USE OF A SMARTPHONE APPLICATION TO PROMOTE PARTICIPATION IN CARDIAC REHABILITATION

Emily C. Monge

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Approved by:

Dr. Cheryl Wicker	Project Team Leader
Dr. Autumn Henson	Project Team Co-Leader
Dr. Lori Lupe	DNP Program Director

I HAVE ABIDED by the UNCG ADACEMIC INTEGRITY Policy on this ASSIGNMENT.
Emily C. Monge April 8, 2022

Table of Contents

Dedication and Acknowledgements

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I humbly dedicate this project to my family and friends, for your unconditional love and support made this possible.

Abstract

Background: Despite the proven benefits of cardiac rehabilitation (CR), utilization is low. The Covid-19 pandemic even further limits participation in traditional CR (Drwal et al., 2020). Home-based cardiac rehabilitation (HBCR) or virtual program models provide a reasonable alternative to the traditional model of CR (Thomas et al., 2019). However, little research exists to compare patient outcomes between the virtual and traditional CR models (Thomas et al., 2019). Despite the increasing availability of these additional CR models, the lack of standardized guidelines, reimbursement, and evidence of effectiveness, particularly in high-risk populations, remain barriers to these programs' success (Drwal et al., 2020). **Purpose:** This program evaluation aims to compare performance and quality of life outcomes between participants in virtual and participants in traditional CR programs. **Methods:** The PI compared de-identified retrospective data for virtual and traditional CR participants at two time points (program start and program end). De-identified quantitative data included distance (in feet) walked in a pre-and-post-six-minute walk test as well as a pre-and post-test score for the Ferrans and Powers Quality of Life Index for both virtual and traditional CR groups. **Results:** There was no significant difference between the walk test score pre-and-post intervention between the virtual (M=169.2 ft) and the traditional (M=231.1 ft) groups (p =.4170). Quality of life scores pre-and post-intervention also showed no significant difference between the virtual (M=.6825) and traditional groups (M=.0623); (p=.4294). **Recommendations and Conclusion:** The evidence to date suggests that home-based or virtual CR may be as effective as the traditional model of CR. Virtual and remote program models provide a reasonable alternative to the traditional synchronous model of CR However, further research is needed to compare the virtual and traditional CR formats. Assessing these models' impact may help standardize the implementation

of virtual and traditional CR and facilitate reimbursement for these services (Thomas et al., 2019).

Key Words: Cardiac rehabilitation, Virtual Cardiac Rehabilitation, COVID-19, Home-based Cardiac Rehabilitation

Population: Cardiac rehabilitation patients

Intervention: Evaluating outcomes using a Smartphone app

Comparison: Virtual vs. traditional program groups

Outcome: Exercise tolerance, measured as the distance in feet achieved in a pre-and post-six-minute walk test, at two determined time points, program start and program end, and a Ferrans and Powers Quality of Life Index score measured at program start and program end.

Purpose Statement: This program evaluation aims to compare exercise tolerance and quality of life index between virtual and traditional cardiac rehabilitation (CR) program groups.

Background and Significance

Cardiovascular disease is the number one cause of death worldwide (World Health Organization [WHO], 2017). Cardiac rehabilitation (CR) is a secondary prevention program proven to reduce morbidity and mortality and improve the quality of life of individuals with cardiovascular disease (Santiago de Araújo Pio et al., 2019). This referral-based program is an essential recommendation in the 2014 American Heart Association (AHA)/American College of Cardiology (ACC) Guidelines for the Management of Patients with Acute Coronary Syndromes (Amsterdam et al., 2014). Adults age 18 and above who have had a myocardial infarction, stable angina, have undergone cardiac surgery, or have heart failure may be eligible to participate in CR with an appropriate referral, though usually at a cost (Santiago de Araújo Pio et al., 2019). Traditionally, CR consists of 36 one-hour sessions over 12 weeks in the outpatient setting, including supervised exercise, education, and counseling to promote adherence to heart-healthy living and reduce the risk of subsequent cardiac events (Centers for Disease Control and Prevention, 2018).

Despite the proven benefits of CR, utilization is low. Only about 30% of those eligible to participate in CR attend, and many who enroll drop out before completing the program (Santiago de Araújo Pio et al., 2019). The underutilization of CR presents a missed opportunity to improve patient outcomes and reduce mortality and morbidity in individuals with cardiovascular disease. Factors such as cost, lack of referral, transportation, distance to program, duration of the program, program delivery hours, conflict with work schedule, time to start (following hospitalization), gender, age, lack of peer support, and depression may negatively influence participation in and adherence to CR (Santiago de Araújo Pio et al., 2019). Additionally, the Covid-19 pandemic currently limits participation in traditional CR (Drwal et al., 2020).

Home-based cardiac rehabilitation (HBCR) or virtual program models provide a reasonable alternative to the traditional model of CR (Thomas et al., 2019). These virtual alternatives often combine home-based and center-based or traditional CR sessions. However, little research exists to compare patient outcomes between the virtual and traditional CR models (Thomas et al., 2019). Despite the increasing availability of these additional CR models, the lack of standardized guidelines, reimbursement, and evidence of effectiveness, particularly in high-risk populations, remain barriers to these programs' success (Drwal et al., 2020). Smartphone applications and wearable sensors often used in virtual CR programs present an opportunity to promote participation and build a standardized yet personalized platform that targets individual success (Thomas et al., 2019). Evaluating the current technology, standardization of program guidelines, and measurement of exercise capacity and clinical outcomes are necessary to strengthen the widespread implementation of home-based virtual and hybrid CR models (Thomas et al., 2019). This program evaluation aims to compare exercise tolerance and quality of life index between virtual and traditional CR program groups.

