diverse variety of responses across the professions was received. The overall median SUS score of 75 equates to a usability between “good” and “excellent” on the adjective rating of the SUS, indicating superior usability especially among health-related applications (see Figure 2).

The results of this study are encouraging—especially considering the fact that health-related electronic applications have not, in general, had a good track-record of usability. For example, a recent study by Bloom et al. found median SUS scores for the electronic health record system in all the UK’s emergency departments to range between 35 and 65.¹³ Therefore, none of these systems meet the internationally validated standard of acceptable usability for information technology (IT; see Figure 2).⁶

The user experience was equivalent among the

various professions of the study's participants (doctors, nurses, and allied health staff). This is an important aspect as much of the documentation and communication is done by team members other than medical professionals.

The two main user concerns were the dependence of Cortex on the iOS system, and the lack of integration with other electronic health systems within the hospital eco-system. iPads and iPhone were provided for clinical staff to document and communicate within the application. The roadmap of future development includes a web-based version of Cortex. Cortex set out to be mobile first, and so this issue highlights an agile approach to product development which requires trade-offs with prioritisation of desired functionality. However, other systems (e.g., medication charting, outpatient letters, and requesting radiological investigations) remained PC-based, and some could not be accessed by Cortex due to their underlying legacy architecture. As Hira (a national platform, currently under development, that will connect health information systems) comes into evolution as part of the health reforms in New Zealand,¹ it is hoped that access to a standard set of patient information will be possible. However, within hospital systems, seamless switching between applications or data transfer between individual vendor systems will be dependent upon the widespread deployment of Fast Healthcare Interoperability Resources standards.¹⁵

Although Cortex documentation may be viewed within the Hospital's PC-based electronic clinical portal, some users also wished to be able to complete documentation via the desktop-based clinical portal. The lack of this functionality was one of the main drivers why Cortex was not deployed to the ED, which crosses both outpatient- and inpatient-type workflows. Such functionality currently remains within the roadmap, and is a good example of the importance of iterative design and understanding end-users' requirements for a minimal viable product. Despite this, it must be acknowledged that Cortex's success, at least in part, could be attributed to its truly "mobile-first" approach. Multiple (if not all) members of the clinical team possess iPad devices which allows for instant access to, and addition/modification of, a patient's clinical notes. In addition, the tasking and communication component also allow for a quick, yet asynchronous, way of communicating among other members of the team who may be at geograph-

ically distant locations (within a large hospital ward, across the campus, or beyond). This is increasingly important as hospitals come under growing occupancy pressures, and the corresponding increase in outlying patients across multiple wards is a regular feature of clinical teams' daily working life.

Creation of Cortex documentation has largely employed a dual approach. Forms that are intended to be used hospital-wide have been standardised. Department-specific forms, on the other hand, have been left to each clinical department to develop independent of the technical team. Shifting the locus of control to the end-users for content development enables quick and multiple iterations as feedback from both document creators and readers accumulates. Typically, a tension exists between these two groups, and so this shift of creation control to end-users helps to ensure open dialogue, and form consensus and understanding of each other's needs helps in reaching a better overall solution. As this process evolves, it does result in multiple form deployments. Although some may see this as a negative, others may perceive it as a positive. The quick iteration of feedback is perceived as people listening to the feedback provided. It also allows clinical form builders to go through a learning process, and to enhance workflows as they develop deeper understanding of the functionality of the product.

Reducing the amount of redundancy of information in clinical documentation is an important concept to increasing usability. Within the application functionality, being able to easily import standardised panels of information (e.g., past medical history or the problem list) across notes has been an important step forward within the application. However, the scalable importing of information from other applications [using the Fast Healthcare Interoperability Resources standards; 15] remains elusive. To solve this will require incentives for vendors or legislation to ensure a connected system. This is an important problem to overcome if Te Whatu Ora – Health New Zealand is to continue the concept of "best-of-breed" as its digital strategy.

The approach taken to the development of Cortex did not come from knowing what the solution was going to be at the start of the project. It consisted of significant experimentation, testing and iteration with a group of early adopters. There were several points where a "pivot" was undertaken given the failure of an "experi-

ment” or feedback from users. This is an important concept for the New Zealand health digital ecosystem as it transitions to a national system. Partnership with clinical users from the start is key to ensuring fitness with the clinical workflow. It would seem unwise to “bet big” on knowing the solution before one starts; instead, adopt the principles associated with successful innovation within a complex adaptive system and improve with cumulative experience.

The current study is not without limitations. The number of responses to the survey has been low, although the validity of the SUS tool for responses as few as 20 mitigates this limitation. Additionally, information on the participants’ service/department was not collected, as the usability may have differed among departments. However, there was representation from across the professions further enhancing the validity of the current study. It is possible that responders were more digitally literate/technologically savvy than non-responders. Whilst this could have biased the results towards high usability, it

would be prohibitively difficult to distribute the survey to such a large scale on paper, or attempt to complete the surveys in person.

The median SUS score of Cortex seems superior to most other electronic health record systems published in the literature, although direct comparison may not be possible owing to the differences in the platforms. However, the present study provides a useful benchmark for Cortex at a point-of-time, and sets up potential to periodically repeat this survey to see how new functionality has added to (or detracted from) its usability. It could also be incorporated into exit surveys for staff as they rotate through roles in the organisation. Finally, health enterprises (e.g., Te Whatu Ora – Health New Zealand) could integrate assessments of usability (such as SUS scores) into future procurement processes. This would allow ongoing assessment of an increasingly digitalised health system to be assessed. It would seem critical at a time when workforces are struggling to cope with clinical demand.

COMPETING INTERESTS

Nil

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A clinical review of monkeypox for the Aotearoa New Zealand clinician

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ABSTRACT

The World Health Organization declared mpox (formerly monkeypox) a Public Health Emergency of International Concern in July 2022. Aotearoa New Zealand has reported cases of mpox since July, with reports of locally acquired cases since October 2022.

The 2022 global mpox outbreak highlights many features of the illness not previously described, including at-risk populations, mode of transmission, atypical clinical features, and complications. It is important that all clinicians are familiar with the variety of clinical manifestations, as patients may present to different healthcare providers, and taking lessons from the HIV pandemic, that all patients are managed without stigma or discrimination.

There have been numerous publications since the outbreak began. Our narrative clinical review attempts to bring together the current clinical evidence for the New Zealand clinician.

A case of mpox (formerly monkeypox) was diagnosed in Aotearoa New Zealand in early July 2022. Mpox is a zoonotic viral illness rarely seen outside Central and West Africa, previously. However, since May 2022 an increasing number of non-endemic countries have reported locally acquired cases of mpox. Over 85,000 cases have been reported from 110 countries globally including 83 deaths as of 24 January 2023.¹ On 23 July 2022, the World Health Organization (WHO) declared the current mpox outbreak a Public Health Emergency of International Concern.² Globally, the incidence of mpox is declining. As of 12 January 2023, 41 cases have been reported in New Zealand, including 31 cases of locally acquired transmission.³

New cases of mpox continue to be reported and all clinicians working in sexual health, primary care, emergency, and urgent care need to be vigilant for mpox, be familiar with diagnostics and the approach of supportive clinical management, and be aware of public health requirements regarding isolation and clearance. A sensitive approach is required to avoid stigma and discrimination. There have been numerous publications since the mpox outbreak began. We aim to consolidate the salient information with a clinical focus for the New Zealand clinician.

