ORIGINAL ARTICLE

The Impact of the SARS-CoV-2 Virus (COVID-19) Pandemic and the Rapid Adoption of Telehealth for Cardiac Rehabilitation and Secondary Prevention Programs in Rural and Remote Australia: A Multi-Method Study

Stephanie Champion, PhD [a], Robyn A. Clark, PhD [a], Rosy Tirimacco, BSc [b], Philip Tideman, MD [b], Lemlem Gebremichael, PhD [a], Alline Beleigoli, MD, PhD [a,*]

[a]Caring Futures Institute, College of Nursing and Health Sciences, Flinders University, Adelaide, SA, Australia
[b]Integrated Cardiovascular Clinical Network SA, Rural and Remote Support Services, SA Department of Health, Adelaide, SA, Australia

Introduction   Centre-based cardiac rehabilitation (CR) programs were disrupted and urged to adopt telehealth modes of delivery during the COVID-19 public health emergency. Previously established telehealth services may have faced increased demand. This study aimed to investigate a) the impact of the COVID-19 pandemic on CR attendance/completion, b) clinical outcomes of patients with cardiovascular (CV) diseases referred to CR and, c) how regional and rural centre-based services converted to a telehealth delivery during this time.

Methods   A cohort of patients living in regional and rural Australia, referred to an established telehealth-based or centre-based CR services during COVID-19 first wave, were prospectively followed-up, for ≥90 days (February to June 2020). Cardiac rehabilitation attendance/completion and a composite of CV re-admissions and deaths were compared to a historical control group referred in the same period in 2019. The impact of mode of delivery (established telehealth service versus centre-based CR) was analysed through a competitive risk model. The adaption of centre-based CR services to telehealth was assessed via a cross-sectional survey.

Results   1,954 patients (1,032 referred during COVID-19 and 922 pre-COVID-19) were followed-up for 161 (interquartile range 123–202) days. Mean age was 68 (standard deviation 13) years and 68% were male. Referrals to the established telehealth program did not differ during (24%) and pre-COVID-19 (23%). Although all 10 centre-based services surveyed adopted telehealth, attendance (46.6% vs 59.9%; p<0.001) and completion (42.4% vs 75.4%; p<0.001) was significantly lower during COVID-19. Referral during vs pre-COVID-19 (sub hazard ratio [SHR] 0.77; 95% CI 0.68–0.87), and to a centre-based program compared to the established telehealth service (SHR 0.66; 95% CI 0.58–0.76) decreased the likelihood of CR uptake.

*Corresponding author at: GPO Box 210, 5001, Adelaide, SA, Australia; Email: Alline.beleigoli@flinders.edu.au; Twitter: @bel_alline

Discussion	An established telehealth service and rapid adoption of telehealth by centre-based programs enabled access to CR in regional and rural Australia during COVID-19. However, further development of the newly implemented telehealth models is needed to promote CR attendance and completion.
Keywords	Cardiac rehabilitation • Telehealth • COVID-19 • Rural health

Introduction

Cardiac rehabilitation (CR) is a comprehensive cardiovascular secondary prevention program that includes exercise/physical activity, diet/nutrition and counselling, education, risk factor modification, and psychosocial support [1]. Clinical guidelines recommend CR to all patients with acute coronary syndrome, coronary revascularisation, chronic heart failure, symptomatic angina, arrhythmias, heart valve surgery, and cardiac transplantation [1–3]. Despite high levels of evidence supporting the impact of CR on cardiovascular-related mortality [4], re-hospitalisation [5], cost-effectiveness [6] and quality of life improvement [7], international and national statistics for the past 20 years report that only 20–50% of eligible patients attend [8,9].

