An NP-led pilot telehealth programme to facilitate guideline-directed medical therapy for heart failure with reduced ejection fraction during the COVID-19 pandemic

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ABSTRACT

AIMS: Heart failure with reduced ejection fraction (HFrEF) is associated with poor outcomes. While several medications are beneficial, achieving optimal guideline-directed medical therapy (GDMT) is challenging. COVID-19 created a need to explore new ways to deliver care.

METHODS: Fifty consecutive patients were taught to identify fluid congestion and monitor their vital signs using BP monitors and electronic scales with NP-led telephone support. Quantitative data were collected and a patient experience interview was performed.

RESULTS: The majority (76%) of the cohort (male, 76%; Māori/Pacific, 58%) had a new diagnosis of HFrEF, with 90% having severe left ventricular (LV) dysfunction. There were 216 contacts (129 (60%) by telephone), which eliminated travelling, (time saved, 2.12 hours per patient), petrol costs ($58.17 per patient), traffic pollution (607 Kg of CO2) and time off work. Most (75%) received contact within two weeks and 75% were optimally titrated within two months. Improvements in systolic BP (SBP) (124mmHg to 116mmHg), pulse (78 bpm to 70 bpm) and N-terminal pro-brain natriuretic peptide (NT-proBNP) (292 to 65) were identified. Of the 43 patients who had a follow-up transthoracic echocardiogram (TTE), 33 (77%) showed important improvement in left ventricular ejection fraction (LVEF).

CONCLUSIONS: Patients found the process acceptable and experienced rapid titration with less need for clinic review with titration rates comparable with most real-world reports.

Heart failure with reduced ejection fraction (HFrEF) is increasing in prevalence[1] and is associated with inequality,[2] significant costs,[3] ill health and preventable mortality.[4] Several evidence-based interventions, including pharmacological, device and care strategies,[5] improve quality of life and survival and reduce hospitalisation.[6] However, the delivery of these treatments can be challenging, as it is impacted by system,[7] clinician[8] and patient factors.[9] To achieve the maximal benefits, pharmacotherapies must be initiated in a timely manner and titrated to maximally tolerated doses, and they often require a number of clinic appointments. In addition, careful monitoring for side effects, alongside a focus on patient empowerment, cannot be overlooked.[10] Perhaps because of this additional complexity of care, and despite a strong evidence base, guideline-directed medical therapy (GDMT) is inconsistently delivered by healthcare teams[11] and, if offered, is not always tolerable to patients.[12]

The heart failure service at Counties Manukau District Health Board (CMDHB) includes a multidisciplinary team and has a strong focus on titrating evidence-based medications to guideline-directed doses. Timely titration may be limited by a variety of factors, such as clinic volumes or barriers to patients attending clinics or filling prescriptions.

Different models of care have been attempted to improve GDMT, with multidisciplinary, HFrEF-specific clinics being effective.[13,14] Telehealth has also shown promise, particularly in patients with complex comorbidities and socioeconomic barriers to access.[15]

On the 23 March 2020, as the COVID-19 pandemic swept across the globe, Aotearoa New Zealand went into level 3 lockdown, and then a full level 4 lockdown two days later. The future of healthcare was uncertain. With a cohort of patients currently in hospital being treated for acute heart failure, normal outpatient titration of GDMT could not continue as usual. Both patients and healthcare providers, anxious about the risk of spreading the virus, limited face-to-face contact. Telephone support for titration of heart failure (HF) therapy was suggested. Although neither new nor novel,[16] it had never been attempted in our department as a method of titrating HF medications. Under lockdown, a rapid and pragmatic response was required, with early reports suggesting that the pandemic was having a significant negative impact on patients attending for care.[17] Remote management raised concerns regarding an inability to safely optimise GDMT without vital sign measurements and laboratory results.[18] A clinical care plan was developed to manage patients safely during this period.

This paper describes the feasibility of telephone support by the HF team with the use of scales and blood pressure (BP) monitoring devices to augment decision-making.

Methods

Using the latest decision pathway for optimisation of heart failure treatment,[6] our aims were to facilitate titration while limiting in-person clinic visits by using patient self-monitoring with a package that included funded home BP monitors and electronic scales alongside nurse practitioner (NP)-led telephone support for patients with HFrEF.

The goal was to titrate medications safely with a target of two weeks between enrolment and first contact and two weeks between medication changes. This had to be achieved within the existing workflow and be acceptable for patients. Pragmatic criteria were developed to identify patients who had a clinical indication for titration and would be able to engage with this approach.