Causative agent and epidemiology

Monkeypox (mpox) virus (MPXV) is a DNA virus from the *Orthopoxvirus* genus of the *Poxviridae*

family. It is the most common *Orthopoxvirus* causing infections in humans since the eradication of smallpox in 1980. There are two clades of MPXV, recently renamed Clade I (formerly Central African or Congo Basin clade) and Clade II (formerly West African clade). Several variants of subclade IIb are responsible for the current outbreak.⁴

The natural reservoirs of MPXV are unknown. Several factors, including the phylogenetic evolution of the virus, changing rodent-to-human interactions, and increased interconnectivity of an immune-naïve human population are all thought to have contributed to the increased human-to-human transmission of MPXV.⁵

Bites, scratches, and consumption of infected meat from MPXV-infected animals can transmit the virus to humans. Previously, it was thought that human-to-human transmission occurred through respiratory droplets, direct contact with mucocutaneous lesions and scabs of an infected individual, and fomite transmission (e.g., through recently contaminated bedding).⁶

While laboratory testing has demonstrated MPXV to be present in pharyngeal samples of cases, skin-to-skin contact, especially when there is microtrauma or skin friction with direct inoculation is the dominant route of transmission during this outbreak.⁷ It is unlikely that an infected human will pass on mpox through the contamination of food subsequently consumed by others.⁸

Transmission to healthcare workers is extremely rare when personal protective equipment (PPE) is used, but has been reported follow-

ing presumed inhalation of infected skin squames from contaminated bedding⁹ and percutaneous exposure from a needle used to obtain a cutaneous sample.¹⁰ There is limited data on the risk of vertical transmission of MPXV, but mpox can be transmitted to the fetus during pregnancy, and through close contact during and after birth, as well as when breastfeeding. There have been reports of miscarriage and stillbirth in mpox-infected pregnant individuals.¹¹ Serial interval studies have shown asymptomatic transmission and a large proportion of transmission occurs as much as 4 days before the patient is symptomatic.¹²

Among cases with known data, WHO reports 86.1% of cases during the 2022 outbreak have been in individuals who identify as men who have sex with men (MSM). “Sexual encounter” is reported as the most common mode of transmission (70.7%). “Party setting with sexual contact” (59.1%) was the most commonly reported situation for infection. The vast majority of cases have been in men between the ages of 30–39 years. Where HIV status is known, 51.4% of infections have been in individuals with known HIV infection.¹

As of 25 January 2023, there have been 41 confirmed cases of mpox in New Zealand. Ten cases acquired their infection overseas and 31 acquired their infection locally. Cases have been reported from Auckland, Bay of Plenty, Canterbury, Capital and Coast, Waikato, Waitemata, and Southern districts. Where data on sexual behaviour were available, the majority (36) were reported to identify as men who have sex with men (MSM). Case ethnicities were reported as NZ European, Asian, Māori, Pacific peoples, and Other. Six cases were admitted to hospital. (J Scott, ESR Health Intelligence Team, email communication, January 25, 2023).

Clinical features

The incubation period of mpox is between 5 and 21 days, with a mean incubation period during this outbreak of around 7.6 days.¹² The illness typically lasts 2–4 weeks. Normally, mpox illness usually commences with a prodromal phase (typically 1–3 days) with constitutional symptoms such as fever (57.8%), headache (31.3%), fatigue (29%), lymphadenopathy (29.7%), myalgia (27.8%), and sore throat (11.5%).¹ This is followed by a rash (85.1%), which typically first appears on the face and then spreads quickly in a centrifugal distribution, with more lesions on the face and extremities, than trunk and abdomen.

Historically the lesions have been described as monomorphic in nature, progressing sequentially through the stages of macular, papular, vesicular, and pustular appearances before crusting over and desquamating. A person is no longer considered infectious once re-epithelialisation occurs.

A notable feature of the current outbreak is the non-classic presentation in the majority of cases (Figure 1).⁷ Many individuals have no prodrome, or systemic features may follow the initial lesions. Most have presented with less than 20 lesions, while many have only one or two skin lesions, which are common in the genital area. Lesions may be focussed in the region of inoculation, and are predominant in the anogenital region, where they may be associated with symptoms of anorectal pain, proctitis, tenesmus, or diarrhoea. Many have also presented with oropharyngeal symptoms of pharyngitis, odynophagia, epiglottitis, and oral or tonsillar lesions. Localised lymphadenopathy may occur with the lesions. Macular-papular rashes and polymorphic lesions have also been common.^{7,13,14} There have also been reports of asymptomatic mpox during this outbreak.^{12,15} Concomitant sexually transmitted infections (STIs) and HIV (including acute seroconversion) are common among individuals diagnosed with mpox during this outbreak.¹⁶

In New Zealand, cases have presented with lesions on fingers, hands, thighs, genitals, perianal and oral cavity.

Mpox lesions often appear non-specific, with similarities to chickenpox, primary and secondary syphilis, hand, foot, and mouth disease, localised and generalised herpes simplex, molluscum contagiosum, and impetigo, amongst others. These differential diagnoses also need to be considered.

The clinical course of the illness is determined by an individual's prior smallpox vaccination status, age, and other factors such as pregnancy. Complications associated with mpox include secondary bacterial superinfections and sepsis, encephalitis, conjunctivitis, keratitis (causing corneal scarring and blindness), pneumonia and, rarely, deaths (1–10%; based on the clade of infection).⁶ Other serious complications seen during this outbreak include severe penile oedema leading to phimosis and paraphimosis; abscesses requiring drainage (e.g., tonsillar abscesses causing airway compromise); significant proctitis, and rectal perforation. The most common reasons for hospital admission are severe rectal pain and severe penile oedema.^{13,14}

Evidence identifying risk factors for severe

Figure 1: Clinical features of mpox [Source: Tarín-Vicente et al⁷ figure 1, p 666, used under Creative Commons CC-BY license]. (A) Pustules in the genital and pubic region, in which the initial umbilication has progressed to a necrotic crust with central depression. (B) Three semiconfluent pustular lesions with a depressed centre located on the left side of the tongue dorsum. (C) Pearly acral vesicles embedded in the thick stratum corneum of the palmar skin, shotty on palpation. (D) Scattered papules, pustules, and umbilicated pustules surrounded by an erythematous halo on the lateral aspect of the chest and left arm. (E) Pustules circumferentially distributed on the anal margin and perianal skin. (F) A pustular lesion with a crusted centre on the lower lip, close to the right oral commissure. (G) Primary inoculation site with a large, crusted lesion on the right cheek. (H) The right palatine tonsil is reddened and enlarged and has a fibrin-covered ulcer. (I) The penile glans and foreskin have lesions of varying sizes and stages of evolution, with oedema surrounding the larger ulcer.

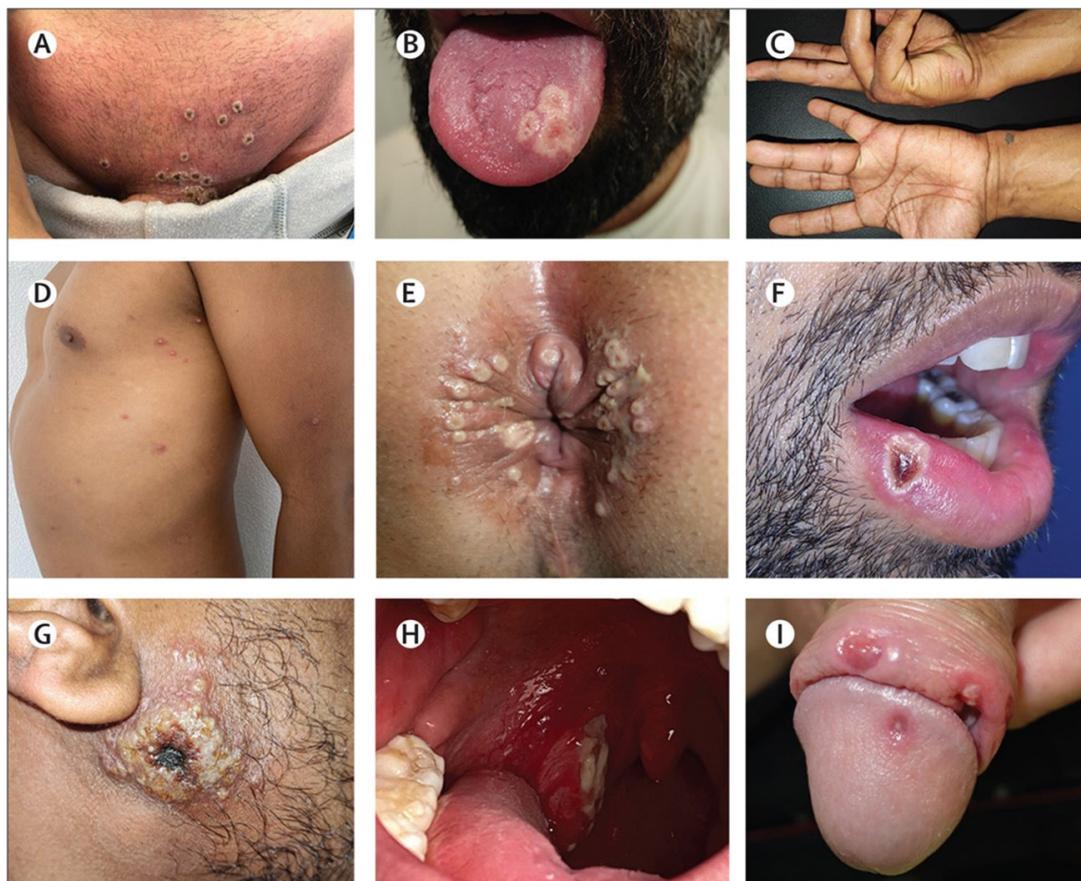


Figure 2: Mpox testing criteria

Clinical criteria

A clinically compatible illness characterized by the presence of acute unexplained skin and/or mucosal lesions or proctitis (for example anorectal pain or bleeding)