Traditionally, CR is delivered by multidisciplinary teams in specialised centres ("centre-based") in hospitals or community clinics via face-to-face individual or group sessions. Globally, it has been estimated that the COVID-19 public health emergency resulted in 4,400 CR programs temporarily or permanently ceasing service [10]. During the first wave of the COVID-19 pandemic in the first months of 2020, Australia had a proportionally lower number of cases and lower impact on the health system compared to most other countries [11]. However, in regional and rural areas where 30% of the Australian population live, cancellation of secondary prevention programs, patients' concerns about the health risks, and redeployment of CR staff to "more essential" roles were common in cardiovascular care [12]. This may have amplified the previously existing barriers to access to and engagement with centre-based CR programs and the poorer cardiovascular outcomes of people living in rural areas compared to those in major cities [13–16].

Home-based and telehealth (telephone, web-based or online) CR are particularly important to people living in rural and remote areas to overcome distance and access issues. These alternative modes of CR delivery, however, were only rarely implemented into practice before the pandemic despite evidence of their effectiveness being comparable to centre-based CR [17,18]. During the COVID-19 first wave, cardiology and CR societies worldwide have urged CR services to adapt rapidly to referral and service delivery models based on telehealth and digital innovations [19–23]. Internationally and in Australia, public and private payers permitted and increased reimbursement for medical and allied health telehealth visits [24]. Whether this favourable context to telehealth implementation resulted in increased adoption, engagement and improved clinical outcomes for rural patients with a clinical indication for CR is unknown.

This study aimed to investigate the impact of the COVID-19 pandemic on centre-based and telehealth CR programs in regional and rural Australia by comparing attendance/completion and clinical outcomes of patients referred to CR during the first wave of COVID-19 to a cohort of patients referred to CR prior to the pandemic. Additionally, we compared the patient attendance/completion and outcomes between the telehealth mode of delivery to centre-based programs and investigated the experiences of services during COVID-19 to understand the impact of centre-based programs' rapid adoption of telehealth modes of delivery.

Material and Methods

Study Design

A multi-design approach using a prospective cohort study was applied to compare CR utilisation and clinical outcomes of patients referred to a telehealth and centre-based CR programs before and during the COVID-19 situation in regional and rural Australia.

A cross-sectional survey design was used to collect data from regional and rural centre-based CR services on their response to the COVID-19 situation.

Setting

The study was implemented across the six regional local health networks (LHNs) in regional, rural and remote South Australia (SA) [25]. This includes 14 public CR services. Of these, 13 were centre-based and delivered in-person CR. One was a telehealth CR program established since 2011 [16].

This telehealth-based CR program involves CR specialist nurses and includes allied health professionals (pharmacist, exercise physiologist, dietitian, social worker) delivering a 7-week program via telephone with video consultation options. The program covers all CR core elements [26,27] and includes clinical assessments before and 7–12 weeks post commencement, with a follow-up at 6 and 12 months after completion. As an alternative to clinical assessments via telehealth, this model offers the opportunity of clinical assessments being completed by the general practitioner (GP) [28]. All point of care data is recorded by the clinicians in the South Australian CR clinical database (Country Access to Cardiac Health—CATCH database).

The regional and rural centre-based programs are located in hospitals (n=1) or community clinics (n=12). Before the COVID-19 pandemic, multidisciplinary teams within these programs delivered primarily in-person CR via a combination of individual appointments and group sessions. Similar

to the telehealth program, these centre-based programs comprise the CR core elements and clinical assessments [26]. The duration of the programs varied between 7–12 weeks.

Participants

Participants of the cohort study were recruited through the CATCH database, which records data on clinical visits and assessments across SA for telehealth and centre-based CR (both public and private). Eligibility criteria comprised: Adults aged ≥18 years old; residence in regional, rural and remote areas of SA as defined by postcodes; referred to CR between 1 February and 30 June 30 2020 ("during COVID-19" group). Controls were participants with similar eligibility criteria referred to CR between 1 February and 30 June 2019 ("pre-COVID-19" group).

For the cross-sectional survey, participants were clinicians coordinating centre-based and telehealth CR programs across the six LHNs from 1 February and 30 June 2020. Participants were recruited via email with a link to an online survey administered through Qualtrics (Provo, UT, USA) between 1 September and 31 December 2020.

