



PERSPECTIVES IN CARDIOLOGY

Mandatory criteria for cardiac rehabilitation programs: 2018 guidelines from the Portuguese Society of Cardiology



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Received 16 January 2018; accepted 18 February 2018

Available online 30 April 2018

KEYWORDS

Norms;
Guidelines;
Cardiac rehabilitation programs;
Portuguese Society of Cardiology

Abstract Cardiac rehabilitation (CR) is a multidisciplinary process for patients recovering after an acute cardiac event or with chronic cardiovascular disease that reduces mortality and morbidity and improves quality of life. It is considered a cost-effective intervention and is expressly indicated in the guidelines of the major medical societies.

In Portugal, only 8% of patients discharged from hospital after myocardial infarction are included in CR programs. In Europe overall, the percentage admitted to CR programs is 30%, while in the USA it is 20-30%.

In view of the underuse of CR in Portugal, we call the attention of the health authorities to the need to increase the number and national coverage of CR programs, while maintaining high quality standards. The aim is for all patients resident in Portugal who are eligible for CR programs to have the same opportunities for access and attendance.

In order to preserve the benefits and safety of this intervention, CR needs to be performed according to international guidelines. The fact that various initiatives in this field have been developed by different professional groups, some of them non-medical, that do not follow the European guidelines, has prompted us to prepare a series of norms defining mandatory criteria for CR, based on current knowledge and evidence. In this way we aim to ensure that the required

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PALAVRAS-CHAVE

Normas;
Recomendações;
Programas de
Reabilitação
Cardíaca;
Sociedade Portuguesa
de Cardiologia

increase in the number of CR programs, linked in a national network of CR centers, does not detract from the need to maintain their efficacy and quality. These criteria should serve as the basis for the future accreditation of CR centers in Portugal.

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CrITÉRIOS mandatÓRIOS para programas de reabilitaÇo cardÍaca: normas da Sociedade Portuguesa de Cardiologia 2018

Resumo A reabilitaÇo cardÍaca é um processo multidisciplinar de recuperaÇo do doente aps evento cardiovascular agudo ou com doenÇa cardÍaca crnica, que conduz à reduÇo da mortalidade e morbidade e melhoria da qualidade de vida. Considera-se uma intervenÇo custo-eficaz com indicaÇo formal expressa em recomendaÇes das mais importantes sociedades cientÍficas internacionais.

Em Portugal, apenas 8% dos doentes com alta hospitalar aps enfarte so incluÍdos em programas de reabilitaÇo cardÍaca. Na Europa, a percentagem de admisso nesses programas é em mdia de 30%, enquanto nos Estados Unidos da Amrica esse percentual se situa entre 20-30%.

Pela subutilizaÇo franca da reabilitaÇo cardÍaca em Portugal, chamamos a atenÇo das autoridades de sade para a necessidade de aumentar o nmero e a distribuiÇo dos programas de reabilitaÇo cardÍaca no territrio nacional e manter padres de elevada qualidade. Pretende-se que todos os doentes residentes em Portugal elegÍveis para programa de reabilitaÇo cardÍaca possam ter idnticas condiÇes de acesso e atendimento relativamente aos programas.

Para que os benefÍcios e a seguranÇa dessa intervenÇo sejam salvaguardados, implica que o programa de reabilitaÇo cardÍaca seja aplicado como é preconizado nas diretrizes internacionais. A existncia de vrias iniciativas por parte de diferentes grupos profissionais, inclusive no mdicos, com pretenso de intervir nesse campo, sem respeito pelas recomendaÇes formais europeias, levou à elaboraÇo de um conjunto de normas que definem os critrios mandatÓrios para a reabilitaÇo cardÍaca, com base no conhecimento e na evidncia cientÍfica atual. Pretendemos dessa forma garantir que o necessrio aumento do nmero de programas de reabilitaÇo cardÍaca no seja dissociado da necessria eficincia e qualidade dos mesmos, articulados numa rede nacional de centros de reabilitaÇo cardÍaca. Esses critrios devero servir de base à futura e necessria acreditaÇo dos Centros de ReabilitaÇo CardÍaca em Portugal.

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Introduction

The present paper is the product of study and reflection by members of the Portuguese Society of Cardiology (SPC), in particular the SPC's Working Group on Exercise Physiology and Cardiac Rehabilitation, most of whom are cardiologists, with the purpose of alerting the health authorities to the deficiencies in cardiovascular prevention and rehabilitation in Portugal and the need to increase the number and national coverage of cardiac rehabilitation (CR) programs, while assuring criteria of quality and efficacy, described below.

Only through rational and balanced distribution of a greater number of cardiac rehabilitation centers, with programs fulfilling the criteria defined in these recommendations, will it be possible to ensure equality of access for all cardiovascular patients to a cost-effective intervention that is safe and indicated as essential due to all its proven benefits.

These criteria for CR, based on the current guidelines of the European Society of Cardiology (ESC)/European Association of Preventive Cardiology (EAPC),¹ the American Heart Association/American Association of Cardiovascular and Pulmonary Rehabilitation (AHA/AACPR),² the American College of Cardiology/American Heart Association,³ the American College of Cardiology Foundation/American Heart Association,⁴ and the British Association for Cardiovascular Prevention and Rehabilitation,⁵ should be mandatory and serve as a basis for the future accreditation of CR centers in Portugal, to be developed in the short term.