AND

Epidemiological criteria

At least one of the following:

- exposure to a confirmed or probable case in the 21 days before symptom onset
- is a priority group for testing
- at this time priority groups for testing include the following:
 - persons who had multiple or anonymous sexual partners in the 21 days before symptom onset
 - gay, bisexual or other men who have sex with men (MSM)
- history of travel to a country where mpox is endemic (as per WHO) in the 21 days before

disease is limited, but more severe cases have been seen in children, those with conditions associated with immune deficiencies (including advanced HIV), and individuals with high mpox viral loads.^{17,18} There is limited experience with mpox in pregnancy, although there are reports of adverse fetal outcomes.¹⁹

Diagnosis

Mpox was declared a notifiable infection in New Zealand in June 2022. The New Zealand Ministry of Health – Manatū Hauora has provided a case definition for Mpox in New Zealand. This is regularly reviewed and updated for clinicians.³

All cases of suspected mpox infection will require a detailed history (including exposure and sexual history) and a thorough clinical examination. The differential diagnoses described earlier in this article should be considered in any suspected case and investigated accordingly.

Currently, mpox testing is recommended for people who fulfil both the clinical and epidemiological criteria, as in Figure 2, or at the request of the Medical Officer of Health. Given the low risk for mpox outside of groups at risk (summarised in Figure 2), widespread testing is currently not advised. However, due to the varied presentations, maintaining a high index of suspicion and a low threshold for testing in at-risk populations especially gay, bisexual or other men who have sex with men (MSM) is important. It is also likely that clinicians will occasionally see cases among individuals outside established risk groups. Clinicians should refer to the Manatū Hauora website for the latest recommendations.³

Consultation for assessment and mpox testing is free in primary care as well as sexual health clinics in New Zealand. HealthPathways have been updated with local contacts for testing and advice.

The use of hard stem swabs is recommended for taking sufficient scrapings of dry lesions or ulcers and should be collected in a universal or viral transport medium. Direct detection of MPXV nucleic acid material through molecular methods like polymerase chain reaction (PCR) from mpox lesions (deroofed pustules/ulcers/scabs) seen on the skin, oral mucous membranes, and anus/rectum is the mainstay of diagnosing mpox.²⁰

The use of PPE including eye protection, gown, gloves, and masks (P2/N95) is recommended for assessment of a suspected case of mpox.

Current Manatū Hauora guidelines recom-

mend isolation pending test results for high-risk patients with advice to avoid close contact with others including sharing bedding or clothing. High-risk patients include those with a very high index of suspicion for mpox, oral mucous membrane lesions, lesions unable to be covered, systemic symptoms, or who are immunocompromised. All others awaiting test results should be advised to avoid people at high risk of serious disease and to isolate if they develop any high-risk features. All patients should be advised to refrain from sexual or intimate contact and to inform any healthcare facilities before seeking medical care.

It is important that anyone tested for mpox is also offered testing for other STIs, including HIV and syphilis, due to high rates of concomitant STIs. Clinicians should consider the need for HIV prophylaxis as patients at risk of mpox may also be at risk of HIV.

Management

Supportive care

Most patients require only supportive care, as the infection is self-limiting for the majority. Specific attention to pain management, skin care, oral care, nutrition and hydration may be required. Many will also require the management of proctitis with agents used to treat hemorrhoids (e.g., lignocaine gel and stool softeners). Regular sitz baths may be helpful. Patients should be counseled to avoid touching their eyes to prevent autoinoculation of the eye. Secondary bacterial infection may require antibiotic therapy.

Hospital admission and antiviral therapy should be considered for those with severe disease (e.g., those with extensive lesions, haemorrhagic or necrotic lesions); or where lesions involve anatomic sites which might result in severe sequelae from scarring or strictures, such as ocular disease, neurological sequelae, urethral involvement requiring catheterisation or severe anorectal involvement interfering with bowel function.

Antivirals

No specific treatments directed against the MPXV have yet been developed; however, some existing therapies for other pox viruses are expected to have activity and have been repurposed. Direct-acting antivirals such as tecovirimat and cidofovir/brincidofovir, together with vaccinia immunoglobulin (VIGIV) have been

included in international treatment guidelines.

Tecovirimat (TPOXX®), an oral antiviral taken twice a day for 2 weeks, was initially approved for smallpox treatment by the Food and Drug Administration (FDA) in 2018 following concerns that smallpox may be used as a biological weapon.²² Subsequently the European Medicines Agency also approved use in 2022 for orthopox infections including smallpox, cowpox, mpox, and complications related to smallpox vaccinations.

Initial reports from the US and other countries indicate that tecovirimat is well tolerated, with headache and nausea being reported as the most common side effects. The efficacy of tecovirimat for mpox is not known and randomised control studies are underway in multiple countries to determine this.^{23,24}

Internationally, tecovirimat use has been prioritised for people who have, or are at risk of progression to, severe disease (such as severely immunocompromised people, pregnancy and breastfeeding, children <8 years old, those with skin integrity issues, e.g., severe dermatitis), and in some settings considered for use where the anatomical location of the lesion is concerning for secondary sequelae (e.g., stricture development).²¹ Use of the other antivirals, cidofovir, and brincidofovir, is limited by the risk of renal and hepatotoxicity, respectively. Consideration for use of directed therapy in New Zealand should be made in conjunction with a sexual health or infectious diseases physician as per local HealthPathways.

Contact tracing and isolation

Mpx is a notifiable disease, and contact tracing will be undertaken by local Medical Officers of Health. Guidance regarding isolation and management of contacts is regularly updated as new evidence emerges in the Communicable Disease Control Manual available on the Manatū Hauora website.³

Currently, cases are required to isolate for a minimum of 7 days from the start of skin lesions and have a staged release from isolation dependent on meeting clinical criteria. During staged de-isolation, cases may return to most normal activities while lesions are covered, but they must continue to avoid contacts at high risk of serious disease and high-risk sexual and intimate activities. The full release from isolation requires clinician confirmation that all lesions have healed. As semen may still contain MPXV, cases must use condoms for a further 3 months.³

Contacts are not required to isolate but are advised to monitor for symptoms for 21 days from the date of last exposure. If contacts develop symptoms, they should inform their GP or sexual health clinician, and if lesions are present and/or they have proctitis they should be tested for mpox.

Prevention

Globally the incidence of mpox has been declining since mid-August 2022.¹ This downward trend is believed to have resulted from a combination of effective public health measures, vaccine-related immunity, natural immunity, and behavioural changes from the affected community.²⁵

The Burnett Foundation Aotearoa and other partner organisations have been instrumental in raising awareness of mpox in the MSM communities in New Zealand, as well as in advocating for urgent action to prevent the escalation of mpox in New Zealand, including vaccine procurement and delivery.²⁶

Specific vaccines have not been developed to prevent mpox. Smallpox vaccines do provide cross-protection against mpox infection and are thought to be at least 85% effective at preventing mpox infection, based on study data from Africa in the 1980s.²⁷ Vaccines can be used as primary preventive (pre-exposure) vaccination (PPV) to prevent infection or as post-exposure preventive vaccination (PEPV) for up to 4 days to abort an episode of active infection. PEPV has also been used between 4–14 days post-exposure and may result in mpox infection with milder symptoms.

The main vaccine used internationally is the Modified Vaccinia Ankara-Bavarian Nordic (MVA-BN) vaccine. It contains a live attenuated non-replicating orthopoxvirus. It is marketed as JYNNEOS® (US), IMAVNEX® (EU), and IMVAMUNE® (Canada). This vaccine has fewer side effects than the earlier second-generation vaccines and can be used in immunocompromised individuals. It is traditionally administered subcutaneously with two doses, four weeks apart.

Side effects of the MVA-BN vaccine include pain at the site of injection (85%); redness, swelling, itching, and induration at the site of injection (40–60%); fatigue, muscle pain, and headaches (20–40%); nausea (17%), chills (10%) and fever (2%).²⁸

There were no vaccine effectiveness studies prior to the release of the MVA-BN vaccine but antibody responses and preclinical studies showed it is effective when given pre-exposure.