Purpose

The purpose of this program evaluation is to compare performance and quality of life outcomes between virtual and traditional CR program participants, including exercise tolerance measured as the distance in feet achieved in a pre-and post-six-minute walk test and a Ferrans and Powers Quality of Life Index score measured at program start and program end**.**

Review of Current Evidence

Investigation of the current literature focused on home-based or virtual and hybrid delivery formats of CR. An electronic search of databases for research, including the Cochrane Database, PubMed, Ovid, CINHAL, and Google Scholar, yielded approximately 75 titles. Search

limits included a publication date of 2016 and beyond, peer-reviewed, full-text articles published in the English language. Keywords and search terms included "cardiac rehab," "cardiac rehabilitation," "adherence," "enrollment," "participation," "barriers," "randomized control trial," "cardiac rehabilitation utilization," "cardiac rehabilitation uptake," "hybrid cardiac rehab," "virtual cardiac rehab," "home-based cardiac rehab," "cardiac rehab COVID-19", "cardiac rehab smartphone app" and "cardiac rehab app." The majority of articles were excluded. Of the results, eight articles were selected for closer consideration to examine the current state of the science and identify possible interventions to promote the utilization of CR (Drwal et al., 2020; Frederix et al., 2015; Harzand et al., 2018; Harzand et al., 2020; Nakayama et al.; Piotrowicz et al.; Thomas et al., 2019; Wakefield et al., 2019).

Interventions to Improve CR Utilization Under the Traditional Model

A comprehensive literature review by Santiago de Araújo Pio et al. (2019) examined 26 randomized control trials aimed at increasing the enrollment, adherence to, and completion of CR by eligible adults. The review by Santiago de Araújo Pio et al. (2019) carefully examined quantitative research literature through July 2018 and focused on traditional CR program delivery. Additional interventions to promote CR utilization, mentioned in the Cochrane review, include peer support, post-hospital-discharge telephone calls or visits, face-to-face education, starting CR soon after hospital discharge, offering shorter programs, and providing women-only programs (Santiago de Araújo Pio et al., 2019). Although several interventions have improved the utilization of traditional CR, the review revealed low-quality evidence due to the wide variety of interventions, limiting the studies' reliability, validity, and generalizability (Santiago de Araújo Pio et al., 2019).

Motivational Interviewing

Additional strategies to increase engagement in CR include motivational interviewing (Rouleau et al., 2018). Rouleau et al. (2018) studied the effects of motivational interviewing to promote the intention to participate in CR. The study results supported the claim that motivational interviewing can increase intentions to attend CR and program adherence (Rouleau et al., 2018). In addition, motivational interviewing is an easily replicated intervention in the virtual setting and presents an opportunity for further research (Snoek et al., 2021).

Strategies for Reaching Under-Represented Populations

Identifiable strategies exist to promote overall participation in traditional CR programs. However, the opportunity remains to address interventions to promote CR utilization, specifically in under-represented groups such as patients of lower socioeconomic status (SES), women, and ethnic minority groups (Santiago de Araújo Pio et al., 2019). Unfortunately, few studies have explored the effects of strategies to promote participation in CR in these under-represented groups, and those that have focused on somewhat non-traditional approaches, including financial incentives and "open-gym" models (Gaalema et al., 2019; Whited et al., 2019).

Financial Incentives

Gaalema et al. (2019) explored financial incentives to increase participation and promote CR adherence among low SES populations. Though the study found financial incentives useful in promoting CR participation, the authors recommended further testing to establish reliability and generalizability (Gaalema et al., 2019).

The "Open Gym" Model

Whited et al. (2019) examined the impact of CR's "open gym" model on completion, attendance, and health outcomes. The open gym model provides a more flexible, less structured

format versus the traditional model of CR. While clinical outcomes favored the traditional CR model, more patients, particularly individuals of racial minority groups, participated in the open gym model (Whited et al., 2019). The results of this study provide insight into the benefits and potential risks associated with the open gym model of CR (Whited et al., 2019). The authors concluded the need for more controlled experiments to better examine the open gym model (Whited et al., 2019). However, like the hybrid and virtual models, the open gym model offers another alternative to the traditional CR model and may increase patient participation.

The success of Virtual and Smartphone Enabled Programs

Virtual CR provides an opportunity to reach a more diverse patient population, allowing for greater overall participation in CR. The Veteran's Health Administration (VHA) successfully pioneered a HBCR program beginning in 2010 (Drwal et al., 2020; Wakefield et al., 2019). In addition, many programs outside of the VHA now incorporate a home-based or hybrid model as an alternative to the traditional model (Drwal et al., 2020). However, the lack of standardized guidelines, reimbursement, and evidence of effectiveness, particularly in high-risk populations, remain barriers to these programs' success (Drwal et al., 2020).

Strategies for telehealth

Tele-Coaching, Functional Ability, and Quality of Life

Virtual CR may provide similar emotional and physical benefits to traditional CR. Frederix et al. (2015) explored tele-coaching as a component of virtual CR. Like the strategy of motivational interviewing to promote participation (Rouleau et al., 2018), a comprehensive virtual CR program that incorporates tele-coaching could improve physical health and quality of life compared to center-based cardiac rehab (CBCR) alone (Frederix et al., 2015).

Smart Phone- Enabled CR Programs

Mobile technology-enabled CR may also represent a viable alternative to traditional CR programs (Harzand et al., 2018). Harzand et al. (2018) explored the feasibility of a Smartphone-enabled CR program for veteran men with CVD. The findings were consistent with previous studies on home-based CR. Overall, HBCR corresponded with high levels of patient engagement and satisfaction; however, the study's small sample size and homogenous population limit its generalizability (Harzand et al., 2018).

