

Current status and future directions of cardiac rehabilitation program: a review of the literature

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ABSTRACT

One of the effective treatments for patients recovering from acute cardiac illness or surgery is cardiac rehabilitation (CR). CR has proven to be effective to reduce mortality, morbidity, and also to improve the quality of life. The purpose of this review is to present the current status of CR program worldwide as well as to identify a potential approach for further investigation. Literature searching of electronic databases was conducted in several databases including CINAHL, MEDLINE, PsycINFO, and EMBASE, and Google Scholar. CR aims to restore patients with CVD to a state of good health. Each country has different approach in the provision and organization of CR as well as the allocation of resources, which depends on their health policies and politics. The indications for CR also differ between countries, but traditionally CR has been used following acute myocardial infarction (MI). CR programs have been divided into three phases of progression. Hospital-based or supervised site-based programs have been known as the most common model of CR in most countries. The core components of CR include patient assessment, nutritional counselling, exercise training, physical activity counselling, weight management, tobacco cessation, aggressive coronary risk-factor management, and psychosocial management. Despite the apparent benefits of CR in patients with CVD, these programs remain largely underused. The participation rates in the USA, Australia, and Europe are low, estimated at 10-30%. New research areas that explore new ways of CR delivery to improve referral and participation rates are essential.

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1. Introduction

Cardiovascular disease (CVD) has been identified as the leading cause of mortality and morbidity in the world. The World Health Organization (WHO) reported that approximately one-third of the annual deaths in the world is due to CVD. According to the 2010 mortality data published in the 2014 Heart Disease and Stroke Statistics, more than 2,150 Americans die of CVD each day, accounting for 34% of total deaths in the United States (US) (Go et al., 2014). Coronary heart diseases (CHD) alone caused approximately one of every six deaths in the United States (US) in 2010 (Go et al., 2014).

In the United Kingdom (UK), CVD causes more than a quarter of all deaths or approximately 160,000 deaths each year. CHD is responsible for around 73,000 deaths in the UK annually or an average of 200 people each day. These rates are almost similar to most European countries. Based on the data compiled by the European Heart Network (EHN) for 2012, the annual mortality of CVD exceeds 4 million or approximately 47% of total death in Europe and over 1.9 million (40% of all deaths) in the European Union (EU). Considering CHD as a singular entity, there were 19% of male

deaths and 17% of female deaths before the age of 75 attributable to CVD. The phenomenon of increasing trend of CHD also takes place in Asian countries. In Indonesia, CVD causes approximately 37% of total death each year (Kemenkes, 2018). In India and Japan, the mortality rates from CVD were significantly lower than those in high and middle-income countries. Nevertheless, there has been an increasing trend in CVD mortality (Goto, 2014). Moreover, the prevalence rates of CVD have more than tripled in the last 50 years. Several factors such as diabetes mellitus, smoking, alcohol consumption, unhealthy diet, and physical inactivity are responsible for 80% of CHD and stroke (BHF, 2015)

Considering the increasing burden of CVD across the globe, primary and secondary prevention both play a vital role. One of the effective treatments for patients recovering from acute cardiac illness or surgery is cardiac rehabilitation (CR). The US Public Health Service defined CR as a long-term, comprehensive program involving medical evaluation, prescribed exercise, cardiac risk factor modification, education, and counselling. Therefore, the term cardiac rehabilitation program should not be merely associated with an exercise training program alone. CR should also include a multifaceted and multidisciplinary strategy to overall cardiac risk reduction (American Association for Cardiovascular Prevention and Rehabilitation, 2013; Leon et al., 2005).

A vast number of studies has already been carried out to assess the effectiveness of CR programs. CR has proven to be effective to reduce mortality rates among those who attend by 26%, to reduce morbidity, and also to improve the quality of life (Taylor et al., 2004). Despite these recognized benefits, attendance rates at CR are relatively poor in most countries. The estimated participation rate of CR was only 10%-30% (Humphrey et al., 2014; Grace et al., 2014) or 25%-32.4% (Taylor et al., 2004) of the total eligible patients per year. Poor referral systems, poor patient motivation, geographic accessibility to program sites, and lack of funding or health insurance coverage have been identified as the major causes of underutilization of CR programs (Grace et al., 2014; Humphrey et al., 2014; Menezes et al., 2014; Madan et al., 2014;). Therefore, the future studies should be directed to the strategies to improve patient participation rates in attending CR programs. There is also a need to assess the role of alternative models of CR such as complementary and alternative medicines. In addition, in most of the studies, women, elderly, and culturally linguistically diverse populations were under-represented (Clark et al., 2005). Hence, more attention should be given to this group of population in future research investigations.

