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2026 ESC Guidelines on cardiac rehabilitation

Developed by the task force on cardiac rehabilitation of the European Society of Cardiology (ESC)

Endorsed by the European Society of Physical and Rehabilitation Medicine (ESPRM) and World Organization of Family Doctors (WONCA)

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Keywords Guidelines • Recommendations • Cardiac rehabilitation • Prevention • Heart disease • Patient-centred care • Shared decision-making • Risk factor management • Exercise training • Mental functioning • Physical functioning • Quality of life • Healthy ageing • Telemedicine

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Abbreviations and acronyms

1RM	One-repetition maximum
10RM	10-repetition maximum
6MWD	6-minute walking distance
6MWT	6-minute walk test
ACHD	Adult congenital heart disease
ACP	Advance care planning
ACS	Acute coronary syndrome
AF	Atrial fibrillation
AI	Artificial intelligence
ALCAPA	Anomalous left coronary artery from the pulmonary artery
ARCAPA	Anomalous right coronary artery from the pulmonary artery
BAV	Bicuspid aortic valve
BMI	Body mass index
BP	Blood pressure
b.p.m.	Beats per minute
CABG	Coronary artery bypass graft
CAD	Coronary artery disease
CBT	Cognitive behavioural therapy
CCS	Chronic coronary syndromes
CDI-SF	Cardiac distress inventory short form
CES-D	Center for Epidemiological Studies Depression Scale
CHD	Coronary heart disease
CI	Confidence interval
CID	Chronic inflammatory diseases
CIED	Cardiac implantable electronic device
CKD	Chronic kidney disease
COM-B	Capability, opportunity, and motivation model of behaviour change
COPD	Chronic obstructive pulmonary disease
CopenHeartRFA	Copenhagen Heart radiofrequency ablation (trial)
CORE	Cardio-oncology rehabilitation
COVID-19	Coronavirus disease
CPET	Cardiopulmonary exercise testing
CR	Cardiac rehabilitation
CRT	Cardiac resynchronization therapy
CRT-D/P	Cardiac resynchronization therapy and defibrillator/pacemaker
CTR	Cardiac telerehabilitation
CTRCD	Cancer treatment-related cardiovascular dysfunction
CTR-CVT	Cancer therapy-related cardiovascular toxicity
CV	Cardiovascular
CVD	Cardiovascular disease
EACH	European Alliance for Cardiovascular Health
EAPC	European Association of Preventive Cardiology
EASO	European Association for the Study of Obesity
ECG	Electrocardiogram
EHRA	European Heart Rhythm Association
ESC	European Society of Cardiology
ESPEN	European Society for Clinical Nutrition and Metabolism
EURASPIRE V	European Action on Secondary and Primary Prevention through Intervention to Reduce Events
EXPERT	Exercise Prescription in Everyday Practice and Rehabilitative Training (tool)
FITT-VP	Frequency, intensity, time, type, volume, and progression
GAD-7	Generalized Anxiety Disorder Assessment
GLP-1 RA	Glucagon-like peptide receptor agonist
HADS	Hospital Anxiety and Depression Scale
HbA1c	Glycated haemoglobin
HDL-C	High-density lipoprotein cholesterol
HF	Heart failure
HFA-ICOS	Heart Failure Association and the International Cardio-Oncology Society
HFpEF	Heart failure with preserved ejection fraction
HFrEF	Heart failure with reduced ejection fraction
HIIT	High-intensity interval training
HI-RT	High-intensity resistance training
HR	Hazard ratio
HRpeak	Peak heart rate
HRQoL	Health-related quality of life
HRrest	Resting heart rate
HRR	Heart rate reserve
HRT	Hormone replacement therapy

HTx	Heart transplantation
ICD	Implantable cardioverter defibrillator
ICF	International Classification of Functioning, Disability and Health
ICM	Implantable cardiac monitor
INOCA	Ischaemia with non-obstructive coronary arteries
KCCQ	Kansas City Cardiomyopathy Questionnaire
LAD	Left anterior descending artery
LDL-C	Low-density lipoprotein cholesterol
LMCA	Left main coronary artery
LV	Left ventricular
LVAD	Left ventricular assist device
MACE	Major adverse cardiovascular event
MCID	Minimal clinically important difference
MD	Mean difference
MET	Metabolic equivalent
mHealth	Mobile health
MI	Myocardial infarction
MINOCA	Myocardial infarction with non-obstructive coronary arteries
MLHFQ	Minnesota Living with Heart Failure Questionnaire
MNA	Mini Nutritional Assessment
MNA-SF	Mini Nutritional Assessment Short-Form
MONITOR-HF	Remote haemodynamic monitoring of pulmonary artery pressures in patients with chronic heart failure (trial)
NYHA	New York Heart Association
OMNI-RES	OMNI Resistance Exertion Scale
OR	Odds ratio
OSAS	Obstructive sleep apnoea syndrome
PAD	Peripheral arterial disease
PCI	Percutaneous coronary intervention
PHQ	Patient Health Questionnaire
PRE	Patient-reported experience
PREM	Patient-reported experience measure
PRO	Patient-reported outcome
PROM	Patient-reported outcome measure
QALY	Quality-adjusted life year
RCA	Right coronary artery
RCT	Randomized controlled trial
REBOOT	Treatment with Beta-Blockers after Myocardial Infarction without Reduced Ejection Fraction (trial)
REHAB-HF	Rehabilitation Therapy in Older Acute Heart Failure Patients (trial)
RPE	Rating of perceived exertion
RR	Relative risk
SAE	Serious adverse event
SARC-F	Strength, Assistance with walking, Rise from a chair, Climb stairs, and Falls (questionnaire)
SAVR	Surgical aortic valve replacement
SCAD	Spontaneous coronary artery dissection
SCORE	Systematic COronary Risk Evaluation
SCORE2	Systematic COronary Risk Evaluation2
SCORE2-OP	Systematic COronary Risk Evaluation2-Older Persons
SELECT	Semaglutide Effects on Heart Disease and Stroke in Patients With Overweight or Obesity (trial)
SMS	Short message service
SPPB	Short Physical Performance Battery
SSRI	Selective serotonin reuptake inhibitor
STEEER-AF	Stroke prevention and rhythm control therapy: evaluation of an educational programme of the ESC in a cluster-randomised trial in patients with atrial fibrillation
STRONG-H-F	Safety, Tolerability and Efficacy of Rapid Optimization, Helped by NT-proBNP Testing, of Heart Failure Therapies (trial)
TAVI	Transcatheter aortic valve implantation
VE	Ventilation
VO_2	Oxygen uptake
VO_2peak	Peak oxygen uptake
VT 1/2	Ventilatory threshold 1/2
W	Watt
WHO	World Health Organization
WHO-FC	World Health Organization Functional Classification
Wpeak	Cycling power output

1. Preamble

Guidelines evaluate and summarize available evidence with the aim of assisting health professionals in proposing the best diagnostic or therapeutic approach for an individual patient with a given condition. ESC Guidelines are intended for use by health professionals but do not override their individual responsibility to make appropriate and accurate decisions in consideration of each patient's health condition and in consultation with the patient or the patient's caregiver where appropriate and/or necessary. It is also the health professional's responsibility to verify the rules and regulations applicable in each country to drugs and devices at the time of prescription and to respect the ethical rules of their profession.

ESC Guidelines represent the official position of the ESC on a given topic. Guideline topics are selected for updating after annual expert review of new evidence conducted by the ESC Clinical Practice Guidelines (CPG) Committee. ESC Policies and Procedures for formulating and issuing ESC Guidelines can be found on the ESC website (https://www.escardio.org/Guidelines/Clinical-Practice-Guidelines/Guidelines-development/Writing-ESC-Guidelines).

This Task Force was selected by the ESC to include professionals involved with the medical care of patients with this pathology and to include patient representatives and methodologists. The selection procedure included an open call for authors and aimed to include members from across the entire ESC region and from relevant ESC Subspecialty Communities. Consideration was given to diversity and inclusion.

Guidelines Task Forces perform a critical review and evaluation of the published literature on diagnostic and therapeutic approaches including assessment of the risk–benefit ratio. Recommendations are based on major randomized trials and relevant systematic reviews and meta-analyses, when available. Systematic literature searches are conducted in cases of controversy or uncertainty to ensure that all key studies are considered. For recommendations related to diagnosis and prognosis, additional types of evidence are included, such as diagnostic accuracy studies and studies focused on the development and validation of prognostic models. The strength of each recommendation and the level of evidence supporting it are weighed and scored according to predefined criteria. The criteria for grading the strength of recommendations are described in *Table 1*. A new system for grading levels of evidence for ESC Guidelines has been published[1,2] and utilized for the first time in the 2026 ESC Guidelines. For therapy and prevention, the framework includes consideration of study type and the number of studies supporting a recommendation, as well as whether a study is adequately powered, shows substantial evidence against the play of chance, and is free of major sources of bias. This is described in *Table 2*. A separate grading system has also been developed for diagnostic tests and prediction models, which is described in *Table 3*.

Patient-reported outcome measures (PROMs) and patient-reported experience measures (PREMs) are also evaluated when available as the basis for recommendations and/or discussion in these guidelines.

Evidence tables summarizing key information from relevant studies are generated to facilitate the formulation of recommendations, to enhance comprehension of recommendations after publication, and to reinforce transparency in the guidelines development process. The tables are published in their own section of the ESC Guidelines and reference specific recommendation tables.

After an iterative process of deliberations, a first Task Force vote on all recommendations is conducted prior to the initiation of rounds of review. A second Task Force vote on all recommendations is conducted after the final round of review and revision. For each vote, the Task Force follows ESC voting procedures: to achieve quorum, at least two-thirds of the Task Force must vote agree or disagree, and to be approved all recommendations require at least 75% of votes in favour, excluding abstentions. Restrictions on voting and on participation in Task Force deliberations are applied as needed based on declarations of interest.

The writing and reviewing panels provide declaration of interest forms for all relationships that might be perceived as real or potential sources of conflicts of interest. Their declarations of interest are reviewed according to the ESC declaration of interest rules which can be found on the ESC website (http://www.escardio.org/doi) and are compiled in a report published in a supplementary document with the guidelines. Funding for the development of ESC Guidelines is derived entirely from the ESC with no involvement of the healthcare industry.

The CPG Committee supervises and co-ordinates the preparation of new guidelines and approves their publication. In addition to review by the CPG Committee, the ESC Guidelines undergo multiple rounds of double-blind peer review on a dedicated online review platform. The review is conducted by a panel of 70 or more topic experts including members from ESC National Cardiac Societies and from relevant ESC Subspecialty Communities. Reviewers critically assess and comment on the content of the guidelines and grade their comments as major and minor. Guideline Task Forces consider all review comments and are required to respond on the online platform to all those classified as major. The review comments inform revisions after each round. After the final review round and the second Task Force vote on all recommendations, the Task Force and the CPG Committee members approve the final document for publication in the *European Heart Journal*.

Unless otherwise stated, ESC Guidelines content refers to sex, understood as the biological condition of being male or female, defined by genes, hormones, and sexual organs. Off-label use of medication may be presented in this guideline if a sufficient level of evidence shows that it can be considered medically appropriate for a given condition. However, decisions on off-label use must be made by the responsible health professional giving special consideration to ethical rules concerning healthcare, the specific situation of the patient, patient consent, and country-specific health regulations.

Table 1 **Classes of recommendations**

Class of recommendation	Definition	Wording to use
I	Evidence and/or general agreement that a given treatment or procedure is beneficial, useful, effective.	*"is recommended"* or *"is indicated"*
II	Conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of the given treatment or procedure.	
IIa	Weight of evidence/opinion is in favour of usefulness/efficacy.	*"should be considered"*
IIb	Usefulness/efficacy is less well established by evidence/opinion.	*"may be considered"*
III	Evidence or general agreement that the given treatment or procedure is not useful/effective, and in some cases may be harmful.	*"is not recommended"*

Table 2 Levels of evidence—therapy and prevention

Level of evidence	Definition
A	Conclusive evidence, usually from at least two adequately powered randomized controlled trials[a] free of major bias, with substantial evidence against the play of chance when combined in a meta-analysis (e.g., P <0.005 for superiority).[b]
B1	Suggestive evidence from at least one adequately powered randomized controlled trial free of major bias, or a meta-analysis of such randomized controlled trials, with some evidence against the play of chance (e.g., P <0.05 for superiority).[c]
B2	Limited evidence from at least two adequately powered non-randomized studies with careful control of major sources of bias and substantial evidence against the play of chance (e.g., P <0.005 for superiority),[b] or from a meta-analysis of small, underpowered randomized controlled trials with some evidence against the play of chance (e.g., P <0.05 for superiority).[c]
C	Preliminary evidence from non-randomized studies without careful control of major sources of bias, a single small, underpowered randomized controlled trial, or expert consensus.

[a]Exceptionally, level of evidence A can be considered if: (i) there is a single very large randomized controlled trial that provides convincing evidence across a wide range of patients that is already widely accepted by most practitioners; or (ii) the effects of the intervention are clinically obvious; in either case, over 90% of voting guideline task force members need to agree with level of evidence A.
[b]Studies do not need to individually show substantial evidence against the play of chance (e.g. a P-value of P < .005 for superiority) if a meta-analysis of these studies provides such evidence.
[c]Studies do not need to individually show some evidence against the play of chance (e.g. a P-value of <. 05 for superiority) if a meta-analysis of these studies provides such evidence.