In an ongoing study, Harzand et al. (2020) continue to explore using a smartphone-enabled, home-based exercise program in patients with symptomatic peripheral arterial disease (PAD) in a low-income setting. It is important to note that patients with PAD often attend CR facilities for exercise rehabilitation. While not focused explicitly on CR patients with coronary artery disease, this study has the potential of providing evidence to support the use of a home-based approach for delivering a structured exercise rehabilitation program (Harzand et al., 2020).

Evidence to Support HBCR as An Alternative to Center-Based CR

In 2019, Thomas et al. issued a scientific statement from the American Association of Cardiovascular and Pulmonary Rehabilitation, the American Heart Association, and the American College of Cardiology, highlighting evidence to support HBCR as an alternative to CBCR for low-moderate risk patients (Thomas et al., 2019). The statement suggested that programs can and should apply these evidence-based standards and guidelines to HBCR (Thomas et al., 2019). In addition, as the technology for HBCR develops, quality metrics should include implementation standards and measurable outcomes (Thomas et al., 2019). The authors note that despite these recommendations, the lack of reimbursement hinders the widespread standardization and implementation of HBCR (Thomas et al., 2019). An additional review of the current literature by Besnier et al., 2020, supported the use of HBCR in the face of the COVID-

19 pandemic (Besnier et al., 2020). The review focused on the importance of developing and promoting HBCR to expand access to low-risk clinically stable cardiac patients if the Centers for Medicare and Medicaid Services are to consider reimbursement for these services in the future (Besneir et al., 2020).

When considering the long-term effects of virtual CR, Piotrowicz et al. (2020) studied whether individuals with heart failure who showed improvements in functional ability and quality of life following a nine-week comprehensive virtual CR program also showed improvements in clinical outcomes after 12-24 months (Piotrowicz et al., 2020). Unfortunately, the results did not support improved clinical outcomes over an extended follow-up period (Piotrowicz et al., 2020). However, Nakayama et al. (2020) evaluated the effects of remote CR on the short-term prognosis of patients hospitalized for heart failure post-discharge. The study revealed a lower emergency readmission rate within 30 days of hospital discharge among remote CR participants (Nakayama et al., 2020). Thus, they found virtual CR to be as effective as outpatient CR for improving the short-term prognosis of patients with heart failure post-hospital discharge (Nakayama et al., 2020). Therefore, increasing participation in CR could potentially help decrease 30-day hospital readmission rates for patients with heart failure.

The evidence to date suggests that home-based or virtual CR may be as effective as the traditional model of CR. However, further research is needed to compare the virtual and traditional CR formats. Assessing these models' impact may help standardize the implementation of virtual and traditional CR and facilitate reimbursement for these services (Thomas et al., 2019).

Conceptual Framework/Theoretical Model

Nola J. Pender's Health Promotion Model (1987) identifies health promotion as a process of behaviors and experiences to increase well-being and self-actualization (Raingruber, 2017). Individual experience, perceptions, and prior behavior influence health-promoting behaviors through habit formation, directly affecting current behavior and decision making (Masters, 2015; Raingruber, 2017). Behavior-specific cognitions, such as perceived benefits, can motivate behavior, provide reinforcement, and promote behavioral changes while increasing self-efficacy and improving health outcomes (Masters, 2015). Behavioral outcomes rise from action plans or engagement in health-promoting behavior, characterized by commitment and action (Raingruber, 2017). CR presents an opportunity for self-actualization while promoting behavioral changes as individuals develop exercise habits, a healthy diet, and self-awareness. These lifestyle modifications require a commitment to an individual action plan to achieve improved health outcomes, particularly in a virtual CR format where the individual's participation and motivation are primarily self-directed.

Methods

Using a convenience sample, the PI examined de-identified retrospective quantitative data using a pre-post-outcome measurement design. The PI collected de-identified retrospective data, including exercise tolerance measured as distance achieved in a pre-and post-six-minute walk test at two time points, program start and program end, and the quality of life index score measured at program start and program end.

Design

Translational Framework

The John's Hopkins Nursing Evidence-Based Practice Model (see Appendix D & E) consists of three main components: inquiry, practice, and learning (Dang & Dearholt, 2018). These components collectively build a foundation for organized evidence-based practice and serve as drivers for practice change to improve clinical outcomes (Dang & Dearholt, 2018). The stepwise process begins with forming a practice question, followed by a review and appraisal of current evidence, and, finally, the translation or implementation and subsequent evaluation of the practice change (Dang & Dearholt, 2018). Thus, this model provides a structured outline to support a program evaluation of existing practice and recommendations for future change, in this case, delivering a virtual format for HBCR compared to a traditional model.

Population

The PI collected de-identified retrospective data about eligible participants in the virtual and traditional phase II CR programs at the site (refer to "data collection" section). A convenience sample included patients enrolled in the virtual and traditional Phase II CR programs at the time of the first data collection point, program start, or 0 weeks. The sample size included 32 participants ($n=32$). Inclusion criteria consisted of all patients ages 18 and above, newly enrolled in the virtual and traditional CR programs at the site at the time of the first data collection point, regardless of race/ethnicity. Exclusion criteria included patients enrolled in the virtual and traditional CR programs before or after the data collection period.

Setting

The site met the national certification requirements for accreditation by the American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR). The multidisciplinary team at the site consisted of cardiologists, registered nurses, exercise physiologists, and

registered dieticians. The facility offers eligible participants a traditional, transitional hybrid, and virtual phase II CR program. The Nurse Navigator for Cardiac and Pulmonary Rehab served as the site liaison. In addition, the site liaison provided a letter supporting this project, including permission to conduct the program evaluation at the site.

