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ORIGINAL ARTICLE

Impact of Early COVID-19 Waves on Cardiac Rehabilitation Delivery in Australia: A National Survey

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Background The novel coronavirus disease of 2019 (COVID-19) pandemic significantly disrupted health care, especially outpatient services such as cardiac rehabilitation (CR). We investigated the impact of early COVID-19 waves on the delivery of Australian CR programs, comparing this time period with usual practice prior to the pandemic (2019) and current practice (2021) once the early waves had subsided. Specifically, we aimed to understand how the delivery of programs during COVID-19 compared to usual practice.

Methods An anonymous online cross-sectional survey of Australian CR program staff was conducted, comprising three sections: program and respondent characteristics, COVID-19 impact on program delivery, and barriers to, and enablers of, program delivery. Respondents were asked to consider three key timepoints: 1) Pre-COVID-19 (i.e. usual practice in 2019), 2) Early COVID-19 waves (March–December 2020), and 3) Currently, at time of survey completion post early COVID-19 waves (May–July 2021).

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Results Of the 314 Australian CR programs, 115 responses were received, of which 105 had complete data, representing a 33% response rate. All states and territories were represented. During early COVID-19 waves programs had periods of closure (40%) or reduced delivery (70%). The majority of programs reported decreased CR referrals (51.5%) and decreased participation (77.5%). The two core components of CR—exercise and education—were significantly impacted during early COVID-19 waves, affecting both the number and duration of sessions provided. Exercise session duration did not return to pre-pandemic levels (53.5 min compared to 57.7 min, p=0.02). The majority of respondents (77%) reported their CR program was inferior in quality to pre-pandemic and more organisational support was required across information technology, staffing, administration and staff emotional and social support.

Conclusion Australian CR programs underwent significant change during the early COVID-19 waves, consistent with international CR reports. Fewer patients were referred and attended CR and those who did attend received a lower dose of exercise and education. It will be important to continue to monitor the long-term impacts of the COVID-19 pandemic to ensure CR programs return to pre-pandemic functioning and continue to deliver services in line with best practice and evidence-based recommendations.

Keywords Cardiac rehabilitation • Secondary prevention • COVID-19 • Telehealth • Health services research

Introduction

Cardiac rehabilitation (CR) programs provide critical support for people who have recently experienced a cardiac event or procedure, or who have been identified as having cardiovascular risk factors [1]. These programs ensure people living with cardiovascular disease are educated and empowered to self-manage their condition long term with the aim of preventing recurrent events. There is Level IA evidence to demonstrate participation in these outpatient programs decreases mortality and morbidity, increases quality of life, and results in broader social and economic benefits [2–4].

The novel coronavirus disease of 2019 (COVID-19) pandemic abruptly and significantly impacted CR delivery worldwide [5]. Across the world, programs were ceased, program elements reduced and delivery modes changed [5–7]. During the first year of the pandemic in Australia in 2020, there were two distinct COVID-19 waves particularly affecting two large eastern states; Victoria and New South Wales. These early waves were managed with containment policies and closure of some outpatient services nationwide [8].

The impact of the pandemic on Australian CR programs is yet to be documented. Therefore, the primary aim of this study was to describe and quantify the impact of COVID-19 on the delivery of CR in Australia. We investigated the impact of the early COVID-19 waves (2020) and compared this to both usual practice pre-pandemic (2019) and ongoing practices after the early COVID-19 waves subsided and restrictions eased (2021). Specifically, we aimed to understand how the delivery of programs, namely the content delivered, modality of delivery and data collected, compared to usual practice. The secondary aim was to investigate variations in program impact in terms of program characteristics; namely, program state, setting, regionality and socioeconomic status (SES).

Methods

The study used a cross-sectional survey design and sought to include all Australian CR programs. Participation in the survey was voluntary and the study was approved by Flinders University Human Research Ethics Committee (#4153).

Participants

At the time this research was conducted, there were approximately 314 CR programs operating in Australia across different settings, including public and private hospitals, and community health [9]. The link to the online questionnaire, using survey platform Qualtrics software, version (08/21), was disseminated via multiple pathways including the following: an email to all members of the peak national body for CR clinicians, researchers, and policy makers, the Australian Cardiovascular Health and Rehabilitation Association (ACRA) (N=503); the mailing list of partner organisation, Australian Centre for Heart Health (ACHH); and advertised on Twitter (via @ACRA_ACRA). One questionnaire was requested to be completed per CR service, with no restrictions on what model of care constituted a CR service. Importantly, we collected several datapoints (postcode, setting, number of sites) which we could triangulate to make a confident assumption that the same service had not answered more than once. Typically, where a service had answered more than once, it was likely due to being interrupted during survey completion as the question completion rate was low on the first attempt. Duplicates such as this were removed during data cleaning. We also provided instruction that the survey was preferably to be completed by a senior clinician of the team; however, as CR programs are run by senior, autonomous practitioners, we anticipated a lack of seniority and knowledge would not be an issue for respondents.

