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Rapid triage and transition to telehealth for heart transplant patients in the COVID-19 pandemic setting

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Abstract

Background: In the setting of the COVID-19 pandemic, a rapid uptake of telehealth services was instituted with the aim of reducing the spread of disease to vulnerable patient populations including heart transplant recipients.

Methods: Single-center, cohort study of all heart transplant patients seen by our institution's transplant program during the first 6 weeks of transition from in-person consultation to telehealth (23 March – 5 June 2020).

Results: Face-to-face consultation allocation strongly favored patients in the early post-operative period (34 vs. 242 weeks post-transplant; $p < 0.001$). Telehealth consultation dramatically reduced patient travel and wait times (80 min per visit saved in telehealth patients). No apparent excess re-hospitalization or mortality was seen in telehealth patients.

Conclusions: With appropriate triage, telehealth was feasible in heart transplant recipients, with videoconferencing being the preferred modality. Patients seen face-to-face were those triaged to be higher acuity based on time since transplant and overall clinical status. These patients have the expected higher rates of hospital re-admission, and therefore should continue to be seen in person.

Keywords

Telehealth, heart transplant, pandemic, COVID-19, telemedicine, transplantation, innovation, health technology

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Background

Coronavirus-19 infection (or COVID-19) was declared as a global pandemic on 12 March 2020. Shortly thereafter, elective surgeries and outpatient clinics were pre-emptively canceled in Australia to reduce the risk of viral transmission to patients and healthcare workers. This presented a unique problem for high-acuity medical patients, such as those who have received a solid organ transplant. In this population, quality of follow-up care has previously been linked with short and long-term graft survival as well as psychosocial wellbeing and medication compliance.[1,2] The urgent need for close monitoring of transplant recipients balanced with the strains placed on the healthcare system by COVID-19 presented a significant challenge.

Heart transplant recipients are a highly complex cohort of patients, who require lifelong follow-up by a quaternary transplant center. Unique management challenges post-surgery include graft function, infection, rejection, and immunosuppression.[3] Almost one-third of transplant recipients

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require re-admission within 30 days of discharge.[3] In addition, patients require long-term close management including diabetic surveillance and control, bone health, and monitoring for neoplasia. Management of COVID-19 itself in these patients was a further challenge in the early stages in the absence of antivirals or monoclonal antibodies such as sotrovimab. More pressing challenges include changes to the immunosuppression regime and the role of vaccination in this cohort. Transplant recipients are particularly vulnerable due to being profoundly immunosuppressed and having poorer response to vaccination, and prolonged viral shedding (up to 62 days).[4,5] Transplant patients have comorbidities that place them at higher risk of more severe outcomes from COVID-19 such as advanced age, hypertension, diabetes, and chronic renal failure.[6] Not surprisingly, heart transplant recipients who contract COVID-19 have a mortality rate as high as 12%.[6] Therefore, there is a clinical imperative to minimize in-person patient interaction where possible to avoid the risk of viral spread.

In the setting of the COVID-19 pandemic, a rapid uptake of telehealth was instituted with the aim of reducing the spread of the disease to vulnerable populations such as transplant patients.[7] Telehealth itself is defined as the remote delivery of medical care using information and communication technologies. Several guidelines now exist for the appropriate use of telehealth in cardiovascular and transplant populations.[8,9] Since the initiation of the vaccine roll-out, there remains an ongoing need for telehealth in this population due to having less of a vaccine response and a prolonged course of illness, objectively measured by cycle times. As such, it is important to understand the usage and feasibility, as well as the outcomes of a telehealth program in this population.

The aims of this study were as follows: (i) to determine the feasibility of a telehealth program in a heart transplant population; (ii) quantify the degree of travel time minimized by the adoption of telehealth, and (iii) to measure the difference in clinical outcomes including hospital admission and mortality in this population.

Methods

This was a retrospective cohort study to capture the first 6 weeks of telehealth initiation at our specialized adult heart failure and transplantation center from 23 March 2020 to 5 June 2020. The study was approved by the hospital's research and ethics committee (HREC Q07042). All patients were aged > 16 years and older. Readmissions during this 6-week period were recorded as was 12-month mortality. This time-period was chosen as we were interested in the rapid transition to adopting new clinical practices and technology. This followed the activation of an emergency response plan in Australia on the 27th of February and the WHO declaration of a global pandemic on 12 March 2020. This period captures the first 6 weeks of transitioning any patient who could be seen via telehealth modality.