Project Implementation

Instruments

The AACVPR certifies and recognizes CR programs while tracking performance measures such as improved functional capacity and quality of life (Beatty et al., 2021). Following a series of in-person and video conference discussions with the site liaison and departmental leadership, the interdisciplinary team selected two instruments to measure patient outcomes, the 6-minute walk test (see Appendix A) and the Ferrans and Powers Quality of Life Index (1985; see Appendix B).

The 6-minute walk test is a commonly used, highly validated tool that measures the distance an individual can walk in six minutes (American Thoracic Society [ATS] Board of Directors, 2002). The test also assesses the physiological response to activity by measuring a patient's oxygen saturation, heart rate, and blood pressure (ATS Board of Directors, 2002). The patient then rates their overall level of fatigue using the Borg Rating of Perceived Exertion Scale (RPE; see Appendix C), which asks the patient to rate their fatigue on a number scale from six to 20 (ATS Board of Directors, 2002; Mellett & Bousquet, 2013). This tool is widely used in the clinical setting and has measured test-retest reliability (Harzand et al., 2020).

The Ferrans and Powers Quality of Life Index (1985; see Appendix B) is another commonly used, validated tool that measures both satisfaction with and importance of various areas of life (Ferrans & Powers, 1985). The questionnaire measures satisfaction and importance using a six-point Likert-type scale ranging from “very satisfied” to “very dissatisfied” or “very

important" to "very unimportant" (Ferrans & Powers, 1985). A scoring process results in a final score ranging from zero to 30, with higher scores indicating a greater quality of life (Ferrans & Powers, 1985). In addition, the tool has criterion-related validity, stability reliability, and internal consistency reliability (Ferrans & Powers, 1985). Both instruments align with the core components of CR and are used in the AACVPR data registries and at the study site (Pack et al., 2018).

IRB approval

The university's Institutional Review Board (IRB) and the site's IRB deemed the study exempt.

Data collection

The PI compared two sets of de-identified retrospective data collected at program start and end for each participant that met the inclusion criteria in the virtual and traditional CR programs. Data collection occurred over 13 months, from January 2021 to February 2020. Data for each participant spanned an average program participation length of 11.4 weeks. The data sets included distance (in feet) walked in a pre-post-six-minute walk test as well as a pre-and post-test score for the Ferrans and Powers Quality of Life Index for both virtual and traditional CR groups. De-identified demographic information included gender, race, age by category, insurance, and qualifying medical diagnosis. The site liaison accessed data using the Chanl Health Better Hearts App, the electronic medical record, and the American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR) outpatient CR registry. No individual data or PHI was shared with the PI or faculty advisor.

The site liaison reported and shared all data with the PI as de-identified data. The PI stored de-identified data in a UNCG-specific BOX site accessible only to the PI, site liaison, and university statistician. The site liaison uploaded the file to BOX.uncg.edu (a secure one-lock

system) for the PI to check data and for backup during the DNP project. BOX is rated a "one-lock" and is secure as long as files are not synced to a hard drive. The PI managed the data within the cloud and did not sync to a hard drive. In addition, the PI did not use the drive in any unsecured areas, such as coffee shops, where data could be viewed by unauthorized personnel. Only the PI and the DNP faculty project team accessed the anonymous raw data. The site received summary data upon the PI's program completion. The PI deleted all data once the project was completed and disseminated the findings.

Data Analysis

The PI analyzed the descriptive and inferential statistics using Microsoft Excel version 16.58. An available program statistician assisted in comparing de-identified retrospective pre-and-post data. A preliminary two-sample *F*-test for variances determined equal variance for both the walk test score difference and the difference in the quality of life scores pre-and-post for both traditional and virtual groups. A two-sample t-test assuming equal variances compared outcome differences between the virtual and traditional CR program groups.

Outcomes

The final sample size consisted of 32 individuals (n=32), with an equal number of participants in the virtual (n=16) traditional CR groups (n=16). Most participants were white; however, the sample included black and Hispanic individuals. Participant age ranged from 42 to 83 years old. Primary medical diagnoses included myocardial infarction (MI) and percutaneous coronary intervention (PCI). Less common diagnoses included coronary artery bypass grafting (CABG), valve replacement, and heart failure (HF). The majority of participants had insurance. Table 1 shows a summary of the demographic data.

Table 1

Demographics

Variable	***Virtual CR* (*N*=16)**	***Traditional CR* (*N*=16)**
	N (%)	*N* (%)
Gender		
Women	4 (25%)	4 (25%)
Men	12 (75%)	12 (75%)
Age, years		
<45	0 (0%)	1 (6%)
46-55	1 (6%)	4 (25%)
56-65	5 (31%)	2 (13%)
66-75	8 (50%)	7 (44%)
>75	2 (13%)	2 (13%)
Race		
White	13 (81%)	12 (75%)
Black	3 (19%)	3 (19%)
Hispanic	0 (0%)	1 (6%)
Insurance Coverage		
Private	7 (44%)	5 (31%)
Medicare	8 (50%)	3 (19%)
Other	0 (0%)	8 (50%)
None	1 (6%)	0 (0%)
Qualifying Diagnosis		
MI/PCI	12 (75%)	8 (50%)
CABG	3 (19%)	3 (19%)
HF	0 (0%)	2 (13%)
Valve replacement	0 (0%)	2 (13%)
Other	1 (6%)	1 (6%)

Tables 2 and 3 show results from a two-sample *t*-test comparing the difference in walk test distance in feet and the difference in the quality of life scores pre-and post-intervention between the virtual and traditional CR groups, with an alpha of p=.05.

