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Home-Based Cardiac Rehabilitation Phase II Telemonitoring Efforts In Patients With Post-Cardiovascular Revascularization: Literature Review

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Abstract

Cardiac rehabilitation (CR) programs should be provided to reduce the risk of death and rehospitalization and improve the quality of life in patients who have undergone cardiac revascularization. The innovative CR method will improve long-term adherence to a sustainable active lifestyle on health-related physical fitness, especially cardiovascular health, thereby reducing patient morbidity and mortality. Electronic media (telemonitoring) is a safer alternative to expand the reach of home-based CR, with remote assistance and indirect supervision than CR programs. This paper aims to provide ideas from the results of a literature review regarding cardiac rehabilitation at home using telemonitoring in post-cardiac revascularization patients and the feasibility of using telemonitoring in phase II CR. Article searches were carried out on the Google Scholar search engine by filtering articles based on keywords, year of publication, article title, abstract, and the entire contents of the article, resulting in 10 journals used as a literature review. The latest technology regarding home-based cardiac rehabilitation for post-cardiovascular revascularization patients is starting to be implemented in various countries. Mobile technology that can be used for home-based cardiac rehabilitation phase II includes mobile health applications, health websites, and messaging applications (chat, telephone, and video calls). The application of this cellular technology can be applied in home-based cardiac rehabilitation phase II because it is effective, efficient, cheap, and useful.

Background

Patients with post-cardiovascular revascularization are patients with coronary heart disease, myocardial infarction (MI), acute coronary syndrome (ACS), angina pectoris, and/or patients who have undergone revascularization (percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG).)) (Ramachandran et al., 2022). In patients who have undergone revascularization, a comprehensive cardiac rehabilitation program (home-based or centre-based) should be provided either before hospital discharge or during the first outpatient visit to reduce the risk of death and rehospitalization and improve quality of life (Lawton et al., 2022).

Cardiac rehabilitation (CR) is therapy in the secondary prevention of coronary heart disease (CHD) and is divided into three main phases: Phase 1/acute phase (early mobilization during hospitalization, 2-5 days); Phase 2/ subacute phase (rehabilitation services provided in an outpatient setting that focuses on health behaviour change, risk factor modification, and psychosocial well-being, 1-3 months); and Phase 3/ Self-Care (long-term maintenance of lifestyle changes, > 3 months) (Ambrosetti et al., 2021).

Innovative CR methods are needed to improve long-term adherence to a physically active lifestyle that will produce more sustainable effects on health-related physical fitness and cardiovascular health, thereby reducing patient morbidity and mortality (Avila et al., 2020). Electronic alternative CR, supported by electronic health or mobile health (mHealth), provides new strategies to promote access, adherence, and effectiveness (Lao et al., 2023). Electronic

health (mHealth) is evolving as an umbrella term reflecting the use of information and communications technology for health purposes, including electronic medical records, telemedicine, and mobile health (mHealth) (SU et al., 2023).

One interesting strategy is the use of home-based exercise training in combination with telemonitoring guidance. Rehabilitation telemonitoring i.e. patients are prescribed a home-based exercise regimen with remote monitoring using face-to-face-based technology (telephone, cell phone/smartphone, mobile application (app), instant messaging service, web-based application, portable computer, video conferencing, internet and biosensors). This monitoring includes communicating with patients and providing them with regular feedback (Bashir, Shahab, & Imran, 2022).

Telemonitoring Home-Based CR can be a safe alternative to expand the reach of home-based CR, with remote assistance and indirect supervision than traditional CR programs and can increase patient compliance with CR programs. The purpose of this paper is to identify the use of Telemonitoring Home-Based Cardiac Rehabilitation Phase II and its advantages and limitations for patients with Post Cardiovascular Revascularization to increase patient compliance with the CR program thereby reducing the risk of death and re-hospitalization and improving the patient's quality of life.

