Acceptability of a New Remote Monitoring Service for Patients with COVID-19 Infection using Wearable BioStickers™: A Mixed Methods Study

Lynne Maher Dr
Te Whatu Ora

Lisa K. Blake Mrs
Te Whatu Ora

Karol J. Czuba Dr
University of Auckland

Mary E. Seddon Dr
Te Whatu Ora

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We would like to express gratitude to the patients who participated in this study and shared their experiences. Their insights have greatly contributed to our understanding of the use and acceptability of RPM. Many thanks to the Counties Manukau Kaupapa Māori Committee and Māori team members for their guidance which ensured the correct procedures, practices, customs, and rules in Te Ao Māori (the Māori world) were respected and incorporated. And to Contractor whānau researchers who were involved in conducting and transcribing survey and interview data. We would also like to acknowledge the assistance provided by our colleagues at Ko Awatea and the Healthy Together Technology Team whose support has been invaluable.

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Acceptability of a New Remote Monitoring Service for Patients with COVID-19 Infection using Wearable BioStickers™: A Mixed Methods Study

Lynne Maher a,*, Lisa K. Blake a, Karol J. Czuba b, Mary E. Seddon a

a Te Whatu Ora
b University of Auckland

ABSTRACT

The COVID-19 pandemic saw rapid adoption of telehealth, including remote patient monitoring (RPM). There is limited evidence about how patients and staff experience such services in New Zealand. This study aimed to understand the acceptability of the RPM experience, particularly for Maori and Pacific peoples, and identify strengths, gaps, and limitations to inform future delivery of services. A mixed methods study was undertaken between 4 July and 11 September 2022 in Auckland. We conducted telephone surveys with patients and semi-structured interviews with patients and staff. Survey, and clinical and administrative data were analysed descriptively using SPSS. Interviews were analysed using Directed Content Analysis. 121 patients took part in the study, with the majority identifying as Maori and Pacific peoples (40% and 17%, respectively). We conducted 75 telephone surveys (62% response rate), and 30 semi-structured interviews (18 patients and 12 staff). Patients reported feeling safe and reassured while in the RPM service and that they would be willing to use it again. Staff reflected on a range of potential benefits that RPM offers, identified learnings and would like to see a more widespread rollout of RPM. This study demonstrated that remote monitoring of patients infected with Covid-19 can provide an acceptable model for a culturally diverse population. Future research could focus on applying this model to other patient groups, such as people with chronic conditions.

Keywords: Consumer engagement, Patient experience, Remote patient monitoring, Indigenous populations, Qualitative research

1. Introduction

The COVID-19 pandemic saw the rapid adoption of telehealth with previous hospital and primary care face-to-face models progressing to virtual visits, virtual clinics and even virtual hospitals.1–3 Recently there has been increased interest in using telehealth to monitor patients’ health remotely.4–6

Remote Patient Monitoring (RPM) consists of technologies and systems that enable healthcare professionals to remotely monitor a patient’s vital signs. RPM is used internationally to improve the quality of care and the use of workforce resources across a wide range of patient groups.7–9 It is no longer only an interesting concept and is becoming a routine approach to safely monitor patients’ health in their own homes, especially during the COVID-19 pandemic.7–9

When supported with algorithms and smart reporting platforms, RPM programmes can be used to alert clinicians to early signs of deterioration and/or support clinicians to triage which patients require attention.10 The published literature is still emerging, but preliminary studies have confirmed that RPM is useful, safe, and a cost-effective way of providing care for COVID-19 outside the hospital setting.10–15
Despite being used internationally, RPM technology is new to New Zealand (NZ) and it may be of particular benefit to NZ’s indigenous population, many of whom experience significant health inequities. Specifically, previous research found that for Māori, (the indigenous people of New Zealand) and Pacifica peoples, telehealth approaches have the potential to eliminate the practical barriers to accessing healthcare. However, the cultural acceptability and the potential risks and benefits to health equity that RPM causes have not been examined. The current study explores patient and their whānau experiences as reported by patients, particularly for Māori and Pacific peoples, as well as staff experience of setting an RPM system up.

Project staff consisted of clinicians, and other staff with digital technology, co-design and evaluation expertise at Te Whatu Ora (the New Zealand Health System) Counties Manukau, in partnership with the Whānau Ora Community Clinic and the Hospital in the Home (HitH) teams, who enrolled patients into the new RPM home monitoring service. This service used the BioIntelliSense BioSticker (BioSticker) supported by the AlertWatch™ monitoring platform. Figure 1 presents an overview of the monitoring service process.

2. Methods

2.1. Setting and location

The study was conducted in a large secondary care institution providing hospital and community services to a culturally diverse patient population within the district of Counties Manukau, Auckland, New Zealand. We used RPM to capture continuous data through a wearable device measuring physiological markers including skin temperature, resting heart and respiratory rate, activity levels and gait analysis. To address potential access inequities, all participants were issued with a mobile phone that could be synced with the BioSticker, which transmitted the vital signs’ data. Cellular coverage was essential and 96% of homes in Counties Manukau had reliable coverage. We established the monitoring centre which was staffed by five registered nurses. Guidelines for eligibility and escalation were developed and used during the programme.