Early evidence from the US has shown that a single dose, given 2 or more weeks before exposure is protective among males aged 18–49. Unvaccinated individuals had a 14 times higher incidence of mpox incidence.²⁹

There is also evidence that intradermal use induces a similar immune response to subcutaneous administration. The intradermal dose requires only one-fifth of the subcutaneous dose and hence it has the advantage of providing doses for more individuals at risk at a time of global and local vaccine shortage.³⁰ It has an increased rate of local adverse events including redness and itch compared with subcutaneous administration and should be avoided in those with immunocompromise, a history of severe keloid, and in children.

At present, it is the role of sexual health services and public health units to advise individuals about the risks and benefits of vaccination against mpox.

Conclusion

Based on global trends,¹ New Zealand is likely to see low levels of local transmission and imported

cases of mpox amongst unvaccinated MSM at risk. Cases may also occur infrequently in other population groups. Clinicians have a central role in managing the outbreak through prompt recognition of cases, appropriate testing, and coordination with public health units. Clinicians working in different healthcare settings need to be aware of the wide variety of presentations, particularly recognising the atypical presentations, such as single lesions, proctitis, tonsillitis, and ophthalmic manifestations in high-risk individuals. Taking lessons from the early HIV pandemic, it is important to remove any barriers to individuals seeking care for mpox and clinicians wishing to offer wider testing, and it is important that individuals with suspected or confirmed mpox are treated without stigma or discrimination. In contrast to the emergence of HIV, effective public health interventions are already recognised and rapid diagnostic testing, antiviral treatments and effective vaccines are all available to swiftly control, and eventually eliminate transmission of this re-emerging infectious disease.

COMPETING INTERESTS

Nil.

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Airborne transmission: a new paradigm with major implications for infection control and public health

Anna Stevenson, Joshua Freeman, Mark Jermy, Jason Chen

ABSTRACT

Recognition of airborne transmission of SARS-CoV-2 and other respiratory viruses is a paradigm shift in the Infection Prevention and Control (IPC) field, contributed to by New Zealand's experience in Managed Isolation Quarantine Facilities (MIQF). Slowness to embrace this shift by the World Health Organization (WHO) and other international bodies highlights the importance of applying the precautionary principle and subjecting established theories to the same level of critical scrutiny as those challenging the status quo. Improving indoor air quality to reduce infection risk and provide other health benefits is a new frontier, requiring much additional work at both grassroots and policy levels. Existing technologies such as masks, air cleaners and opening windows can improve air quality of many environments now. To achieve sustained, comprehensive improvements in air quality that provide meaningful protection, we also need additional actions that do not rely on individual human's behaviour.

In early January 2020, news filtered through to the general public of a disease outbreak caused by a novel coronavirus centred around a live animal market in Wuhan, China. A media release from New Zealand's Ministry of Health on 24 January 2020 noted the virus caused pneumonia.¹ It advised the public to "take steps to reduce their risk of infection", including by "regularly washing your hands, covering your mouth and nose when you sneeze", staying home when sick and "avoiding close contact with anyone with cold or flu-like symptoms". These risk reduction measures assumed the virus spread via close contact, contaminated surfaces and large droplets of saliva emitted during coughing and sneezing. These assumptions aligned with longstanding teaching within the international Infection Prevention and Control (IPC) community that respiratory viruses generally spread via large respiratory droplets that fall rapidly to the ground within 1–2 metres of the source ("droplet transmission").

By March 2020, aerosol scientists were publicly arguing that SARS-CoV-2 and other respiratory viruses also spread via tiny respiratory droplets that remain suspended in the air for longer periods ("airborne transmission").² Significantly, they noted such tiny droplets ("aerosols") are emitted during normal breathing and talking, even without coughing, sneezing or "aerosol generating procedures". This understanding subsequently

helped explain several observations about the pandemic, including indoor super-spreading events; instances of long-range transmission; and the tendency of the virus to transmit during the pre-symptomatic phase of infection.

Unfortunately, the World Health Organization (WHO) was initially reticent to acknowledge the expertise of non-clinical aerosol scientists and explicitly recognise SARS-CoV-2 as an airborne pathogen, delaying important IPC mitigation measures in both healthcare and community settings.²

Science of airborne disease transmission

Any respiratory activity (including shallow breathing) emits particles of various sizes defined loosely by droplet size and aerodynamic properties. At two ends of the spectrum, are small droplets (aerosols) that float and large droplets that rapidly fall to the ground under gravity.

The content of the droplets depends on their origin within the respiratory tract. They consist principally of saliva, hydrated mucus and/or lung surfactant, meaning they are mostly water with some carbohydrates, proteins and salts. They may carry virions, in proportion to the concentration of virions in the fluids from which they originate. When exhaled, the droplets change in size in relation to temperature and humidity,

and tend to shrink by evaporation, leaving small low-water-content particles (“droplet nuclei”).³

When infected with a respiratory pathogen, a person may generate exhaled droplets in the lung and conducting airways, or in the upper airway (trachea, mouth, pharynx and nasal passages). Breathing, speaking, shouting, singing, coughing and sneezing can generate more droplets of larger average sizes. Large droplets tend to fall faster than they evaporate and cluster around the source. Small droplets are also more concentrated near the source but can be coughed or sneezed several metres and drift in the air for up to several hours.³

Historically, the IPC literature has distinguished between particles which are droplets (diameter >5 microns) or aerosols (diameter <5 microns). Aerosol scientists have always seen this threshold as inaccurate and unhelpful. Wells’ original research in this area generated an “evaporation falling curve” and placed the division at 100 microns.⁴

This is the largest particle size that in appropriate environments can remain suspended in the air for more than five seconds and be inhaled.³ Generally, respiratory droplets follow the exhaled air, but also settle towards the ground under gravity. Settling may be slowed, or prevented altogether, by up-draughts of air. Wells observed large droplets (>100 microns) tended to settle faster and fall under gravity within two metres of the source. This led to the recommendation for two-metre distancing between people when infection transmission via large respiratory droplets is a concern.⁵

In the last three years, researchers and clinicians have increasingly recognised that most SARS-CoV-2 transmission occurs via aerosol transmission (<100 microns). This occurs when an infected person exhales virion-containing aerosols, which mix with the ambient air, and a susceptible person close to or distant from the infectious case inhales them. The probability of exposure to an infectious dose depends on many factors including the viral load of the source; the rate of aerosol production; proximity and duration of exposure; the recipient’s immune status; inhalation dose (which masking at source and recipient may mitigate); and the rate of dilution with clean air through ventilation. Infectious dose dilution is very quick in the outdoor environment. Indoors, dilution may occur through mechanical (fan-based) ventilation systems, open windows, humidity, temperature, and air movement and mixing.³

A pictorial summary is shown in Figure 1.

Based on this new understanding of airborne transmission of SARS-CoV-2, recommended IPC measures have extended to include precautions to limit airborne transmission. No single IPC measure will provide 100% protection from infection. A key principle is to mitigate infection risk with multiple layers of protection, such as immunisation and public health measures which reduce the frequency or duration of contact with infectious people—this includes physical distancing, use and type of mask, ventilation levels and air-cleaning technologies.

Modelling airborne transmission risk

Modelling can estimate the risk of a susceptible person developing an infection from inhaling droplets an infectious person has exhaled. It involves estimating the total mass and active virus concentration of virus-carrying particles exhaled (related to viral load); dilution by mixing with clean air; settling out of droplets on surface; inactivation of virus by time, ultraviolet (UV) light or other means; the rate at which the susceptible person inhales air; and the effect of masking by either person. The probability of infection developing must also be calculated using a dose-response model.

Several groups have developed risk estimation tools based on these methods. One of the most detailed is the “Airborne Infection Risk Calculator”.⁶ The most common is an exponential dose-response model, defining an “infectious quantum”, which is the number of viable ribonucleic acid (RNA) copies required to start an infection in 63% of susceptible people. As the infectious quantum and the susceptible person’s vulnerability are usually uncertain, they represent the greatest uncertainty in this method. The method is more robust when used to calculate odds ratios between two different scenarios, such as well-ventilated vs poorly ventilated rooms.

Where exhaled breath can be assumed to mix immediately and uniformly throughout the room, the Wells–Riley formulation can be used to calculate the quantity of virus inhaled.⁷ This assumption is reasonable over long periods in rooms with much air motion. In practice the risk of infection is higher when people are in close proximity, inhaling each other’s breath before it is diluted with ambient air. Better estimates come from using computational fluid dynamics (CFD) to model air flow and mixing, which can

Figure 1: Airborne transmission.

