



UEMS SPECIAL SECTION

Evidence-based position paper on Physical and Rehabilitation Medicine (PRM) professional practice for people with cardiovascular conditions. The European PRM position (UEMS PRM Section)

Alvydas JUOCEVICIUS¹, Aydan ORAL^{2*}, Aet LUKMANN³, Peter TAKÁČ⁴,
Piotr TEDERKO⁵, Ilze HÄZNERE⁶, Catarina AGUIAR-BRANCO⁷, Milica LAZOVIC⁸, Stefano NEGRINI^{9,10},
Enrique VARELA DONOSO¹¹, Nicolas CHRISTODOULOU¹²

¹Department of Rehabilitation, Physical and Sports Medicine, Faculty of Medicine, Vilnius Santariskiu Klinikos University Hospital, Vilnius, Lithuania; ²Department of Physical Medicine and Rehabilitation, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Turkey; ³Department of Sports Medicine and Rehabilitation, University of Tartu, Tartu, Estonia; ⁴L. Pasteur University Hospital, Kosice Faculty of Medicine, Pavol Jozef Safarik University, Kosice, Slovak Republic; ⁵Department of Rehabilitation, Medical University of Warsaw, Warsaw, Poland; ⁶Department of Physical and Rehabilitation Medicine, Pauls Stradins Clinical University Hospital, Riga, Latvia; ⁷Department of Physical and Rehabilitation Medicine, Hospital of Entre o Douro e Vouga E.P.E, Porto, Portugal; ⁸Institute for Rehabilitation, Faculty of Medicine, University of Belgrade, Belgrade, Serbia; ⁹Department Clinical and Experimental Sciences, University of Brescia, Brescia, Italy; ¹⁰Don Gnocchi Foundation and Institute for Research and Care, Milan, Italy; ¹¹Department of Physical and Rehabilitation Medicine, Complutense University School of Medicine, Madrid, Spain; ¹²Medical School, European University Cyprus, Nicosia, Cyprus

*Corresponding author: Aydan Oral, Department of Physical Medicine and Rehabilitation, Istanbul Faculty of Medicine, Istanbul University, 34093 Istanbul, Turkey. E-mail: aydanoral@yahoo.com

ABSTRACT

Cardiovascular conditions are significant causes of mortality and morbidity leading to substantial disability. The aim of the paper is to improve Physical and Rehabilitation Medicine (PRM) physicians' professional practice for people with cardiovascular conditions in order to promote their functioning and to reduce activity limitations and/or participation restrictions. A systematic review of the literature and a Consensus procedure by means of a Delphi process have been performed involving the delegates of all European countries represented in the UEMS PRM Section. The systematic literature review is reported together with thirty recommendations resulting from the Delphi procedure. The professional role of PRM physicians having expertise in the rehabilitation of cardiovascular conditions is to lead cardiac rehabilitation programs in multi-professional teams, working in collaboration with other disciplines in a variety of settings to improve functioning of people with cardiovascular conditions. This evidence-based position paper represents the official position of the European Union through the UEMS PRM Section and designates the professional role of PRM physicians in persons with cardiovascular conditions.

(Cite this article as: Juocevicius A, Oral A, Lukmann A, Takáč P, Tederko P, Häzner I, *et al.* Evidence-based position paper on Physical and Rehabilitation Medicine (PRM) professional practice for people with cardiovascular conditions. The European PRM position (UEMS PRM Section). Eur J Phys Rehabil Med 2018;54:634-43. DOI: 10.23736/S1973-9087.18.05310-8)

KEY WORDS: Cardiovascular diseases - Rehabilitation - Physical and rehabilitation medicine - Practice guideline.

Introduction

Cardiovascular diseases are leading causes of mortality, ischemic heart disease resulting in increased deaths

within the last decade by 16.6% globally.¹ Substantial disability is also associated with cardiovascular conditions among which ischemic heart disease ranked the first accounting for more than seven million years lived with dis-

ability (YLD). Likewise, heart failure and even atrial fibrillation and flutter impose a great burden of disability on the affected individual and society with YLDs of 6.2 and 2.6 million years, respectively, as calculated in the Global Burden of Disease study for the year 2015.² Last but not least, hypertension was found as the leading risk factor in both genders with the largest contribution to death and YLDs.³

The discrepancy between rates of mortality in general and YLDs, the latter decreasing much more slowly (or even increasing) than the former due to the ageing of the population globally leads to a substantial number of chronically ill individuals with cardiovascular conditions who survive which represent a reservoir of disability, requiring health services for secondary prevention and reduction of the disability.⁴

Disability is an umbrella term describing problems in functioning including impairments in body functions, activity limitations, and participation restrictions as defined the International Classification of Functioning, Disability and Health (ICF).⁵ The management of any problems in functioning falls within the scope of Physical and Rehabilitation Medicine (PRM), defined as “medicine of functioning.”^{6, 7} Significant problems in functioning of individuals with cardiovascular conditions place PRM physicians in a position to carry out successful cardiac rehabilitation with “add-on” specific PRM interventions when necessary.

The aim of this evidence-based position paper (EBPP) is to improve PRM physicians' professional practice for people with cardiovascular conditions in order to promote their functioning and to reduce activity limitations and/or participation restrictions.

Literature search

This EBPP is produced according to the methodology proposed by the UEMS-PRM Section.⁸ The EBPP comprises of two parts: a systematic review of the literature and a consensus with Delphi procedure among UEMS PRM Section delegates. The details of systematic literature search PubMed/MEDLINE and the Cochrane Library and paper selection with the main inclusion criterion as the relevance of the article with the PRM profession are given in Supplementary Digital Material 1 (Text File 1).

Information on the strength of evidence (SoE) and recommendation (SoR) grading as well as how the consensus on recommendations has been reached by the Delphi procedure can be found in the methodology paper by Negrini *et al.*⁸

Results

Flow chart of paper selection for reviewing the literature is shown in Supplementary Digital Material 2 (Supplementary Figure 1). Systematic review of the literature provided us with below listed rehabilitation programs of care/PRM interventions along with their evidence of effectiveness leading to recommendations in specific cardiovascular conditions.

Coronary heart disease/Ischemic heart disease/Coronary artery disease

Exercise-based cardiac rehabilitation

Exercise-based cardiac rehabilitation is the cornerstone of management for patients with coronary heart disease (CHD). A cardiac rehabilitation program is a multicomponent initiative, core components of which includes assessment of the patient, medical (*e.g.* cardioprotective treatments) and lifestyle risk factor management involving change of health behaviors and education relevant to physical activity, exercise, diet, smoking cessation, weight control, lipid and blood pressure management as well as exercise prescription, vocational support, and psychosocial management performable by a multiprofessional team in in-patient and/or out-patient settings or at home or in the community requiring lifelong continuation along with audit and evaluation.^{9, 10} Exercise training is the mainstay and the most studied component of cardiac rehabilitation programs with varying recommendations in guidelines/ across countries.¹¹ Exercise prescription recommendations in guidelines in different parts of the world and also country specific guidelines in Europe are provided in Supplementary Digital Material 3 (Supplementary Table I) and Supplementary Digital Material 4 (Supplementary Table II).

Before prescribing an exercise-based cardiac rehabilitation program, assessment with a focus on functioning is the major step which can be done using the brief ICF Core Sets for cardiopulmonary conditions for acute and post-acute care (www.icf-research-branch.org/download/category/12-cardiovascularandrespiratoryconditions) as well as ICF Core Sets for chronic ischemic heart disease.¹² Rehabilitation goal setting follows the assessment process. PRM physicians may refer to clinical algorithms for the prescription of exercise for patients with CHD as demonstrated in the paper by Achttien *et al.*¹³

There is also a strong need for the assessment and inclusion of psychosocial risk factor (such as stress, anxiety, de-

pression, type-D personality, social isolation) management strategies to be accomplished by relevant team members in cardiac rehabilitation programs due to their unfavorable effects on required lifestyle modifications, HRQoL, program adherence, and ultimately prognosis. These strategies can be found in the position paper by ESC/EACPR/ Cardiac Rehabilitation Section.¹⁴ Attention is needed particularly for depression which is very common in cardiovascular diseases, affecting nearly half (~40%) of those with CHD¹⁵ and even those with peripheral arterial disease with a prevalence ranging from 3% to 48% depending on study type.¹⁶ Depression is not only associated with mortality in CHD or heart failure, but also with worse HRQoL, more frequent use of health services and costs/economic burden.¹⁵ Another aspect is its negative influence on exercise capacity, walking capabilities, and physical functioning which can ultimately lead to worse prognosis with further increase in mortality risk.¹⁷

Patient education for the modification of CHD risk factors for secondary prevention (certainly also for primary prevention) should be prioritized in cardiac rehabilitation programs with the objectives of promoting a healthy lifestyle including cessation of smoking, regular physical activity/exercise, a healthy diet, stress management along with adherence to treatment/programs, health-care system use, and return-to-work.¹⁸ Exercise-based cardiac rehabilitation programs may additionally include sexual counseling.¹⁹

Cardiac rehabilitation programs may be delivered in a variety of ways. In addition to conventional hospital/center-, home-, or community-based cardiac rehabilitation programs, tele-cardiac rehabilitation programs/telehealth interventions tailored to the needs of the individual patient are available as alternative models.²⁰ Guidelines for cardiac rehabilitation in low-resource settings are also available.²¹

Possible basic/intracellular mechanisms of beneficial cardioprotective effects of exercise may relate to favorable outcomes in the production of nitric oxide and heat shock proteins, improvements in potassium channel function (ATP-dependent), opioid system and cardiac antioxidant capacity.²²

Risk stratification for each individual to be admitted to cardiac rehabilitation programs, tailored exercise, monitoring, and ensuring safety are of paramount importance, the measures for which can be found in guidelines (Supplementary Digital Material 3, Supplementary Table I; Supplementary Digital Material 4, Supplementary Table II).

As summarized in the 2014 overview of six Cochrane reviews, exercise-based cardiac rehabilitation leads to reductions in hospitalizations in clinically stable patients with low-risk after myocardial infarction, percutaneous coronary intervention, or heart failure with improvements in health-related quality of life (HRQoL) and with similar effects and costs of center- or home-based programs when compared with usual care.²³ Additionally favorable effects on mortality have been evidenced in recent CRs/SRs (Supplementary Digital Material 5, Supplementary Table III), mortality benefits of exercise being similar to those of drug interventions in CHD or heart failure.²⁴

Despite well-established efficacy of exercise-based cardiac rehabilitation programs on function and HRQoL as well as on mortality based on good evidence,^{23, 24} availability of cardiac rehabilitation programs globally is low with only 38.8% of countries globally having cardiac rehabilitation programs, 68.0%, 28.2%, and 8.3% of which in high-income, middle-income, and low-income countries, respectively.²⁵ Even at the availability of programs, participation in and adherence to those programs are problematic issues resulting from either patient- or program-related factors which include existence of co morbidities, unemployment, low income, lack of a spouse, less education, living away from facilities, not being able to drive or use transportation, showing similarities at different parts of the world.²⁶ Even in outpatient/home/community settings, participation in exercise training is associated with problems albeit less when referred and/or recommended by a physician.²⁷ Therefore, it is very important for physicians to motivate patients with CHD to exercise in different settings.