Patients were identified during an acute HF admission by the cardiology team and asked to participate if they met the inclusion criteria. A commitment to engage with the home monitoring system was agreed by the patient and the HF team.

Inclusion criteria:

- Patients willing to participate with symptomatic HFrEF (left ventricular ejection fraction (LVEF) <40%) and requiring titration
- Ability to collect prescriptions from a community pharmacy and have blood tests collected every two weeks
- Patients who can understand instructions in English
- Arm diameter between 22cm and 42cm
- Weight <200kg

Exclusion criteria:

- Chronic kidney disease (CKD; eGFR <30 ml/min/1.73m^2)
- Hyperkalaemia (K+ >5.4mmol/l)
- Hypotension (SBP <90mmhg)
- More than first degree heart block with no pacemaker
- Severe aortic stenosis
- End stage heart failure and not for active titration
- Atrial or Ventricular arrhythmia that could interfere with the accuracy of the BP and HR monitor

The team introduced the process and discussed the need for frequent dose adjustments and blood tests following dose adjustments. Self-help material included 'How has your breathing been in the last 2–3 days' (a visual scale) and the book *Living Well with Heart Failur*e (available

from www.heartfoundation.org.nz), which facilitates monitoring symptoms and vital signs. A HF action plan and guidance for daily checks looking for signs and symptoms of decompensated HF was introduced. The blood pressure monitors (Omron HEM-RML31) and electronic scales (capacity 200kg) were given to each patient following a practical demonstration.

A booked fortnightly telephone call from the NP or clinical nurse specialist (CNS) was agreed. Clinical support and guidance were available from a consultant cardiologist. The first New Zealand lockdown was coming to an end by the time we started; but contact was still uncertain because patients preferred not to come to outpatient reviews, and health teams were still being advised to maintain virtual reviews, where possible. However, we relaxed the non-contact rule, and a face-to-face option was made available if required. Each patient, where possible, met the HF team member who would support them at the beginning of the trial. Some patients preferred email contact and text, although telephone support was the most common way of communicating.

Up-titration was facilitated by a new electronic ePrescription and eLabform process that had been fast tracked into clinical use.

Data was statistically analysed using excel and a QI Macro with support from the statistics team from Ko Awatea, CMDHB's centre for health innovation and improvement. For each hypothesis test, we set an alpha value of 0.05 and used a paired t-test to compare the variables before and after the trial participation, after having verified that the difference between pairs were normally distributed.

Quantitative data was collected in a secure database, and a patient experience telephone interview was conducted by Ko Awatea, independently of the cardiology team.

Patient symptoms, clinical findings and any change in the HF plan were notified in real time using a secure, electronic template that communicated directly to the designated primary care provider.

The accessibility benefits to the patient from the virtual consultation was calculated based on distance travelled from the patient's home address to the outpatient department (Google Maps was used to calculate distance). Standard car petrol usage was used to calculate petrol costs. The travel time was based on off peak traffic volumes to calculate a conservative estimate of time saved.

Data collected include:

- Baseline
  - Demographics
  - Vital signs and weight
  - NT-proBNP, renal function and electrolytes
  - Date of HF recent hospitalisation
  - Transthoracic echocardiogram (TTE) assessment of LVEF
  - Baseline medication use/doses
- Follow-up
  - Number of contacts
  - Time to contact
  - Time to maximal tolerated GDMT
  - Reason for variation in titration
  - Hospitalisations/deaths
  - Change in clinical parameters

Results

Between 7 March and 5 August 2020, 52 patients were enrolled with HFrEF and agreed to take part in the trial. Two patients accepted but died before any outpatient contact was initiated and were excluded, leaving 50 patients in the cohort for analysis.

Support for medication concordance, alcohol harm reduction and smoking cessation support was offered to all.

Table 1: Demographics.

	Total =50 (%)
Male	38 (76%)
Mean age (all) Female Male	58.9 years 65.1 years 56.9 years
Māori	12 (24%)
Pacific Islanders	17 (34%)
Others	21 (42%)

Compared to the population of CMDHB: Māori 16%, Pacific 34% and others 63%.[19]

Each participant had an assessment of their left ventricular ejection fraction (LVEF) either at the time of hospital admission or prior to clinic referral. Almost all (90%) were classified as having severe left ventricular dysfunction (LVEF <30%),[4] with 48 (96%) reporting being symptomatic, New York Heart Association (NYHA) class 2 or above. This is a high-risk cohort of patients with significant HFrEF with a prognosis worse than most cancers.[20]

Time to first contact

The time to contact was consistent, with low standard variation (5 days over a mean of 10.8 days): 50% were contacted within 9 days, 75% contacted within 14 days and all were contacted by 28 days.