Methods

The research was conducted using a literature review method to describe phase 2 cardiac rehabilitation with telemonitoring in reducing the risk of death and re-hospitalization and improving the patient's quality of life, with the following criteria:

1. Article Type
   The author does not limit the types of articles, all types of articles can be sources for literature reviews that can describe Telemonitoring Home-Based Cardiac Rehabilitation Phase II in Patients with Post Cardiovascular Revascularization.
2. Search Strategy
   The author uses the keywords "home-based, cardiac, rehabilitation, healthy lifestyle, phase II, PCI" to collect articles that are relevant to the research.
3. Article Selection
   Article selection is carried out by searching for articles on the Google Scholar search engine and narrowing several search criteria by limiting the year the article was published, then screening the title, screening the abstract, reading the contents of the entire article, and reducing articles that are reviews of several other articles.
4. Analysis of Results
   Analysis of the results is described through a table of journal search results

Results and Discussion

The following are selected journals that were used as references in compiling this literature review:

Table 1 Selected journals for literature review references

No.	Author/Year	Journal Name	Research Place	Research Objectives	Research Methods	Research Results
1.	Bryant et al., 2022	*Journal of Medical Systems*	United States	This program can provide an alternative home-based form of Cardiac	*retrospective study*	The patients reported changes in health status. This shows that continuation of care

No.	Author/Year	Journal Name	Research Place	Research Objectives	Research Methods	Research Results
				Rehabilitation that is safe and usable		after CABG can be carried out effectively through Telerehabilitation.
2.	Pakrad et al., 2021	*Archives of Physical Medicine and Rehabilitation*,	Iran	to test whether the CR (cardiac rehabilitation) hybrid model with an additional 3 months with a remote method based on the continuous care model (CCM) is superior to traditional CR on QOL (quality of life) and functional capacity (primary outcome), indicators of psychosocial well-being (depression, anxiety, stress), and rehospitalization (secondary outcome) in low-resource settings.	*Randomized Controlled Trial*	This trial demonstrated that applying CCM to CR in a hybrid model resulted in clinically significant improvements in quality of life and functional capacity, as well as reduced readmission rates. CCM positively influences patients' perceptions of quality of care, continuity and their beliefs about CR.
3.	Imran et al., 2021	*Journal of the American Heart Association*	Boston, United States	This study aimed to determine whether the use of mobile technology increases compliance with cardiac rehabilitation and increases the number of sessions attended, as well as whether it increases the prevention of cardiovascular disease	*A Propensity Score-Matched Study*	We found that those in the mobile technology CR (cardiac rehabilitation) group attended a higher number of prescribed sessions, were 1.6 times more likely to complete the CR program, and had slightly greater weight (pounds) loss after rehabilitation compared with those in the standard CR group; other results were similar between the groups.
4.	Ma et al., 2021	*Frontiers in Cardiovascular Medicine*	China	to evaluate the impact of Major Adverse Cardiac	*a prospective observational cohort study*	This model of HBCR administered via

No.	Author/Year	Journal Name	Research Place	Research Objectives	Research Methods	Research Results
				Events (MACE) with a follow-up of up to 42 months, along with other clinical outcomes, including cardiovascular disease risk factors, exercise capacity, quality of life, and psychological outcomes in a Chinese population.		smartphone using the WeChat application in China showed a significant reduction in MACE in the HBCR group compared with the control group, confirming the clear benefit of HBCR during the follow-up period was 24–48 months
5.	Lao et al., 2023	*Journal of Cardiovascular Nursing*	Macao, China	to assess the effectiveness of mHealth Cardiac Rehabilitation (mCR) in a mobile application (app), compared with usual care, on levels of anxiety and depression, exercise capacity, physical activity levels, cardiovascular risk modification, self-efficacy, quality of life, medication adherence, and utility health care among patients with PCI in Macau	*single-blinded, 2-arm, randomized controlled trial*	There were significant improvements in reducing total and LDL cholesterol, improvements in 6 MWT, reduced levels of anxiety and depression, and increased self-efficacy in heart activity, diet, and healthy living habits.
6.	Lao & Chair, 2022	*International Journal of Qualitative Studies on Health and Well-Being*	Macao, China	To determine the feasibility of electronic applications in Cardiac Rehabilitation in patients after percutaneous coronary intervention (PCI).	*descriptive qualitative approach dengan semi-structured interviews*	These findings provide insight for cardiac healthcare providers to understand the feasibility of mHealth applications in Cardiac Rehabilitation phase II in Macau. The mCR app facilitates CR engagement that contributes to health and well-being by promoting CHD and CR knowledge, and