The questionnaire was available for completion between 21 May to 12 July 2021, with two email reminders. Participation was incentivised through a prize draw for one free ACRA membership and four gift cards (valued at $50 each) for participants who completed the questionnaire by a specified date.

Setting and COVID-19 Cases

During the first year of the pandemic in Australia, there were approximately 30,000 COVID-19 cases which occurred over two distinct 'waves' (Figure 1) [8]. The first wave affected all states and territories (March–April 2020) and the second distinctly affected the state of Victoria (June–September 2020) [8]. During this time, containment and control of the COVID-19 virus was managed through travel restrictions and quarantine, border closures (international and interstate), limits on gatherings and lockdowns, initially nationwide and then in severely affected states (in particular, Victoria) [8]. Details on restrictions can be found in Table 1. During this time, COVID-19 vaccines were not yet available.

Data Collection

An anonymous online questionnaire developed by an ACRA working group was used to collect data. To aid international comparisons, the survey adapted questions from an international COVID-19 impact survey conducted by the International Council of Cardiovascular Prevention and Rehabilitation (ICCPR) [5]. The questionnaire was comprised of three sections: 1) CR program and respondent demographics; 2) COVID-19 impact on program delivery; and 3) barriers to, and enablers of, program delivery. There was a total of 43 multiple-choice questions, many with the option to add free text if there was no appropriate response available, and three free-text questions. Given the objective of the survey was to understand the impact of COVID-19 on Australian CR programs, sections 2 and 3 were considered the most important to data collection. Consequently, if survey respondents completed only section 1, their response was considered to have incomplete and unusable data. This classification of incomplete data is consistent with published guidance [10].

Respondents were asked to consider three key time periods when answering the survey questions:

1) Pre-COVID-19, defined as service activity in 2019
2) During early COVID-19 waves, defined as service activity from March to December 2020
3) Currently, defined as activity at the time of survey completion, post early COVID-19 waves (May–July 2021)

For COVID-19 daily case numbers across all three timepoints, refer to Figure 1.

Respondents were asked to identify which diagnostic group category (e.g. cardiac surgery patients, patients with cardiovascular disease (CVD) risk factors, patients with implantable cardiac devices, etc.) participated in their CR programs across the three time points. Furthermore, CR programs collect data for both internal reporting and quality improvement processes, so based on national CR quality indicators [11] respondents were also asked to indicate if seven key indicators had been collected at program commencement and completion, during the three key defined timepoints. The seven key indicators were: depression screening, depression referral, smoking status, smoking cessation referral, medication adherence, exercise capacity, and quality of life.

Prior to distribution, the questionnaire was pilot tested by seven ACRA committee members, four of whom were current practicing CR clinicians. This pilot test enabled us to identify potentially confusing items and important omissions, and the length of time to complete the survey. This feedback enabled us to modify item wording to ensure clarity, and to add additional items to ensure comprehensiveness of the items included.

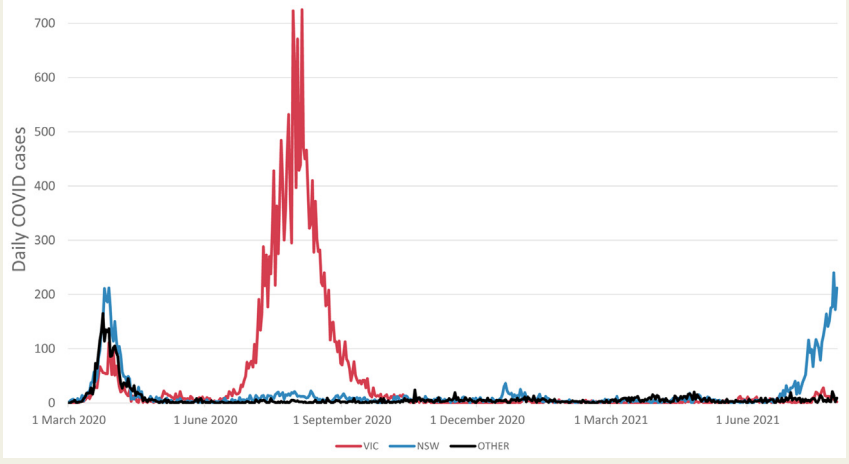

Figure 1 COVID-19 cases in Australia from March 2020 to July 2021 by state. Data sourced from www.covid19data.com.au
Abbreviations: VIC, Victoria, Australia; NSW, New South Wales, Australia.

Table 1 Timeline and description of lockdowns across Australia in 2020 (defined early COVID-19 wave period).