It is important to acknowledge that all health research conducted in Aotearoa New Zealand should be relevant to Māori. The extent of relevance is determined by Māori. Consulting with the Counties Manukau Kaupapa Māori Committee prior to the commencement of the study and having Māori team members in the project team ensured the correct procedures, practices, customs, and rules in Te Ao Māori (the Māori world) were respected and incorporated. Māori research staff were also involved in conducting, transcribing, and analysing survey and interview data. The study was undertaken over a 12-week period between 4 July and 11 September 2022.

2.2. Study design

The aim of this mixed methods study was to evaluate the experience of developing and implementing the RPM service. Specifically, to:

1. Explore patient experiences and acceptability of the BioSticker.
2. Explore staff (clinician, health technology and leadership) experiences of development, implementation, and service delivery of remote monitoring models of care, to inform future work.
3. To identify strengths, gaps and limitations of the RPM technology use, relating to user experiences, and healthcare processes and systems.

Patients who had a positive COVID-19 rapid antigen test result and, after examination, were considered by a clinician to be clinically appropriate for monitoring at home, were approached by the HitH team (directly from the ED or from the inpatient wards), or the Whānau Ora clinic staff. They were provided with an
information sheet which explained the purpose of the study and were given an opportunity to ask questions. Patients had to be over 18 years old and displaying capacity to provide informed consent. Patients were not included if they did not have the ability to converse in English, Tongan or Te Reo Māori.

Quantitative methods were used to identify any potential signals in the data relating to patient outcomes and service delivery that could inform the design of future studies evaluating RPM.

Qualitative methods were used to explore experiences of patients and staff, and their ideas for improvements to RPM services. This approach provided an opportunity to describe acceptability of the RPM service from several perspectives, including a cultural perspective for Māori and Pacific people. To achieve adequate information power, we aimed to recruit approximately 20 patient participants for semi-structured interviews, including: six patients of Māori ethnicity, and six patients of Pacific ethnicity; and 10 staff participants.

3. Data collection

3.1. Demographic data

Patient data from the start of their RPM until 30 days post discharge from the service included demographics, level of care required, ambulance callouts, hospitalisations, and mortality. We also report monitoring alert types and frequencies, length of stay (LoS) in the RPM service, and the number of people consenting to take part in the study.

3.2. Patient survey

The survey was developed by the study team to provide insights into the acceptability of RPM as a potential solution for future healthcare services. It was designed to capture patients’ experiences and viewpoints about wearing a remote monitoring device and being monitored 24/7. The survey aimed to identify whether there were any differences in RPM acceptability based on factors such as ethnicity, age, and sex.

Patients who consented to complete the survey were contacted via telephone on day three of their RPM. Their responses were recorded via Survey Monkey (http://www.surveymonkey.com). The data included demographics (gender, age, and ethnicity) and participants’ responses to questions about their experience, e.g., wearing the BioSticker, cultural acceptability, being a part of the RPM service. There were seven Yes/No questions, and ten questions with a five-point Likert scale ranging from Strongly Disagree (1) to Strongly Agree (5). Participation in the survey was acknowledged with koha (a gift) in accordance with the internal Counties Manukau Consumer Participation Recognition Policy.

Once discharged from the RPM service, patients who expressed interest in taking part in the interview were purposively selected (seeking diversity of ethnicity) and contacted by telephone. Staff from the clinical, monitoring and implementation workforce involved in the development and delivery of the RPM service were invited to take part in an interview via an e-mail.

The interviews were semi-structured and patient participants were given the option of a video call via Zoom or a telephone call. All patient participants opted for a telephone call. We used four interview guides (one for patients, and one for each staff team involved; Appendix 1, 2, 3 and 4) to explore participants’ experience of receiving and providing the RPM service. The interviews lasted between 8 and 45 minutes. All interviews were audio recorded and transcribed verbatim.

Four experienced qualitative interviewers were contracted; all were female; one European, one Māori, one Asian and one Samoan. There were three transcribers: one European, one Māori and one Tongan.

3.3. Data analysis

Data for continuous variables are presented as mean with standard deviation or median with interquartile range based on the distribution of the data. Categorical and ordinal data are presented as frequencies and/or proportions. Length of stay (LoS) in the RPM service is defined as the difference between the RPM discharge and admission dates. ‘Care level escalation’ is a categorical variable with three categories: 1) at least one ambulance callout, 2) presentation at the emergency department and 3) inpatient admission.

Interview transcripts were analysed using Directed Content Analysis.22 There were two coders: LB (English; Cert Public Health and Health Promotion; experienced in consumer experience, beginner in qualitative research), and CK (English; PhD; experienced in qualitative research). The coding focused specifically on the RPM service’s acceptability, implementation considerations and benefits. The resulting codes were linked to the prespecified categories. The two coders’ interpretations of the participants’ reports
Table 1. Demographic characteristics of all participants enrolled into the RPM service.