No.	Author/Year	Journal Name	Research Place	Research Objectives	Research Methods	Research Results
						heart-healthy lifestyle modifications.
7.	Batalik et al., 2021	*Journal of Clinical Medicine*	Republik Ceko	to find out whether training with telehealth versus outpatient in phase II Cardiac Rehabilitation is different.	*prospective, single-center, two-arm randomized, controlled trial*	This study shows that telehealth Cardiac Rehabilitation with strong intensity can be carried out effectively in CAD patients if initial symptom assessment and cardiopulmonary exercise testing (CPET) are carried out.
8.	Arjunan & D'Souza, 2021	*Clinical Epidemiology and Global Health*	India	To assess the efficacy of nurse-led cardiac rehabilitation on healthcare behaviours in adults with chronic heart failure	*An experimental design*	Results showed nurse-led cardiac rehabilitation had improved compliance with controls, medications, weight checks, sodium restriction, fluid restriction, exercise, smoking cessation, and lifestyle modification at posttest 1 and posttest 2 for adults in the intervention group. This means there was better adherence efficacy and healthcare behaviour in the intervention group.
9.	SU et al., 2023	*Heart and Lung*	China	This study aimed to explore the experiences of patients participating in the nurse-led eHealth cardiac rehabilitation (NeCR) program	descriptive qualitative design with semi-structured individual in-depth interviews	The findings suggest that NeCR helps patients manage the disease and assess the prognosis. Patients recognize that NeCR becomes a peer networking platform to build connections and reciprocal relationships for behaviour change. Findings revealed that NeCR provides

No.	Author/Year	Journal Name	Research Place	Research Objectives	Research Methods	Research Results
						a proactive and responsible network for post-discharge consultations that supports patient disease management.
10.	Vonk et al., 2021	*BMJ Open Sport and Exercise Medicine*	bagian tenggara Belanda	This study will assess the effects of additional home-based training modules during CR and post-CR on habitual levels of physical activity among coronary artery disease patients.	*randomised controlled trial*	The Cardiac RehApp study provides detailed insight into the acute and long-term effects of objectively measured physical activity and a less active lifestyle on four different CR programs. The Cardiac RehApp study has an extensive measurement protocol that allows detailed phenotyping of CR-induced changes in cardiovascular risk factors across multiple domains (i.e., behaviour, biomarkers, fitness, mental health)

The table above shows several of the latest technologies regarding home-based cardiac rehabilitation for post-cardiovascular revascularization patients. This technology has begun to be applied in many countries in the world and its use has increased since the Covid-19 pandemic began in 2020.

The use of cellular technology in home-based cardiac rehabilitation phase II is closely related to education level, age, and ownership of mobile devices. Most studies include the ability to use a computer, tablet, or smartphone, or having a family member to help them, as inclusion criteria in the study. In research in Macao, China, out of 180 respondents, 40 respondents were not included in the study, 26 of them because they were not smartphone users. (Lao et al., 2023).