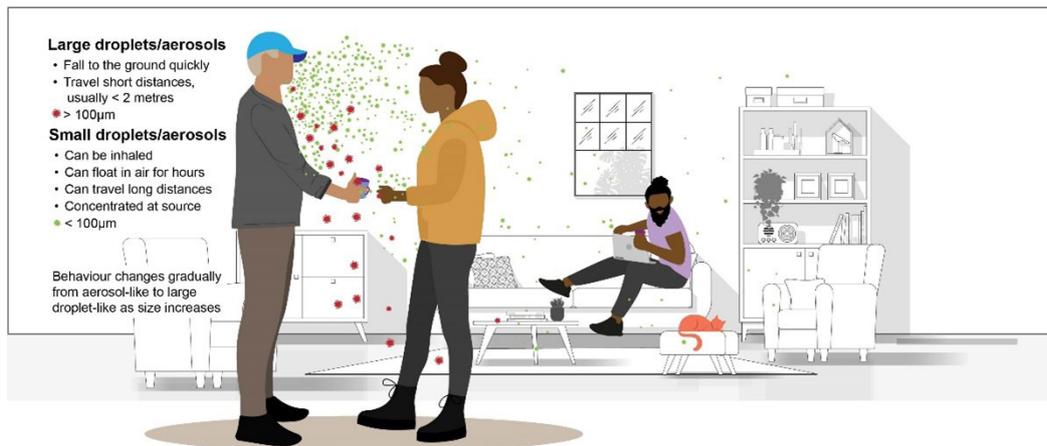
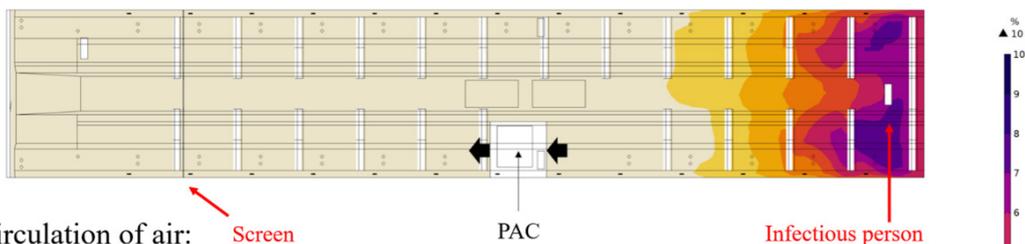
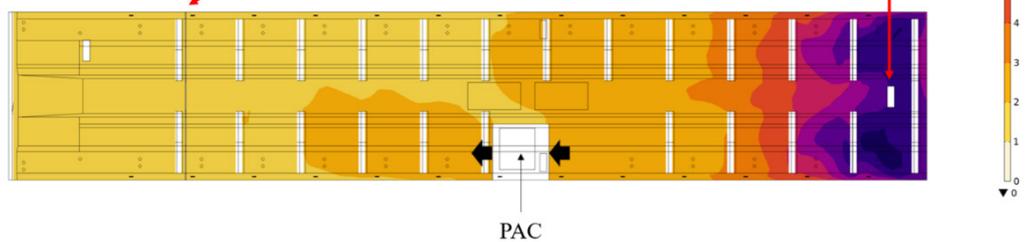


Figure 2: Contour plot of an infection risk to an occupant in a bus travelling from airport to MIQ.

0% recirculation of air:



80% recirculation of air:



- Driver's compartment is on the left, separated from the passenger compartment by a screen
- The screen is full height but 1 cm gap
- Any recirculated air enters both the passenger compartment and the driver's compartment, feeding air with infectious material into the driver's compartment

Note: PAC marks the position of a portable air cleaner. The colour at any one place indicates the estimated probability that a susceptible person, sitting at that place for the duration of the journey, will develop an infection. The plots show risk on a horizontal slice through the bus at the average head height of a seated passenger. The upper plot indicates the risk when all air flowing through the bus' ventilation system is fresh. The lower plot indicates the risk when 80% of the air is recirculated without filtration.⁸

Table 1: Measures to reduce airborne disease transmission.³

Source controls	Transmission controls	
Testing, scheduling or cohorting to reduce the probability of an infectious person being present	Increasing ventilation to dilute and remove exhaled air	Ventilation with ducted systems: increasing the flow rate (set exactly) of clean air
		Natural ventilation through external windows and doors (flow rates vary with weather and human intervention)
Increasing physical spacing so aerosols disperse and become less concentrated before being inhaled	Removing aerosols from the air with HEPA filters (in ventilation ducts or standalone systems)	
	Inactivating virus in airborne aerosols (UV germicidal irradiation or other technologies)	
Masking infectious people	Masking susceptible people	

Table 2: Measures to improve air quality in the built environment.³

Dilution	Disinfection
Opening external windows and doors if possible	Air filtration: portable units or high-grade filters in enough ducted ventilation systems units to achieve equivalent to 6 ACH minimum
Enough portable air filtration units to achieve 6 ACH minimum	Upper room ultraviolet-C disinfection
Maintaining ducted ventilation systems to work as effectively and efficiently as possible	Ultraviolet-C disinfection in central ventilation systems
Source control—masking	

resolve jets of breath and air currents caused by ventilation and heat sources. Uncertainties remain as the air motion at any given time is highly variable, but CFD can yield insight into the importance of close-range vs long-range infection—see Figure 2 for an example of its use in the Managed Isolation Quarantine Facilities (MIQF) ventilation assessments.

New Zealand's contribution to the growing understanding of airborne transmission

New Zealand had border restrictions in place from March 2020. Everyone entering the country had to quarantine for 14 days in hotels that were functionally converted into MIQF. These facilities had extensive processes, protocols and rules for physical distancing between guests. During their stay, guests routinely underwent polymerase chain reaction (PCR) testing of nasopharyngeal swabs at set intervals and if symptoms developed. All positive swabs underwent whole-genome sequencing (WGS). This arrangement effectively allowed for a natural observational experiment as WGS identified all transmission events, which then enabled targeted and highly thorough investigations into how and when transmission occurred. Tools for investigation included routinely collected records of guest and staff activity; CCTV footage; interviews; and key-card data (giving the precise time whenever a guest re-entered their room). Using all of this information, the investigators generated hypotheses on when and how transmission most likely occurred.

In October 2020, two transmission events from a guest cohort to Christchurch MIQF nurses were identified. Work records and interviews narrowed down possible transmission events to brief interactions at each source case's doorway. In each event the nurse was following protocol: wearing full personalised protective equipment including a standard ear-loop medical mask, eye protection, gown and gloves. In one case, two senior IPC nurses observed the interaction and identified no breaches in process. Throughout the interaction, which lasted 40–60 seconds, the asymptomatic source case stood in the doorway wearing a medical mask and remained silent. The nurse removed their wristband and replaced it with another of a different colour. This was the only contact the nurse had with any potential source case with a matching WGS profile. The

investigators concluded that airborne transmission facilitated by poor ventilation was the most likely mechanism, bypassing the standard medical masks the two nurses wore. They thought the nurses were probably exposed to a sudden wave of air heavily contaminated with infectious aerosols from each source's room soon after they opened their door.⁹

Given these findings, investigators reviewed an earlier transmission event in September 2020, when one guest infected another in the adjacent room. The first investigation had attributed the infection to fomite transmission through a virally contaminated lid of a shared rubbish bin in the corridor outside both guests' rooms. However, re-examining the evidence made it clear that airborne transmission relating to opening of adjacent doors in rapid succession was far more likely.¹⁰

Other transmission events in MIQF around the country were investigated—some with the use of modelling described above to test plausibility—and in most cases airborne transmission was found to be the most likely explanation. Interdisciplinary collaboration was critical to understanding these transmission events.¹¹

Merging clinical and aerosol scientist expertise

On 28 March 2020, WHO stated that except for “aerosol generating procedures”, SARS-CoV-2 was not airborne. In July 2020, 239 aerosol scientists published an open letter calling on the medical community to recognise airborne spread of SARS-CoV-2. The authors noted that recognition of airborne transmission had substantial implications for preventative public health measures including improving indoor ventilation; air cleaning (by filtering or disinfection); avoidance of indoor crowding; and masking.¹²

In March 2021, a WHO-funded systematic review of the evidence for airborne transmission stated, “the lack of recoverable viral culture samples of SARS-CoV-2 prevents firm conclusions to be drawn about airborne transmission”.¹³ The key pitfall of this review was that the evidence underpinning the existing paradigm of “droplet transmission” was not given the same level of critical scrutiny or even examined. A month later, “Ten scientific reasons in support of airborne transmission of SARS-CoV-2” was published.¹⁴ The authors urged clinicians and policy makers to act, rather than waiting for somewhat arbitrary laboratory-

level proof that would be difficult to obtain. Their preferred precautionary approach would assume airborne transmission has occurred until proven otherwise.