Rationale
Definition of cardiac rehabilitation

CR is defined as an intervention intended to help the patient recover or improve their physical, psychological, social and vocational functioning after an acute cardiac event or

in the context of chronic cardiovascular disease (such as angina or heart failure). It consists of an integrated multidisciplinary process with various components, emphasizing physical exercise, changes in behaviors aimed at healthier lifestyles, control of risk factors and intervention in psychological factors, with the main purpose of delaying the progression of the underlying cardiovascular disease.^{2,3}

The benefits of CR have been thoroughly demonstrated, including reductions in mortality and morbidity following myocardial infarction, and improvements in quality of life and functional capacity in cardiovascular disease, including heart failure.⁶⁻¹⁰

The ESC/EAPC¹ and the AHA/AACPR² classify CR as a therapeutic intervention with class I indication (mandatory), based on the highest levels of scientific evidence (A or B, according to the indications) in multiple cardiac conditions. Those eligible for this procedure are mainly coronary patients (with or without percutaneous intervention),³ those with heart failure (with or without devices)^{6,7} and those undergoing cardiac surgery (including revascularization, valve surgery and cardiac transplantation).^{4,6,7}

Cardiac rehabilitation in Portugal, Europe and the world

Cardiovascular disease remains the leading cause of death in Europe, and rapid, effective intervention is necessary. Although there have been significant improvements in pharmacological therapy, percutaneous coronary intervention and cardiac surgery, it is now urgent to invest in the areas of prevention and rehabilitation, complementing the other interventions.

Portugal has one of the lowest rates of inclusion in CR programs in Europe, due to cultural, scientific, organizational and financial factors.¹¹⁻¹³ Only 8% of patients suffering myocardial infarction participate in these programs,¹² in contrast to the European average of over 30% (in many countries it exceeds 50%).¹³

The last survey performed by the SPC, in 2013-2014,¹² identified 23 centers in Portugal with CR programs, 12 public and 11 private, which represents an increase compared to 2007, when there were 16 centers.¹¹ The percentage of patients discharged from hospital after myocardial infarction who participated in a CR program has almost tripled in recent years, increasing from 3% in 2007¹¹ to 8% in 2014,⁸ even though this figure is clearly insufficient to meet the country's needs.^{11,12,14}

Portuguese cardiac patients with indication for a CR program, especially north of the Douro river (except for the Greater Porto area), in the Central region, and south of the Tejo river, are largely excluded from a therapeutic intervention known to be cost-effective, that reduces mortality and hospitalization, improves quality of life and accelerates the normalization of daily life, especially return to work.^{6,8,9,15-17} These benefits have positive effects on the psychosocial well-being of cardiovascular patients and on the economic status of individual patients, their families, and society as a whole.

The 2010 European survey on cardiac rehabilitation, the European Cardiac Rehabilitation Inventory,¹³ which covered 28 countries, showed considerable differences in the picture

of cardiac rehabilitation, and placed Portugal among the 15 countries with CR use below 15%. These countries differ from the others in not having national associations, recommendations, legislation or funding for CR. Currently, according to data on the EAPC's Country of the Month project, available on the EAPC's website, the situation in Europe regarding CR remains heterogeneous, with different obstacles, participation rates and programs.¹⁸

In the US, the participation rate in CR programs is only 20-30%. It has been estimated that increasing this rate to 70% would save 25 000 lives and prevent 18 000 hospitalizations per year.¹⁹

Worldwide, only 38.8% of countries have CR programs: 68% of high-income countries, 28.2% of median-income countries and 8.3% of low-income countries. The availability of CR is much lower than that of other evidence-based interventions, such as revascularization and pharmacological therapy. In high-income countries, the density of CR programs ranges from 1:100 000 to 300 000 population, which if applied to Portugal, and using the lower figure, would require the existence of 100 programs for a population of 10 million.²⁰ In fact, there are fewer than one fifth of the CR programs required in Portugal, and many of these have fewer than 50 admissions per year.

Role of the Portuguese Society of Cardiology in cardiac rehabilitation in Portugal: implementation, accreditation and certification

The SPC has performed several national surveys of active CR centers since 1998,²¹ and has found centers to be concentrated in the areas of Greater Porto and Greater Lisbon, with only one center in the south (Faro) and none in Trás-os-Montes, the central and interior regions of the country, Ribatejo or the Alentejo. In view of this situation, implementation of a CR program in each cardiology or cardiothoracic department has been recommended, in order to widen national coverage.

In recent decades, the SPC has been the leading voice in promoting awareness and discussion of the issue of CR availability among cardiologists, physical medicine and other specialist physicians, other health professionals including psychologists, physiotherapists, exercise physiologists, nurses and nutritionists, and others. Recently, increased interest in CR has been noted from several groups of health professionals, who have expressed the intention to assume responsibility for coordinating CR programs, with no medical background or specific education or training in the area of CR.

Due to the need to develop and implement CR while following the international guidelines and ensuring that programs are performed by skilled multidisciplinary teams, the SPC, in conjunction with specialists from the Working Group on Exercise Physiology and Cardiac Rehabilitation, decided to prepare this document, which defines mandatory criteria for CR, in order to ensure the safety, efficacy and quality of CR programs.