It is important to note that cardiac rehabilitation programs require a multiprofessional team, working in collaboration with other disciplines. The authors of this EBPP on behalf of the UEMS PRM Section recommend more involvement of PRM physicians in cardiac rehabilitation programs as leaders in in-patient and outpatient settings (center-based) in collaboration with other health professionals trained in cardiac rehabilitation and as joint leaders, coordinators, advisors, evaluators, or consultants at home and/or community settings. The reasons for this recommendation include the following: first of all, PRM is the primary medical specialty concerned with the improvement of physical and cognitive functioning including behavior as well as promotion of participation (including quality of life) and modification of personal and environmental factors with responsibility of rehabilitation management of persons with disabling health conditions and

their comorbidities across all ages in addition to the prevention, medical diagnosis and treatment of health conditions.^{7, 28, 29} This definition of PRM covers the aspects to fulfil the components of cardiac rehabilitation programs. Collaboration with cardiologists is certainly required regarding the basic cardiovascular examination and assessment, planning cardiac rehabilitation tailored to the individual patient, regulating cardiovascular medications, and possible adverse events.³⁰ It should also be noted that effective team working is fundamental in PRM.³¹ Additionally, in in-patient/hospital settings, it may be more feasible to use the facilities already available in PRM departments in hospitals (exercise equipment, physical therapists, and other rehabilitation professionals) in circumstances where there is no common physical therapy units or competent rehabilitation professionals serving to all medical specialties, which might be the case for some countries, particularly in university hospitals. In center-based cardiac rehabilitation programs which are more common in European countries,³² or at home or community settings, PRM physicians may contribute significantly to cardiac rehabilitation programs by virtue of their competence and rehabilitation as their health strategy.^{6, 7, 28}

Hypertension

Hypertension is the globally ranking first and the most important risk factor for death responsible for 49% of CHD and for 62% of cerebrovascular disease.³ Each augmentation of 20/10 mmHg in suboptimal systolic blood pressure (SBP) (SBP>115 mmHg) was noted to double the risk of cardiovascular disease by the World Health Organization.³³

Exercise training is considered as a significant non-pharmacological intervention in the management of hypertension with cardiovascular risk, pharmacological intervention related cost and adverse event reducing effects. Potential acute or chronic mechanisms by which exercise training reduces/improves blood pressure include decreased peripheral vascular resistance, reduced cardiac output, stroke volume, and left ventricular end-diastolic volume, improvement in myocardial contractility and coronary perfusion, arterial compliance and endothelial function, increased nitric oxide production and reduced rate of atherosclerosis.^{34, 35}

Exercise recommendations on hypertension by several guidelines are shown in Supplementary Digital Material 6 (Supplementary Table IV). Recommendations may vary in guidelines in terms of frequency, intensity, time, and type (FITT).³⁶ It should also be noted that hypertension

may complicate the health condition when concomitantly exists with CHD and/or heart failure. Also, in this case, exercise training with close and careful supervision and monitoring (mostly with ECG for arrhythmias) as well as CHD risk factors management are suggested based on C level of evidence and class I recommendation in a guideline.³⁷

Safety concerns should be prioritized by all of the exercise prescribing and supervising health professionals. Cautious evaluation, pharmacological treatment, if required, exercise testing for men aged ≥ 45 years and for women ≥ 55 years, and risk stratification and close monitoring are major issues regarding safety before and during tailored exercise training of individuals with hypertension. The association between strenuous exercise and increased thrombocyte activation and adhesion should be well known in order to prevent the risk of sudden death, particularly important for those who are not used to exercising. It is also important to know that cardiovascular event and mortality risk may increase by 4% for each augmentation of 10 mm Hg in SBP when exercising at moderate intensity.³⁸ Gradual increase in exercise intensity could be a good safety measure. Medications the patient is using should also be evaluated since β -blockers and diuretics may adversely affect thermoregulation and may be reasons for hypoglycemia. Gradual cessation of exercise and control of room temperature are recommended for individuals taking β -blockers, calcium channel blockers, and vasodilators due to their possible post-exercise hypotensive effects.^{39, 40} It is important to follow exercise testing and prescription guidelines.⁴⁰

Heart failure

The details of exercise training can be found in HFA/EACPR consensus document.⁴¹ In addition to exercising, heart failure disease management programs supporting self-management/care (management of medications and behaviors) are the backbone of rehabilitation in heart failure. Attention should be given to components of these programs such as those which provide better patient understanding and self-care of the health condition, improved self-efficacy, more involvement of family members/caregivers in self-care, improvement in psychosocial well-being and health-care professionals support for the use of technology.⁴² Supported self-management strategies may contribute to greater self-efficacy and facilitate understanding/learning as well as adapting and applying health professionals' advices into daily living.⁴³ Self-efficacy strategies are also important for exercise programs with

beneficial effects on initiation and maintenance of exercise and confidence.⁴⁴ Patient-centeredness involving the concepts of collaboration between the patient and health professionals, joint efforts in goal-setting, identifying and respecting the preferences of the patient, and “shared decision making” with active role of the patient on care has been found associated with better outcomes including symptom reduction, decreased rehospitalization rates and improvement in HRQoL.⁴⁵

Exercise adherence,⁴⁶ patient centeredness to be measurable with appropriate tools not yet existing,⁴⁷ and transitional care⁴⁸ are other issues to be considered adequately in the rehabilitation of patients with heart failure.

Peripheral artery disease/intermittent claudication

Individuals with lower extremity peripheral artery disease are now considered as a target population for cardiac rehabilitation which forms the first-line intervention with the goal of improving functioning, particularly mobility (walking) as well as reducing the risk of cardiac events through lifestyle modifications.⁴⁹ An Australian guideline presents exercise training with supervision and appropriate monitoring as the most effective intervention for improving exercise tolerance as well as daily physical activity and HRQoL, and reducing the risk of cardiovascular disease. Tailored exercise prescription and progression appropriate for the specific individual may include walking, cycling, or arm-crank ergometer, 3 sessions/week for 40 minutes at a moderate intensity till the threshold of severe claudication pain. Dynamic resistance exercises can be added two sessions/week at least. Safety measures are very important due to commonality of comorbidities including hypertension, diabetes mellitus, and peripheral neuropathy and also for high cardiovascular risk in these patients.⁵⁰

Venous insufficiency and venous ulcers

Individuals with venous insufficiency and/or venous ulcers may benefit from compression garments and physical activity/exercise at a moderate level (e.g. walking).⁵¹

Coronary artery bypass graft surgery (CABGS)

Cardiac rehabilitation after CABGS involves the same principles as for CHD.¹⁰

Heart valve surgery

Cardiac rehabilitation following heart valve surgery may offer benefits to the individual and health-care cost reduction.⁵²

Heart transplantation

It is well known that exercise training results in improvements in cardiopulmonary functional variables, exercise capacity, body composition, and HRQoL in heart transplant recipients.⁵³ It has recently been shown in a retrospective study that early participation in a cardiac rehabilitation program following heart transplantation is associated with long-term survival.⁵⁴

Implantable cardioverter defibrillators (ICD)

Exercise combined with psychoeducational interventions may induce extra benefits of approximately 14% to 25% in improving exercise capacity, HRQoL, and general physical and mental well-being in patients with an implanted ICD in a safe manner.⁵⁵ PRM physicians should observe attentively any shoulder disability which may be associated with implanted ICDs due to avoidance of shoulder movements in fear of dislodgement of the leads.⁵⁶ Also, some concerns and fear of unfavorable interactions with the use of some physical modalities in individuals with cardiac rhythm devices such as pacemakers and/or implantable ICDs exist. Despite lacking guidelines and/or robust research on this issue, the avoidance of electrical currents such as TENS and interferential current and also diathermy is suggested.⁵⁷ However, a recent SR based on four trials (three of which being safety studies and one being a case report) on the safety of the use of neuromuscular electrical stimulation (NMES) for increasing exercise capacity and strength of lower extremity (thighs) in individuals with ICDs did not reveal any interference with electromagnetism which could jeopardize ICD function when used for the thighs; however, the opposite was observed when used for abdominal muscles.⁵⁸ It is apparent that utmost caution is required, the recommendations for which can be found in this SR.⁵⁸

The evidence for the effectiveness of nonpharmacological/conservative interventions which may fall within the scope of PRM for patients with cardiovascular conditions can be found in Supplementary Digital Material 5 (Supplementary Table III).

Final recommendations for PRM professional practice in Europe

Overall general recommendation

1. It is recommended that rehabilitation programs for patients with cardiovascular conditions involve PRM physicians. Their role is, according to their expertise, to

lead exercise-based cardiac rehabilitation programs in collaboration with cardiologists and/or with other medical specialists trained in cardiac rehabilitation (*e.g.* sports medicine physicians or others) and with a competent team in in-patient, out-patient settings, home, and in the community to reduce impairments in function, activity limitations, and participation restrictions associated with these conditions. It is recommended that PRM physicians make every effort to promote participation in and adherence to exercise-based cardiac rehabilitation. It is recommended that PRM physicians follow available guidelines and evidence-based interventions when performing cardiac rehabilitation [SoE: IV;^{7, 13, 28-31} SoR: A].

Recommendations on PRM physicians' role in Medical Diagnosis according to ICD

2. It is recommended that PRM physicians make a thorough consideration of the assessments and diagnoses made by the cardiologists and/or other medical specialists relevant to the individual with cardiovascular conditions which represent an absolute indication for exercise-based cardiac rehabilitation (*i.e.* coronary heart disease, coronary artery bypass graft surgery, heart valve surgery, chronic stable heart failure) and also those with high likelihood of benefiting from exercise (*i.e.* hypertension, atrial fibrillation, cardiac rhythm device users, heart transplantation, peripheral artery disease/intermittent claudication [SoE: IV;³⁰ SoR: A].

Recommendations on PRM physicians' role in PRM diagnosis according to ICF

3. It is recommended that PRM physicians perform a complete bio-psycho-social evaluation of the patients with cardiovascular conditions considering the diagnosis/identification of emotional functions and social functions such as psychological conditions (*i.e.* stress, anxiety, depression, type-D personality, social isolation) that are associated both with reworstening of the health condition and also with poor adherence to the rehabilitation program [SoE: IV; SoR: A].

4. It is recommended that PRM physicians examine elderly patients with chronic cardiac conditions with regard to the diagnosis of muscle weakness, sarcopenia, frailty or other comorbidities in order to target appropriate interventions [SoE: IV;^{6, 7, 28-30} SoR: A].

5. It is recommended that PRM physicians pay particular attention to lifestyles of cardiovascular patients with regard to healthy living in order to identify/diagnose unfavorable conditions such as obesity, metabolic syndrome,

diabetes mellitus or nutritional deficits or any other unfavorable life habits such as smoking or a sedentary lifestyle [SoE: IV;^{6, 7, 28-30} SoR: A].

Recommendations on PRM physicians' role in PRM assessment according to ICF

6. It is recommended that PRM physicians focus on the diagnosis of impairments in body functions, activity limitations, and participation restrictions of patients with cardiovascular conditions, which is of primary importance for cardiac rehabilitation goal setting [SoE: IV;^{6, 7, 28-30} SoR: A].

7. It is recommended that PRM physicians carefully consider the assessment of ICF category titles in the environmental factor component such as products and technology, family, personal care providers, health professionals, other professionals, support and relationships, attitudes of care providers, health and related professionals as well as services, systems and policies category titles in relation to supported self-management, use of information technology for health promotion/lifestyle changes, well-being of family caregivers, improved coordination among health professionals to enhance motivation, exercise adherence and quality of cardiac rehabilitation programs, and better organization of PRM projects of cardiac rehabilitation [SoE: IV;^{6, 7, 28, 29} SoR: B].

8. It is recommended that PRM physicians use the ICF for the assessment of functioning properties of the patient with a cardiovascular condition to target PRM interventions [SoE: IV;^{5-7, 28} SoR: B].

9. It is recommended that PRM physicians use the comprehensive and/or brief ICF Core Sets for cardiopulmonary conditions for acute and post-acute care as well as ICF Core Sets for chronic ischemic heart disease that are available for this purpose (www.icf-research-branch.org/download/category/12-cardiovascularandrespiratoryconditions) [SoE: IV; SoR: A].

