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COLLEGE OF HEALTH SCIENCE

CARDIAC REHABILITATION IN THE EASTERN MEDITERRANEAN REGION:

UTILIZATION AND BARRIERS

BY

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ABSTRACT

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Title: Cardiac Rehabilitation in the Eastern Mediterranean Region: Utilization and Barriers

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Background: Cardiovascular diseases (CVDs) are the leading cause of death and disability in the Eastern Mediterranean Region (EMR). In the next decade, CVDs are estimated to increase in the EMR more dramatically than any other World Health Organization-designated region, except Africa. Cardiac rehabilitation (CR) is a comprehensive secondary prevention program that designed to recover a cardiovascular event.

Purpose: The purpose of this study is to investigate characteristics, availability, utilization, and barriers to CR programs in the EMR.

Methods: This is an observational, cross-sectional study, based on a secondary dataset driven from a global study conducted by the International Council of Cardiovascular Disease Prevention and Rehabilitation.

Statistical analysis methods: Descriptive statistics: frequencies, percentages, means, standard deviations, and medians were used to describe findings.

Results: Of the 22 countries in EMR, only 12 (54.5%) countries offered CR; 49 programs were identified but only 24 participated (response rate=49.0%). All identified CR programs were located in urban areas. CR density in EMR, ranged from 184,744 patients with ischemic heart disease per program in Egypt to 3,842 patients per program in Bahrain. Only 8 (38.1%) respondents reported that patients were referred regularly to their CR program. The duration of CR programs varied from 5 weeks in Tunisia to 20 weeks in Lebanon with an average of 9.4 ± 5.4 weeks in EMR. Only 5 (20.8 %) programs were publicly funded

while 8 (33.3%) were privately funded. CR programs were underutilized with a range of ratio of capacity served to actually serve per year of 1.2:1 to 8.0:1 in Qatar and Egypt, respectively. Lack of patient referral, lack of financial and human resources were perceived as the most barriers to CR.

Conclusion: In EMR, CR programs were insufficiently implemented for a population with a high and growing burden of cardiovascular diseases. CR was underutilized and this should trigger policy makers to conduct further studies to explore the factors that affect utilization of these programs in these countries. Additionally, development of national and regional regulations and laws regarding CR is a necessity to drive improvement of services and bringing evidence-based guidelines.

جاسر عبد احمد عفانه ،ماجستير صحة عامه ،يوليو 2018

العنوان :التأهيل القلبي في إقليم شرق المتوسط: الاستخدام و العوائق

المشرف: كرم عدوي ،محمد فصيح علام

نبذة مختصرة:

الخلفية: الأمراض القلبية الوعائية هي السبب الرئيسي للوفاة والعجز في إقليم شرق المتوسط و من المتوقع أن تزداد هذه الأمراض في العقد القادم في منطقة شرق المتوسط بشكل أكبر من أي منطقة أخرى في منظمة الصحة العالمية ، باستثناء أفريقيا. إعادة التأهيل القلبي هو برنامج شامل يهدف للوقاية الثانوية للقلب والأوعية الدموية .

الغرض: الغرض من هذه الدراسة هو دراسة توافروخصائص واستخدام وحواجزاستخدام برامج إعادة التأهيل القلبي في إقليم شرق المتوسط .

أساليب الدراسة: هذه دراسة قائمة على الملاحظة ، مستندة إلى مجموعة بيانات ثانوية من دراسة عالمية أجراها المجلس الدولي للوقاية وإعادة التأهيل القلبي لمرضى القلب .

طرق التحليل الإحصائي: الإحصاء الوصفي: التكرارات والنسب المئوية والانحراف المعياري والمتوسط , استخدمت لوصف النتائج .

النتائج: من بين 22 بلداً في إقليم شرق المتوسط ، فقط ١٢ دولة (٥٤ .٥٪) لديها برامج إعادة التأهيل القلبي .لقد تم تحديد ٤٩ برنامجاً في المنطقه ، لكن لم يشارك في دراسته سوى ٢٤ برنامجاً (معدل الاستجابة = ٤٩٪). جميع برامج إعادة التأهيل القلبي في إقليم شرق المتوسط موجودة في المناطق الحضرية. تتراوح كثافة برامج إعادة التأهيل القلبي في منطقة شرق المتوسط ما بين ١٨٤,٧٤٤ مريض مصاب بمرض القلب الإقفاري لكل برنامج في مصر إلى ٣,٨٤٢ مريضاً لكل برنامج في البحرين. فقط ٨ (١ .٣٨٪) من المستجيبين للدراسة الاستقصائية ذكروا أن المرضى قد أحيلوا

بانتظام إلى برنامج إعادة التأهيل القلبي الخاص بهم. تفاوتت مدة برامج التأهيل من ٥ أسابيع في تونس إلى ٢٠ أسبوعًا في لبنان بمتوسط ٤,٩ إلى ٤,٥ أسابيع. فقط ٥ (٨,٢٠٪) من برامج إعادة التأهيل القلبي ممولة من القطاع العام بينما ٨ (٣,٣٣٪) ممولة من القطاع الخاص. عدم إحالة المرضى إلى برامج إعادة التأهيل القلبي ، ونقص الموارد المالية والبشرية تعد أكثر العوائق التي تحول المرضى دون المشاركة في البرامج .

الخلاصة: برامج إعادة التأهيل القلبي موجوده بشكل غير كاف في إقليم شرق المتوسط على الرغم من العبء المرتفع والمتزايد من الأمراض القلبية الوعائية على السكان.بالاضافه لذلك لم يتم استغلال برامج إعادة التأهيل القلبي بشكل كافٍ في جميع بلدان إقليم شرق المتوسط ، وهذا من شأنه أن يدفع واضعي السياسات إلى إجراء مزيد من الدراسات لاستكشاف العوامل التي تؤثر على استخدام هذه البرامج بشكل فعال .

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LIST OF ABBREVIATIONS

Symbol.....	Definition
Cardiovascular diseases.....	CVDs
The Eastern Mediterranean Region	EMR
Cardiac rehabilitation	CR
World Health Organization	WHO
Disability adjusted life year.....	DALY
Low-income and middle-income countries.....	LMICs
Non-communicable diseases	NCDs
American Heart Association.....	AHA
Acute coronary syndrome.....	ACS
Coronary artery bypass grafting surgery.....	CABG
Percutaneous coronary intervention.....	PCI
The American Association of Cardiovascular and Pulmonary Rehabilitation.....	AACVPR
Cardiac rehabilitation specialist nurse.....	CRSN
Get with the Guidelines.....	GWTG
The International Council of Cardiovascular Prevention and Rehabilitation	ICCPR
Myocardial infraction	MI
Heart failure.....	HF
High-income countries.....	HICs
Middle-income countries.....	MICs

Low-income countries.....	LICs
IHD ischemic heart disease.....	IHD
Global Burden of Disease.....	GBD

CHAPTER 1: INTRODUCTION

Cardiovascular diseases (CVDs) are a serious threat to human health. It is considered as number one cause of death globally.(1) CVDs are responsible for 17.7 million deaths around the globe in 2015, accounting for 31% of all global deaths .(2)

Like other areas, the Eastern Mediterranean Region (EMR), one of the six official World Health Organization (WHO) regions, is highly affected by CVDs .EMR is comprised of 22 countries (Afghanistan, Bahrain, Djibouti, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Pakistan, Palestine, Qatar, Saudi Arabia, Somalia, Sudan, Syria, Tunisia, United Arab Emirates, and Yemen). (3)

In the next decade, CVD is estimated to increase in EMR more dramatically than in any other WHO region, except Africa. (1) In additions, CVDs are the major cause of disability in the EMR, with 9.2% of total disability adjusted life year (DALY)(4). In 2015, age standardized rates of CVD for men and women in the EMR were higher than in other WHO regions. It was 1.51 times the global rate for males and 1.86 times the global rate for females. (4)

As a result of the high morbidity and mortality rates, the economic system is staggering and pushing more people under the level of poverty. In 2010, the estimated global cost of CVDs was US\$863 billion and is expected to increase by 22% by 2030.(4) Therefore, comprehensive strategies are needed to minimize the socioeconomic burden of CVDs on the healthcare systems in these countries. Cardiac rehabilitation (CR)/secondary prevention programs are recognized as a comprehensive continuum of care for patients with cardiovascular disease. It is a multidisciplinary approach that helps in reducing the cardiovascular risk (5).

CR can reduce morbidity and mortality by up to 25%,(6) control CVD risk factors (smoking, hypertension, hyperlipidemia, physical inactivity, and obesity), lowering re-hospitalization rates, improve quality of life and psychological well-being. (6) Despite economic and clinical importance of CR, only 38.8% of the world's countries are implementing it (68.0% of high income and 23% of low-income and middle-income countries LMICs).(7)In addition CR density (in term of population per program) estimates ranged from 1 program per 0.1–6.4 million inhabitants which is another indicator for the low availability of CR globally (7). There is a lack of research on CR characteristics and barriers affecting CR utilization in the EMR. There is only one survey, a pilot study, on CR programs in the region to characterize the nature of services and barriers. (7). Still, the pilot study was conducted in the Arab countries, of which 19 countries are Eastern Mediterranean countries and there has been no study, at the regional level, to update findings from the pilot study. Furthermore, factors affecting utilization in terms of number of patients served annually by a program have not been investigated.

Therefore, the purpose of this study is to investigate availability and characteristics of CR programs in the EMR, barriers to CR, and to determine utilization of CR, defined as the ratio between the average annual numbers of patients could be served and the average of annual patients actually served per country per year.

CHAPTER 2: LITERATURE REVIEW

Cardiovascular diseases (CVDs)

Over the past 4 decades, there was an epidemiologic transition with a shift in the burden of disease from communicable diseases, such as lower respiratory infections, to non-communicable diseases, especially the CVDs. (8)

CVDs are a group of diseases that include coronary heart disease, cerebrovascular disease, rheumatic heart disease and congenital heart disease. (9). Unhealthy diet, physical inactivity, tobacco use and harmful use of alcohol are the major behavioral risk factors of heart disease and stroke. (9) Additionally, raised blood pressure, blood glucose, and blood lipids, and overweight and obesity are risk factors for CVDs. (9)

Cardiovascular diseases (CVDs) in EMR

In EMR, the data on prevalence of the CVDs and the mortality rate is alarming, where CVDs are responsible for 27.4% of total deaths and 54.4% of deaths from non-communicable diseases (10). CVD is estimated to increase to 32.1% by 2030(1). CVD mortality in the EMR ranges from 6% in Somalia to 49% in Tunisia. (11) CVD mortality for each country in the EMR is shown in Table 1. These high rates are associated with a dramatic increase in the clinical and behavioral CVDs risk factors in EMR over the past 3 decades. (12)

Table 1

Cardiovascular mortality of countries in the Eastern Mediterranean Region

County	% CVD death
Afghanistan	19%
Bahrain	26%
Djibouti	14%
Egypt	46%
Iran	46%
Iraq	33%
Jordan	35%
Kuwait	41%
Lebanon	47%
Libya	43%
Oman	33%
Morocco	34%
Pakistan	19%
Palestine	NA
Qatar	24%
Saudi Arabia	46%
Somalia	6%
Sudan	12%
Syria	28%
Tunisia	49%
United Arab Emirates	30%
Yemen	21%

NA: not available.