Date (2020)	Lockdown description
Nationwide	
23 March–late April/early May	Different restrictions in each state and territory
Victoria	
1 July	Hotspot lockdown
8 July	Stage 3 lockdown of two shires (including metropolitan Melbourne)
2 August	Stage 4 lockdown—metropolitan Melbourne
13 September	Easing of restrictions
27 October	Restrictions fully eased
31 December	Restrictions in response to a small cluster
New South Wales	
17 December	Hotspot restrictions (Northern Beaches)
South Australia	
19–22 November	Lockdown

Stage 3 lockdown: closure of pubs, bars, entertainment venues, churches and places of worship, restriction of restaurants and cafes to takeaway only, limiting public gathering to two people; Stage 4 lockdown: in addition to stage 3 restrictions, evening curfew, 5 km travel limit, supermarket shopping limited to one person, one-hour outdoor exercise limit, no weddings, limit on funeral attendance.

Variables

The variables of interest related to the following: program impacts, referral and participation rates, program delivery (exercise and education), perceived program quality, data collection, and support required. Additionally, a composite variable to assess COVID-19 impact was created by meaningfully combining responses to questions regarding impacts on CR program delivery and CR staff changes. Specifically, programs were classified as having experienced no COVID-19 impact (no program or staff changes), moderate impact (either program changes or staff changes), or major impact (both program and staff changes). This meaningful grouping [12] of variables was based on the interpretation of the value of the variables and formed a new ordinal variable that is meaningful to the context of this descriptive study (rather than being driven by statistical significance, given the small sample size and lack of power).

We examined variations by state, CR program setting (public, private, community), rurality (as measured by the Modified Monash Model [MMM] [13]), and SES (as measured by the socioeconomic indexes for areas [SEIFA], using the index of relative socioeconomic advantage and disadvantage [IRSAD] [14]). The IRSAD is a comprehensive metric of SES, incorporating data on income, occupation, education, employment and housing, with a low index representing higher disadvantage.

Statistical Methods

Analyses were undertaken using SPSS (IBM Corp., Version 26.0. Armonk, NY) . Descriptive analyses were reported as median values with interquartile range (IQR) or mean values with standard deviations (±SD). Following descriptive analyses, we undertook tests of association using the chi-squared test where the significance level was set at $p<0.05$. To compare differences between groups over the three timepoints we used paired t-tests and repeated measures analyses of variance (ANOVA) using the generalised linear model (GLM) procedure within SPSS reported as F-value (F) with degrees of freedom (df) to identify variations in the dependent variables (program delivery, program impacts, referral rates, data collection, staff impacts, and patient impacts) by the independent variables (state, setting, MMM, SEIFA and SES). Free-text answers underwent a qualitative conceptual content analysis using an inductive approach to generate codes. Codes were then consolidated into higher level categories. One author experienced in this method (B.A.) completed the qualitative analysis.

In light of the higher COVID-19 daily case rates in the eastern states of Victoria and New South Wales (NSW) in the early stages of the pandemic in Australia, and to account for a lower response rate from other smaller states and territories, the state variable was recoded into Victoria, NSW and all other states.

Results

Program and Respondent Characteristics

Of the 314 Australian CR programs [9], 115 programs completed the survey. Of these, 10 respondents were excluded due to incomplete and unusable data (those with only completed demographic questions), resulting in a final sample of 105, representing a 33% response rate. Program characteristics are shown in Table 2.

Responding programs were based in public hospitals (58%) or community health centres (33%), and respondents were predominantly the program coordinator (76%), most were nurses (85%). Programs from each state and territory were represented. Around half (52%) were from metropolitan areas, with the remaining half from regional (19%) and rural (30%) areas. The socioeconomic indices for programs were split across three categories (low, medium and high disadvantage) relatively evenly with slightly more programs (43%) located in higher SES areas with less disadvantage (Table 2).

Overall Impact of COVID-19 on Cardiac Rehabilitation Programs

Respondents were given a list of five potential program impacts and were asked to nominate all that applied during

Table 2 Characteristics of responding programs.

Program characteristic	n (%)
Setting (N=105)	
Public hospital	61 (58)
Private hospital	9 (9)
Community health centres and other	35 (33)
Multiple sites (N=105)	
Yes	31 (30)
Median number (IQR)	3 (0,5)
State/Territory (N=100)	
Victoria	39 (39)
New South Wales	24 (24)
South Australia	13 (13)
Queensland	10 (10)
Western Australia	7 (7)
Australian Capital Territory	3 (3)
Tasmania	3 (3)
Northern Territory	1 (1)
Rurality (MMM) (N=97)	
Metropolitan (MMM1)	50 (52)
Regional centre/Large rural town (MMM2–3)	18 (19)
Small rural town, remote and very remote (MMM4–7)	29 (30)
Socioeconomic Status of CR program location[a] (SEIFA using IRSAD) (N=97)	
Low (1–3)	29 (30)
Medium (4–6)	26 (27)
High (7–10)	42 (43)
Respondent role (N=104)	
Coordinator	80 (77)
CR team member	20 (19)
Other	4 (4)
Respondent profession (N=104)	
Nursing	89 (85)
Physiotherapy	8 (8)
Exercise physiology	6 (6)
Dietetics	1 (1)