Measures

In the cohort study, primary and secondary outcomes, exposure, and confounding variables were assessed through the CATCH database. At the time of the study, the minimum dataset in the CATCH database comprised the following process and outcomes indicators [29]: dates of referral, commencement, completion, and care transition to primary care; pre, post, 6 and 12-month assessments of cardiovascular risk factors, depression screening through Patient Health Questionnaire (PHQ) 2 and PHQ9 [30], self-reported smoking and medication adherence, and exercise capacity through 6-minute walking tests [31].

Primary outcomes: Cardiac rehabilitation referral and attendance rates among patients referred and completion rates among those who attended CR were the primary outcomes of this study. Referral was defined as a health professional assessment of a patient as clinically suitable for CR post-discharge from a cardiac hospital admission and recorded in the CATCH database. Attendance was defined as participation in ≥1 CR program session among those referred to CR. As this study recruited patients referred to CR before the publication of the Australian CR Quality Indicators (QIs), we adopted the definition traditionally used by the clinicians in South Australia and considered completion of a CR program as attendance to at least 70% of the CR sessions. In addition, we used the Australian CR QIs definition of completion (i.e., participation in at least some of the CR intervention components plus having a documented reassessment) [29].

Secondary outcomes: Secondary outcomes included waiting time and clinical outcomes. Waiting time was defined as the number of days between referral and the first attendance to CR session. Clinical outcomes were defined by a composite of all-cause death and cardiovascular-related

hospital re-admissions based on the following international codes of diseases (ICD-10): acute myocardial infarction (I21-I21.4, I21.9), hypertensive heart disease (I11.0, I11.9, I13, I13.0, I13.2, I13.9), ischaemic heart disease (I20-I25), arrhythmias (I48-I48.4, I48.9, I49.9), and/or heart failure (I50-I50.1, I50.9) [32]. In-hospital length of stay was calculated as the number of days spent in hospital in case of a re-admission.

Exposure to the COVID-19 public health emergency was defined as being referred to CR during the first wave of the COVID-19 pandemic in SA — 1 February to 30 June 2020 [33]. The same period in 2019 defined non-exposure to the COVID-19 situation (i.e., control group "pre-COVID-19").

Demographics (age, sex), reason for referral (arrhythmia management, heart failure, valve repair procedure, revascularisation procedure, coronary artery disease or other), mode of delivery (telephone versus centre-based) and the Index of Relative Socio-Economic Advantage and Disadvantage (IRSAD) were assessed as potential confounders. This index is based on socioeconomic data including income, education, and occupation, and ranks of Australian suburbs according to their relative socio-economic advantage and disadvantage in terms of access to material and social resources [34]. We grouped the IRSAD lower and upper five deciles forming two categories—most disadvantaged and most advantadged categories, respectively.

A 68-item questionnaire was developed by the investigators to examine the objectives of this study (Supplementary File 1). The questionnaire was divided into three sections that explored the impact of COVID-19 on: (1) changes in mode of delivery; (2) delivery of CR core elements; and (3) work processes, staff, and patients. The items had forced-choice and open-ended response options. Skip-logic was applied to obtain more detail where applicable.

Bias

To decrease the likelihood of selection bias, all eligible patients referred to CR over the two periods through the CATCH database were included in the study sample. It is likely that eligible patients referred to CR via alternative means, such as by their GP or self-referral, may not have been captured in this cohort.

Study Size

All patients referred to CR through the CATCH database during the study periods were recruited. All CR coordinators (n=12) working at across 13 clinic-based programs and the one telehealth service in SA were invited to participate in the survey.