The main purpose of the present literature review is to describe the current status of CR program worldwide as well as to identify a potential approach for further improvement in the future.

2. Method

Literature searching of electronic databases was conducted in several databases including CINAHL, MEDLINE, PsycINFO, and EMBASE, and Google Scholar. Search term used included 'cardiac rehabilitation', 'myocardial infarction', 'cardiovascular disease', 'heart disease', 'hospital based', 'community based', and 'home based'. These terms were identified as relevant following a general review of related literature, discussions with supervisors and expert academics in the field. The electronic search was also supplemented by manual searching of the reference list of retrieved articles. In addition, several guidelines or policies related to cardiac rehabilitation were also included in this review. The literature search was started in 2015 and was regularly updated through the following three years.

3. Results and Discussion

CR programs have become an integral part of the standard of care for people with cardiovascular disease in modern cardiology. Over the past decades, the focus of intervention provided by the CR programs has shifted from exercise-based therapy alone to a more comprehensive secondary prevention strategies managing risk factors (blood pressure, lipid, diabetes, smoking cessation), nutritional, and psychological, behavioural, and social factors that can affect patient outcomes.

3.1. Definition

Cardiac rehabilitation was initially defined by as "the sum of activity and interventions required to ensure the best possible physical, mental, and social conditions so that patients with chronic or post-

acute CVD may regain their proper place in society and lead an active life” (p.831). The AACVPR and the American Heart Association (AHA) have refined the definition by stating that "cardiac rehabilitation refers to coordinated, multifaceted interventions designed to optimise a cardiac patient's physical, psychological, and social functioning, in addition to stabilizing, slowing, or even reversing the progression of the underlying atherosclerosis processes, thereby reducing morbidity and mortality" (Leon et al., 2005, p.369).

3.2. Objectives of CR

In general, CR aims to restore patients with cardiovascular disease to a state of good health (Jolliffe et al., 2001). According to there are four main objectives of CR. First, CR is aimed to help the patients regain autonomy and improve regular activities. Second, CR is a strategy to manage modifiable risk factors, such as smoking cessation, and diabetes and cholesterol control. Third, therapeutic education, which becomes the integral part of CR programs, is expected to increase the patients' responsibility and autonomy in managing their medical treatment and lifestyle changes. Lastly, the objective of CR is also to help the patients managing psychosocial and professional problems related to their diseases.

3.3. Indications of CR

Each country has different approaches in the provision and organization of CR, which depends on their health policies and politics. The allocation of resources into CR also varies between countries. There is a tendency that countries with a higher level of income are more likely to put more resources into CR. The indications for CR therefore also differ between countries.

Traditionally, CR has been used following acute myocardial infarction (MI). However, currently many other patients benefit from the structured CR programs as well. It can be seen that in most countries, the generally accepted indications for referring the cardiac patients for CR are acute myocardial infarction (MI) including ST-segment-elevation myocardial infarction (STEMI) and non-ST-segment-elevation myocardial infarction (NSTEMI), coronary artery bypass graft surgery (CABG), percutaneous coronary intervention (PCI), stable angina pectoris, implantable cardiac defibrillators, heart failure, heart valve repair or replacement, and heart and lung transplantation (Leon et al., 2005; Niebauer et al., 2013; NICE, 2013; Madan et al., 2014; Grace et al., 2014; Goto, 2014). According to in the UK, patients with unstable angina may also get benefit from CR program. It is interesting since most of the other countries do not recommend patients with unstable angina to attend CR programs.

3.4. Contraindications

The contraindications for CR include acute endomyocarditis or other acute infections, severe hypertension, recent pulmonary artery embolism, haemodynamically relevant arrhythmia, critical obstructions of the left ventricular discharge apparatus (Niebauer et al., 2013). Additionally, physical, psychological or mental limitations may also prohibit the patients to be referred to CR (Niebauer et al., 2013).