N=105 unless otherwise indicated. Lower N due to missing data.
Abbreviations: IQR, interquartile range; MMM, Monash modified model; SEIFA, Socio-economic indexes for areas; IRSAD, index of relative socio-economic disadvantage; CR, cardiac rehabilitation.
[a]For socioeconomic status scoring, a lower score indicates that an area is relatively disadvantaged compared to an area with a higher score.

the defined COVID-19 period (Figure 2). The possible program impacts were as follows: closing the program, reducing some elements offered, deferring physical assessment, shortening program duration, and/or not taking new patients. Many CR programs had periods of closure (n=42, 40%), or reducing program elements offered to patients (n=73, 70%). The number of impacts nominated ranged from zero to five, with an average of two impacts.

Only 11 (10%) of programs continued usual business during the early COVID-19 waves. These programs were located in NSW (n=3), Queensland (n=3), South Australia (n=2), Tasmania and Victoria (n=1 each) and one unknown state. Three programs had the advantage of already using a remote-delivery model including telephone (n=2) and home-based (n=1) CR.

Using the combined program and staff COVID-19 impact variable (N=104), over a third of programs (37.4%) had no impact, almost half (45.5%) had moderate impact (either program or staff changes), and the remaining 17.2% had a severe impact (both program and staff changes) in this early period of the COVID-19 pandemic. There was a significant difference by state, with Victoria being more likely than other states to have moderate impact (68.4% compared to 45.5% overall) and NSW more likely than other states to have no impact (62.5% compared to 37.4% overall) (χ^2=16.68, df=4, $p<0.002$) (Figure 3). The COVID-19 impact score did not vary by program setting, rurality or SES (of the program).

Impact on Referral and Participation

During the early COVID-19 waves, referral rates (N=103) were reported to have reduced for 51.5% programs overall, however over a third of programs (37.9%) stated that referral rates were unchanged. At time of questionnaire completion (mid-2021), only 21.4% of programs stated referrals were back to normal, while for 19.4% referral rates remained lower than usual. For the remaining 59.2%, referrals rates remained unchanged from the early COVID-19 period. Referral rates both during the early COVID-19 waves and at time of questionnaire completion did not vary by state, program setting, rurality or SES. For CR participation during the early COVID-19 waves, the majority of programs (77.5%) reported reduced participation, while a small number of programs reported increased participation (12.7%).

Program Delivery

Diagnoses with the largest decrease during the defined COVID-19 period were patients with the following: CVD risk factors (reported to have decreased from 70.5% to 53.3% of programs), implantable cardiac devices (70.5% to 57.1%), arrhythmia (66.7% to 52.4%), and stable angina (87.6% to 74.3%). By 2021, these conditions had returned to near baseline proportions. Conditions such as percutaneous coronary intervention (PCI), cardiac surgery, acute coronary syndrome (ACS) and heart failure had minimal drops in proportion of CR delivery during the COVID-19 period (average decrease of 7%) (Supplementary Table 1).

The mode of program delivery shifted significantly from predominantly in-person programs to telehealth (84% of service delivery was in-person in 2019 compared to 27% in 2020, $p<0.0001$). Telephone was the predominant form of telehealth used in 2020 (84% of services reported some telephone use), followed by video conferencing (53% of services). Findings relating to telehealth use will be described in full elsewhere.

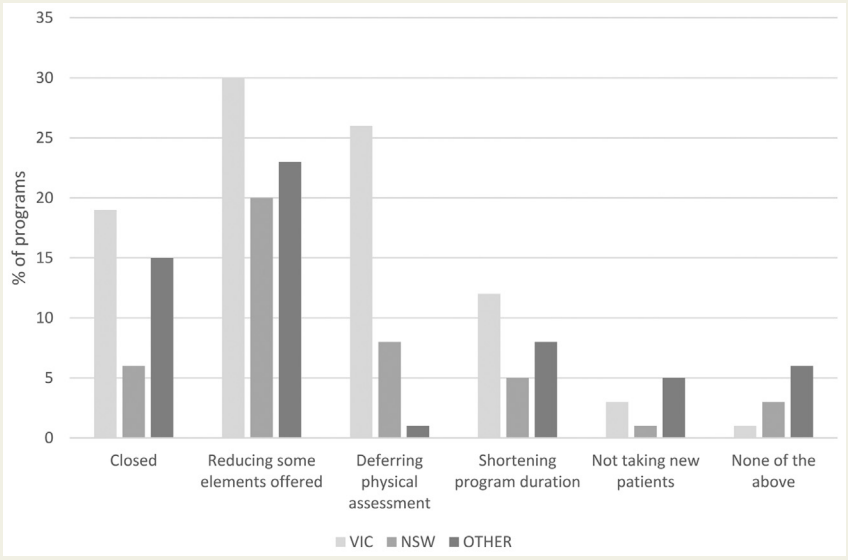

Figure 2 Effect of early COVID-19 pandemic wave on cardiac rehabilitation programs in 2020. N=105. Respondents could nominate more than one option, hence total percentage >100.
Abbreviations: VIC, Victoria, Australia; NSW, New South Wales, Australia.

