Wolters Kluwer Health | Lippincott Williams & Wilkins

EUROPEAN SOCIETY OF CARDIOLOGY®

Review

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

Massimo Francesco Piepoli, Ugo Corrà, Werner Benzer, Birna Bjarnason-Wehrens, Paul Dendale, Dan Gaita, Hannah McGee, Miguel Mendes, Josef Niebauer, Ann-Dorthe Olsen Zwisler and Jean-Paul Schmid

Heart Failure Unit, Cardiac Department, Guglielmo da Saliceto Hospital, Piacenza, Italy

Received 19 January 2009 **Accepted** 13 July 2009

Increasing awareness of the importance of cardiovascular prevention is not yet matched by the resources and actions within health care systems. Recent publication of the European Commission's European Heart Health Charter in 2008 prompts a review of the role of cardiac rehabilitation (CR) to cardiovascular health outcomes. Secondary prevention through exercise-based CR is the intervention with the best scientific evidence to contribute to decrease morbidity and mortality in coronary artery disease, in particular after myocardial infarction but also incorporating cardiac interventions and chronic stable heart failure. The present position paper aims to provide the practical recommendations on the core components and goals of CR intervention in different cardiovascular conditions, to assist in the design and development of the programmes, and to support healthcare providers, insurers, policy makers and consumers in the recognition of the comprehensive nature of CR. Those charged with responsibility for secondary prevention of cardiovascular disease, whether at European, national or individual centre level, need to consider where and how structured programmes of CR can be delivered to all patients eligible. Thus a novel, disease-oriented document has been generated, where all components of CR for cardiovascular conditions have been revised, presenting both well-established and controversial aspects. A general table applicable to all cardiovascular conditions and specific tables for each clinical disease have been created and commented. ***Eur J Cardiovasc Prev Rehabil*** **17:1–17 © 2010 The European Society of Cardiology**

European Journal of Cardiovascular Prevention and Rehabilitation 2010, **17**:1–17

Keywords: blood pressure, cardiac rehabilitation, diet/nutritional counselling, exercise training, lipid management, physical activity, prevention, psychosocial management, smoking, weight control

Background and rationale

Recent years have witnessed impressive progress in pharmacological therapies and in sophisticated technology-based diagnostic and therapeutic procedures in cardiovascular diseases. As a consequence, a greater number of men and women now survive acute events but with a heavier individual and health system burden of chronic conditions driving up health service needs and costs.

In this context, both health authorities and the general population have started to recognize that the current approach, based mainly on the interventional cardiology and pharmacological treatments, is neither effective nor

Correspondence to Professor Massimo F. Piepoli, MD, PhD, FACC, FESC, Heart Failure Unit, Cardiac Department, Guglielmo da Saliceto Hospital, Cantone del Cristo, I-29100 Piacenza, Italy
Tel: +390 523 303217; fax: +390 523 303220; e-mail m.piepoli@ausl.pc.it
Document reviewers: Pantaleo Giannuzzi, Hugo Saner, David Wood.
EACPR Committee for Science Guideline: Ugo Corrà (Chairperson), Massimo F. Piepoli, François Carré; Peter. Heuschmann; Uwe Hoffmann; Monique Verschuren; Julian Halcox.

1741-8267 © 2010 The European Society of Cardiology

DOI: 10.1097/HJR.0b013e3283313592

sustainable. Cardiovascular disease is eminently preventable, as outlined in the recent European Heart Health Charter: 'the burden of established cardiovascular disease may also be reduced by early diagnosis, appropriate disease management, rehabilitation, and prevention, including structured lifestyle counselling.' (European Heart Health Charter, article 7) [1].

Cardiac patients after an acute event, intervention or diagnosis with a chronic heart condition deserve special attention to restore their quality of life, to maintain or improve functional capacity. They require counselling to prevent event recurrence, by adhesion to a medication plan and adoption of a healthy lifestyle. Cardiac rehabilitation (CR) is a multifaceted and multidisciplinary intervention, which improves functional capacity, recovery and psychological well-being [2]. It is recommended (with the highest level of scientific evidence-class I) by the European Society of Cardiology, the American Heart Association and the American College of Cardiology in the treatment of patients with coronary artery disease (CAD) [3–5]. Moreover, it is a cost-effective intervention following an acute coronary event [6] and chronic heart failure (CHF) [7], as it improves prognosis by reducing recurrent hospitalization and health care expenditures, while prolonging life. It compares favorably in terms of costs per year life saved with other well-established preventive and therapeutic interventions in the treatment of CAD and CHF such as cholesterol-lowering medication, thrombolysis, coronary angioplasty, surgery or device implantation.

CR programmes are based on long-established models involving residential or ambulatory programmes, according to local and national preferences [8]. To provide this approach, CR programmes have become a meeting point for multidisciplinary team, working together with the coordination of a cardiologist, to promote the range of health behaviour changes, including medication adherence that have been shown to reduce further cardiovascular events and increase patients' quality of life.

Aim of this study

A number of recent professional association position statements have outlined core components of CR [9–11] To complement these recent statements, we aim to move them toward implementation by making the more concrete descriptions of the actions needed in a way that is useful to working CR teams. This study summarizes key steps to deliver all the components of CR for cardiac conditions and highlights key differences and exceptions for specific cardiac manifestations, for example CHF or transplantation. Well-established principles of management for general and specific conditions, as well as areas which are currently controversial or unresolved, are outlined.

The study is organized in a series of tables, the first presenting commonly agreed CR acivities applicable to all conditions as a standard reference. Complementary to this are a series of tables oriented to address specific recommendations and current controversies specific for each clinical condition. Thus for each condition, the reader should first consider the common CR activities to be undertaken, as presented in Table 1 ('Core components and objectives common to all clinical conditions'), and then combine this with recommendations in the table specific to the clinical condition of the patient being managed. All recommendations provided are based on the scientific evidence with the levels of evidence from the most robust (class 1) and reference source presented.

Table 1 Core cardiac rehabilitation components and objectives common to all clinical conditions

Components
Patient assessment
Clinical history: screening for cardiovascular risk factors, co-morbidities and disabilities
Symptoms: cardiovascular disease (NYHA class for dyspnoea and CCS class for angina)
Adherence: to the medical regime and self-monitoring (weight, BP, symptoms)
Physical examination: general health status, heart failure signs, cardiac and carotid murmurs, BP control, extremities for presence of arterial pulses and orthopaedic pathology, cardiovascular accidents with/without neurological sequelae
ECG: heart rate, rhythm, repolarization
Cardiac imaging (2-dimensional and Doppler echocardiography): in particular ventricular functions and valve heart diseases where appropriate
Blood testing: routine biochemical assay, fasting blood glucose, (HbA1C if fasting blood glucose is elevated), total cholesterol, LDL-C, HDL-C, triglycerides
Physical activity level: domestic, occupational, and recreational needs, activities relevant to age, gender, and daily life, readiness to change behaviour, self-confidence, barriers to increased physical activity, and social support in making positive changes
Peak exercise capacity: symptom-limited exercise testing, either on bicycle ergometer, or on treadmill
Education: clear, comprehensible information on the basic purpose of the CR programme and the role of each component
Expected outcomes
Formulation of 'tailored', patient-specific, objectives of the CR programme
Physical activity counselling
A minimum of 30–60 min/session of moderately intense aerobic activity, preferable daily, or at least 3–4/week
Emphasize: sedentary lifestyle as risk factor, and benefits of physical activity: any increase in activity has a positive health benefit
Recommend: gradual increases in daily lifestyle activities over time, and how to incorporate it into daily routine
Advise: individualize physical activity according to patient's age, past habits, co-morbidities, preferences and goals
Reassure: regarding the safety of the recommended protocol
Encourage: involvement in leisure activities which are enjoyable and in group exercise training programme as patients tend to revert to previous sedentary habits over time

Table 1 (***continued***)