The majority (60%) of enrolled patients had been in hospital within the last six months with a primary diagnosis of decompensated HF: 50% of patients were enrolled within two months from their most recent hospitalisation and 75% within four months.

Table 2: Baseline characteristics.

	Total=50, (%)
New diagnosis of HFrEF	38 (76%)
History of CVD	21 (42%)
Hypertension	34 (68%)
Atrial fibrillation/ flutter	12 (24%)
Obstructive sleep apnoea	6 (12%)
Type 2 diabetes	22 (44%)
HbA1c (mmol/l)	Mean 64 (range 43–100)
Body mass index (kg/m2)	Mean 32 (range 18–59)
CKD (eGFR <50 ml/ min/1.73m^2)	11 (22%)
Implantable defibrillator (ICD) in situ	4 (8%)
Reported non-concordance	8 (16%)
Current smoking	10 (20%)
Harmful alcohol use	8 (16%)

Table 3: Baseline left ventricular ejection function.

LVEF	**N =50 (%)**
Less than 20%	23 (46%)
21–30%	22 (44%)
31–35%	5 (10%)

The virtual consultation effect

During the period of the trial, 216 contacts were made: 129 (60%) by telephone and 87 (40%) face to face.

By eliminating the need to travel to the outpatient department, we estimated each patient saved on average 2.12 hours and travelled 73.6 fewer kilometres. This equates to savings in travel costs of $2,908 during the pilot, or $58.17 per patient. Total CO_2 emissions were reduced by 607 Kg, which would have required 27.9 medium-sized trees to absorb this amount within one year.

GDMT summary

Within two months of entering the trial (56 days), 75% of patients were deemed to be optimally titrated, with 88% achieving ≥50% of target dose of renin angiotensin blocker, 74% achieving ≥50% of target dose of beta blocker and 62% being on spironolactone (MRA).

The use of Entresto (ARNI), a novel neprisylin inhibitor/angiotensin receptor blocker agent, increased from 12% to 40% and diuretic use fell from 46% to 26%.

Reasons for variation in GDMT

Over one third (17 (38%)) of patients were up titrated in a step-like fashion with regular monitoring and tolerated the process uneventfully. A resting heart rate consistently less than 60bpm limited titration in 11 patients (22%). A resting systolic blood pressure less than 90mmhg or symptomatic hypotension limited titration in nine (18%), and a further four (8%) developed significant hyperkalaemia or a deterioration in eGFR, requiring stopping or reducing the dose of GDMT. Two patients (4%) had significant comorbidity related to cancer therapy, which delayed contact due to frequent hospitalisations. Despite multiple attempts, five (10%) patients were either unable to be consistently contacted or declined to optimise any therapy. Cardiology outpatient clinic non-attendance rates are approximately 20%.

HF outcomes

With a mean of 203 days (range 140–264 days) follow-up, there were no deaths during the course of the pilot.

Twenty-five admissions in 19 patients (38%) were recorded with four admissions (8%) related to HF.

Clinical outcomes

During the evaluation there were significant reductions in systolic blood pressure (p. 0.004), heart rate (p. 0.002) and NT-proBNP (p. 0.001) (Figure 1). Other indicators, such as eGFR, serum potassium and NYHA class, showed no significant changes (p. 0.2).

Assessment of LVEF

Forty-three patients (86%) received a follow-up TTE after titration to maximum tolerated GDMT.

Ten patients (20%) had continued severe left ventricular (LV) dysfunction and were referred back into the HF clinic for device therapy or further GDMT optimisation. Thirty-three patients (66%) showed improved LV function with 10 (20%) moving from severe LVEF <30% to moderate LVEF >35% and 23 (46%) improving to mild dysfunction, defined as LVEF >40% (p 0.0001).

Table 4: Cause of heart failure.

Cardiomyopathy	N=50 (%)
Ischaemic	14 (28%)
Non-ischaemic	36 (72%)
Dilated (not further defined)	17 (34%)
Accelerated heart rate	9 (18%)
Alcohol	4 (8%)
Valvular	3 (6%)
Anthracycline	2 (4%)
Sarcoid	1 (2%)

Table 5: Optimal tolerated titration dose of GDMT.