Data Analysis

IBM SPSS version 27 (IBM Corp. Armonk, NY, USA) [35] and Stata 15 (StataCorp, Stata Statistical Software, College Station, TX, USA) [36] were used to conduct the analysis. Descriptive statistics were calculated for variables from the cohort study and the survey. In the cohort study, we

compared patients' characteristics and outcomes between the two groups according to the exposure to the COVID-19 situation (pre vs during COVID-19) through independent sample t-tests (two-tailed), Mann-Whitney or Chi-square tests for means, medians and frequencies, respectively. Subgroup analyses were performed according to the mode of CR delivery (telehealth vs in-person). Where patient data were missing, patients were excluded from the analysis of that variable.

Since death could be a likely event in this older population with multimorbidities and death precludes the occurrence and assessment of the primary event of interest (CR attendance/completion), a competitive risk survival analysis was performed to investigate the association between exposure to the COVID-19 situation (pre vs during COVID-19) and CR attendance/completion. The model was adjusted for adjusted for age (continuous), sex (male/female), IRSAD (most disadvantaged vs most advantaged), reason of referral to CR (arrhythmia management, heart failure, valve repair procedure, revascularisation procedure, coronary artery disease, others) and mode of CR delivery (telehealth vs centre-based). A similar model was performed to investigate the association between the composite clinical outcome (cardiovascular-related readmissions and all cause deaths) and the exposure to the COVID-19 situation. Completion of CR (yes, no) was added as a co-variable for this model.

Ethics

This project was approved by the Southern Adelaide Local Health Network Human Research Ethics Committee (OFR 153.20). A waiver of patient consent was obtained for the cohort study. Participation in the survey constituted voluntary consent to participate. Responses were confidential. To maintain the anonymity of the respondents, no personal identifiers were collected, information on the location of the service was limited to the region rather than to service name or exact location.

Results

All 1,954 patients referred to CR pre-COVID-19 (n=922) and "during COVID-19" (n=1,032) were included in the analysis. Median (interquartile range-IQR) follow-up time was 161 (IQR123–202) days. There was no difference in age, sex distribution or IRSAD score between the two groups. Coronary artery disease and revascularisation procedures were the main reasons for referral in both groups. However, the proportion of patients referred for arrythmia management was higher (20.5%) "during COVID-19" than pre-COVID-19 (15.4%; p=0.010). The study population characteristics according to the exposure to the COVID-19 situation is reported in Table 1.

CR Use and Clinical Outcomes Pre and During COVID-19

There was no difference in the proportion of patients referred to telehealth or centre-based programs across the two time periods with 23.0% (n=211) being referred to telehealth pre-COVID-19 and 24.0% (n=246) during COVID-19 (p=0.614). However, overall, CR attendance was significantly lower during COVID-19 (481; 46.6%) than pre-COVID-19 (552; 59.9%, p<0.001). Similarly, completion was significantly lower during COVID-19 (204; 42.4%) than pre-COVID-19 (416; 75.4%, p<0.001). The median waiting time for commencing a CR program was not different between the two periods (28.0; IQR 17.0–47.0 vs 28.0, IQR 19.0–40.0 days; p=0.511) and median program duration was 51 days (IQR 42–71).

In cumulative incidence competing risks analysis, being referred during COVID-19 (sub-distribution hazard ratio [SHR] 0.77; 95% CI 0.68–0.87; Figure 1) and to a centre-based service (SHR 0.66; 95% CI 0.58–0.76) decreased the chances of attending or completing CR.

Overall, there were 268 (13.7%) occurrences of the composite clinical outcome with 241 (12.3%) being cardiovascular-related rehospitalisations and 27 (1.4%) being death. Among the total hospitalisations, 113 (46.9%) occurred pre COVID-19 and 128 (53.1%) during COVID-19 (p=0.472). In regard to the outcome of death prior to readmission, 13 individuals died (48.2%) pre COVID-19 and 14 died (51.9%) during COVID-19 (p=0.991).

In cumulative incidence competing risks analysis, the occurrence of the composite clinical outcome was not associated with being referred pre or during COVID-19 (SHR 0.94; 95% CI 0.72–1.21) nor with the mode of delivery (SHR 1.31; 95% CI 0.98–1.75).