CVDs risk factors in EMR

For the clinical risk factors in EMR , prevalence of diabetes was the highest compared with all other regions in 2014.(1) Obesity prevalence was the third highest among all the WHO's six regions.(11) Hypertension prevalence was the second highest after Africa Region(1); hypercholesterolemia is the third highest prevalence(13).

In addition , for the behavioral risk factors, the prevalence of tobacco smoking in the EMR was 25.4% , which was higher than the global prevalence (22.7%), insufficient physical activity prevalence was the highest compared with other region (38.7% for women and 27.5% for men), the prevalence of heavy episodic drinking in the EMR is

0.1% among individuals aged ≥ 15 years, compared with the global prevalence of 7.0%, which most likely due to religious and cultural considerations in the majority of the population living in the EMR. (14)

Despite the high prevalence of risk factors, there is lack of policies and strategies to tackle non-communicable diseases (NCDs) including CVD across all 22 countries in the EMR as reported by the WHO. (2). Most of the countries have poor adherence to the WHO's guidelines to monitor NCDs. For example, of the 22 countries, 13 countries did not have evidence based national guidelines, protocols, or standards for the management of NCDs through primary care (i.e. glucose, lipid, and blood-pressure measurement and management); 14 countries did not have operative unit in their ministry of health with a responsibility to address the NCDs. (11) Several approaches can be used to tackling CVDs in the EMR. These include health promotion and education to rise the public awareness about the CVDs risk factors, signs and symptoms; and the curial role of the primary health care in tackling the risk assessment, management and monitoring of chronic CVDs. (14)

Cardiac rehabilitation/secondary prevention program is multidisciplinary approach that helps in reducing the cardiovascular risk. (5) Despite the well-documented benefits, CR programs still under-implemented and under-utilized in the EMR. (7)

Cardiac rehabilitation programs

Cardiac rehabilitation program is a comprehensive, professionally supervised program that designed to help patients to recover cardiovascular event. (15) Several national and international professional health associations and organizations have recommended CR as a guideline for secondary prevention for patients with heart

diseases. (15) These organizations include: American Heart Association (AHA), the American College of Cardiology, the Canadian, the Australian, and the European Association of Cardiovascular Prevention and Rehabilitation. (16)(17)(18)(19)

CR has been recommended for both inpatient and outpatient settings for recent myocardial infarction (MI) patients and acute coronary syndrome (ACS), chronic stable angina, heart failure, or after cardiac procedure such as coronary artery bypass grafting surgery (CABG) or percutaneous coronary intervention (PCI). Also indicated after valve surgery or cardiac transplantation. (15)

CR program generally consisted of three phases, Phase I, which is initiated while the patient still in the hospital. It is mainly focused on early mobilization of the stable patient to the level of activity required to perform simple everyday tasks. Phase II, in most countries, is a supervised outpatient program with 3 to 6 months duration with risk factor reduction strategies and monitored exercise. It may be started in inpatient settings also. Phase III, life time phase, which emphasizes on the importance of continuity of healthy life style especially the exercise and risk factor modification.(20) Indeed, CR is a class I intervention with evidence level A endorsed by most current guidelines of cardiovascular societies globally. (15)

CR core components

CR program consists mainly of baseline patient assessment, health education to manage the CVDs risk factors (lipids, blood pressure, weight, diabetes mellitus, and smoking), guide the change in the patient life style, nutritional counseling, and Physical activity and exercise training to improve the cardiovascular system efficiency, psychological support to promote emotional well-being and to reduce stress. (5)

The American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR), and the AHA set specific core components for the CR programs to assist in developing and designing a standardized program. Standard CR programs play an important role in guiding the policy makers, insurers, consumers and the healthcare providers, to recognize the comprehensive nature of these programs and thus financial reimbursement. (5)

CR multidisciplinary team

To deliver CR program of multidisciplinary approach, the team of CR program generally includes physician, nurses, dietitians, physiotherapists, psychological counselors, exercise specialists, and pharmacists. (16) Each health professional team member has a unique role in providing care for CVDs patients in the CR programs. (16) Physician is a key player, who is responsible for initiating CR through issuing a referral request to CR, and i.e. patients cannot enroll in CR without the physician's referral (19).

They manage the patients medically while they are in the CR program. Also supervise directly or indirectly the outpatient physical exercises. The cardiac rehabilitation specialist nurse (CRSN) plays major role in health education, especially about CVDs risk factor, CVDs, and psychosocial issues during the CR program (21).The exercise therapist is the designer of the exercise for the patient, and the supervisor for running the prescribed exercise. Exercise Therapist monitors patient through the exercise to identify any sign or symptoms of distress. (21)

Smoking cessation counselor assesses the smoking status of a patient and explores his intention for the change, readiness and helps them towards success (22). A psychosocial counselor evaluates the psychosocial status of patients and their families and addresses the possibility of depression after the cardiac event and coping strategies.

Many studies showed that there is significant relationship between the acute myocardial infarction patients and depression. (23) Nutritional counselor provides education and counseling regarding the patient dietary goals and modifications in his dietary habits with the consideration for the personal and cultural values. (22)

Finally the pharmacist plays significant part in maintaining the adherence to cardiac medications and provides education to optimize the medication's efficacy and safety. (24) Each member in the multidisciplinary team should have certified backgrounds of different areas of expertise and training. (25)

Different models of CR

The traditional CR delivery model is the hospital based cardiac rehabilitation .Due to the challenges in delivering this, model such as the cost and accessibility; different designs and models of CR program have been offered and delivered to guarantee safe, sufficient, accessible, effective and cost effective services of care for the cardiac patient. (26) For example, in Canada, 70% of the CR programs are supervised site-based programs, 28.2 % offered community-based programs, and only 2.6 % offered home-based programs. (7)

Using technology is another emerging example of CR delivery model. It includes one to one chat with specialists with online intake forms, patient exercise logs, and blood pressure and heart rate online recordings. (27)

Efficiency of the alternative CR delivery models was proven in many studies. In British Columbia, patients showed significantly greater improvements in exercise capacity and risk factors using the technology model compared to the usual care.(27) An Iranian study, revealed that using a hybrid CR model, (i.e. hospital-based and home-based CR model) was effective as the traditional supervised program in decreasing the

chest pain and discomfort. It was also cost-saving compared to hospital-based delivery. (26) Moreover, in a Cochrane systematic review and meta-analysis study, comparison between home-based and center-based CR programs revealed no major difference, in mortality rate, modifiable risk factors and exercise capacity (28)

CR benefits

Benefits of CR were addressed in many studies. CR played a major role in reducing the mortality rate post cardiac event. In 2011, a retrospective study found that CR participation after PCI was significantly associated with 40% reduction in all-cause mortality (29). Similarly in 2015, a large community cohort study in the Netherland found that CR was associated with significant survival benefit up to 4 years regardless of diagnosis, intervention and age. (30)

CR has also significant impact on hospitalization rate; in 2015, a systematic review and meta-analysis study showed that using CR reduced the risk of overall hospitalization by 25% and hospitalization for heart failure by 31 %.(31) In 2008, a cohort study in Belgium aimed to analyze the impact of hospital-based multidisciplinary CR on health related long term costs after PCI by comparing CR to no CR. The study indicated a significant reduction in patients' hospitalizations for angina (75% vs. 45%), coronary revascularizations (17% vs. 7%) and total cost after follow up of 4.5 year. (32)

Moreover, several studies have reported improvement in CVDs risk factors among patients who attended the CR. A systematic review and meta-analysis study in 2013 found that CR helps in inducing a considerable improvement in lifestyle habits including the physical activity, healthy diet, and decrease in smoking and/or alcohol consumption and had significant role in reductions of obesity, fasting blood sugar and

blood lipids. (33) Further, many studies have reported a positive relationship between attending CR and reduction in the depression symptoms. (34)

The improvement of the psychological status of cardiac patient results in improving the survival rate. (34) In 2011, an observational study showed a 40% reduction of depression symptoms in cardiac patient post exercise training CR. (34) In addition, CR had influence on mortality rate as the depressed patients who completed the CR had a 59% lower mortality rate compared to depressed dropout patients not undergoing exercise training CR. (34). Also in 2007, a cohort study had similar result as the depression symptoms decreased after CR by 63% and indicated 73% lower mortality in depressed patients who completed CR compared with control depressed subjects who did not complete rehabilitation. (35)

CR has constructive influence on the quality of life of CVDs patients. In 2015, a clinical trial in Iran showed that the quality of life of the CVDs patients increased significantly post attending the CR compared to the control group who didn't attend. (36) In 2011, a systematic review reported a significant evidence between exercises based CR and higher level of quality of life compared to the usual patient care. (37)

The cost-effectiveness of CR was proven through many studies. In 2015 a study conducted to evaluate the cost effectiveness of an outpatient CR program by comparing between patients had CR and others hadn't, indicated that CR was cost effective for those had higher risks for subsequent cardiac events and those with an acute coronary syndrome. (32). In 2012, a systematic review study evaluated the effectiveness of exercise-based CR, determined that CR lowered the costs, and reduced re-hospitalization. (38)

Unfortunately fewer studies covered the cost effectiveness of CR in low income countries. In 2015, a study conducted in low income country to evaluate CR effectiveness in patients with heart failure in Brazil and Colombia showed CR as cost-effective program (39)

Factors affecting utilization of CR

Despite the evident benefits of CR program and the clinical practice guideline recommendations to refer cardiac patients, there is a clear underutilization of CR. The data from Canada, United Kingdom and the United States, showed that up to 70% to 80% of eligible CVDs patient do not receive CR after hospital discharge. (40), (41) low CR participation affected by many factors, evident at the patient, medical team, and healthcare system level. (42) One of the main healthcare system factors is the referral. Patients referral of is a vital step to increase the participation in a CR program. (15) In 2009, data analysis for the American Heart Association's (AHA's) Get with the Guidelines (GWTG) program, showed that only 56% of total eligible patients were referred to CR programs before discharge from hospital. (43)

One of the proven strategies to overcome the low rate of the referral is the automatic computerized referral for all eligible admitted patients to CR before the hospital discharge. But automatic referral for patients is not a sufficient inclusive intervention. (44)

So the follow-up or facilitation of enrollment after referral is an important Healthcare system factors that affect the enrollment rate (15).As we found in another study that, 26% of patients who were referred to CR program before the discharge couldn't recall that they being referred. (45) In 2011, a Prospective, Controlled Study was conducted in 11 hospitals in Ontario, Canada, to evaluate three referral strategies for the CR

compared with usual referral strategies (46). The Combined of automatic and liaison referral was the most efficient strategy to increase the CR use. (46) So adoption of these strategies could ensure that more patients would have access to and realize the benefits of CR. (46) Furthermore two studies supported the strategy of calling the patients shortly after the discharge as it will increased the proportion enrollment in a CR program by 50-80 %. (47), (48)

Physicians are affecting the referral to CR programs and patient enrollment. In 2013 systematic review study showed that CR referral and enrollment was associated with physician endorsement, medical specialty, and physician attitudes toward CR. (49)

Moreover, the percentage of eligible patients referred to CR was lower than the percentage of other known therapies such as beta-blocker use (93%), aspirin use (98%), and angiotensin converting enzyme inhibitor or angiotensin receptor blocker use (84%), which is suggesting that there is gap in physicians perception about the importance and the effectiveness of CR programs compared to other proven treatment. (43)