As more observational case studies, mathematical modelling and experimental studies supporting airborne transmission accumulated, the WHO's communications began to implicitly support this message. Yet it was not until December 2021 that its website explicitly stated both short- and long-range transmission of SARS-CoV-2 was important.¹⁵

Environmental controls for airborne diseases

Protective measures against airborne transmission can involve source control (reducing viral dispersion from the index case) or transmission control (reducing the likelihood of non-infected people inhaling the virus) (see Table 1).

Practical responses to new information and understanding

The observations of airborne spread in New Zealand's MIQFs led to a revision of IPC practices, starting in Canterbury in late 2020 and rolling out quickly to other centres. Staff masks were progressively upgraded to N95s, ventilation engineers were employed to assess every MIQF, and air cleaners with HEPA filtration were strategically located in "dead air" spots such as elevators and corridors. Routine surveillance testing frequency increased to identify and move asymptomatic infectious cases to appropriate isolation earlier. These rapid changes in response to the new paradigm were enabled by strong leadership from the clinical staff involved in MIQF.¹⁶

How to protect the community from transmission of SARS-CoV-2 now

In late 2022 it is well understood that SARS-CoV-2 is predominantly spread by airborne transmission. Masking, particularly of the infected person (source control), is very effective at reducing transmission. The more people who wear masks, the greater the impact. For greatest impact, everyone should be masked in crowded and/or poorly ventilated indoor public spaces, although this is not always achievable or reasonable.¹⁷ Additional measures to prevent transmission are needed.

Consider the analogy of potable drinking water. Just as the majority of New Zealanders can access clean water from a tap without having to personally filter and disinfect it, so too should people be able to trust that the air they breathe is clean. Many public buildings achieve around 1–2 air changes an hour (ACH) when the aim should be a minimum of 4–6 ACH.¹⁸ Encouragingly, researchers in Hong Kong have shown that improved ventilation of a room can significantly reduce long-range *and* short-range transmission of respiratory pathogens.¹⁹ Table 2 presents these and other measures for improving indoor air quality, which from a health perspective is both achievable and desirable.

Dilution with fresh air is favoured where sufficiently high flow rates can be achieved and comfortable temperatures and noise levels maintained. If windows cannot be opened, ducted ventilation systems can often be adjusted or upgraded to achieve greater dilution, although building occupants may have limited control over the system a landlord installs. Carbon dioxide (CO₂) monitors are inexpensive and give an immediate assessment of the fresh air supply rate relative to the number of occupants.^{20,21} This monitoring has additional benefits given CO₂ itself is a hazard in high concentrations, affecting cognition.²² Many CO₂ monitors also measure temperature and humidity, which help building occupants learn to balance fresh air and heating or cooling to maintain a comfortable, healthy environment. Our experience is that using CO₂ monitors for even one week can develop new healthy ventilation habits.

Where sufficient fresh air flow is unattainable, air cleaning can be effective in reducing virus and particulate matter, although it does not reduce CO₂ levels as fresh air does. It can be achieved by filtration (HEPA or similar filters) installed in either ducted ventilation systems, which can require expensive installation work, or portable units. The latter are relatively inexpensive and quick to install although when bought in bulk capital costs can mount up and maintenance costs (power and filter cleaning and/or replacement) need to be budgeted for. The major limitations associated with portable air filters are ensuring physical placement is appropriate, reliance on occupants to turn them on and, sometimes, noise levels can be problematic.²³ Guidance to assist in choosing appropriate air cleaners is available, for example <https://cleanairstars.com/>. Those filters which introduce reactive species into the air to break down

pathogens (e.g., ionizers and hydrogen peroxide systems) are not recommended without careful risk assessment, as the reactive species may potentially be harmful if inhaled.²⁴ If sufficient ACH cannot be achieved with air filters another alternative is upper air or in-duct UV germicidal irradiation (UVC, UGVI) although unlike filtration it does not remove particles such as soot, which might in themselves be hazardous.²⁵

Poor air quality leads to health and wellbeing issues beyond infectious diseases. A large body of research documents concerns with volatile organic compounds, build-up of CO₂ and many other air pollutants. In one such report, published (ironically) in January 2020, the Royal College of Physicians in the United Kingdom recommended that the government should establish a cross-government committee to coordinate working to improve indoor air quality in public sector buildings and residential homes.²⁶ More recently, similar recommendations have been made in New Zealand and the United Kingdom.^{27,28,29}

Guidance is available on how to assess air quality in New Zealand classrooms using CO₂ meters along with methods to improve the air quality.³⁰ This guidance is generic and transferable to many public and private buildings.

In the short-term similar accessible information guides with advice that is easy to implement

needs to be provided to the business sector including hospitality and entertainment. Longer term, an equity-based approach would target investment and education in environments which house poorly vaccinated populations, e.g., pre-schools and primary schools. Monitoring of CO₂ levels in public buildings where people congregate in groups such as entertainment venues, cafeterias, education facilities, whare kai and churches should be normalised. Appropriate responses to high CO₂ levels and education about using ventilation (ducted and natural) and air cleaning to achieve comfortable, safe indoor environments should be part of the commissioning process in all buildings used by the public.

In the longer term, the Government needs to lead with building codes in residential and commercial sectors that treat clean air provision with as much importance as earthquake safety.

The removal of non-pharmaceutical public health interventions (such as mask wearing requirements in public spaces) makes the use of engineering controls to minimise exposure to contaminated air even more important.³¹ Improving indoor air quality will not only reduce COVID-related illness, but all morbidity related to poor air quality. With this in mind, it's understandable that reliably maintaining high indoor air quality standards has been described as the new "sanitation".³²

COMPETING INTERESTS

Nil

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Conversion of locally advanced to resectable pancreatic body cancer aided by phosphorus-32 brachytherapy (OncoSil)

Fraser Welsh, Bernadette Goodwin, Laxmi Lanka, Berry Allen, Jayden Wong, Frank Weilert

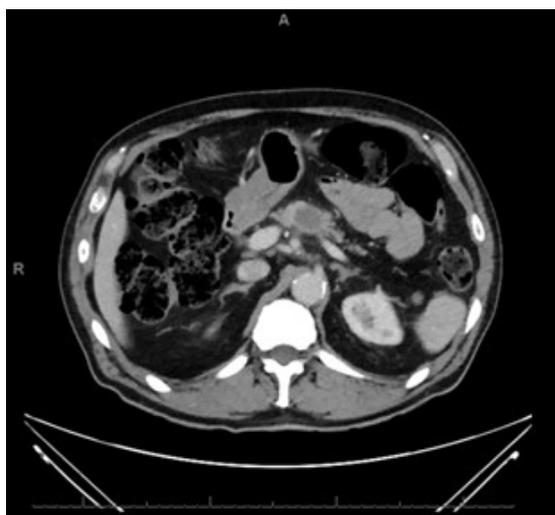
Prognosis for locally advanced pancreatic cancer (LAPC) patients remains poor. Conversion to resectability is infrequent with existing treatment strategies. Brachytherapy is a novel treatment option in this patient group.

Case report

A fit 75-year-old male developed abdominal pain in November 2020. Ultrasound reported a pancreatic mass. Computed tomography (CT) scan demonstrated a 25mm pancreatic body mass consistent with pancreatic adenocarcinoma (Figure 1) without biliary dilatation. Abnormal soft tissue extended into the coeliac axis and common hepatic artery. The mass abutted the splenoportal venous confluence. There were no distant metastases (cT4cN0cM0).

In the local upper-gastrointestinal MDM, the lesion was adjudged to be inoperable due to

Figure 1: Initial CT: pancreatic tumour, soft tissue around coeliac branches.



arterial involvement. Endoscopic ultrasound (EUS) biopsy confirmed moderately differentiated adenocarcinoma, strongly positive for s-100p. The patient consulted a medical oncologist. Palliative-intent chemotherapy was recommended. The option of brachytherapy was offered.

Treatment began with intravenous gemcitabine (1000mg/m²) and nab-paclitaxel (125mg/m²) on days 1, 8 and 15 in a 28-day cycle. After chemotherapy cycle one, OncoSil brachytherapy was administered using EUS on 10 February 2021, observing radiation-safe precautions. A tumour volume of 7.7ml was calculated from CT data with semi-automatic software (Intellispace Portal, Phillips Workstation). 4MBq (0.62ml) phosphorus-32 solution was injected via a 22G FNA needle.¹ Bremsstrahlung scan confirmed OncoSil placement (Figure 2).