CR Use and Clinical Outcomes According to Mode of CR Delivery

Cardiac rehabilitation attendance and completion were higher for telehealth CR programs both pre and during COVID-19 compared to centre-based CR. The proportion of patients completing their CR program was lower during COVID-19, dropping from 90.8% to 73.5% for telehealth programs and from 68.1% to 25.1% for centre-based programs (p<0.001).

Clinical outcomes did not significantly differ between the two modes of delivery (Table 2).

How Centre-Based and Telehealth Programs Adapted to COVID-19: Survey Results

Of the 13 CR coordinators recruited, 10 responded to the survey (77% response rate). All respondents were nurses. There was at least one response from each of the six regional LHNs.

Centre-based services reported the COVID-19 situation had high impact on the service delivery overall with 80% reporting patients expressed concerns about exposure to COVID-19 and preferred to cancel or delay commencement of their CR program. Two-thirds (60%) of services cancelled group sessions and 100% used telehealth alone or combined with one-to-one appointments for patients at high risk. The

Table 1 Characteristics of participants referred to CR pre (February to June 2019) and during (February to June 2020) the first wave of COVID-19.

Characteristic	Total Population (n=1,954)	Pre-COVID (n=922)	During COVID (n=1,032)	P-value
Age, years (SD)		69.2 (13.0)	68.1 (12.5)	0.062
Sex (%)				
Female	614 (31.4)	297 (32.2)	317 (30.7)	
Male	1,340 (68.6)	625 (67.8)	715 (69.3)	0.477
IRSAD (%)				
Most disadvantaged[a]	1,374 (70.3)	646 (70.0)	728 (70.5)	
Most advantaged[a]		275 (30.0)	304 (29.5)	0.421
Reason for Referral (%)				
Arrhythmia management	354 (18.1)	142 (15.4)	212 (20.5)	
Heart failure	123 (6.3)	61 (6.6)	62 (6.0)	
Valve repair procedure	153 (7.8)	86 (9.3)	67 (6.5)	
Revascularisation procedure	535 (27.4)	245 (26.6)	290 (28.1)	
Coronary artery disease	620 (31.7)	299 (32.4)	321 (31.1)	
Others	169 (8.6)	89 (9.7)	80 (7.8)	0.010
Mode of CR Delivery (%)				
Telehealth-based CR	459 (23.4)	212 (23)	247 (24)	
Centre-based CR[b]	1,495 (76.3)	710 (77)	785 (76)	0.614
Follow-Up, Days	161 (123-202)	165 (125-201)	161 (119-202)	0.799

[a]Most disadvantaged category refers to IRSAD 5 lowest deciles, whereas most advantaged category refers to IRSAD 5 highest deciles.
[b]During COVID, centre-based services used telehealth alone or combined with one-to-one appointments for patients at high risk.
Abbreviations: IRSAD, Index of Relative Socio-Economic Advantage and Disadvantage; SD, standard deviation; CR, cardiac rehabilitation.

adaption of centre-based programs to telehealth was mostly telephone-based with 90% of the services offering between one and eight telephone sessions for individual patients via one-to-one appointments. Only one service combined the telephone-based CR program with video consultations.

Supervised exercise training was the CR component most affected during COVID-19 with 90% of the services reporting moderate or high impact of the COVID-19 situation on its delivery. All centre-based programs closed their gyms, and all group classes were replaced by one-to-one sessions either via phone (30%) or via in-home exercise training (20%). Regarding clinical assessments, 60% of the services referred that COVID affected their ability to perform and complete those. All these services reported using the phone to replace face-to-face assessments and none reported using video. However, details on how certain assessments, such as functional capacity, were adapted and conducted within a telehealth environment are lacking. The impact of COVID-19 on other CR components is shown in Figure 2.