Table 3 Levels of evidence—diagnostic tests and prediction models

Level of evidence	Diagnostic test	Prediction model (including diagnostic and prognostic models)
A	Conclusive evidence of adequate diagnostic ability from at least two high-quality studies	Conclusive evidence of adequate predictive ability from at least one high-quality derivation study, and two or more external validation studies of at least moderate quality.
B	Suggestive evidence of adequate diagnostic ability from a single high-quality or at least two moderate-quality studies.	Suggestive evidence of adequate predictive ability from one or more derivation and one or more external validation studies of at least moderate quality.
C	Preliminary evidence of adequate diagnostic ability from a single moderate-quality study, any number of low-quality studies, or expert consensus.	Preliminary evidence of adequate predictive ability from a derivation study of at least moderate quality, but with external validation absent or in a low-quality study, or a derivation study of low quality (irrespective of external validation).

2. Introduction

2.1. Seeking solutions for the challenges of demographic transition

Cardiovascular disease (CVD) and cancer are the leading causes of death and disability in Europe. More than 60 million potential years of life are lost to CVD in Europe annually.[3] Advances in therapies for prevention and treatment have contributed to a substantial decline in both cardiovascular and cancer mortality.[4,5] Consequently, societies are ageing and the proportion of individuals living with chronic conditions is rapidly growing in most regions of Europe, putting a major burden on healthcare systems. Preventing disease onset, progression, and functional decline, as well as promoting well-being and health equity, are major challenges in modern medicine.[6]

Rehabilitation is a multimodal, patient-centred, collaborative process[7] that has been shown to improve health outcomes and prognosis in patients with a broad spectrum of chronic conditions, including CVD and cancer.[8,9] Against this backdrop, the World Health Organization (WHO) has positioned rehabilitation as being key for health in the 21st century and an essential part of universal health coverage services.[10] The WHO's 'Rehabilitation 2030: A Call for Action' aims to increase the global profile and integration of rehabilitation, including cardiovascular rehabilitation, into healthcare systems.[11]

The European Alliance for Cardiovascular Health (EACH) has emphasized the critical role of cardiac rehabilitation (CR) in improving cardiovascular health outcomes across Europe.[12] Cardiac rehabilitation has become a cornerstone in the holistic management for patients with CVDs, and is an emerging intervention in patients with cancer during or after cardiotoxic treatments.[13] The European Society of Cardiology (ESC) Guidelines recommend CR to optimally implement preventive measures, and to improve physical and mental functioning, health-related quality of life (HRQoL), and various other health outcomes as well as clinical outcomes.[14–18] The ESC has accordingly integrated competencies in CR management into its core curricula and identified CR as a quality indicator for the optimal management of cardiovascular conditions such as acute coronary syndrome (ACS).[19–22]

As a core health service, CR should be integrated across all levels of care, beginning with pre-surgical rehabilitation (prehabilitation, Phase 0), acute hospital-based rehabilitation (Phase I), continuing through centre- or home-based post-acute rehabilitation (Phase II), and extending into long-term care and health promotion (Phase III). From the patient's perspective, however, these phases are not isolated; rather, they represent interconnected stages along a continuous journey of care within the context of chronic disease management (*Figure 1*).[23,24] Supervised CR programmes are typically delivered during Phase II, serving as a structured secondary prevention strategy.[25]

Despite well-documented recommendations and proven benefits, CR availability and delivery in Europe remains highly fragmented, with significant under-use, especially among women and elderly people. Moreover, due to country-specific reimbursement policies in Europe, ∼40% of CR programmes lack financial support from social security systems, resulting in some patients needing to partially or fully cover programme costs themselves, while others are unable to participate at all.[26–28]

Digital technologies and telehealth enable alternative forms of CR delivery such as cardiac telerehabilitation (CTR), which helps to address many of the challenges related to traditional centre-based CR.[29,30] Moreover, actionable solutions to overcome system-, clinician-, programme-, and patient-level barriers to CR access in low- and middle-income countries are available.[31,32]

In this dynamic and rapidly evolving field, the release of the *2026 ESC Guidelines on cardiac rehabilitation*, the first ESC Guidelines on cardiac rehabilitation, is a timely initiative, complementing the existing recommendations in contemporary ESC Guidelines and other ESC scientific documents.

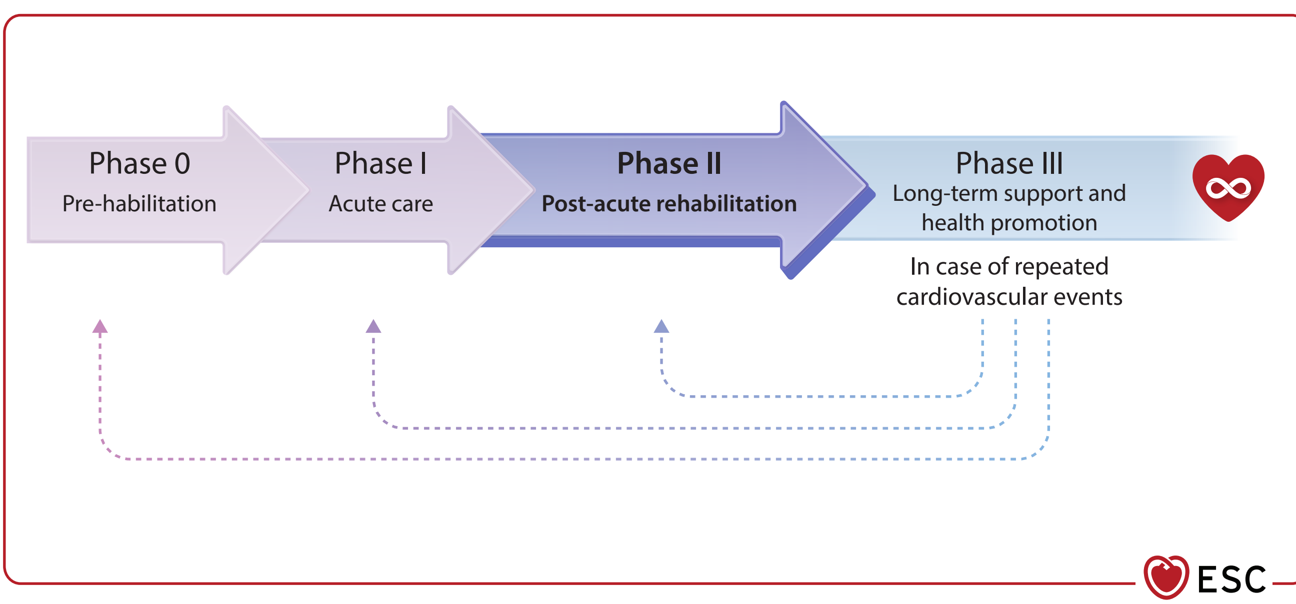

Figure 1 Phases of cardiac rehabilitation across the continuum of care.

2.2. Scope and purpose

The purpose of this document is to provide comprehensive guidance on the indications for CR and the management of patients in Phase II CR programmes. It covers key aspects such as infrastructure requirements, staff composition, core components, delivery methods, care goal setting, and outcome assessments. The recommendations apply to adults with cardiac diseases, and patients with cancer undergoing or recovering from cardiotoxic therapies, with or without the common comorbidities outlined in *Section 5*. In order to maintain focus and coherence, patients with stroke or vascular diseases, such as aortic aneurysms or peripheral arterial disease (PAD), are out of scope for this document. Cardiovascular rehabilitation and exercise training in these populations have been addressed in the *2024 ESC Guidelines for the management of peripheral arterial and aortic disease*[33] and the *2024 European Society for Vascular Surgery (ESVS) clinical practice guidelines on the management of asymptomatic lower limb peripheral arterial disease and intermittent claudication.*[34]

These Guidelines address the following key questions:

- Which patient populations benefit from participating in CR programmes?
- Which healthcare professionals and core components should be included in CR programmes?
- What are the most effective modes for delivering CR?
- Which outcomes are most meaningful for assessing CR effectiveness, setting care goals with patients, and assuring CR programme quality?
- Which interventions can improve patient enrolment and adherence in CR?
- What are the key gaps in the scientific evidence for CR?

By addressing these questions, these Guidelines aim to enhance CR implementation and reimbursement across Europe and improve the long-term management of patients with cardiac conditions. This, in turn, seeks to optimize a patient's prognosis, functioning, quality of life, and social inclusion. Furthermore, the Guidelines strive to promote health equity and reduce healthcare costs by supporting the delivery of effective, accessible, and standardized CR services (see *Figure 2*). Accordingly, the evidence in these Guidelines should be used to advocate for CR at a health system and policy level.

2.3. Stakeholder involvement

These Guidelines have been developed by a collaborative team comprising members of the ESC Patient Forum, ESC associations, working groups, councils, and external experts. The team reflects the diverse, multidisciplinary, and interprofessional groups

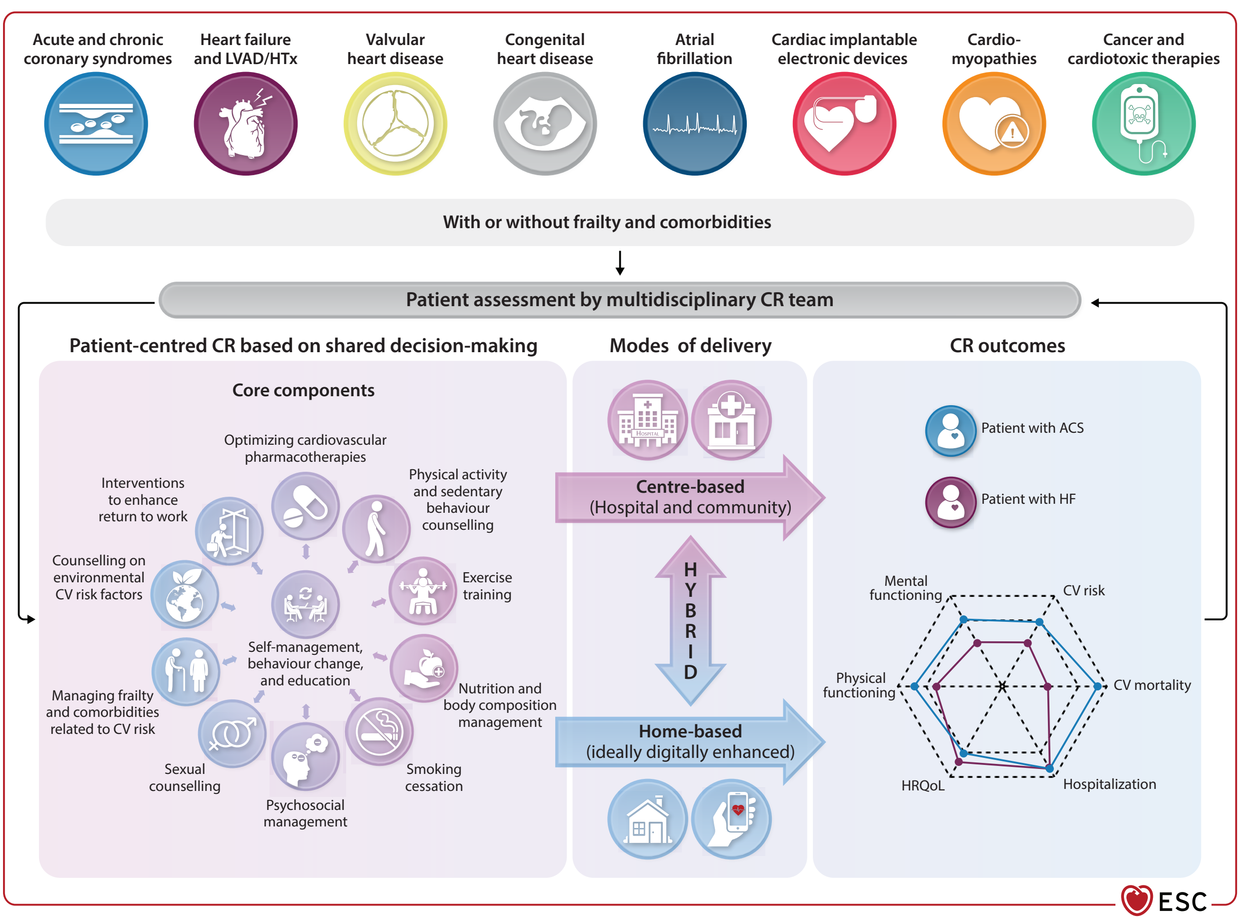

Figure 2 Central illustration. See online animated version. ACS, acute coronary syndrome; CR, cardiac rehabilitation; CV, cardiovascular; HF, heart failure; HRQoL, health-related quality of life; HTx, heart transplantation; LVAD, left ventricular assist device.

involved in the referral to CR, its delivery, and post-rehabilitation management.

The Guidelines are primarily intended for members of the multidisciplinary CR team. These include cardiologists, physician specialists in physical and rehabilitation medicine, psychiatrists, CVD nurse specialists, exercise specialists (e.g. physiotherapists, sports scientists, or exercise physiologists), nutrition specialists (e.g. dietitians or nutritionists), psychologists, and social workers. In addition, they address referring cardiovascular healthcare professionals [e.g. interventional cardiologists, cardiac surgeons, heart failure (HF) and adult congenital heart disease (ACHD) specialists, electrophysiologists, cardiac physiologists, and cardio-oncologists], as well as physician specialists in physical and rehabilitation medicine, primary care physicians, internal medicine physicians, geriatricians, neurologists, clinical pharmacologists, social workers, patients and their families, healthcare administrators, and policymakers.