<table>
<thead>
<tr>
<th>Group</th>
<th>n (% )</th>
<th>LOS (days) mean (SD)</th>
<th>Total alert rate per participant (sd)</th>
<th>Total alert frequency per monitoring day</th>
<th>Significant alert rate per participant (sd)</th>
<th>Significant alert frequency per monitoring day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>121 (100)</td>
<td>5.33 (2.48)</td>
<td>10.30 (11.57)</td>
<td>1.55</td>
<td>5.56 (8.46)</td>
<td>0.84</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>72 (60)</td>
<td>5.48 (2.81)</td>
<td>9.90 (11.59)</td>
<td>1.42</td>
<td>4.99 (7.72)</td>
<td>0.71</td>
</tr>
<tr>
<td>Male</td>
<td>49 (40)</td>
<td>5.10 (1.90)</td>
<td>10.90 (11.65)</td>
<td>1.77</td>
<td>6.33 (9.52)</td>
<td>1.05</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>48 (40)</td>
<td>5.74 (1.98)</td>
<td>10.17 (10.42)</td>
<td>1.47</td>
<td>5.63 (7.46)</td>
<td>0.64</td>
</tr>
<tr>
<td>European</td>
<td>33 (27)</td>
<td>4.79 (2.76)</td>
<td>12.33 (14.71)</td>
<td>1.87</td>
<td>5.45 (10.16)</td>
<td>1.10</td>
</tr>
<tr>
<td>Pacific</td>
<td>21 (17)</td>
<td>4.86 (2.14)</td>
<td>7.90 (10.70)</td>
<td>1.15</td>
<td>4.43 (6.95)</td>
<td>0.66</td>
</tr>
<tr>
<td>Asian</td>
<td>10 (8)</td>
<td>5.61 (3.96)</td>
<td>11.00 (10.66)</td>
<td>1.96</td>
<td>8.00 (12.90)</td>
<td>1.46</td>
</tr>
<tr>
<td>Indian</td>
<td>8 (7)</td>
<td>5.86 (2.68)</td>
<td>9.00 (7.63)</td>
<td>1.55</td>
<td>5.63 (4.69)</td>
<td>0.95</td>
</tr>
<tr>
<td>Age Group</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18–30</td>
<td>5 (4)</td>
<td>4.42 (2.12)</td>
<td>5.20 (2.59)</td>
<td>1.34</td>
<td>4.00 (5.24)</td>
<td>0.88</td>
</tr>
<tr>
<td>31–45</td>
<td>11 (9)</td>
<td>5.46 (2.39)</td>
<td>9.55 (9.05)</td>
<td>1.69</td>
<td>4.18 (4.92)</td>
<td>0.76</td>
</tr>
<tr>
<td>46–60</td>
<td>23 (19)</td>
<td>5.39 (1.97)</td>
<td>11.30 (10.25)</td>
<td>1.94</td>
<td>5.43 (7.30)</td>
<td>0.99</td>
</tr>
<tr>
<td>Over 60</td>
<td>82 (68)</td>
<td>5.35 (2.66)</td>
<td>10.44 (12.55)</td>
<td>1.47</td>
<td>5.83 (9.35)</td>
<td>0.82</td>
</tr>
</tbody>
</table>

were reviewed and discussed with other project team members.

De-identified quotes (in italics) from participants’ transcripts are presented to support our interpretations of the data. We used the following abbreviations to describe participants’ ethnicity when reporting their quotes: MP - Māori patient, PP - Pacifica patient, NOP – New Zealand European/Other, AP – Asian patient.

3.4 Ethics approval

Ethical approval for the study was received from the Auckland Health Research Committee, 13th May 2022, (AH243111). A written consent form was furnished to respondents for review prior to starting the interviews. Those who participated in telephone interviews were given an opportunity to further discuss the consent process prior to providing verbal consent which was audio recorded. Five staff who participated in in person interviews provided written consent prior to starting the interview. The study was also culturally reviewed and endorsed by the Kaupapa Māori Committee.

4. Results

In total, 129 patients were eligible to take part in this study, eight patients (6.2%) did not consent; leaving 121 (93.8%) possible participants. One subsequently opted out during participation, the reason reported was that the person had changed their mind. One patient did not provide their ethnicity, all other data for analyses were complete. The majority of patients were female (60%) and over 60 years old, with Māori patients being the largest ethnic group in the study (40%). Mean LOS in the RPM service was just over 5 days (5.33, SD=2.48). All patients had at least one RPM alert, the highest number of alerts for a single patient was 70. On average, each patient triggered just over 10 RPM alerts whilst in the service, with about half of these alerts considered ‘significant,’ requiring additional clinical review. Demographic data, LOS in RPM, and RPM alert rates and frequencies are presented in Table 1.

Table 2 presents the number of people whose care required escalation during the monitoring period; this includes both Covid-19-related and other causes. Overall, 7.4 percent of participants had an ambulance callout and 3.3 percent required admission to the hospital. All patients who required care escalation were aged over 60 years old.

4.1 Patient survey

Of the 121 enrolled patients, 75 (62% response rate) completed the phone survey, 22 (18%) declined and 24 patients were not included as we were not able to contact them by telephone. Participants aged over 60 years old and Māori participants made up about half of the interviewed group, Table 3.