	ACE/ARB/ ARNI	Beta blocker	MRA
Target	28 (56%)	16 (32%)	24 (48%)
50–99% of target dose	16 (34%)	21 (42%)	7 (14%)
Low/ none	6 (12%)	13 (26%)	19 (38%)

Patient experience

Fourteen patients consented to a telephone interview: half female, half male, four Māori, four Pacific, five Pākehā and one Asian (Appendix Figure 1). The majority of patients expressed confidence in using and reading the BP monitor from home. Patients reported feeling empowered and having increased motivation to manage their health conditions since participating in the trial. Patient experience with clinicians was positive, with the majority describing appreciation for the interaction and rapport. They expressed an understanding of the changes to their medication and felt that the alterations were beneficial to their health. The booklet provided by the service facilitated patients' understanding and acceptance of changes to medication. There were a few patients who specifically needed more support, including a better understanding of the detail of what they needed to do, when they needed to do it and what to expect.

Discussion

In New Zealand, approximately 5,500 patients generate about 12,000 hospital admissions for HF each year. The average length of stay is five days, and the overall costs associated with HF account for 1.5–2% of the total health budget, most of which is for inpatient care.[3] It is estimated that approximately 20% of the population will develop HF in their lifetime, which places a significant burden on individuals, communities and health services.[21] Having skilled teams provide gold-standard and individualised HF assessment and management is vital work, but many patients remain underserved.[22] During the COVID-19 pandemic, this became even more challenging, and the HF team introduced an inexpensive, home-based approach to heart failure care. We achieved rates of timely GDMT optimisation—at least as good as many contemporary clinical studies—and we managed to do this within existing workloads and good engagement from most patients.[23]

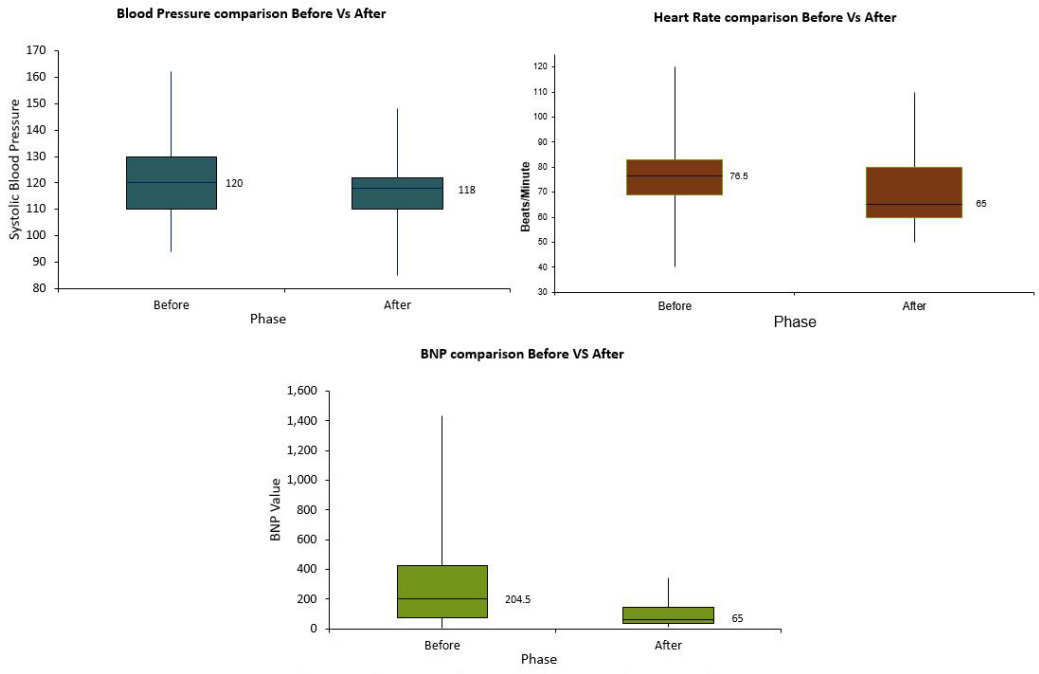
It is projected that the number of people with heart failure will increase as people live longer and can access more effective treatments for coronary heart disease associated with a reduction in mortality.[24] Inequality persists, with the mortality rate from heart failure for male and female Māori aged over 65 years being significantly higher than for non-Māori. Rates of hospitalisation for heart failure among Māori in this age group are also significantly higher than for non-Māori. Māori are significantly younger on admission to hospital for heart failure than New Zealand Europeans (62 years compared to 78 years). Morbidity and mortality from heart failure for Pacific peoples is approximately twice as high compared to the total population.[25] Over half (58%) of our pilot group were Māori or Pacific and we were able to show active engagement and equitable outcomes compared to the non-Māori or non-Pacific participants.