Mobile technology that can be used for home-based cardiac rehabilitation phase II includes mobile health applications, health websites, and messaging applications (chat, telephone, and video calls). Mobile health apps are flexible platforms for providing patient education, monitoring physical activity, exchanging patient data, and providing real-time communication and clinical support, and are a better form of telemedicine that can be provided to patients compared to phone call-based care or text messages (Ma et al., 2021). Health websites focus on knowledge, education, and learning, and integrate individualized and comprehensive interventions that include educational, cognitive, and psychological elements (Duan et al.,

2018). The WeChat messaging application is a social application that is widely used as the main tool for providing HBCR (home-based cardiac rehabilitation) with tele-education, telecommunications, telemonitoring and data transfer functions. (Ma et al., 2021).

Other telemonitoring media that can be used in cardiac rehabilitation include educational modules containing educational material; a physical exercise data collection module; and a reminder module, to remind patients of upcoming clinic visits (Ma et al., 2021). In applications, websites and messaging applications educational videos are also provided covering how to do physical activity and appropriate exercise (type of exercise, duration, intensity) (Ma et al., 2021). Educational videos may also include disease knowledge and risk factor modification; illness-related self-care, medication adherence skills, and chest pain management; physical exercise for heart health; heart-healthy diet; and stress coping skills and psychological support (SU et al., 2023).

Telemonitoring refers to the use of technology in cardiac rehabilitation phase II to monitor and improve long-term adherence to a physically active lifestyle, which will result in a more sustainable effect on health-related physical fitness and cardiovascular health, thereby reducing morbidity and mortality. This telemonitoring includes heart rate monitoring and how to upload physical activity in the application, then there is a feedback session via telephone or email including monitoring injuries during training, exercises that have been carried out during the previous week, training programs regarding duration and intensity, as well as compliance and obstacles if There is (Avila et al., 2018).

Mobile technology specifically related to cardiac rehabilitation is mentioned in Telehealth CR (cardiac rehabilitation) in the United States, where patients connect with a physical therapist (PT) via a secure Veterans Health Administration internet connection (VA Video Connect, VVC) from their home using a computer, tablet/iPad, or smartphone (Bryant et al., 2022a). In the United States, there is also mobile technology in the form of an application called Welframe App. The app features an interactive daily list of written and video-based educational and support materials that have been developed based on evidence-based, peer-reviewed guidelines and literature, as well as two-way messages that comply with the Health Insurance Portability and Accountability Act (HIPAA) between patients. and cardiovascular rehabilitation program staff (Imran et al., 2021).

Extended Hybrid CR is implemented in Iran, namely CR with an additional 3 months remotely based on a continuous care model (CCM) with an application on a cell phone. This application contains educational content about heart disease (including videos about heart attacks), controlling risk factors with medication (HT, cholesterol, blood sugar), controlling lifestyle risk factors (diet, dangers of smoking, smoking cessation strategies, and stress management), and cardiac resuscitation. This application is also a medium for communication with the care team if the patient needs help (Pakrad et al., 2021).

CR technology with smartphones in China, one of which uses the WeChat application. This technology was developed by Halents Life-Info Technologies. This application contains several modules, including electronic medical management (EMM) software, educational modules that display educational materials; an exercise data collection module, which collects data from wearable devices; and a reminder module, to remind patients of upcoming clinic visits (Ma et al., 2021). Another application developed in China is mHealth. mHealth applications are typically used in mobile phones, monitoring devices, personal digital assistants, and other wireless devices. The three core features of mHealth-based electronic health and cardiovascular

rehabilitation (mCR) are patient education, task reminders, and self-inputting health data. Components of electronic cardiovascular rehabilitation, including physical exercise, healthy diet, cardiovascular risk modification, and psychosocial support (Lao et al., 2023).

The mHealth application is also used in the Netherlands, namely the Welfaster ApS smartphone application in Denmark. This application is capable of displaying various training programs, including strength and aerobic exercises such as squatting, walking, and running, and provides instructions in the form of video, text, and audio during exercise (Vonk et al., 2021). Telehealth in the Czech Republic contains a guide with telephone consultations. Researchers supervised participants' exercise sessions and analyzed training data, exercise adherence records (intensity and duration), and the occurrence of exercise-related adverse events consulted via the web. (Batalik et al., 2021).