Patients and clinicians were given training in the local health area virtual platform technologies, and clinic rooms were equipped with appropriate audio-visual technology. Patients and clinicians were encouraged to complete their consultation via videoconferencing wherever possible. Patients not capable of videoconferencing facilities were reviewed via a telephone call.

All patients were allocated to a treatment group by a senior transplantation cardiologist was defined as (i) having a minimum of 15 years of clinical experience; (ii) holding a subspecialty fellowship, as well as; (iii) a Doctor of Philosophy in cardiology. Six clinicians met this criterion and participated in the study (range of 3–40 subspecialty years).

Patients were allocated to either face-to-face (F2F) or telehealth consultation according to (i) time since transplant; (ii) time since discharge from the hospital, and; (iii) clinical acuity. In general, patients less than 1 year following transplant, as well as patients within 30 days post-hospital discharge for any indication were allocated F2F consultations. Clinical acuity was defined using the aforementioned time criteria, as well as any patient who had experienced a significant rejection episode or transplant-related illness (cardiovascular or otherwise) requiring hospitalization in the preceding 12 months. Any patient deemed to be requiring an in-person visit as per the criteria above was allocated to be seen F2F. Despite a state-wide patient referral base (> 801,150 km²), the proximity of the home to our quaternary referral center was not considered as part of the treatment allocation design.

All in-person visits were kept to an absolute minimum duration to avoid the risk of exposure to COVID-19. For F2F visits, all nursing staff and clinicians wore eye protection and an N95 mask. All other patients determined to be suitable for telehealth consultation were allocated as such.

Rejection and graft surveillance. The standard rejection monitoring protocol of our institution was continued during this period. This includes weekly endomyocardial biopsies and Luminex screens for viral and antibody-mediated rejection, for the first month, then fortnightly out to 3 months. Patients are then on a monthly biopsy regime, however, if patients had reached the three-month mark and where stable, further biopsy was delayed.

Any non-urgent echocardiogram or routine echocardiogram was delayed. Echocardiograms were only ordered based on a clinical indication such as suspicion of pericardial effusion at a F2F appointment.

Telehealth protocol. Any patients seen via telehealth were asked to have blood tests conducted at peripheral laboratories close to their place of residence capable of doing immunosuppression levels. They were asked to complete these blood tests 3–7 days prior to their telehealth appointment. If a patient required medication scripts from their telehealth appointment these were sent to them in the mail via the transplant coordinators with a follow-up phone call to ensure they were received. If a patient was seen by a transplant physician who required additional specialist involvement such as transplant endocrinology, this was arranged via a subsequent telehealth appointment.

COVID treatment protocol. Any transplant patient that contracted COVID was reviewed by the dedicated COVID team via telehealth in the first instance. The hospital rapidly set up a home monitoring system and patients were kept at home where possible. Based on clinical status, unwell patients were admitted to the hospital for ongoing care.

Qualitative interview scores. All patients completed one simple, validated qualitative interview score within 24 h of their appointment.

Statistics. All statistics were calculated using the standard statistical package SPSS version 28 (IBM Corporation, Armonk, New York). Normality was calculated using the Shapiro-Wilks tests. Continuous data is presented as either mean (standard deviation) or median (interquartile range). A Chi-squared test was used to calculate differences in categorical variables whereas the Kruskal-Wallis test was used to calculate differences between groups of continuous variables.

Results

Baseline characteristics

There was no significant difference in the age or sex of patients between F2F and telehealth groups (Table 1). As expected, there was a significant difference in time from transplant to first clinic review ($p < 0.001$), as this was a core component of treatment group allocation.

Uptake of telehealth

Proportion of telehealth sessions completed. Patients were seen either F2F or via telehealth by their regular transplant team. This team consisted of six specialist transplant cardiologists, one fellow, and two registrars all trained in transplant medicine.

Table 1. Baseline characteristics.

	Face-to-face	Telehealth	*p*-value
Age, years	58 ± 11	58 ± 13	*p* = N/S
Sex, male or female	M = 32 F = 11	M = 108 F = 39	*p* = N/S
Median time from transplant to first review, weeks	34 (IQR 6–153)	232 (IQR 101–626)	***p* < 0.001**

F: female; IQR: inter quartile range; M: male.