3.5. Components and Organisation of CR

CR facilities offer a wide variety of programs. A vast majority of the literature identified the importance of a multifaceted and multidisciplinary approach that not only provides exercise training as a single program.

Along with the exercise-based training, it is highly recommended that CR offers a comprehensive program, including such services as patient education and psychological intervention. It has been suggested that CR programs should comprise several specific core components targeted to improve patient outcomes by lessening risks of re-infarction, managing symptoms, and promoting a healthy lifestyle (Balady et al., 2007; Tod, Lacey, & McNeill, 2002). According to the secondary prevention guidelines issued by the AHA/American College of Cardiology (ACC), core components of CR should include: a) patient assessment, b) nutritional and physical exercise counselling, c) exercise training, d) weight control management, e) tobacco cessation, f) aggressive coronary risk-factor management (i.e. blood pressure, lipid, diabetes), and g) psychosocial management (Balady et al., 2007). Meanwhile there is study identified six core components of CR, including: a) health behaviour change and education, b) lifestyle risk factor management, c) psychosocial health, d) medical risk management, e) long-term strategies, and f) audit and evaluation.

There are many variations in the organisation and delivery of CR programs, including the type and intensity of exercise, duration, and program length (Price, Gordon, Bird, & Benson, 2016). However, with regard to the type of exercise, aerobic endurance exercise have been accepted and incorporated into the CR guidelines of most countries (Price et al., 2016). In terms of the exercise intensity, there are differences between locations. For instance, moderate to higher intensity training programs have been implemented in CR delivery by countries such as the USA, Canada and several countries in Europe. Whereas, the clinical guidelines throughout the UK, Australasia, France, and Japan have recommended a lower-intensity exercise training, with less focus on resistance training (Price et al., 2016). The organization of CR also differs with regard to the number of phases of delivery; for instance in the UK and most European countries, CR is divided into four phases (Bethell, Lewin, & Dalal, 2009). Whereas, in the USA, and some other countries, CR consists of three phases, where phases II and III are merged. The UK, for instance, currently has a four phase CR model because there is an additional phase between the inpatient and outpatient CR phases (Bethell et al., 2009). Phase II in the UK constitutes the “period of convalescence at home” before the outpatient CR begins (Bethell et al., 2009, p. 271). In Indonesia, CR programs are divided into three distinct phases and consist of exercise training, educational, and psychological interventions. The overview of the content and structure of each stage in Indonesia’s current CR program is presented below:

a) Phase I: inpatient phase

Phase I is known as the inpatient phase and begins while the patient is still in the hospital during the acute phase of their illness. At this stage, patients are exposed to early mobilization, which is delivered on an individual basis. Also, formal inpatient education and training programs often take place during this phase. However, the shorter hospital stay (4-6 days after MI, 5-7 days after CABG, and one day after Percutaneous Coronary Intervention (PCI) makes it exceptionally difficult to carry out formal inpatient education and training programs (Bjarnason-Wehrens et al., 2010). Therefore, phase I CR is mostly limited to early mobilization and brief counselling about the nature of the illness, the treatment, risk factor modification, and follow-up planning.

b) Phase II: early outpatient phase

Phase II is the early outpatient phase of CR with its duration varying between countries; normally ranging from 2 weeks to 16 weeks after discharge (Bjarnason-Wehrens et al., 2010; Grace, Bennett, Ardern, & Clark, 2014). During this period, patients participate in a structured and closely monitored program of physical activity, psycho-educational activities, nutritional counselling, and other forms of risk factor management. Programs are usually based in an outpatient clinic, patient’s home, or a wing of a hospital or community centre (Balady et al., 2007). The result of the European Cardiac Rehabilitation Inventory Survey (ECRIS) showed that most of the countries in Europe (86%) offer inpatient rehabilitation with a duration of less than 2 weeks (Bjarnason-Wehrens et al., 2010). Some European countries also offer a home-based phase II part of the CR program, although the number is still far below the inpatient and outpatient programs (Bjarnason-Wehrens et al., 2010). The content of formal outpatient CR programs varies widely across different settings. However, exercise training has been identified as the central element of most phase II CR programs (Bjarnason-Wehrens et al., 2010).

c) Phase III: long-term maintenance

Phase III is a long-term maintenance program in which emphasis is given to physical fitness and additional risk-factor reduction (Bjarnason-Wehrens et al., 2010). The aim of the third phase is to maintain lifestyle changes established in the previous phases. This phase is more varied in content and structure than the early outpatient phase (phase II).