Components
Forewarn: patients need to be forewarned of the risk of relapses: thus education should underline how benefits may be achieved and the need for its lifelong continuation. If physical activity interruption has occurred, physical, social and psychological barriers to attendance should be explored, and alternative approaches suggested [12]
Expected outcomes
Increased participation in domestic, occupational, and recreational activities
Improved psychosocial well-being, prevention of disability, and enhancement of opportunities for independent self-care
Improved aerobic fitness
Improved prognosis
Exercise training (ET)
ET should be prescribed on an individualized approach after careful clinical evaluation, including risk stratification, behavioural characteristics, personal goals and exercise preferences. As general advice, recommend:
$\geq$ 150 min/week (two and half hours); ideally 3–4 h/week
Sub-maximal endurance training, i.e., starting at 50% of maximal work load or VO_2 max if available and gradually increasing till 70%
Energy consumption: 1000–2000 kcal/ week
Expand physical activity to include weight/resistance training 2 times/week [14]
During the initial phases supervised, in-hospital ET programme may be recommended, especially, to verify individual responses and tolerability, clinical stability and promptly identify signs and symptoms indicating to modify or terminate the programme. The supervision should include physical examination, monitoring of HR, BP and rhythm before, during and after ET. The supervised period should be prolonged in patients with new symptoms, signs, BP abnormalities and increased supraventricular or ventricular ectopy during exercise
Expected outcomes
Increased cardiorespiratory fitness and enhanced flexibility, muscular endurance, and strength
Reduction of symptoms, attenuated physiological responses to physical challenges, and improved psychosocial well-being
Diet/nutritional counselling
Assessment: daily caloric intake and dietary content of fat, saturated fat, sodium, and other nutrients. Assess eating habits
Education: of patient (and family members) regarding dietary goals and how to attain them; salt, lipid and water content of common foods
Healthy food choices:
Wide variety of foods; low salt foods;
Mediterranean diet: fruits, vegetables, wholegrain cereals and bread, fish (especially oily), lean meat, low fat dairy products
Replace saturated fat with the above foods and with monounsaturated and polyunsaturated fats from vegetable (oleic acid as in olive oil and rapeseed oil) and marine sources to reduce total fat to less than 30% of energy, of which less than 1 of 3 is saturated
Avoid: overweight, particularly beverages and foods with added sugars and salty food
Integrate: behaviour-change models and compliance strategies in counselling sessions
Expected outcome
Loss of 5–10% of body weight and modification of associated risk factors
Weight control management
Assessment: analysis of nutrition habits, calories intake and physical activity
Education: provide behavioural and nutritional counselling with follow-up to monitor progress in achieving goals
Weight reduction: is recommended in obese patients (BMI $\geq$ 30, or waist circumference $\geq$ 102 cm in men or $\geq$ 88 cm in women), and should be considered in overweight patients (BMI $\geq$ 25, or waist circumference $\geq$ 94 cm in men or $\geq$ 80 cm in women), particularly if associated with multiple risk factors (such as hypertension, hyperlipidaemia, smoking and insulin resistance or diabetes)
Expected outcomes
Elaboration of an individualized strategy to reduce 5–10% of body weight and modification of associated risk factors
Where goal is not attained, consider referring patient to specialist obesity clinic
Lipid management
Assessment: lipid profile. Modify diet, physical activity, and medication therapy if appropriate
Expected outcomes
Primary goal: LDL-C level $<$100 mg/dl (2.5 mmol/l) with an option of $<$80 mg/dl (2.0 mmol/l) if feasible, particularly if associated with multiple risk factors [12]
Secondary goals: HDL-C level $>$40 mg/dl (1.0 mmol/l) in men and $>$45 mg/dl (1.2 mmol/l) in women; total cholesterol level less than 175 mg/dl with an option of $<$155 mg/dl if feasible; fasting triglyceride level less than 150 mg/dl (1.7 mmol/l)
Blood pressure monitoring
Assessment: BP frequently at rest. During exercise BP should be monitored when hypertension on effort is suspected
Education: if resting systolic BP is 130–139 mmHg or diastolic BP is 85–89 mmHg, recommend life-style modifications, exercise, weight management, sodium restriction, and moderation of alcohol intake (i.e., $<$30 g/day in men and $<$15 g/day in women) according to DASH diet [15]; if patient has diabetes or chronic renal or cardiovascular disease, consider drug therapy
If resting systolic BP is $\geq$ 140 mmHg or diastolic BP is $\geq$ 90 mmHg, initiate drug therapy [16]
Expected outcomes
BP$<$140/90 mmHg (or $<$130/80 mmHg if patient has diabetes or chronic heart or renal failure); BP$<$120/80 mmHg in patients with left ventricular dysfunction
Smoking cessation
All smokers should be professionally encouraged to permanently stop smoking all forms of tobacco. Follow-up, referral to special programmes, and/or pharmacotherapy (including nicotine replacement) are recommended, as a stepwise strategy for smoking cessation. Structured approaches to be used, for example, 5As: Ask, Advise, Assess, Assist, Arrange
Ask the patient about his/her smoking status and use of other tobacco products. Specify both amount of smoking (cigarettes per day) and duration of smoking (number of years)
Determine readiness to change; if ready, choose a date for quitting
Assess for psychosocial factors that may impede success
Intervention: provide structured follow-up. Offer behavioural advice and group or individual counselling
Offer nicotine replacement therapy, bupropion, varenicline, or both
Expected outcome
Long-term abstinence from smoking
Psychosocial management
Assessment: screen for psychological distress as indicated by clinically significant levels of depression, anxiety, anger or hostility, social isolation, marital/family distress, sexual dysfunction/adjustment, and substance abuse of alcohol and/or other psychotropic agents. Use interview and/or other standardized measurement tools

Table 1 (*continued*)

Components
Intervention: offer individual and/or small group education and counselling on adjustment to heart disease, stress management, and health-related lifestyle change (profession, car driving and sex activities resumption)
Whenever possible, induce spouses and other family members, domestic partners, and/or significant others in such sessions. Teach and support self-help strategies and ability to obtain effective social support. Provide vocational counselling in case of work related stress
Expected outcome
Absence of clinically significant psychosocial problems and acquisition of stress management skills

BP, blood pressure; BMI, body mass index; CCS, Canadian Class Score; CR, cardiac rehabilitation; DASH, dietary approaches to stop hypertension; ET, exercise training; HDL-C, high-density lipoprotein cholesterol; HR, heart rate; LDL, low-density lipoprotein cholesterol; NYHA, New York Heart Association.

Core components and objectives common to all clinical conditions

Each individual affected by cardiovascular disease can benefit from either an in-patient or out-patient CR programme. The first components of CR should start as soon as possible after hospital admission. Follow-on CR is a necessary component to reach and maintain CR goals on the medium and long-term. In some countries, this is provided as an out-patient service whereas in others, mainly for historical service-organization reasons, this is provided in in-patient settings. Even where most follow-up CR programmes are delivered on an out-patient basis, some provision of a structured inpatient (residential) CR programme, in a major CR centre preferably for efficiency, should be considered for high-risk patients to promote stable clinical conditions and a rapid functional recovery. These high-risk patients may include:

(1) patients with severe in-hospital complications after acute coronary syndrome (ACS), cardiac surgery, or percutaneous coronary intervention (PCI);
(2) patients with persistent clinical instability or complications after the acute event, or serious concomitant diseases at high risk of cardiovascular events;
(3) clinically unstable patients with advanced CHF (NYHA class III and IV), and/or needing intermittent or continuous drug infusion and/or mechanical support;
(4) patients after a recent heart transplantation;
(5) patients discharged very early after the acute event, even uncomplicated, if they are older, women, or at higher risk of progression of CAD;
(6) patients unable to attend a formal outpatient CR programme for any logistic reasons.

Patients should be supported to adopt strategies appropriate to their condition and present status by addressing the core components of CR. This may include group patient sessions and also sessions involving family members to provide efficient education and direction to patients in a supportive environment with fellow patients and engaged family members. Table 1 outlines the core components for CR [patient assessment, physical activity counselling, exercise training (ET), diet/nutritional counselling, weight control management, lipid management, blood pressure (BP) monitoring, smoking cessation, psychosocial management] with the issues common to all clinical conditions being presented [10–12]. Expected outcomes of all the CR intervention are improved clinical stability and symptom control; reduced overall cardiovascular risk; higher adherence to pharmacological advice; better health behaviour profile, all leading to superior quality of life and improved prognosis.

As evidence is constantly informing new targets and methods for intervention, the specific detail of some guidelines are in constant modification according to the progress in the knowledge and may be superseded very quickly. One illustration of this is targets for waist circumference. In the fourth Joint Societies Task Force guidelines, they are less than 102 cm for men and less than 88 cm for women [12]. Other recommendations from the International Diabetes Federation are less than 94 cm for European men and less than 80 cm for European women [13]. In this position study of the EACPR, we report the fourth Joint Societies Task Force recommendation as the expert guidelines of the EACPR and ESC, with the knowledge that this guideline is constantly under revision and updated (Table 1).

Core components and objectives in specific clinical conditions

Post acute coronary syndrome and post primary coronary angioplasty

Although PCI, during the early hours of ST elevation ACS [17] (defined as primary PCI) and in non ST elevation ACS with intermediate-to-high risk feature [18], has become the preferred therapeutic option, CR with risk factor assessment and management is crucial for patient prognosis.

After an uncomplicated procedure, risk factor management and physical activity counselling can start the next day, and such patients can be walking around the flat, and upstairs within a few days. After a large and/or complicated myocardial damage, CR should start after clinical stabilization, and physical activity be increased slowly, according to the symptoms.

Table 2 Core components of cardiac rehabilitation in post acute coronary syndrome (ACS) and post primary percutaneous coronary intervention (PCI)

Components	Established/agreed issues	Class (level)	Issues requiring further evidence
Patient assessment	Clinical history: review clinical course of ACS	I (A)	
	Physical examination: inspect puncture site of PCI, and extremities for presence of arterial pulses		
	Exercise capacity and ischaemic threshold: submaximal exercise stress testing by bicycle ergometry or treadmill maximal stress test (cardiopulmonary exercise test if available) within 4 weeks after acute events while a maximal testing at 4–7 weeks	IIa (C) [19]	
Physical activity counselling	Exercise stress test guide: in the presence of exercise capacity more than five METs without symptoms, patient can resume routine physical activity; otherwise, the patients should resume physical activity at 50% of maximal exercise capacity and gradually increase	I (B) [20]	Should resistance physical activity 2 days per week be encouraged? [current evidence class II b (C)] [21]
	Physical activity: a slow gradual and progressive increase of moderate intensity aerobic activity, such as walking, climbing stairs and cycling supplemented by an increase in daily activities (such as gardening, or household work)		
Exercise training	The programme should include supervised medically prescribed aerobic exercise training: Low risk patients: at least three sessions of 30–60 min/week aerobic exercise at 55–70% of the maximum work load (METs) or HR at the onset of symptoms $\geq$ 1500 kcal/week to be spent by low risk patients Moderate to high-risk patients: similar to low risk group but starting with less than 50% maximum work load (METs) Resistance exercise: at least 1 h/week with intensity of 10–15 repetitions per set to moderate fatigue	I (B) [19,20]	When should the training programme start? After exercise stress testing?
Diet/nutritional counselling	Caloric intake should be balanced by energy expenditure (physical activity) to avoid weight gain	I (C) [22]	
Weight control management	(see Table 1)	I (B) [19,23]	
Lipid management	Mediterranean diet with low levels of cholesterol and saturated fat	I (B) [9,22]	
	Foods rich in omega-3 fatty acids		
	Statins for all patients, intensified to a lipid profile of cholesterol $<$175 mg/dl or $<$155 mg/dl in high risk patients, LDL-C $<$100 mg/dl or $<$80 mg/dl in high risk patients; triglycerides $<$150 mg/dl		
Blood pressure monitoring	(see Table 1)	I (B) [19,16]	
Smoking cessation	(see Table 1)	I (B) [19]	
Psychosocial management	(see Table 1)	I (B) [24]	

ACS, acute coronary syndrome; CR, cardiac rehabilitation; ET, exercise training; HR, heart rate; LDL-C, low-density lipoprotein; METs, metabolic equivalent tasks.

After hospital discharge, structured CR should continue, depending upon local facilities. In-hospital CR for 4 weeks can be useful in patients with severe left ventricular dysfunction or relevant co-morbidity. All other patients can follow an outpatient CR programme (Table 2).

Stable coronary artery disease and elective coronary angioplasty

Secondary prevention measures and exercise-based CR are an essential part of long-term therapy because they reduce future morbidity and mortality associated with the atherosclerotic process [6].

Thus indications for CR in chronic stable angina pectoris and following elective PCI has been underlined in recent guidelines [25–27].