CT after nine chemotherapy cycles demonstrated partial response² with separation from the

Figure 2: Bremsstrahlung scan: focal phosphorus-32 OncoSil radiotracer activity at pancreatic body injection site.

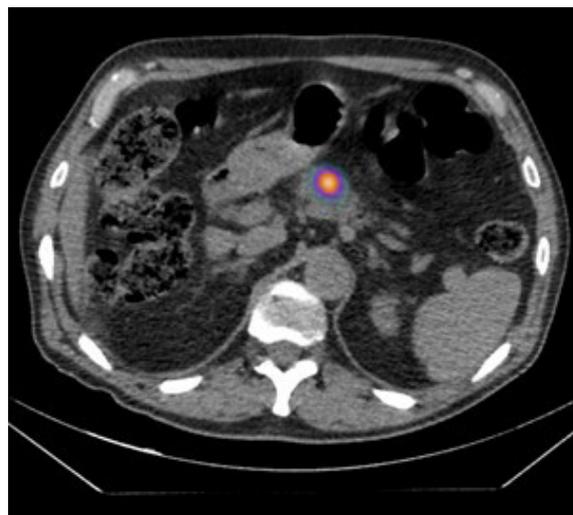


Figure 3: Post treatment CT: tumour shrinkage, resolution of perivascular soft tissue changes.



coeliac artery (Figure 3).

Trial resection was offered. Surgery on 11 November 2021 confirmed sclerotic tumour in the pancreatic body without peritoneal or solid organ metastases. The coeliac axis and portal vein were tumour free. Peri-arterial tissue biopsy was negative for malignancy. Distal pancreatectomy with splenectomy was performed. Final histology showed a 17mm grade 2 adenocarcinoma with clear surgical margins. Lymph nodes were negative for cancer (ypT1ypN0).

Surgical recovery was uneventful. He completed three more chemotherapy cycles. Follow-up CT scans show no recurrent disease. He remains well 12 months after surgery.

Discussion

Despite improvements in treatment, pancreatic cancer has the lowest survival rate of all major cancers (8.2% 5-year survival).³ Most patients are not candidates for curative-intent surgery due to locally advanced features (vascular invasion) or distant metastases. Prognosis for inoperable patients is poor with median survival <12 months. Treatment options for this group include chemotherapy alone, chemotherapy then chemoradiotherapy or stereotactic body radiotherapy. Resection of LAPC after chemoradiotherapy has been described, although R0 rates vary widely.⁴

Brachytherapy is a form of radiation therapy where a radiation source is implanted next to the area requiring treatment. The use of

brachytherapy is established in selected solid organ tumours,⁵ including prostate cancer,⁶ but has not been hitherto widely adopted in pancreatic cancer. Implanted radiation damages tumour DNA, arresting cell proliferation and resulting in tumour ablation. OncoSil is a targeted radioactive isotope (phosphorus-32) designed for implantation directly into a pancreatic tumour via EUS. The delivery method provides more concentrated and localised beta radiation (100Gy¹) compared to external beam radiation (typically around 40Gy⁷), reducing collateral toxicity.⁸ The isotope is given concurrently with sensitising chemotherapy.

In one international pilot study including 50 patients with LAPC, 10 patients were able to have pancreaticoduodenectomy after OncoSil. R0 margins were achieved in eight. Six remained alive after 26.4–35.3 months follow-up. The safety profile was comparable with standard-of-care chemotherapy.⁹

OncoSil is a new therapeutic option for patients with LAPC in New Zealand. Conversion to operable disease has been observed overseas, providing the opportunity to improve the prognosis for this otherwise devastating disease. In New Zealand, one case of pancreatic head cancer has been resected with clear margins after OncoSil. One other case was found to be unresectable at laparotomy. To our knowledge this case is the first to describe the downstaging of locally advanced pancreatic body cancer to R0-resectable disease after brachytherapy in New Zealand.

COMPETING INTERESTS

Nil.

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Welcoming the Medical Council's review of doctors and health-related commercial organisations: more is needed to ensure financial factors never influence patient care

Adrian Balasingam

In September 2022, the Medical Council of New Zealand released a consultation paper suggesting that referrals to a facility where a doctor has a financial interest should only occur where there is no suitable alternative that meets the patient's needs. As independent radiologists, we strongly believe that financial factors should never influence decisions relating to patient care. The Medical Council's draft guidelines are less restrictive than the situation in countries such as Australia and the United States, where ownership interests that conflict with patient care are heavily proscribed or banned.

Those who oppose the proposed changes to the Medical Council's draft regulations may argue that disclosing their own financial interest in a facility to their patient sufficiently mitigates the potential impact on patient care. This does not take into account the power imbalance that exists in a relationship between medical professionals and patients.

The draft guidelines released by the Medical Council are rightly the topic of rigorous debate. It is our opinion that the guidelines should be further strengthened, ensuring that the personal or business interests of medical practitioners play no part in seeking out and providing the best treatment for patients.

One of the strengths of the New Zealand health system is the existence of vigorous and competitive private practices operating alongside our core public health system and adding vitality, innovation and outreach to it. Good health outcomes for all depend on an effective interplay between these two parts of the system. Therefore, anything that might undermine public confidence and trust in those private practices and how they operate would have significant negative impacts on the

whole sector, not just private providers. Evidence globally and locally is clear. When citizens lose trust in their institutions, we are all worse off. We need to do everything we can to ensure that this does not happen in our health system.

At the very heart of public trust is an explicit understanding that all parts of the health sector will put the needs of the patient first and that the personal or business interests of the practitioners will play no role in seeking out and providing the best treatment for each patient. It is in this context that we should react to the Medical Council's current consideration of submissions on a draft statement concerning doctors and health-related commercial organisations.

With reference to referrals to a facility in which the doctor has a financial interest, the draft consultation document includes the statement that: *"You should only do so if you have explored other options with your patient, and there is no suitable alternative that meets your patient's needs."*¹

Unsurprisingly, the draft is the subject of vigorous debate and has solicited a record number of responses. Our organisation has argued that the guidelines should be further strengthened. The fact that such vigorous debate is occurring around these issues should be supported and celebrated.

In our speciality, being objective is especially important. Part of a radiologist's role is to act at arm's length, providing independent advice to the referring practitioner on the best treatment for the patient. This ensures that the patient is less likely to be exposed to unnecessary radiation or surgical treatment.

As independent radiologists, we take a strong view that our commercial interests should never interfere with what is best for the patient. And it

is in radiology that we are seeing the emergence of business models that arguably do not put the needs of the patient at their core. We are seeing the emergence of what we consider to be a deeply concerning trend where some specialists are becoming financial shareholders in the radiology practices that they refer to. These are considered “non-arm’s length referrals”.

In our view, this is the opposite of actively avoiding potential conflicts of interest.

The obvious dangers are that surgeons are incentivised to over-refer when they have a financial interest in the radiology practices they are sending their patients to. It may also mean that they will refer more to the practice that they have an ownership stake in, even if a better qualified or specialist independent practitioner might be more suited to their patient’s needs. It could mean that unnecessary medical procedures take place as a result.

What is more, this trend could well be exacerbated if ownership arrangements of this sort lead to less competition in private radiology services, because the surgeons minimise referrals elsewhere. This could be particularly problematic in regional New Zealand.

In this context it is striking to note that the Medical Council’s draft guidelines—criticised by some as being too tough—are actually far less restrictive than similar guidance and laws in the countries New Zealand often compares itself. In Australia and the United States, ownership interests that might conflict with patient centrality are heavily proscribed or even banned.^{2,3} This is in part because these countries have been down this path before us and have seen the evidence. Non-arm’s length arrangements have led to unnecessary referrals and unnecessary operations.⁴

One alternative put forward by those who would seek to operate non-arm’s length referral businesses appears to be that simply disclosing these interests to the patient will ensure that their interests are at the forefront. With the greatest of respect, we think that disclosure without other safeguards will be inadequate. It is hard to think of a more unequal relationship than the one between an expert and well-resourced medical professional and a patient who is, by definition, unwell, vul-

nerable and less likely to question the advice they are given. That is the very reason we have codes of ethics. In our view, it is simply not good enough to rely on disclosure alone.