3.6. Benefits of CR

CR is an evidence-based form of secondary prevention which relies on early detection of the disease process and interventions to prevent the progression of the disease (Clark et al., 2005; Taylor et al., 2004). Some clinical trials have proven that CR can slow, stabilize or even modestly reverse the progression of atherosclerosis and reduce CVD relapses (Balady et al., 2007).

CR has proven to be useful and beneficial for patients with a wide range of cardiac conditions, including those who suffered from: a) acute MI, b) have undergone coronary artery bypass graft surgery (CABG) and coronary revascularization, c) present with stable angina, d) exhibit symptoms of chronic heart failure, e) have undergone heart valve repair or replacement, and f) have received heart and/or lung transplantations (Y. Goto, Itoh, Adachi, Ueshima, & Nohara, 2003; Grace et al.,

2014; Leon et al., 2005; Madan et al., 2014; Niebauer, Mayr, Tschentscher, Pokan, & Benzer, 2013). Secondary prevention programs have been proven effective to enhance the health outcomes of cardiac patients by lowering the risk of subsequent cardiac events and maintain a certain level of physical functioning (Ades, 2001; Balady et al., 2007; Leon et al., 2005). There has been considerable evidence supporting the effectiveness of exercise-based CR in i) decreasing mortality and readmissions, ii) improving quality of life and iii) exercise tolerance among CVD patients (Clark, Hartling, Vandermeer, & McAlister, 2005; NICE, 2013). Based on the strong evidence of its effectiveness, the national and cardiology organizations in the USA and Canada recommend CR as a Class I level A recommendation for patients with CVD (Antman et al., 2004; Balady et al., 2007; Leon et al., 2005). This recommendation for CR has also been supported by many international cardiology societies, such as those from Australia, Europe, New Zealand, and the UK (Oldridge, 2012).

Various studies and meta-analyses have consistently shown the effectiveness of CR program in reducing mortality, morbidity, promoting health and the quality life of patients with CVD, as well as preventing subsequent cardiac events (Heran et al., 2011; Jolliffe et al., 2001; Lawler, Filion, & Eisenberg, 2011; R. S. Taylor et al., 2014). Furthermore, CR programs tailored for women significantly increased the quality of life of those female patients, when compared with traditional CR models (Theresa M Beckie & Beckstead, 2010). Jolliffe et al. (2001) analyzed 32 randomized controlled trials (RCTs) reporting data from 8440 patients to compare the effectiveness of exercise-only versus comprehensive CR programs. The results were somewhat surprising, as they suggested that the exercise-only program showed a higher reduction in all-cause mortality (27%) and total cardiac mortality (31%) when compared with the comprehensive program (26%) (Jolliffe et al., 2001). However, in the comprehensive CR groups, there was a more significant net decrease in lipid profiles (total cholesterol and LDL). Although, this review collected data from studies that involved predominantly middle-aged, low-risk male patients, these findings indicate that there is barely any difference in the outcomes of exercise-only programs versus comprehensive programs. A small-scale quasi-experimental study in South Korea by Kim, Lee, Kim, Kang, and Ahn (2014) examined the effect of the delivery of a comprehensive CR program. They recruited both male and female patients into the study, in which 33 participants were enrolled in the intervention group, while 29 participants were in the control group. The results found that participants in the intervention group demonstrated improved physiological indicators: i) reduced BMI, ii) reduced waist circumference, and iii) increased LV diastolic function, as well as significant improvements in the quality of their lives. However, the researchers also reported that there was no difference between the intervention and control groups in terms of recurring symptoms or cardiac events. This study, however, suffers from low sample size and lack of randomization.