Nurse-led eHealth in India contains educational and practical components including recommendations on diet, physical exercise, medication use, weight monitoring, smoking cessation, sodium restriction, fluid restriction, and lifestyle modification. The virtual educational video entitled 'Healthy Ways for a Healthy Heart', focuses on educational and practical components to be adapted to the needs of patients in the intervention group (Arjunan & D'Souza, 2021). Nurse-led eHealth is also being implemented in China, allowing patients to access educational information, learn skills, upload real-time health data with biofeedback, get personalized instructions, and receive ongoing social support. These technologies also enable a patient-focused and self-paced approach by enabling individualized settings (e.g., personal goals) and progress tracking/visualization on a personal homepage (SU et al., 2023).

Existing mobile applications can be applied to patients who have undergone cardiac revascularization, have completed phase I rehabilitation, and will undergo phase II cardiac rehabilitation. The application used is expected to contain disease-related education, physical activity guidance, consultations regarding lifestyle changes, recording of patient symptoms, and monitoring or consultation regarding achievements during rehabilitation or complaints experienced by patients while undergoing cardiac rehab at home. The application can be given when the patient completes phase I rehabilitation before the patient goes home from the hospital.

Advantages of phase II cardiac rehabilitation with cellular technology:

1. Effective
   Remote cardiovascular rehabilitation programs are interactive, supervised, and self-monitored sessions with a physical therapist (PT). This shows that continuation of care can be carried out effectively through Telerehabilitation (Bryant et al., 2022). Smartphone-based cardiovascular rehabilitation facilitated by social networking applications (WeChat) is effective in reducing major cardiovascular events, increasing exercise capacity, and controlling risk factors (Ma et al., 2021). mCR is feasible and effective in supporting the primary goals of cardiovascular rehabilitation and adherence to cardiovascular health recommendations (Lao et al., 2023).
2. Efficient
   Remote media can make it more cost-efficient so that cardiovascular rehabilitation doses can be increased (Pakrad et al., 2021).

3. Easy

In this feasibility study, 83% of patients reported a positive or very positive experience, and 93% of patients said that the app made it easier to comply with cardiovascular rehabilitation activities (Imran et al., 2021).

4. Helpful
   The healthcare behavioural components in the intervention group gradually increased from pre-test to post-test 1 and post-test 2. This suggests that the 3-month and 6-month nurse-led cardiac rehabilitation programs were beneficial for improving healthcare behaviour and compliance. in adults with chronic heart failure (Arjunan & D'Souza, 2021).

Limitations of phase II cardiac rehabilitation with cellular technology:

1. 1. Must have a smartphone to access the application. Bryant et al., 2022 stated that one of the inclusion criteria is having the ability to use a computer or tablet, or having family members who can help them. Pakrad et al., 2021 listed no smartphone as an exclusion criterion in the study. In their research, Lao et al., 2023 and Ma et al., 2021 stated that the inclusion criteria also required ownership of a smartphone.
2. 2. Must have an internet connection to be able to connect to the website or chat media. Ownership and literacy in information and communication technology (personal computer, telephone or cellular connection, and internet access) is a requirement to participate in research according to Batalik et al., 2021.
3. Must have a weighing machine or medical device for independent HR measurement at home (Arjunan & D'Souza, 2021)

Conclusion

Integration of the use of mobile-based technology in phase II cardiac rehabilitation with telemonitoring can be used to improve patient compliance at home. Mobile-based technology includes education in the form of modules or videos, guidance on physical activity at home, motivation for controlling risk factors, motivation for lifestyle changes, consultations, and diaries covering patient achievements and compliance. Implementation of phase II cardiac rehabilitation with telemonitoring can be useful in reducing patient mortality and morbidity.

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