Recommendations on PRM management and process

Inclusion criteria (e.g. when and why to prescribe PRM interventions)

10. It is recommended that PRM physicians prescribe exercise-based cardiac rehabilitation within the multiprofessional team as early as possible following the diagnosis or accomplishment of a procedure (*e.g.* surgery) for a cardiovascular condition with absolute consideration of the individual's specific health status and his/her preference [SoE: IV; SoR: A].

11. Cardiac rehabilitation is prescribed to patients with cardiovascular conditions to improve body functions impairments (particularly those relevant to cardiovascular system and mainly exercise capacity), to modify cardiovascular risk factors favorably for secondary prevention, to reduce activity limitations and participation restrictions, to improve HRQoL, and to reduce cardiovascular morbidity and mortality as well as to reduce health-care costs [SoE: IV; SoR: A].

Project definition (definition of the overall aims and strategy of PRM interventions)

12. It is recommended that PRM treatment or programs are offered in acute hospitals (intensive care units), in post-acute settings, in centers specialized in cardiac rehabilitation, at home or in the community or with the use of information and communication technologies in the form of telemedicine or telerehabilitation interventions with the aim of improving body functions and reducing activity limitations, and participation restrictions [SoE: IV;²⁰ SoR: B].

13. It is recommended that PRM treatment or programs are designed absolutely tailored to the specific patient considering his/her medical condition, risk stratification, and needs [SoE: IV; SoR: A].

Team work (professionals involved and specific modalities of team work)

14. It is recommended that cardiac rehabilitation is performed by a multiprofessional expert team working in interdisciplinary way. The team can be composed of physicians (expert PRM physicians by virtue of their competence, cardiologists, sports medicine physicians and others, e.g. internal medicine physicians, occupational physicians with expertise and training in cardiac rehabilitation and psychiatrists for psychological problems), other rehabilitation professionals (physiotherapists, exercise physiologists, occupational therapists, rehabilitation nurses, social workers, vocational counselors, horticultural therapists, and others), other health professionals including clinical psychologists, dieticians, human movement scientists, health informaticians) social care providers or community-based workers, and also family members/caregivers. PRM physician can make a unique contribution in the teamwork as a leader or joint leader with cardiologists, and/or as a coordinator, advisor, evaluator, or consultant depending on the functioning properties of the patient or setting [SoE: IV;³¹ SoR: A].

PRM interventions

15. It is recommended that PRM physicians prescribe exercise training, tailored to the individual and compatible with the diagnosis and in cooperation with cardiologists and/or other relevant physicians, in the context of cardiac rehabilitation programs after a thorough review of the patient's medical condition with recognition of the risks (by risk stratification) and paying utmost attention to safety issues [SoE: IV; SoR: A].

16. It is recommended that PRM physicians refer to guidelines/consensus documents/position papers for conducting cardiac rehabilitation programs including exercise training prescription for coronary heart disease patients (Supplementary Digital Material 3, Supplementary Table I) [SoE: IV; SoR: A].

17. It is recommended that PRM physicians provide guideline-based exercise prescription for individuals with hypertension (with or without diabetes mellitus and other risk factors) (Supplementary Digital Material 6, Supplementary Table IV) [SoE: IV; SoR: A].

18. It is recommended that PRM physicians use in general Heart Failure Association and the European Association for Cardiovascular Prevention and Rehabilitation guideline⁴¹ or certainly other local guidelines pertinent to their countries, if available (Supplementary Digital Material 4, Supplementary Table II), for exercise prescription [SoE: IV; SoR: A].

19. It is recommended that PRM physicians consider suitable exercise prescription in cooperation with relevant physicians for other cardiovascular conditions/patients such as atrial fibrillation, coronary artery bypass surgery, heart valve surgery, heart transplantation, peripheral artery disease/intermittent claudication, venous insufficiency, and individuals with pacemakers or cardioverter defibrillators [SoE: IV; SoR: A].

20. It is recommended that PRM physicians motivate cardiovascular patients for starting, maintaining, and adhering to exercise at different settings [SoE: IV; SoR: A].

21. It is recommended that PRM physicians consider tele-cardiac rehabilitation [SoE: IV; SoR: B].

22. It is recommended that PRM physicians get involved in self-management education to favorably modify coronary heart disease risk factors and to improve self-efficacy [SoE: IV; SoR: A].

23. It is recommended that a PRM program of care involve psychological/psychosocial interventions supported by clinical psychologists and/or social workers to improve psychological conditions and/or social support [SoE: IV; SoR: B].

Outcome criteria

24. It is recommended that PRM physicians determine patient-centered outcome criteria in relation to the individual patient's functional impairments, activity limitations, and participation restrictions [SoE: IV; SoR: A].

25. It is recommended that PRM physicians use main outcome criteria including aerobic endurance parameters/exercise capacity (as measured using VO_2max , 6-Minute Walk Test, or others), coronary heart disease risk factor modification, HRQoL (as measured using generic or disease specific assessment tools), recurrence of cardiac events, rehospitalization rates, hospital days, and even survival in cardiac patients, blood pressure as the main outcome in addition to the others in patients with hypertension, and cardiac function/hemodynamic parameters (e.g. ejection fraction) as an additional main outcome in patients with heart failure [SoE: IV; SoR: A].

26. It is recommended that PRM physicians use secondary outcome criteria such as improvement in depressive symptoms or anxiety, body composition (e.g. BMI, muscle strength, body fat), ADL ability, return-to-work or autonomic function (particularly in patients with heart failure) or heart rate control in patients with atrial fibrillation or glycemic control in patients with diabetes mellitus [SoE: IV; SoR: A].

Length/duration/intensity of treatment (overall practical PRM approach)

27. It is recommended that PRM physicians follow guidelines/consensus documents/position papers (Supplementary Digital Material 3, Supplementary Table I; Supplementary Digital Material 4, Supplementary Table II; Supplementary Digital Material 6, Supplementary Table IV) for the length, duration, and intensity of PRM approaches with an absolute adaptation to the medical condition and needs of the specific patients [SoE: IV; SoR: A].

Discharge criteria (e.g. when and why to end PRM interventions)

28. It is recommended that patients with cardiovascular conditions are followed up and monitored closely throughout their lifespan with regard to progression of impairments in body functions, activity limitations, and participation restrictions as well as adherence to requirements of cardiac rehabilitation programs including exercise and favorable lifestyle changes [SoE: IV; SoR: B].

Recommendations on future research on PRM professional practice

29. It is recommended that PRM physicians are involved in research on integrative rehabilitation sciences research associated with rehabilitation services, rehabilitation administration and management⁵⁹ in order to provide suitable cardiac rehabilitation services in hospitals, rehabilitation centers or at home or community settings to meet the needs of cardiovascular patients [SoE: IV; SoR: A].

30. It is recommended that PRM physicians are also involved in research to identify effectiveness of the individual components of cardiac rehabilitation (i.e. lifestyle modifications, self-management, exercise, psychological interventions) [SoE: IV; SoR: B].

Results of the Consensus procedure during the Delphi process for producing the recommendations and overall view of recommendations are presented in Supplementary Digital Material 7 (Supplementary Table V and Supplementary Table VI).

Conclusions

Rehabilitation in cardiovascular conditions not only improves functioning, but also has significant effects on mortality as well as reduction in costs. The professional role of PRM physicians having expertise in the rehabilitation of cardiovascular conditions is to lead cardiac rehabilitation programs within the context of multiprofessional teams, working in collaboration with other disciplines in a variety of settings to reduce impairments in function, activity limitations, and participation restrictions associated with these conditions. PRM physicians are expected to make every effort to promote participation in and adherence to cardiac rehabilitation programs. It is recommended that PRM physicians follow available guidelines and evidence-based interventions when performing cardiac rehabilitation with careful attention to patient safety issues.

References

1. GBD 2015 Mortality and Causes of Death Collaborators. Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980-2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet* 2016;388:1459–544.
2. GBD 2015 Disease and Injury Incidence and Prevalence Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet* 2016;388:1545–602.

- August 2018

the American Heart Association, American College of Cardiology, and American Society of Hypertension. *J Am Soc Hypertens* 2015;9:453–98.

38. Schultz MG, Otahal P, Cleland VJ, Blizzard L, Marwick TH, Sharman JE. Exercise-induced hypertension, cardiovascular events, and mortality in patients undergoing exercise stress testing: a systematic review and meta-analysis. *Am J Hypertens* 2013;26:357–66.

39. Pescatello LS. Exercise and hypertension: recent advances in exercise prescription. *Curr Hypertens Rep* 2005;7:281–6.

40. Thompson PD, Arena R, Riebe D, Pescatello LS; American College of Sports Medicine. ACSM's new preparticipation health screening recommendations from ACSM's guidelines for exercise testing and prescription, ninth edition. *Curr Sports Med Rep* 2013;12:215–7.

41. Piepoli MF, Conraads V, Corrà U, Dickstein K, Francis DP, Jaarsma T, *et al.* Exercise training in heart failure: from theory to practice. A consensus document of the Heart Failure Association and the European Association for Cardiovascular Prevention and Rehabilitation. *Eur J Heart Fail* 2011;13:347–57.

42. Clark AM, Wiens KS, Banner D, Kryworuchko J, Thirsk L, McLean L, *et al.* A systematic review of the main mechanisms of heart failure disease management interventions. *Heart* 2016;102:707–11.

43. Spaling MA, Currie K, Strachan PH, Harkness K, Clark AM. Improving support for heart failure patients: a systematic review to understand patients' perspectives on self-care. *J Adv Nurs* 2015;71:2478–89.

44. Rajati F, Sadeghi M, Feizi A, Sharifirad G, Hasandokht T, Mostafavi F. Self-efficacy strategies to improve exercise in patients with heart failure: A systematic review. *ARYA Atheroscler* 2014;10:319–33.

45. Kane PM, Murtagh FE, Ryan K, Mahon NG, McAdam B, McQuillan R, *et al.* The gap between policy and practice: a systematic review of patient-centred care interventions in chronic heart failure. *Heart Fail Rev* 2015;20:673–87.

46. Tierney S, Mamas M, Woods S, Rutter MK, Gibson M, Neyses L, *et al.* What strategies are effective for exercise adherence in heart failure? A systematic review of controlled studies. *Heart Fail Rev* 2012;17:107–15.

47. Ulin K, Malm D, Nygårdh A. What is known about the benefits of patient-centered care in patients with heart failure. *Curr Heart Fail Rep* 2015;12:350–9.

48. Vedel I, Khanassov V. Transitional care for patients with congestive heart failure: a systematic review and meta-Analysis. *Ann Fam Med* 2015;13:562–71.

49. Ambrosetti M. Advances in exercise rehabilitation for patients with lower extremity peripheral artery disease. *Monaldi Arch Chest Dis* 2016;86:752.

50. Askew CD, Parmenter B, Leicht AS, Walker PJ, Golledge J. Exercise & Sports Science Australia (ESSA) position statement on exercise prescription for patients with peripheral arterial disease and intermittent claudication. *J Sci Med Sport* 2014;17:623–9.

51. Pascarella L, Shortell CK. Medical management of venous ulcers. *Semin Vasc Surg* 2015;28:21–8.

52. Hansen TB, Zwisler AD, Berg SK, Sibilitz KL, Thygesen LC, Kjellberg J, *et al.* Cost-utility analysis of cardiac rehabilitation after conventional heart valve surgery versus usual care. *Eur J Prev Cardiol* 2017;24:698–707.

53. Janaudis-Ferreira T, Mathur S, Konidis S, Tansey CM, Beaurepaire C. Outcomes in randomized controlled trials of exercise interventions in solid organ transplant. *World J Transplant* 2016;6:774–89.