Impact on Exercise Delivery

Before the early COVID-19 waves, the mean number of exercise sessions offered per program was 8.23 (range 0–18, SD± 4.1). This reduced significantly to a mean of 3.3 (SD± 4.1) (F= 8.07, df=74, p<0.001) during the early COVID-19 waves. By 2021, there was a significant increase to near pre-pandemic levels with a mean of 7.9 sessions (SD ±4.1) (F=7.89 df=72, p<0.001).

A similar pattern was seen with exercise session duration. Before COVID-19, the mean length of exercise sessions was 57.7 min per session (range 0–90 min, SD ±10.8). Length of exercise sessions reduced significantly during early COVID-19 waves to a mean of 25.8 min (SD ±27.8) (F=9.60, df=71, p<0.001). However, exercise duration did not fully recover with services reporting a mean duration of 53.5 min (SD ±17.9), significantly lower than pre-pandemic levels (F=2.43, df=86, p=0.02). For both number and duration of exercise sessions, there were no variations in terms of state, setting, MMM or SES.

Impact on Education Delivery

Before COVID-19, the number of education sessions offered ranged from 0 to 16, with a mean of 6.8 sessions (SD ±3.2). The number of sessions significantly decreased to 4.5

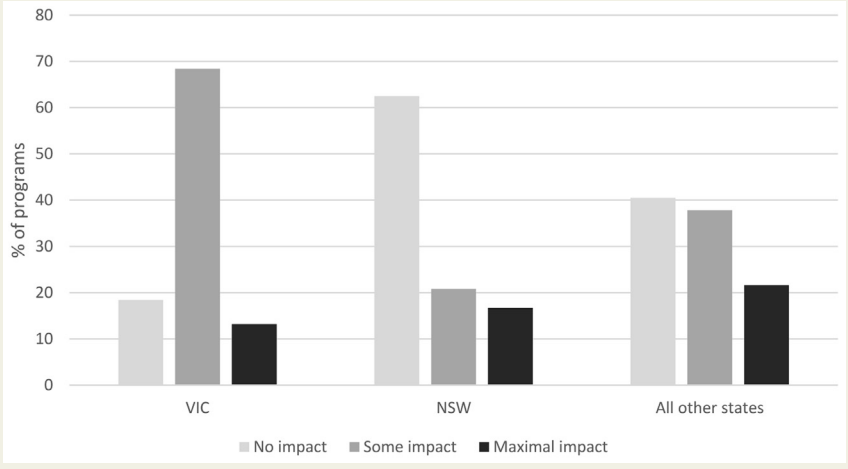

Figure 3 Level of impact of early COVID-19 wave on cardiac rehabilitation programs by state (n=100).
Abbreviations: VIC, Victoria, Australia; NSW, New South Wales, Australia.

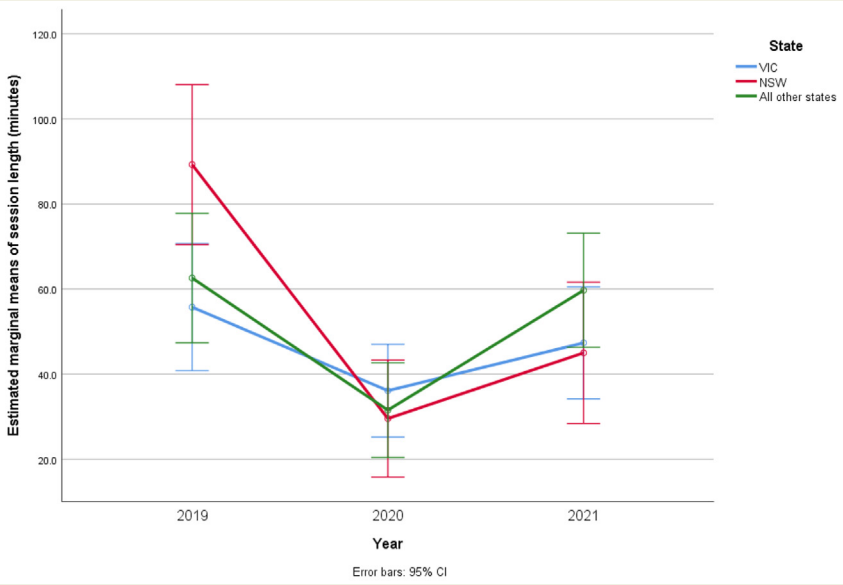

Figure 4 Profile plot depicting interaction of states with the estimated marginal mean length of education sessions. Abbreviations: VIC, Victoria, Australia; NSW, New South Wales, Australia; CI, confidence interval.