The present recommendations constitute a solid basis for national accreditation of CR programs. The SPC considers desirable the creation of a specific competence in CR, to be

recognized by the *Ordem dos Médicos* (the Portuguese Order of Physicians).

Basis for launching a cardiac rehabilitation program

It is important to be aware that it is not sufficient simply to create a program and call it 'cardiac rehabilitation' in order to intervene beneficially and safely in cardiovascular patients.

The establishment of a CR program should take into consideration the following questions:

Is there a need for a CR program?

According to the above considerations, there is no doubt concerning the need to establish quality CR centers and programs, with a more balanced national distribution.

What are the target populations?

Current developments in cardiology, particularly in terms of percutaneous and surgical interventions, as well as increasing awareness of the benefits of CR, are leading to a significant widening of CR indications²²:

- Acute coronary syndromes
- Chronic heart failure (with or without resynchronization/defibrillator or left ventricular assist device)
- Post cardiac surgery (valvular, coronary, congenital and cardiac transplantation)
- Post percutaneous intervention (coronary, aortic valve implant, mitral clip, and others).

What is the location of implementation?

In view of the present state of cardiac rehabilitation in Portugal, we argue that phase I should be performed in the hospital where admission took place, and phase II in the same location or alternatively where periodic outpatient follow-up of cardiac patient is performed.

Patients who were discharged from the hospital after the acute event without CR, or who have difficulty in attending the hospital where the admission took place, should be referred in phase II to the most convenient and easily accessible CR center, at a maximum of 30 km from their place of residence or work, or alternatively to a home-based program linked to the admission hospital.

When phase II is concluded, long-term CR should be provided, which usually runs in centers external to the hospitals accredited for this purpose.

Do physicians consider rehabilitation?

Physicians' awareness is an important aspect of cardiac rehabilitation. The large cardiovascular centers in Portugal recently had to demonstrate that they had CR programs in order to be considered referral centers in several areas, which demonstrates the importance of these programs. However, not all physicians place an appropriate value on CR.

Every cardiologist and cardiac surgeon has the responsibility to refer all eligible patients to a CR program, as part of a therapeutic plan of excellence. The involvement of the referring physician, hospital or outpatient cardiologist, cardiac surgeon, or generalist is crucial for the enrollment and continuation of the patient in the program.

Is it feasible?

The performance of CR programs depends on adequate funding and access of patients with formal indication.

Funding should be provided by the National Health Service, Social Security, health insurance, other entities or patients' private payment, according to the organization of the local health system, and may vary over the course of the different phases of the program.

Access of all patients with formal indication for CR should be guaranteed for phases I and II in CR centers that fulfill the mandatory criteria set out in this document.

Structure of a cardiac rehabilitation program

Central components

Each CR center should have previously defined its exercise and education program for each of the diagnostic groups of patients being treated, the following components being considered mandatory.^{2,5,22-24}

Medical assessment

- Clinical history of cardiovascular disease, risk factors, comorbidities; general physical exam, identification of locomotor and cognitive limitations.
- Assessment of functional capacity, including exercise testing in phases II and III in all patients except in cases of patient incapacity.
- Assessment and stratification of cardiovascular risk for exercise and determination of the level of supervision required.
- Initial blood and cardiac function tests (Table 1).

Exercise training and counseling on physical activity

- Individualized medical exercise prescription by a cardiologist or physical medicine specialist, specifying a structured exercise training program to ensure efficacy and safety.
- Supervision of exercise training will be performed, according to cases and phases (Table 2), by a physiotherapist, exercise physiologist or rehabilitation nurse in person, under coordination by a physician (Table 2).
- Medical advice on extra-program physical activity, including leisure, vocational and sexual activity, driving and traveling.

Identification and control of risk factors

- Cardiology consultation
- Specific consultations as necessary for all risk factors: diabetes, smoking cessation, hypertension, dyslipidemia, obesity, and others.

Table 1 Patient assessment at admission to the different program phases.

	Phase I	Phase II	Phase III
Clinical history	y	y	y
Hemogram	y	y	y
Blood glucose/HbA1c	y	y	y
Renal function	y	y	y
Lipid profile	y	y	y
BNP/NT-pro BNP		In HF	In HF
ECG	y	y	y
Cardiac function	y	y	y
Exercise test		y	Annual
CPET		In HF	In HF
Imaging test		If appropriate	If appropriate

BNP: brain natriuretic peptide; cardiac function: usually assessed by echocardiography; CPET: cardiopulmonary exercise test; HF: heart failure; NT-pro BNP: N-terminal pro-brain natriuretic peptide; y: yes.

Nutritional assessment and counseling

- Nutritional consultation for all patients in general and specifically for diabetic, obese, frail, hypertensive and dyslipidemic patients.

Psychological assessment and intervention

- Psychological assessment of all patients, ideally through psychology and/or psychiatry consultations, according to the clinical indication
- Psychological intervention by a psychologist or psychiatrist, particularly through cognitive-behavioral techniques for lifestyle modification, control of cardiovascular risk factors and adherence to pharmacological and non-pharmacological therapy, and relaxation techniques when indicated.