To ensure the Guidelines reflect the perspectives of the target population, two patient representatives with cardiac conditions from the ESC Patient Forum were included in the Task Force. Their expectations, values, preferences, and experiences were actively incorporated throughout the guideline development process via regular discussions and participation in voting procedures. Additionally, they contributed directly to drafting the manuscript and provided their perspectives on CR and long-term management following CR in two dedicated sections. Their involvement aimed to ensure that the recommendations are meaningful, patient-centred, and reflect real-world needs.

3. Patients' perspectives on cardiac rehabilitation

Cardiac rehabilitation is a key component of recovery and health optimization for individuals with acute or chronic cardiac conditions. Its effectiveness depends not only on the physical and psychosocial components of rehabilitation but also on understanding and addressing patients' perspectives, needs, and expectations. Tailoring CR programmes to reflect these individual priorities enhances satisfaction and supports sustainable, long-term health outcomes. This section explores two critical aspects of patient-centred CR: patient satisfaction and patient-reported outcomes (PROs).

3.1. Patient satisfaction and expectations of cardiac rehabilitation programme components

Patient satisfaction in CR depends on how well the programme aligns with the patient's personal goals, emotional needs, and expectations. A major challenge reported by patients is a lack of knowledge about their condition and what to expect during and after rehabilitation. Education plays a vital role in building confidence, with clear communication about the nature of their cardiac condition, the purpose of rehabilitation, and the long-term benefits of participation. Ensuring patients understand the purpose and benefits of CR can improve willingness to participate.

Many patients seek functional independence, the ability to resume daily activities, and a return to pre-disease or pre-event routines. Achieving these goals through collaborative goal setting with healthcare providers ensures that patients feel their CR to be relevant and motivating (*Figure 3*).

Individualized care is a crucial factor in patient satisfaction. Integrating rehabilitation into real-world tasks, such as lifting groceries or climbing stairs, makes the programme more relatable and practical. Cardiac rehabilitation programmes must consider the diversity of patients' needs, including differences in age, sex, comorbidities, occupation, and mobility.[35] For instance, patients with physically demanding jobs will require a different rehabilitation strategy than those with sedentary lifestyles. Furthermore, understanding the heterogeneity of cardiovascular conditions is vital. Patients recovering from heart transplants face challenges distinct from those recovering from, e.g. coronary artery disease (CAD) or those living with lifelong cardiac conditions. Effective rehabilitation must reflect the unique disease trajectory of each condition. Stratification, though often difficult to implement due to practical constraints, ensures that care is relevant, and that patients feel their circumstances are fully understood.

A common source of dissatisfaction is the uncertainty patients experience regarding what to expect during CR and what their recovery journey will involve. Without clear information, patients may feel anxious, depressed, and disengaged.[36] Educating patients about their condition, CR goals, and the long-term benefit of CR is key to building confidence and empowering patients. This includes addressing the patient's emotional needs and psychological challenges. From the patient's perspective, the period following a cardiac event is often characterized by a loss of trust in their bodies, feelings of guilt about past behaviours (such as smoking or diet), and fear of recurrence. Providing psychological support through tailored counselling and peer-support groups, and addressing emotional vulnerability can help rebuild trust, alleviate guilt, increase motivation, and be mindset changing. Psychosocial interventions will be further covered in *Section 7.8* of these guidelines.

3.2. Patient-reported outcome measures

Patient-reported outcomes describe perspectives of health and well-being as directly reported by the patient. These outcomes refer to symptoms, functional status, health-related and overall quality of life, all of which can be generic or disease specific. They can also be domain specific, such as health behaviours including self-management and adherence. Patient-reported experiences (PREs) with care, however, include relationships with healthcare providers (relational) and satisfaction with care facilities (functional).

The outcomes are measured using patient-reported outcome measures (PROMs) and patient-reported experience measures (PREMs).

Use of PREMs in CR settings are closely linked to quality indicators (see *Section 6*).[37] Assessment using PREMs is feasible for local centres in order to monitor and facilitate quality improvement. In order to avoid bias, it is particularly important that data are not gathered by healthcare professionals involved in the care of the patient.

There are three types of PROMs: generic, disease specific, and domain specific. Generic PROMs allow for comparison with other disease groups or with the general population. For example, in populations with HF, generic measures have been shown to be less responsive.[38] Conversely,

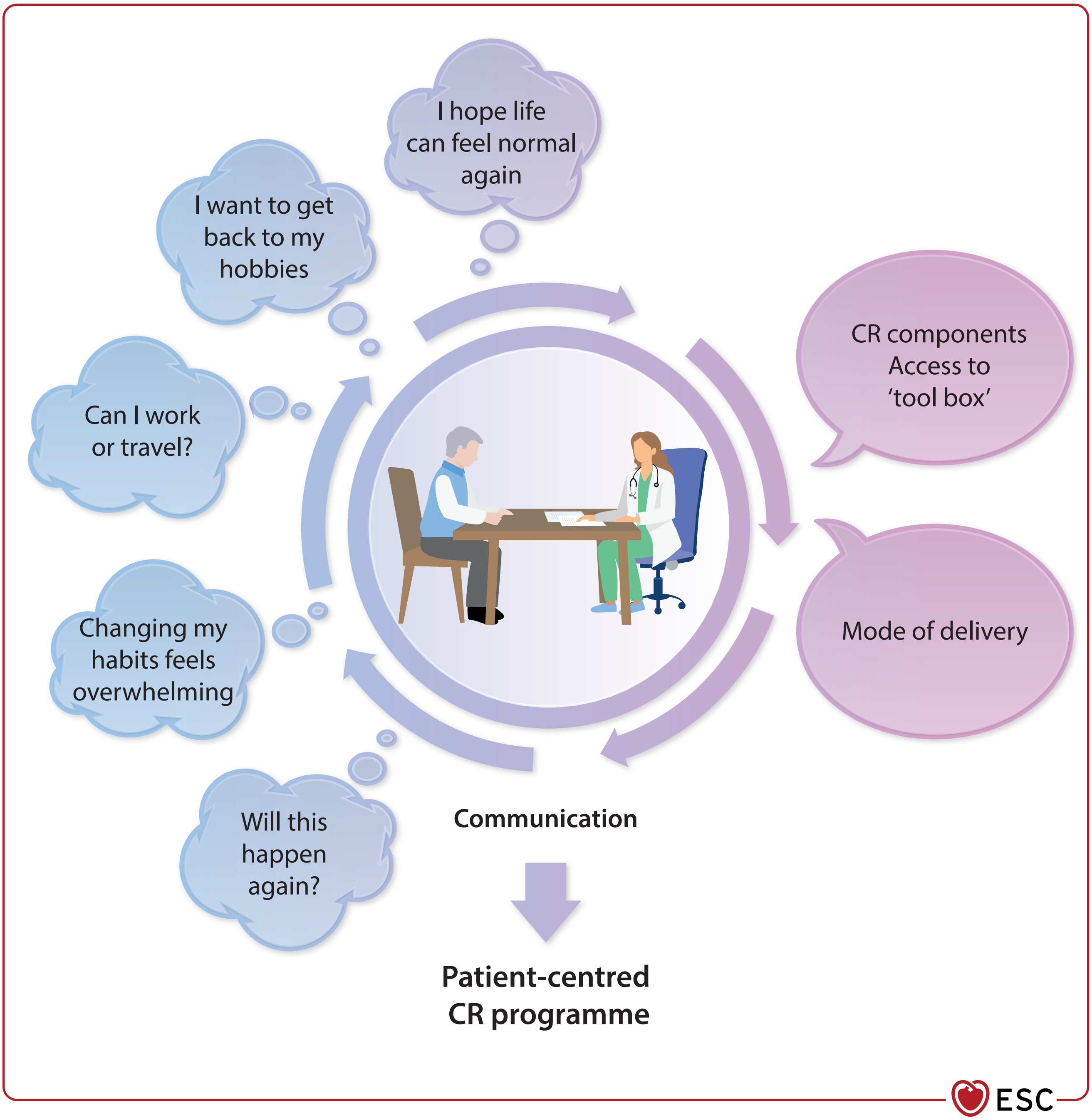

Figure 3 Aligning cardiac rehabilitation programmes with patients' goals, needs, and expectations through communication and collaborative goal setting. CR, cardiac rehabilitation.

disease-specific PROMs are more sensitive to clinical manifestations of the disease and may also be perceived as more relevant by the patient.

Patient-reported outcomes are shown to be independent predictors of both mortality[39] and readmission[40] across cardiac diagnoses. Therefore, PROs can contribute to informing the selection and use of therapeutic interventions. In order to ensure the patient's voice is heard, PROs should be used in all clinical research studies. Integrating PROs into comprehensive efficacy evaluations can ultimately improve the quality of care for patients.[41] As an example, a systematic review reported the under use of PROMs in randomized controlled trials (RCTs) of cardiac catheter ablation, a field in which quality of life is a core treatment goal. Including PROMs would also generate a more meaningful comparison between treatments.[42]

Patient-reported outcomes can be used in disease monitoring and in evaluating treatment outcomes. Patients' expert knowledge on the effect of treatment is pivotal when tailoring optimal care. Patients may experience different treatment benefits or side effects. To set goals for CR and promote adherence (see *Section 7.2*), it is important to include patients in clinical decision-making, which can be done systematically using PROs. A systematic review of the routine use of PROMs in clinical care showed better symptom control and HRQoL,[43] and combined evidence supports the use of PROMs to improve communication and decision-making in clinical practice.[44] A good example is an e-PROM system of routine administration of PROMs to patients with CAD giving summarized information of results to their care providers. The system supports patient-centred communication during the clinical encounter.[45] PROMs need to be carefully implemented as a practical tool in clinical practice and not a burden.[46] Patient acceptability of PROMs in a CR setting has, however, shown to be high with a strong willingness to engage with PROMs.[47]

Importantly, PROs used in clinical practice or research should be combined with clinical outcomes. The goal of optimal CR is to improve both clinical outcomes and PROs (*Figure 4*).

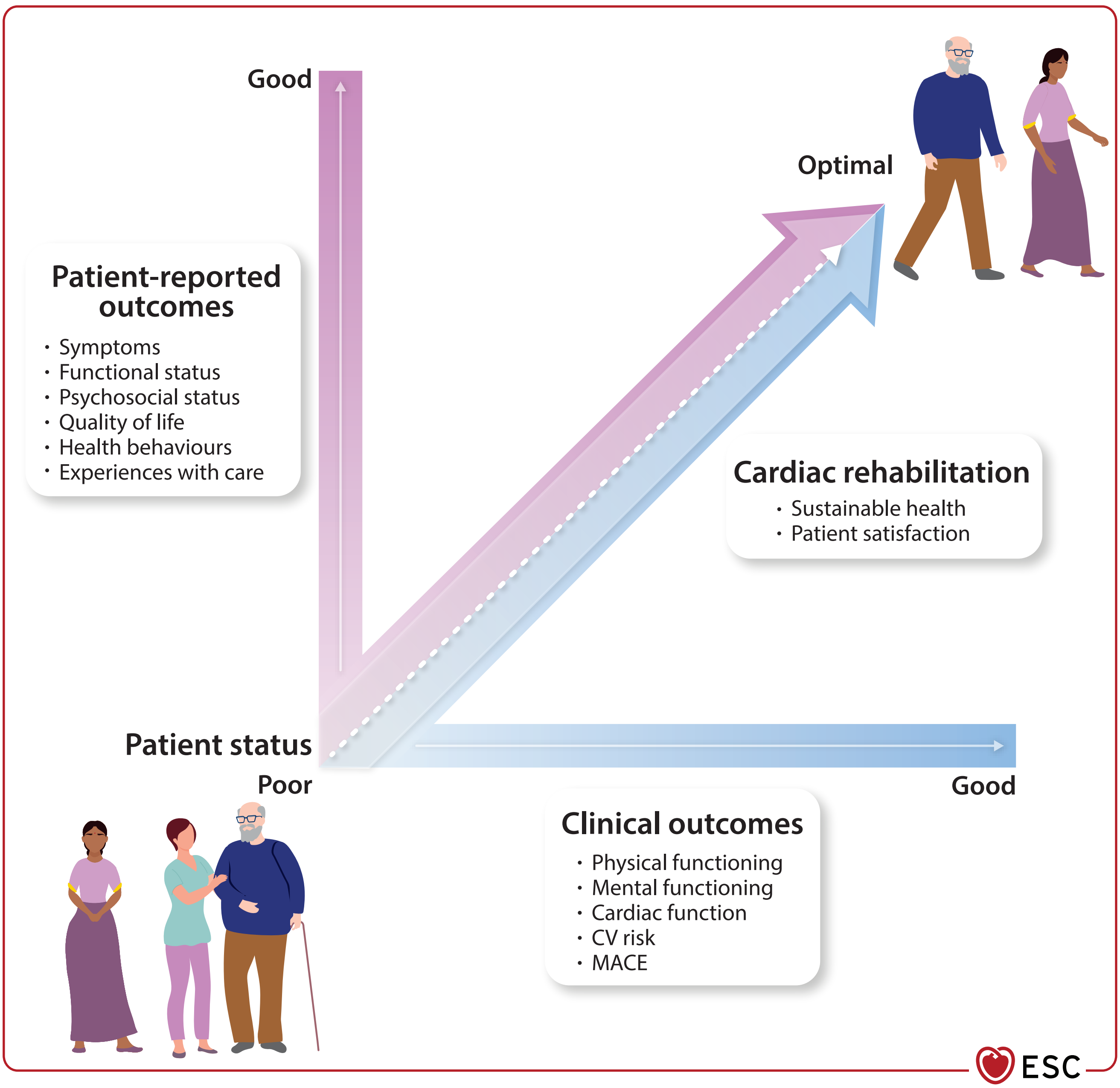

Figure 4 The goal of optimal cardiac rehabilitation is to improve both clinical and patient-reported outcomes. CV, cardiovascular; MACE, major adverse cardiovascular event.