Regarding the impact on work processes, the switch to telehealth services because of COVID-19 was considered time consuming for 30% of the respondents and 30% reported an increase in staff workload particularly to allied health professionals. They attributed the increased working hours to the replacement of group sessions by one-to-one telephone sessions.

Figure 1 Adjusted cumulative incidence of cardiac rehabilitation attendance pre and during COVID over the follow-up.

Discussion

Summary of the Main Findings

This study, which included an established telehealth service and 13 centre-based services in regional, rural, and remote Australia, showed widespread adoption of telehealth primarily via telephone visits by the centre-based CR programs during the first wave of COVID-19 in South Australia. However, CR uptake was significantly lower during than pre-COVID-19 with reduction in both attendance and
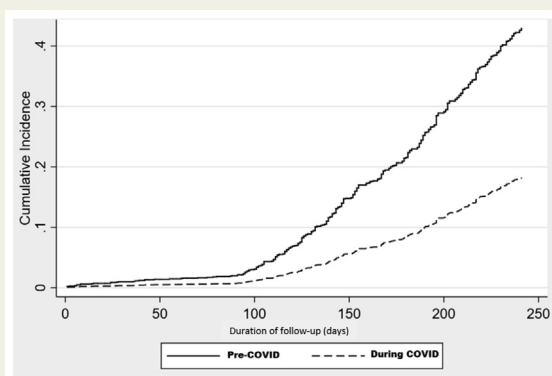
Table 2 Impact of COVID-19 on cardiac rehabilitation attendance, completion and waiting time between telehealth and centre-based CR.

	Pre-COVID-19	P-value	During COVID-19	P-value
Attendance to CR				
Telehealth CR (%)	153/211 (72.5)		170/246 (69.1)	
Centre-based CR[a] (%)	399/708 (56.4)	<0.001	310/782 (39.6)	<0.001
CR Completion (Based on Completion of 70% of Sessions)				
Telehealth CR (%)	139/153 (90.8)		125/170 (73.5)	
Centre-based CR (%)	272/399 (68.1)	<0.001	78/310 (25.1)	<0.001
CR completion (Based on Completion of Post Assessment)				
Telehealth CR (%)	126/153 (82.3)		117/170 (68.8)	
Centre-based CR (%)	241/399 (60.4)	<0.001	78/310 (25.1)	<0.001
Median Waiting Time, days[b]				
Telehealth CR (IQR)	29.0 (18.0-34.4)		29.5 (21.0-41.0)	
Centre-based CR (IQR)	39.5 (23.0-71.0)	0.142	35.0 (22.0-73.0)	0.274
Composite Clinical Outcome				
Telehealth CR (%)	19 (9.0)		36 (15.0)	
Centre-based CR (%)	94 (13.3)	0.097	92 (11.8)	0.234
In-Hospital Length of Stay, Days				
Telehealth CR (IQR)	5.0 (1.0-6.0)		2.0 (1.0-8.5)	
Centre-based CR (IQR)	3.0 (1.0-6.0)	0.383	4.5 (1.0-9.5)	0.104

[a]During COVID, centre-based services used telehealth alone or combined with one-to-one appointments for patients at high risk.
[b]Waiting time for commencing CR from time of referral.
Abbreviations: SD, standard deviation; CR, cardiac rehabilitation.

completion particularly in the centre-based programs. Waiting times to commence a program and clinical outcomes did not differ between the two periods.

CR Use and Clinical Outcomes Pre and During COVID-19

The attendance rates before (59.9%) and during (46.6%) COVID were higher than those shown in the 2013–2015 South Australian audit (28.4%) [9]. This may reflect a trend to