Those who argue that the draft regulations should be watered down also suggest that investment and innovation may decline as a result of the proposed changes. It is important to differentiate here between surgeons owning facilities that are a core part of their speciality—such as a surgeon owning an operating theatre—and surgeons owning radiology practices that need to be independent to offer them and patients an independent view. We see no evidence of a lack of investment in radiology practices in New Zealand—indeed, just the opposite. Independently owned radiology practices in New Zealand have historically been the subject of very significant new technology investment, with improved treatment as a result. That continues today. The reason is obvious: they invest because it is their core business. That is how they innovate and compete. The emergence of non-arm’s length radiology practices may well lead to exactly the opposite outcome, and that is a real danger. Surgeon owners may see radiology practices as a subservient part of their core business and therefore not worthy of proper investment over time. That doesn’t just go to the level of investment in new technology and innovation, but also to their propensity to service all customers, not just the most profitable.

Public trust in our health system—including private providers—is critically important for its future success. Patients and those close to them need to feel confident that the medical practitioner advising them has their interests at the forefront. That is not antithetical to the existence of private sector health providers competing vigorously with each other. To the contrary, such competition is likely to lead to investment, innovation and better outcomes over time. But if we later find that commercial interests were impacting that advice, the damage to public trust would be enormous and long lived. That is why we should support the Medical Council review and advocate for strengthening the guidance concerning activities where conflicts might occur.

COMPETING INTERESTS

The New Zealand Institute of Independent Radiologists supported the creation of this letter. Adrian Balasingam has leadership roles in the New Zealand Institute of Independent Radiologists and the RHCNZ Medical Imaging Group, where he is also a shareholder.

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Unusual Infection with the Diphtheria Bacillus

(Kleb's Loeffler's Bacillus)

NZMJ, 1923

CLINICAL NOTES BY SAMUEL GREEN, F.R.C.S.E.

On 13th May, my daughter, æt. 13 months. vomited her evening meal. For some days after this she refused her food, although she did not lose much weight. Temperature 100-102 deg. (axilla), pulse 114-120; stools undigested, not green, obvious colic; examination of the throat revealed nothing pathological. In spite of routine treatment, energetically carried out, no improvement took place.

Let me here state that at no time during the illness was there any vomiting or diarrhœa; furthermore, that daily examination of the throat failed to reveal any suggestion of membrane or even reddening of the fauces and pharynx. There were no respiratory symptoms.

May 26th.—Suspicion of an intussusception having arisen, the child was examined under an anæsthetic by three fellow-practitioners who unanimously agreed that the condition was a severe enteritis.

A stool passed during examination was sent to the Laboratory, Waikato Hospital. The Bacteriologist reported that the fæces were crowded with an organism which had the staining properties of Klebs Loeffler's bacillus.

The throat was immediately swabbed; the swab being positive.

Anti-toxin produced an immediate improvement, which was maintained until 3rd June when the child suddenly collapsed, became pale and cold, respiration, sighing and irregular. Three such attacks occurred on this day.

4th, 5th and 6th June.—There was slight regurgitation of food through the nose on these days, and difficulty in swallowing for about a week. There was a transient otitis media in the right ear.

The chief interest in the case lies, of course, in the Bacteriology which is fully reported by Mr. J. G. Smith, Bacteriologist at the Waikato Hospital.

No attempt to review the literature on the subject is made, for the good reason that it is not available.

No membrane was passed at any time and there was apparently no ulceration as the occult blood test was only faintly positive (Benzidine). The site of the lesion can only be conjectured, but, from the absence of vomiting and diarrhœa, and from the fact that nutrition was wonderfully well sustained, it might be reasonable to suppose that the small intestine was not seriously affected.

The child undoubtedly owes her life to the painstaking work of Mr. Smith, to which the use of the anti-toxin was a natural sequel.

Any opinion as to the date of onset of the infection is purely speculative. The simplest view would be that a faucial diphtheria was missed, as it so often is in infants, and that the diphtheria organism became implanted in an intestine already the seat of enteritis.

Against this is the fact that the throat was carefully inspected daily. Of course, I should have taken a swab, but there was no indication to do so.

As to the source of the infection, the only fact of any interest is that a fox terrier in the house was ill at the time, and later developed paralysis of the hind quarters; however, swabs from the animal showed no Kleb's Loeffler's Bacillus.

BACTERIOLOGICAL NOTES BY MR. J. G. SMITH, BACTERIOLOGIST, WAIKATO HOSPITAL.

On 26th May a specimen of fæces was sent to me from a case of enteritis.

The specimen consisted chiefly of a greenish mass which appeared to be mucus, hanging drop preparation revealed bacilli in masses, no protozoa or cysts being discovered.

I decided to stain films to exclude T.B., and, upon examining the films (counterstained with methylene blue), there appeared to be many-beaded bacilli which resembled K.L.B., and, in spite of never having heard of this organism in

the fæces, I stained further films with Gram's and Neisser's stains, with the result that the bacilli were morphologically K.L.B., in fact, the films resembled those of a pure culture of the diphtheria bacillus from serum.

I immediately reported the specimen as suspicious, and in the meantime prepared cultures which proved to be K.L.B.

Specimens of both fæces and culture were sent to Dr. Gilmour, pathologist, Auckland, who confirmed these findings.

A throat swab (taken after the fæces examination) showed a few K.L.B., but another swab taken next day was negative, as were several consecutive

throat swabs.

A further series of fæces specimens was obtained from this case every few days, and during the first 14 days the Kleb's bacilli were very abundant, in fact very few gram negative organisms being seen in the films, but after 14 days from the first examination the diphtheria bacilli began to diminish and more coliform bacilli appear, until after a month the infection disappeared altogether.

I inoculated a guinea pig with the first culture obtained, and the organism was highly virulent, the animal dying in 36 hours, and the *post mortem* features were very typical.

John Lyndon McLeod Hawk

8 November 1942–25 December 2022



Emeritus Professor John Lyndon McLeod Hawk was born in Auckland, New Zealand on 8 November 1942. He was brought up with his younger brother Richard in Hamilton, New Zealand by their parents Charles and Dorothy.

In his final year at Hamilton Boys' High School, John was awarded a national scholarship as the top languages scholar in New Zealand. This achievement was recognised with a large article and photograph in the *NZ Herald*. John was invited to return to Hamilton Boys' High School in later life, selected as one of their top alumni to be given an award and asked to give an inspirational talk to the schoolboys. From high school, John left to study physics at Auckland University, before attending medical school at Otago University in Dunedin. His early career took him to St Mary's in London, where he was offered a fast-track role towards a dermatology consultancy at St John's Institute of Dermatology, St Thomas' Hospital and King's College—a world-leading dermatological unit. John was appointed consultant in 1979, finalised his training at Harvard University in Boston and rose to Head of the Photobiology Unit, where he ran a department of about 30 people for more than 20 years. In 1988, he was a founder of the British Photodermatology Group, and was a founding member of the American

Photomedicine Society. He served as President of the European Society for Photodermatology and Congress President of the World Congress on Cancers of the Skin. As well as delivering numerous key-note speeches at high-profile conferences outlining his latest research, he wrote multiple scientific papers, book chapters and books. John also ran a successful private practice in Windsor until he finally retired in 2019.

His work as a doctor was both a career and a vocation; it was his life's work and his passion. He helped people—he changed peoples' lives for the better. Beyond the titles and roles, objectively speaking, he reached the pinnacle of his profession. John was regularly featured in the news talking about matters of public concern relating to sunlight and damage to the skin. He was a doctor to high-profile patients who would come from across the globe to manage complex conditions of the skin. He advanced his field materially with research from him and his teams, inspiring colleagues who respected him hugely. The words spoken around the room at his retirement Festschrift are not something that anyone there would forget.

His generosity towards his patients was also notable, regularly offering free advice or service for those in need. Many patients became friends, not just because he was a good doctor, but also

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because he was a good man with a wonderful (almost unique) sense of humour. He was very proud to be nominated for honours for his work, but unfortunately it came too late.

Beyond his work, John remained a staunch sports fan all his life, particularly of rugby and cricket, and anything involving New Zealand. A fine athlete in his youth, he played for St Mary's

medical school and scored many tries as a tall and speedy winger.

John passed away on 25 December 2022, after valiantly battling idiopathic pulmonary fibrosis for longer than he was expected to. He leaves behind Lorna, his wife of nearly 50 years, sons Simon and Tim, and grandchildren Ben, Marnie, Amelie, Darcey and Clemmie.

AUTHOR INFORMATION

This obituary was compiled by John's sons, Simon and Tim, and his wife Lorna, in loving memory.