Education and information

Counseling for lifestyle modification by physicians, nurses, nutritionists, psychologists and other members of the CR team, including:

- Increased physical activity and appropriate diet
- Return to work, participation in sports (if possible), sexual activity, driving, and plane travel
- Adherence to pharmacological and non-pharmacological therapy
- Control of stress and anxiety through education programs, group therapy and different specialist consultations included in the CR program.

Table 3 Multidisciplinary team required in a cardiac rehabilitation program.

	Phase I	Phase II	Phase III
Cardiologist	y	y	y
Physical medicine specialist	y	y	y ^a
Psychiatrist/psychologist	y	y	
Specialist in smoking cessation	y	y	
Rehabilitation nurse	y	y	
Physiotherapist	y	y	y ^b
Exercise physiologist		y ^b	y
Cardiopulmonary technician		y ^a	
Nutritionist	y	y	y
Social worker	y	y	

^a Important if the session monitors are unable to interpret ECG monitoring.

^b 2nd option to perform exercise sessions.

y: yes.

Socioeconomic support

- Support from a social worker for patients to return to work
- Financial support from a social worker in cases of economic difficulties in obtaining essential medication and transport to the CR center.

Long-term maintenance strategies

- Follow-up in person in consultations, by phone and/or by mail, by physician and nurse
- Follow-up with coaching and motivational techniques, by psychologist and/or nurse.

Patient assessment after the cardiac rehabilitation program

- Clinical, exercise testing, echocardiogram, laboratory analysis and quality of life.

Evaluation of program quality

- Assessment of patients' degree of satisfaction
- Assessment of the program's characteristics and conditions

A multidisciplinary team is needed with specific tasks for each member (Tables 3 and 4).

A local database is essential, and a national database would be desirable, bringing together data from national centers, as part of the SPC's National Center for Data Collection in Cardiology (CNCDC).

Internal assessment of the program should be performed through questionnaires evaluating patient satisfaction, anal-

Table 2 Exercise monitoring during program phases.

	Exercise monitoring	Borg scale	Heart rate	ECG monitoring	Emergency cart	Staff trained in BLS
Phase I	y	y	y	y	y	y
Phase II	y	y	y	y ^a	y	y
Phase III	y	y	y		y	y

^a Unnecessary in low-risk patients.

BLS: basic life support and defibrillation; y: yes.

Table 4 Roles of members of the multidisciplinary cardiac rehabilitation program team.

	Coordination	cardiovascular assessment	overall and motor assessment	Exercise prescription	Exercise sessions attendance and monitoring	Risk factor control	Education	Psychological/social intervention	Nutritional intervention	Smoking cessation	Follow-up
Cardiologist ^a with CR training	R	R	C	R	C	R	R	C	C	C	R
Physical Medicine specialist ^a with CR training	R	C	R	R	C	C	C	C	C	C	
Other medical specialists ^a with CR training	R	C	C	R	C	C	R	C	C	C	C
Psychiatrist/psychologist						C		R		C	
Specialist in smoking cessation										R	
Nurse					C	C	R	C	C	C	R
CR nurse, physiotherapist, or exercise physiologist				C	R	C	C	C	C	C	C
Cardiopulmonary technician					C		C				
Nutritionist						C	C		R		
Social worker						C		R			

^a Physicians with competence and training in cardiac rehabilitation.
C: complementary intervention; CR: cardiac rehabilitation; R: responsible.

ysis of individual and group gains, and indicators such as the proportion of eligible patients referred for CR and uptake and dropout rates.

External assessment should be performed periodically, using the mandatory criteria for CR, by independent entities that are responsible for accrediting and periodically checking centers.

Time phases

Phase I – hospital phase

This is performed during hospital stay, beginning 24-48 hours after a non-complicated acute event.

A phase I program consists of early mobilization, low-intensity exercises, educational actions aimed at the adoption of a healthy lifestyle and control of risk factors, and encouragement to adhere to therapy and to participate in the following CR phases.^{2,25,26}

Purposes.

- To avoid problems associated with prolonged immobilization: loss of postural reflexes, negative nitrogen balance, postural hypotension, atelectasis and pneumonia, thromboembolic phenomena, deconditioning, joint stiffness, muscle atrophy, depression, and urinary infections
- To identify and initiate control of risk factors
- To promote the adoption of a healthier lifestyle from the outset, working with both the patient and healthcare personnel
- To identify and minimize psychological disturbances caused by the acute event
- To establish a positive attitude that motivates the patient to continue the rehabilitation process and to take responsibility for long-term self-care with the help of professionals.

Patients eligible for the program. Individuals eligible for a phase I program are:

- Patients with acute coronary syndrome
- Patients with heart failure, including those undergoing cardiac transplantation (before and after)
- Patients with left ventricular assist or resynchronization devices, defibrillators or pacemakers
- Patients undergoing coronary artery bypass grafting or percutaneous coronary intervention
- Patients undergoing valve surgery or percutaneous implantation of prosthetic valves or clips
- Patients undergoing surgery to correct congenital heart disease.

When to begin. Phase I begins as soon the patient stabilizes after the acute event, usually after 24-48 hours, according to the indication of the intensive care unit physician.