Time spent traveling. No significant difference in metropolitan versus regional patient referral distribution was observed between the two groups. The average distance from the patient home to the transplant center was 67 ± 81 km across the cohort (F2F 88 ± 99 km vs. telehealth 66 ± 80 km; $p = 0.56$). In the F2F group, there were 64 visits where data was available. In this group, patients spent a cumulative total of 5290 (± 81) minutes traveling, or 82.7 min per visit. In the telehealth group, patients saved a cumulative total of 17330 (± 81) minutes traveling over 217 visits, or 79.86 min per visit. This did not include time spent waiting to see the doctor or to undergo additional investigations.

Telehealth parameters. Patients who presented F2F were more likely to have observations, blood tests, and weight available ($p < 0.01$). Patients who presented F2F were more likely to have a medication list available ($p < 0.01$). In each parameter, patients were more likely to have information available if they were seen via videoconference compared with a phone call, however, this only reached statistical significance in terms of blood tests available ($p = 0.048$).

Follow-up. Seventy-eight of the 87 patients who had F2F visits, were asked to follow-up via the same method. There was a significant difference between F2F as the requested follow-up and the two modes of telehealth. Between the two telehealth groups, a higher proportion of phone call patients had F2F follow-up requested (40/129) compared to videoconference patients (14/100), $p = 0.003$ (Table 2).

Clinical outcomes. At the 3-month time point, there were eight of 87 adverse events in the F2F group, four of 128 adverse events in the phone call group, and zero of 100 adverse events in the teleconference group. The adverse events are listed in Table 3. Adverse events included rejection requiring admission for pulse IV methyl prednisone and infections.

Over a 12-month period, there were five deaths in the cohort, two in the F2F group, and three in the telehealth group. Using a Mann-Whitney *U*-test, there was no significant difference in the time to death between the first clinic visit and death between the two groups. The time to death was 26.5 weeks ± 29.0 in the F2F group and 48.3 weeks ± 44.3 ($p = 0.8$) in the telehealth group.

There were a total of six cardiovascular admissions, and two non-cardiovascular admissions over the first 6 weeks after telehealth were instituted. Patients who were seen F2F had a higher cardiovascular-related hospital readmission rate, which was consistent with their triaged level of acuity and time since transplant.

Patient and clinician user experience. This was measured via a qualitative interview score (see Appendix 1 for details). Patients had less satisfaction with their consultation (as evidenced in a higher median qualitative interview score) in Phone group 2 (IQR 1-2), compared to F2F 1 (IQR 1-2)

Table 2. Telehealth parameters.

Group	Face-to-face	Phone call	Videoconference	p-value
Observations available	95%	40%	44%	$\mathbf{p < 0.01}$
Blood	97%	69%	81%	$\mathbf{p < 0.01}$
Weight	95%	37%	55%	$\mathbf{p < 0.01}$
Medication list	98%	78%	85%	$\mathbf{p < 0.01}$

Table 3. Six-week cardiovascular and non-cardiovascular hospital admissions.

Group	Face-to-face	Phone call	Videoconference	p-value
CVS hospital admissions	4	2	0	$p = 0.025$
Non-CVS hospital admissions	0	1	1	$p = 1.000$
Total hospital admissions	4	3	1	$p = 1.000$

CVS: cardiovascular.

and Teleconference group 1 (IQR 1-1), $p < 0.01$. There was no difference between the F2F and teleconference groups.

Discussion

The overall findings of our study were as follows: (i) F2F consultation allocation strongly favored patients in the early post-operative period; (ii) a telehealth model could be feasibly completed in patients who were outside the early post-operative period with no apparent excess re-hospitalization or mortality; (iii) telehealth consultation dramatically reduced patient travel and wait times; (iv) there remains an important role for F2F consultation in selected patient groups, and; (v) patients undergoing F2F consultation had a higher rate of hospital re-admission owing to their risk profile. The latter finding is unsurprising and in keeping with general rates of readmission in the early post-transplant period.[10,11]

In the Australian setting, where geographical isolation and distances traveled are considerable, we have shown that telehealth consultation dramatically reduced patient travel and wait times. Indeed throughout the pandemic, telehealth services have played a vital role in the emergency clinical response and have been shown to be an efficient model of minimizing risk to patients.[12] To our knowledge, no other group has previously reported on the outcomes following a rapid transition to telehealth services in an adult heart transplantation cohort during the COVID-19 pandemic. One study in a pediatric transplant population,[13] showed that telehealth improved access to care, and was associated with lower overall healthcare costs. This, however, was written in the pre-COVID-19 era, with limited discussion on safety outcomes. In this pediatric study by Chen et al., issues identified included scalability, reimbursement, and the safety monitoring of telehealth platforms. These setbacks were quickly overcome in our study by the urgency of implementing telehealth during the COVID-19 pandemic.