All patients should be instructed about necessary behaviour and risk factor modification, and the appropriate medical therapies should be initiated for the secondary prevention of atherosclerosis before the patient leaves the hospital. An important contribution should come from the interventional cardiologist who should emphasize the importance of these measures directly to the patient, because failure to do so may suggest that secondary prevention therapies are not necessary. The interventional cardiologist should interact with the primary care physician, and the physicians in charge of the CR programme to ensure that the necessary secondary prevention therapies initiated during hospitalization are maintained after discharge from the hospital.

Uncertainties remain for important aspects such as the ET programme or the best way to increase compliance and adherence to a healthy lifestyle. Other general controversies include what to do with Prinzmetal's angina pectoris or microvascular angina pectoris (Table 3).

Table 3 Core components of cardiac rehabilitation in stable coronary artery disease and following elective percutaneous coronary intervention [25–27]

Components	Established/agreed issues	Class (level)	Issues requiring further evidence
Patient assessment	Risk stratification	I (B)	
	Blood testing (FBC, creatinine, glucose, lipid profile, PCR)		
	OGTT	IIa (B)	
	Arrhythmias by ECG with ambulatory ECG monitoring if needed		
	LV function by cardiac imaging test		
	Physical activity level by history		
	Exercise capacity and ischaemia threshold by exercise stress test (3–6 months after PCI)		
	Exercise or pharmacological imaging technique in patients with un-interpretable ECG		
	Vascular access site problems		
Physical activity counselling	Activity plan: 30–60 min, 7 days/ weekly (minimum 5 days/week) of moderate intensity aerobic activity	I (B)	Best ways to increase adherence/ compliance
	Also refer to Table 2		
Exercise training	Medical supervision: supervised exercise training programmes recommended, particularly for patients with multiple risk factors, and with moderate-to-high risk (i.e., recent revascularization, heart failure)	I (B)	Need for continuous ECG monitoring for whom?
	Resistance training: expand physical activity to include resistance training on 2 days/week		Training above the ischaemic threshold?
	Also refer to Table 2		
	Medication: prophylactic nitro-glycerine can be taken at the start of exercise training session		
Diet/nutritional counselling	Daily physical activity and weight management are recommended for all patients	I (B)	Vitamin supplements
	Diet: mediterranean diet in all patients (<7% of total calories as saturated fat and <200 mg/day of cholesterol)		
	Supplements: add plant stanol/sterols (2 g per day) and/or viscous fibre (> 10 g per day)		
	Omega-3: encourage consumption of omega-3 fatty acids in the form of fish or in capsule form (1 g per day) for risk reduction	IIb (B)	
	Also refer to Table 2		
Weight control management	BMI and waist circumference should be assessed regularly	I (B)	Control of overweight in the elderly and chronic disease patients
	Manage-BMI: on each patient visit, it is useful to consistently encourage weight maintenance/ reduction through an appropriate balance of physical activity, caloric intake, and formal behavioural programmes when indicated to achieve and maintain healthy BMI (18.5–24.9 kg/m^2)		
	Manage waist circumference: if waist circumference is ≥ 89 cm in women or ≥ 103 cm in men, it is beneficial to initiate lifestyle changes and consider treatment strategies for metabolic syndrome as indicated. Some male patients can develop multiple metabolic risk factors when the waist circumference is only marginally increased (e.g., 94–102 cm). They may have a strong genetic contribution to insulin resistance and could benefit from changes in life habits, similar to men with categorical increases in waist circumference		
	Goal: the initial goal of weight loss therapy should be to gradually reduce body weight by approximately 10% from baseline. With success, further weight loss can be attempted if indicated through further assessment		
Lipid management	Assess fasting lipid profile in all patients, preferably within 24 h of an acute event. Initiate lipid lowering medication as recommended below as soon as possible:		High dose statins for all
	Statin therapy for all patients	I (A)	What in low cholesterol and/or low HDL
	Triglycerides: if ≥150 mg/dl or HDL-C <40 mg/dl emphasize weight management and physical activity, alcohol abstention, smoking cessation		
	If triglyceride 200–499 mg/dl, consider adding fibrate and niacin	I (B)	Regular monitoring of liver function and creatine kinase is required with combined therapy of statin and fibrate
	If triglyceride ≥ 500 mg/dl, consider adding omega-3 fatty acids	I (C)	
Blood pressure monitoring	Target: BP less than 130/80 mmHg	I (B)	
	Lifestyle approach: patients should initiate and/or maintain lifestyle modifications–weight control; increased physical activity; moderation of alcohol consumption; limited salt intake; maintenance of a diet high in fresh fruits, vegetables, and low-fat dairy products	I (B)	
	Medication: for hypertensive patients with well established CAD, it is useful to add BP medication as tolerated, treating initially with β blockers and/or ACE inhibitors, with addition of other drugs as needed to achieve target blood pressure	I (C)	
Smoking cessation	Smoking cessation and avoidance of exposure to environmental tobacco smoke at work and home is recommended	I (B)	
Psychosocial management			Role of type D personality? Use of pharmacotherapy in depression? Effect of stress reduction strategies on outcomes? [28]

BP, blood pressure; BMI, body mass index; CAD, coronary artery disease; FBC, full blood count; ET, exercise training; HDL-C, high-density lipoprotein cholesterol; HR, heart rate; OGTT, oral glucose tolerance test; PCI, percutaneous coronary intervention.

Cardiac rehabilitation following cardiac surgery: coronary artery or valve heart surgery

CR programmes should be available for all patients undergoing coronary artery surgery [29,30] and valve surgery [31,32]. For surgical patients, the preventive and rehabilitation strategy should also focus on the potential effect of preoperative rehabilitation. Similarly to other sub-groups of patients, CR should be tailored according to the individual risk profile, physical, psychological and social status assessed as part of the perioperative medical history and examination (Table 1). Furthermore, it should be appreciated that the clinical condition and concerns of surgical patients often relate to the surgical procedure itself. Approaching and resolving these issues in addition to understanding the underlying clinical conditions should be part of comprehensive CR (Table 4).

Chronic heart failure

All patients with established CHF, with or without implantable cardioverter defibrillator and with or without cardiac resynchronization therapy, require a multi-factorial CR approach [33–36]. In-patient rehabilitation should begin as soon as possible after hospital admission. As the length of stay for acute decompensation and intervention procedures continues to decrease, structured out-patient CR is crucial for the development of a life-long approach to prevention. This may be provided in a wide range of settings, such as CHF clinics, non-clinic settings (community health centres and general medical practices), or a combination of these. Out-patient CR may also be provided on an individual basis at home, including a combination of home visits, telephone support, telemedicine or specially developed self-education materials (Table 5).

Table 4 Core Components of cardiac rehabilitation following cardiac surgery – coronary artery or valve heart surgery

Components	Established/agreed issues
Patient assessment	Assess: wound healing, co-morbidities, complication and disabilities Echocardiography: pericardial effusion, prosthetic function and disease at other valve sites, when appropriate Exercise capacity to guide exercise prescription Sub-maximal exercise stress test as soon as possible A maximal exercise test about 4 weeks after surgery Patient education: about anticoagulation, including drug interactions and self-management if appropriate; in-depth knowledge on endocarditic prophylaxis
Physical activity counselling	Physical activity counselling (Table 1) should be offered to all patients taking into account wound healing and exercise capacity (Table 2)
Exercise training	Exercise training can be started in the early in-hospital phase In-patient and/or out-patients ET programmes immediately after discharge lasting 8–12 weeks are advisable Upper-body training can begin when the chest is stable, i.e. usually after 6 weeks. ET should be individually tailored according to the clinical condition, baseline exercise capacity, ventricular function (Table 2) and different valve surgery: After valve surgery exercise tolerance will take a significant time to recover After mitral valve replacement exercise tolerance is much lower than that after aortic valve replacement, particularly if there is residual pulmonary hypertension
Diet/nutritional counselling	Note interaction between anticoagulation and k-vitamin rich food and other drugs, in particularly amiodarone
Tobacco cessation	Risk of complications depends on how long before surgery the smoking habit has been changed, whether smoking was reduced or stopped completely
Psychosocial management	Sleep disturbances, anxiety, depression and impaired quality of life may occur after surgery

Table 5 Core components of cardiac rehabilitation in chronic heart failure

Components	Established/agreed issues	Class (level)	Issues requiring further evidence
Patient assessment	Haemodynamic and fluid status: signs of congestion, peripheral and central oedema	I (C)	
	Cachexia signs: reduced muscle mass, muscle strength and endurance		
	Blood testing: serum electrolytes, creatinine, BUN and BNP		
	Peak exercise capacity: maximal symptom-limited cardiopulmonary with metabolic gas exchange. For testing protocol small increments 5–10 W per min on bicycle ergometer or modified Bruce or Naughton protocols are indicated		
	Six minute walk test is accepted stress test to assess exercise tolerance		
	Other tests: coronary angiography, haemodynamic measurements, endomyocardial biopsy, sleep test	IIa (C)	

Table 5 (***continued***)