Before patients begin a phase I program, they should be assessed by the CR team, observing the admission criteria, contraindications and levels and progression of physical activity set out in the international guidelines.^{25,26}

Exercise testing is not indicated in phase I. The intensity of exercise in this phase is defined by the subjective perception of effort as assessed by the Borg scale, without

allowing heart rate to exceed resting heart rate by 20-30 bpm, according to the patient's clinical condition.^{27,28}

Cardiac rehabilitation program team. The core components of CR require the contribution of different health professionals. The composition of the multidisciplinary team may differ, but it will need to provide the knowledge and skills needed for the core components, inclusion of the following being mandatory:

- Cardiologist
- Physical medicine specialist
- Rehabilitation nurse/physiotherapist
- Nurse
- Nutritionist
- Psychologist/psychiatrist.

The CR team may need to request support from other specialist physicians, such as internists, endocrinologists or pneumologists, to manage the patients' various comorbidities.

The program coordinator will be a cardiologist or other physician with qualifications in cardiac rehabilitation, recognized by the Order of Physicians.

Location and equipment.

Location

Many of the activities in Phase I are executed in bed – in the intensive care unit or in the ward, using areas located nearby, such as corridors and stairs.

Some centers subdivide Phase I into:

- Phase Ia – performed in the intensive care unit
- Phase Ib – performed in the ward.

If the department already has specific areas reserved for phase II, patients can be directed to this sector in the final part of phase Ib.

Ideally there will be a place for meetings used for individual and group educational activities (not mandatory in phase I).

Equipment

The following equipment is essential:

- Heart rate monitor or electrocardiograph (ECG) (by telemetry or portable monitor)
- Sphygmomanometer
- Scales
- Oximeter.

Phase II – early post-discharge phase

This phase covers patients after hospital discharge. It can be performed in the hospital, in a specialized CR center or, in some cases, at the patient's home.

In any of the above settings, the exercise program prescribed is individualized in terms of intensity, type (aerobic, continuous or interval, resistance), duration, frequency and modality.

Formal programs for patient education and lifestyle modification are considered essential components of this phase.

Purposes.

- To improve cardiovascular function, functional capacity, strength, balance and flexibility

- To optimize pharmacological therapy
- To detect and treat arrhythmias or hemodynamic and electrocardiographic changes occurring during exercise
- To educate the patient regarding how exercise and to remain active in the long term
- To work with the patient and their close family or caregiver to help them adopt a healthier lifestyle
- To improve the patient's psychological condition
- To individualize the exercise program in terms of intensity, duration, frequency, modality, and the type of physical activity
- To promote patients' autonomy regarding their treatment program.

Patients eligible for the program. All patients who are eligible for phase I, whether or not they participate in this phase, are eligible for phase II. Besides these, individuals at high cardiovascular risk, diabetic, hypertensive and dyslipidemic patients, and smokers, may be indicated for phase II CR.

When to begin. The patient should start phase II as soon as possible, preferably within two weeks of discharge or after diagnosis (for non-hospitalized patients). If not begun before, it may be performed up to six months after the acute cardiac event.

The initial assessment and cardiovascular risk stratification (low, intermediate or high) is undertaken by the program's cardiologist. This stratification is based mainly on symptom severity, degree of left ventricular dysfunction, functional capacity, and the presence of residual ischemia or arrhythmias.^{29,30} Complementary exams required for this assessment include exercise testing (preferably cardiorespiratory testing in heart failure patients), echocardiogram (and other imaging methods if necessary), and 24-hour Holter monitoring (mostly for patients with arrhythmias).

Exercise testing is also essential for prescription of an exercise program, and is performed in all cases except in cases of complete patient incapacity.

In these specific and limited cases, possible alternatives are the six-minute walk test or other functional tests. Holter monitoring and new blood tests may be required.

At the end of this phase the patient should be reassessed to ascertain the extent to which the purposes were achieved, to quantify the gains of CR, and to help optimize therapy.

Cardiac rehabilitation program team. The CR team to implement phase II should include:

- Cardiologist
- Physical medicine specialist
- Exercise specialist: physiotherapist, exercise physiologist or rehabilitation nurse
- Nutritionist
- Psychiatrist/psychologist
- Nurse
- Cardiopulmonary technician

The coordinator of a phase II CR program, as in phase I, should be a cardiologist or other certified physician with specific competence in cardiac rehabilitation.³¹ The coordinator is responsible for the efficacy and safety of the program and for defining the programs offered in the

center according to pathology, as well as for ensuring that the members of the team have certification and training in basic life support and resuscitation. He or she should assess the patient's progress and the achievement of program outcomes, supervise the quality of care offered by the team, ensure the implementation of legislation, and produce periodic reports on the CR program's activities.³¹

Prescription of the intensity of aerobic exercise and other types of exercise (Tables 4 and 5) should be determined by the cardiologist, the exercise specialist's task being to apply this during the program's exercise sessions, informing the prescribing cardiologist of how the patient and the exercise specialist perceive the level of intensity, as well as the clinical response to the type of activity prescribed.

The exercise specialist coordinates exercise training under medical supervision and is responsible for the diversification and progression of training.

As a general rule, a ratio of one exercise specialist to 5-10 low- or intermediate-risk patients per session should be used. For high-risk patients, the ratio should be higher: one exercise specialist to 2-3 patients, according to severity.