Recommendation Table 1 — Recommendations for patient-reported outcome measures (see Evidence Table 1)

Recommendations	Class[a]	Level[b]
The assessment of PROs reflecting both physical and mental health is recommended in all patients with an indication for CR to monitor disease progression and evaluate treatment outcomes, facilitate communication between patients and healthcare professionals during the clinical encounter, and enhance shared decision-making.[c] [40,44,45,48,49]	I	A
The use of validated PROMs relevant to the patient condition and setting is recommended in all patients with indication for CR with disease-specific PROMs preferred and if possible combined with generic measures.[38,42,46,49–51]	I	C
The assessment of PREs is recommended in all patients undergoing CR to monitor quality of care and standardization from patients' perspectives.[49]	I	C
The assessment of PROs using validated tools is recommended to be included in all clinical research studies (i.e. measuring quality of life, symptom management, adherence to and adverse effects of medication) to improve outcome relevance, comparability, and integration of patient perspective.[41,42]	I	C

CR, cardiac rehabilitation; ESC, European Society of Cardiology; PRE, patient-reported experience; PRO, patient-reported outcome; PROM, patient-reported outcome measure; RCT, randomized controlled trial.
[a]Class of recommendation.
[b]Level of evidence.
[c]While ESC guidance typically requires strong evidence for benefit ($P < .005$) from at least two randomized trials free of major bias to achieve level of evidence A, exceptionally, level of evidence A can be considered if the effects of the intervention are clinically obvious and >90% of voting guideline Task Force members agree with providing level of evidence A. Patient-reported outcome measures are key to guiding therapeutic strategies in patients undergoing CR, and their general utility is unlikely to be tested in future RCTs.

4. The rationale for cardiac rehabilitation: who benefits, what it achieves, and why it matters

4.1. From exercise-based to comprehensive cardiac rehabilitation

Phase II CR is a multidisciplinary, patient-centred, and medically supervised intervention designed to optimize a patient's physical, mental, and social functioning following a cardiac event or diagnosis of cardiac disease.[52] Initially, CR primarily focused on exercise training to help patients, often immobilized after an acute cardiac event or surgery, regain their functional capacity, and resume daily activities, including returning to work. This early emphasis led to CR being commonly referred to as exercise-based CR.[8,9]

Over time, the scope of CR has expanded significantly, encompassing a wide range of indications, goals, and outcomes. In addition to its well-established use for patients with either ACS or chronic coronary syndromes (CCS) (after percutaneous or surgical interventions)[8] or HF [either chronic, after an acute event, implantation of a left ventricular assist device (LVAD), or heart transplantation (HTx)],[53–55] growing evidence supports the broader application of CR. Positive health outcomes have been observed in other patient populations, including those with valvular heart disease,[56,57] congenital heart disease,[58] atrial fibrillation (AF),[59] pulmonary hypertension with right ventricular dysfunction,[60] and individuals with arrhythmias and cardiac implantable electronic devices (CIEDs).[61] Furthermore, the core components of CR programmes are very well suited for patients with cancer during or after therapies associated with cardiotoxicity, especially for those at elevated cardiovascular risk.[17] These programmes are now evolving into specialized cardio-oncology rehabilitation (CORE) programmes.[13,62,63]

Consequently, CR has evolved into a multicomponent intervention with an overarching goal of improving cardiovascular, respiratory, metabolic, muscular, and mental health, as well as improving health literacy and leveraging social determinants of health in a wide range of patients with cardiac conditions. It provides an ideal platform for implementing comprehensive CVD prevention strategies.[25] While exercise training remains a central element of CR, modern programmes encompass additional core components such as self-management and education, optimization of pharmacotherapies, lifestyle modification, and psychosocial support.[24] These interventions are usually individualized and patient-centred and delivered by multidisciplinary teams using a collaborative care approach (*Section 6.2*).[24] Reflecting this more holistic approach, a European Association of Preventive Cardiology (EAPC) position paper introduced the term comprehensive CR.[52]

This Task Force suggests that, given the evolution of CR, the term 'cardiac rehabilitation' should now be used without qualifiers, as it inherently implies a multimodal, multidisciplinary, and patient-centred approach (see *Figure 2*).

Although the term CR is often poorly perceived by both the cardiovascular community and by patients, this Task Force, consistent with WHO's Rehabilitation 2030 initiative, recommends addressing misconceptions rather than renaming, by emphasizing CR's evidence base, its innovation capacity, and its role in fostering healthy ageing.

4.2. Effectiveness of cardiac rehabilitation and the emerging role of functioning and health-related quality of life as primary outcomes

4.2.1. Challenges of outcome assessments in cardiac rehabilitation

Cardiac rehabilitation is a complex, multimodal intervention that poses methodological and ethical challenges for randomized trials, including difficulties with standardization, recruitment, blinding, and adequate powering for mortality outcomes. Despite these limitations, evidence from systematic reviews and meta-analyses consistently shows that CR improves clinical outcomes and HRQoL, with particularly strong effects on cardiovascular mortality and hospitalizations (see Supplementary data online and *Table S1*).

4.2.2. Relevant health outcomes for cardiac rehabilitation

In an ageing population with CVD, functioning and HRQoL are central, patient-relevant outcomes in CR, and key targets for care and evaluation. This focus is particularly relevant given that gains in life expectancy worldwide have not been matched by equivalent gains in healthy life years. Over the past two decades, the healthspan-lifespan gap (the number of years lived burdened by disease) has widened from 8.5 to 9.6 years across 183 WHO Member States, with non-communicable diseases, including CVD, identified as a principal driver of this gap.[64] This trend underscores that living longer without living better cannot be considered a success, and that interventions such as CR, which target functioning and HRQoL rather than survival alone, are essential to narrowing this gap. Accordingly, this Task Force prioritizes functioning and HRQoL as independent outcomes, assigning a high class of recommendation to CR when benefits are demonstrated, despite inherent limitations in blinding that cap the level of evidence (see Supplementary data online).

4.2.3. The International Classification of Functioning, Disability and Health

The International Classification of Functioning, Disability and Health (ICF), developed by the WHO, provides a comprehensive framework for health and disability, grounded in the biopsychosocial model. The ICF classifies health and health-related domains by describing changes in body functions and structures, what a person can do in a standardized environment (capacity), and what they actually do in their usual environment (performance). These domains are organized from body, individual, and societal perspectives through two core lists: (i) body functions and structures; and (ii) activities and participation. Functioning serves as an umbrella term encompassing body functions, activities, and participation, while disability encompasses impairments, activity limitations, and participation restrictions. Environmental and personal factors that interact with all components are additionally specified, supporting a holistic understanding of health and lived experience (*Figure 5*).[65]

In rehabilitation, this multipurpose classification is particularly valuable for structuring interdisciplinary communication, supporting collaborative goal setting, and enabling systematic outcome assessment.

Clinical assessment schedules have been developed for specified rehabilitation services,[67] as well as core sets for patients with chronic ischaemic heart disease,[68] and those with cardiopulmonary conditions in early post-acute rehabilitation facilities.[69] Guidelines for developing core sets for other conditions have been published,[70] along with ICF linking rules.[71]

Supplementary data online, *Table S2* illustrates how relevant health outcomes of CR and social determinants of health can be linked to ICF categories. The linking was done by Task Force members and aligns well with the ICF Core Set for chronic ischaemic heart disease.[68] From the patient's perspective, all health outcomes and social determinants of health were considered relevant for informed shared decision-making.

Recommendation Table 2 — Recommendations for goal setting and outcome assessment (no Evidence Table available)

Recommendations	Class[a]	Level[b]
The framework of the ICF should be considered in patients with cardiac disease participating in CR to structure care goal setting and outcome assessment.[66,72]	IIa	C

CR, cardiac rehabilitation; ICF, International Classification of Functioning, Disability and Health.
[a]Class of recommendation.
[b]Level of evidence.

4.3. Cost-effectiveness of cardiac rehabilitation

Across health systems and delivery models, adding CR to usual care is consistently cost-effective and often cost-saving, driven by reduced health service utilization and improved quality-adjusted life expectancy. Different CR delivery models show high probabilities of cost-effectiveness, while economic outcomes vary more widely for individual non-exercise components (see Supplementary data online).

4.4. Early initiation and safety of cardiac rehabilitation

Both centre-based and supervised home-based CR programmes are generally safe for patients with cardiac diseases and should be initiated as early as possible following a cardiovascular event, intervention, or surgery, provided that appropriate risk stratification, including an exercise test, has been conducted and potential contraindications to exercise testing and training have been considered (see *Table 4*). Specific congenital conditions that can raise the arrhythmic risk and anomalies associated with potential safety concerns must be considered (see Supplementary data online, *Tables S3* and *S4*). Importantly, such recommendations are necessarily general and must be adapted to the individual clinical context based on current circumstances and clinical judgement. Core components of CR such as nutritional or psychological counselling, smoking cessation support, and optimization of pharmacotherapy could be initiated without delay, even if the patient is not yet ready to begin the exercise component.

After an ACS event, CR should ideally begin in the first 14 days and no later than 30 days. Following coronary artery bypass graft (CABG) surgery, CR should commence within 28 days and must not be delayed beyond 42 days.[24] Patients hospitalized with an episode of decompensated HF may begin CR shortly after achieving decongestion and haemodynamic stabilization, once hospital discharge is considered feasible and guideline-directed medication has been initiated.[73]

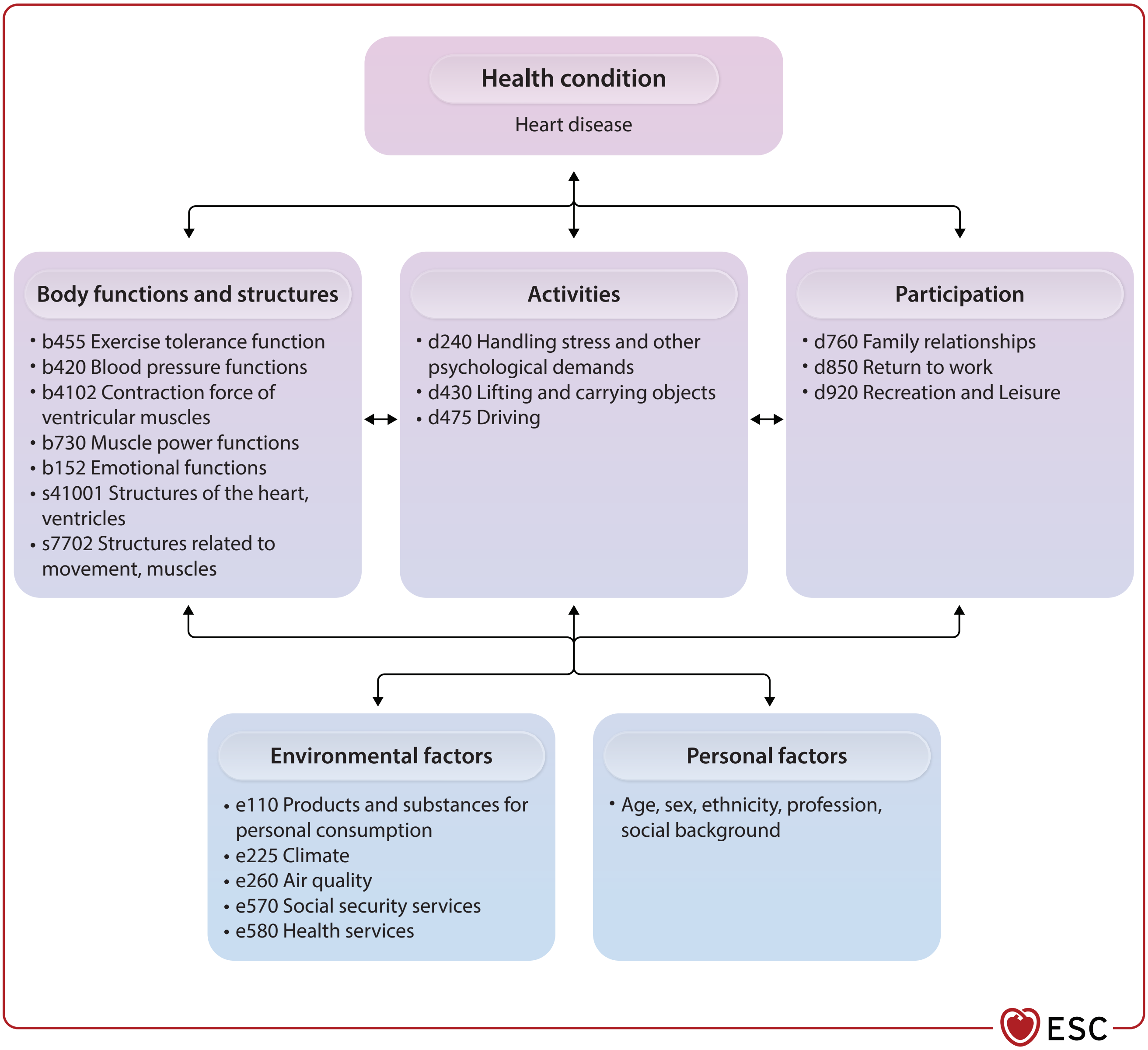

Figure 5 International Classification of Functioning, Disability and Health (ICF) applied to heart disease: an illustration using selected ICF categories. The model illustrates the five ICF domains, including the three levels of human functioning (body functions and structures, whole-body activities, and participation in the social context), and their interactions with the health condition as well as external (environmental) and internal (personal) contextual factors. Example ICF categories, relevant in the context of heart disease are provided (see Supplementary data online, *Table S2*).[65] Adapted from WHO (Licence: CC BY-NC-SA 3.0 IGO)[66].