Overall, responses from patients of all four demographic groups were in support of the RPM service. They found the information provided was easy to understand, they felt safe wearing the BioSticker, no one raised any cultural or privacy concerns, and participants and family found the service to be helpful (Appendix 5 and 6). There were no differences in RPM acceptability between any of the demographic groups.
Table 2. Care level escalation received during the monitoring period for all participants (n=121).

<table>
<thead>
<tr>
<th></th>
<th>Ambulance callout</th>
<th>Emergency Department Admission</th>
<th>Inpatient Admission</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[n], (%)</td>
<td>[n], (%)</td>
<td>[n], (%)</td>
</tr>
<tr>
<td>All</td>
<td>9 (7.44)</td>
<td>6 (4.96)</td>
<td>4 (3.31)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>4 (3.31)</td>
<td>2 (1.65)</td>
<td>2 (1.65)</td>
</tr>
<tr>
<td>Male</td>
<td>5 (4.13)</td>
<td>4 (3.31)</td>
<td>2 (1.65)</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>1 (0.83)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>European</td>
<td>6 (4.96)</td>
<td>5 (4.13)</td>
<td>3 (2.48)</td>
</tr>
<tr>
<td>Indian</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Māori</td>
<td>1 (0.83)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Pacific Islander</td>
<td>1 (0.83)</td>
<td>1 (0.83)</td>
<td>1 (0.83)</td>
</tr>
<tr>
<td>Age Group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18–30</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>31–45</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>46–60</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Over 60</td>
<td>9 (7.44)</td>
<td>6 (4.96)</td>
<td>4 (3.31)</td>
</tr>
</tbody>
</table>

1 Some patients were referred to their GP, others were taken to ED/hospital
2 Some patients were self-presentations at ED.

Table 3. Survey participants' demographics.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>45</td>
<td>60</td>
</tr>
<tr>
<td>Male</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>Ethnic Group*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>35</td>
<td>47</td>
</tr>
<tr>
<td>Pacific</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>Asian</td>
<td>14</td>
<td>19</td>
</tr>
<tr>
<td>NZ European/Other</td>
<td>14</td>
<td>19</td>
</tr>
<tr>
<td>Home Occupancy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Live Alone</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>Two occupants</td>
<td>24</td>
<td>32</td>
</tr>
<tr>
<td>Three occupants</td>
<td>19</td>
<td>25</td>
</tr>
<tr>
<td>Four occupants</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>Five - Eight occupants</td>
<td>11</td>
<td>15</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18–30 years old</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>31–45 years old</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>46–60 years old</td>
<td>20</td>
<td>27</td>
</tr>
<tr>
<td>Over 60</td>
<td>42</td>
<td>56</td>
</tr>
<tr>
<td>&quot;Prefer not to answer&quot;</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

* We used the Ministry of Social Development (MSD) Prioritised ethnicity guidance (https://www.msd.govt.nz/).
Prioritised ethnicity means people are allocated to a single ethnic group in an order of priority, even if they identify with more than one ethnicity. For example, if someone identifies as Māori and Tongan, they’re reported as Māori only.

4.2. Semi-structured interviews with patients and staff

Once discharged from the RPM service, those patients who also expressed interest in taking part in the semi-structured interview, were purposively selected seeking diversity of ethnicity and were contacted by telephone. They were invited to have their family/whānau present during interviews. Additionally, twelve staff (who had been contacted by email), consented to interviews. Concurrently to conducting the interviews, we were reviewing the emerging data. After 18 patient and 12 staff interviews, we observed a strong synergy of experiences and high quality of the interview dialogues. At this point we concluded that the sample appeared to hold adequate information power. Patient interviews were all conducted by telephone, five staff interviews were in-person with the remainder by telephone (Appendix 7).

Staff reported that setting up the RPM services was challenging at times mostly relating to the complexities of medical device importation to New Zealand. Counties Manukau Clinical Engineers were required to confirm the compliance of the BioSticker with NZ electrical safety standards and with Radio Spectrum Management legislation; a Privacy Impact Assessment and a Cloud Risk Assessment were also completed.

Staff reported that they appreciated having a manager that they could rely on if encountering any potential issues.

“She was always a phone call away so whatever we missed out on the day, or we’ve forgotten she was just a phone call away.” (Staff)

Staff reported feeling that the training was comprehensive and prepared them well to perform their monitoring duties. They also noted that their confidence increased with experience in the role.

“We had some training online, some in person, going out to the patients and observing.” (Staff)
Staff reported that most of the administration was manual and was significantly more intensive than anticipated. They commented that there was significant potential to automate many of the processes for future RPM services.

“It’s quite a high admin overhead if you’re doing remote patient monitoring.” (Staff)

4.3. Enrolment and induction to the RPM service

HitH staff found that during the discharge process from hospital, some patients were overwhelmed with the amount of information being provided in relation to their discharge generally and to the RPM Service.

“What I’ve found is they get told so much information, not just about the Biosticker or about their condition, but what they need to do... They’ve got too much going on in their heads.” (Staff)

The induction process was adapted to be as brief as possible while ensuring critical information was shared and patients confirmed their understanding.