During the training sessions, the cardiologist does not need to be present in the exercise room in most cases, but must be nearby and contactable to identify and rapidly intervene in the event of complications and to resolve questions regarding training or clinical problems, including adjustment of pharmacological therapy. In this case, health personnel with training in interpretation of ECG traces, such as a cardiopulmonologist, should always be present.

Location and equipment.

Location

- There should be at least 3-4 patients per session³²
- Minimum area of 6 m² for ergometry (cycle ergometer or treadmill)
- Dressing-room (ideally with shower)
- Waiting room
- Education room (which can be the exercise room).

It is not mandatory for complementary exams such as the exercise test, echocardiogram, Holter and other exams to be performed in the CR center, but these should be able to be performed rapidly in accredited centers.

Equipment

The CR program should offer different activities, if possible using various ergometers and other equipment for functional training, adapted to the needs of the target population.

As a minimum, the following should be available:

- Treadmills and cycle ergometers
- Elastic bands and weights
- Sphygmomanometer
- Chronometer
- Digital oximeter
- Continuous ECG monitoring, except for low-risk patients
- Cardiopulmonary resuscitation equipment including defibrillator and emergency cart
- Plan for urgent evacuation

Monitoring should be appropriate for the patient's cardiovascular risk level (Table 6), taking into account the risk

Table 5 Types of mandatory training available in the center.

	Passive mobilization	Active mobilization (ROM)	Flexibility	Balance	Callisthenics	Aerobic	Muscle strength
Phase I	y	y					
Phase II			y	y	y	y	y
Phase III			y	y	y	y	y

ROM: range of movement; y: yes.

Table 6 Minimal program in the different phases of a cardiac rehabilitation program.

	Phase I	Phase II	Phase III
Passive mobilization (ROM)	y		
Active mobilization (ROM)	y		
Corridor walking	y		
Descending stairs	y		
Ascending stairs	y		
Warm-up		y	y
Flexibility		y	y
Balance		y	y
Callisthenics		y	y
Continuous aerobic training		y	y
Interval training		If appropriate	If appropriate
Strength training		y	y
Games			y
Cool-down		y	y
Duration of aerobic training		20-45 min	30-60 min
Weekly frequency		3-5	2-5
Duration of phase	Hospital admission	8-12 weeks	Rest of life
Education program, minimum	Alternate days	Once a week	2-3 times/year

ROM: range of movement; y: yes.

due to the underlying disease, the program phase, and the time the patient has been participating in the program.

Low-risk patients can be monitored with a heart rate monitor only, while moderate- and high-risk patients need telemetry or continuous monitoring, at least during the first eight weeks.

Patients should be encouraged to wear sports shoes and loose, comfortable clothing.³²

Integration between cardiac rehabilitation centers and attending physicians. From the outset, the phase II team should coordinate with the attending physicians (cardiologists, generalists, internists and others) and with phase III centers, in order to ensure the continuity of the patient's CR program.

Phase III centers should be coordinated by those of phase II, in terms of clinical assistance, education and training, and investigation.

Referral from a phase II to a phase III center should include a discharge report from phase II, to ensure the continuity of the intervention. This report should provide information on the patient's current situation and clinical and functional evolution, limitations, difficulties, and issues which need improvement.

Phase III – long-term phase

The long-term phase usually begins after phase II, according to the physician's indication, and should last for the

rest of the patient's life. This phase covers other low-risk patients who did not participate in phase II and are referred (six months or more after the acute event) by phase II CR centers, after medical assessment.

Purposes.

- To provide professional supervision of exercise, with clinical monitoring of symptoms and signs, heart rate, blood pressure and ECG (if required; only in high-risk patients)
- To teach self-monitoring
- To maintain patients' awareness of the behavioral aspects of cardiovascular disease and the need to continue preventive measures (annually)
- To maintain long-term control of cardiovascular risk factors and adherence to pharmacological therapy and healthy lifestyles
- To ensure annual assessment of patients through clinical, functional (exercise test) and laboratory tests and echocardiogram (when indicated).

Patients eligible for the program. Patients with previously established indications for phases I and II CR programs, those who have completed phase II, and those who did not participate in phase II six or more months after the acute cardiac event, are eligible for long-term CR programs, if they are stable and present no contraindications.

When to begin. After phase II, or as soon as they are identified if they have not participated in a phase II program.

Cardiac rehabilitation program team. In this phase the minimum CR team should be composed of:

- Cardiologist, physical medicine specialist or other physician with competence in CR recognized by the Order of Physicians
- Exercise specialist: exercise physiologist or physiotherapist

Exercise specialists who implement the exercise sessions need to be certified to perform basic life support. Plans to deal with possible events, although rare, need to be rehearsed and contacts of the emergency team, transportation (ambulance) and referral hospitals need to be easily available. The presence of other health professionals is optional.

Location and equipment.

Location

Long-term programs should be implemented in sites that can accommodate a variety of activities, including games, aerobic exercise, walking, dancing, running, and strength exercises. In some cases they can occupy the same site as the phase II program.

The size of the space and type and structure of the location are dictated by the activities which are offered. It may include closed spaces and/or open spaces.