Many researchers considered the cost of CR as predictor of CR program utilization. In two different systematic review study, they found that financial costs is one of the key reason for under use of CR. (50), (51)

In addition, the limitation of health care coverage for CR services is another reason for CR underuse. In 2016, the result of the International Council of Cardiovascular Prevention and Rehabilitation survey on national CR reimbursement policies by government and insurance companies demonstrate that, patients are paying for some or all of services in 54.8 % of countries. (52)

Further barriers to CR utilization are related to patient's factors. Patient awareness of the benefits and perceived need of CR have a major affect the on

enrollment rate.(53) In 2017, a Korean survey showed that 69.8% of the cardiac patient that participated in the survey had never heard about CR program. (54)

In 2007, a prospective study, conducted in the cardiac unit in a teaching hospital in London, found that patients who participated in CR were more likely to believe that CR was essential and to recognize its benefits compared with non-participants. (55) Other patient related barriers include distance to CR facility from patient's home, lack of programs in rural areas and in low-income countries, conflicting hours of operation with work demands and parking issues or access to public transportation. (56) A cross sectional study in Ontario-Canada examined barriers to CR enrollment among minority groups. They recognized that patients living in rural areas were less likely to attend CR sessions compared to patients living in urban areas. (57) In addition, patients with low socioeconomic status were less likely to be referred, enroll, and participate in CR compared to the patients with high socioeconomic status. (57) Despite that, distance, cost, and transportation still considered as barriers for both groups. (57)

According to a study conducted in the United State in 2007, which examined predictors of CR referral and enrollment, they found that Older individuals, women, non-whites, and patients with comorbidities (including previous stroke, congestive heart failure, cancer and diabetes mellitus) were less likely to be referred and enroll in CR (58).Also they found that 71% of the patients who lived more than a mean distance of 31.8 miles from the available CR, were less likely to join the CR. Moreover, patients with a higher income were 23% more likely to participate in CR compared to those with lowest income. (58) Another research suggested that barriers to participate in CR among the patients of low SES include transportation, program expense, insurance coverage and less health benefits (for example, the paid off time for preventive health

programs) .(59) Lastly, more research is needed to explore barriers affecting CR utilization. (56)

CHAPTER 3: METHODS

Objectives and Research question(s)

The purpose of this study is (a) to investigate availability, characteristics and barriers to CR programs in the EMR; (b) to determine utilization of CR, defined as the ratio between the average annual numbers of patients could be served to the average of annual number of patients actually served per program; and (c) to explore the barriers for utilization of these programs.

Objectives

- To assess availability of cardiac rehabilitation programs in Eastern Mediterranean countries.
- To describe density of supervised CR programs per CVD patients in a country
- To explore availability of alternative models of CR, namely, home-based and community-based programs.
- To describe CR characteristics offered in Eastern Mediterranean countries i.e. location, duration before the referral, diagnosis of patients served, health professionals on CR team, CR duration, number of sessions, and source of fund (i.e. who pays for CR program)
- To determine CR barriers for patient participation in the program in EMR.
- To assess CR utilization in EMR, defined as the ratio between national or total number of patients that could be served by CR programs per country and national or total number of patients that actually served by CR programs per country.
- To determine factors affecting utilization of cardiac rehabilitation programs in the EMR

Research questions

This study has 4 main research questions:

- A) What are the characteristics of CR (CR duration, number of sessions, diagnosis of patients served, components, health professionals on CR team, and source of payment) in the EMR?
- B) What is the density of CR programs in the EMR?
- C) What are the barriers affecting participation in cardiac rehabilitation programs in the EMR?
- D) What are the factors affecting number of patients served by cardiac rehabilitation programs in the EMR?

Source of data

The study is based on a secondary data set driven from a global study called Global Cardiac Rehabilitation Survey: Availability and Characteristics of Programs. Development of the survey was based on previous national and regional CR programs surveys (e.g., Bjanarson-Wehrens, Cortes-Bergoderi et al.; Polyzotis et al.).(60)(61)(62)

The investigative team underwent a process of integration and cleaning of overlapping content. Most items had forced-choice response options, and skip-logic was used to get more detail where applicable. Then revised based on responses; i.e. some questions have been slightly revised to improve clarity. It consisted of questions addressing 8 main components: program capacity, funding sources, staff composition, dose, alternative models, core components, and barriers). (63)

The final survey was translated to Portuguese, Spanish, and Mandarin. The translated survey was reviewed by a national champion with the corresponding first

language. The translations underwent several review processes including back translation to English to verify its linguistic validation or accuracy of concepts in the translated survey. (63) The survey was pilot-tested in the Arab World and Canada. (7)

Target population

The International Council of Cardiovascular Prevention and Rehabilitation (ICCPR) global team used the following inclusion criteria for CR programs: (1) initial assessment, (2) at least one other strategy to control CV risk factors and (3) structured exercise.

To determine which countries have CR programs, the Global Team of the ICCPR used several strategies and sources: (a) previous published studies of global availability of CR, (64) among other reviews (65), and (b) a search of: Google Scholar for abstracts or articles on CR, MEDLINE and EMBASE. For countries where no CR was in evidence, the CR Global Team: (a) searched the internet via Google using the term “cardiac rehabilitation” and country, (b) searched Google for hospitals within these countries, which were then searched for CR programs, (c) used a snowball sampling strategy by the members of International Council of Cardiovascular Prevention and Rehabilitation (ICCPR) and key persons in the field (including European Society of Cardiology national CVD prevention coordinators), as well as (d) attended international conferences of relevant societies to approach experts in the given countries. Finally, before any country was designated as having no CR, international societies (e.g., International Society of Physical Medicine and Rehabilitation, European Association of Preventive Cardiology, African Heart Network) were contacted to ascertain whether there were any CR programs in countries where there was no confirmation of availability. (63)

Consent

Participants provided informed consent electronically before completing the online survey.

Data Collection

Data collection was carried out by the ICCPR team from February, 2016 to July, 2017 via online survey administered through RED Cap.(66) All programs were contacted in countries with ≤ 250 CR programs; otherwise, a random subsample of 250 were contacted (this was only applicable to the United States). The survey was confidential.

In countries where CR existed, the total number of programs was obtained through several strategies: first, available CR associations or cardiac society leadership if no CR association in that country. If there was no society available or response by the cardiac society other champions were identified from the peer-reviewed or grey literature / web. If there was no champion for a given country, the ICCPR team directly contacted CR programs that could be identified on the internet or through key informants via email. CR program potential participants were sent 2 survey e-mail reminders, at 2-week intervals.

National champions were asked to circulate a link of the survey to all identified programs, or provide the study team with the email addresses of the programs to survey them directly. The survey filled by the responsible person of the CR program (i.e. program director, program coordinator). Through the survey, the total number of patients served per program and other capacity indicators were ascertained.

National leaders were contacted 4 weeks from initial administration to review the response rate. Where it was $< 40\%$, they were invited to suggest other approaches to

increase response rate; this often involved personally calling programs to ascertain whether they were aware of the survey, and to request completion if they had not done so already. (63)

Validity of responses

Before sharing or disseminating data, the ICCPR team examined the data for outliers and errors in entry. Then representatives of countries were contacted for verification of data with suspected major errors. (63) We also checked for outliers, and contacted representatives to verify the responses. Finally, before knowledge translation (disseminating any results stemmed from these data, country and regional representatives are asked to verify results of their own country or region) (63)

Statistical analysis

This is a descriptive study where the finding was presented as frequencies, percentages, mean, standard deviation and median. The outputs from analysis were used to plot graphics and to summarize findings in tabular format .We used SPSS version 24 for statistical analyses of the data.

To achieve the first objective (assess the availability of cardiac rehabilitation programs in Eastern Mediterranean countries), descriptive analysis was carried out, i.e. frequencies and percentages. They were used to define the availability of the CR program in EMR countries and according to their income.

To reach the second objective (describe density of supervised CR programs per CVD patients in a country), descriptive analysis was conducted; CR density was computed as the number of patients with IHD in 2016 per available CR programs in EMR .This is the first study to estimate the density of CR by IHD based on the Global Burden of Disease study. Though there are other indications recommended (68) (6) (69)

for CR, IHD estimates were used due to availability of data and as it was the closest diagnostic option to CR-indicated conditions.

To accomplish the third objective (explore availability of alternative models of CR, namely, home-based and community-based programs), descriptive analysis was carried out, i.e. frequencies and percentages. They were used to define the availability of the alternative models in EMR.

To achieve the fourth objective (describe CR characteristics offered in Eastern Mediterranean countries i.e. location, duration before the referral, patient referral, diagnosis of patients served, health professionals on CR team, source of fund (i.e. who pays for CR program), CR duration and number of sessions), descriptive analysis was carried out, i.e. frequencies and percentages used to describe the location, diagnosis of patients served, health professionals on CR team and source of fund. Mean and standard deviation used to express the CR duration, number of sessions and dose (weeks x sessions/week)

To achieve the fifth objective (to determine the CR barriers for patient participation in CR programs in EMR), descriptive analysis was carried out, i.e. the mean and standard deviations were used to summarize CR barrier on a scale ranged from 1 (this is definitely not an issue) to 5 (this is a major issue).

To achieve the sixth objective (assess the CR utilization i.e. ratio between patient could be served/actually served by CR program at national level) also descriptive analysis was carried out, i.e. the ratio between national or total number of patients that could be served in CR programs per country and national or total number of patients that actually served by CR program per country used to describe the CR utilization.

Finally, to achieve the seventh objective (determine factors affecting number of patients served by cardiac rehabilitation programs in the EMR), generalized estimating equations (GEE) model was performed to account for clustering of programs in a country, where number of patients served was the dependent variable and the independent variables included: CR location (urban, suburban, rural), located in a hospital (yes, no), providing alternative model (yes, no), funding source (public, private, mixed), total number of staff, total number of equipment, source of referral (cardiologist, non-cardiologist).

Variable definitions

1- CR density: number of patients with ischemic heart diseases per available CR programs in 2016.

2- Availability of CR program: existence of CR in the country (yes, no). (67)

3- Availability of alternative CR program: existence of the alternative CR program in EMR (yes, no). (67)

4-Utilization of CR program: defined as the ratio between national or total number of patients that could be served in CR programs per year and national or total number of patients that actually served by CR program per country. To calculate the national or total number of patients that could be served in CR programs per country, the mean of patients in each country were multiplied by the number of CR programs available in that country. Also, for the national or total number of patients that actually served by CR programs, the mean number of patients served was multiplied by number of CR programs available in the country. (70)

5- CR Characteristics in EMR:

A. CR locations (urban, suburban, rural)

- B. CR located in a hospital (yes, no)
- C. Accepted patient diagnosis by CR program , cardiac diagnosis: CABG(yes , No), MI/ACS(yes , No),PCI(yes , No), HF(yes , No), valve procedure(yes , No) ,stable coronary artery disease(yes , No) , implantable heart devices (pacemaker or defibrillators) (yes , No) , rhythm device(yes , No) , cardiomyopathy(yes , No), arrhythmias(yes, No), congenital heart disease(yes, No), rheumatic heart disease(yes, No) , percutaneous valve implantation(yes , No), heart transplant(yes , No) , ventricular assist devices(yes , No).
- D. Non-cardiac diagnosis: high-risk / primary prevention(yes , No), diabetes(yes , No) , chronic lung disease(yes , No) , intermittent claudication/ peripheral vascular disease(yes , No) , stroke / transient, ischemic attack(yes , No) , cancer(yes , No).
- E. Patient referral ,patient can self-refer(yes , No) , physicians(yes , No) , allied healthcare providers and / or nurses(yes , No) , community health care workers(yes , No)
- F. Healthcare professionals in CR team , nurse(yes , No) , physiatrists (physical medicine and rehabilitation) (yes , No) , psychiatrist (yes , No) , administrative assistant/ secretary (yes , No) , kinesiologist/ exercise specialist (yes , No) , dietitian (yes , No) , social worker(yes , No) , physio-therapist (yes , No) , sports medicine –physician (yes , No) , psychologist (yes , No) , pharmacist (yes , No) , cardiologist(yes , No) , community health worker (yes , No) .
- G. CR duration in weeks.
- H. CR program sessions, total number of per country.
- I. Funding source by country, (Public, private, Combination (public and private)).