Overall, patients found they had enough information, and it was helpful. Some were worried that the BioSticker may emit radiation and identified a need for more reassurance that it does not.

“I thought it was just enough to know what to do and, not too complicated. It was quite reassuring to know there was information I could read in case I needed to do something with the monitor...without having to call for help.” (PP)

4.4. The BioSticker

Patients found the BioSticker easy to apply and wear. Nine of the 18 patients (50%) interviewed replaced the adhesive sticker during the trial.

“I was aware that it was there, but it wasn’t uncomfortable.” (NOP)

Wearing the BioSticker for a prolonged period did cause some skin irritation and inconvenience when showering. Five of the 18 participants interviewed experienced minor skin reactions, reported as itchiness and irritation. Different silicone adhesives were supplied and proved to be an effective alternative.

“They sent out some different stickers to use because I was getting a rash from the original sticky labels. And the other ones they sent me were awesome!” (NOP)

Although most participants did shower while wearing the sticker, some expressed hesitation about getting it wet.

“It made it less sticky (showering). That was the only thing that was bothering me was trying to keep it from getting too wet.” (PP)

Overall, patients of all four demographic groups reported that being monitored at home was a good experience. The number of calls they received was considered by most to be appropriate, helpful and reassuring. Patients appreciated being able to identify their preferred times for daily RPM checks.

4.5. The mobile hub

Remote monitoring was facilitated through the BioSticker which transmitted data to a mobile phone. Prior to use, all standard functions apart from the Bluetooth function were removed from the phone to enable reliable synchronisation with the BioSticker and protect patient privacy. It took up to 4 hours to prepare 10 phones.

“Setting up a unit basically means we need to start the phone up and make a significant number of changes which effectively locks the device so it can’t be used as a phone. We then load the BioIntelliSense app and check that the connections will work.” (Staff)

Staff described intermittent problems when syncing the phone with the BioSticker. This was time consuming especially if they needed to replace a phone. Staff subsequently adapted the process to synchronise the phone and BioSticker prior to visiting the patient at home. This was more time efficient and reduced the time spent in a COVID-19 environment.

All patients acknowledged receiving a modified phone as part of the trial. They were required to keep the phone charged. While there was some concern about short battery life, most reported that keeping the phone charged and within the recommended distance was manageable.

“As long as I remembered to plug it in and keep it charged. I didn’t need to do anything else to it”. (MP)

Failed synchronisation with the BioSticker resulting in interruption of monitoring was the most frequent concern.

“The monitoring wasn’t coming through, so it said click on this and click on that and yeah, my one wasn’t
transmitting for some reason, or the Bluetooth wasn’t working, so I had to sync it.” (NOP)

Two patients wanted clarification as to whether the BioSticker recorded or tracked their location where others queried whether the BioSticker had a camera and could see or record visual data. Once reassured that it did neither, participants did not consider the monitoring to be a concern with regards to their personal privacy.

“They reassured me that it’s not a tracking device and it can’t track me wherever I go”. (PP)

4.6. Being at home

Patients in all four demographic groups valued the service highly. It allowed them to be at home rather than at the hospital and gave them a sense of control relating to their daily life: they could shower, eat, be with family, listen to music and watch television when they wanted to. Participants mentioned that hospitals can be stressful, noisy environments, while home is a more comfortable and relaxing environment which they felt would aid and speed up their recovery. Patients felt that by being monitored at home they were at less risk as they were not exposed to other patients and illnesses in the hospital environment. Those who were immunocompromised or had other comorbidities reported feeling less stressed when monitored at home.

“So much relief, stress wise, I received a kidney transplant, so my risk is higher if I am exposed in the hospital.” (NOP)

“You were in your own home; you’re in your own bed. You don’t have the people banging on the tables because they can’t seem to work a button and everything the hospital brings. I mean they are incredibly awesome, the nurses and the doctors at the hospital, but it does wear on you after a while. Being at home with your family in surroundings that you know is so much better.” (NOP)

All patients who were interviewed said that in the future if clinically appropriate they would choose the RPM service.

4.7. Feeling safe and reassured

During interviews 17 of 18 patients (94%) said that they felt safe and reassured that they were being monitored and contacted regularly by nursing staff.

“You knew somebody was looking at you or monitoring you. Basically, like in the hospital but they didn’t disturb you all the time, the machines were on a screen somewhere else.” (NOP)

Information provided to patients did state that if they felt unwell, they were to contact the ambulance service immediately even if they had not been contacted by monitoring staff. However, four of the 18 patients expected to be contacted by the monitoring team if their condition deteriorated.

“If something had of been wrong, I think they would have contacted me more, I would assume.” (MP)

Patients reported their whānau (family) were reassured by the monitoring and regular calls from staff.

“My children were very happy because I was out for nearly two weeks, and they had COVID-19 too. I had the BioSticker and they didn’t have to keep an eye on me like they usually do.” (PP)

Some patients recalled receiving after-hours calls and were very appreciative about someone ‘checking on them’. Two, patients reported that the monitoring staff also provided healthcare-related advice to others in their family.