54. Rosenbaum AN, Kremers WK, Schirger JA, Thomas RJ, Squires RW, Allison TG, *et al.* Association between early cardiac rehabilitation and long-term survival in cardiac transplant recipients. *Mayo Clin Proc* 2016;91:149–56.

55. Iliou MC, Blanchard JC, Lamar-Tanguy A, Cristofini P, Ledru F. Cardiac rehabilitation in patients with pacemakers and implantable cardioverter defibrillators. *Monaldi Arch Chest Dis* 2016;86:756.

56. Findikoglu G, Yildiz BS, Sanlialp M, Alihanoglu YI, Kilic ID, Evregul H, *et al.* Limitation of motion and shoulder disabilities in patients with cardiac implantable electronic devices. *Int J Rehabil Res* 2015;38:287–93.

57. Digby GC, Daubney ME, Baggs J, Campbell D, Simpson CS, Redfearn DP, *et al.* Physiotherapy and cardiac rhythm devices: a review of the current scope of practice. *Europace* 2009;11:850–9.

58. Cenik F, Schoberwalter D, Keilani M, Maehr B, Wolzt M, Marhold M, *et al.* Neuromuscular electrical stimulation of the thighs in cardiac patients with implantable cardioverter defibrillators. *Wien Klin Wochenschr* 2016;128:802–8.

59. Stucki G, Reinhardt JD, Grimby G. Organizing human functioning and rehabilitation research into distinct scientific fields. Part II: conceptual descriptions and domains for research. *J Rehabil Med* 2007;39:299–307.

Conflicts of interest.—The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

Acknowledgements.—The authors wish to acknowledge other members of the UEMS PRM Section Professional Practice Committee* and other delegates/experts** involved in Delphi procedure for their very valuable comments on this paper: C. Kiekens*, E. Ilieva*, K. Sekelj-Kauzlaric*, J.J. Glaesener*, B. Hansen*, A. Nikitina*, A. Delarque*, C.A. Rapidi*, G. Fazekas*, A. Giustini*, D. Wever*, J. Kujawa*, F. Antunes*, D. Khasanova*, G. Aleshin*, G. Ivanova*, K. Stibrant Sunnerhagen*, K. Grabljevec*, G. Devecerski*, I. Petronic Markovic*, A. Küçükdeveci*, R. Singh*, V. Golyk*, M.G. Ceravolo**.

Article first published online: May 2, 2018. - Manuscript accepted: April 27, 2018. - Manuscript received: April 8, 2018.

For supplementary materials, please see the online version of this article at www.minervamedica.it

SUPPLEMENTARY DIGITAL MATERIAL 1

Systematic Literature Search

For the systematic review of the literature, the main inclusion criterion was the relevance of the article with the PRM profession according to the judgment of two authors (A.O. & P.Te). The literature search for the identification of studies relevant to ‘persons with cardiovascular conditions’ was conducted using the search terms/strings in the databases including Pubmed/MEDLINE and the Cochrane library. The search was run between the dates January 31st, 2016 and January 31st, 2017. Language was restricted to English and some other European languages covered by the searched databases. Cochrane reviews (CRs), systematic reviews (SRs) and/or meta-analyses (MAs), randomized controlled trials (RCTs), and guidelines were our priority in the systematic literature search. Search in the cited references for articles relevant to the topic in the retrieved articles was also made. General statements/reports/position papers on the subject by major relevant international bodies (the UEMS PRM Section and others) were also considered.

Search strings

PUBMED/MEDLINE:

Pubmed: (“Cardio*” OR “cardiac” OR “vascular”) AND rehabilit* ((Guideline[ptyp] OR Meta-Analysis[ptyp] OR Randomized Controlled Trial[ptyp] OR systematic[sb])) (String 1) and PubMed Clinical Queries/Systematic reviews: Cardiovascular rehabilitation AND (coronary heart disease OR heart failure OR hypertension OR Peripheral artery disease OR Venous insufficiency OR atrial fibrillation OR Heart valve surgery OR Heart transplantation OR Implantable cardioverter defibrillators) (String 2)

Cochrane Library:

[http://onlinelibrary.wiley.com/cochranelibrary/search/mesh?searchRow.searchCriteria.meshTerm=Hear+Diseases&searchMesh=Lookup&searchRow.ordinal=0&hiddenFields.strategySortBy=last-modified-date%3Bdesc&hiddenFields.showStrategies=false&hiddenFields.containerId= &hiddenFields.etag=&hiddenFields.originalContainerId= \(String 1\),](http://onlinelibrary.wiley.com/cochranelibrary/search/mesh?searchRow.searchCriteria.meshTerm=Hear+Diseases&searchMesh=Lookup&searchRow.ordinal=0&hiddenFields.strategySortBy=last-modified-date%3Bdesc&hiddenFields.showStrategies=false&hiddenFields.containerId= &hiddenFields.etag=&hiddenFields.originalContainerId= (String 1),)

[http://onlinelibrary.wiley.com/cochranelibrary/search/mesh?searchRow.searchCriteria.meshTerm=Hypertension&searchMesh=Lookup&searchRow.ordinal=0&hiddenFields.strategySortBy=last-modified-date%3Bdesc&hiddenFields.showStrategies=false&hiddenFields.containerId=&hiddenFields.etag=&hiddenFields.originalContainerId= \(String 2\)](http://onlinelibrary.wiley.com/cochranelibrary/search/mesh?searchRow.searchCriteria.meshTerm=Hypertension&searchMesh=Lookup&searchRow.ordinal=0&hiddenFields.strategySortBy=last-modified-date%3Bdesc&hiddenFields.showStrategies=false&hiddenFields.containerId=&hiddenFields.etag=&hiddenFields.originalContainerId= (String 2))

[http://onlinelibrary.wiley.com/cochranelibrary/search/mesh?searchRow.searchOptions.conceptId=D001157&searchRow.searchCriteria.meshTerm=Arterial%20Occlusive%20Diseases&meshTreeSelect=true&searchRow.ordinal=0&hiddenFields.strategySortBy=last-modified-date;desc&hiddenFields.showStrategies=\(String 3\) and](http://onlinelibrary.wiley.com/cochranelibrary/search/mesh?searchRow.searchOptions.conceptId=D001157&searchRow.searchCriteria.meshTerm=Arterial%20Occlusive%20Diseases&meshTreeSelect=true&searchRow.ordinal=0&hiddenFields.strategySortBy=last-modified-date;desc&hiddenFields.showStrategies=(String 3) and)

[http://onlinelibrary.wiley.com/cochranelibrary/search/mesh?searchRow.searchOptions.conceptId=D014689&searchRow.searchCriteria.meshTerm=Venous%20Insufficiency&meshTreeSelect=true&searchRow.ordinal=0&hiddenFields.strategySortBy=last-modified-date;desc&hiddenFields.showStrategies=\(String 4\)](http://onlinelibrary.wiley.com/cochranelibrary/search/mesh?searchRow.searchOptions.conceptId=D014689&searchRow.searchCriteria.meshTerm=Venous%20Insufficiency&meshTreeSelect=true&searchRow.ordinal=0&hiddenFields.strategySortBy=last-modified-date;desc&hiddenFields.showStrategies=(String 4))

Due to the tremendous number of CRs or SRs/MAs corresponding to the importance and very wide scope of the topic addressed in this EBPP, review selection for presenting evidence of effectiveness of PRM interventions for secondary prevention was as follows: For each specific subject a most recent CR and additionally a most recent SR/MA was selected considering the nature of CRs being updated regularly with the addition of published appropriate articles since the last search date of the initial/previous CR and other SRs comprising of generally the same/similar articles depending on the methodology of the SR which vary. However, CRs or SRs providing evidence on different outcomes of

the same subject were also included in the SR part. Evidence from RCTs was included if a CR or SR was lacking on a specific subject, if a good quality RCT was not included among evaluated studies in CRs or SRs already cited in this EBPP, or if a subsequent RCT (published after the last search date for CRs or SRs) provided a differing evidence rather than adding to the previous evidence.

Paper identified through electronic search in PUBMED/MEDLINE (AO) #850 (string 1) and # 305 (String 2); Cochrane reviews from Cochrane Library # 225 for string 1 and # 97 for string 2; # 76 for string 3, # 13 for string 4 (Total # 411); Papers identified from cited references or position papers/general articles (AO) # 15 (Total # 1581)

Titles excluded because not relevant to PRM/topic or for other reasons (duplications, study/review protocols, older versions) (AO, PTe) # 339 (String 1), # 232 (String 2) (PUBMED); #201 (String 1), # 93 (String 2), #73 (String 3), # 11(String 4)(Cochrane Library)
Total excluded: # 949

Abstracts reviewed # 511(string 1) and # 73 (String 2), (Pubmed); #24 (string 1) and # 4 (string 2), #3 (String 3), # 2(String 4) (Cochrane Library); From cited ref./other papers # 15 Total # 632

Abstract excluded because not relevant to PRM or for other reasons (Cochrane reviews published in other journals, replications, similar conclusions) #356 (String 1), # 42 (String 2) (PUBMED); # 11 (String 1), # 2 (String 2) # 3 (String 3) (Cochrane Library)
None from position papers/general articles
Total excluded: # 414

Papers reviewed #153 (string 1) and # 31 (String 2) (Pubmed); #15 (string 1), # 2 (string 2), # 2 (String 4) (Cochrane Library);
From cited ref./other papers # 15
Total # 218

Papers excluded because not relevant to PRM or for other reasons (RCT's already included in reviews, similar conclusions, our selection principles) # 63(String 1), #16 (String 2) (PUBMED); # 3 (String 1), (Cochrane Library)
None from position papers/general articles
Total excluded: # 82

Papers considered to produce this EBPP#136
(61 providing evidence of effectiveness of rehabilitation/PRM interventions)

Supplementary Table I.—Cardiac rehabilitation exercise recommendations based on guidelines for people with coronary heart disease.

Guidelines/ FITT	EACPR, 2014 ¹	AACVPR, 2013 ²	ACRA, 2014 ³	JCS, 2012 ⁴
Exercise type	Aerobic endurance (AET) + Dynamic resistance training (DRT)	AET + DRT + Flexibility training (FT)	AET+DRT	AET
Frequency	3 sessions/week (6–7 better) for AET; 2 sessions/ week for DRT	3–5 sessions /week for AET; 2–3 sessions/ week for DRT and FT (not consecutively)	1-2sessions/week for AET; not specified for DRT	1–3 sessions/ week
Intensity	50–80% VO ₂ max; 50–80% HR peak; 40–60% HRR; 10–14 of RPE	40–80% VO ₂ peak or HR _{max} (as determined by max. exercise test); 11–16 of RPE for AET; To moderate fatigue (11–13 of RPE); From 50% 1RM and increasing to 60–70% 1RM for DRT; To a mild discomfort level for FT	Low- to moderate intensity for AET; as appropriate for DRT	40–60% VO ₂ peak; 40–60% HRR; 12–13 of RPE
Time/ Duration	≥ 20–30 min/session for AET; 10–15 repetitions/ set for DRT for 2–16 weeks	20–60 min./session for AET; 1–3 sets of 10–15 repetitions of 8–10 varying exercises for DRT; 3–5 repetitions/exercise of 30–90 sec. for FT with the duration ≤36 sessions	30–60 min/session for 3–12 weeks	15–60 min/session for 5 months
AACPR: American Association of Cardiovascular and Pulmonary Rehabilitation; ACRA: Australian Cardiovascular Health and Rehabilitation Association; Aerobic endurance training (AET) may include walking, jogging, treadmill, cycling, bicycle ergometer, stair climbing, stepping, swimming, dancing, rowing, elliptical trainer; CACR: Canadian Association of Cardiac Rehabilitation; Dynamic resistance training (DRT) may include circuit training with light weights and pulley exercises for upper extremities, machine weights, calisthenics; EACPR: European Association of Cardiovascular Prevention and Rehabilitation; FITT: Frequency, Intensity, Time, Type; Flexibility training (FT) may include static stretches, gymnastics exercises; HR: Heart rate; HRR: heart rate reserve; JCS: Japanese Circulation Society; RM: Repetition maximum; RPE: Rating of perceived exertion (Borg scale); Please see the ref. n. 11 (Price et al., 2016) in the main text, a paper comparing these guidelines in detail.				