Some programs can home-based, especially in low-risk patients, which eliminates the need for travel to CR centers and removes problems with scheduling. Monitoring of parameters and periodic supervision by a team which includes a nurse or physiotherapist are essential in home-based programs.

Equipment

A variety of options should be provided, to fulfill the specific needs of each patient and to meet safety standards:

- Equipment for cardiopulmonary resuscitation, including emergency cart, defibrillator and certified team for immediate life support
- Facilities for monitoring high-risk patients (with the need for medical supervision, as in phase II)
- Ergometers (cycle, rowing and arm cycle ergometers, treadmills, and/or stair steppers (minimum areas as for phase II)
- Equipment for muscle training
- Equipment for functional training and non-competitive sports and recreational activities.

Final comments

Following the norms defined in the international guidelines and based on the above criteria, which are crucial to ensure the quality of a CR program, it will be possible to obtain the benefits of CR demonstrated in randomized clinical trials, without increasing the patient's cardiovascular risk.

It is essential for every hospital cardiology department to offer phase I CR programs and to include a CR center (preferably inside the hospital) to which, following phase I, cardiovascular patients can be referred for phase II, directly

and without impediment, in order to continue their CR program.

Links should then be established between hospitals and non-hospital outpatient centers, to offer long-term phase III CR, which in principle is for life. These outpatient centers may be located in health centers, community sport centers, or university sports faculties, in liaison with the originating hospital centers.

It is essential to carry out all components of the program, which should always be performed by the multidisciplinary team. Liaison between the CR team coordinator and attending physicians (cardiologist and generalist) is crucial.

Only patient follow-up, promoting healthy lifestyles, continuation of pharmacological therapy and patients' personal autonomy in the treatment of their disease, will enable long-term adherence and the success of the program.

Finally, home-based CR for low-risk patients, which will enable various problems to be overcome, needs to be introduced carefully and appropriately, following specific standards that are still to be defined.

Good clinical practice in CR, with quality programs, depends on thorough internal and external evaluation by means of audits, performed by experts and by patients.

The SPC is strongly committed to the implementation of CR programs and to the maintenance of their quality, through accreditation and evaluation of CR centers and competences, and certification of health personnel qualified for CR.

Conflicts of interest

The authors have no conflicts of interest to declare.

References

1. Piepoli MF, Hoes AW, Agewall S, et al. 2016 European Guidelines on cardiovascular disease prevention in clinical practice: The Sixth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of 10 societies and by invited experts) Developed with the special contribution of the European Association for Cardiovascular Prevention & Rehabilitation (EACPR). *Eur Heart J.* 2016;37:2315–81.
2. Balady GJ, Williams MA, Ades PA, et al. Core Components of Cardiac Rehabilitation/Secondary Prevention Programs: 2007 Update. A Scientific Statement from the American Heart Association Exercise, Cardiac Rehabilitation, and Prevention Committee, the Council on Clinical Cardiology; the Councils on Cardiovascular Nursing, Epidemiology and Prevention, and Nutrition, Physical Activity, and Metabolism; and the American Association of Cardiovascular and Pulmonary Rehabilitation. *Circulation.* 2007;115:2675–82.
3. Amsterdam EA, Wenger NK, Brindis RG, et al. 2014 AHA/ACC guideline for the management of patients with non-ST-elevation acute coronary syndromes: executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation.* 2014;130:2354–94.
4. Hillis LD, Smith PK, Anderson JL, et al. 2011 ACCF/AHA guideline for coronary artery bypass graft surgery: executive summary: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *J Thorac Cardiovasc Surg.* 2012;143:4–34.