6- Barriers for patient participation in CR as perceived by participant i.e. Scores range from 1 (this is definitely not an issue) to 5 (this is a major issue).

Ethical approval:

The study was approved by Qatar University, QU-IRB 871-E\18.

Chapter 4: Results

This chapter shows the results of the study; it starts by describing availability of CR programs in EMR, availability of alternative models of CR, and the density of supervised CR programs per Ischemic heart diseases cases in a country followed by a description of the CR programs characteristics and utilization of these programs. Lastly, barriers affecting the CR utilization were described.

Availability and density of CR program in EMR

Of the 22 countries in EMR, 12 (54.5%) countries offered CR for their patients with a total of 49 programs (Figure 1). Though, only 24 programs participated in the study (response rate=49.0% at program level) with more than half of these programs from Iran (n=14; 58.3%) as shown in Table 2.

Table 2

Number of participating CR programs by country

Country	Number of Programs	Number of responses	Response Rate
Afghanistan	1	1	100.0%
Bahrain	1	1	100.0%
Egypt	2	2	100.0%
Iran	34	14	41.2%
Kuwait	1	0	0.0%
Lebanon	1	1	100.0%
Morocco	1	1	100.0%
Pakistan	4	2	50.0%
Qatar	1	1	100.0%
Saudi Arabia	1	0	0.0%
Tunisia	1	1	100.0%
United Arab Emirates	1	0	0.0%
Total	49	24	49.0%
Response across countries (9/12; 75.0%)			

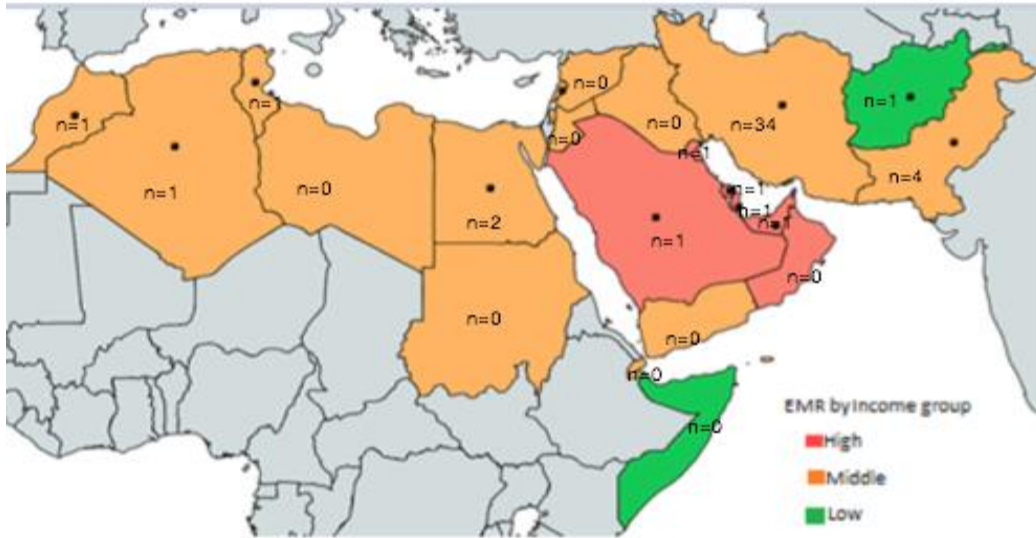


Figure 1: Availability of CR programs in EMR

Iran was the first country that implemented CR program (in 1994) in the EMR, followed by Bahrain (1998), then Pakistan (2004). The rest of the EMR countries recently implemented CR, i.e. since 2010. All high-income countries (HICs) in EMR (n=5; 100.0%) had CR; however, only five of the middle-income countries (MICs) countries (33.3%), and 1(50.0%) of the low-income countries (LICs) of the EMR were offering CR programs (Figure 1). Interestingly, 46% of the CR programs in EMR offered women-only classes. CR density, defined as number of patients with ischemic heart diseases per available CR programs in 2016 as recommended by previous studies (61) (67), ranged from 184,744 patients in Egypt to 3,842 patients in Bahrain per program (Table 3).

Table 3

Number of the available CR programs by country and density

Country	Income classification	Number of Programs	Year 1st CR program	No of IHD new cases* (in 2016)	Density
Afghanistan	LIC	1	2014	89,056	89,056
Bahrain	HIC	1	1998	3,842	3,842
Egypt	MICs	2	2010	369,488	184,744
Iran	MICs	34	1994	235,157	6,916
Kuwait	HIC	1	NA	7,648	7,648
Lebanon	MICs	1	2014	27,633	27,633
Morocco	MICs	1	2016	156,088	156,088
Pakistan	MICs	4	2004	622,146	155,537
Qatar	HIC	1	2013	7,003	7,003
Saudi Arabia	HIC	1	NA	82,510	82,510
Tunisia	MICs	1	2010	50,217	50,217
United Arab Emirates	HIC	1	NA	21,885	21,885

*Number of new IHD cases was obtained from Global Burden of Disease study (Institute for Health Metrics and Evaluation (IHME). GHDx. 2016.

<http://ghdx.healthdata.org/gbd-results-tool> (accessed Dec 6, 2017).

* LIC, Low-income country; MICs, middle-income countries; HIC, high-income country; IHD, ischemic heart diseases; CR cardiac rehabilitation; NA, not available.

Alternative models

Only two countries offered alternative CR models: Iran and Pakistan. Seven of the 24 participated programs (29.1%) offered alternative models: six programs in Iran and one program in Pakistan. Three of the alternative models (42.9%) were home-based programs, two (28.6%) were hybrid of supervised and home- or community-based programs, and one was community-based (14.3%).

CR Characteristics in EMR

CR locations

All identified CR programs in EMR (100%) were located in an urban area. The majority of the programs were located in hospitals (n=21; 87.5%) and most of the programs (n=18; 75%) were located in a referral center/ tertiary facility, two programs (n=2; 8.3%) were located in a community hospital and one (n=1; 4.2%) was located in a rehabilitation hospital. In addition, (n=19; 90.5%) of those located in hospitals had an inpatient cardiology unit. From those units, only 8 (38.1%) respondents reported that patients were referred regularly to their CR, 6 (28.6%) reported that patients were referred sometimes, and 5 (23.8%) programs reported that patients were rarely referred to their program. Furthermore, of these cardiology units, 18 (94.7%) offered coronary artery bypass graft surgery (CABG), 15 (78.9%) offered percutaneous coronary intervention (PCI), 14 (73.7%) offered implantable heart devices (pacemakers or defibrillators), 11 (57.8%) offered percutaneous valve implantation, and 7 (36.8%) offered cardiac transplant. CR Programs were placed equally in a cardiology department or physical medicine and rehabilitation department (n=9; 37.5%, for each), 3 (12.5%) programs were stand-alone, and 1 (4.2%) program was in a community facility.

Accepted patient diagnosis by CR program

Based on the available data, CABG was the most accepted diagnosis (n=18 programs; 75.0%), followed by myocardial infarction (n=17; 70.8%), then PCI (n=16; 66%) (Table 4). Additionally, 11 programs (61.1%) accepted patients with low level of cardiac risk and 16 programs (88.9%) accepted patients with moderate and high level of cardiac risk. Programs also accepted non-cardiac diagnosis, such as diabetes and high risk/primary prevention, those were the most accepted (n= 12; 66.7%) non-cardiac

diagnosis (Table 4).

Table 4

Cardiac diagnosis accepted by country

Country (n)	Afghanistan (n=1)	Bahrain (n=1)	Egypt (n=2)	Iran (n=12)	Lebanon (n=1)	Morocco (n=1)	Pakistan (n=2)	Qatar (n=1)	Tunisia (n=1)	Total (n=24)
CABG	NA	1 (100%)	2 (100%)	11 (78.5%)	1 (100%)	NA	1 (50%)	1 (100%)	1 (100%)	18 (75%)
MI/ACS	NA	1 (100%)	0 (0.0%)	11 (78.5%)	1 (100%)	NA	1 (50%)	1 (100%)	1 (100%)	17 (70.8%)
PCI	NA	1 (100%)	0 (0.0%)	10 (71.4%)	1 (100%)	NA	1 (50%)	1 (100%)	1 (100%)	16 (66%)
HF	NA	1 (100%)	0 (0.0%)	10 (71.4%)	1 (100%)	NA	1 (50%)	1 (100%)	1 (100%)	15 (62.5%)
Valve procedure	NA	1 (100%)	0 (0.0%)	11 (78.5%)	1 (100%)	NA	1 (50%)	1 (100%)	0 (0.0%)	15 (62.5%)
Stable coronary artery disease	NA	1 (100%)	0 (0.0%)	10 (71.4%)	1 (100%)	NA	1 (50%)	0 (0.0%)	1 (100%)	15 (62.5%)
Implantable heart devices (pacemaker)	NA	0 (0.0%)	2 (100%)	8 (57.1%)	1 (100%)	NA	1 (50%)	1 (100%)	0 (0.0%)	14 (58.3%)
defibrillators										
Rhythm device	NA	1 (100%)	0 (0.0%)	9 (64.2%)	1 (100%)	NA	1 (50%)	0 (0.0%)	1 (100%)	13 (54.1%)
Cardiomyopathy	NA	1 (100%)	0 (0.0%)	8 (57.1%)	1 (100%)	NA	1 (50%)	1 (100%)	1 (100%)	13 (54.1%)
Arrhythmias	NA	1 (100%)	0 (0.0%)	8 (57.1%)	1 (100%)	NA	1 (50%)	0 (0.0%)	0 (0.0%)	12 (50%)
Congenital heart disease	NA	1 (100%)	0 (0.0%)	7 (50%)	1 (100%)	NA	1 (50%)	1 (100%)	1 (100%)	12 (50%)
Rheumatic heart disease	NA	1 (100%)	0 (0.0%)	8 (57.1%)	1 (100%)	NA	1 (50%)	0 (0.0%)	1 (100%)	12 (50%)
Percutaneous valve implantation	NA	0 (0.0%)	2 (100%)	6 (42.8%)	1 (100%)	NA	1 (50%)	1 (100%)	0 (0.0%)	11 (45.8%)
Heart transplant	NA	0 (0.0%)	NA	9 (64.2%)	1 (100%)	NA	0 (0.0%)	1 (100%)	0 (0.0%)	11 (45.8%)
Ventricular assist devices	NA	1 (100%)	NA	6 (42.8%)	1 (100%)	NA	1 (50%)	1 (100%)	0 (0.0%)	10 (41.6%)