improved attendance rates to be investigated by a new state-wide audit in the future. Acute coronary syndromes and revascularisation procedures remained the main reason for referral during COVID. However, the proportion of referrals due to arrhythmias increased during COVID. It is unlikely that this increase is related to the association between the COVID-19 infection and increased incidence of arrhythmias [37] as there were only about 400 COVID-19 cases in South Australia during the period of the study. Rather, it may reflect unavailability of the specialised arrhythmia centres
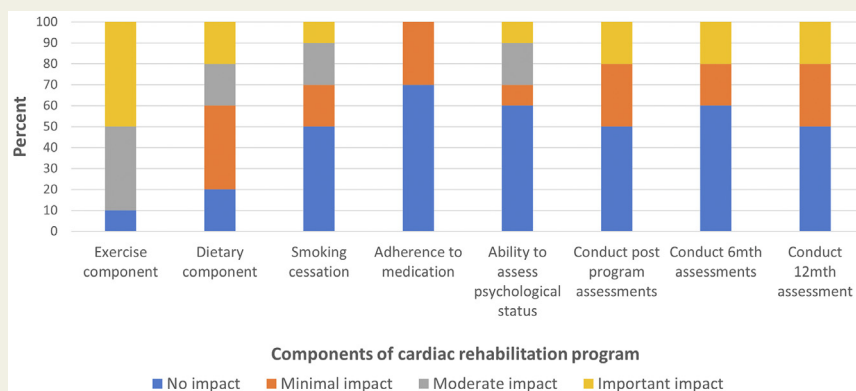
Figure 2 Impact of COVID-19 on delivery of cardiac rehabilitation core components by centre-based services.

during COVID which may have shifted these patients to the cardiac rehabilitation services. Further investigation would require access to data on the arrhythmia services.

The completion rates among those who started CR was lower during COVID (75.4% vs 42.4%) despite similar waiting times between the two periods for both modes of delivery. A 3-month audit of CR services in other Australian regions (New South Wales, Tasmania and ACT) pre-COVID-19 showed lower completion rates (59.1%) and lower waiting times (15 days vs 28 days) than ours [38]. Internationally, the national audit of 170 British services showed higher completion rates (83%) and higher (38–50 vs 28 days) waiting times than ours regardless of the period of our study [39]. Making inferences based on comparison of these process indicators in other regions is not straightforward due to differences in the characteristics of the programs, services and health systems. For example, our study included only regional, rural and remote services, whereas in the study by Gallagher et al. 64% of the services were in major cities [37]. As pointed out by those authors, the duration of the programs may influence the waiting time with programs with shorter duration being more likely to be completed. Median program duration in the study by Gallagher et al. was 12 (IQR 6–16) days, whereas the duration of our programs was 51 days (IQR 42–71).

Since engagement and dose of participation in CR are directly related to clinical outcomes [40], we would expect lower participation during COVID-19 to be associated with worse outcomes. However, we did not find any association of the time of referral to CR (pre vs during COVID-19) with the composite outcome of hospitalisations and cardiovascular death. This may be related to the short follow-up (median of 161 days) as the magnitude of the benefit of CR on clinical outcomes seems to be higher after 12 months and, in particular, after 3 years of follow-up.

CR Use and Clinical Outcomes According to Mode of CR Delivery

Cardiac rehabilitation attendance and completion were lower during than before COVID. This included reduced participation in the established telehealth service and may be related to neglected chronic disease management and self-care during COVID-19 associated with feelings of loneliness, isolation and anxiety experienced by patients during the public health emergency [41]. The reduced uptake of CR in centre-based programs may have been exacerbated by the hesitancy to physically attend health services during COVID-19. As shown by our surveys with clinicians, 80% of the clinicians reported patients expressed concerns about exposure to COVID-19 related to attending CR.

Weaknesses on the telehealth models rapidly implemented within the centre-based CR programs may explain why participation in these services was lower than in the established telehealth model during COVID-19. The centre-based services may not have had time and/or resources to address patients' and clinicians' barriers to engagement with technology. These include patient perception of impersonal care,

resistance to change, low e-health literacy and lack of access to broadband connection [42,43]. In addition, these models were most likely not co-designed with patients, in particular with patients who are older, have low literacy, Aboriginal and Torres Strait Islander peoples and culturally and linguistically diverse groups. Co-design enables services to address patients' needs and preferences, which is a key factor for adoption of both telehealth and CR programs [44,45].