Centre-based CR offers direct supervision by healthcare professionals while home-based CR, on the other hand, provides a more flexible and accessible option (see *Section 9*). Studies have demonstrated comparable safety outcomes between supervised home-based and centre-based CR programmes, provided that appropriate patient selection, education, and remote monitoring [with and without electrocardiogram (ECG)] are ensured. The incidence of exercise-related serious adverse events (SAEs) is low and has been estimated at ~1 per 53 770 patient-hours during remotely supervised exercise sessions.[74] In comparison, centre-based high-intensity interval training (HIIT) is associated with a higher estimated rate of 1 SAE per 11 333 patient-hours, while no SAEs have been reported for centre-based moderate-intensity continuous training.[75] One caveat is that studies (either individual or collectively) comparing home-based to centre-based CR have not been sufficiently powered to detect potential differences in rare but important cardiovascular complications, and further research in this area is needed.

However, selected clinical conditions place patients at higher risk of exercise-related adverse events and may favour centre-based CR, ECG monitoring, and lower intensities of exercise training (see Supplementary data online, *Table S5*). Further studies are needed to evaluate the safety of exercise across all cardiac diagnoses and to guide the selection of the most appropriate training modality and setting.

Ultimately, the decision to initiate CR, along with the choice of delivery mode and monitoring strategy, should be individualized, based on clinical judgement, considering the patient's preferences, clinical risk profile, results from exercise testing, and the resources available within the healthcare system.

Recommendation Table 3 — Recommendations for early initiation and safety of cardiac rehabilitation (see Evidence Table 3)

Recommendations	Class[a]	Level[b]
Early initiation[c] of CR is recommended in patients with an indication for CR to improve enrolment and functional outcomes.[14,76–78]	I	C
Early initiation[d] of CR should be considered in patients hospitalized for decompensated HF to reduce in-hospital mortality.[79,80]	IIa	B2
Telemetry during exercise training in CR may be considered in selected patients with cardiac disease at high risk[e] to detect arrhythmias, ischaemia, or abnormal haemodynamic responses.	IIb	C

ACS, acute coronary syndrome; CABG, coronary artery bypass graft; CR, cardiac rehabilitation; HF, heart failure.
[a]Class of recommendation.
[b]Level of evidence.
[c]After an ACS event, CR should ideally begin in the first 14 days and no later than 30 days. Following CABG surgery, CR should commence within 28 days and must not be delayed beyond 42 days.[24]
[d]Patients hospitalized with an episode of decompensated HF may begin CR shortly after achieving decongestion and haemodynamic stabilization, once hospital discharge is considered feasible and guideline-directed medication has been initiated.
[e]High risk as defined in *Table 4*.

Table 4 Clinical conditions that should be considered as contraindications to exercise testing, and/or training, or increased risk for exercise training

Increased risk for exercise training	Contraindications to exercise testing and training	Contraindications to exercise training
>1.8 kg increase in body weight over the previous 1–3 days	Early phase after acute coronary syndrome (up to 2 days)	Progressive worsening of exercise tolerance or dyspnoea at rest over previous 3–5 days
Decrease in systolic blood pressure with exercise	Untreated life-threatening cardiac arrhythmias	Significant ischaemia during low-intensity exercise (<2 METs, <50 W)
NYHA functional class IV	Decompensated heart failure (during the initial period of haemodynamic instability)	Uncontrolled diabetes
Complex ventricular arrhythmia at rest or appearing with exertion	Uncontrolled hypertension	Recent embolism
Supine resting heart rate >100 b.p.m.	Advanced atrioventricular block	Thrombophlebitis
Pre-existing comorbidities limiting exercise tolerance	Acute myocarditis and pericarditis	New-onset atrial fibrillation/atrial flutter
Critical coronary stenosis	Symptomatic aortic stenosis	
	Hypertrophic cardiomyopathy with severe obstruction	
	Acute systemic illness	
	Intracardiac thrombus	

b.p.m., beats per minute; MET, metabolic equivalent; NYHA, New York Heart Association; W, Watt.
Adapted with permission from Piepoli *et al.*[73]

5. Indications for cardiac rehabilitation

The multidisciplinary activities integrated in CR programmes may be beneficial in patients with many heart diseases and cardiac disturbances, providing the basis for establishing the indications for CR in different scenarios. These are summarized and illustrated in *Figure 6* and in more detail in *Table 5*.

5.1. Acute and chronic coronary syndromes

Patients with symptomatic CAD, particularly in the immediate period after ACS, have traditionally been the primary focus of CR programmes. Indeed, a meta-analysis published in 2023, including 23 172 patients after ACS or with CCS [with or without percutaneous coronary intervention (PCI) or CABG] showed that CR reduced the risk of cardiovascular mortality, myocardial infarction (MI), and all-cause hospitalization.[8] Most of the evidence concerned patients who were post-MI and post-revascularization, but also to a lesser extent patients with CCS. Indeed, favourable results have also been reported in patients with MI with non-obstructive coronary arteries (MINOCA).[81] Trials collecting data about HRQoL varied in their outcome measures, but reported consistent improvements in HRQoL, especially its mental component (rather than physical). There was an acceptable level of evidence that CR could be cost-effective.[8] Meta-regression analyses indicated that the benefits of CR seemed to be consistent across types and settings of CR programmes and study characteristics. However, despite the benefit on CVD death and MI, the 2023 meta-analysis did not report that CR lowered the risk of revascularization and all-cause mortality. This null finding has been interpreted as reflecting the improvement in the general management of CAD in the past decades, with the introduction of many life-saving therapies.[8] A meta-analysis from 2022, including 6380 patients from low- and middle-income countries provides additional evidence that CR improves functional capacity and control of risk factors.[82]

Recommendation Table 4 — **Recommendations for cardiac rehabilitation indications in patients with acute and chronic coronary syndromes (see Evidence Table 4)**

Recommendations	Class[a]	Level[b]
CR is recommended in patients after ACS or with CCS (with or without PCI or CABG) to reduce the risk of cardiovascular mortality and myocardial infarction.[8,81]	I	A
CR is recommended in patients after ACS or with CCS (with or without PCI or CABG) to reduce all-cause hospitalization and to improve physical functioning (VO_2peak) and HRQoL.[8,81–83]	I	B1

ACS, acute coronary syndrome; CABG, coronary artery bypass graft; CCS, chronic coronary syndromes; CR, cardiac rehabilitation; HRQoL, health-related quality of life; PCI, percutaneous coronary intervention; VO_2peak, peak oxygen uptake.
[a]Class of recommendation.
[b]Level of evidence.

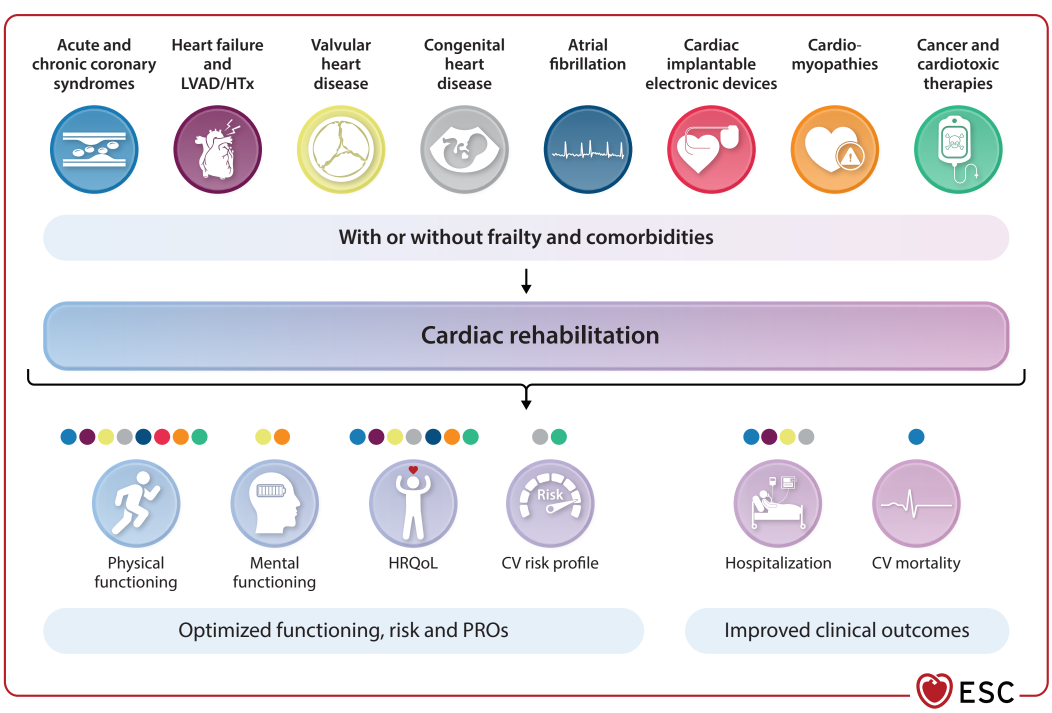

Figure 6 Benefits of cardiac rehabilitation for different indications. CR, cardiac rehabilitation; CV, cardiovascular; HRQoL, health-related quality of life; HTx, heart transplantation; LVAD, left ventricular assist device; PRO, patient reported outcome. Coloured dots denote CR indications. Dots adjacent to outcome icons indicate that evidence supports CR effectiveness in improving the respective outcome in the corresponding disease group.

Table 5 Recommendations and evidence matrix for cardiac rehabilitation indications and outcomes

	Outcomes										
Patients	CV mortality	CV risk profile	Myocardial infarction	All-cause hospitalization	Physical functioning	Mental functioning	HRQoL	AF symptoms	CTR-CVT	Frailty status	Health outcomes
After acute coronary syndrome[a]	I A		I A	I B1	I B1		I B1				
With chronic coronary syndrome[a]	I A		I A	I B1	I B1		I B1				
With chronic HFrEF				I B1	I B1		I B1				
after heart transplantation					I B1						
With HFpEF				IIa B1	I B1		I B1				
With decompensated heart failure[b]					IIa B1		IIa B1				
With advanced heart failure and LVAD					I B1						
After heart valve surgery				IIb B2							
With aortic stenosis After SAVR or TAVI					I B1	I B1	I B1				
With congenital heart disease		I C[c]			I B1[d]		I B1[d]				
With atrial fibrillation					IIa B1		IIa B1	IIa B1			
With atrial fibrillation following ablation					IIa B1		IIa B1				
With ICD or CRT devices					I B1						
With primary cardiomyopathies in the absence of arrhythmias or symptomatic heart failure					IIb C	IIb C	IIb C				
With pulmonary arterial hypertension and right ventricular dysfunction					IIa B1		IIa B1				
With or after cancer and at high risk of CTR-CVT		IIa B1			IIa B1		IIa B1		IIb B2		
With cardiac disease and frailty										I B2	
With cardiac diseases and comorbidities											I C

AF, atrial fibrillation; CRT, cardiac resynchronization therapy; CTR-CVT, cancer therapy-related cardiovascular toxicity; CV, cardiovascular; HFpEF, heart failure with preserved ejection fraction; HFrEF, heart failure with reduced ejection fraction; HRQoL, health-related quality of life; ICD, implantable cardioverter defibrillator; LVAD, left ventricular assist device; SAVR, surgical aortic valve replacement; TAVI, transcatheter aortic valve implantation.
Different colours are used to indicate the class of recommendation and level of evidence. Grey boxes indicate the absence of specific recommendations and evidence.
[a]With or without coronary artery bypass graft or percutaneous coronary intervention.
[b]As soon as safely possible after cardiac surgery or with reduced cardiorespiratory fitness.
[c]Adults.
[d]Adolescents and adults.

5.2. Heart failure

Heart failure, either with reduced (HFrEF) or preserved (HFpEF) ejection fraction, has a significant impact on patients, with symptoms including reduced exercise tolerance, a decline in HRQoL, and increased risks of cardiovascular and non-cardiovascular mortality and hospitalization.[84–86] Notably, the pathophysiology of exertional dyspnoea and exercise intolerance in left ventricular (LV) dysfunction has both central and peripheral components. Respiratory and skeletal myopathy commonly develops with varying degrees of severity, ranging from subclinical manifestations to advanced cardiac cachexia (see *Figure 7*).