References

1. Piepoli MF, Corrà U, Adamopoulos S, Benzer W, Bjarnason-Wehrens B, Cupples M. Secondary prevention in the clinical management of patients with cardiovascular diseases. Core components, standards and outcome measures for referral and delivery: a policy statement from the cardiac rehabilitation section of the European Association for Cardiovascular Prevention & Rehabilitation. Endorsed by the Committee for Practice Guidelines of the European Society of Cardiology. Eur J Prev Cardiol 2014; 21:664-81.
2. American Association of Cardiovascular and Pulmonary Rehabilitation. Guidelines for Cardiac Rehabilitation and Secondary Prevention Programs, 5th ed. Champaign, IL: Human Kinetics, 2013.
3. Woodruffe S, Neubeck L, Clark RA, Gray K, Ferry C, Finan J, et al. Australian Cardiovascular Health and Rehabilitation Association (ACRA) core components of cardiovascular disease secondary prevention and cardiac rehabilitation 2014. Heart Lung Circ 2015; 24: 430–41.
4. JCS Joint Working Group. Guidelines for rehabilitation in patients with cardiovascular disease (JCS 2012). Circ J 2014; 78:2022-93.

Supplementary Table II—Some country specific guidelines for cardiac rehabilitation.

Country	Guideline	Author, year
Austria	Austrian model of outpatient cardiac rehabilitation	Niebauer et al., 2013 ¹
Belgium	Position paper of the Belgian Working Group on Cardiovascular Prevention and Rehabilitation: cardiovascular rehabilitation	Dendale et al., 2008 ²
France	French Society of Cardiology guidelines for cardiac rehabilitation in adults	Pavy et al., 2012 ³
Germany	Cardiac rehabilitation in Germany Recommendations for resistance exercise in cardiac rehabilitation. Recommendations of the German Federation for Cardiovascular Prevention and Rehabilitation	Karoff et al., 2007 ⁴ Bjarnason-Wehrens et al., 2004 ⁵
Ireland	Cardiac Rehabilitation Guidelines 2013. Dublin: Irish Association of Cardiac Rehabilitation	McCreery et al., 2013 ⁶
The Netherlands	Exercise-based cardiac rehabilitation in patients with coronary heart disease: a practice guideline	Achtien et al., 2013 ⁷
UK	The BACPR Standards and Core Components for Cardiovascular Disease Prevention and Rehabilitation 2012	BACPR, 2012 ⁸
BACPR: British Association for Cardiovascular Prevention and Rehabilitation		

References

1. Niebauer J, Mayr K, Tschentscher M, Pokan R, Benzer W. Outpatient cardiac rehabilitation: the Austrian model. *Eur J Prev Cardiol* 2013; 20:468-79.
2. Dendale P, Dereppe H, De Sutter J, Laruelle C, Vaes J, Lamotte M, et al.; Working Group on Cardiovascular Prevention and Rehabilitation of the Belgian Society of Cardiology. Position paper of the Belgian Working Group on Cardiovascular Prevention and Rehabilitation: cardiovascular rehabilitation. *Acta Cardiol* 2008; 63:673-81.
3. Pavy B, Iliou MC, Vergès-Patois B, Brion R, Monpère C, Carré F, et al.; Exercise, Rehabilitation Sport Group (GERS); French Society of Cardiology. French Society of Cardiology guidelines for cardiac rehabilitation in adults. *Arch Cardiovasc Dis* 2012; 105:309-28.
4. Karoff M, Held K, Bjarnason-Wehrens B. Cardiac rehabilitation in Germany. *Eur J Cardiovasc Prev Rehabil* 2007; 14:18-27.
5. Bjarnason-Wehrens B, Mayer-Berger W, Meister ER, Baum K, Hambrecht R, Gielen S; German Federation for Cardiovascular Prevention and Rehabilitation. Recommendations for resistance exercise in cardiac rehabilitation. Recommendations of the German Federation for Cardiovascular Prevention and Rehabilitation. *Eur J Cardiovasc Prev Rehabil* 2004; 11:352-61.
6. McCreery C, Cradock K, Fallon N, Duffy R, Doherty VO, Kingston C. Cardiac Rehabilitation Guidelines 2013. Dublin: Irish Association of Cardiac Rehabilitation. [Internet] Available from: <http://www.iacr.info/about/guidelines/> [cited 2017 Jan 28]
7. Achtien RJ, Staal JB, van der Voort S, Kemps HM, Koers H, Jongert MW, et al.; Practice Recommendations Development Group. Exercise-based cardiac rehabilitation in patients with coronary heart disease: a practice guideline. *Neth Heart J* 2013; 21:429-38.
8. British Association for Cardiovascular Prevention and Rehabilitation. The BACPR Standards and Core Components for Cardiovascular Disease Prevention and Rehabilitation 2012. 2nd ed. London: British Cardiovascular Society. [Internet] Available from: http://www.bacpr.com/resources/46C_BACPR_Standards_and_Core_Components_2012.pdf [cited 2017 Jan 28]

SUPPLEMENTARY DIGITAL MATERIAL 5

Supplementary Table III.—Summary of the evidence for the effectiveness of PRM approaches/interventions in people with cardiovascular conditions.

Health condition	PRM approach	Evidence of effectiveness	Source	Author(s), year	LoE/SoE
CHD	Exercise-based cardiac rehab	Reduction in cardiovascular mortality and hospitalization risk as well as improvements in HRQoL.	CR	Anderson <i>et al.</i> , 2016 ¹	I/Low-mod.
CHD, heart failure, or revascularization	Home-based vs. centre-based cardiac rehab	Similar favorable outcomes regarding mortality, cardiac events, exercise capacity, modifiable risk factors such as total cholesterol, LDL, smoking status, SBP, and HRQoL outcomes with home- and centre-based cardiac rehab following low risk MI, heart failure, or revascularization in a period of follow-up of up to a year. Small differences between the two (with similar care costs) regarding HDL, triglycerides, and DBP in favor of centre-based cardiac rehab.	CR	Taylor <i>et al.</i> , 2015 ²	I/---
CHD	Home-based exercise/long term effects	Significant difference (albeit small) in exercise capacity favoring home-based rehab when compared with centre-based rehab (by a SMD of 0.25) in the long-term (over a year).	SR/MA	Claes <i>et al.</i> , 2016 ³	I/Limited
CHD, heart failure	Exercise-based cardiac rehab	Higher exercise capacity (VO ₂ max by 3.3 ml/kg.min) following exercise, higher intensity exercise accounting for the largest improvements in VO ₂ max.	MA	Uddin <i>et al.</i> , 2016 ⁴	I/---
CHD, CABGS	Sexual counselling	Conflicting evidence of efficacy, two reporting favorable effects and one reporting no difference when compared with controls based on 3 trials.	CR	Byrne <i>et al.</i> , 2016 ⁵	I/Very low
CHD	High intensity interval vs. moderate intensity continuous training	Ability of high intensity interval training to improve exercise capacity (VO ₂ max) significantly better (+1.78 mL/kg/min) than that of moderate intensity continuous training; the latter with better efficacy on decreasing resting heart rate (-1.8/min) and body weight (-0.48 kg). No significant differences between the two types regarding blood triglyceride, glucose, and HDL levels.	SR	Liou <i>et al.</i> , 2016 ⁶	I/Limited
CHD	Interval training vs. continuous exercise	Significantly more beneficial effects on VO ₂ max (by a WMD of 1.53 ml/kg/min) when compared with continuous exc. as well as on anaerobic threshold without any effect on SBP. No studies with very long-term follow-ups to assess mortality and/or morbidity.	MA	Elliott <i>et al.</i> , 2015 ⁷	I/---
CHD/Heart failure/COPD	Eccentric exercise	Similar effects in increasing mobility (walking) and muscle strength with lesser consumption of O ₂ and greater power when compared with concentric exercise	SR	Ellis <i>et al.</i> , 2015 ⁸	I/Limited

CHD	Resistance training	Significantly more favourable effects in improving VO ₂ max (by a WMD of 0.92 mL/kg/ min in the middle-aged; 0.70 mL/kg/ min in the old) and strength of muscles (by a SMD of 0.73 in middle-aged, 1.18 in the old for upper ext.; 0.65 in the middle-aged, 0.63 in the old for lower ext.) and also mobility (by a SMD of 0.61) compared with controls.	MA	Yamamoto <i>et al.</i> , 2016 ⁹	I/---
CHD	Resistance training	Significant Improvements in VO ₂ max (by a WMD of 0.61), max. work capacity (by a SMD of 0.38), and strength of muscles (by a SMD of 0.65) when combined with aerobic training in comparison to the latter alone. No difference in effectiveness as a single treatment when compared with aerobic training. Combined treatments of shorter duration with more beneficial effects on exercise capacity and strength; those with long duration with effects on only strength.	SR/MA	Xanthos <i>et al.</i> , 2017 ¹⁰	I/Moderate
CHD	Aerobic+ resistance training	Aerobic + resistance training with more beneficial effects in terms of body (by a WMD of 2.3%) and trunk fat (by a SMD of 0.56) decrease, fat free mass increase (by a WMD of 0.9kg), lower (SMD: 0.77) and upper body strength (SMD: 1.07) increase, and work capacity improvement and also with a trend of increase in VO ₂ (by a WMD of 0.41ml/ kg/min) compared with aerobic training alone without any reported serious adverse events	MA	Marzolini <i>et al.</i> , 2012 ¹¹	I/---
CHD	Tele-cardiac rehab	Significant increase on physical activity level when compared with usual care and centre-based CR; also more effective on adherence to exercise, LDL and DBP compared with centre-based rehab. Similar effects of both on exercise capacity and other CHD risk factors.	SR/MA	Rawstorn <i>et al.</i> , 2016 ¹²	I/---
CHD	Patient education	Potential favourable effects on HRQoL and costs of healthcare; weak evidence on reducing mortality (all-cause), cardiac morbidity, and admissions to hospital.	SR/MA	Brown <i>et al.</i> , 2013 ¹³	I/Weak-limited
CHD	Internet-based interventions	Potential (inconclusive) favourable effects on physical activity, nutrition, and HRQoL; no apparent evidence on CHD risk factors, cardiac events, or cost-efficacy (with promotion of a healthy life style and physical activity).	CR	Devi <i>et al.</i> , 2015 ¹⁴	I/Weak-limited
CVD/Type D personality	Cardiac rehab	Significant improvements in depression and anxiety, physical functioning, and HRQoL as preliminary evidence.	SR	Cao <i>et al.</i> , 2016 ¹⁵	I/Weak
CHD	Psychological interventions	Potential effectiveness on treatment of psychological conditions: depression (by a SMD of -0.21-small/moderate), anxiety (by a SMD of -0.25); moderate favourable effect on cardiac mortality (RR:0.80).	CR	Whalley <i>et al.</i> , 2011 ¹⁶	I/Weak
CHD/depression	Psychological interventions	Clinically significant (albeit small) favourable effects on depression (by SMDs ranging from -0.81 to 0.12) when compared with usual care. No favourable effects on cardiac events, hospital admissions,	CR	Baumeister <i>et al.</i> , 2011 ¹⁷	I/Limited