A recent New Zealand-wide cohort study of patients with acute coronary syndrome (ACS) showed that rates of GDMT in those with reduced LVEF was low at one year post discharge—only 34% and 35% received ≥50% target doses of ACEi/ARB and beta-blockers respectively.[26] Suboptimal use of GDMT therefore persists despite its association with improved patient mortality and reduced heart failure hospitalisations.[6]

Technological advances have allowed increasingly sophisticated methods to remotely monitor and manage heart failure. Simple telephone-based remote assessments, stand-alone home-based systems, implanted devices with advanced haemodynamic monitoring features and now wearable technologies have opened up a range of opportunities to facilitate patient management.[27] It is relatively easy to collect data remotely, but it has been a challenge to find a way to integrate continuous data streams into already overloaded systems of care, and to convert remote data into better decision-making that improves the outcome or experience of care.[28,29]

Both structured telephone support and telemonitoring have been reported as being effective in reducing all-cause mortality and heart failure related hospitalisations, as well as improving quality of life, reducing healthcare costs and enhancing GDMT.[30] A positive effect was noted using telehealth to monitor heart failure patients in a home environment, with patients showing an increased self-awareness around managing their condition[31] and increased empowerment and confidence.[32] Essential characteristics of effective telehealth include clinical feedback in the form of 'teachable

Figure 1: Comparison between BP, HR and BNP at baseline compared to follow-up.



NZMJ 9 July 2021, Vol 134 No 1538
ISSN 1175-8716
www.nzma.org.nz/journal

moments', a system which is easy and quick to use and patients perceiving tangible benefits from the system.[33]

Interviews suggest that telehealth is generally acceptable to most patients, including Māori and their whānau.[34] Despite this, there is a high rate of telehealth refusal among patients, which is not well understood.[35] The perception for many, particularly older and less tech-aware people, is that telehealth is remote, cold and distant, and many people prefer a more personal touch from their healthcare provider.[36] However, we did not find this to be a significant issue, perhaps as the COVID-19 environment increased acceptability of alternative models of care.

The benefits of telemonitoring are dependent on a number of factors. Researchers have not consistently shown positive outcomes, which has led commentators to criticise speed of uptake and implementation.[37] Increased costs and clinical workloads have also been reported.[33] It is possible the benefits seen in telemonitoring trials could be due to enhancement of the underpinning clinical service rather than the telemonitoring communication itself.[38]

Because of increased communication with patients, which often occurs outside of formally booked clinic times, the CMDHB pilot resulted in additional workload for the clinicians. This was offset by fewer face-to-face appointments during and immediately after lockdown. This additional workload will likely be unsustainable when face-to-face clinics are again running to full capacity. Additional staff and monitoring device resources will be required for a sustainable programme. The patients accepted the process and appreciated the efforts of the HF team to reassure and support them through these challenging times.

Limitations

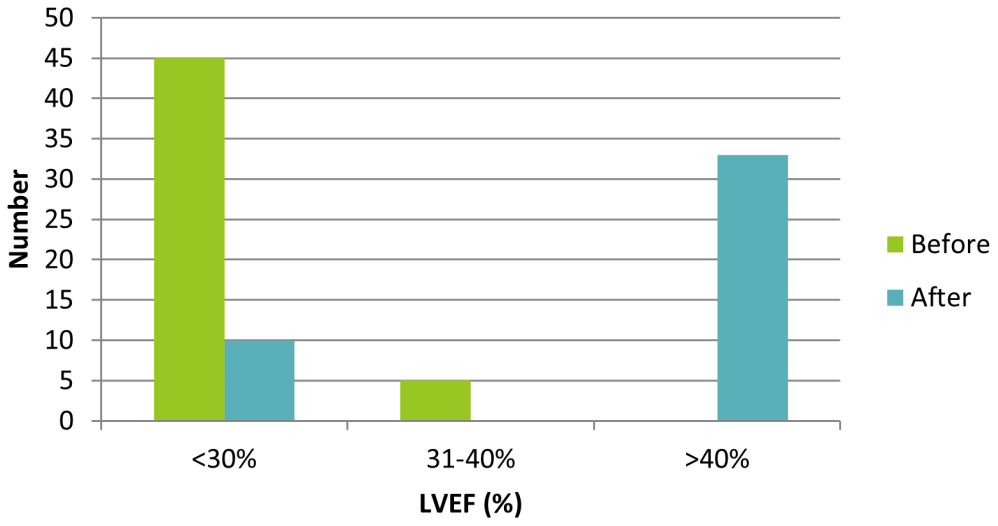
This was a small feasibility pilot project, delivered rapidly and in very uncertain times by an enthusiastic team of HF focused clinicians. The patients were a selected cohort and may not represent the entire HF cohort.