Components	Established/agreed issues	Class (level)	Issues requiring further evidence
	are necessary for selected patients or cardiac transplantation candidates		
Physical activity counselling	At least 30 min/day of moderate-intensity physical activity to be gradually increased to 60 min/day	I (B)	
Exercise training	Progression of aerobic ET for stable patients: Initial stage: intensity should be kept at a low level (40–50% of peak VO_2), increasing duration from 15 to 30 min, 2–3 times/week according to perceived symptoms and clinical status for the first 1–2 weeks Improvement stage: a gradual increase of intensity (50, 60, 70–80% of peak VO_2, if tolerated) is the primary aim. Prolongation of exercise session is a secondary goal Supervised, in-hospital training programme may be recommended, especially during the initial phases, to verify individual responses and tolerability, clinical stability and promptly identify signs and symptoms indicating to modify or terminate the programme	I (A)	Limited information about combined aerobic and strength training, interval, resistance and respiratory ET is available Resistance training: short stress phases (10 repetitions max.) at $<$60% MVC, interrupted by phases of muscle relaxation [14] Respiratory training: 20–30 min/day on 3–5 days/week for a minimum of 8 weeks, starting at 30–35% maximum inspiratory pressure and readjusting every 7–10 days Monitoring exercise intensity: HR can be used for exercise prescription, but its applicability is limited in patients with advanced HF (chronotropic incompetence), in those treated with β-blockers and when atrial fibrillation is coexisting Exercise training and patients with ICD: limited experiences are available. ET seems feasible and safe. Supervision by qualified staff and constant surveillance during exercise activity are strongly recommended. Exercise intensity: pre-determined HR threshold = ICD detection rate minus 20–30 beats/min
Diet/nutritional counselling	Prescribe specific dietary modifications: Fluid intake: less than 1.5 l/day (or 2 litres in hot weather) Sodium intake: severe restriction should usually be considered in severe HF	I (C)	Particular dietary recommendations: How to regain weight: with episodes of acute HF, appetite is much reduced and weight loss may occur. After clinical stabilization, recovery of appetite leads to slow regain of weight A liberalized fat intake is allowed to weight maintenance and adequate caloric intake in poorly nourished CHF patients, with normal or low levels of total and LDL-C The role of chronic sodium supplementation in severe patients treated with high dose of diuretics with fluid balance but unvarying low natriaemia is unknown Combined increases in saturated fat intake and weight, and increasing insulin resistance and BP, may lead to further episodes of myocardial infarction or ischaemia with severe adverse consequences
Weight control management	Weight monitoring: the patients must be educated to weight themselves daily. Weight gain is commonly because of fluid retention, which precedes the appearance of symptomatic pulmonary or systemic congestion. A gain $>$1.5 kg over 24 h or $>$2.0 kg over 2 days suggest developing fluid retention	I (C)	Unintentional weight loss: clinical or sub clinical malnutrition is common in HF. Cardiac cachexia is a serious complication and is associated with bad outcome. Although the definition of cardiac cachexia remains arbitrary, its prevalence is increasing The mechanism of the transition from CHF to cardiac cachexia is complex and not completely known. The effects of medical treatment, dietary and physical activity are still poorly evaluated
	Weight reduction: In moderate-severe HF, weight reduction is not recommended since unintentional weight lost and anorexia are common complications. It may occur because of loss of appetite, induced by renal and hepatic dysfunction, hepatic congestion, or it may be marker of psychological depression	IIa (C)	
Lipid management	Statins should be considered only in patients with established atherosclerotic disease	I (A)	
Tobacco cessation		I (C)	Smoking is a risk factor for cardiovascular disease, but no studies have evaluated the effect of smoking cessation in HF cohorts
Psychosocial management	Depression is common in HF. Recognition and management of depression may be enhanced through the use of multidisciplinary team or disease management programmes Treatment of depression is an important clinical strategy as this condition is associated with more frequent hospital admissions, decline in activities of daily living, worse NYHA functional classification and increased medical costs	IIa (C)	Depression commonly goes undiagnosed: Patient's unwillingness to disclose emotional distress for fear of being stigmatized with the label of mental illness Physicians may not address depression because they have not been adequately trained

BNP, brain natriuretic peptide; BP, blood pressure; BUN, blood urea nitrogen; CHF, chronic heart failure; ET, exercise training; HR, heart rate; ICD, implantable cardioverter defibrillator; MVC, maximal voluntary contraction; NYHA, New York Heart Association.

Table 6 Core components of cardiac rehabilitation in cardiac transplantation

Components	Established/agreed issues	Issues requiring further evidence
Patient assessment (and self-assessment)	Clinical: wound healings	
	Echocardiography: pericardial effusion	
	Exercise capacity: cardiopulmonary exercise stress test 4 weeks after surgery to guide detailed exercise recommendations. For testing protocols, small increments of 10 W per min on bicycle ergometer, or modified Bruce protocols or Naughton protocols on treadmill are appropriate	
	Physician knowledge of the anatomical and physiological reasons for limited exercise tolerance: e.g. the immune-suppression therapy side effect (impairments of inflammatory response, metabolism, osteoporosis)	
	Risk of acute rejection: rapid, appropriate treatment is necessary. Patients should be instructed to practice self-monitoring: an unusually low BP, a change of HR, unexplained weight gain or fatigue may be early signs of rejection even in the absence of major symptoms	
	Patients and physiotherapists should be educated to adhere to the recommendations concerning personal hygiene and general measures to reduce the risk of infection (Table 7)	
Physical activity counselling	Chronic dynamic and resistance exercises prevents the side-effects of immunosuppressive therapy	
	Exercise intensity relies more on perceived exertion than on a specific HR. Borg scale: scores of 12–14 to achieve. For example: instruct the patients to start walking 1.5 or 2 km five times weekly at a pace resulting in a perceived exertion of 12–14 on the Borg scale. The pace should be increased slowly over time to nordic walking	
Exercise training	Early training programme can be beneficial in the early post-operative period as well as in the long-term	Although exercise training would theoretically delay or prevent CAD progression in the transplanted heart, this still has to be studied
	Before hospital discharge, respiratory kinesiotherapy, active and systematic mobilization of the upper and lower limbs are advisable	
	After discharge, aerobic exercise may be started in the second or third week after transplant but should be discontinued during corticosteroid bolus therapy for rejection. Resistance exercise should be added after 6–8 weeks	
	Regimen: at least 30–40 min/day of combined resistance exercise (muscle strength) and aerobic training (walking) at moderate level, slowly progressing warm-up, closed-chain resistive activities (e.g., bridging, half-squats, toe raises, use of therapeutic bands) and walking/nordic walking/cycling	
	Resistance training: 2–3 sets with 10–12 repetitions per set at 40–70% MVC with a full recovery period (>1 min) between each set. The goal is to be able to do five sets of 10 repetitions at 70% of MVC	
	Aerobic training: the intensity of training should be defined according to peak VO_2 (<50% or 10% below anaerobic threshold) or peak work load (<50%)	
Diet/nutritional counselling	Dietary infection prophylaxis – food to be avoided: Raw meat Raw seafood Un-pasteurized milk Cheese from un-pasteurized milk Mouldy cheese Raw eggs Soft ice	There are good reasons to follow a Mediterranean style diet, even though controlled studies in these patients to assess the influence of nutrition on CAV or survival have not been published
Weight control management	Avoidance of overweight is mandatory to balance the side-effects of immunosuppressants, to limit the classical cardiovascular risk factors	
	Obesity increases the risk of cardiac allograft vasculopathy. It should be controlled by daily exercise and healthy diet	
Lipid management	Hyperlipidaemia increases the risk of CAV. It should be controlled by statins, daily exercise and healthy diet	Statins are now part of standard therapy, but dose-related myopathy and myolysis because of interaction with ciclosporin must be considered
	Statins (pravastatin, simvastatin) not only lowered LDL-C levels but also decreased the incidence of CAV and significantly improved survival	
Blood pressure monitoring	Target BP is 130/80 mmHg	
	Hypertension is linked to immunosuppressive therapy and denervation of cardiac volume receptors	
	It is sensitive to a low-sodium diet. Treatment with diltiazem and ACE inhibitors are first choice, usually completed by diuretics. Beta-blockers are contra-indicated as they hamper the already delayed chronotropic response of the denervated heart	
Tobacco cessation	Cessation of smoking is a prerequisite for transplantation in most centres. Psychological support may be needed so patient does not resume smoking post-transplantation	
Psychosocial mangement	Clear medical information and advice on life after transplant are needed to manage challenges such as patient guilt or problems with high levels of anxiety and apprehensiveness	
	Careful presentation of recommendations is necessary, leaving the choice up to the patient and offering every possible support he/she may need to adjust	

ACE, angiotensin-converting enzyme; BP, blood pressure; CAD, coronary artery disease; CAV, cardiac allograft vasculopathy; ET, exercise training; HR, heart rate; LDL-C, low-density lipoprotein cholesterol; MVC, maximal voluntary contraction.

Cardiac transplantation

It is hard to imagine a group of patients more obviously in need of rehabilitation than heart transplant recipients, because of the multifaceted physical and mental problems encountered preoperatively and postoperatively [37]. Of all patients surviving the first year, 50% will live more than 12 years. As short-term survival is no longer the key issue for heart transplant recipients, a return to functional lifestyle with good quality of life becomes the desired outcome [38] (Tables 6 and 7).

Diabetes mellitus

Impaired glucose tolerance is one of the strongest prognosticators after acute myocardial infarction (AMI). Furthermore, worldwide we see an epidemic of diabetes mellitus (DM), which is associated with an increased risk of CAD and an impaired prognosis after AMI. Nevertheless, a substantial proportion of adults meeting the criteria of DM are not identified as patients with DM. As adequate diagnosis and treatment is associated with improved survival, screening for impaired glucose

Table 7 General measures to reduce the risk of infection after cardiac transplantation

Good dental hygiene, no toothbrush older than 4 weeks
Frequent hand washing using liquid soap
Avoidance of close contact with people with infectious diseases (measles, chickenpox, mumps, mononucleosis, common cold, flu)
Avoidance of contact with persons having received oral polio vaccination for 8 weeks
If indispensable, pets in the household only under strict precautions and with limited contact with patient
No gardening without gloves
No contact with decaying plants, fruits, vegetables
No stay near construction work and compost heaps
No mould inside the home
Hydroculture (hydroponics) better than potting compost in the home
Avoidance of swimming in public baths

Table 8 Core components of cardiac rehabilitation in diabetes mellitus

Components	Established/agreed issues	Class (level)	Issues requiring further evidence
Patient assessment	Predicted type 2 DM: combination of risk score tools (e.g., FINDRISK), and OGTT (2 h post-load plasma glucose level)	I (A)	OGTT: often lack of time during hospital stay; thus, recommendation for OGTT in discharge note to GP or CR facility?
	Patients with CAD and unknown DM: OGTT	I (B)	
	Functional capacity and exercise induced ischaemia by maximal symptom-limited exercise stress testing		Cardiopulmonary stress test as an adjunct to exercise testing?
Physical activity counselling	Daily walking for more than 30 min	I (A)	
	Three hours per week of moderate intensity (i.e., brisk walking on a slight [approximately 3%] incline, 5–7 days/week) or		
	One hour per week of vigorous-intensity exercise (i.e., jogging for 20 min, 3 days/week)		
Exercise training	$\geq$ 150 min/week of moderate-intensity aerobic physical activity ($\geq$ 4.5 METs) and/or 90 min/week of vigorous aerobic exercise ($\geq$ 7.5 METs)	I (A)	Relative benefits of resistance training (e.g., eight muscle groups, two sets per muscle group, 8–12 repetitions, 70–80% of repetition maximum) versus
	The physical activity should be distributed at least 30 min on at least 5 days/week		Endurance training (e.g., 8 muscle groups, 2 sets per muscle group, 25–30 repetitions, 40–55% of repetition maximum)
	Resistance training three times/week, targeting all major muscle groups, 2–4 sets of 7–40 repetitions		
Diet/nutritional counselling	In case of overweight, caloric restriction to approx. 1500 kcal/day	I (A)	
	Anti-atherogenic diet: low fat, that is, 30–35% of daily energy uptake (10% for monounsaturated fatty acids, e.g., olive oil); avoidance of trans fats; high fibre, that is, 30 g/day; low in industrialised sugars; five servings of fruits/vegetables per day		
	Diet is more effective when combined with exercise training (see above)		
Weight control management	Regular weight control		Weight-reducing medications
Lipid management	Statins for all aiming at LDL $<$ 80 mg/dl	I (A)	Need mortality and cost-effectiveness evidence for Ezetimib
	Initiate therapy regardless of baseline LDL levels;	I (B)	
	If monotherapy with a statin is not sufficient it can be combined with Ezetimib	IIb (B)	
	aim: LDL $<$ 70 mg/dl;	I (B)	
Blood pressure monitoring	Aim at BP $<$ 130/80	I (B)	
	ACE inhibitors or ARBs are first choice therapy	I (A)	
	Usually combination therapy required; choice according to concomitant diagnoses	I (A)	
	Anti-hypertensive therapy is more important than glucose control		
Tobacco cessation			
Psychosocial management	In selected patients		