				Non cardiac diagnosis						
High-risk / primary prevention	NA	1 (100%)	0 (0.0%)	9 (64.2%)	0 (0.0%)	NA	1 (50.0%)	0 (0.0%)	1 (100%)	12 (50%)
Diabetes	NA	1 (100%)	0 (0.0%)	8 (57.1%)	0 (0.0%)	NA	2 (100%)	0 (0.0%)	1 (100%)	12 (50%)
Chronic lung disease	NA	0 (0.0%)	0 (0.0%)	7 (50%)	1 (100%)	NA	1 (50.0%)	0 (0.0%)	0 (0.0%)	9 (37.5%)
Intermittent claudication/peripheral vascular disease	NA	0 (0.0%)	0 (0.0%)	5 (35.7%)	0 (0.0%)	NA	1 (50.0%)	0 (0.0%)	1 (100%)	7 (29.1%)
Stroke / transient ischemic attack	NA	0 (0.0%)	0 (0.0%)	5 (41.7%)	0 (0.0%)	NA	1 (50.0%)	0 (0.0%)	0 (0.0%)	6 (33.3%)
Cancer	NA	0 (0.0%)	0 (0.0%)	3 (25.0%)	0 (0.0%)	NA	0 (0.0%)	0 (0.0%)	0 (0.0%)	3 (16.7%)

MI/ACS, Myocardial Infarction/ Acute coronary syndrome; CABG, coronary artery bypass graft; HF, heart failure; PCI, percutaneous coronary intervention; NA, not available

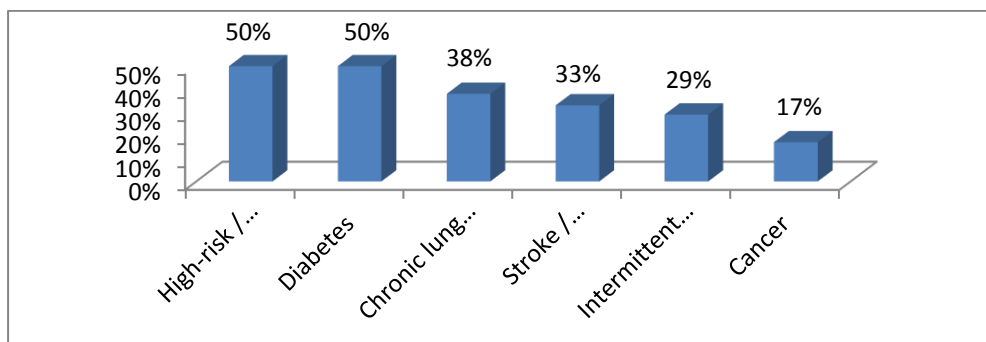


Figure 2: Accepted cardiac diagnosis in CR program.

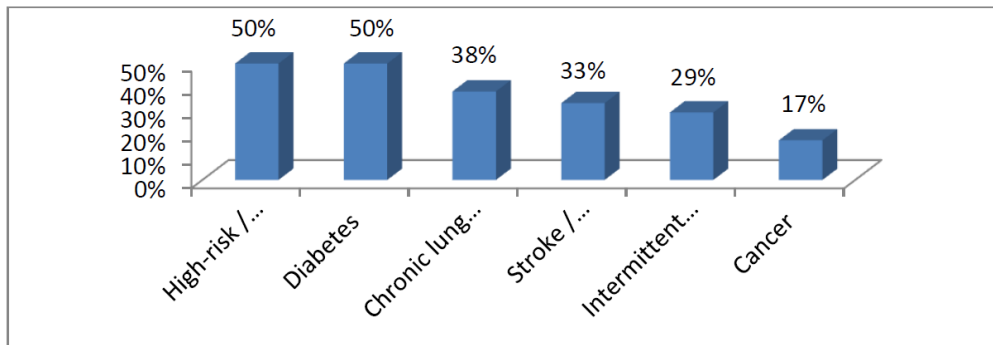


Figure 3: Accepted non-cardiac diagnosis in CR program.

Patient referral

In the majority of the CR programs (n=21; 87.5%), physicians had the overall responsibility for patient referral to CR (Table 5). Interestingly, patient self-referral (n=12; 50.0%) were reported in Pakistan and Iran. Moreover, less frequently reported, referral by nurses and /or allied healthcare providers in 6 programs (25.0%) and by community health worker in 5 programs (20.8%) (Table 5). The duration for patients to start a CR program after discharge from a hospital varies between countries; it ranged from 2 weeks in Lebanon, Pakistan and Tunisia to 25 weeks in Qatar. (Table 6)

Table 5

Patient referral to CR per country

Country (n)	Afghanistan (n=1)	Bahrain (n=1)	Egypt (n=2)	Iran (n=14)	Lebanon (n=1)	Morocco (n=1)	Pakistan (n=2)	Qatar (n=1)	Tunisia (n=1)	Total (n=24)
Patients	0 (0.0%)	0 (0.0%)	1 (100%)	7 (50%)	0 (0%)	1 (100%)	1 (50%)	0 (0.0%)	1 (100%)	12 (50.0%)
Self-refer Physicians	1 (100%)	1 (100%)	2 (100%)	14 (100%)	1 (100%)	0 (0.0%)	2 (100%)	1 (100%)	1 (100%)	21 (87.5%)
Allied healthcare providers and / or nurses	0 (0%)	0 (0%)	0 (0%)	4 (30.8%)	1 (100%)	0 (0.0%)	1 (50%)	0 (0%)	0 (0%)	6 (25.0%)
Community health care workers	0 (0%)	0 (0%)	1 (50%)	3 (23.1%)	0 (0%)	0 (0.0%)	1 (50%)	0 (0%)	0 (0%)	5 (20.8%)

Table 6

Duration for patient to start CR program after discharge from a hospital

Country (n)	Afghanistan	Bahrain	Egypt	Iran	Lebanon	Morocco	Pakistan	Qatar	Tunisia	Median	IQR
Duration to start CR after patient discharge in weeks	3	18	3.5	4.1	2	NA	1.5	25	2	3	2-14.52

NA, not available

Healthcare professionals on CR team

As shown in Table 6, nurses were the most common healthcare professionals on the CR team (n=17; 70.8%), followed by physical medicine and rehabilitation (n=13; 54.1%), then psychiatrist (n=11; 45.8%). Pharmacists were a part of the team in 4

programs (16.6%). None of the programs had community workers on the CR team (Table 7).

In the majority of the programs (n=19; 79.2%), physician had the overall responsibility for the program followed by a nurse or physiotherapist (n=1; 4.2%) for each.

Table 7
Health professionals on CR team by country

Country (n)	Afghanistan (n=1)	Bahrain (n=1)	Egypt (n=2)	Iran (n=14)	Lebanon (n=1)	Morocco (n=1)	Pakistan (n=2)	Qatar (n=1)	Tunisia (n=1)	Total (n=24)
Nurse	0 (0.0%)	1 (100%)	0 (0.0%)	12 (85.7%)	1 (100%)	0 (0.0%)	1 (50.0%)	1 (100%)	1 (100%)	17 (70.8%)
Physiatrists (Physical medicine and rehabilitation)	1 (100.0%)	1 (100%)	1 (100%)	6 (42.8%)	1 (100%)	1 (100%)	1 (50.0%)	0 (0.0%)	1 (100%)	13 (54.2%)
Psychiatrist	0 (0.0%)	0 (0.0%)	1 (100%)	7 (50.0%)	0 (0.0%)	1 (100%)	2 (100%)	0 (0.0%)	0 (0.0%)	11 (45.8%)
Administrative assistant/ secretary	0 (0.0%)	0 (0.0%)	0 (0.0%)	8 (57.1%)	1 (100%)	0 (0.0%)	0 (0.0%)	1 (100%)	1 (100%)	11 (45.8%)
Kinesiologist/ Exercise specialist	1 (100.0%)	0 (0.0%)	0 (0.0%)	5 (35.7%)	1 (100%)	0 (0.0%)	1 (50.0%)	1 (100%)	1 (100%)	10 (41.7%)
Dietitian	0 (0.0%)	0 (0.0%)	0 (0.0%)	5 (35.7%)	0 (0.0%)	0 (0.0%)	2 (100%)	1 (100%)	1 (100%)	9 (37.5%)
Social worker	1 (100.0%)	1 (100.0%)	0 (0.0%)	4 (28.5%)	1 (100%)	1 (100%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	8 (33.3%)
Physiotherapist	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (28.5%)	1 (100%)	0 (0.0%)	1 (50.0%)	1 (100%)	1 (100%)	8 (33.3%)

Sports medicine – physician	0 (0.0%)	0 (0.0%)	0 (0.0%)	7 (50.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	7 (29.1%)
Psychologi st	1 (100%)	0 (0.0%)	1 (100%)	4 (28.5%)	0 (0.0%)	0 (0.0%)	1 (50.0%)	0 (0.0%)	0 (0.0%)	7 (29.1%)
Pharmacist	0 (0.0%)	1 (100%)	0 (0.0%)	2 (14.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100%)	0 (0.0%)	4 (16.6%)
Cardiologis t	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	0 (0.0%)	2 (8.3%)
Communit y health worker	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Patients received individual consultations with a physician during the program in 19 (79.2%) programs with an average of 8.7 ± 1.8 consultations over the course of a program. Further, in 11 (45.8%) programs, patients received individual consultations with a nurse. Staff supervising patients during exercise sessions had cardiopulmonary resuscitation (CPR) certification in most of the CR programs (n=18; 75%), and in 15 programs (62.5%) the staff required to renew CPR certification regularly. Additionally, physician had advance CPR training in 16 programs (66.6%), a while nurses had advanced CPR training in 12 programs (50%).

CR duration and total number of sessions per country

The duration of CR programs varied among the EMR countries. It ranged from 5 weeks in Tunisia to 20 weeks in Lebanon with an average of 9.4 ± 5.4 weeks in the region. Besides that, the total number of sessions offered during a program ranged from 20 to 60 sessions in Tunisia and Lebanon, respectively, with an overall average of 30.14.8 sessions (Table 8).

Table 8

CR duration and dose by country

	Afghanist an	Bahrai n	Egy pt	Ira n	Lebano n	Moroc co	Pakista n	Qata r	Tunisi a	Mea n ± SD	Confiden ce Interval 95%
Average (# Duration in weeks)	NA	8	NA	9.2	20	NA	6	8	5	9.4 ± 5.4	3.67-15.1
Frequency (sessions / week)	NA	3	NA	2.8	3	NA	4.5	3	4	3.4 ± 0.7	2.65-4.1
Dose (# weeks x Sessions/wee k)	NA	24	NA	25. 3	60	NA	27	24	20	30.1 ± 14.8	14.5-45.6

NA, not available

Funding

Only, one fifth (n=5; 20.8%) of the programs were funded publicly, 8 programs were funded privately (33.3%), and the others were funded by a combination of public and private fund (n=11; 45.8%). The combination of public and private fund was seen only in Iran (Table 9).