The strengths of this report are the inclusion of participants representative of our HF cohort and the wider community. We performed telephone interviews to understand the patient experience and a further follow-up telephone interview is planned.

The exclusion of non-English speaking participants impacted on our ability to provide an equitable service, and we have since explored the use of interpreters using three-way telephone conversations. The majority of patients were able to be contacted, although access to mobile phones was inconsistent for some and did limit engagement.

Further research is needed to understand the components of this observational

Figure 2: LVEF at baseline compared to follow-up.



study that can be used as an adjunct to good quality heart failure care.

Conclusion

For most patients, the home monitoring/telephone process resulted in rapid titration and less need for clinic review. Patients found the process acceptable and 60% of clinic visits were able to be held remotely, saving patients both time and money. Titration rates and markers of improved outcomes improved across cardiac imaging, biochemical and clinical findings, and were comparable to most real-world clinical reports. Although this is not a novel or innovative process, it is not usual care in New Zealand. This simple and straightforward process could be replicated across DHBs.

ISSN 1175-8716

Appendix

Appendix Figure 1: Patient experience questionnaire page one. View the complete Appendix Figure 1.

Blood pressure monitoring questions for telephone interviews

Proposed telephone interviews with patients at approximately day three (to identify immediate concerns) and follow-up interviews at the date that drop outs tend to occur

Patient details

Anonymised Name: Age: Suburb you live in: Ethnic group/s: Zoom or Telephone Interview: Contact Number: Zoom Link: Availability for interview (Fill in details below) Date: Time:

Elevator pitch

Hello/Kia ora/Talofa/ Malo e lelei/ Namaste/ Ni hao/ Fakaa alofa lahi atu my name is… from Counties Manukau Health. I am calling to see how you are finding doing your own blood pressure and weight checks from home? Are you happy to speak with me in an interview about how it is going?

- **No…** is there another time that would be better for me to call you?
- **No…** ok thank you for your time, take care and stay safe, goodbye.
- **Yes…** ok thank you… Are you available for 20 minutes now or would you like me to call you back?

Thank you, we will continue.

For the first time we are helping patients to check their own blood pressure and weight from home, while also making sure that you are safe and your health is not getting worse. Our patients' feelings are important to us, so we need to make sure we support you as best we can, this interview will help us to do this. We would like to know your thoughts about checking your own blood pressure and weight changes from home and have some questions we would like to ask you. Your thoughts will also help us to understand what is going well, and not so well and how it may work better.

We are asking patients to take part in telephone interviews lasting around 20 minutes of your time.

We will not be audio recording our conversation, but will write notes as we are speaking. The information you share with us will be confidential and no one involved in your care will know that you have spoken with us. All information you provide is confidential and will not include your name or other personal details that identify you in any of our reports.

Competing interests:
Dr Lund reports other from Amgen inc and personal fees from Novartis outside the submitted work.
Acknowledgements:
Te Hao Apaapa-Timu-Programme Manager Co-design, Ko Awatea.
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www.nzma.org.nz/journal-articles/an-np-led-pilot-telehealth-programme-to-facilitate-guideline-directed-medical-therapy-for-heart-failure-with-reduced-ejection-fraction-during-the--covid-19-pandemic-open-access