Three research teams performed a meta-analysis to assess the effectiveness of exercise-based CR and reported consistent findings (Lawler et al. (2011); Taylor et al., 2014; Anderson et al., 2016). A small scope meta-analysis by Lawler et al. (2011) looked at 34 randomized control trials to estimate the effect of exercise-based CR on the CVD outcomes. The findings demonstrated that patients randomized to the program showed a significant reduction in the risk of reinfarction, the risk of cardiac mortality, cardiovascular mortality, and all-cause mortality. Similarly, R. S. Taylor et al. (2014) analyzed 33 trials involving a total of 4740 people to examine the effects of exercise-based CR for patients with heart failure. They found that compared with standard care, CR demonstrated a significant reduction of all causes of mortality and hospital readmission, in more than a 12 months' follow up, as well as lowering the cost of healthcare. In addition, CR also has proven to be effective to improve the health-related quality of life (HRQoL). After two years, L. Anderson et al. (2016) updated their previous review which included more trials than before. In total 63 trials, with a total of 14,486 people with CHD (<15% women), were included in the analysis. The findings were consistent with previous studies (Lawler et al., 2011; R. S. Taylor et al., 2014), in which exercise-based CR was effective in reducing the risk of cardiovascular mortality, thereby reducing the risk of rehospitalization, and improving patients' quality of life.

While there is strong evidence supporting the effectiveness of exercise-based CR programs, psychological and education-based interventions alone demonstrated little effect in reducing either mortality or hospitalization (Anderson and Taylor, 2014). The latest update of the Cochrane review, which evaluated the impact of the psychological interventions as part of CR from documented CHD, was undertaken by Richards et al. (2017). A total of 35 studies, involving 10,703 patients, was included in this review. Results showed that there was no difference in terms of total mortality and

the risk of revascularization between the patients enrolled in the CR with psychological intervention and those in standard care. However, patients who received psychological therapies showed some degree of reduction in their levels of depression, anxiety and/or stress.

The studies of the effectiveness of CR outlined above have demonstrated that men and women obtained similar benefits from their CR experiences. Theresa M. Beckie, Beckstead, Schocken, Evans, and Fletcher (2011) conducted a randomized controlled trial to assess the impact of a tailored-CR on the levels of depression evident among women in the USA. A total of 225 women participated in this study, divided into two groups. The women enrolled in the tailored intervention exercised in the women-only program, received a multiple behavioural change intervention and motivational interviewing. The results found that the women in the tailored group program showed a greater reduction in depressive symptoms than women in the traditional CR group. The summary of CR benefits for women, presented in Table 1., is provided by Bennett, Lavie, and Grace (2017).

Table 1 shows the benefit of CR in women. Overall, it is reasonable to assert that there is sufficient evidence to support the claim that CR benefits both male and female patients who suffer from heart disease.

Table 1. Benefits of CR in women

Physical	Psychological
<i>Decreased</i>	
Hospitalisation	Anxiety
Mortality	Depression symptoms
Morbidity	Stress
Frailty	
<i>Improved</i>	
Microvascular disease	Patient-physician relationship
Angina symptoms	Quality of life
<i>Increased</i>	
Control of menopause symptoms	Personal medical advocacy
Peak VO ₂	Medication adherence
Functional capacity	Heart-healthy behaviours
Strength	Social support
Balance	

Source: Bennet et al. (2017, p. 4)

Despite the benefits, CR utilization by women remains lower than for men (Brown et al., 2009; Neubeck et al., 2012).

3.7. Risks

Most risks of CR are as the result of incorrect indication or inappropriate surveillance especially regarding exercise levels. The most serious complications of CR are ventricular fibrillation, myocardial infarction, and sudden death during or after exercise. However, the 2007 AHA scientific statement on exercise and acute cardiovascular events estimated that the risk of any major complication is one event in 60,000 to 80,000 patient-hours of supervised exercise. In hospital facility, this complication can be treated immediately and death for this cause is rare.

3.8. CR Referral and Participation: Underutilisation of CR

Despite the apparent benefits of CR in patients with CVD, these programs remain largely underused. The emerging pattern of study results in CR attendance rates indicates that the suboptimal uptake of CR is an international problem. The participation rates in the USA, Australia, and Europe are low, estimated at 10-30% (Bjarnason-Wehrens et al., 2010; Humphrey, Guazzi, & Niebauer, 2014; Menezes et al., 2014; Scott, Ben-Or, & Allen, 2002). From the data drawn during the period of 1998-2004 in the UK, the percentage enrolled for CR ranged from 25% to 31.5%. The data also revealed that the highest attender of CR programs in the UK was patient with CABG, followed by AMI patients and PCI patients.