Table 9

Funding source by country

County(n)	Afghanist an (n=1)	Bahra in (n=1)	Egyp t (n=2)	Iran (n=14)	Lebano n (n=1)	Moroc co (n=1)	Pakista n (n=2)	Qatar (n=1)	Tunisia (n=1)	Total (n=24)
Public	1 (100%)	1 (100%)	1 (50%)	-	-	-	1 (50%)	1 (100%)	-	5 (20.8%)
Private	-	-	1 (50%)	4 (28.6%)	1 (100%)	-	1 (50%)	-	1 (100%)	8 (33.3%)
Combination (public and private)	-	-	-	10 (71.4%)	-	-	-	-	-	10 (41.6%)

Utilization of CR program

Utilization of CR program was defined as the ratio between national or total number of patients that could be served in CR programs per country and national or total number of patients that actually served by CR program per country. Based on the reported data, CR programs were underutilized with a ratio ranged from 1.2:1 to 8.0:1 per year in Qatar and Egypt respectively showed in figure 2 and table 10.

Table 10

CR programs utilization by Country

Country	National or total number of patients that could be served in CR programs per country	National or total number of patients that actually served by CR program per country	Ratio between patient could be served/actually served by CR program per country
Afghanistan	150	100	1.5
Bahrain	500	140	3.6
Egypt	200	40	8
Iran	12150	4135	2.9
Kuwait	NA	NA	NA
Lebanon	300	100	3
Morocco	NA	NA	NA
Pakistan	3,000	1800	1.7
Qatar	192	157	1.2
Saudi Arabia	NA	NA	NA
Tunisia	150	90	1.7
United Arab Emirates	NA	NA	NA

NA, not available

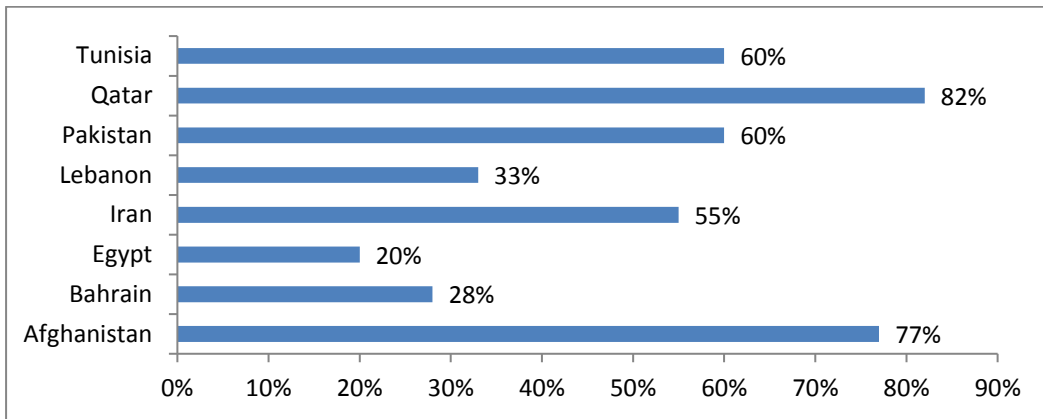


Figure 4: CR program utilization by country

Barriers for patient participation in CR programs

Patient referral was the most recognized barrier (n=14; 66.6%) for patient participation in CR programs, followed by lack of financial resources/budget (n=8; 33.3%), then human resources (n=3; 12.5%) (Table 11). Other reported barriers included, distance and transport and (n=4; 16.7%), lack of other CR in the area (n=2; 8.3%), and working hours conflict (n=1; 4.2%).

Table 11

Barriers for patient participation in CR as perceived by participant *

Country	Afghanistan (n=1)	Bahrain (n=1)	Egypt (n=2)	Iran (n=4)	Lebanon (n=1)	Morocco (n=1)	Pakistan (n=2)	Qatar (n=1)	Tunisia (n=1)	Mean \pm SD	Confidence Interval 95%
Lack of patient referral	4.0 \pm 0.0	5.0 \pm 0.0	5.0 \pm 0.0	4.8 \pm 0.5	4.0 \pm 0.0	NA	5.0 \pm 0.0	1.0 \pm 0.0	5.0 \pm 0.0	4.2 \pm 1.4	3.1-5.4
Lack of equipment	5.0 \pm 0.0	2.0 \pm 0.0	4.0 \pm 0.0	2.3 \pm 1.3	1.0 \pm 0.0	NA	2.5 \pm 2.1	3.0 \pm 0.0	1.0 \pm 0.0	2.6 \pm 1.4	1.4-3.8
Lack of space	4.0 \pm 0.0	2.0 \pm 0.0	3.0 \pm 0.0	2.5 \pm 1.4	2.0 \pm 0.0	NA	3.0 \pm 1.4	5.0 \pm 0.0	1.0 \pm 0.0	2.8 \pm 1.3	1.8-3.9
Lack of human resources	5.0 \pm 0.0	5.0 \pm 0.0	4.0 \pm 0.0	2.8 \pm 1.5	2.0 \pm 0.0	NA	3.5 \pm 0.7	4.0 \pm 0.0	1.0 \pm 0.0	3.4 \pm 1.4	2.2-4.6
Lack of financial resources	5.0 \pm 0.0	3.0 \pm 0.0	5.0 \pm 0.0	4.0 \pm 1.2	5.0 \pm 0.0	NA	4.5 \pm 0.7	4.0 \pm 0.0	2.0 \pm 0.0	4.1 \pm 1.3	3.2-5

*Scores ranged from 1 (this is definitely not an issue) to 5 (this is a major issue). NA, not available

Factors affecting number of patients served

Because of the small sample size, we were unable to obtain results of the generalized estimating equations procedure; the model did not reveal any outcome.

Chapter 5: DISCUSSION

Despite the well-documented benefits of CR, the clinical recommendations by professional organizations (5) and the high CVD mortality in the EMR, only 54.5% countries in EMR offered CR for their patients. Clearly, there is lack in CR services despite the growing burden of CVD in the region, specifically, ischemic heart disease (IHD), which is expected to have the highest increase after Africa by 2030 according to the World Health Organization's report.(1)

CR density was computed as the number of patients with IHD per program .This is the first study to estimate the density of CR by IHD based on the Global Burden of Disease study. Though there are other indications recommended (68) (6) (669) for CR, IHD estimates were used due to availability of data and as it was the closest diagnostic option to CR-indicated conditions. (68) In addition, previous studies (61) (64) (67) computed density as total population in a country or region per program, so comparison is inapplicable.

CR density in EMR was 34,136 patients per program with a range of 3,842 patients per program in Bahrain to 184,744 patients in Egypt. Clearly, there is a huge gap between supply and demand of CR programs due to lack of supply of CR services provided for IHD patients, not to mention the demand on CR services for other indications or diagnosis. Further, all CR programs were located in urban areas which could add another burden for CVD patients to attend these programs as it was identified as barrier in many studies. (71) (57)

The results of this survey showed that there is lack of standardize duration and number of sessions of these programs. Studies from other regions have also demonstrated lack of consistency and a wide variability in CR services suggesting that

this issue is a universal problem that should be addressed. For example in South America, CR session per week varies among the programs as it ranged between 2 up to >3 and in Latin America and the Caribbean the session per week varies between 1 up to 3 and in the duration per weeks between <10 and >15 wk. (66), (61)

Interestingly, 46% of the CR programs in EMR offered women-only classes which is considerably high compared to similar programs in high income countries, such as Canada, where 10% of the programs offered women-only classes.(7). The availability of these classes is expected, due to the religious beliefs and cultural values of the countries in EMR. (51)

Current survey showed that referral of the eligible patients to CR program was alarmingly low. Patient referral is playing vital part in increasing the participation rate in these programs. (15)(72) Furthermore, the patients who underwent CABG, MI and PCI were the most accepted diagnosis in CR which was in line with international guidelines (68)and similar to the result of previous surveys run in different regions such Europe , Latin America and the Caribbean and South America .(60)(61)(67)

However, there is increasing evidence on the effectiveness of the alternative models, such as reducing the cost of traditional CR, mortality, CVD risk factors (28) and the barriers for program participation (26), our study revealed a shortage in offering these types of CR programs, such as home and community-based models. Only two countries offered these programs: Iran and Pakistan.

Similarly to the results of other studies conducted in Arab , South America, Latin America and the Caribbean countries .(7), (61),(66) , lack of patient referral and lack of financial resources were recognized as the biggest barriers to CR participation in EMR.

Finally, nevertheless the extremely low availability of CR programs in EMR, they were underutilized with a ratio of capacity to serve to actually served patients that ranged between 1.2:1 - 8.0:1. Underutilization of cardiac rehabilitation still a consistent problem that has been documented in published studies.(20)(58) (73) For example, in 2008 , a large cohort study, Suaya and colleagues found that only 13.9% of the myocardial infarction patients and 31.0% of those who underwent coronary artery bypass graft surgery who are eligible to CR enrolled in the program. Barriers to CR were documented at patient, provider and organizational levels. (74)(75)(76) Financial resources and lack of referral were the most reported barriers at organizational level in our study.

Finally, unfortunately, we were unable to examine the factors that affecting CR number of patients served because of the small sample size.

Strengths

This study was the first empirical study to address CR in the EMR (base-line study), only one pilot study explored CR in the Arab countries, where some EMR countries were not included (e.g. Iran, Afghanistan, and Pakistan). This study contributed in filling gaps in literature regarding availability of traditional center-based CR and alternative models (home-based and community-based) and explored the characteristics of CR programs in the EMR.

Further, to the best of our knowledge, this is the first study to compute density in term of number of CR programs per number of patients (IHD cases). Previous studies used number of programs per country population (61) (63) (67). Though IHD was used as a proxy for guideline-indicated patients, still, it is more informative than per population of a country. The study also addressed barriers to CR utilization; results of

this study are expected to guide policy makers on addressing barriers that affect CR utilization.

Limitations

The results of the study should be carefully interpreted due to the following limitations: first, use of secondary data could influence results especially due to missing data, such as data on diagnosis and level of risk that could be accepted in the CR program. Missing data, especially on program capacity could under or overestimate the CR density at country and regional levels. Second, the limitation on generalizability of our findings due to the small sample of 24 programs and low response rate within countries. Most probably, the respondents were from resourceful programs, i.e. financially or human resources, therefore results might present characteristics and capacity of these programs, which could overestimate our finding. Additionally, more than half of these programs were from Iran that our finding could mostly represent characteristics of programs in Iran.

Third, to calculate the CR density, estimates from the Global Burden of Disease (GBD) study were used. Because CVD grouping included rheumatic heart disease and stroke, to be conservative, ischemic heart disease (IHD) was selected, as it was the closest diagnostic option to CR-indicated conditions. Therefore, density might be underestimated.

Conclusion

Cardiac rehabilitation is increasingly acknowledged as a necessary element of the continuum of care for CVDs patient and considered as class I recommendation by most current guidelines of cardiovascular societies globally.

In EMR, CR programs were insufficiently implemented for a population with a high and growing burden of cardiovascular diseases. Additionally, there was shortage in CR alternative models such as home-based and community-based models. There is a need to standardize the CR services which can be facilitated by creation of national guidelines. Additionally, referral of the eligible patients to CR programs was vastly underutilized in the region which raises the need for supportive policies to improve it.

Limited public funding was identified in most of EMR countries and it could affect the utilization of these programs. Still, financial resources and lack of referral were acknowledged as the most reported barriers which were similar to other surveys in other region.