REFERENCES

1. Savarese G, Lund LH. Global Public Health Burden of Heart Failure. *Card Fail Rev*. 2017. doi:10.15420/cfr.2016:25:2
2. Inkrot S. Comparison of New Zealand European vs New Zealand maori patients with acute heart failure: The New Zealand heart failure registry. *Eur J Cardiovasc Nurs*. 2014.
3. Braunschweig F, Cowie MR, Auricchio A. What are the costs of heart failure? *Europace*. 2011. doi:10.1093/europace/eur081
4. CSANZ Heart Failure Guidelines Working Group N, Atherton MBBS JJ, Sindone BMed A, et al. National Heart Foundation of Australia and Cardiac Society of Australia and New Zealand: Guidelines for the Prevention, Detection, and Management of Heart Failure in Australia 2018 Contents. *Hear Lung Circ*. 2018;27:1123-1208. doi:10.1016/j.hlc.2018.06.1042
5. Hauptman PJ, Rich MW, Heidenreich PA, et al. The Heart Failure Clinic: A Consensus Statement of the Heart Failure Society of America. *J Card Fail*. 2008. doi:10.1016/j.cardfail.2008.10.005
6. Maddox TM, Januzzi JL, Allen LA, et al. 2021 Update to the 2017 ACC Expert Consensus Decision Pathway for Optimization of Heart Failure Treatment: Answers to 10 Pivotal Issues About Heart Failure With Reduced Ejection Fraction. *J Am Coll Cardiol*. 2021. doi:10.1016/j.jacc.2020.11.022
7. Driscoll A, Meagher S, Kennedy R, et al. What is the impact of systems of care for heart failure on patients diagnosed with heart failure: A systematic review. *BMC Cardiovasc Disord*. 2016. doi:10.1186/s12872-016-0371-7
8. Jarjour M, Henri C, de Denus S, et al. Care Gaps in Adherence to Heart Failure Guidelines: Clinical Inertia or Physiological Limitations? *JACC Hear Fail*. 2020. doi:10.1016/j.jchf.2020.04.019
9. Fiuzat M, Ezekowitz J, Alemayehu W, et al. Assessment of Limitations to Optimization of Guideline-Directed Medical Therapy in Heart Failure from the GUIDE-IT Trial: A Secondary Analysis of a Randomized Clinical Trial. *JAMA Cardiol*. 2020. doi:10.1001/jamacardio.2020.0640
10. Yancy CW, Januzzi JL, Allen LA, et al. 2017 ACC Expert Consensus Decision Pathway for Optimization of Heart Failure Treatment: Answers to 10 Pivotal Issues About Heart Failure With Reduced Ejection Fraction. *J Am Coll Cardiol*. 2018. doi:10.1016/j.jacc.2017.11.025
11. Shanbhag D, Graham ID, Harlos K, et al. Effectiveness of implementation interventions in improving physician adherence to guideline recommendations in heart failure: A systematic review. *BMJ Open*. 2018. doi:10.1136/bmjopen-2017-017765
12. Cornelio C, Palo KE Di. Guideline-Directed Medical

Therapy in Hospitalized Heart Failure Patients: Still Underprescribed Despite Updated Guidelines and Over 20 Years of Evidence. *J Card Fail*. 2018;24(8):S100. doi:10.1016/j.cardfail.2018.07.380