“Especially for the whole family, every time they rang, they would also check on the other adults as well. Couldn’t fault it!” (PP)

4.8. Freeing up hospital resources

Staff noted that being able to collect real-time data on a group of patients allowed them to understand whose observations were within the agreed ranges and prioritise checking in on those who’s weren’t.

“I think it’s got potential to safely keep people out of hospital when they don’t necessarily need to be there”. (Staff)

5. Discussion

This study demonstrated the acceptability of RPM to patients from a broad range of demographic backgrounds who had a diagnosis of COVID-19 and were supported to recover in their homes within the Counties Manukau community. The alert system and escalation pathway were considered safe and effective in identifying deterioration, resulting in the provision of different levels of support up to and
including hospitalisation. Participants reported that the RPM's resulted in a range of actions, such as provision of support, advice, additional care and/or clinical treatment for patients. This included phone discussions with clinicians and clinician home visits.

This study is unique in its focus on the experiences shared by Māori and Pacific patients and therefore the findings provide important insights about the cultural acceptability of RPM for these communities. Overall, patients valued the combination of traditional monitoring methods (e.g., telephone calls and home visits) with the more novel passive remote monitoring. This combined approach can facilitate involvement in RPM services of people who are hesitant about remote monitoring or do not feel confident about digital health approaches.

The inclusion of patients and staff experiences are an important factor in the design and development of all new models of care. Patients reported positively about the RPM service, and all said that they would consider this model of care again. However, there was some concern from staff about patient’s overreliance on the monitoring rather than initiating a call for help if they felt unwell, and this should be considered by future services. Staff also identified the need for specific recruitment strategies and enhanced organisational systems and processes, which is consistent with the literature describing RPM programmes internationally, that report a lack of infrastructure, policies and the established regulatory frameworks required to effectively scale up these services.

The COVID-19 pandemic prompted exploration of different ways to safely care for patients out of hospital. Internationally, a range of different RPM studies have and are creating new knowledge that can be used to provide safe, high-quality care for patients and staff outside of traditional hospital environments. RPM programmes have the potential to remotely monitor a wide range of clinical conditions such as diabetes, heart failure, Chronic Obstructive Pulmonary Disease (COPD) and other respiratory illnesses. They can also be used to monitor for acute or chronic deterioration of older people living in the community. However, RPM programmes do require upfront investment in terms of acquisition of devices, developing purpose-built systems and recruitment and training. Given the investment, systems and skills required, consideration should be given to establishing a coherent strategy to accommodate different RMP platforms going forward.

The main limitation of this study was the relatively small cohort of patients who participated, which is due to the reduction in COVID-19 cases at that time. Although the overwhelming support for the RPM service is certainly encouraging, a study of a longer duration may be useful in identifying any potential adverse events and other unintended consequences of the proposed service. Also, services provided were implemented with slight differences, depending on the team (HitH or the Whānau Ora Community Clinic team) who were supporting patients, and this may impact on the ability for direct comparison in the future.

6. Conclusion

We found that patients with Covid-19 who were remotely monitored at home in the culturally diverse district of Counties Manukau felt safe and considered this approach acceptable. There appear to be opportunities for using RPM in other patient populations, such as those with communicable diseases, and conditions such diabetes and respiratory diseases. However, it’s important to consider the limitations of RPM, such as technical difficulties, costs, and infrastructure and resource requirements (clinical and non-clinical) to ensure its effective use in healthcare.

Acknowledgements

We would like to express gratitude to the patients who participated in this study and shared their experiences. Their insights have greatly contributed to our understanding of the use and acceptability of RPM.

Many thanks to the Counties Manukau Kaupapa Māori Committee and Māori team members for their guidance which ensured the correct procedures, practices, customs, and rules in Te Ao Māori (the Māori world) were respected and incorporated. And to Contractor whānau researchers who were involved in conducting and transcribing survey and interview data. We would also like to acknowledge the assistance provided by our colleagues at Ko Awatea and the Healthy Together Technology Team whose support has been invaluable.

Competing Interests

None

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References


Appendix

Appendix 1

Patient Interview Questions

This document serves as a guide only; each interview is likely to be different.

1. Which of the following symptoms have you experienced over the time you have been monitored at home?

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Ask them to describe this</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever</td>
<td></td>
</tr>
<tr>
<td>Cough</td>
<td></td>
</tr>
<tr>
<td>Tiredness</td>
<td></td>
</tr>
<tr>
<td>Loss of taste or smell</td>
<td></td>
</tr>
<tr>
<td>Sore throat</td>
<td></td>
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<tr>
<td>Headache</td>
<td></td>
</tr>
<tr>
<td>Aches and pains</td>
<td></td>
</tr>
<tr>
<td>Diarrhoea</td>
<td></td>
</tr>
<tr>
<td>Rash</td>
<td></td>
</tr>
<tr>
<td>Where?</td>
<td></td>
</tr>
<tr>
<td>Difficulty breathing</td>
<td></td>
</tr>
<tr>
<td>Shortness of breath</td>
<td></td>
</tr>
<tr>
<td>Chest pain</td>
<td></td>
</tr>
</tbody>
</table>

2. Can you tell me what sort of information you were given at the start of your home monitoring?

Did you find it easy or difficult to understand?