Consequently, exercise training, as part of CR, is a valuable therapeutic strategy for patients with HF, as it helps reduce ergoreflex sensitivity, restores the sympatho–vagal equilibrium, and enhances tolerance to physical activity.[87,88] Regular exercise training may also restore endothelial function, reduce inflammation, and improve muscle and LV function.[89] The *2025 ESC Guidelines for the diagnosis and treatment of heart failure* proposed two categories based on LV ejection fraction (HFpEF, ejection fraction ≥50% and HFrEF, ejection fraction <50%).[90] However, this detailed classification has yet to be reflected in CR trials: most of the evidence to date has been in patients with HF with reduced ejection fraction <40%.[91] However, in systematic reviews including patients with chronic HF with either reduced or preserved ejection fraction, participation in CR (either exercise interventions alone or a comprehensive programme) has been shown to improve functional capacity and HRQoL, as well as to reduce the rate of all-cause and HF-specific hospitalizations.[9,92,93] Nevertheless, referrals to CR remain low in patients with HF.[94] While recent meta-analyses have found no evidence of a reduction in

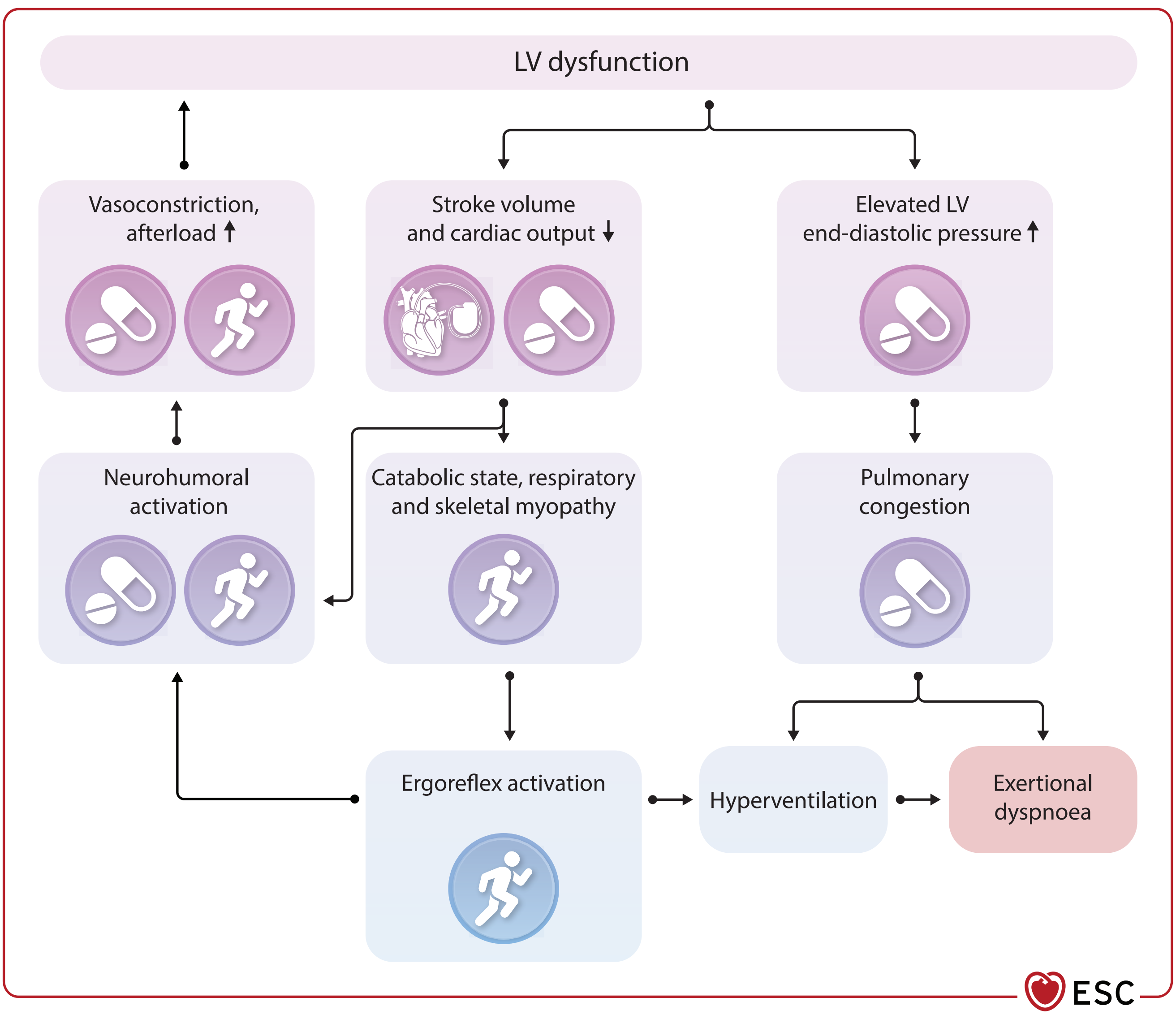

Figure 7 Pathophysiology of exertional dyspnoea in left ventricular dysfunction: central and peripheral components and evidence-based interventions. LV, left ventricular.

all-cause mortality with CR, large retrospective cohort studies indicate a potential overall survival benefit.[95,96] However, the possibility of confounding in these observational studies cannot be excluded. Moreover, there is substantial evidence that participating in CR programmes significantly improves clinical outcomes at all stages of the disease process. Two recent meta-analyses showed that starting CR as soon as safely possible in patients with decompensated HF could effectively enhance functional capacity and HRQoL.[97,98] Large-scale nationwide registries show that starting CR early associates with decreased in-hospital mortality[79] and readmission rates.[80] A recent secondary analysis of the REHAB-HF (Rehabilitation Therapy in Older Acute Heart Failure Patients) trial also showed that early intervention prevents sarcopenia and frailty.[99] Similarly, in patients with advanced HF following LVAD implantation, CR was associated with greater improvements in functional capacity[100–102] and physical quality of life[103] compared with standard care. Finally, in patients with end-stage HF who underwent HTx, CR has been shown to be useful to improve patients' capabilities, functional capacity, and HRQoL.[104,105] Cardiac rehabilitation after HTx needs to be specifically tailored to this patient population and to be multidisciplinary in nature. Cardiac rehabilitation programmes should be started early after HTx and continued during the entire post-transplantation journey.[104,105] Furthermore, in patients undergoing elective HTx, multimodal prehabilitation has been shown to improve short-term post-transplant outcomes.[106–108]

Recommendation Table 5 — Recommendations for indications in patients with heart failure (see Evidence Table 5)

Recommendations	Class[a]	Level[b]
CR is recommended in patients with chronic HFrEF to reduce all-cause hospital admissions and improve physical functioning (VO_2peak) and HRQoL.[9,92,93]	I	B1
CR is recommended in patients with advanced HF and LVAD and in patients after heart transplantation to improve physical functioning (VO_2peak, 6MWD).[54,101,102,104]	I	B1
CR is recommended in patients with HFpEF to improve physical functioning (VO_2peak) and HRQoL.[109,110]	I	B1
CR should be considered in patients with chronic HFpEF to reduce all-cause hospitalizations.[9,92,93]	IIa	B1
CR should be considered in patients with decompensated HF, as soon as safely possible, to improve physical functioning (6MWD) and HRQoL.[97,98]	IIa	B1

6MWD, six-minute walking distance; CR, cardiac rehabilitation; HF, heart failure; HFpEF, heart failure with preserved ejection fraction; HFrEF, heart failure with reduced ejection fraction; HRQoL, health-related quality of life; LVAD, left ventricular assist device; VO_2peak, peak oxygen uptake.
[a]Class of recommendation.
[b]Level of evidence.

5.3. Valvular heart disease

Patients with valvular heart disease are frequently referred to CR, mainly in the post-operative period. Few trials have analysed the effect of CR on these patients. A meta-analysis published in 2021 with 10 small RCTs, comprising 580 patients with surgical or percutaneous valve surgery, found the impact of CR to be uncertain in this population, in terms of mortality, hospitalization, and HRQoL.[57] However, further RCTs and meta-analyses including observational studies have shown improvements in several parameters of functional capacity and daily life activities.[111,112] The evidence was stronger for patients with aortic stenosis who underwent surgical aortic valve replacement (SAVR) or transcatheter aortic valve implantation (TAVI).[56,113]

Recommendation Table 6 — Recommendations for indications in patients with valvular heart disease (see Evidence Table 6)

Recommendations	Class[a]	Level[b]
CR is recommended in patients with aortic stenosis after SAVR or TAVI to improve physical (6MWD, SPPB, activities of daily living) and mental functioning (depression) and HRQoL.[112–114]	I	B1
CR may be considered in patients following heart valve surgery to reduce re-hospitalizations.[111,113,115]	IIb	B2

6MWD, six-minute walking distance; CR, cardiac rehabilitation; HRQoL, health-related quality of life; SAVR, surgical aortic valve replacement; SPPB, Short Physical Performance Battery; TAVI, transcatheter aortic valve implantation.
[a]Class of recommendation.
[b]Level of evidence.

5.4. Adults and transitional-age patients with congenital heart disease

Congenital heart disease encompasses a spectrum of structural heart anomalies present at birth.[116] The rates of successful surgical repair and life expectancy for patients with congenital heart disease have significantly improved over recent decades. However, lifelong exposure to cardiovascular risk factors is reshaping the outlook and late clinical trajectory of ACHD. The disease burden is progressively shifting from congenital abnormalities to acquired conditions, particularly atherosclerotic CVD, with concerning implications. Furthermore, the complex medical background of ACHD often hampers the implementation of effective preventive strategies by general practitioners and cardiologists.[117] Individuals with congenital heart disease, particularly those transitioning from adolescence into adult care, tend to have reduced exercise capacity,[118] which, together with congenital heart disease complexity, independently associates with all-cause mortality.[119] In this context, exercise training plays an important role and has been shown to enhance physical functioning and decrease circulatory natriuretic peptide levels, and to deliver small improvements in HRQoL in patients with congenital heart disease after surgery.[120] Therefore, lifelong CR should be standardized as part of the secondary prevention for ACHD. Despite these benefits, CR including exercise interventions and cardiovascular risk factor control is under-used in this population. Many individuals with ACHD continue to receive follow-up care in paediatric settings where CR is less commonly offered.[121] These individuals often present with reduced fitness levels, which decline further over time as evidenced by serial cardiopulmonary exercise testing.[122–125] Emerging evidence suggests that CR programmes can help mitigate these trends and improve physical performance and HRQoL.[58,126–130] However, paediatric and transitional-age CR programmes remain scarce, and thus so are real-world data on their efficacy in younger patients preparing for adult care.

Traditional centre-based CR programmes pose logistical challenges, including disruptions to school or work schedules and the burden of travel, particularly for adolescents and young adults. To address these barriers, CTR programmes are being developed; a shift accelerated by the coronavirus (COVID-19) pandemic and the growing need for accessible strategies to support long-term health.[131,132] Early studies indicate that CTR, could be both feasible and effective.[133] Nonetheless, more research is needed to evaluate the implementation and outcomes of CTR in transitional-age and young adult populations with heart disease, which represent a critical but underserved group.

Recommendation Table 7 — Recommendations for indications in adults with congenital heart disease (see Evidence Table 7)

Recommendation	Class[a]	Level[b]
CR is recommended in adults and transitional-age patients with congenital heart disease with reduced cardiorespiratory fitness, or after cardiac surgery, to improve physical functioning (VO_2peak) and HRQoL.[58,120,134–137]	I	B1
CR is recommended in adult patients with congenital heart disease to improve the cardiovascular risk profile and cardiovascular health.[117]	I	C

CR, cardiac rehabilitation; HRQoL, health-related quality of life; VO_2peak, peak oxygen uptake.
[a]Class of recommendation.
[b]Level of evidence.

5.5. Atrial fibrillation

Atrial fibrillation is the most common cardiac arrhythmia and frequently associates with underlying CVD, such as CCS or HF.[138] Compared with individuals without AF, patients with AF often have a greater burden of comorbidities and face a higher risk of complications.[138] These patients typically qualify for CR owing to their underlying cardiac conditions. Additionally, CR has shown potential benefits for AF-specific outcomes.

A recent systematic review and meta-analysis of 20 RCTs, involving 2039 patients with short-term follow-up, showed that CR reduced AF recurrence, symptom burden, and episode duration. It also improved the mental component of HRQoL. However, the certainty of evidence ranged from moderate to very low, and the effects of CR on all-cause mortality and SAEs remain uncertain.[59]

Other systematic reviews have assessed CR in patients with AF undergoing radiofrequency catheter ablation.[139] Although AF recurrence was slightly lower in the CR group than the control group, the difference was not statistically significant. However, significant improvements were observed in peak oxygen uptake (VO_2peak) and 6-minute walk test (6MWT) scores in the CR group, suggesting that CR enhances physical performance after radiofrequency catheter ablation. Similarly, the CopenHeartRFA (Copenhagen Heart radiofrequency ablation) trial found slightly better physical functioning and lower anxiety levels at 12–24 months in patients with AF who completed a CR programme after ablation.[140] A few non-RCTs have addressed the effect of CR in patients with AF and HF and have concluded that CR may improve physical functioning and HRQoL.[141–144] In patients undergoing left atrial appendage occlusion, CR has been shown to accelerate device endothelialization while improving HRQoL and physical functioning.[145,146]

Recommendation Table 8 — Recommendations for indications in patients with atrial fibrillation (see Evidence Table 8)

Recommendation	Class[a]	Level[b]
CR should be considered for patients with AF to reduce AF symptom severity, symptom burden, episode frequency and duration, and recurrence of AF, as well as to increase physical functioning (VO_2peak, 6MWD) and improve the mental component of HRQoL.[59]	IIa	B1
CR should be considered for patients with AF following radiofrequency catheter ablation to improve physical functioning (VO_2peak, 6MWD) and HRQoL.[139,140]	IIa	B1

6MWD, six-minute walking distance; AF, atrial fibrillation; CR, cardiac rehabilitation; HRQoL, health-related quality of life; VO_2peak, peak oxygen uptake.

5.6. Cardiac implantable electronic devices

A significant subset of patients with cardiac conditions receive CIEDs, such as pacemakers, implantable cardioverter defibrillators (ICDs), or cardiac resynchronization therapy and defibrillator/pacemaker (CRT-D/P). These patients are eligible for CR not only due to their underlying heart disease but also because of specific challenges associated with CIEDs. These include psychological adaptation to living with an implanted device and, particularly for patients with ICDs and CRT-D/P, managing the risks of arrhythmias, syncope, and sudden cardiac death.