(SD ±3.8) during the early waves of the pandemic (F=5.43, df=74, p<0.001) and did not return to pre-pandemic levels, remaining significantly lower (6.2, SD ±3.4) in 2021 at time of survey completion (F=2.3, df=84, p=0.02). There were no variations by state, setting, MMM or SES.

Before COVID-19, the duration of education sessions ranged from 5 min to 4 hrs, with a mean of 64.1 min (SD ±37.5). During the early COVID-19 waves, education session length significantly decreased to 35 min with a range from 5 min to 4 hrs (SD ±36.7) (F=5.70, df=73, p<0.001). Education session duration did not return to pre-pandemic length, with duration at time of survey completion reported as 52.5 min (SD ±32.4) (F=3.70, df=86, p<0.001). While there were no differences between states overall, there was a significant interaction between state and time (F=4.62, df=4, p<0.001), with each state showing different patterns of change (Figure 4). Specifically, NSW showed a significant reduction from pre-pandemic (89.3 min) to during-COVID-19 (29.6 min), with education session length post-COVID-19 wave remaining significantly lower (45 min) than it had been pre-COVID-19; Victoria showed a decline and recovery, but changes were not statistically significant; all other states showed a significant decline and a significant recovery, such that by mid-2021 they had returned to their near pre-pandemic session length. There were no other significant interactions to education session length by setting, MMM or SES.

To ascertain which education topics were prioritised during the early stages of the pandemic, respondents were asked to indicate what session topics (based on current standardised program content guidelines [15]) were delivered at each time point. Education topics delivered consistently (i.e. that had the least reduction in proportion of delivery) during the COVID-19 waves were: smoking cessation (73.3% of programs pre-pandemic compared to 67.6% during COVID-19), alcohol reduction (73.3% compared to 66.7%), and sexual activity (63.8% compared to 58.1%). Topics that were somewhat less likely to be delivered during the early COVID-19 waves were: education regarding exercise and physical activity (85.7% of programs pre-COVID-19 compared to 71.4% during-COVID-19, p<0.06), medications (83.8% compared to 70.5%) and goal setting (76.2% compared to 63.8%). Importantly though, none of these changes reached statistical significance at p<0.05. All education topics returned to pre-pandemic proportions of delivery at the time of survey completion (Supplementary Table 2).

Impact on Perceived Program Quality

Respondents were asked to rate the quality of their CR program during the defined COVID-19 period (N=91). Over three quarters (77%) reported that during the early COVID-19 waves their program was inferior to pre-pandemic, with 46% rating it as "somewhat inferior to pre-COVID-19" and 31% rating it as "very inferior to pre-COVID-19". Only one respondent rated their program as superior to the pre-COVID-19 period. The qualitative, free-text analysis offered greater insight into these findings. Concerns related to lengthening waitlists, patient welfare, the lack of face-to-face connection and delivering a "minimalist service" which lacked essential components. This led to a sense of disappointment from CR staff about not being able to deliver an appropriate, high-quality program for patients which ultimately impacted on job satisfaction.

Data Collection

Overall, collection of the key indicators varied from 35%–84.5% and indicators were less likely to be collected at program completion (N=104). Comparing the pre-pandemic period with the early COVID-19 waves, data collection on exercise capacity had the most significant decrease at program commencement (84.5% to 54.4%, $p<0.001$) and completion (74.8% to 41.7%, $p<0.001$). While not statistically significant, collection of depression screening (81.6% to 69.9% at CR commencement) and depression referral were also lower (74.8% to 64.1% at CR commencement) during the early COVID-19 waves. While the proportion of collection of all indicators returned to their baseline levels at time of questionnaire completion in 2021, data on quality of life had a non-significant increase at both program commencement (50.5% to 58.3%) and completion (43.7% to 51.5%) (Supplementary Table 3).

Organisational Support Required

When asked what organisations could do better to support CR staff during the pandemic, participants' insights via free-text comments were constructed around four clear categories: information technology (IT), staffing, administration, and emotional and social support. These are presented as categories and explanatory codes in Table 3.

Table 3 Organisational supports required by CR staff: qualitative categories and codes.