ACE, angiotensin-converting enzyme; ARB, angiotensin receptor blocker; BP, blood pressure; CR, cardiac rehabilitation; CAD, coronary artery disease; DM, diabetes mellitus; ET, exercise training; METs, metabolic equivalent tasks; OGTT, oral glucose tolerance test.

Table 9 Core components of cardiac rehabilitation in peripheral artery disease

Components	Established/agreed issues	Class (level)	Issues requiring further evidence
Patient assessment	Clinical: any exertional limitation of the lower extremity muscles or any history of walking impairment, that is, fatigue, aching, numbness, or pain		
	Primary site(s) of discomfort: buttock, thigh, calf, or foot		
	Any poorly healing wounds of the legs or feet		
	Any pain at rest localized to the lower leg or foot and its association with the upright or recumbent positions		
	Reduced muscle mass, strength and endurance		
	Bilateral arm BP: palpation of peripheral arteries and abdominal aorta with annotation of any bruits and inspection of feet for trophic defects		
	Ankle-brachial index measurement: values 0.5–0.95: claudication range; 0.20–0.49: rest pain; less than 0.20: tissue necrosis		
	Functional capacity: markedly impaired. Peak O_2 consumption is 50% of the predicted value		
	Difficulty in walking short distances, even at a slow speed, associated with impairment in the performance of activities of daily living		
	To exclude occult CAD, perform treadmill or bicycle exercise testing to monitor symptoms, ST–T wave changes, arrhythmias, claudication thresholds, HR and BP responses, useful for exercise prescription		
Physical activity counselling	Exercise activities, such as walking, lasting more than 30 min, ≥ 3 times/ week, until near-maximal pain		
Exercise training	Supervised hospital- or clinic-based ET programme ensures that patients are receiving a standardised exercise stimulus in a safe environment, is effective and recommended as initial treatment modality for all patients	I (A)	Usefulness of unsupervised ET programmes [IIb, (B)]
	Exercise–rest–exercise: each training session consists of short periods of treadmill walking interspersed with rest throughout a 60-min exercise session, three times weekly		Time course of the response to a ET programme (clinical benefits have been observed as early as 4 weeks after the initiation and may continue to accrue after 6 months of supervised ET rehabilitation three times/week and were sustained when continued for an additional 12 months)
	Treadmill exercise: more effective. The initial workload is set to a speed and grade that elicit claudication symptoms within 3–5 min. Patients are asked to continue to walk at this workload until they achieve claudication of moderate severity. This is followed by a brief period of rest to permit symptoms to resolve. The exercise–rest–exercise cycle is repeated several times during the hour of supervision. (Table 10)		
	Resistance training: appropriately prescribed, is generally recommended		
Diet/nutritional counselling	To achieve a serum LDL concentration <100 mg/dl (2.6 mmol/l)	I (B)	
	Treatment with statin to achieve a target LDL <80 mg/dl (1.8 mmol/l) in high risk patients	IIa (B)	
	A statin should be given as initial therapy, but niacin and fibrates may play an important role in patients with low serum HDL or high serum triglyceride concentrations (>150 mg/dl or 1.7 mmol/l)	IIa (C)	
Blood pressure monitoring	Antihypertensive therapy to achieve a goal <140 mmHg systolic over 90 mmHg diastolic (non-diabetics) or <130 mmHg systolic over 80 mmHg diastolic (diabetics and individuals with chronic renal disease)	I (A)	Does treatment alter the progression of the disease or the risk of claudication? (antihypertensive drugs may decrease limb perfusion pressure and potentially exacerbate symptoms of claudication or critical limb ischaemia, even though most patients tolerate anti-hypertensive treatment. Beta-adrenergic-antagonist drugs have been thought to have unfavourable effects on symptoms. Critical reviews however concluded that beta-adrenergic antagonists are safe, except in the most severely affected patients [I (A)])
	The use of ACE-inhibitors in patients with PAD may confer protection against cardiovascular events beyond that expected from BP lowering	IIa (C)	
Smoking cessation	Stopping smoking is exceptionally important in PAD, smoking-cessation programmes involving nicotine-replacement therapy, and the use of medications such as bupropion or varenicline should be encouraged	I (B)	
Psychosocial management			

ACE, angiotensin-converting enzyme; BP, blood pressure; CAD, coronary artery disease; ET, exercise training; HDL, high-density lipoprotein; HR, heart rate; LDL, Low-density lipoprotein; PAD, peripheral arterial disease.

tolerance and DM has to be improved. Participation in a CR programme offers late but optimal opportunities for screening [39–41] (Table 8).

Peripheral artery diseases

Peripheral artery disease (PAD) is part of the multi-site presentation of atherosclerosis. At the time of diagnosis of PAD, a history of AMI or stroke, or related surgery can be expected in approximately 30% of male and 20% of female patients. Among patients presenting with CAD or cerebrovascular disease, 32% of men and 25% of women have also peripheral arterial involvement, which is two to three times the prevalence in respective control groups. The patient with PAD should therefore be regarded as an actual or potential polyvascular patient and an integrated approach to prevention and treatment of atherothrombosis as a whole is highly warranted [42] (Tables 9 and 10).

Table 10 Key elements of a therapeutic exercise-training programme for rehabilitation from peripheral artery disease in patients with claudication [43]

Exercise guidelines for claudication
Warm-up and cool-down periods of 5–10 min each
Types of exercise
Treadmill and track walking are the most effective
Resistance training has benefit for patients with other forms of cardiovascular disease, and its use, as tolerated, for general fitness is complementary to walking but not a substitute for it
Intensity
The initial workload of the treadmill is set to a speed and grade that elicits claudication symptoms within 3–5 min
Patients walk at this workload until claudication of moderate severity occurs, then rest standing or sitting for a brief period to permit symptoms to subside
Duration
The exercise–rest–exercise pattern should be repeated throughout the exercise session
The initial session usually includes 35 min of intermittent walking; walking is increased by 5 min each session until 50 min of intermittent walking can be accomplished
Frequency
Treadmill or track walking 3–5 times per week
Role of direct supervision
As the patient's walking ability improves, the exercise workload should be increased by modifying the treadmill grade or speed (or both) to ensure that the stimulus of claudication pain always occurs during the workout
As walking ability improves, and a higher HR is reached, there is the possibility that cardiac signs and symptoms may appear. These symptoms should be appropriately diagnosed and treated

HR, heart rate.

Table 11 Cardiac rehabilitation in older patients

Components	Established/agreed issues
Patient assessment	Clinical history: cardiovascular disease (e.g., CAD, HF, arterial fibrillation, PAD, renal failure) and risk factors as well as concomitant diseases (e.g., stroke, neurological dysfunction, COPD, visual/hearing impairment, arthritis, osteoporosis, urinary incontinence, cognitive impairment, dementia)
	Education: take into account the fact that older patients typically more often have visual, hearing and cognitive impairments
	Expected outcomes: formulation of a therapeutic regime with a high level of individual care and support
Physical activity counselling	Emphasize participation in supervised group activities to advance social integration and social support
Exercise training	Tailored exercise recommendations: prescriptions for a given patient should:
	Depend on existing co-morbidities and on the baseline level of physical capacity as well as existing activity limitation
	Include activities to develop endurance, strength, flexibility, coordination (balance skills) and body awareness
	Start at a very low level and gradually progress to a goal of moderate activity
	Frailty: for frail patients stationary cycling may provide a greater degree of stability and less risk of injury than walking exercise
	Recommended intensity for resistance exercise $<$ 30–60% of one repetition maximum (RM)
	Select exercise appropriate to musculoskeletal conditions in older patients
	Avoid exercises that require rapid postural variations for orthostatic hypotension risk
	Greater benefits from shorter single exercise session with prolonged duration of the CR/ET programmes
Diet/nutritional counselling	
Weight control management	Less likely to be severely obese than younger patients, especially those with HF which are at higher risk to develop cardiac cachexia
	BMI 28–29 kg/m^2 is the target value
Lipid management	Benefit from lipid lowering medication (statins) as for other patients
BP monitoring	Target BP in older people is $\leq$ 130/89 mmHg, $\leq$ 120/80 in patients with diabetes, HF, CAD or renal failure
	A careful management of hypertension in older patients is mandatory including pharmachological and nonpharmacological interventions (weight reduction, exercise and low salt intake)
Smoking cessation	
Psychosocial management	Treatment should focus on identifying and reducing depression and anxiety, improving social adaptation and reintegration as well as overall quality of life

BP, blood pressure; BMI, body mass index; CAD, coronary artery disease; COPD, chronic obstructive pulmonary disease; HF, heart failure; PAD, peripheral arterial disease.

Core components and objectives in challenging populations

It is important to emphasize that there is typically more variety within groups such as older people and women, than between them and comparison groups – in this case younger people and men. It is nonetheless important to signal some issues, which will be more prominent in groups who have been less involved in CR programmes to date. Five such groups are identified here. These groups are older and female patients and patients with specific co-morbidity, transient ischaemic attack or stroke, chronic obstructive pulmonary disease (COPD) and chronic renal failure (CRF). Of course many others could also be identified.