A European Association for Preventive Cardiology/European Heart Rhythm Association (EAPC/EHRA) consensus document provided guidance on managing patients with CIEDs in the CR setting,[61] emphasizing that these patients require tailored care, as their needs differ from those of other CR participants. Cardiac rehabilitation offers a unique opportunity to address these needs by optimizing medical therapy, enhancing exercise capacity, improving overall clinical condition, and ensuring the correct functioning of the device during exercise.[61]

Currently, evidence on CR effectiveness in patients with CIEDs is limited. A 2019 Cochrane systematic review analysed eight RCTs involving 1730 patients with ICDs. It provided very low-quality evidence suggesting that CR may improve exercise capacity compared with standard care. However, due to insufficient data, the review was unable to assess the impact of CR on all-cause mortality, SAEs, or HRQoL.[147]

A more recent systematic review, including 16 RCTs with 2053 patients using either ICDs or cardiac resynchronization therapy devices, showed that exercise training as part of CR had a good safety profile, as indicated by the finding that the numbers of ICD discharges were not significantly different between the intervention and control groups. Furthermore, CR meaningfully improved exercise capacity for patients with both ICDs and cardiac resynchronization therapy devices.[148]

Evidence from single RCTs suggests that comprehensive CR, including psycho-educational interventions, can improve HRQoL in patients with ICDs.[149,150] Observational studies further indicate that participation in a multidisciplinary CR programme associates with higher event-free survival and lower all-cause mortality.[151,152] However, these findings are limited by residual confounding factors.

Recommendation Table 9 — Recommendations for indications in patients with cardiac implantable electronic devices (see Evidence Table 9)

Recommendation	Class[a]	Level[b]
CR is recommended for patients after ICD or CRT device implementation to improve physical functioning (VO_2peak, 6MWD).[147,148,150,153]	I	B1

6MWD, six-minute walking distance; CR, cardiac rehabilitation; CRT, cardiac resynchronization therapy; ICD, implantable cardioverter defibrillator; VO_2peak, peak oxygen uptake.
[a]Class of recommendation.
[b]Level of evidence.

5.7. Cardiomyopathies

Cardiomyopathies comprise a diverse group of primary and secondary myocardial disorders in which the heart muscle is structurally and/or functionally abnormal in the absence of relevant coronary, valvular, or congenital disease.[154] From genetically driven entities such as hypertrophic, arrhythmogenic, or lamin-related phenotypes to acquired forms associated with arterial or pulmonary hypertension, and metabolic (e.g. diabetes mellitus) or systemic (e.g. amyloidosis, sarcoidosis) diseases, these conditions share a common trajectory of progressive ventricular remodelling, arrhythmia burden, and HF risk. Their clinical profiles range from the silent gene-carrier to the patient with advanced biventricular dysfunction or recurrent defibrillator shocks, demanding nuanced, multidisciplinary care.[90,154,155]

Although the evidence base for CR in cardiomyopathies is sparse, cumulative experience indicates that carefully selected patients, particularly those with symptomatic HF (*Section 5.2*), significant arrhythmia loads, and an ICD (*Section 5.6*) can gain benefits in physical and mental functioning, as well as HRQoL.[155]

Patients with hypertrophic cardiomyopathy are often considered for CR. Although high-intensity exercise training, with a high heart rate or blood pressure, has been traditionally discouraged with concerns for safety and possible triggering arrhythmias in patients with hypertrophic cardiomyopathy, the *2023 ESC Guidelines for the management of cardiomyopathies* recommended regular low- to moderate-intensity exercise in able individuals.[154]

A supervised exercise training programme, involving moderate-intensity and high-intensity training, has been found to be safe, showing to be associated with improvements in cardiorespiratory fitness, and apparently some haemodynamic and psychological parameters, with the absence of an increase in arrhythmias, in patients with stable hypertrophic cardiomyopathy, with or without LV outflow obstruction.[156–158] However, these beneficial effects are lost several months after ceasing the activity.[158] Exercise training should be individualized and closely monitored for those patients at high risk of arrhythmias.

Patients with primary and secondary right ventricular cardiomyopathies may need different approaches. Whereas moderate- and high-intensity exercise is discouraged in patients with arrhythmogenic cardiomyopathy,[18] it may be useful in individuals with right ventricular dysfunction secondary to pulmonary hypertension. A recent meta-analysis of 11 RCTs with 462 individuals found that supervised CR is safe and may result in an increase in exercise capacity and HRQoL, with reductions in pulmonary artery pressure and adverse events.[60] However, the patients included in this study were mainly from Group 1 pulmonary arterial hypertension (pre-capillary pulmonary hypertension) and, therefore, these beneficial effects cannot be generalized to all other groups of pulmonary hypertension.

The effect of CR in other cardiomyopathies has not been studied. Specific data on CR outcomes in patients with dilated cardiomyopathy are scarce and most data derives from those involved in CR for HF. Indeed, there are no studies exploring the benefit of CR in laminopathies, or metabolic or restrictive cardiomyopathies, including the increasing prevalence of amyloidosis, although a small RCT found mild improvements in functional capacity in patients with endomyocardial fibrosis.[159]

Recommendation Table 10 — Recommendations for indications in patients with cardiomyopathies (see Evidence Table 10)

Recommendation	Class[a]	Level[b]
CR should be considered in individuals with pulmonary arterial hypertension and right ventricular dysfunction to improve physical functioning (6MWD, VO_2peak, power) and HRQoL and reduce pulmonary artery pressure and adverse events.[60]	IIa	B1
CR may be considered in patients with primary cardiomyopathies in the absence of significant arrhythmias or symptomatic heart failure to improve self-management, physical and mental functioning, and HRQoL.	IIb	C

6MWD, six-minute walking distance; CR, cardiac rehabilitation; HRQoL, health-related quality of life; VO_2peak, peak oxygen uptake.
[a]Class of recommendation.
[b]Level of evidence.

5.8. Cancer and cardiotoxic therapies

Advances in their early detection and treatment have significantly improved the survival rates for several cancers. This has led to growing awareness about the increased risk of morbidity and mortality from non-cancer causes among cancer survivors. Cardiovascular diseases are among the most common causes of death among cancer survivors.[17] Cancer and CVD share common risk factors such as ageing, obesity, and smoking.[17] Moreover, several pathophysiological processes are common to both cancer and CVD, such as inflammation, resistance to cell death, cellular proliferation, neuro-hormonal stress, angiogenesis, and genomic instability.[160] Cancer itself induces a pro-thrombotic state that increases the risk of venous and arterial thrombosis. Moreover, many cancer drugs may induce cardiotoxicity, with HF and CAD among the most serious complications. For these reasons, it is becoming more important to implement preventive strategies for patients with cancer who are at increased risk of cancer therapy-related cardiovascular toxicity (CTR-CVT). The *2022 ESC Guidelines on cardio-oncology* recommend stratifying cardiovascular risk according to Systematic COronary Risk Evaluation 2 (SCORE2) or Systematic COronary Risk Evaluation2-Older Persons (SCORE2-OP),[25] and stratifying cardiovascular toxicity risk by using the Heart Failure Association and the International Cardio-Oncology Society (HFA-ICOS) risk score, which takes into consideration patient-related factors, such as cardiovascular risk factors, previous cardiovascular events, LV ejection fraction, and biomarkers, in addition to factors related to cancer therapy.[17]

A pronounced drop in exercise tolerance may occur during and after cancer therapy. Impaired functional capacity is a strong predictor of adverse clinical outcomes and may be an important target for intervention in patients with cancer and in cancer survivors. Current evidence shows that exercise-based interventions have a good safety profile and are effective for patients with various different cancer types (breast, lung, prostate, gastrointestinal, haematological).[161,162] They improve physical functioning, HRQoL, and cardiovascular risk profile leading to reductions in cardiovascular morbidity.[13,17,163–167] The benefits achieved through exercise-based rehabilitation persist for months post-intervention in cancer survivors.

A suppressive effect on prostate cancer growth has been described, suggesting that exercise may reduce some cancers' progression.[168] Several studies suggested that exercise-based rehabilitation may help attenuate cancer treatment-related cardiovascular dysfunction in women with breast cancer receiving anthracyclines and/or anti-HER2 antibodies. However, data are not sufficient to define a clear cardioprotective effect.[169–172]

Dedicated CORE programmes are currently under development.[13,17,63] Cardio-oncology rehabilitation is a multimodality approach including a complete structured exercise programme, associated with comprehensive nutritional counselling, psychological support, and cardiovascular risk assessment. In the CORE team, the basic professionals of CR are complemented by oncologists and cardio-oncologists. The greatest effectiveness of CORE has been shown in patients at high risk of CVD and undergoing active therapy for some types of cancer (breast, prostate, lung, lymphoma, and other haematological diseases).

Therefore, CORE should be delivered especially to patients at high-risk of CVD, according to the Systematic COronary Risk Evaluation (SCORE) or SCORE2-OP,[25] or who are at high CTR-CVT risk according to the HFA-ICOS risk score[17] and who are undergoing cardiotoxic cancer therapy in the pre-, active-, and post-treatment settings, to improve functional capacity and quality of life (anxiety, depression, and fatigue).[163] Detailed inclusion criteria for CORE have been suggested by the American Heart Association.[13]

Recommendation Table 11 — Recommendations for indications in patients with cancer (see Evidence Table 11)

Recommendation	Class[a]	Level[b]
CORE should be considered in patients with cancer and in cancer survivors, particularly if at high risk of CTR-CVT, to improve physical functioning (muscle strength, VO_2peak, 6MWD), HRQoL, and cardiovascular risk profile.[163–167]	IIa	B1
CORE may be considered in patients with cancer and in cancer survivors undergoing cardiotoxic treatments to prevent or mitigate CTRCD cardiotoxicity, particularly from anthracyclines.[169–172]	IIb	B2

6MWD, six-minute walking distance; CORE, cardio-oncology rehabilitation; CTRCD, cancer treatment-related cardiovascular dysfunction; CTR-CVT, cancer therapy-related cardiovascular toxicity; HRQoL, health-related quality of life; VO_2peak, peak oxygen uptake.
[a]Class of recommendation.
[b]Level of evidence.

5.9. Frailty and comorbidities related to cardiovascular risk

Many patients with cardiac diseases are older and often present with frailty, which is defined as a multidimensional and multisystem condition characterized by reduced functional reserve and increased vulnerability to stress, and acute adverse events, including falls, hospitalization, disability, and mortality.[173] In addition, comorbidities such as obesity,[174] diabetes,[175] hypertension,[176] dyslipidaemias,[177] obstructive sleep apnoea syndrome (OSAS),[178] chronic obstructive pulmonary disease,[179] chronic kidney disease (CKD),[180–182] or chronic inflammatory diseases,[183] as well as a history of stroke,[184] PAD,[33,185–187] or cancer[17] are also common.

Therefore, frailty and multimorbidity, defined as the coexistence of two or more medically diagnosed diseases in the same individual, are highly prevalent among patients referred to CR and critically influence programme design, participation, and outcomes. Evidence shows that CR is feasible, safe, and effective in these populations.[13,188–198] Furthermore, comorbidities such as chronic obstructive pulmonary disease, CKD, rheumatoid arthritis, stroke, PAD, and cancer have their own guideline-directed indications for disease-specific rehabilitation, creating opportunities for synergistic approaches with CR.[198–203] However, delivering personalized and effective care requires a thorough understanding of these coexisting conditions that often discourage clinicians to refer patients to CR and may also complicate patients' abilities to fully engage in the programmes. Cardiac rehabilitation for frail patients should include individualized and progressive exercise programmes prioritizing safety and function over intensity, with multimodal interventions addressing nutrition, cognitive function, and emotional well-being.

Recommendation Table 12 — **Recommendations for indications in patients with frailty and comorbidities (see Evidence Table 12)**

Recommendations	Class[a]	Level[b]
CR is recommended in patients with frailty having an indication for CR to improve frailty status.[191]	I	B2
CR is recommended in patients with comorbidities[c] having an indication for CR to address disease-specific aspects and to improve health outcomes.[174–178,198–206]	I	C
CR is not recommended to be withheld from patients with an indication for CR because of frailty or comorbidities.	III	C

CR, cardiac rehabilitation.
[a]Class of recommendation.
[b]Level of evidence.
[c]Such as obesity, diabetes, hypertension, dyslipidaemias, obstructive sleep apnoea syndrome, chronic obstructive pulmonary disease, chronic kidney disease, chronic inflammatory disease, stroke, peripheral arterial disease, musculoskeletal diseases, cognitive decline, or cancer.

6. Quality standards of cardiac rehabilitation

Substantial heterogeneity remains across CR programmes throughout Europe, regarding their content, duration, aims, and other aspects. Quality standards likewise vary between programmes, despite a robust evidence base. To support quality improvement two recent EAPC position statements define standards: one for CR[24] and another specifically for CTR.[30] Structure-based metrics, covering infrastructure, multidisciplinary team composition, and centre requirements are specified. Process-based metrics should align with the core components of CR care delivery and include indicators of programme delivery and uptake. Importantly, evidence supports a dose–response relationship in CR, whereby greater participation (i.e. higher session ‘dose’) is associated with lower mortality and morbidity, with no clear plateau within the range of doses observed in contemporary practice. Therefore, programme completion and session adherence (e.g. number and proportion of prescribed sessions attended) should be considered key quality indicators.[207] Based on the EAPC standards,[24] and updated to reflect this guideline, we propose quality indicators and outcome assessments to evaluate delivered care. The full set of quality standards is provided in the Supplementary data online, *Section S2*. A dedicated companion paper detailing these standards, developed according to ESC methodology,[208] will be published separately.