Cardiac rehabilitation is underutilized in all EMR countries and this should trigger the policy maker to conduct further studies to explore the factors that affect utilization of these programs. Finally, development of national and regional regulation and laws regarding CR is a necessity to drive improvement of services and bringing evidence-based guidelines.

REFERENCES

1. WHO. Global status report on noncommunicable diseases 2014. World Health. 2014;176.
2. WHO. Global action plan for the prevention and control of noncommunicable diseases 2013-2020. World Heal Organ [Internet]. 2013;102. Available from: http://apps.who.int/iris/bitstream/10665/94384/1/9789241506236_eng.pdf
3. World Health Organization. <http://www.who.int/about/regions/emro/en/>. 2016;
4. Mokdad AH. Burden of cardiovascular diseases in the Eastern Mediterranean Region, 1990–2015: findings from the Global Burden of Disease 2015 study. *Int J Public Health*[Internet].2017;Availablefrom:<http://link.springer.com/10.1007/s0038-017-1012-3>
5. Balady GJ, Williams MA, Ades PA, Bittner V, Comoss P, Foody JAM, et al. Core components of cardiac rehabilitation/secondary prevention programs: 2007 update - A sci. statement from the Am. Heart Assoc. exercise, cardiac rehabilitation, and prevention comm., the council on clinical cardiology; the councils on cardiovascular nu. *Circulation*. 2007;115(20):2675–82.
6. Anderson L, Oldridge N, Thompson DR, Zwisler A-D, Rees K, Martin N, et al. Exercise-Based Cardiac Rehabilitation for Coronary Heart Disease. *J Am Coll Cardiol*[Internet].2016;67(1):1–12.Availablefrom: <http://linkinghub.elsevier.com/retrieve/pii/S0735109715071193>
7. Turk-Adawi KI, Terzic C, Bjarnason-Wehrens B, Grace SL. Cardiac rehabilitation in Canada and Arab countries: comparing availability and program characteristics.

- BMCHHealthServRes[Internet].2015;15(1):521.Availablefrom:
<http://bmchealthservres.biomedcentral.com/articles/10.1186/s12913-015-1183->
8. Omran AR. The Epidemiologic Transition: A Theory of the Epidemiology of Population Change. Milbank Mem Fund Q [Internet]. 1971;49(4):509. Available from: <http://www.jstor.org/stable/3349375?origin=crossref>
 9. World Organization. World Heart Federation. World Stroke Organization. Global Atlas on Cardiovascular disease prevention and control. Glob atlas Cardiovasc Dis PrevControl[Internet].2011;Availablefrom:
[https://www.cabdirect.org/cabdirect/abstract/20123402600%0Afile:///C:/Users/USER/Downloads/9789241564373_eng \(2\).pdf](https://www.cabdirect.org/cabdirect/abstract/20123402600%0Afile:///C:/Users/USER/Downloads/9789241564373_eng%20(2).pdf)
 10. World Health Organization. Projections of mortality and causes of death, 2015 and 2030. WHO: Regional Office for the Eastern Mediterranean http://www.who.int/healthinfo/global_burden_disease/projections/en/ (2013). 2013;
 11. World Health Organization (WHO). Non-communicable Diseases Country Profiles. Genève WHO Press 2014 [Internet]. 2014;1–210. Available from: http://www.who.int/nmh/countries/ben_en.pdf?ua=1
 12. Traina MI, Almahmeed W, Edris A TE. Coronary Heart Disease in the Middle East and North Africa: Current Status and Future Goals. Current atherosclerosis reports. 2017 May 1;19(5):24. 2017;
 13. WHO.Raisedcholesterol http://www.who.int/gho/ncd/risk_factors/cholesterol_text/en. 2008;
 14. Turk-Adawi K, Sarrafzadegan N, Fadhil I, Taubert K, Sadeghi M, Wenger NK, et al. Cardiovascular disease in the Eastern Mediterranean region: epidemiology

- and risk factor burden. *Nat Rev Cardiol* [Internet]. 2017; Available from: <http://www.nature.com/doi/10.1038/nrcardio.2017.138>
15. Balady GJ, Ades PA, Bittner VA, Franklin BA, Gordon NF, Thomas RJ, et al. Referral, enrollment, and delivery of cardiac rehabilitation/secondary prevention programs at clinical centers and beyond: A presidential advisory from the American Heart Association. *Circulation*. 2011;124(25):2951–60.
 16. AACVPR. Guidelines for Cardiac Rehabilitation and Secondary Prevention Programs-5th ... - American Association of Cardiovascular & Pulmonary Rehabilitation. 2013.
 17. Krum H, Jelinek MV, Stewart S, Sindone A AJ. 2011 update to National Heart Foundation of Australia and Cardiac Society of Australia and New Zealand Guidelines for the prevention, detection and management of chronic heart failure in Australia, 2006. *Medical journal of Australia*. 2011 Apr 18;194(8):40. 2011;
 18. Genest J, McPherson R, Frohlich J, Anderson T, Campbell N, Carpentier A, Couture P, Dufour R, Fodor G, Francis GA GS. . 2009 Canadian Cardiovascular Society/Canadian guidelines for the diagnosis and treatment of dyslipidemia and prevention of cardiovascular disease in the adult—2009 recommendations. *Canadian Journal of Cardiology*. 2009 Oct 1;25(10):567-79. 2009;
 19. Piepoli MF, Corrà U, Benzer W, Bjarnason-Wehrens B, Dendale P, Gaita D, et al. Secondary prevention through cardiac rehabilitation: from knowledge to implementation. A position paper from the Cardiac Rehabilitation Section of the European Association of Cardiovascular Prevention and Rehabilitation. *Eur J Cardiovasc Prev Rehabil* [Internet]. 2010;17(1):1–17. Available from: <http://journals.sagepub.com/doi/10.1097/HJR.0b013e3283313592>

20. Mampuya WM. Cardiac rehabilitation past, present and future: an overview. *CardiovascDiagnTher*[Internet].2012;2(1):38–49.Availablefrom:
<http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3839175&tool=pmcentrez&rendertype=abstract>
21. Stone JA AH. Canadian guidelines for cardiac rehabilitation and cardiovascular disease prevention, 2004: Executive summary. *The Canadian journal of cardiology*. 2005 Oct;21:3D-19D. 2004;
22. Wenger NK. Current Status of Cardiac Rehabilitation. *J Am Coll Cardiol*. 2008;51(17):1619–31.
23. Zellweger MJ, Osterwalder RH, Langewitz W, Pfisterer ME. Coronary artery disease and depression. *Eur Heart J*. 2004;25(1):3–9.
24. Packard K, Herink M, Kuhlman P. Pharmacist’s role in an interdisciplinary cardiac rehabilitation team. *J Allied Health*. 2012;41(3):113–7.
25. Dalal HM, Dohert P. Cardiac rehabilitation. *Br Med J*. 2015;35(5):530–5.
26. Saeidi M, Soroush A, Komasi S, Singh P. A hybrid cardiac rehabilitation is as effective as a hospital-based program in reducing chest pain intensity and discomfort. 2017;30(4):265–71.
27. Zutz A, Ignaszewski A, Bates J, Lear SA. Utilization of the Internet to Deliver Cardiac Rehabilitation at a Distance: A Pilot Study. *Telemed e-Health* [Internet]2007;13(3):323–30.Availablefrom:
<http://www.liebertonline.com/doi/abs/10.1089/tmj.2006.0051>
28. Taylor RS, Dalal H, Jolly K, Moxham T, Zawada A. Europe PMC Funders Group Home-based versus centre-based cardiac rehabilitation. 2014;(1):1–64.
29. Goel K, Lennon RJ, Tilbury RT, Squires RW, Thomas RJ. Impact of cardiac

rehabilitation on mortality

and cardiovascular events after percutaneous coronary intervention in the community. *Circulation*.

2011;123(21):2344–52.

30. De Vries H, Kemps HMC, Van Engen Verheul MM, Kraaijenhagen RA, Peek N. Cardiac rehabilitation and survival in a large representative community cohort of Dutch patients. *Eur Heart J*. 2015;36(24):1519–28.
31. Sagar VA, Davies EJ, Briscoe S, Coats AJS, Dalal HM, Lough F, et al. Exercise-based rehabilitation for heart failure: systematic review and meta-analysis. *Open Hear*[Internet].2015;2(1):e000163.Available from:
<http://openheart.bmj.com/lookup/doi/10.1136/openhrt-2014-000163>
32. Dendale P, Hansen D, Berger J, Lamotte M. Long-term cost-benefit ratio of cardiac rehabilitation after percutaneous coronary intervention. *Acta Cardiol*. 2008;63(4):451–6.
33. Chatziefstratiou AA, Giakoumidakis K, Brokalaki H. Cardiac rehabilitation outcomes: modifiable risk factors. *Br J Nurs* [Internet]. 2013 Feb 28;22(4):200–7. Available from: <https://doi.org/10.12968/bjon.2013.22.4.200>
34. Milani R V., Lavie CJ, Mehra MR, Ventura HO. Impact of exercise training and depression on survival in heart failure due to coronary heart disease. *Am J Cardiol*[Internet].2011;107(1):64–8.Available from:
<http://dx.doi.org/10.1016/j.amjcard.2010.08.047>
35. Milani R V, Lavie CJ. Impact of Cardiac Rehabilitation on Depression and Its Associated Mortality. *Am J Med* [Internet]. 2017 Nov 27;120(9):799–806. Available from: <http://dx.doi.org/10.1016/j.amjmed.2007.03.026>

36. Khalife-Zadeh A, Dorri S, Shafiee S. The effect of cardiac rehabilitation on quality of life in patients with acute coronary syndrome. *Iran J Nurs Midwifery Res*[Internet].2015Aug23;20(5):588–93.Availablefrom:
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4598906/>
37. Heran BS, Chen JMH, Ebrahim S, Moxham T, Oldridge N, Thompson DR, et al. Europe PMC Funders Group Exercise-based cardiac rehabilitation for coronary heart disease. *Cochrane Database Syst Rev*. 2014;(7).
38. Wong WP, Feng J, Pwee KH, Lim J. A systematic review of economic evaluations of cardiac rehabilitation. *BMC Heal Serv Res* [Internet]. 2012;12(1):243. Available from: BMC Health Services Research
39. Oldridge NB, Pakosh MT, Thomas RJ. Cardiac rehabilitation in low- and middle-income countries: A review on cost and cost-effectiveness. *Int Health*. 2015;8(2):77–82.
40. Candido E, Richards JA, Oh P, Suskin N, Arthur HM, Fair T AD. The relationship between need and capacity for multidisciplinary cardiovascular risk-reduction programs in Ontario. *Canadian Journal of Cardiology*. 2011 Apr 30;27(2):200-7. 2011;
41. Thomas RJ, King M, Lui K, Oldridge N, Pina IL, Spertus J. AACVPR/ACCF/AHA 2010 Update: Performance Measures on Cardiac Rehabilitation for Referral to Cardiac Rehabilitation/Secondary Prevention Services: A Report of the American Association of Cardiovascular and Pulmonary Rehabilitation and the American College . *Circulation* [Internet]. 2010;122(13):1342–50.Availablefrom:
<http://circ.ahajournals.org/cgi/doi/10.1161/CIR.0b013e3181f5185b>