These results differ from those of other CR services which rapidly adapted to telehealth. In a Canadian service, CR acceptance and adherence were not significantly reduced during the public health emergency [46]. A Japanese study, where remote consultations raised from 3% pre COVID-19 to 69% during COVID-19, showed higher participation rates during the COVID-19 pandemic [47]. Like in our study, clinical outcomes did not differ between the two periods. International differences in the components and complexity of CR programs make comparisons difficult.

How Centre-Based and Telehealth Programs Adapted to COVID-19: Survey Results

Compared to a global survey on CR delivery during COVID-19 which involved 63.1% of countries in the world [10], our survey showed higher rates of telehealth adoption by the centre-based services (100% vs 39.7%). However, like in CR programs worldwide, disruption in the delivery of the exercise training was very high. Concerns about the safety of unsupervised exercise for these patients at high risk of recurrent cardiovascular events combined with low availability of exercise monitoring technologies might explain these numbers [10]. The adoption of primarily low-tech modes, such as telephone, by South Australian programs is akin to what happened worldwide. Only 20% of the centre-based programs adopted video consultations. This low uptake may indicate poor interest and acceptance, a lack of digital literacy for this modality among both patients and practitioners, low access to high-speed internet, devices and technology support, and low training levels of the staff [10,48]. The increase in the workload due to transition to remote CR delivery reported by 30% of the respondents of our service may have impacted on further development of the telehealth models.

Implications for Practice, Policy and Future Research

Our results suggest that alternative modes of CR delivery such as through telehealth is an important step to provide options to patients during public health emergencies. However, availability of telehealth does not necessarily translate into CR utilisation. Understanding barriers, needs and preferences of CR patients through research, including those related to the availability of infra-structure (e.g., internet connection, devices) and technology literacy, is key to engagement and participation. Moreover, co-design of telehealth services with the users and professionals, and training

of CR providers demands time and preparation and is paramount to the success of telehealth-enabled CR.

Strengths and Limitations

The strength of this study is the use of quantitative clinical data combined with survey data to understand the clinicians' perspective on the impact of COVID-19 on CR services and their response through telehealth. This comparison between an established telehealth service to those of centre-based programs that adopted telehealth is unique as, before COVID-19, the number of telehealth CR programs implemented into practice across regional, rural and remote areas world-wide was very low [17,43].

As limitations, we acknowledge that our study is not designed to study the impact of COVID-19 on Aboriginal and Torres Strait Islander peoples and culturally and linguistically diverse (CALD) populations. Additionally, the study was not powered to detect statistically significant differences in clinical outcomes between the established telehealth service and the centre-based services. Moreover, due to the low number of cases in South Australia and relatively low public health impact of COVID-19 in the state during the period of the study, our results may not be generalisable to national or international settings. Also, eventual changes made without previous planning were not considered i.e., the survey reflected a snapshot in time rather than a follow-up of the rapid changes occurring in the services during COVID. Finally, further research on the perspectives of the CR participants and interviews with the clinicians would elucidate a more comprehensive understanding of the impact of COVID-19 on the CR programs.

Conclusions

The COVID-19 public health emergency triggered rapid adoption of telehealth by CR programs in regional and rural Australia mainly by incorporation of telephone programs. Although this prevented suspension of CR programs during the restrictions, CR participation was lower than pre-COVID regardless of CR being delivered by an established telehealth service or by the centre-based services who rapidly adopted telehealth. This suggests a shift in patients' priorities and neglect of self-care and secondary prevention during the pandemic. Moreover, it highlights the need of further co-design of the telehealth models of care to better engage participants.

Declarations of Interest

None.

Funding

Data Statement

The data utilised in this study were collected from the Country Access to Cardiac Health (CATCH) database. Due to the nature of this data, the authors are unable to share supporting data.

Acknowledgments

Appendices

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.hlc.2022.07.006

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