		HRQoL (apart from psychosocial dimension, and mortality based on one study for each outcome; no differences between different psychological interventions regarding outcomes.			
CHD/depression	Psychosocial interventions	Significant modest reduction in symptoms of depression (by a SMD of 0.15) and improvement in social support (by a SMD of 0.17); without any difference regarding anxiety, HRQoL, MI, revascularisation, or mortality.	SR/MA	Ski <i>et al.</i> , 2016 ¹⁸	I/Weak
CHD/anxiety	Music therapy	A small but consistent favorable effect on psychological distress with listening to music; a moderate but inconsistent efficacy on anxiety more apparent in those with MI and in those who selected music themselves; reduction in heart (by a MD of -3.40) and respiratory (by a MD of -2.50) rate, and SBP (by a MD of -5.52 mmHg); potential pain-reducing (with ≥ 2 sessions) and sleep quality improving effects.	CR	Bradt <i>et al.</i> , 2013 ¹⁹	I/Weak
Hypertension	Aerobic exercise	Significant effects on SBP (by a WMD of -4.06mmHg) and DBP (by a WMD of -2.77 mmHg) (24h), more prominent in those with BP $\geq 130/85$ mmHg.	MA	Sosner <i>et al.</i> , 2016 ²⁰	I/Fair
Hypertension	Walking	Favorable effects with walking at moderate-high intensity (intensity is important)	SR	Lee <i>et al.</i> , 2010 ²¹	I/Poor
Hypertension (various chronic dis.)	Nordic walking	Favorable effects on exercise capacity, VO ₂ max, BP, resting heart rate, and HRQoL; superior to walking.	SR	Tschentscher <i>et al.</i> , 2013 ²²	I/---
Hypertension	Resistance exercise	Decrease in SBP by -3.03 mmHg and in DBP by -2.10 mmHg	MA	MacDonald <i>et al.</i> , 2016 ²³	I/Fair to mod.
Hypertension	Isometric exercise	Reductions (as MD) SBP -5.20 mmHg, DBP -3.91 mmHg, MAP -3.33 mmHg. More reduction in MAP in males (-4.13 mmHg) than in females, in persons ≥ 45 years (-5.51 mmHg), in those with ≥ 8 weeks of isometric exercise (-4.22 mmHg), in hypertensives (-5.91 mmHg). Effects on other CHD risk factors unexplored.	SR/MA	Inder <i>et al.</i> , 2016 ²⁴	I/Good to moderate
Hypertension	High-intensity interval vs. moderate-intensity continuous training	Significant beneficial effects on vascular function (by a MD of 2.26%) (as measured by brachial artery flow-mediated dilation) when compared with moderate-intensity continuous training. Potential favorable effects also on CHD risk factors, aerobic capacity, inflammation, oxidative stress, and insulin sensitivity.	SR/MA	Ramos <i>et al.</i> , 2015 ²⁵	I/Limited
	Yoga	Very low-quality evidence for effects of yoga on SBP (-9.65 mmHg) and DBP (-7.22 mmHg) compared with usual care, with more prominent effects in hypertensives; Exercise is superior; More adverse events with yoga	SR/MA	Cramer <i>et al.</i> , 2014 ²⁶	I/Limited

	Tai chi	Reductions in SBP ranging from -22.0 mmHg to -11.5 mmHg in 6 RCTs. No difference in 2 RCTs; an increase in SBP (5.2 mmHg) in 1 RCT; Limited/inconclusive evidence.	CR	Hartley <i>et al.</i> , 2014 ²⁷	I/Limited
	Qigong	Significant reductions in SBP (-17.40mm) and DBP (-10.15 mmHg) when compared with controls; Exercise is superior; Non-significant reduction in SBP when compared with antihypertensives. More reduction with Qigong + antihypertensives in SBP (-11.99 mmHg) and DBP (-5.28 mmHg).	SR	Xiong <i>et al.</i> , 2015 ²⁸	I/Weak
	Baduanjin	Significant reductions in SBP (-13.00 mmHg) - DBP (-6.13 mmHg). No significant difference between antihypertensives. More reduction with Baduanjin + antihypertensives in SBP (-7.49 mmHg) - DBP (-3.55 mmHg).	SR/MA	Xiong <i>et al.</i> , 2015 ²⁹	I/Weak
Hypertension/diabetics	Exercise	A change in SBP of 2.42 mmHg, DBP of 2.23 mmHg, HDL of 0.04 mmol/L, and LDL of 0.16 mmol/L.	MA	Hayashino <i>et al.</i> , 2012 ³⁰	I/---
Hypertension	Relaxation therapies	Significant (albeit small) reductions in SBP (by a MD of -5.5 mmHg) and DBP (by a MD of -3.5 mmHg) when compared with controls. Not a significant SBP reducing effect in single-blinded (by a MD of -3.2 mmHg) or sham-controlled (by a MD of -3.5 mmHg) trials; conflicting evidence	CR	Dickinson <i>et al.</i> , 2008 ³¹	I/Weak
Heart failure	Exercise-based cardiac rehab	A tendency towards reduced mortality in exercise-based cardiac rehab studies with a follow-up exceeding a year (long-term). Reduced overall and disease specific hospitalization rates. Improvements in HRQoL. Potential cost-effectiveness of exercise-based cardiac rehab in relation to quality-adjusted life years and saved life-years, however, with additional costs for exercise training.	CR	Taylor <i>et al.</i> , 2014 ³²	I/---
Heart failure	Home- vs. centre-based cardiac rehab	Improvement in VO ₂ max (by a MD of 1.6 ml/kg/min) and HRQoL (MLHFQ) (by a MD of -3.3) with home-based cardiac rehab when compared with usual care. Similar outcomes with home-based and centre-based rehab regarding hospitalisation, mortality, or costs.	SR/MA	Zwisler <i>et al.</i> , 2016 ³³	I/---
Heart failure/normal ejection fraction	Exercise	Significant increase in VO ₂ max (by a MD of 2.08 mL/kg/min - 17% from baseline), heart rate max. (by a MD of 3.46 bpm), 6MWT (by a MD of 32.1 m) and HRQoL (by an MD of 11.38 in SF-36) when compared with controls.	SR/MA	Chan <i>et al.</i> , 2016 ³⁴	I/---
Heart failure	Exercise + inspiratory muscle training	Improvements in maximal inspiratory pressure (by a WMD of 20.89 cm H ₂ O) and HRQoL without any significant difference in VO ₂ max when compared to exercise alone.	SR/MA	Neto <i>et al.</i> , 2016 ³⁵	I/Fair
Heart failure	Comparison-exercise	A significant improvement in HRQoL with continuous endurance +strength training. Significant improvement in left ventricular end-	SR/MA	Cornelis <i>et al.</i> , 2016 ³⁶	I/---

	modalities	diastolic diameter and left ventricular ejection fraction in favor of Interval training when compared with continuous training. Favourable effects of any kind of exercise training on cardiac function, HRQoL, and prognosis.			
Heart failure	Aquatic exercise	Similar beneficial effects when compared with land-based exercise in terms of muscle strength, exercise capacity (VO ₂ peak), and HRQoL	SR/MA	Adsett <i>et al.</i> , 2015 ³⁷	I/Fair-good
Heart failure	Hydrotherapy	Improvements in exercise capacity when compared with sedentary controls	SR	Neto <i>et al.</i> , 2015 ³⁸	I/
Heart failure	Exercise/high-vigorous vs. moderate intensity	Significant improvements in total and physical scores of MLHFQ (by a MD of -8.24, and -2.89, respectively) at moderate to high/vigorous intensity. Significant reductions in MLWHF total score at high- (by a MD of -13.74) and vigorous-intensity (by a MD of -8.56), but not at moderate-intensity exercise. Significant improvements of -3.87 after aerobic and -9.82 after combination of aerobic and resistance exercise in total MLWHF score, but not after resistance exercise only. The higher the intensity, the greater the improvement.	SR/MA	Ostman <i>et al.</i> , 2016 ³⁹	I---
Heart failure/elderly	Exercise	Significant improvements in 6MWT (by 50.05 m) and generic HRQoL with no difference in VO ₂ max, disease-specific HRQoL, hospital admission, or mortality when compared with controls.	SR/MA	Chen <i>et al.</i> , 2013 ⁴⁰	I---
Heart failure	Resistance training	Significant improvement in VO ₂ max (by a MD of 1.43 ml/kg/min), HRQoL (by a MD of -8.31), 6MWT (by a MD of 13.49 m) with the combined and with resistance exc. alone VO ₂ max (by a MD of 3.99 ml/kg/min) and 6MWT (by a MD of 41.77 m) compared with controls, with unchanged outcomes in terms of left ventricular ejection fraction, resting BP, hospitalization, or mortality for both.	SR/MA	Jewiss <i>et al.</i> , 2016 ⁴¹	I---
Heart failure	Comparison: exercise vs. drug	Improvements with exercise in exercise capacity (VO ₂ max) (by a WMD of 2.283 ml/min/kg), 6MWT (by 30.275m), and MLHFQ (HRQoL) total score (by 8.974) when compared with usual care, but not with medications (VO ₂ max by a WMD of -0.393 ml/min/kg), 6MWT (by -9.463m), or MLHFQ (1.042) when compared with no medications/placebo.	MA	Fukuta <i>et al.</i> , 2016 ⁴²	I---
Heart failure	Exercise/autonomic function	Favourable effects on cardiac autonomic function with improvements in heart rate recovery at 2 min. following moderate intensity aerobic exercise and also on heart rate variability.	SR	Hsu <i>et al.</i> , 2015 ⁴³	I/Fair to good
Heart failure	Self-management	Favorable effects on time to and hospitalization alone related to disease, disease specific HRQoL (by a SMD of 0.15), hospital days in the elderly, and mortality of all causes. No effect on survival in those without depression; reduction in survival in those with depression and requires caution.	MA	Jonkman <i>et al.</i> , 2016 ⁴⁴	I---

Heart failure	Tai Chi	Significant improvements in HRQoL (by a WMD of -14.54), but not on SBP DBP, or VO ₂ max.	MA	Pan <i>et al.</i> , 2013 ⁴⁵	I/Insufficient
Heart failure	NMES	Improvement in VO ₂ max (by a SMD of 4.86 ml/kg/min), 6MWT (by a SMD of 63.54 m), strength of muscles (by a SMD of 30.74 N), endothelial function (by a SMD of 2.67%), symptoms of depression (by a SMD of - 3.86) and HRQoL when compared with those without exercise; No significant differences in VO ₂ max, 6MWT, or HRQoL when compared to those with exercise.	SR/MA	Gomes Neto <i>et al.</i> , 2016 ⁴⁶	I/---
Heart failure (also chronic respiratory disease and some other chronic diseases)	NMES	Significant quadriceps muscle strength improving effect (by a SMD of 0.53; ~1.1 kg)(based on low evidence) and muscle mass increase; improvements in 6MWT (by a MD of 35 m) when compared with the controls (based on very low to low evidence) without any serious adverse events, but with some muscle soreness (based on moderate evidence).	CR	Jones <i>et al.</i> , 2016 ⁴⁷	I/Very low-low-moderate
Heart failure	Acupuncture	Varying, inconsistent, conflicting results in studies: improvement in left ventricular ejection fraction by 9.95%; improvement in heart rate variability, exercise capacity, HRQoL; reduction in stay in intensive care and rehospitalisation risk; inconclusive evidence.	SR	Lee <i>et al.</i> , 2016 ⁴⁸	I/Limited
Heart failure/on ECMO	Physiotherapy	Early mobilization and ambulation safe and leading to autonomy at an acceptable level as preliminary evidence	SR	Polastri <i>et al.</i> , 2016 ⁴⁹	I/Limited
Atrial fibrillation	Exercise	Improvement in exercise capacity, ADL abilities and HRQoL with moderate-intensity physical activity; high-intensity physical activity may be risky	SR	Giacomantonio <i>et al.</i> , 2013 ⁵⁰	I/Limited
Atrial fibrillation	Exercise	Significant improvements in exercise capacity, strength of muscles, heart rate control, ADL, and/or HRQoL based on conflicting evidence.	SR	Reed <i>et al.</i> , 2013 ⁵¹	I/Conflicting
Pacemakers	Exercise	More favorable effects on exercise capacity and HRQoL added to those of the pacemaker.	RCT	Patwala <i>et al.</i> , 2009 ⁵²	II/---
Cardioverter defibrillators	Exercise-based cardiac rehab	Improvement in aerobic capacity safely, without increasing the risk of shocks; insufficient data of effects on HRQoL, or anxiety/depression.	SR	Isaksen <i>et al.</i> , 2012 ⁵³	I/Weak
CABG surgery	Exercise-based cardiac rehab	Reduction in mortality	SR/MA	Rauch <i>et al.</i> , 2016 ⁵⁴	I/Limited
Heart valve surgery	Exercise-based cardiac rehab	Potential exercise capacity improving effects (by a SMD of -0.47) when compared with no exercise based on moderate quality evidence based on two trials. Insufficient evidence on the effects on serious adverse events, mortality, or return-to-work; Lack of evidence on HRQoL, hemodynamic parameters, or cost.	CR	Sibiltz <i>et al.</i> , 2016 ⁵⁵	I/Insufficient to moderate
Cardiac	Preoperative	Significant reductions in the risk of pulmonary complications	CR	Hulzebos <i>et al.</i> ,	I/Limited