IT support required	Formal training in the use of IT and telehealth for patient care
	A dedicated videoconferencing/ telehealth room or space
	Accessible, high quality videoconferencing equipment
	General IT support for day-to-day challenges
Staffing support required	Increase in number of program staff (or hours of existing staff), backfill of absent staff
	Recognise the increased demands that a telehealth model of delivery places on staff time, program workloads and ability to meet targets
	Work-from-home practices: provide opportunity and resources, understand constraints, trust staff
Administration support required	Additional staff to provide general administration support for CR program (e.g., GP letters, patient tracking, phone calls, planning)
	Additional time for existing staff to undertake required administration tasks
Emotional and social support required	Timely communication from executive about changes to programs or processes
	Regular and open communication and meetings at all levels
	Acknowledgement of the increased pressure, challenges, and burnout for CR staff
	Reassurance, compassion, and emotional support measures
	Make it clear that the organisation values CR and CR staff

Abbreviations: IT, information technology; CR, cardiac rehabilitation; GP, general practitioner.

Discussion

This national survey demonstrates that the COVID-19 pandemic had a significant impact on the delivery of CR programs in Australia. During the early COVID-19 waves, CR programs had fewer referrals and decreased attendance, which did not return to baseline levels as the waves eased, despite decreases in case numbers and easing of restrictions. While the second wave predominantly affected the state of Victoria, most health care services in other states also continued to operate on COVID-19 restrictions.

In particular, exercise—the cornerstone of CR programs [16,17]—was significantly affected in multiple ways during the early COVID-19 waves. In particular, session duration decreased and did not recover to baseline levels, education on exercise and physical activity decreased, and data collection on exercise capacity (a CR quality indicator [11]) also decreased. This is even more concerning when paired with the fact that education frequency and duration of sessions decreased simultaneously and did not return to baseline in 2021 at time of survey completion. The lack of return in education session length to baseline levels in NSW is perplexing but may be due to many factors including the following: the fact NSW had a comparative greater session length in 2019 (which may also be subject to recall bias or overestimation); a change in patient profile (demonstrated by prioritisation of more acute patients during COVID); or a combination of these and other extraneous factors not captured by the survey.

Our main results can be compared with an international survey conducted by Ghisi et al. earlier in the pandemic (April–June 2020) [5]. CR programs around the world also had a similar, but slightly higher, rate of closure ("completely stopped delivery", 49.1%) or a "period of closure" (27.1%) [5]. As with Australian programs, the most frequent adaptation to CR programs internationally was a reduction in the elements offered (19.5%). The type of reduction itself differed, however, in that international programs were most likely to only treat existing patients (17.3%), whereas this was the case in only 9.5% of

Australian programs. An examination of Medicare beneficiary data from the USA also demonstrated reduced CR participation at the end of 2021, which remained significantly lower than pre-pandemic levels [18]. Our composite COVID-19 impact variable (effect of COVID-19 on CR program combined with effect of COVID-19 on CR staffing) demonstrated a significant COVID-19 impact, with almost half of the responding programs (45.5%) having a moderate impact and 17.2% of programs a severe impact. This may be underreported in our sample, as those programs that closed or were under significant strain may not have been able to participate in the survey.

Program Adaptations During Early COVID-19 Waves

Further adaptations made by Australian CR programs included an apparent prioritisation of more acute cardiac patients. While the survey did not specifically ask about triage of patients, the analysis of diagnoses less likely to be treated during early COVID-19 waves appears to be those cardiac patients who were less acute (CVD risk factors, implantable devices, arrhythmias, etc.) compared to diagnoses with higher acuity such as ACS, PCI, cardiac surgery, and heart failure. From these results it appears that CR clinicians were using appropriate judgement to ensure patients who were in more critical need of CR, and who potentially had the most to gain, were able to attend programs. Our finding differed, however, from the results of a UK study that observed nearly half of respondents (48.8%) did not provide CR to high-risk patients [6]. The overall "dose" of CR in Australia however (that is, the number of sessions completed), was likely suboptimal during the early COVID-19 waves.

An additional adaptation was the decrease in the collection of CR quality indicators. The decrease in collection of quality indicators related to exercise capacity may be explained by the fact that it was difficult for CR clinicians to measure exercise capacity remotely. However, the (non-significant) decrease of data collection on depression screening and referral is concerning, given that the pandemic itself and containment measures, such as lockdowns, caused heighted depression and anxiety at a community level [19]. Interestingly however, the collection of quality-of-life data had a non-significant increase from the pre-COVID timepoint to time of survey completion for both program commencement and completion data collection (Supplementary Table 3). This is in opposition to another recent South Australian study, which demonstrated that the health-related quality-of-life quality indicator was the least-measured indicator [20]. It is possible that CR clinicians in our national sample were more aware of quality of life and thus the value of collecting this data. This is following the challenges of the pandemic in 2020, with much discussion and research around the quality of life of Australians after restrictions and lockdowns [21,22].