Was it helpful?

Was it enough information?

Was there anything that you think was missing from the information?

What could have made the information better?

3. Now I would like to ask some questions about the monitoring sticker.

Was the sticker easy to apply?

How many days did you wear a monitoring sticker for?

Did the sticker come off unexpectedly at any time?

Did you need to change the sticker? If yes – how many times?

Was the sticker comfortable?

Did you have any reactions to the sticker?

4. Were you provided with a Smartphone for the trial?

Do you know what the phone was for?

Was the phone easy to use?

Was it convenient to have the phone with you? Keeping it charged etc?

5. I would like you to think about the calls you received while you were being monitored.

Were there Too Many - Not enough - Just right?

Did you find these calls helpful?

Do you feel you were able to ask questions during these calls?

Is there anything that could have made these calls more helpful?

6. Did you get any unexpected calls late at night or early morning?

If yes – what was the reason for the call?

How did you feel about getting these calls?

7. Did you feel safe while wearing the sticker and being monitored at home?

Yes – can you tell me what made you feel safe?

No – can you tell me why you did not feel safe?

8. How do you think your whānau (family) felt about you wearing the sticker and receiving the phone calls?

9. Were your cultural needs met while you were being monitored at home?

10. What do you think are the benefits of being monitored at home?

11. What did and didn’t work so well being monitored at home?

What could make it better?

12. Would you have liked to be able to see your monitoring data (temperature, pulse, respiratory rates)?

If so, how would you like to see that instantly on-line/via a website?

Paper copy on a daily basis?
13. If it was clinically appropriate, would you be happy being monitored at home in the future?
   Yes – can you tell me why?
   No – can you tell me why?

14. Is there anything else you would like to tell me about your experience of Remote Patient Monitoring?

Appendix 2

Staff Questions - whānau Ora and HiTH

This document serves as a guide only; each interview is likely to be different.

1. In relation to the Biostickers and remote patient monitoring (RPM), what training did you receive?
   Was it useful?
   Was it enough? Is there other information or training you feel would have been helpful?

2. Did you orientate the patients into the trial?
   If Yes – go to question 3
   If No – go to question 5

3. Where did you do the orientation?
   In the home – at the hospital etc.

4. Can you talk me through the process?
   Was it easy?
   Did you place the sticker on the patient?
   Did you connect the device (smart phone)?
   Do you feel that the patients understood the information?
   Were there any communication or language barriers?
   Is there anything that could make this process better?

5. Do you feel that the criteria to identify patients suitable for Remote Patient Monitoring (RPM) were appropriate?
   Yes – Why?
   No – Why not?
   Is there anything you would suggest that might improve this?

6. How many patients were you responsible for at one time?

7. How many times per day would you call each patient (the same one)?
   Would you say that this was about right, too many times, not enough?

8. What was your experience of building a relationship (whakawhanaungatanga) with patients over the phone?

9. Thinking now about this type of remote patient monitoring?
   a. What do you think are the benefits?
   b. What do you think are the barriers?
   c. Did you have any clinical concerns about this type of care?
   d. Were the patients whānau (family) members able to be involved in their care/monitoring?
   e. Do you feel patients and whānau (family) cultural needs are able to be supported with this type of model of care? Can you give me any examples?

10. Do you feel that that RPM was safe and effective in the detection of clinical deterioration?
    a. Strengths, efficiencies, gaps, limitations
    b. In what ways can these processes be improved/ strengthened?

11. How did you find the interaction between your team and the monitoring team?
    Did any of the patients you were looking after require escalation?
    Did you get any feedback from the monitoring team about the reason for escalation?
    Is there anything you could suggest that might make this better?

12. How did having the data from RPM change your practice? How did you use the data to improve your practice? Would you do anything differently without having the RPM data?

13. What do you think are the benefits of remote patient monitoring?

14. What does NOT work well about remote patient monitoring?

*Prompts*
a. I did not feel connected with the patient on a personal level.
   b. I found it difficult to technically navigate the systems.

15. What else is needed to make remote patient monitoring more effective?
16. Any other comments?

Appendix 3
Staff Questions – Remote Monitoring Team

This document serves as a guide only; each interview is likely to be different.

1. In relation to the Biostickers and remote patient monitoring, what training did you receive?
   Was it useful?
   Was it enough?
   Is there other information or training you feel would have been helpful?
2. Do you feel that the criteria to identify patients suitable for Remote Patient Monitoring (RPM) was appropriate?
   Yes – Why?
   No – Why not?
   Is there anything you would suggest that might improve this?
3. How many patients were you responsible for at one time?
4. What clinical concerns do you have about the Biostickers/remote patient monitoring?
5. Do you feel that that RPM through the Biostickers was safe and effective in the detection of clinical deterioration?
   Strengths, efficiencies, gaps, limitations
   In what ways can these processes be improved/ strengthened?
6. Did you have any concerns about the accuracy of the data provided by the Biostickers?
7. Did you have any situations where you had to escalate support for the patient?
   Call the patient? If yes – were any of the call’s afterhours?
   Support the patient to go to hospital via ambulance or other means?
8. How did you / find the interaction between your team and Whānau Ora or the Hospital in the Home Team?
   How much contact did you have with them?
   Did you have any concerns about patients being followed up?
   Did you get any feedback after the patient had been followed up?
   Is there anything you could suggest that might make this better?
9. What do you think the benefits of remote patient monitoring are?
10. What does and does NOT work well about remote patient monitoring?
    *Prompts*
    a. I found it difficult to technically navigate the systems.
11. What other support do you need to make remote patient monitoring more effective?
12. Any other comments?