surgery/preop	physical therapy	(atelectasis, pneumonia) and duration of hospitalization after surgery with preoperative incentive spirometry, breathing and/or coughing exercises; respiratory muscle and/or; cardiorespiratory exercise training); no effects on pneumothorax, duration of mechanical ventilation, or mortality (all-cause); Possible beneficial effects on 6MWT or HRQoL.		2012 ⁵⁶	
Heart transplantation	Exercise	Significant improvements in VO ₂ max (by a MD of 2.34 ml/kg/min) and muscle strength (as measured by chest pres 1RM (by a SMD of 23.3 kg).	MA	Hsieh <i>et al.</i> , 2011 ⁵⁷	I/---
Heart transplantation	Exercise	Significant improvement in VO ₂ max (by a SMD of 0.77); no difference as to BP, lipids, or blood glucose control compared with usual care.	SR/MA	Didsbury <i>et al.</i> , 2013 ⁵⁸	I/Limited
Peripheral artery disease/intermittent claudication	Exercise/home- vs. hospital-based	Home-based exercise inferior to centre-based exercise regarding walking distance (max. and pain free), superior regarding walking capacity in daily life based on low quality of evidence. Similar HRQoL between the two.	SR	Bäck <i>et al.</i> , 2015 ⁵⁹	I/Low
Venous insufficiency	Exercise	Some evidence of symptom reducing efficacy, increases in half venous refilling time (by a MD of 4.20 sec) and total venous refilling time (by a MD of 9.40 sec.), however, insufficient evidence based on very low quality of evidence due to the high risk of bias of the studies.	CR	Araujo <i>et al.</i> , 2016 ⁶⁰	I/Weak
Venous ulcers	Compression treatments	Unclear evidence on self-management programmes or education on healing or adherence	CR	Weller <i>et al.</i> , 2016 ⁶¹	I/Low
---: strength of evidence not indicated or not clear in the review; CHD: Coronary heart disease; CABGS: Coronary artery bypass surgery; COPD: Chronic obstructive pulmonary disease; CR: Cochrane review; DBP: Diastolic blood pressure; ECMO: Extracorporeal membrane oxygenation; HRQoL: Health-related quality of life MA: Meta-analysis; MD: Mean difference; MLHFQ: Minnesota Living with Heart Failure Questionnaire; 6MWT: Six-Minute Walk Test; mod.: moderate; NMES: neuromuscular electrical stimulation; SBP: Systolic blood pressure; SMD: Standardized mean difference; SR: Systematic review; SGRQ: St. George's Respiratory Questionnaire; WMD: Weighted mean difference					

References

1. Anderson L, Thompson DR, Oldridge N, Zwisler AD, Rees K, Martin N, *et al.* Exercise-based cardiac rehabilitation for coronary heart disease. Cochrane Database Syst Rev 2016; 1:CD001800.
2. Taylor RS, Dalal H, Jolly K, Zawada A, Dean SG, Cowie A, *et al.* Home-based versus centre-based cardiac rehabilitation. Cochrane Database Syst Rev 2015; 8:CD007130.
3. Claes J, Buys R, Budts W, Smart N, Cornelissen VA. Longer-term effects of home-based exercise interventions on exercise capacity and physical activity in coronary artery disease patients: A systematic review and meta-analysis. Eur J Prev Cardiol. 2017; 24:244-56.

4. Uddin J, Zwisler AD, Lewinter C, Moniruzzaman M, Lund K, Tang LH, *et al.* Predictors of exercise capacity following exercise-based rehabilitation in patients with coronary heart disease and heart failure: A meta-regression analysis. *Eur J Prev Cardiol* 2016; 23:683-93.
5. Byrne M, Doherty S, Fridlund BG, Mårtensson J, Steinke EE, Jaarsma T, *et al.* Sexual counselling for sexual problems in patients with cardiovascular disease. *Cochrane Database Syst Rev* 2016; 2:CD010988.
6. Liou K, Ho S, Fildes J, Ooi SY. High intensity interval versus moderate intensity continuous training in patients with coronary artery disease: A meta-analysis of physiological and clinical parameters. *Heart Lung Circ* 2016; 25:166-74.
7. Elliott AD, Rajopadhyaya K, Bentley DJ, Beltrame JF, Aromataris EC. Interval training versus continuous exercise in patients with coronary artery disease: a meta-analysis. *Heart Lung Circ* 2015; 24:149-57.
8. Ellis R, Shields N, Lim K, Dodd KJ. Eccentric exercise in adults with cardiorespiratory disease: a systematic review. *Clin Rehabil* 2015; 29:1178-97.
9. Yamamoto S, Hotta K, Ota E, Mori R, Matsunaga A. Effects of resistance training on muscle strength, exercise capacity, and mobility in middle-aged and elderly patients with coronary artery disease: A meta-analysis. *J Cardiol* 2016; 68:125-34.
10. Xanthos PD, Gordon BA, Kingsley MI. Implementing resistance training in the rehabilitation of coronary heart disease: A systematic review and meta-analysis. *Int J Cardiol* 2017; 230:493-508.
11. Marzolini S, Oh PI, Brooks D. Effect of combined aerobic and resistance training versus aerobic training alone in individuals with coronary artery disease: a meta-analysis. *Eur J Prev Cardiol* 2012; 19:81-94.
12. Rawstorn JC, Gant N, Direito A, Beckmann C, Maddison R. Telehealth exercise-based cardiac rehabilitation: a systematic review and meta-analysis. *Heart* 2016; 102:1183-92.
13. Brown JP, Clark AM, Dalal H, Welch K, Taylor RS. Effect of patient education in the management of coronary heart disease: a systematic review and meta-analysis of randomized controlled trials. *Eur J Prev Cardiol* 2013; 20:701-14.
14. Devi R, Singh SJ, Powell J, Fulton EA, Igbinedion E, Rees K. Internet-based interventions for the secondary prevention of coronary heart disease. *Cochrane Database Syst Rev* 2015; 12:CD009386.
15. Cao X, Wong EM, Chow Choi K, Cheng L, Ying Chair S. Interventions for cardiovascular patients with type D personality: A systematic review. *Worldviews Evid Based Nurs* 2016; 13:314-23.
16. Whalley B, Rees K, Davies P, Bennett P, Ebrahim S, Liu Z, West R, Moxham T, Thompson DR, Taylor RS. Psychological interventions for coronary heart disease. *Cochrane Database Syst Rev* 2011; 8:CD002902.
17. Baumeister H, Hutter N, Bengel J. Psychological and pharmacological interventions for depression in patients with coronary artery disease. *Cochrane Database Syst Rev* 2011; 9:CD008012.
18. Ski CF, Jelinek M, Jackson AC, Murphy BM, Thompson DR. Psychosocial interventions for patients with coronary heart disease and depression: A systematic review and meta-analysis. *Eur J Cardiovasc Nurs* 2016; 15:305-16.
19. Bradt J, Dileo C, Potvin N. Music for stress and anxiety reduction in coronary heart disease patients. *Cochrane Database Syst Rev* 2013; 12:CD006577.
20. Sosner P, Guiraud T, Gremeaux V, Arvisais D, Herpin D, Bosquet L. The ambulatory hypotensive effect of aerobic training: a reappraisal through a meta-analysis of selected moderators. *Scand J Med Sci Sports* 2017; 27:327-41.

21. Lee LL, Watson MC, Mulvaney CA, Tsai CC, Lo SF. The effect of walking intervention on blood pressure control: a systematic review. *Int J Nurs Stud* 2010; 47:1545-61.
22. Tschentscher M, Niederseer D, Niebauer J. Health benefits of Nordic walking: a systematic review. *Am J Prev Med* 2013; 44:76-84.
23. MacDonald HV, Johnson BT, Huedo-Medina TB, Livingston J, Forsyth KC, Kraemer WJ, *et al.* Dynamic resistance training as stand-alone antihypertensive lifestyle therapy: A meta-analysis. *J Am Heart Assoc.* 2016 Sep 28; 5(10). pii: e003231. doi: 10.1161/JAHA.116.003231.
24. Inder JD, Carlson DJ, Dieberg G, McFarlane JR, Hess NC, Smart NA. Isometric exercise training for blood pressure management: a systematic review and meta-analysis to optimize benefit. *Hypertens Res* 2016; 39:88-94.
25. Ramos JS, Dalleck LC, Tjonna AE, Beetham KS, Coombes JS. The impact of high-intensity interval training versus moderate-intensity continuous training on vascular function: a systematic review and meta-analysis. *Sports Med* 2015; 45:679-92.
26. Cramer H, Haller H, Lauche R, Steckhan N, Michalsen A, Dobos G. A systematic review and meta-analysis of yoga for hypertension. *Am J Hypertens* 2014; 27:1146-51.
27. Hartley L, Flowers N, Lee MS, Ernst E, Rees K. Tai chi for primary prevention of cardiovascular disease. *Cochrane Database Syst Rev.* 2014 Apr 9; 4:CD010366.
28. Xiong X, Wang P, Li X, Zhang Y. Qigong for hypertension: a systematic review. *Medicine (Baltimore)* 2015; 94:e352.
29. Xiong X, Wang P, Li S, Zhang Y, Li X. Effect of Baduanjin exercise for hypertension: A systematic review and meta-analysis of randomized controlled trials. *Maturitas* 2015; 80:370-8.
30. Hayashino Y, Jackson JL, Fukumori N, Nakamura F, Fukuhara S. Effects of supervised exercise on lipid profiles and blood pressure control in people with type 2 diabetes mellitus: a meta-analysis of randomized controlled trials. *Diabetes Res Clin Pract* 2012; 98:349-60.
31. Dickinson HO, Campbell F, Beyer FR, Nicolson DJ, Cook JV, Ford GA, *et al.* Relaxation therapies for the management of primary hypertension in adults. *Cochrane Database Syst Rev* 2008; 1:CD004935.
32. Taylor RS, Sagar VA, Davies EJ, Briscoe S, Coats AJ, Dalal H, *et al.* Exercise-based rehabilitation for heart failure. *Cochrane Database Syst Rev* 2014; 4:CD003331.
33. Zwisler AD, Norton RJ, Dean SG, Dalal H, Tang LH, Wingham J, *et al.* Home-based cardiac rehabilitation for people with heart failure: A systematic review and meta-analysis. *Int J Cardiol* 2016; 221:963-9.
34. Chan E, Giallauria F, Vigorito C, Smart NA. Exercise training in heart failure patients with preserved ejection fraction: a systematic review and meta-analysis. *Monaldi Arch Chest Dis* 2016; 86:759.
35. Neto MG, Martinez BP, Conceição CS, Silva PE, Carvalho VO. Combined exercise and inspiratory muscle training in patients with heart failure: a systematic review and meta-analysis. *J Cardiopulm Rehabil Prev* 2016; 36:395-401.
36. Cornelis J, Beckers P, Taeymans J, Vrints C, Vissers D. Comparing exercise training modalities in heart failure: A systematic review and meta-analysis. *Int J Cardiol* 2016; 221:867-76.
37. Adsett JA, Mudge AM, Morris N, Kuys S, Paratz JD. Aquatic exercise training and stable heart failure: A systematic review and meta-analysis. *Int J Cardiol.* 2015; 186:22-8.