Table 2

t-Test: Two-Sample Assuming Equal Variances
Difference in Walk Test Scores

	Traditional CR	*Virtual CR*
Mean	231.1	169.2
Variance	43682.7	46758.7

Observations	16	16
Pooled Variance	45220.7	
Hypothesized Mean Difference	0	
df	30	
t Stat	0.8230	
P(T<=t) one-tail	0.2085	
t Critical one-tail	1.6973	
P(T<=t) two-tail	0.4170	
t Critical two-tail	2.0423	

*p<0.05

Table 3

t-Test: Two-Sample Assuming Equal Variances
Difference in Quality of Life Scores

	Traditional CR	*Virtual CR*
Mean	0.6825	0.0623
Variance	6.0744	2.0493
Observations	16	13
Pooled Variance	4.2855	
Hypothesized Mean Difference	0	
df	27	
t Stat	0.8023	
P(T<=t) one-tail	0.2147	
t Critical one-tail	1.7033	
P(T<=t) two-tail	0.4294	
t Critical two-tail	2.0518	

*p<0.05

There was no significant difference between the walk test score between the virtual (M=169.2 ft) and the traditional (M=231.1 ft) groups (p =.4170) pre-and-post intervention. The difference in the quality of life scores also failed to show a significant difference between the virtual (M=.6825) and traditional groups (M=.0623); (p=.4294) pre-and post-intervention. In both cases, p>.05 revealed no significant difference between the two groups pre-and-post, failing

to reject the null hypothesis that there is no significant difference between the virtual and traditional program groups.

Barriers to success

Despite consistent results when comparing outcomes between virtual and traditional CR program participants, several barriers remain to the successful implementation of virtual CR. While the Covid-19 pandemic sparked the need for alternative CR formats, the pandemic also hindered the development of a virtual CR program in this setting primarily due to staffing shortages and cost concerns. The lack of available staff to support the virtual CR program also contributed to the small sample size, start date delay, and variation in program length for virtual and traditional groups participants. The available technology, in this case, also limited the ability to monitor patients, bringing about safety concerns, particularly for higher-risk patients. Furthermore, exercise was mainly self-reported, which can be highly subjective. Finally, lack of reimbursement remains the ultimate barrier to the further development and standardization of virtual CR in this setting. Unless reimbursement for services occurs, staff cannot provide the same standard of care to patients in the virtual program as in the traditional program.

Strengths to overcome barriers

Despite these barriers, there remain several advantages to virtual CR. Virtual CR provides greater flexibility and can reach patients previously excluded from traditional CR, notably uninsured or underinsured patients when space is limited due to Covid-19 social distancing requirements or when staffing shortages restrict the number of participants in the traditional setting. However, the site found the transition from traditional to virtual CR challenging due to staffing shortages. The development of standardized guidelines and dedicated staff for virtual programs could help ease the transition from traditional to virtual formats in the future.

Discussion

This program evaluation compared exercise tolerance and quality of life index between virtual and traditional CR program groups. The results showed no significant difference between the walk test scores or the quality of life scores between the virtual and traditional groups. The similarity in scores between the virtual and traditional CR groups suggests comparable outcomes for both groups and is consistent with current literature (Besnier et al., 2020; Frederix et al., 2015; Harzand et al., 2018; Harzand et al., 2020; Nakayama et al., 2020; Piotrowicz et al., 2020; Thomas et al., 2019). However, the small sample size and inconsistent time frames for participation limit the reliability and generalizability of this program evaluation. Nonetheless, as a form of health promotion consistent with Nola J. Pender's Health Promotion Model (1987), virtual CR provides a framework that promotes self-motivation and self-actualization, leading to behavioral changes that improve overall outcomes (Masters, 2015). Though ultimately, for practice changes to occur, the health care system must address the lack of sustainability of a virtual CR program under the current structure. The development of standardized guidelines that incorporate the standards of care under the traditional CR model is necessary to strengthen the delivery format of virtual CR (Beatty et al., 2021). Technological advancements for HBCR and quality metrics, such as the AACVPR Registry, should implement these standards and include them as measurable outcomes for virtual programs, which could help justify the reimbursement for virtual delivery formats (Beatty et al., 2021; Pack et al., 2019; Thomas et al., 2019).

Until reimbursement for virtual CR is an option, however, the inconsistencies between virtual and traditional CR remain notable. To minimize these inconsistencies, the Million Hearts collaborative national initiative between the CDC and CMS introduced new standard terminology following the 2020 Million Hearts Cardiac Rehabilitation Think Tank proceedings

while aiming toward a 70% participation rate in CR (Beatty et al., 2021). This new terminology addresses new delivery formats since the Covid-19 pandemic and includes in-person synchronous, synchronous with real-time audiovisual communication (virtual), and asynchronous (remote) formats (Beatty et al., 2021).

Future recommendations for practice changes include the development of CR core components for all program types to standardize delivery regardless of the format (Beatty et al., 2021). Additional recommendations include payer coverage of CR with zero cost-sharing irrespective of delivery format to reduce financial barriers and safety strategies for the virtual and remote formats (Beatty et al., 2021). In addition, more studies like the TELEREH-HF randomized trial (Piotrowicz et al., 2020) should focus on establishing patient eligibility and safety data for virtual and remote formats as well as providing evidence of effectiveness, particularly in high-risk populations ((Beatty et al., 2021; Drwal et al., 2020). Finally, dedicated multidisciplinary teams, including a supervising physician, for the virtual setting are also necessary to provide the standard of care defined by the CR core components (Beatty et al., 2021). Notably, beginning in 2024, non-physician clinicians will also supervise CR sessions (Beatty et al., 2021).