13. Rice H, Say R, Betihavas V. The effect of nurse-led education on hospitalisation, readmission, quality of life and cost in adults with heart failure. A systematic review. *Patient Educ Couns*. 2018;101(3):363-374. doi:https://doi.org/10.1016/j.pec.2017.10.002
14. Gandhi S, Mosleh W, Sharma UC, Demers C, Farkouh ME, Schwalm JD. Multidisciplinary Heart Failure Clinics Are Associated With Lower Heart Failure Hospitalization and Mortality: Systematic Review and Meta-analysis. *Can J Cardiol*. 2017. doi:10.1016/j.cjca.2017.05.011
15. Gorodeski EZ, Goyal P, Cox ZL, et al. Virtual Visits for Care of Patients with Heart Failure in the Era of COVID-19: A Statement from the Heart Failure Society of America. *J Card Fail*. 2020. doi:10.1016/j.cardfail.2020.04.008
16. Hannah J, Humphrey G, Doughty R, McGrinder H, Bos N, Bowman C. Telehealth in Heart Failure Management: A Proof of Principle Study. *Hear Lung Circ*. 2010. doi:10.1016/j.hlc.2010.04.028
17. Wong B, El-Jack S, Armstrong G. Pandemic control: getting to the heart of unintended consequences. *N Z Med J*. 2020.
18. Ugolini S, Mondesir FL, Maires C, et al. Virtual Outpatient Heart Failure Care - Lessons From the Covid-19 Era. *J Card Fail*. 2020. doi:10.1016/j.cardfail.2020.09.021
19. Winnard D, Lee M MG. *Demographic Profile: 2013 Census, Population of Counties Manukau.*; 2015.
20. Mamas MA, Sperrin M, Watson MC, et al. Do patients have worse outcomes in heart failure than in cancer? A primary care-based cohort study with 10-year follow-up in Scotland. *Eur J Heart Fail*. 2017. doi:10.1002/ejhf.822
21. Wall R, Bell A, Devlin G, Lawrenson R. Diagnosis and treatment of heart failure in Māori and New Zealand Europeans at the Waikato Hospital. *N Z Med J*. 2013.
22. Chan D, Doughty RN, Mazengarb J, McLachlan A, Kerr AJ. Heart failure clinics improve use of evidence-based heart failure therapies in patients with reduced ejection fraction following acute coronary syndrome (ANZACS-QI 48). *N Z Med J*. 2020;133(1516):58-71. https://www.nzma.org.nz/journal-articles/heart-failure-clinics-improve-use-of-evidence-based-heart-failure-therapies-in-patients-with-reduced-ejection-fraction-following-acute-coronary-syndrome-anzacs-qi-48. Accessed February 7, 2021.
23. Greene SJ, Butler J, Albert NM, et al. Medical Therapy for Heart Failure With Reduced Ejection Fraction: The CHAMP-HF Registry. *J Am Coll Cardiol*. 2018;72(4):351-366. doi:10.1016/j.jacc.2018.04.070
24. Sidney S, Quesenberry CP, Jaffe MG, et al. Recent trends in cardiovascular mortality in the United States and public health goals. *JAMA Cardiol*. 2016. doi:10.1001/jamacardio.2016.1326
25. Identifying patients with heart failure - BPJ Issue 50. https://bpac.org.nz/bpj/2013/february/identifying-heart-failure.aspx. Accessed February 1, 2021.
26. Chan D, Doughty RN, Lund M, Lee M, Kerr AJ. Target Doses of Secondary Prevention Medications Are Not Being Achieved in Patients With Reduced Left Ventricular Ejection Fraction After Acute Coronary Syndrome (ANZACS-QI 34). *Hear Lung Circ*. 2020. doi:10.1016/j.hlc.2020.03.013
27. Brahmbhatt DH, Cowie MR. Remote Management of Heart Failure: An Overview of Telemonitoring Technologies. *Card Fail Rev*. 2019. doi:10.15420/cfr.2019.5.3
28. Andrès E, Talha S, Zulfiqar A-A, et al. Current Research and New Perspectives of Telemedicine in Chronic Heart Failure: Narrative Review and Points of Interest for the Clinician. *J Clin Med*. 2018. doi:10.3390/jcm7120544
29. Fairbrother P, Ure J, Hanley J, et al. Telemonitoring for chronic heart failure: The views of patients and healthcare professionals - a qualitative study. *J Clin Nurs*. 2014. doi:10.1111/jocn.12137
30. Sousa C, Leite S, Lagido R, Ferreira L, Silva-Cardoso J, Maciel MJ. Telemonitoring in heart failure: A state-of-the-art review. *Rev Port Cardiol*. 2014. doi:10.1016/j.repc.2013.10.013
31. Varon C, Alao M, Minter J, et al. Telehealth on heart failure: results of the Recap project. *J Telemed Telecare*. 2015. doi:10.1177/1357633X15577310
32. Inglis SC, Clark RA, McAlister FA, Stewart S, Cleland JGF. Which components of heart failure programmes are effective? A systematic review and meta-analysis

of the outcomes of structured telephone support or telemonitoring as the primary component of chronic heart failure management in 8323 patients: Abridged Coc. *Eur J Heart Fail*. 2011. doi:10.1093/eurjhf/hfr039

33. Seto E, Leonard KJ, Cafazzo JA, Barnsley J, Masino C, Ross HJ. Perceptions and experiences of heart failure patients and clinicians on the use of mobile phone-based telemonitoring. *J Med Internet Res*. 2012. doi:10.2196/jmir.1912
34. Venter A, Burns R, Hefford M, Ehrenberg N. Results of a telehealth-enabled chronic care management service to support people with long-term conditions at home. *J Telemed Telecare*. 2012. doi:10.1258/jtt.2012.SFT112
35. Woo K, Dowding D. Factors affecting the acceptance of telehealth services by heart failure patients: An integrative review. *Telemed e-Health*. 2018. doi:10.1089/tmj.2017.0080
36. Greenhalgh T, A'Court C, Shaw S. Understanding heart failure; explaining telehealth - A hermeneutic systematic review. *BMC Cardiovasc Disord*. 2017. doi:10.1186/s12872-017-0594-2
37. Chaudhry SI, Mattera JA, Curtis JP, et al. Telemonitoring in Patients with Heart Failure. *N Engl J Med*. 2010. doi:10.1056/nejmoa1010029
38. Pinnock H, Hanley J, McCloughan L, et al. Effectiveness of telemonitoring integrated into existing clinical services on hospital admission for exacerbation of chronic obstructive pulmonary disease: Researcher blind, multicentre, randomised controlled trial. *BMJ*. 2013. doi:10.1136/bmj.f6070