5. British Association for Cardiovascular Prevention and Rehabilitation. BACPR standards and core components for cardiovascular disease prevention and rehabilitation 2012. 2nd ed. UKBACPR; 2012. www.bacpr.com/resources/46C_BACPR_Standards_and_Core_Components_2012.pdf
6. Piepoli MF, Conraads V, Corrà U, et al. Exercise training in heart failure: from theory to practice. A consensus document of the Heart Failure Association and the European Association for Cardiovascular Prevention and Rehabilitation. *Eur Heart Fail.* 2011;13:347–57.
7. Ponikowski P, Voors AA, Anker SD, et al. 2016 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure: The Task Force for the diagnosis and treatment of acute and chronic heart failure of the European Society of Cardiology (ESC) Developed with the special contribution of the Heart Failure Association (HFA) of the ESC. *Eur Heart J.* 2016;37:2129–200.
8. Anderson L, Oldridge N, Thompson DR, et al. Exercise-based cardiac rehabilitation for coronary heart disease. *J Am Coll Cardiol.* 2016;67:1–12.
9. Rauch B, Davos CH, Doherty P, et al. The prognostic effect of cardiac rehabilitation in the era of acute revascularisation and statin therapy: a systematic review and meta-analysis of randomized and non-randomized studies – The Cardiac Rehabilitation Outcome Study (CROS). *Eur J Prevent Cardiol.* 2016;23:1914–39.
10. Van Halewijn G, Deckers J, Tay HY, et al. Lessons from contemporary trials of cardiovascular prevention and rehabilitation: a systematic review and meta-analysis. *Int J Cardiol.* 2017;232:294–303.
11. Abreu A, Bettencourt N, Fontes P. Panorama Nacional de Reabilitação Cardíaca em 2007-2009. *Rev Port Cardiol.* 2010;29:545–58.
12. Silveira C, Abreu A, Dores H. Reabilitação cardíaca em Portugal. Inquérito 2013-2014. *Rev Port Cardiol.* 2016;35:659–68.
13. Bjarnason-Wehrens B, McGee H, Zwisler AD, et al. Cardiac rehabilitation in Europe: results from the European Cardiac Rehabilitation Inventory Survey. *Eur J Cardiovasc Prev Rehabil.* 2010;17:410–8.
14. Ferreira R, Abreu A. Reabilitação Cardíaca: Realidade Nacional e Recomendações Clínicas. Publicação da Coordenação Nacional para as Doenças Cardiovasculares em colaboração com o Grupo de Estudos de Fisiopatologia do Esforço e Reabilitação Cardíaca da Sociedade Portuguesa de Cardiologia. DGS-Ministério da Saúde; 2008.
15. Leggett LE, Hauer T, Martin BJ, et al. Optimizing value from cardiac rehabilitation: a cost-utility analysis comparing age, sex, and clinical subgroups. *Mayo Clin Proc.* 2015;90:1011–20.
16. Wong WP, Feng J, Pwee KH, Lim J. A systematic review of economic evaluations of cardiac rehabilitation. *BMC Health Services Research.* 2012;12:243. <http://www.biomedcentral.com/1472-6963/12/243>
17. Dunlay SM, Pack QR, Thomas RJ, et al. Participation in cardiac rehabilitation, readmissions, and death after acute myocardial infarction. *Am J Med.* 2014;127:538–46.
18. Perck J on behalf of National Coordinators for Prevention of EAPC. The Country of the Month. ESC/EAPC. [https://www.escardio.org/Sub-specialty-communities/European-Association-of-Preventive-Cardiology-\(EAPC\)/Prevention-in-your-country/country-of-the-month](https://www.escardio.org/Sub-specialty-communities/European-Association-of-Preventive-Cardiology-(EAPC)/Prevention-in-your-country/country-of-the-month).
19. Ades PA, Keteyian SJ, Wright JS, et al. Increasing cardiac rehabilitation participation from 20% to 70%: a road map from the Million Hearts Cardiac Rehabilitation Collaborative. *Mayo Clin Proc.* 2017;92:234–42.
20. Turk-Adawi K, Sarrafzadegan N, Grace SL. Global availability of cardiac rehabilitation. *Nat Rev Cardiol.* 2014;11:586–96.
21. Teixeira M, Sampaio F, Brízida L, et al. Reabilitação Cardíaca em Portugal – evolução entre 1998 e 2004. *Rev Port Cardiol.* 2007;26:815–25.
22. Piepoli M, Corrà U, Abreu A, et al., on behalf of the Cardiac Rehabilitation Section of the European Association for Cardiovascular Prevention & Rehabilitation of the ESC. Challenges in secondary prevention of cardiovascular diseases: a review of the current practice. *Int J Cardiol.* 2015;180:114–9.
23. Piepoli M, Corrà U, Adamopoulos S, et al. Secondary prevention in the clinical management of patients with cardiovascular diseases. Core components, standards and outcome measures for referral and delivery. *Eur J Prev Cardiol.* 2014;21:664–81.
24. Piepoli MF, Corra U, Benzer W, 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.* 2010;17:1–17.
25. Macedo RF, Faria-Neto JR, Costantini CO, et al. Phase I of cardiac rehabilitation: a new challenge for evidence based physiotherapy. *World J Cardiol.* 2011;3:248–55.
26. Pescatello LS, Arena R, Riebe D, et al. ACSM’s guidelines for exercise testing and prescription. 9th ed. Rio de Janeiro, RJ: Guanabara Koogan; 2014. p. 53–134.
27. Wright DJ, Williams SG, Riley R, et al. Is early, low level, short term exercise cardiac rehabilitation following coronary bypass surgery beneficial? A randomised controlled trial. *Heart.* 2002;88:83–4.
28. Dressendorfer RH, Franklin BA, Cameron JL, et al. Exercise training frequency in early post-infarction cardiac rehabilitation. Influence on aerobic conditioning. *J Cardiopulm Rehabil.* 1995;15:269–76.
29. Fletcher GF, Balady JT, Amsterdam EA, et al. Exercise standards for testing and training: a statement for healthcare professionals from the American Heart Association. *Circulation.* 2001;104:1694–740.
30. Guidelines for Cardiac Rehabilitation and Secondary Prevention Programs 5th Edition Web Resource. American Association of Cardiovascular and Pulmonary Rehabilitation. 5th ed. Human kinetics; 2013. ISBN-13: 9781450459648.
31. King M, Bittner V, Josephson R, et al. Medical director responsibilities for outpatient cardiac rehabilitation/secondary prevention programs: 2012 update. A statement for health care professionals from the American Association of Cardiovascular and Pulmonary Rehabilitation and the American Heart Association. *Circulation.* 2012;126:2535–43.
32. Araujo CG, Carvalho T, Castro CLB, et al. Normatização dos Equipamentos e Técnicas de Reabilitação Cardiovascular Supervisionada. *Arch Bras Cardiol.* 2004;5:448–52.