Conclusion

The results of this program evaluation provide additional evidence to support virtual or remote CR program models as a reasonable alternative to the traditional in-person or synchronous CR model. However, the underutilization of CR, which now increasingly includes virtual or remote CR, is an ongoing dilemma that demands attention. Therefore, developing standardized program guidelines for virtual or remote CR formats is necessary to strengthen the delivery of a virtual or remote format for HBCR compared to a traditional in-person synchronous

model (Beatty et al., 2021). In addition, the implementation of standardized program guidelines could support the case for reimbursement for virtual and remote CR and presents an opportunity to promote health equity for underrepresented populations and improve patient outcomes (Beatty et al., 2021).

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Appendices

Appendix A

Six-Minute Walk Test

CONE HEALTH
The Network for Exceptional Care

Cardiac Walk Test Data Sheet

Name: _____ **Diagnosis:** _____

Pre-Test: **Date/Time:** _____ **Height:**_____ **Weight (kg):** _____

Pre: HR: _____ BP: _____ Laps
Post: HR: _____ BP: _____ RPE:_____
2 min Post HR: _____ BP: _____
Distance: _____ **VO2peak:**_____ **METs:**_____ **MPH:** _____
TM:_____ **RB:**_____ **AD:**_____ **AC:**_____
Symptoms: _____

Signature:_____

Post-Test **Date/Time:** _____ **Weight (kg):** _____

Pre: HR: _____ BP: _____ Laps
Post: HR: _____ BP: _____ RPE:_____
2 min Post HR: _____ BP: _____
Distance: _____ **VO2peak:**_____ **METs:**_____ **MPH:** _____
Symptoms:_____

Signature:_____

Balance Assessment/Fall Screening

Single Leg Stand Pre-Test:_____ Single Leg Stand Post-Test: _____

Falls in Past Year: Y / N #_____ >4 Medications: Y / N
Loses Balance w/out Falling: Y / N Difficulty Around Home: Y / N
Changed Routines 2º Balance: Y / N Dizziness/Lightheadedness: Y / N
Assistive Device (Cane or Walker): Y / N Difficulty W/ Stairs/Curb: Y / N
Dx Affecting Mobility: Y / N

Musculoskeletal Evaluation

Orientation Date: _____		**Post-Test Date:** _____	
Waist:_____		Waist:_____	
Hip:_____		Hip:_____	
Triceps:_____		Triceps:_____	
Grip Strength:	(1)_____	Grip Strength:	(1)_____
	(2)_____		(2)_____
	(3)_____		(3)_____
Flexibility:	(1)_____	Flexibility:	(1)_____
	(2)_____		(2)_____
	(3)_____		(3)_____

Orientation Interview

General Mobility:

_____

_____

_____

Treadmill: Y / N

Home Exercise:

_____

_____

_____

Diabetic: Type I / Type II / N/A

Employment:

_____

Hobbies:

_____

Short-Term Goals:

_____

Long-Term Goals:

_____

Signature:_____ **Date:** _____

Appendix B

Ferrans and Powers Quality of Life Index

Ferrans and Powers
QUALITY OF LIFE INDEX©
CARDIAC VERSION - IV

PART 1. For each of the following, please choose the answer that best describes how ***satisfied*** you are with that area of your life. Please mark your answer by circling the number. There are no right or wrong answers.

HOW SATISFIED ARE YOU WITH:	Very Dissatisfied	Moderately Dissatisfied	Slightly Dissatisfied	Slightly Satisfied	Moderately Satisfied	Very Satisfied
1. Your health?	1	2	3	4	5	6
2. Your health care?	1	2	3	4	5	6
3. The amount of chest pain (angina) that you have?	1	2	3	4	5	6
4. Your ability to breathe without shortness of breath?	1	2	3	4	5	6
5. The amount of energy you have for everyday activities?	1	2	3	4	5	6
6. Your ability to take care of yourself without help?	1	2	3	4	5	6
7. The amount of control you have over your life?	1	2	3	4	5	6
8. Your chances of living as long as your would like?	1	2	3	4	5	6
9. Your family's health?	1	2	3	4	5	6
10. Your children?	1	2	3	4	5	6
11. Your family's happiness?	1	2	3	4	5	6
12. Your sex life?	1	2	3	4	5	6
13. Your spouse, lover, or partner?	1	2	3	4	5	6
14. Your friends?	1	2	3	4	5	6
15. The emotional support you get from your family?	1	2	3	4	5	6
16. The emotional support you get from people other than your family?	1	2	3	4	5	6

(Please Go To Next Page)

HOW SATISFIED ARE YOU WITH:	Very Dissatisfied	Moderately Dissatisfied	Slightly Dissatisfied	Slightly Satisfied	Moderately Satisfied	Very Satisfied
17. Your ability to take care of family responsibilities?	1	2	3	4	5	6
18. How useful you are to others?	1	2	3	4	5	6
19. The amount of worries in your life?	1	2	3	4	5	6
20. Your neighborhood?	1	2	3	4	5	6
21. Your home, apartment, or place where you live?	1	2	3	4	5	6
22. Your job (if employed)?	1	2	3	4	5	6
23. Not having a job (if unemployed, retired, or disabled)?	1	2	3	4	5	6
24. Your education?	1	2	3	4	5	6
25. How well you can take care of your financial needs?	1	2	3	4	5	6
26. The things you do for fun?	1	2	3	4	5	6
27. Your chances for a happy future?	1	2	3	4	5	6
28. Your peace of mind?	1	2	3	4	5	6
29. Your faith in God?	1	2	3	4	5	6
30. Your achievement of personal goals?	1	2	3	4	5	6
31. Your happiness in general?	1	2	3	4	5	6
32. Your life in general?	1	2	3	4	5	6
33. Your personal appearance?	1	2	3	4	5	6
34. Yourself in general?	1	2	3	4	5	6
35. The changes in your life that you have had to make because of your heart problem (for example, changes diet, physical activity, and/or smoking?)	1	2	3	4	5	6

(Please Go To Next Page)

PART 2. For each of the following, please choose the answer that best describes how ***important*** that area of your life is to you. Please mark your answer by circling the number. There are no right or wrong answers.