Older patients

Older cardiac patients are often excluded from CR programmes [44]. However, benefits of CR and ET in exercise capacity, in functional capacity, in behavioural characteristics (depression, anxiety, somatization and hostility) and in overall quality of life, modification of cardiovascular risk factors, smoking cessation, antihypertensive therapy and lipid lowering medication has been documented also in older patients, even in those with severe clinical status and multiple co-morbidity condition [45]. The planning and implementation of CR in older groups requires a high level of individual care and support with a careful clinical evaluation beyond cardiovascular

function, including psychosocial assessment and evaluation of co-morbidities. Accordingly, residential CR may be an appropriate option. Main goals of CR in the aging patient are preservation of mobility, independence and mental function, prevention/ treatment of anxiety and depression, improving quality of life, encouragement of social adaptation and reintegration, and enabling the patient to return to the same lifestyle as before the acute event (Table 11).

Women

Women benefit from comprehensive CR as much as men [46]. This is also true for older women. The planning and implementation of CR in women needs to consider that women are more likely to be older, to have hypertension, diabetes, hypercholesterolemia, obesity and HF, as well as lower exercise and functional capacity compared to male patients and may therefore carry a higher cardiac risk as a CR population. Beyond the impact of the cardiac disease, older women in particular are more likely to experience activity limitations and other exercise-limiting co-morbid conditions such as arthritis, osteoporosis and urinary incontinence. At recruitment to CR, women typically score lower in health-related quality of life and they are more likely to be diagnosed with depressive disorders and higher scores of anxiety (Table 12).

History of transient ischaemic attack/stroke

Owing to the common underlying risk factors, patients admitted to CR may sometimes have a history of transient ischaemic attack or stroke, which has therefore to be screened. Depending on the localization of stroke, residual neurological deficits might influence the CR process [47] (Table 13).

History of chronic obstructive lung disease

Long-time smokers often develop COPD, thus its prevalence is high in patients admitted to CR. COPD (stage II, III and VI) has significant extra pulmonary effects including reduced exercise capacity, weight loss and skeletal muscle dysfunction similar to those known in HF patients. All COPD patients will benefit from exercise based CR programmes improving exercise tolerance and symptoms of dyspnoea and fatigue [48] (Table 14).

History of chronic renal failure (CRF)

In patients with CRF, cardiovascular disease is the major cause of morbidity and mortality [49]. The prevalence of CRF in patients admitted to CR is therefore high and has to be considered by a comprehensive screening for cardiovascular co-morbidities in these patients. Depending on the duration and classification of renal failure a moderate

Table 12 Cardiac rehabilitation in women

Components	Established/agreed issues	Class (level)
Patient assessment	Clinical history: (see also Table 11)	
	Patient education: crucial to provide comprehensive information on the contents and the basic purpose of the CR programme to improve adherence and reduce possible barriers	
Physical activity counselling	Advise and encourage to perform regular physical activities (e.g., walking or biking >30 min 5–7 days a week)	I (B)
	Women who need to lose weight or sustain weight loss should accumulate a minimum of 60–90 min of moderate-intensity physical activity (eg, brisk walking) on most, and preferably all, days of the week	I (C)
	Emphasize participation in supervised group activities to advance social integration and support	
Exercise training	Exercise recommendations and prescriptions (see also Table 11):	I (A)
	Incorporate individual preferences which might be different from those of male patients	
	Include combined programme of endurance (cycle, walking, nordic walking) and resistance exercise (major functional, postural and pelvic flour muscle)	
	Include callisthenics to develop flexibility, coordination (balance skills) and, body awareness	
	Include activities and games which enhance communication and social integration	
Diet/Nutritional counselling	A diet rich in fruits and vegetables, whole-grain, high-fibre foods; fish, especially oily fish, ≥ twice a week;	I (B)
	Limit intake of saturated fat to less than 10% of energy (<7% if possible), cholesterol to less than 300 mg/day, alcohol intake to ≤ 1 drink/day, sodium intake to less than 2.3 g/day (approximately 1 tsp salt). Consumption of trans-fatty acids should be as low as possible (<1% of energy)	
Weight control management	Maintain/achieve a BMI between 18.5 and 24.9 kg/m^2 and a waist circumference <88 cm	I (B)
	In obese women, weight reduction and maintenance is mandatory through appropriate caloric intake, physical activity and exercise as well as behavioural programmes	
	Older women with CHF and other chronic diseases are at risk to develop cardiac cachexia	
Lipid management	Encourage optimal lipid management through lifestyle approaches and lipid lowering medication (statin therapy, unless contraindicated)	I (B)
	Use LDL-C lowering drug therapy simultaneously with lifestyle therapy in women with CAD	I (A)
Blood pressure monitoring	Management of hypertension should include non-pharmacological interventions (weight reduction, exercise and low salt intake) and antihypertensive therapy	I (B)
	Target BP are ≤ 130/80	
	Pharmacotherapy is indicated when blood pressure is >140/90 mmHg or at an even lower blood pressure in the setting of chronic kidney disease or diabetes (>130/80 mmHg). Thiazide diuretics should be part of the drug regimen for most patients unless contraindicated	I (A)
Smoking cessation		I (B)
Psychosocial management	Focus on identifying and treating anxiety and depression, improvement in social adaptation and reintegration as well as overall quality of life	IIa (B)

BP, blood pressure; BMI, body mass index; CAD, coronary artery disease; CHF, chronic heart failure; CR, cardiac rehabilitation; tsp, teaspoon.

Table 13 Cardiac rehabilitation in patients with history of TIA/stroke

Components	Established/generally agreed issues
Patient assessment	Risk factors and (a history of) neurological symptoms and deficits (e.g., amaurosis fugax, diplopic images, aphasia, hemiparesis, paresthesia, dementia, vertigo) Gait ability, sitting balance, standing balance and functional mobility [e.g., Berg Balance Scale (*www.strokecenter.org*)], Clinical Outcome Variables Scale (*www.rehab.onca/irrd/covs*) Residual neurological deficits especially those which might affect the patients ability to participate in the CR-programme (e.g., paresis, motor deficits, movement deficits, impaired sensibility, cognitive deficits, and/or neuro-psychological symptoms, such as attention deficits, apraxia, aphasia) In patients with residual and severe deficits, consider if participation in the usual educational programme can be of benefit
Physical activity counselling	
Exercise training	Provided there are no contraindications, all heart patients with history of TIA or stroke should be encouraged to participate in exercise-based CR When possible the patient should participate in the normal CR exercise programme. However, ET prescriptions for a given patient should depend on the baseline level of physical capacity as well as existing exercise-limiting neurological deficits and/or disabilities In the presence of impaired sitting or standing balance and gait ability, as well as the dependence on supports or mobility devices, the exercise programme has to be modified to meet the patient's special needs. In case of reduced sitting ability, balance cycling in supine position or with other available sitting support should be considered. In case of reduced standing ability, balance gymnastic programme to improve flexibility, coordination and strength (low to moderate intensity) should be performed in sitting position. In the presence of reduced gait ability, individual physiotherapy, example, special gait training on the treadmill should be considered The implementation of relaxation training also has to take into account possible motor deficits and consider if the participation in the sitting position might fit better In the presence of spastic paresis, motor deficits and impaired sensor-motor function, individual physiotherapy is indicated To avoid cardiac overload, it has to be considered that patients with motor deficits or disabilities (e.g., caused by spasticity) have higher energy demands for given activity
Diet/nutritional counselling	
Weight control management	
Lipid management	
Blood pressure monitoring	
Smoking cessation	
Psychosocial management	

CR, cardiac rehabilitation; ET, exercise training; TIA, transient ischaemic attack.

Table 14 Cardiac rehabilitation in patients with COPD

Components	Established/agreed issues
Patient assessment	Risk factors and symptoms (dyspnoea, chronic cough, chronic sputum production) Spirometry (for classification of COPD severity; specific cut points e.g., post-bronchodilator FEV_1/FVC ratio or FEV_1) Exercise capacity by cardio pulmonary stress test and/or 6 min walk test Echocardiography (exclusion/diagnosis of pulmonary hypertension; cor pumonale)
Physical activity counselling	Introduction to peak flow-based self management
Exercise training	ET prescriptions should depend on the baseline level of physical capacity and the COPD severity. The programme should include endurance (interval training), resistance exercise (especially lower body exercise), breathing exercise and instruction into postures to help shift and cough up phlegm Patients with measurable obstruction should be advised to use a bronchodilator medication before starting the exercise. In case of post-bronchodilator FEV_1: More than 75%, the patient can be integrated into the regular CR exercise training regime Less than 75% $>$50% the level of endurance exercise should be reduced by 10–15% Less than 50%, participation to low dose endurance/interval cycle ergometer training as well as gymnastics (Borg-Dyspnoea-Scale value $\leq$ 5, breathing rate $\leq$ 20/min) is advisable Less than 30%, O_2 saturation should not exceed values less than 90%
Educational programme	
Diet/nutritional counselling	
Weight control management	Patients with severe COPD are at risk of developing cachexia
Lipid management	
Blood pressure monitoring	
Smoking cessation	Stopping smoking is a particularly important intervention and all forms of treatment programme should be offered
Psychosocial management	

COPD, chronic obstructive pulmonary disease; CR, cardiac rehabilitation; ET, exercise training.

to severe reduction of physical capacity can be assumed, generated by renal anaemia, uraemic myopathy and polyneuropathy, disturbances in volume status, electrolyte balance and or acid-base metabolism, physical inactivity as well as immunosuppressive therapy in patients after kidney transplantation (Table 15).

Future challenges

Despite the body of professional recommendations on cardiovascular disease prevention, integration of prevention strategies into daily practice is still inadequate. In Europe only about a third of CAD patients receive any form of CR, with considerable variation between European regions [50].