The Effect of COVID-19 on Cardiac Rehabilitation Core Components

Education and particularly exercise are key components of CR [16,17]. There is an established dose-response relationship between exercise and key CR outcomes such as physical and social functioning, repeat cardiac events and mortality [23–25]. While the optimal CR exercise dose is yet to be fully determined, studies have identified that the range may be anywhere from six sessions [26] to more than 12 sessions [23]. For both education and exercise, number and duration of sessions provided decreased during the early COVID-19 waves, with only number of exercise sessions returning to pre-pandemic levels. This is particularly concerning given that Australian CR programs already offer comparatively fewer sessions of CR compared to European, Canadian and American programs [9], and lower doses of exercise training [27]. Interestingly however, there were 11 programs that were able to continue business as usual during the pandemic. One of those programs was able to adapt to less in-person supervised exercise sessions during COVID by using home walking programs and introducing telehealth [28]. Program adaptations such as these may need to be a part of the toolkit for when COVID waves surge and in-person care is more challenging to deliver.

During the early COVID-19 waves, CR clinicians had to rapidly pivot to remote models of care [7], not previously highly prevalent (2.4%) in Australia [9]. As evidenced by a qualitative study conducted with CR clinicians in the Australian state of Victoria, conducting exercise assessments and providing exercise prescriptions remotely was a huge challenge for CR staff [7]. Indeed, for the same study sample, this was the largest barrier reported by CR staff in implementing telehealth during COVID-19. These delivery challenges may in part explain the decrease in exercise sessions and duration. The outcome, however, is that patients received an even lower dose of exercise during the early COVID-19 waves, with program impacts lasting beyond the early pandemic period.

Program Support

Some of the challenges associated with pivoting to remote CR delivery could be substantially addressed with better ongoing organisational support at the local and national level. While some of these factors need to be addressed at the local health service level (for example the allocation of IT space/equipment, day-to-day technological support), there may be a role for a national association such as ACRA to facilitate educational sessions and communities of practice specific to using telehealth for CR and exercise delivery. Moreover, given the findings of this survey, and significant impacts of COVID-19 on the availability and quantity of CR delivered in Australia, a national approach to CR advocacy, funding, and CR guideline development (including telehealth options) may be warranted now more than ever.

The COVID-19 pattern we now currently see in Australia is a fluctuating pattern of waves, therefore this was one of the early and many COVID-19 waves that the healthcare system and CR have endured. More waves have occurred since this survey, with likely more to come, in which the consequences could be cumulative with each subsequent wave. It will be important to monitor the outcomes for people who had acute cardiac events during pandemic years, as we may see an increased long-term burden of disease due to an inadequate dose (or complete lack of attendance) of CR. This is further compounded by cardiovascular complications that are now emerging due to prior COVID-19 infections [29,30].

Strengths and Limitations

This study is the first to report the impact of COVID-19 on CR programs in Australia. A key strength of this study was reaching CR staff at a time of key change, when they could reflect on their current and previous practice. These results do come with several limitations, however. The main limitation is our small sample size due to a slightly lower than typical response rate (33%) (compared to between 47%–82% in previous similar CR survey studies) [9,27,31], and likely lack of representation of all Australian CR programs, particularly those in the private sector, despite having survey responses from every state and territory. This may be due to our recruitment methods, primarily relying on the ACRA membership network of CR clinicians, of which not all programs have members. However, the survey was promoted through other methods, including partner organisations with broad CR coverage. We hypothesise that non-responding programs may have been closed or having significant time and staffing constraints as a result of the pandemic. The sample size therefore limited us to predominantly descriptive statistics. Ideally, we would conduct a comparative analysis of program characteristics of responding programs to non-responding programs, however due to no current and complete national CR database or registry, this is not possible and is a limitation of current CR research in Australia. This gap is currently being addressed by the Synergy Grant from the National Health and Medical Research Council, for the SOLVE-CHD research group [32].

We also acknowledge that recall bias is a possibility, with data collection relying on recall of differing time points. Additionally, all responses were self-report only and were not able to be validated though other data sources. Finally, despite conducting face validity and using a number of questions from a previous similar international survey [5], there may have been some confusion in how clinicians understood some questions.

Conclusion

In summary, our data suggest the COVID-19 pandemic significantly affected the delivery of CR programs in Australia. In particular, fewer patients attended as evidenced by reduced participation and lower referrals (persisting beyond early COVID-19 waves) and there was a decreased dose of both exercise and education provided.

The COVID-19 pandemic has been a time of rapid change and adaptation and has both highlighted and exacerbated gaps in CR delivery. These necessitate reviewing the dose of CR offered to patients to ensure the full benefit of secondary prevention programs and providing more choice in program modality, including in-person, fully remote programs, and hybrid programs, to support patient care preferences and encourage program completion. It will be important to ensure that we continue to improve and develop remote and hybrid models of CR both to address the ongoing COVID-19 waves and to progress and future-proof the delivery of CR.

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Dedication

The authors would like to dedicate this manuscript to the memory of Anna Storen, who was an inspirational and dedicated cardiac rehabilitation nurse in Tasmania. Her memory will live on through her clinical contribution and her commitment and service to ACRA.

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Appendices

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.hlc.2022.12.008

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