42. Grace SL, Angevaere KL, Reid RD, Oh P, Anand S, Gupta M, et al. Effectiveness of inpatient and outpatient strategies in increasing referral and utilization of cardiac rehabilitation: a prospective, multi-site study. *Implement Sci* [Internet]. 2012;7(1):120. Available from: <http://implementationscience.biomedcentral.com/articles/10.1186/1748-5908-7-120>
43. Brown TM, Hernandez AF, Bittner V, Cannon CP, Ellrodt G, Liang L, Peterson ED, Piña IL, Safford MM FG. American Heart Association Get With The Guidelines Investigators. Predictors of cardiac rehabilitation referral in coronary artery disease patients: findings from the American Heart Association's Get With The Guidelines Program. *Journal of the American Co.* 2009;
44. Patrick D. Savage M, A, , Bonnie K. Sanderson P, B, , Todd M. Brown, MD M, Kathy, et al. Clinical Research in Cardiac Rehabilitation and Secondary Prevention: Looking Back and Moving Forward. *J Cardiopulm Rehabil Prev.* 2011;31(6):333–41.
45. Mazzini MJ, Stevens GR, Whalen D, Ozonoff A, Balady GJ. Effect of an American Heart Association Get With the Guidelines Program-Based Clinical Pathway on Referral and Enrollment Into Cardiac Rehabilitation After Acute Myocardial Infarction. *Am J Cardiol.* 2008;101(8):1084–7.
46. Grace SL. Effect of Cardiac Rehabilitation Referral Strategies on Utilization Rates. *ArchInternMed*[Internet]. 2011;171(3):235. Available from: <http://archinte.jamanetwork.com/article.aspx?doi=10.1001/archinternmed.2010.501>
47. Harkness K, Smith KM, Taraba L, MacKenzie CL, Gunn E, Arthur HM. Effect

of a postoperative telephone intervention on attendance at intake for cardiac rehabilitation after coronary artery bypass graft surgery. *Hear Lung J Acute Crit Care*[Internet].2005;34(3):179–86.Availablefrom:

<http://www.sciencedirect.com/science/article/pii/S0147956304001700>

48. Pasquali SK, Alexander KP, Lytle BL, Coombs LP, Peterson ED. Testing an intervention to increase cardiac rehabilitation enrollment after coronary artery bypass grafting. *Am J Cardiol* [Internet]. 2001;88(12):1415–6. Available from: <http://www.sciencedirect.com/science/article/pii/S0002914901021233>
49. Ghisi GLM, Polyzotis P, Oh P, Pakosh M, Grace SL. Physician factors affecting cardiac rehabilitation referral and patient enrollment: A systematic review. *Clin Cardiol*. 2013;36(6):323–35.
50. Clark AM, King-Shier KM, Thompson DR, Spaling MA, Duncan AS, Stone JA, et al. A qualitative systematic review of influences on attendance at cardiac rehabilitation programs after referral. *Am Heart J* [Internet]. 2012;164(6):835–845.e2. Available from: <http://dx.doi.org/10.1016/j.ahj.2012.08.020>
51. Neubeck L, Freedman S Ben, Clark AM, Briffa T, Bauman A, Redfern J. Participating in cardiac rehabilitation: a systematic review and meta-synthesis of qualitative data. *Eur J Prev Cardiol* [Internet]. 2011 May 5;19(3):494–503. Available from: <https://doi.org/10.1177/1741826711409326>
52. Babu AS, Lopez-Jimenez F, Thomas RJ, Isaranuwatjai W, Herdy AH, Hoch JS, et al. Advocacy for outpatient cardiac rehabilitation globally. *BMC Health ServRes*[Internet].2016;16(1):471.Availablefrom: <http://bmchealthservres.biomedcentral.com/articles/10.1186/s12913-016-1658->
53. Shanmugasegaram M, Health L. Author Manuscript / Manuscrit d â€™TM auteur

- Barriers to Cardiac Rehabilitation : 2010;29(3):183–7.
54. Kweon S, Sohn MK, Jeong JO, Kim S, Jeon H, Lee H, et al. Quality of life and awareness of cardiac rehabilitation program in people with cardiovascular diseases. *Ann Rehabil Med*. 2017;41(2):248–56.
 55. Cooper AF, Weinman J, Hankins M, Jackson G, Horne R. Assessing patients' beliefs about cardiac rehabilitation as a basis for predicting attendance after acute myocardial infarction. *Heart* [Internet]. 2007;93(1):53–8. Available from: <http://heart.bmj.com/cgi/doi/10.1136/hrt.2005.081299>
 56. American Heart Association. Facts: cardiac rehabilitation: putting more patients on the road to recovery. 2013;
 57. Shanmugasegaram S, Oh P, Reid RD, McCumber T, Grace SL. Cardiac rehabilitation barriers by rurality and socioeconomic status: a cross-sectional study. *Int J Equity Health* [Internet]. 2013;12(1):72. Available from: <http://equityhealthj.biomedcentral.com/articles/10.1186/1475-9276-12-72>
 58. Suaya JA, Shepard DS, Normand S-LT, Ades PA, Prottas J, Stason WB. Use of Cardiac Rehabilitation by Medicare Beneficiaries After Myocardial Infarction or Coronary Bypass Surgery. *Circulation* [Internet].2007;116(15):1653–62.Availablefrom: <http://circ.ahajournals.org/cgi/doi/10.1161/CIRCULATIONAHA.107.701466>
 59. Valencia HE, Savage PD, Ades PA. Cardiac Rehabilitation Participation in Underserved Populations. *J Cardiopulm RehabilPrev*[Internet].2011;31(4):20310. Availablefrom:<http://content.wkhealth.com/linkback/openurl?sid=WKPTLP:landingpage&an=01273116-201107000-00001>

60. Bjarnason-Wehrens B, McGee H, Zwisler A-D, Piepoli MF, Benzer W, Schmid J-P, et al. Cardiac rehabilitation in Europe: results from the European Cardiac Rehabilitation Inventory Survey. *Eur J Cardiovasc Prev Rehabil* [Internet]. 2010;17(4):410–8. Available from: <http://journals.sagepub.com/doi/10.1097/HJR.0b013e328334f42d>
61. Cortes-Bergoderi M, Lopez-Jimenez F, Herdy AH, Zeballos C, Anchique C, Santibañez C, et al. Availability and Characteristics of Cardiovascular Rehabilitation Programs in South America. *J Cardiopulm Rehabil Prev* [Internet]. 2013;33(1):33–41. Available from: <http://content.wkhealth.com/linkback/openurl?sid=WKPTLP:landingpage&an=01273116-201301000-00005>
62. Polyzotis PA, Tan Y, Prior PL, Oh P, Fair T, Grace SL. Cardiac rehabilitation services in Ontario. *J Cardiovasc Med* [Internet]. 2012;13(11):727–34. Available from: <http://content.wkhealth.com/linkback/openurl?sid=WKPTLP:landingpage&an=01244665-201211000-00009>
63. Supervia Pola, M., Turk-Adawi, K., Lopez Jimenez, F., Pesah, E., Rongjing, D., Britto, R., Bjarnason-Wehrens, B., Derman, W., Abreu, A., Babu, A., Santos, C., Khiong, J.S., Cuenza, L., Yeo, T.J., Scantlebury, D., Andersen, K., Gonzalez, G., Giga, V., Vulic, D., Vataman, E., Cliff, J., Kouidi, E., Yagci, I., Benaim, B., Kim, C., Fernandez, R., Radi, B., Gaita, D., Attila, S., Chen, S.Y., Roxburgh, B. Castillo Martin, J., Mendis, S., Maskhulia, L., Burdiat, G., Salmon, R., Lomelí,

- R., Sadeghi, M., Sovova, E., Hautala, A., Prasciene, E., Ambrosetti, M., Neubeck, L., Asher, E., Kemps, H., DeMaeyer, C., Eysymontt, Z., Farsky, S., Hayward, J., Prescott, E., Craddock, K., Dawkes, S., Santibanez, C., Zeballos, C., Pavy, B., Goto, Y., Kiessling, A., Sarrafzadegan, N., Baer, C., Thomas, R., Hu, D., & Grace, S.L. Quality of cardiac rehabilitation services around the globe: Indications served, providers delivering, and components offered. (Under review)
64. Turk-Adawi K, Sarrafzadegan N, Grace SL. Global availability of cardiac rehabilitation. *Nat Rev Cardiol* [Internet]. 2014;11(10):586–96. Available from: <http://dx.doi.org/10.1038/nrcardio.2014.98>
65. Ragupathi L, Stribling J, Yakunina Y, Fuster V, McLaughlin MA VR. Availability, Use, and Barriers to Cardiac Rehabilitation in LMIC. *Global Heart*. 2017 Mar 13. 2017.
66. Harris PA, Taylor R, Thielke R, Payne J, Gonzales N, Conde JG. Research electronic data capture (REDCap) - A metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inf*. 2009;42(2):377–81.
67. Korenfeld Y, Mendoza-Bastidas C, Saavedra L, Montero-Gómez A, Perez-Terzic C, Thomas RJ, et al. Current status of cardiac rehabilitation in Latin America and the Caribbean. *Am Heart J*. 2009;158(3):480–7.
68. Fihn SD, Gardin JM, Abrams J, et al. 2012

ACCF/AHA/ACP/AATS/PCNA/SCAI/STS Guideline for the diagnosis and management of patients with stable ischemic heart disease. *J Am Coll Cardiol* 2012; 60: e44–164.

69. Smith SC, Benjamin EJ, Bonow RO, et al. AHA/ACCF secondary prevention and risk reduction therapy for patients with coronary and other atherosclerotic vascular disease: 2011 update: a guideline from the American Heart Association and American College of Cardiology Foundation. *J Am Coll Cardiol* 2011; 58: 2432–46.
70. Pack, Q. R., Squires, R. W., Lopez-Jimenez, F., Lichtman, S. W., Rodriguez-Escudero, J. P., Zysek, V. N., & Thomas, R. J. (2014). The current and potential capacity for cardiac rehabilitation utilization in the United States. *Journal of cardiopulmonary rehabilitation and prevention*, 34(5), 318-326.
71. Sangster J, Furber S, Phongsavan P, Allman-Farinelli M, Redfern J, Bauman A. Where you live matters: Challenges and opportunities to address the urban–rural divide through innovative secondary cardiac rehabilitation programs. *Australian Journal of Rural Health*. 2013 Jun 1;21(3):170-7.
72. Curnier DY, Savage PD, Ades PA. Geographic distribution of cardiac rehabilitation programs in the United States. *Journal of Cardiopulmonary Rehabilitation and Prevention*. 2005 Mar 1;25(2):80-4.
73. Cardiac rehabilitation: why is it an underused therapy?
Jari A. Laukkanen *European Heart Journal*, Volume 36, Issue 24, 21 June 2015, Pages 1500–1501,
74. Dunlay SM , Witt BJ , Allison TG , et al. Barriers to participation in cardiac rehabilitation . *Am Heart J* .

2009 ; 158 : 852-859 .

75. Gurewich D , Prottas J , Bhalotra S , Suaya JA , Shepard DS. System-level factors and use of cardiac rehabilitation . J Cardiopulm Rehabil Prev . 2008 ; 28 : 380-385 .
76. Grace S , Gravely-Witte S , Bruhal J , et al
Contribution of patient and physician factors to cardiac rehabilitation enrollment: a prospective multilevel study. Eur J Cardiovasc Prev Rehabil .2008 ; 15 : 548-556.