Table 15 Cardiac rehabilitation in patients with chronic renal failure (CRF)

Components	Established/agreed issues
Patient assessment	Risk factors (hypertension, diabetes, family history of kidney disease) and symptoms of CRF (e.g., proteinuria) Glomerular filtration rate by the modification of diet in renal disease equation (*http://www.nephron.com*) is essential
Physical activity counselling	
Exercise training	The programme should include a combination of endurance and resistance exercise (especially lower body exercise) and activities to develop flexibility, coordination and body awareness For a given patient, ET should depend on the baseline level of physical capacity and the CRF severity. In stage I–III, the CRF usually does not affect the exercise programme which should be deduced by the heart disease *Special advices for haemodialysis patients (stage V):* To avoid injury of the arteriovenous fistula and pain in the shunt-arm: the puncture-area should be protected with dressing while exercising Patients should not wear wristwatches or wristbands BP should not be measured on the shunt-arm side HR can more easily be measured on the shunt-arm side Avoid exercises (gymnastics and resistance exercises) which include pressing on the arms and/or holding the arms in head up position ET should be performed on the day between haemodialysis treatments *Special advice for patients after kidney trans-plantation* Consider the vulnerability of the kidney transplant in the fossa iliaca directly under the abdominal wall, the reduced perfusion of the transplant and adverse effects of the immunosuppressive therapy Avoid exercises performed in face down position and extreme stretching exercises for the upper part of the body
Educational program	
Diet/nutritional counselling	In patients with higher stage of the CRF ($\geq$ IV stage CRF) hyper-phosphataemia and hypocalcaemia have to be considered and the intake of foods rich of phosphate (e.g., milk products, eggs and meat) should be reduced, whereas calcium supplementation is recommended The intake of food rich of potassium (e.g., fresh fruits, nuts, fruit juice) should be reduced The supplementation of a vitamin D analogue (calcitol, afacitol or paracitol) should be considered In stage V CRF, supplementation of water soluble vitamins should be considered
Weight control management	
Lipid management	
Blood pressure monitoring	
Smoking cessation	
Psychosocial management	

BP, blood pressure; ET, exercise training; HR, heart rate; RF, renal failure.

Discontinuation of medication after acute events is frequent and occurs early after hospital discharge. Patients with other clinical manifestations of atherosclerotic cardiovascular disease receive little or no formal preventive and rehabilitative care. The results of the EUROASPIRE audits of preventive care of coronary patients over the last 12 years show adverse lifestyle trends; increasing prevalence of smoking among younger (< 50 years) patients, especially women, and increasing obesity, central obesity and diabetes. Control of BP is unchanged over this period, with over half of all patients still above the therapeutic target, despite increasing use of anti-hypertensive medications. Only lipid management has improved with the use of statins [51]. Moreover, even when implemented, most of the CR programmes rely mainly on short-term interventions and are not adequately implemented on the long term. Short-term approaches are, in fact, unlikely to yield long-term benefits, impact quality of life, or decrease morbidity and mortality. Some lessons and optimism may have been provided by recent studies on prevention and CR, specifically aimed at maintaining beneficial long term life changes and improving prognosis in cardiac patients, for example, the EuroAction and GlObal Secondary Prevention strategiEs to Limit studies.

The EuroAction demonstration project in preventive cardiology was a nurse-managed, multidisciplinary, lifestyle, risk factor and therapeutic management programme. It was evaluated in a cluster randomized controlled trial in 24 hospital and general practice centres across eight countries [52]. Patients presenting with coronary disease in hospital, and individuals at high risk of developing cardiovascular disease in primary care, were randomized to either a family-based comprehensive lifestyle intervention with management of BP and lipids or to usual care. The EuroAction programme reduced the risk of cardiovascular disease compared with usual care through lifestyle changes by families, who together made healthier food choices and became more physically active over 1 year. These lifestyle changes led to modest weight loss in both groups of patients and, for high-risk patients, there was also a significant reduction in central obesity. BP control was significantly improved in both groups of patients, and for those with CAD this was achieved without the use of additional antihypertensive drugs. Control of blood cholesterol concentrations improved in both groups of patients and significantly so in high-risk patients because of increased use of statins. Overall the use of all cardioprotective drugs was substantially higher in the hospital compared to the primary care programme, although for high risk patients ACE inhibitors and statins were both prescribed more frequently compared to usual care. EuroAction is one model of preventive care, successfully implemented and objectively assessed, which shows that standards of care can be raised in routine clinical practice.

The GlObal Secondary Prevention strategiEs to Limit event recurrence after myocardial infarction study was a 3-year, multi-centre, randomized, controlled trial comparing a long-term, reinforced multifactorial educational and behavioural intervention coordinated by a cardiologist versus usual care after a standard CR programme following MI [53]. At 3 years the intervention proved to be effective in countering the risk factors and increasing medication adherence over time, with significant improvement in lifestyle habits (i.e., exercise, diet, psychosocial stress, body weight control). In harmony with these results, all the clinical endpoints were reduced by the intensive intervention: cardiovascular mortality, nonfatal MI and stroke by 33% and cardiac death plus nonfatal MI by 36%, total stroke by 32% and total mortality by 21% [54]. These preliminary but encouraging experiences should promote strategies to help patients to keep the achievements of the CR in the medium and longer-term.

In conclusion, there is now a large and tailored body of evidence addressing the generality of the benefits of CR for all patients but also increasing evidence of specific modalities to address the variety of clinical, functional, dietary and psychosocial needs of specific groups of patients. This report provides a summary of the best available evidence to promote comprehensive CR for all along generally agreed principles and with the tailoring necessary and proven for specific sub-groups.

References

1 *http://www.heartcharter.eu/*

2 Rehabilitation After Cardiovascular Diseases, With Special Emphasis on Developing Countries. *Report of a WHO Expert Committee*. Geneva, Switzerland: World Health Organization; 1993. WHO Technical Report Series, No. 831.

3 Antman EM, Anbe ST, Armstrong PW, Bates ER, Green LA, Hand M, *et al*. ACC/AHA guidelines for the management of patients with ST-elevation myocardial infarction: executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol* 2004; **44**:671–719.

4 Braunwald E, Antman EM, Beasley JW, Califf RM, Cheitlin MD, Hochman JS, *et al*. ACC/AHA 2002 guideline update for the management of patients with unstable angina and non–ST-segment elevation myocardial infarction: summary article: a report of the American College of Cardiology/ American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol* 2002; **40**:1366–1374.

5 Gibbons RJ, Abrams J, Chatterjee K, Daley J, Deedwania PC, Douglas JS, *et al*. ACC/AHA 2002 guideline update for the management of patients with chronic stable angina: summary article: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation* 2003; **107**:149–158.

6 Joliffe JA, Rees K, Taylor RS, Thompson D, Oldridge N, Ebrahim S. Exercise-based rehabilitation for coronary heart disease. *Cochrane Database Syst Rev* 2001; Issue 1 Art No: CD001800. DOI: 10.1002/ 14651858.CD001800

7 Piepoli MF, Davos C, Francis DP, Coats AJ, ExTraMATCH Collaborative. Exercise training meta-analysis of trials in patients with chronic heart failure (ExTraMATCH). *BMJ* 2004; **328**:189–193.

8 Recommendations by the Working Group on Cardiac Rehabilitation of the European Society of Cardiology. Long term comprehensive care of cardiac patients. *Eur Heart J* 1992; **13** (**Suppl C**):1C–45C.

9 Balady GJ, Williams M, Ades PA, Bittner V, Comoss P, Foody JM, *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**:2675–2682.

10 Giannuzzi P, Saner H, Björnstad H, Fioretti P, Mendes M, Cohen-Solal A, *et al*. Secondary prevention through cardiac rehabilitation: position paper of the working group on cardiac rehabilitation and exercise physiology of the European society of Cardiology Eur. *Heart J* 2003; **24**: 1273–1278.

11 Giannuzzi P, Mezzani A, Saner H, Björnstad H, Fioretti P, Mendes M, *et al*. Physical activity for primary and secondary prevention. Position paper of the working group on cardiac rehabilitation and exercise physiology of the European society of cardiology. *Eur J Cardiovasc Prev Rehabil* 2003; **10**:319–327.

12 Graham I, Atar D, Borch-Johnsen K, Boysen G, Burell G, Cifkova R, *et al*. Fourth Joint Task Force of the European Society of Cardiology and other societies on cardiovascular disease prevention in clinical practice. *Eur J Cardiovasc Prev Rehabil* 2007; **14** (**Suppl 2**):S1–113.

13 Alberti KGMM, Zimmet P, Shaw J. International Diabetes Federation: a consensus on Type 2 diabetes prevention. *Dia Med* 2007; **24**:451–463.

14 Bjarnason-Wehrens B, Mayer-Berger W, Meister ER, Baum K, Hambrecht R, Gielen S. Recommendations for resistance exercise in cardiac rehabilitation. Recommendations of the German Federation for Cardiovascular Prevention and Rehabilitation. *Eur J Cardiovasc Prev Rehabil* 2004; **11**:352–361.

15 DASH-Sodium Collaborative Research Group, Sacks FM, Svetkey LP, Vollmer WM, Appel LJ, Bray GA, Harsha D, *et al*. Effects on blood pressure of reduced dietary sodium and the dietary approaches to stop hypertension (DASH) diet. *N Engl J Med* 2001; **344**:3–10.

16 Mancia G, De Backer G, Dominiczak A, Cifkova R, Fagard R, Germano G, *et al*. 2007 Guidelines for the Management of Arterial Hypertension: the Task Force for the Management of Arterial Hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC). *J Hypertens* 2007; **25**:1105–1187.

17 Van de Werf F, Ardissino D, Betriu A, Cokkinos DV, Falk E, Fox KA, *et al*. Management of acute myocardial infarction in patients presenting with ST-segment elevation. The Task Force on the Management of Acute Myocardial Infarction of the European Society of Cardiology. *Eur Heart J* 2003; **24**:28–66.

18 Bassand JP, Hamm CW, Ardissino D, Boersma E, Budaj A, Fernandez-Aviles F, *et al*. ESC Guidelines for the Diagnosis and Treatment of Non-ST-segment Elevation Acute Coronary Syndromes. *Eur Heart J* 2008; **28**:1598–1660.

19 Smith SC Jr, Allen J, Blair SN, Bonow RO, Brass LM, Fonarow GC, *et al*. AHA/ACC/National Heart, Lung, and Blood Institute, AHA/ACC guidelines for secondary prevention for patients with coronary and other atherosclerotic vascular disease: 2006 update. *J Am Coll Cardiol* 2006; **47**:2130–2139.

20 Thompson PD, Buchner D, Pina IL, Balady GJ, Williams MA, Marcus BH, *et al*. Exercise and physical activity in the prevention and treatment of atherosclerotic cardiovascular disease: a statement from the Council on Clinical Cardiology and the Council on Nutrition, Physical Activity, and Metabolism. *Circulation* 2003; **107**:3109–3116.