38. Neto MG, Conceição CS, de Jesus FL, Oliveira Carvalho V. Hydrotherapy on exercise capacity, muscle strength and quality of life in patients with heart failure: A meta-analysis. *Int J Cardiol* 2015;198:216-9.
39. Ostman C, Jewiss D, Smart NA. The effect of exercise training intensity on quality of life in heart failure patients: A systematic review and meta-analysis. *Cardiology* 2017; 136:79-89.
40. Chen YM, Li Y. Safety and efficacy of exercise training in elderly heart failure patients: a systematic review and meta-analysis. *Int J Clin Pract* 2013; 67:1192-8.
41. Jewiss D, Ostman C, Smart NA. The effect of resistance training on clinical outcomes in heart failure: A systematic review and meta-analysis. *Int J Cardiol* 2016; 221:674-81.
42. Fukuta H, Goto T, Wakami K, Ohte N. Effects of drug and exercise intervention on functional capacity and quality of life in heart failure with preserved ejection fraction: A meta-analysis of randomized controlled trials. *Eur J Prev Cardiol* 2016; 23:78-85.
43. Hsu CY, Hsieh PL, Hsiao SF, Chien MY. Effects of exercise training on autonomic function in chronic heart failure: systematic review. *Biomed Res Int* 2015; 2015:591708.
44. Jonkman NH, Westland H, Groenwold RH, Ågren S, Atienza F, Blue L, *et al.* Do self-management interventions work in patients with heart failure? An individual patient data meta-analysis. *Circulation* 2016; 133:1189-98.
45. Pan L, Yan J, Guo Y, Yan J. Effects of Tai Chi training on exercise capacity and quality of life in patients with chronic heart failure: a meta-analysis. *Eur J Heart Fail* 2013; 15:316-23.
46. Gomes Neto M, Oliveira FA, Reis HF, de Sousa Rodrigues- E Jr, Bittencourt HS, Oliveira Carvalho V. Effects of neuromuscular electrical stimulation on physiologic and functional measurements in patients with heart failure: A systematic review with meta-analysis. *J Cardiopulm Rehabil Prev* 2016; 36:157-66.
47. Jones S, Man WD, Gao W, Higginson IJ, Wilcock A, Maddocks M. Neuromuscular electrical stimulation for muscle weakness in adults with advanced disease. *Cochrane Database Syst Rev* 2016; 10:CD009419.
48. Lee H, Kim TH, Leem J. Acupuncture for heart failure: A systematic review of clinical studies. *Int J Cardiol* 2016; 222:321-31.
49. Polastri M, Loforte A, Dell'Amore A, Nava S. Physiotherapy for patients on awake extracorporeal membrane oxygenation: A systematic review. *Physiother Res Int* 2016; 21:203-209.
50. Giacomantonio NB, Bredin SS, Foulds HJ, Warburton DE. A systematic review of the health benefits of exercise rehabilitation in persons living with atrial fibrillation. *Can J Cardiol* 2013; 29:483-91.
51. Reed JL, Mark AE, Reid RD, Pipe AL. The effects of chronic exercise training in individuals with permanent atrial fibrillation: a systematic review. *Can J Cardiol* 2013; 29:1721-8.
52. Patwala AY, Woods PR, Sharp L, Goldspink DF, Tan LB, Wright DJ. Maximizing patient benefit from cardiac resynchronization therapy with the addition of structured exercise training: a randomized controlled study. *J Am Coll Cardiol* 2009; 53:2332-9.
53. Isaksen K, Morken IM, Munk PS, Larsen AI. Exercise training and cardiac rehabilitation in patients with implantable cardioverter defibrillators: a review of current literature focusing on safety, effects of exercise training, and the psychological impact of programme participation. *Eur J Prev Cardiol* 2012; 19:804-12.
54. Rauch B, Davos CH, Doherty P, Saure D, Metzendorf MI, Salzwedel A, *et al.*; 'Cardiac Rehabilitation Section', European Association of Preventive Cardiology (EAPC), in cooperation with the Institute of Medical Biometry and Informatics (IMBI), Department of Medical Biometry, University of Heidelberg, and the Cochrane Metabolic and Endocrine Disorders Group, Institute of

General Practice, Heinrich-Heine University, Düsseldorf, Germany.. The prognostic effect of cardiac rehabilitation in the era of acute revascularisation and statin therapy: A systematic review and meta-analysis of randomized and non-randomized studies - The Cardiac Rehabilitation Outcome Study (CROS). *Eur J Prev Cardiol* 2016; 23:1914-39.

55. Sibilitz KL, Berg SK, Tang LH, Risom SS, Gluud C, Lindschou J, *et al.* Exercise-based cardiac rehabilitation for adults after heart valve surgery. *Cochrane Database Syst Rev*. 2016; 3:CD010876.

56. Hulzebos EH, Smit Y, Helders PP, van Meeteren NL. Preoperative physical therapy for elective cardiac surgery patients. *Cochrane Database Syst Rev* 2012; 11:CD010118.

57. Hsieh PL, Wu YT, Chao WJ. Effects of exercise training in heart transplant recipients: a meta-analysis. *Cardiology* 2011; 120:27-35.

58. Didsbury M, McGee RG, Tong A, Craig JC, Chapman JR, Chadban S, Wong G. Exercise training in solid organ transplant recipients: a systematic review and meta-analysis. *Transplantation* 2013; 95:679-87.

59. Bäck M, Jivegård L, Johansson A, Nordanstig J, Svanberg T, Adania UW, *et al.* Home-based supervised exercise versus hospital-based supervised exercise or unsupervised walk advice as treatment for intermittent claudication: a systematic review. *J Rehabil Med* 2015; 47:801-8.

60. Araujo DN, Ribeiro CT, Maciel AC, Bruno SS, Fregonezi GA, Dias FA. Physical exercise for the treatment of non-ulcerated chronic venous insufficiency. *Cochrane Database Syst Rev* 2016; 12:CD010637.

61. Weller CD, Buchbinder R, Johnston RV. Interventions for helping people adhere to compression treatments for venous leg ulceration. *Cochrane Database Syst* 2016; 3:CD008378.

SUPPLEMENTARY DIGITAL MATERIAL 6

Supplementary Table IV.—Exercise recommendations based on guidelines for people with hypertension.

Guidelines/ FITT	ESH/ESC, 2013¹	AHA, 2013²	CHEP, 2014³	JNC 8, 2014⁴
Exercise type	Aerobic exercise + Dynamic resistance training	Aerobic exercise + Dynamic resistance training	Aerobic exercise +Dynamic, Isometric, or Handgrip resistance training	Aerobic exercise
Frequency	5-7 days/week	Most days/week	4-7 days/week	3-4 sessions/ w for ≥ 12 weeks
Intensity	Moderate	Moderate to high, >40%-60% of maximum	Moderate	Moderate to Vigorous
Time/Duration	≥ 30 min/day; Dynamic RT 2-3 days/week	150 minutes/ week +Dynamic RT	30-60 min/d + Dynamic, Isometric, or Handgrip RT	40 min/session
Outcome/ reductions	2-3 mmHg; 5-7 mmHg in hypertensives	-----	-----	1-5 mmHg
AHA: American Heart Association; CHP: Canadian Hypertension Education Program; ESC: European Society of Cardiology; ESH: European Society of Hypertension; FITT: Frequency, Intensity, Time, Type; JNC 8: Eighth Joint National Committee; Aerobic exercise training protocols including walking, jogging, calisthenics, bicycle ergometer, treadmill, stair climbing, swimming....; Dynamic resistance training protocols including weights, resistance training machines, dynabands; Isometric exercise training protocols including 4 sets of 2-min handgrip, leg contractions sustained at 20–50 % of maximal voluntary contraction with a rest period of 1–4 min between each set. Please also see ref. n. 36 (Pescatello et al., 2015) in the main text, a paper which compares these guidelines in detail.				

References

1. Mancia G, Fagard R, Narkiewicz K, Redon J, Zanchetti A, Böhm M, et al. 2013 ESH/ESC 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). *Eur Heart J* 2013; 34:2159-219.
2. Brook RD, Appel LJ, Rubenfire M, Ogedegbe G, Bisognano JD, Elliott WJ, et al.; American Heart Association Professional Education Committee of the Council for High Blood Pressure Research, Council on Cardiovascular and Stroke Nursing, Council on Epidemiology and Prevention, and Council on Nutrition, Physical Activity. Beyond medications and diet: alternative approaches to lowering blood pressure: a scientific statement from the American Heart Association. *Hypertension* 2013; 61:1360-83.
3. Dasgupta K, Quinn RR, Zarnke KB, Rabi DM, Ravani P, Daskalopoulou SS, et al.; Canadian Hypertension Education Program. The 2014 Canadian Hypertension Education Program recommendations for blood pressure measurement, diagnosis, assessment of risk, prevention, and treatment of hypertension. *Can J Cardiol* 2014; 30:485-501.
4. James PA, Oparil S, Carter BL, Cushman WC, Dennison-Himmelfarb C, Handler J, et al. 2014 evidence-based guideline for the management of high blood pressure in adults: report from the panel members appointed to the Eighth Joint National Committee (JNC 8). *JAMA* 2014; 311:507-20.

SUPPLEMENTARY DIGITAL MATERIAL 7

Supplementary Table V.—Results of the Consensus procedure.

Round		Number of recommendations	Accept as it is	Accept with suggestions	Reject
1	1 st vote	29	93.4%	6.3%	0.3%
	2 nd vote	29+1=30	93.6%	6.1%	0.3%
2		30	99.4%	0.6%	0
3		30	100%	0	0
4		30	99.4%	0	0.6%
5		30	100%	0	0

Supplementary Table VI.—Overall view of the recommendations.

Content	Number of recommendations	Strength of recommendations				Strength of evidence			
	Number	A	B	C	D	I	II	III	IV
Overall recommendation	1	100%	0	0	0	0	0	0	100%
PRM physicians' role in Medical Diagnosis according to ICD	1	100%	0	0	0	0	0	0	100%
PRM physicians' role in PRM diagnosis according to ICF	3	90.91%	9.09%	0	0	0	0	0	100%
PRM physicians' role in PRM assessment according to ICF	4	59.09%	40.91%	0	0	0	0	0	100%
Recommendations on PRM management and process	19	77.51%	22.01%	0.48%	0	0	0	0	100%
Recommendations on future research on PRM professional practice	2	54.55%	45.45%	0	0	0	0	0	100%
TOTAL	30	76.37%	23.33%	0.30%	0	0	0	0	100%