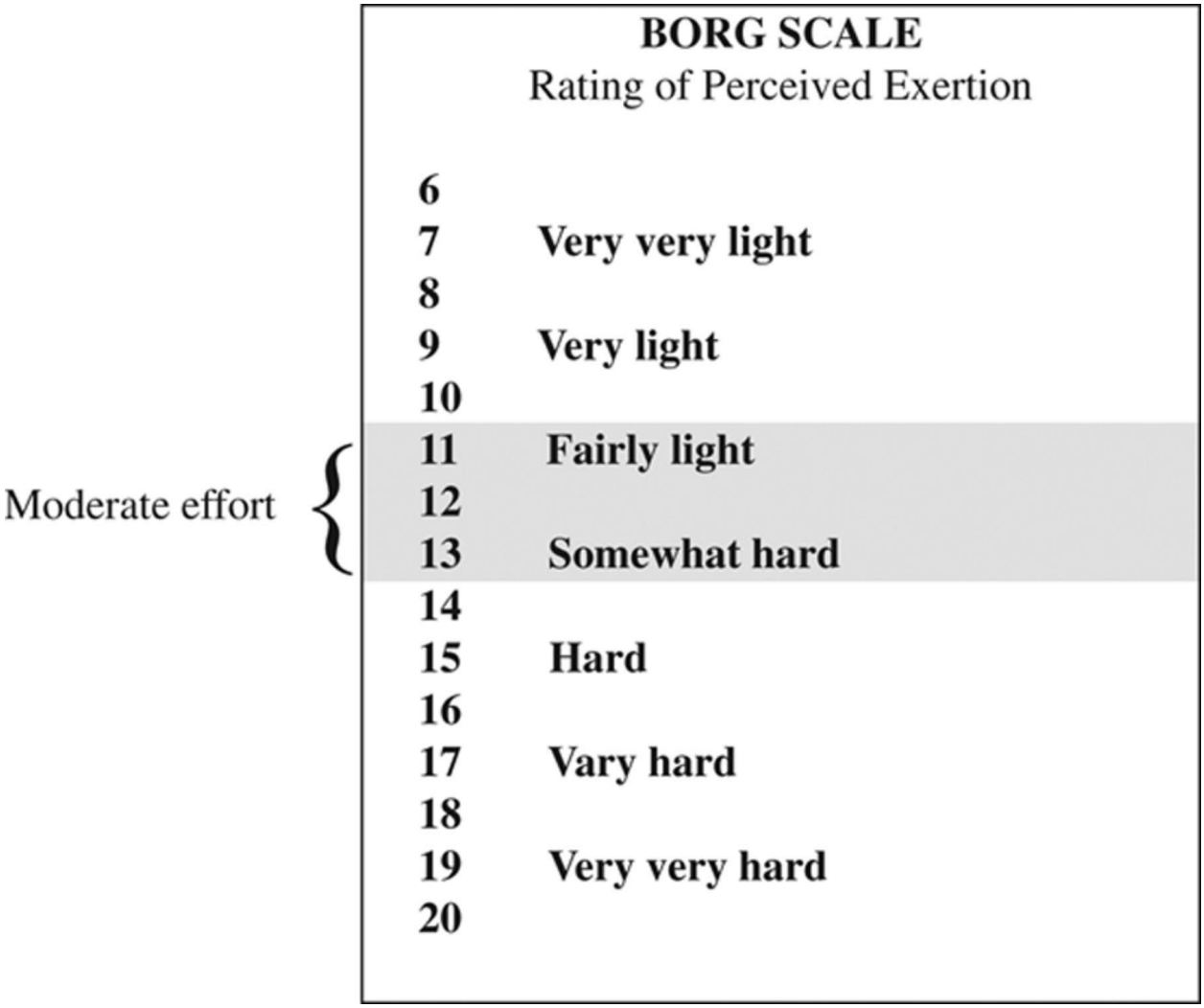
HOW IMPORTANT TO YOU IS:	Very Unimportant	Moderately Unimportant	Slightly Unimportant	Slightly Important	Moderately Important	Very Important
1. Your health?	1	2	3	4	5	6
2. Your health care?	1	2	3	4	5	6
3. Having no chest pain (angina)?	1	2	3	4	5	6
4. Having no shortness of breath?	1	2	3	4	5	6
5. Having enough energy for everyday activities?	1	2	3	4	5	6
6. Taking care of yourself without help?	1	2	3	4	5	6
7. Having control over your life?	1	2	3	4	5	6
8. Living as long as you would like?	1	2	3	4	5	6
9. Your family's health?	1	2	3	4	5	6
10. Your children?	1	2	3	4	5	6
11. Your family's happiness?	1	2	3	4	5	6
12. Your sex life?	1	2	3	4	5	6
13. Your spouse, lover, or partner?	1	2	3	4	5	6
14. Your friends?	1	2	3	4	5	6
15. The emotional support you get from your family?	1	2	3	4	5	6
16. The emotional support you get from people other than your family?	1	2	3	4	5	6
17. Taking care of family responsibilities?	1	2	3	4	5	6