21 UK Department of Health. Evidence on the Impact of Physical Activity and its Relationship to Health. A Report from Chief Medical Office 2004. Available at :*http.//www.dh.gov.uk*

22 National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) final report. *Circulation* 2002; **106**:3143–3421.

23 Executive summary of the clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults. *Arch Intern Med* 1998; **158**:1855–1867.

24 American Association for Cardiovascular and Pulmonary Rehabilitation. *Guidelines for Cardiac rehabilitation and secondary prevention programs*. 4th ed. Champaign, illinois: Human Kinetics Publishers; 2004.

25 Fox K, Alonso Garcia MA, Ardissino D, Buszman P, Camici PG, Crea F, *et al*. Guidelines on the management of stable angina pectoris: executive summary. The task force on the management of stable angina pectoris of the ESC. *Eur Heart J* 2006; **27**:1341–1381.

26 Fraker TD Jr, Fihn SD, writing on behalf of the 2002 Chronic Stable Angina Writing Committee. 2007 chronic angina focused update of the ACC/AHA 2002 Guidelines for the Management of Patients With Chronic Stable Angina: a report of the American College of Cardiology/ American Heart Association Task Force on Practice Guidelines Writing Group to Develop the Focused Update of the 2002 Guidelines for the Management of Patients With Chronic Stable Angina. *J Am Coll Cardiol* 2007; **50**:2264–2274.

27 Smith SC Jr, Feldman TE, Hirshfeld JW Jr, Jacobs AK, Kern MJ, King SB 3rd, *et al.* ACC/AHA/SCAI 2005 guideline update for percutaneous coronary intervention: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (ACC/AHA/SCAI Writing Committee to Update the 2001 Guidelines for Percutaneous Coronary Intervention). American College of Cardiology Web Site. Available at: *http://www.acc.org/clinical/guidelines/percutaneous/ update/index.pdf*

28 Rees K, Bennett P, Wst R, Davey Smith G, Ebrahim S. Psychological interventions for coronary heart disease. *Cochrane Database Syst Rev* 2004; Issue 2 Art No : CD002902. DOI: 10.1002/14651858.CD002902.pub2.

29 Eagle KA, Guyton RA, Davidoff R, Ewy GA, Fonger J, Gardner TJ, *et al.* ACC/AHA Guidelines for Coronary Artery Bypass Graft Surgery: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (committee to revise the 1991 Guidelines for Coronary Artery Bypass Graft Surgery). American College of Cardiology/American Heart Association. *J Am Coll Cardiol* 1999; **34**:1262–1347.

30 Eagle KA, Guyton RA, Davidoff R, Edwards FH, Ewy GA, Gardner TJ, *et al.* ACC/AHA 2004 guideline update for coronary artery bypass graft surgery: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (committee to update the 1999 Guidelines for Coronary Artery Bypass Graft Surgery). *Circulation* 2004; **110**:e340–e437.

31 Vahanian A, Baumgartner H, Bax J, Butchart E, Dion R, Filippatos G, *et al.* Guidelines on the management of valvular heart disease: the Task Force on the Management of Valvular Heart Disease of the European Society of Cardiology. *Eur Heart J* 2007; **28**:230–268.

32 Butchart EG, Gohlke-Barwolf C, Antunes MJ, Tornos P, De Caterina R, Cormier B, *et al.* Recommendations for the management of patients after heart valve surgery. *Eur Heart J* 2005; **26**:2463–2471.

33 Hunt SA, Baker DW, Chin MH, Cinquegrani MP, Feldman AM, Francis GS, *et al.* ACC/AHA guidelines for the evaluations and management of chronic heart failure in the adult: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol* 2001; **38**:2101–2113.

34 Task Force for Diagnosis and Treatment of Acute and Chronic Heart Failure 2008 of European Society of Cardiology, Dickstein K, Cohen-Solal A, Filippatos G, McMurray JJ, Ponikowski P, Poole-Wilson PA, *et al.* ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure 2008: the Task Force for the Diagnosis and Treatment of Acute and Chronic Heart Failure 2008 of the European Society of Cardiology. Developed in collaboration with the Heart Failure Association of the ESC (HFA) and endorsed by the European Society of Intensive Care Medicine (ESICM). *Eur Heart J* 2008; **29**:2388–2442.

35 Arnold JMO, Howlett JG, Ducharme A, Ezekowitz JA, Gardner MJ, Giannetti N. The 2001 Canadian cardiovascular society consensus guidelines update for the management and prevention of heart failure. *Can J Cardiol* 2001; **17** (**Suppl E**):5E–25E.

36 Krum H. Guidelines for management of patients with chronic heart failure in Australia. *Med J Aust* 2001; **174**:459–466.

37 Taylor DO, Edwards LB, Boucek MM, Trulock EP, Deng MC, Keck BM, Hertz MI. Registry of the international society for heart and lung transplantation: twenty-first official adult heart transplant report – 2005. *J Heart Lung Transplant* 2005; **24**:945–955.

38 Niset G, Vachiery JL, Lamotte M, Godefroid C, Degre S. Rehabilitation after heart transplantation. In: Rieu M, editors. *Physical work capacity in organ transplantation*. Vol 42. Basel, Karger: Med Sport Sci; 1998. pp. 67–84.

39 Rydén L, Standl E, Bartnik M, Van den Berghe G, Betteridge J, de Boer MJ, *et al.* Task Force on Diabetes and Cardiovascular Diseases of the European Society of Cardiology (ESC); European Association for the Study of Diabetes (EASD). Guidelines on diabetes, pre-diabetes, and cardiovascular diseases: executive summary. *Eur Heart J* 2007; **28**:88–136.

40 Lindstrom JK, Toumilehto J. The diabetes risk score: a practical toll to predict type 2 diabetes risk. *Diabetes Care* 2003; **26**:725–731.

41 Sigal RJ, Kenny GP, Wasserman DH, Casteneda-Sceppa C. Physical activity/exercise and type 2 diabetes. *Diabets Care* 2004; **27**:2518–2539.

42 Hirsch AT, Haskal ZJ, Hertzer NR, Bakal CW, Creager MA, Halperin JL, *et al.* ACC/AHA 2005 Practice Guidelines for the management of patients with peripheral arterial disease (lower extremity, renal, mesenteric, and abdominal aortic): a collaborative report from the American Association for Vascular Surgery/Society for Vascular Surgery, Society for Cardiovascular Angiography and Interventions, Society for Vascular Medicine and Biology, Society of Interventional Radiology, and the ACC/AHA Task Force on Practice Guidelines. *Circulation* 2006; **113**:e463–e654.

43 Stewart KJ, Hiatt WR, Regensteiner JG, Hirsch AT. Exercise training for claudication. *N Engl J Med* 2002; **347**:1941–1951.

44 Marchionni N, Fattirolli F, Fumagalli S, Oldridge N, Del Lungo F, Morosi L, *et al.* Improved exercise tolerance and quality of life with cardiac rehabilitation of older patients after myocardial infarction:results of a randomized, controlled trial. *Circulation* 2003; **107**:2201–2206.

45 Williams MA, Fleg JL, Ades PA, Chaitman BR, Miller NH, Mohiuddin SM, *et al.* Secondary prevention of coronary heart disease in the elderly (with emphasis on patients $\geq$75 years of age): an American Heart Association scientific statement from the Council on Clinical Cardiology Subcommittee on Exercise, Cardiac Rehabilitation, and Prevention. *Circulation* 2002; **105**:1735–1743.

46 Mosca L, Banka CL, Benjamin EJ, Berra K, Bushnell C, Dolor RJ, *et al.* Evidence-based guidelines for cardiovascular disease prevention in women. 2007 update. *J Am Coll Cardiol* 2007; **49**:1230–1250.

47 Rosamond W, Flegal K, Furie K, Go A, Greenlund K, Haase N, *et al.* Heart disease and stroke statistics–2008 update: a report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. *Circulation* 2008; **117**:e25–e146.

48 National Heart, Lung and Blood Institute/ World Health Organisation: Global Initiative for Chronic Obstructive Lung Disease. Global Strategy for the Diagnosis, Management, and Prevention of Chronic Obstructive Pulmonary Disease. Executive Summary [Web Page] 2007 [Accessed May 2007] *www.goldcopd.com*

49 US Renal Data System. USRDS 2007. 2 Annual Data Report. [Web Page] 2007; *http://www.usrds.org/adr.htm* [Accessed May 2007].

50 Kotseva K, Wood D, De Backer G, De Bacquer D, Pyörälä K, Keil U, EUROASPIRE Study Group. Cardiovascular prevention guidelines in daily practice: a comparison of EUROASPIRE I, II and III surveys in 8 European countries. EUROASPIRE Study Group. *Lancet* 2009; **373**:929–940.

51 Kotseva K, Wood D, De Backer G, De Bacquer D, Pyörälä K, Keil U, EUROASPIRE Study Group. EUROASPIRE III: a survey on the lifestyle, risk factors and use of cardioprotective drug therapies in coronary patients from twenty two European countries. EUROASPIRE Study Group. *Eur J Cardiovasc Prev Rehabil* 2009; **16**:121–137.

52 Wood DA, Kotseva K, Connolly S, Jennings C, Mead A, Jones J, *et al.*, on behalf of EUROACTION Study Group. Nurse-coordinated multidisciplinary, family-based cardiovascular disease prevention programme (EUROACTION) for patients with coronary heart disease and asymptomatic individuals at high risk of cardiovascular disease: a paired, cluster-randomized controlled trial. *Lancet* 2008; **371**:1999–2012.

53 Giannuzzi P, Temporelli PL, Maggioni AP, Ceci V, Chieffo C, Gattone M, *et al.* GIObal Secondary Prevention strategiEs to Limit event recurrence after myocardial infarction: the GOSPEL study. A trial from the Italian Cardiac Rehabilitation Network: rationale and design. *Eur J Cardiovasc Prev Rehabil* 2005; **12**:555–561.

54 Giannuzzi P, Temporelli PL, Marchioli R, Maggioni AP, Balestroni G, Ceci V, *et al.* Global secondary prevention strategies to limit event recurrence after myocardial infarction: results of the GOSPEL study, a multicenter, randomized controlled trial from the Italian Cardiac Rehabilitation Network. *Arch Intern Med* 2008; **168**:2194–2204.