3.9. Barriers to CR Referral and Participation

Several factors contributed to the suboptimal participation of patients at CR programs. The most commonly cited barriers include the distance from the program facility, socio-demographic factors (age, sex, race, and income level), low motivation or low perceived benefits, the lack of physician

referral or recommendation, transportation, and social support {Formatting Citation}Humphrey et al., 2014; Menezes et al., 2014; Madan et al., 2014; Goto, 2014). Another identified barrier was the lack of funding or health insurance coverage. Studies have also suggested that there are inequalities in CR referral and participation against women, elders, and minorities. The populations of racial and ethnic minority have higher rates of cardiovascular disease and related risk factors but have limited participation to CR programs. The most common reasons for this group for not attending CR programs were the lack of accessibility to program sites, lack of insurance coverage, as well as low patient referral rates.

3.10. Sex Difference in CR Enrollment

A number of studies have reported a higher participation among males at CR facilities (Madan et al., 2014). A recent study revealed that women are 36% less likely to enroll in CR compared with men. Grace et al. (2014) also mentioned the under-representation of women at CR in Canada. Some factors attributed to this condition including lack of financial resources, transportation difficulties, and the lack of social and emotional support. As reported, the most frequently reported reasons for women for not attending CR were transportation difficulties and distance of the cardiac centre. Meanwhile, for men the most frequent reasons for refusing a CR program were distance, not having time, and low motivation. The results of this study in line with a study conducted previously reporting that women are less likely to participate in CR programs because of transportation, family responsibilities, lack of awareness, experiencing exercise as tiring or painful, and comorbidities reason.

3.11. Strategies to Improve CR Referral and Participation

The difficulties in assessing CR programs that mainly based in the hospital led to the development of a broad and diverse array of delivery models of CR. These programs involve home visit, community services, or home manuals with phone/electronic support for flexible and individualized management. Home-based CR programs as an alternative to hospital-based CR have been recommended as a method to improve participation rate. In a systematic review about the alternative models of CR, which included 83 studies revealed a broad category of alternative models of CR. Telehealth, community- and home-based have been proven to be as effective as hospital-based CR. The use of modern technologies (the internet, phone, and other communication tools) is also considered as an alternative method of CR and to tackle the problem of geographic limitation, distance, work, and sickness. Another strategy to increase attendance rates is by developing an automated referral systems and patient education by physicians and other healthcare providers regarding the benefits of CR. The endorsement of a physician was found to be one of the strongest predictors of CR participation (Brown et al., 2009). Nevertheless, automating referral system to increase patient's participation in CR services has several drawbacks. First, CR staff may become overloaded with referrals to process. On the other hands, patients may also neglect the recommendation to attend their intake appointment. Second, as the impact of a significant increase in referrals, the wait list for CR may lengthen, thus patients cannot access services in a timely fashion. Third, the automatic referral may replace personal doctor-to-patient endorsement of CR. Fourth; the significant increases in referrals hold important financial ramifications for these CR programs. Finally, automatic referral requires 'buy-in' from cardiologists, cardiovascular surgeons, internists, and family doctors in a given region (Beckie, 2010).

In addition, although CR programs are mostly run by cardiologists, primary-care physicians have an important role in managing all three phases of CR by representing a critical aspect of patient continuity. This involvement is thought to improve access and retention in the long term. stated that cardiac rehabilitation does not end with a patient's discharge from a formal program. The rehabilitative and secondary preventative processes need to continue in the community to reduce the risk of subsequent cardiovascular morbidity and mortality. This continuation necessarily requires transfer of care to, or co-management with, primary care provider and primary care team.

4. Conclusion

There is a robust evidence of the effectiveness of cardiac rehabilitation programs in improving patients' quality of life and reducing morbidity and mortality. Unfortunately, despite the recognized benefits of CR, these programs remain largely underused worldwide. Several factors including the lack of physician referral and recommendation as well as the distance from the CR facilities lead to

the development of alternative models of CR. Some studies also suggested the importance of improving referral system to increase the participation rates to CR programs.

New research areas that explore new ways of CR delivery to improve referral and participation rates are essential. In addition, developing new exercise regimens that are more effective and versatile and that incorporates new technologies in CR would also important to maximize the benefits of CR. Finally, more attention also should be given to the group of women, elderly, and patients in underserved population to increase their participation in CR program.

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