(Please Go To Next Page)

HOW IMPORTANT TO YOU IS:	Very Unimportant	Moderately Unimportant	Slightly Unimportant	Slightly Important	Moderately Important	Very Important
18. Being useful to others?	1	2	3	4	5	6
19. Having no worries?	1	2	3	4	5	6
20. Your neighborhood?	1	2	3	4	5	6
21. Your home, apartment, or place where you live?	1	2	3	4	5	6
22. Your job (if employed)?	1	2	3	4	5	6
23. Having a job (if unemployed, retired, or disabled)?	1	2	3	4	5	6
24. Your education?	1	2	3	4	5	6
25. Being able to take care of your financial needs?	1	2	3	4	5	6
26. Doing things for fun?	1	2	3	4	5	6
27. Having a happy future?	1	2	3	4	5	6
28. Peace of mind?	1	2	3	4	5	6
29. Your faith in God?	1	2	3	4	5	6
30. Achieving your personal goals?	1	2	3	4	5	6
31. Your happiness in general?	1	2	3	4	5	6
32. Being satisfied with life?	1	2	3	4	5	6
33. Your personal appearance?	1	2	3	4	5	6
34. Are you to yourself?	1	2	3	4	5	6
35. The changes in your life that you have had to make because of your heart problem (for example, changes diet, physical activity, and/or smoking?)	1	2	3	4	5	6

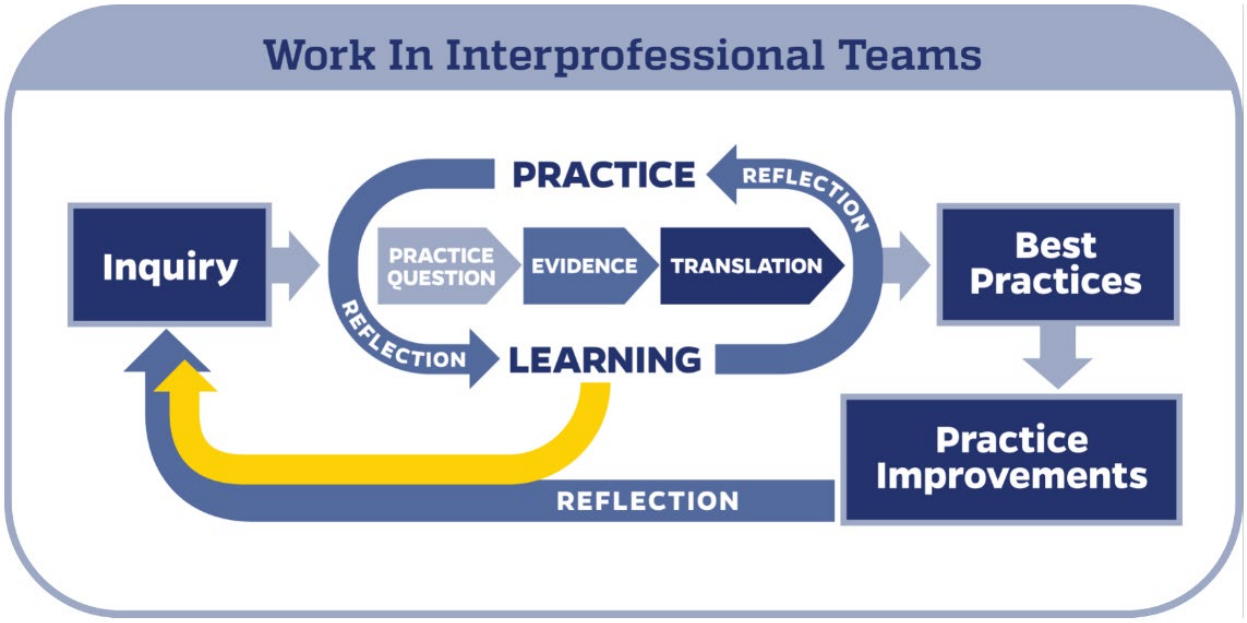
Appendix C

Borg Rating of Perceived Exertion



Appendix D

Johns Hopkins EBP Translational Model



Appendix E

Johns Hopkins Evidence-Based Practice Model for Nursing and Healthcare Professionals

PET Process Guide

Johns Hopkins Evidence-Based Practice Model for Nursing and Healthcare Professionals

PET Process Guide
Appendix A

EBP Work Plan										
Initial EBP question: Enter text										
EBP team leader(s): Enter text										
EBP team members: Enter text										
Goal completion date: Enter text										
Steps		**Month**								
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Practice Question & Project Planning	1. Recruit interprofessional team	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text
	2. Determine responsibility for project leadership	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text
	3. Schedule team meetings	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text
	4. Clarify & describe the problem (App. B)	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text
	5. Develop & refine the EBP question (App. B)	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text
	6. Determine the need for an EBP project	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text
	7. Identify stakeholders (App. C)	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text
Evidence	8. Conduct internal & external search for evidence	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text
	9. Appraise the level & quality of each piece of evidence (Apps. E/F)	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text
	10. Summarize the individual evidence (App. G)	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text
	11. Synthesize findings (App. H)	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text
	12. Develop best evidence recommendations (App. H)	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text
Translation	13. Identify practice setting–specific recommendations (App. I)	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text
	14. Create action plan (App. I)	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text
	15. Secure support & resources to implement action plan	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text
	16. Implement action plan	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text
	17. If change is implemented, evaluate outcomes to determine if improvements have been made	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text
	18. Report results to stakeholders (App. C)	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text
	19. Identify next steps	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text
	20. Disseminate findings (App. J)	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text	Enter text