Appendix 4
Staff Questions – Project Team

This document serves as a guide only; each interview is likely to be different.

1. What was your specific role in the remote patient monitoring trial?
2. Did you receive any training relevant to your role in the Remote Patient Monitoring (RPM) trial?
   Was it useful?
   Was this enough?
   Is there information or training you feel would have been useful?
3. What did you learn that was completely new to you during the trial?
4. Thinking about this type of home-based care?

*What do you think are the main benefits of this model of care?*

*Prompt: Consider patients, equity, systems and processes.*

*What do you think are the main barriers of this model of care?*

*Prompt: Consider patients, equity, systems, and processes.*

5. What were the main challenges of setting up the RPM trial?

6. What advice would you give to others about implementing RPM?

7. What is needed in the future to make remote patient monitoring as effective as possible?

8. Any other comments?

**Appendix 5 – Facilitated Survey Likert Scale responses (n = 75).**

<table>
<thead>
<tr>
<th>Question (Likert Scale 1(strongly disagree)-5(strongly agree))</th>
<th>Median (IQ range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The information I received about the remote monitoring service was easy to understand</td>
<td>5.00 (4.00–5.00)</td>
</tr>
<tr>
<td>The information I received about the Biosticker was easy to understand.</td>
<td>5.00 (4.00–5.00)</td>
</tr>
<tr>
<td>I feel safe wearing the Biosticker.</td>
<td>5.00 (4.00–5.00)</td>
</tr>
<tr>
<td>I feel comfortable getting it wet when having a shower, etc.</td>
<td>5.00 (4.00–5.00)</td>
</tr>
<tr>
<td>Wearing the sticker gives me reassurance that someone is monitoring my health while I’m at home with COVID.</td>
<td>5.00 (4.00–5.00)</td>
</tr>
<tr>
<td>The sticker is comfortable to wear.</td>
<td>5.00 (4.00–5.00)</td>
</tr>
<tr>
<td>My whānau (family) are happy about me being monitored at home.</td>
<td>5.00 (4.00–5.00)</td>
</tr>
<tr>
<td>The number of calls I receive each day is appropriate.</td>
<td>5.00 (4.00–5.00)</td>
</tr>
<tr>
<td>The calls I receive each day are helpful.</td>
<td>5.00 (4.00–5.00)</td>
</tr>
<tr>
<td>I feel comfortable to ask any questions I may have during the calls.</td>
<td>5.00 (4.00–5.00)</td>
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</tbody>
</table>

**Appendix 6 – Facilitated Survey Yes/ No responses (n = 75).**

<table>
<thead>
<tr>
<th>Question (Yes-No)</th>
<th>Yes (%)</th>
<th>No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Were you given a Smartphone to use as part of this trial?</td>
<td>96.1</td>
<td>3.9</td>
</tr>
<tr>
<td>Did you receive a brochure/information about the BioSticker?</td>
<td>98.6</td>
<td>1.4</td>
</tr>
<tr>
<td>Did you need any help putting the sticker on?</td>
<td>47.9</td>
<td>52.1</td>
</tr>
<tr>
<td>Have you had any reactions to the BioSticker? For example, a skin rash.</td>
<td>15.1</td>
<td>84.9</td>
</tr>
<tr>
<td>Do you have any cultural concerns about having the Biosticker on your body?</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Do you or your whānau (family) have any concerns about having the BioSticker on your body?</td>
<td>2.7</td>
<td>97.3</td>
</tr>
<tr>
<td>Do you have any privacy concerns about the sticker?</td>
<td>0</td>
<td>100</td>
</tr>
</tbody>
</table>

**Appendix 7 – Demographic characteristics of patients and staff who took part in Semi Structured Interviews (n=18).**

<table>
<thead>
<tr>
<th>Semi Structured Interview</th>
<th>Patients</th>
<th>Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Male</td>
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<td>1</td>
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<tr>
<td>Ethnic Group</td>
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<td></td>
</tr>
<tr>
<td>Māori (MP)</td>
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<td>1</td>
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<tr>
<td>Pacific (PP)</td>
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<tr>
<td>Asian (AP)</td>
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<td>NZ European/Other (NOP)</td>
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<td>5</td>
</tr>
<tr>
<td>Role</td>
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<td></td>
</tr>
<tr>
<td>Project Team</td>
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<tr>
<td>Whānau Ora</td>
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<td>3</td>
</tr>
<tr>
<td>Hospital in the Home</td>
<td>N/A</td>
<td>4</td>
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</tbody>
</table>