Telehealth services were rapidly adopted by our center, with a triage system being used to determine which patients required a F2F appointment. Patients were asked to have self-recorded weight and blood pressure, as well as their medication lists available at the time of consultation. In the TIM-HF2[14] trial, telehealth has previously been shown to be most effective when home monitoring includes weight, blood pressure, and general health status, resulting in reduced heart failure admissions and all-cause death. Overall, the implementation of our program was in line with the rapid uptake of telehealth services seen worldwide with proven safety and efficacy for patients. In a Cochrane review of telehealth utilization in a heart failure cohort,[15] telemedicine reduced all-cause mortality by approximately 20% and re-hospitalization for heart failure by 30%.

One key finding of our paper was that heart transplant patients in the telehealth group saved a total of 17,330 (± 81.03) minutes traveling over 217 visits, or 79.86 min per visit. This does not include time spent waiting to see doctors or to undergo investigations. This was particularly important during the COVID-19 pandemic as our immunosuppressed patients avoided the risk of community or nosocomial-acquired infection during travel and waiting periods. Telehealth may help establish equitable access to organ transplantation for Aboriginal and Torres Strait Islander people and those living in rural, regional, and remote areas, which has been identified as a priority area by the Transplant Society of Australia and New Zealand.

All study patients, irrespective of allocation to F2F or telehealth consultation, significantly preferred F2F contact with their treating physician—either in person or via videoconference. The phone consultation was the least preferred method. This finding very much reflects what is known in existing literature in that patients who use videoconference technology achieve better rapport with their clinicians when they can see their faces.[16] Although video conference has been shown to take longer than phone consultation, it is also known to have lower rates of medication errors.[16]

The pandemic bred uncertainty and fear amongst patients, healthcare workers, hospital managers, health departments, and politicians which became fertile ground for rapid and transformative changes to the provision of healthcare. The cardiac transplant population conventionally has requirements for close outpatient surveillance, including coronary artery vasculopathy with regular coronary assessment, bone health, and malignancy screening. Although the long-term fallout of delayed or missed in-person follow-up with targeted screening is yet to be seen, the findings of our study suggest that telehealth consultation is both feasible and safe in stable patients more than a year following cardiac transplantation. A prospective study of F2F versus telehealth consultation in stable cardiac transplantation patients is warranted.

There are certain limitations to this study. Firstly, this was a retrospective study by design. Although two different groups were analyzed—one via F2F and the other via phone call or telehealth consultation, a comparison of clinical outcomes in early and late transplant recipients using F2F or telehealth modalities was not performed. While the study design was out of necessity due to the COVID-19 pandemic, we acknowledge the inherent selection bias within the two treatment groups. Nevertheless, this study challenges what was previously considered to be the standard of care for outpatient cardiac transplantation follow-up.

There are many slated future directions for telehealth use in conjunction with hemodynamic and biomarker parameters.[17–19] For example, the CardioMEMS device, though not currently used in the transplant population, is a way of measuring invasive pulmonary artery pressures in the community and could be used in conjunction with other patient parameters such as dry weight to adjust diuretic therapy.[20] In cardiac transplantation, cell-free DNA may reduce the requirement for invasive rejection monitoring[21] and has been used during the pandemic to minimize in-person visits.[22] In short, telehealth has the potential to reduce overall healthcare costs as well as reduce overall patient risk and can safely be incorporated into standard practice for selected patient populations.[23,24]

Conclusions

Telehealth is an important model for monitoring heart transplant patients who are not in the early postoperative period. Telehealth consultation in selected patient populations does not result in excess re-hospitalization or mortality. With appropriate triage, telehealth was safe and feasible at our center with videoconferencing being the preferred modality.

Declaration of conflicting interests

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Appendix 1

Patient satisfaction questionnaire

Please rank from 1 to 4, with 1 being the highest level of satisfaction.

1. My needs were met in full and the appointment was of benefit to me
2. Most of my needs were met and the appointment was mostly of benefit to me
3. My needs were partially met and the appointment was of partial benefit to me
4. My minimum needs were met and the appointment was of minimal benefit to me