6.1. Infrastructure

Appropriate infrastructure and governance procedures (see Supplementary data online, *Section S2.2*) are essential for providing centre-based CR or delivering CTR. For specific guidance on implementation and service models, see *Section 9*.

6.2. The multidisciplinary team

The delivery of high-quality, comprehensive CR requires a co-ordinated multidisciplinary team, with defined leadership and accountability, supported by institutional governance and standardized protocols. Emphasis on team dynamics and the key principles of effective team-based care is required.[209] These include shared goals, clearly defined roles, a collaborative approach to care, mutual trust, effective communication, and measurable processes and outcomes (see *Section 4.2.2*). As the CR landscape evolves towards patient-centred hybrid models, an interdisciplinary, interprofessional approach is essential to ensure care is coherently integrated across delivery settings and modalities. Accordingly, the further development of CR services should incorporate co-creation with patients and families, alongside structured input from all members of the multidisciplinary team.

Depending on national regulations, institutional resources, and patient characteristics, the team typically includes cardiologists, physicians in physical and rehabilitation medicine/psychiatrists, CVD nurse specialists, exercise specialists (e.g. physiotherapists, sports scientists, or exercise physiologists), nutrition specialists (e.g. dietitians or nutritionists), psychologists, occupational therapists, clinical pharmacologists, internal medicine specialists, oncologists, geriatricians, and social workers. Cardiac rehabilitation programmes may be led by any suitably qualified member of the multidisciplinary team who has demonstrable organizational, managerial, and interpersonal competence. Ideally, the overall medical responsibility should be held by a board-certified cardiologist with substantial CR experience. Where permitted, physicians with adequately training in cardiology and CR, such as physicians in physical medicine and rehabilitation, may fulfil this role. In such cases, a formal linkage to board-certified cardiologists should be in place to ensure support for specialty-specific decisions (e.g. optimization of guideline-directed medical therapy, CIED management).

All team members should maintain role-appropriate, knowledge, skills, and competencies, supported by recognized certifications (e.g. the EAPC Certification in Preventive Cardiology or equivalent) to deliver the CR core components to the agreed standards. Continuous professional development and multidisciplinary training should be integrated into service for quality assurance. The clinical competencies required to deliver CR are outlined in several ESC position papers, including the core curriculum for Cardiovascular Nurses and Allied Professionals,[210] the EAPC Core Curriculum for Preventive Cardiology,[19] and the ESC Core Curriculum for cardio-oncology,[21] and by other educational authorities (e.g. European Union of Medical Specialists).[211]

6.3. Centre requirements

Regular multidisciplinary meetings help ensure that care is aligned with the patient’s needs and goals by facilitating co-ordinated discussion and decision-making in complex clinical cases. The centre will need to have protocols for handling adverse events and complaints and should have an up-to-date strategic plan. It must also evaluate its delivery and outcomes annually.[24]

Recommendation Table 13 — **Recommendations for quality standards in cardiac rehabilitation (no Evidence Table available)**

Recommendations	Class[a]	Level[b]
Phase II CR programmes are recommended to be managed according to EAPC structure- and process-based metrics, quality indicators and outcome assessment (or equivalent national standards) to improve quality of care and standardization.[24,30]	I	C

CR, cardiac rehabilitation; EAPC, European Association of Preventive Cardiology.
[a]Class of recommendation.
[b]Level of evidence.

7. Core components of cardiac rehabilitation

7.1. Patient assessment

A comprehensive patient-led baseline assessment and risk stratification is essential when defining a personalized treatment plan for a patient. An appropriate plan involves implementing a CR programme that addresses the various core components of the patient's needs.[24,52]

Accordingly, the patient is evaluated by comprehensively analysing their clinical history, physical examinations, and the results of diagnostic tests and PROMs. It is essential that the medical history encompasses not only cardiovascular events, procedures and surgeries, comorbid conditions, and current symptoms, but also that it focuses on the individual's health and lifestyle habits (see *Sections 7.4*, *7.6* and *7.7*), culture, education, ethnicity, and social determinants of health (*Figure 8*).

In addition to the traditional and non-traditional cardiovascular risk factors (including sleep),[212] it is recommended that sex-related risk factors be investigated in women. These include cardiometabolic disorders of pregnancy (e.g. gestational diabetes and hypertensive disorders of pregnancy), premature menopause, and endocrinopathies such as polycystic ovarian syndrome and endometriosis, which are known to enhance cardiovascular risk.[213,214] It would be beneficial to consider investigating the presence of sexual dysfunction that may adversely affect mental health, vitality, social functioning, and overall quality of life in both women and men (see *Section 7.9*).

To optimize the management of patients undergoing CR, it is essential to diagnose all relevant comorbidities and disabilities in addition to the index cardiovascular event. The presence of multiple chronic conditions associates with increased symptom burden and may contribute to progression of the underlying disease.[16] Although the multidisciplinary nature of the CR setting, based on an interprofessional team (see *Section 5*), favours an integrated treatment approach and ensures adherence, CR is under-utilized for patients with comorbidities or musculoskeletal limitations.[205]

The physical examination will encompass a comprehensive evaluation of the cardiovascular system. An assessment of sternal and wound healing is of paramount importance in patients who have undergone cardiac surgery. In patients with diabetes, undergoing cardiac surgery, implementing a tight glycaemic control protocol, particularly in the post-operative period, has been shown to reduce the incidence of complications associated with cardiac surgery.[215]

All pertinent components should be tested, with the objective of determining the patient's cardiovascular health to ensure safety of interventions. This encompasses analysing a resting 12-lead ECG (and ECG monitoring in selected conditions), evaluating cardiac imaging, and examining blood samples for a range of biomarkers, including routine biochemical assays, lipid profiles [including lipoprotein (a) for patients not previously tested], fasting blood glucose, and haemoglobin A1C, uric acid, renal function, and urinary testing. The initial examination also includes an assessment of physical fitness, vascular function, nutritional status, and mental health (see *Sections 7.4*, *7.5*, *7.6* and *7.8*).

The level of physical activity can be evaluated using a patient-completed questionnaire (see *Section 3.2* on PROMs) or activity diary, or alternatively, with physical activity monitors (such as accelerometers or wearable devices) that provide an objective assessment.[216]

Echocardiography (two-dimensional and Doppler echocardiography) is central to the assessment of cardiac function, including left and right ventricular function, cardiac dimensions, estimated pulmonary pressures, valvular abnormalities, and pericardial effusion after cardiac surgery. Echocardiography provides critical information to properly tailor medical and exercise therapy, and to identify those at high risk. In addition, some echocardiographic parameters have also been used as outcome measures for rehabilitation interventions.[217,218] In addition to standard echocardiography, other imaging techniques can be used when needed to gain a better understanding of the heart's structure and function.

Cardiopulmonary exercise testing is the gold standard for stratifying risk, assessing global functional capacity, identifying exercise tolerance limits, evaluating the chronotropic response, and establishing parameters for the prescription of endurance exercise training.[219,220] However, in routine clinical practice, the referral and performance rates of such testing are low, and the prescription of exercise training protocols for patients with CVD is frequently based on the results of the classic treadmill or cycle ergometer tests and rating of perceived exertion scales (see *Section 7.5*). For individuals with lower limb disabilities, the arm ergometer test, which can also include oxygen consumption measurement, is a valuable alternative for assessing cardiovascular fitness.[221]

Managing patients with CIEDs in the CR setting poses specific challenges in ensuring the correct functioning of the device during exercise. The CR team needs to be aware of the device settings, especially the rate cut-off for therapy in patients with defibrillators.[61]

The 6MWT or other evidence-based functional capacity test may be employed as an alternative for assessing functional capacity when graded exercise testing is not available.[222] Furthermore, the one-repetition maximum test is recommended to be incorporated into the functional assessment for prescribing resistance training.[223]

Although no standardized tool exists to assess frailty in the CR setting, the need to assess frailty status is growing, due to the increasing number of geriatric cardiac patients admitted to CR.

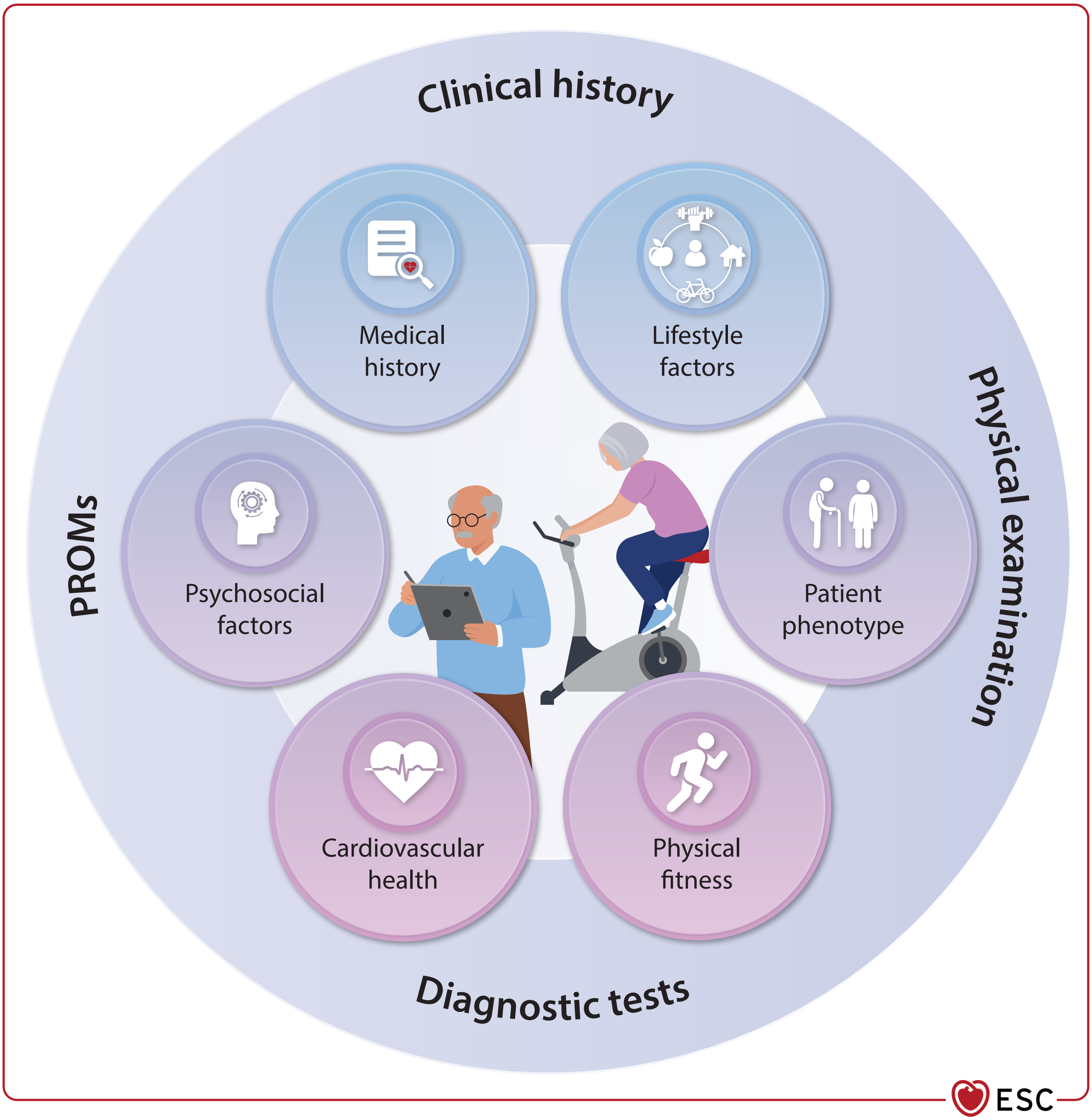

Figure 8 Elements of a comprehensive baseline assessment for defining a personalized treatment plan in cardiac rehabilitation. PROM, patient-reported outcome measure.

In their Call to Action,[224] the EAPC recommends the Edmonton Frail Scale[225] and the 7-point Clinical Frailty Scale[226] as appropriate tools to assess frailty in the context of CR to better plan patient management. The Heart Failure Frailty Score, which was recently developed by the ESC's Heart Failure Association, will undergo a validation phase to ascertain its prognostic capacity and ease of use in clinical practice.[205,227] The Short Physical Performance Battery (SPPB) is a valuable diagnostic tool for assessing physical performance and identifying physical limitations in older people.[228] Although data suggest that CR may be most beneficial for physically frail patients with CVD,[229] patients with poor functional status are less likely to attend CR.[230] Additional tests, including a neuromuscular or orthopaedic examination, should be performed on patients with such limitations in order to prescribe personalized exercise.[205] Psychological risk factors such as depression and anxiety should be screened for in patients with heart disease to guide referral, intervention, and management, and to identify individual needs and barriers to behaviour change.[231–233]

A detailed systematic assessment of nutritional status is essential in patients considered to be at increased nutritional risk (see *Section 7.6*). In addition to dietary habits and preferences, anthropometric measurements, laboratory tests, and depending on the individual patient and the underlying pathology, body composition studies may be done to estimate lean, bone, and fat mass. Examples of such studies include bioelectrical impedance analysis and dual-energy X-ray absorptiometry (see *Section 7.6*) that can allow interventions to be tailored more effectively to address the specific nutritional needs and challenges of each patient. Several nutritional assessment tools have been developed for categorizing malnutrition, and the utility of these tools in the prognostication of ACS and HF has been shown.[234,235]

7.2. Self-management, behaviour change, and education

7.2.1. Self-management

Self-management of health is becoming increasingly complex, and strategies are needed to support patients to improve health literacy and understand complex health information. Self-management of health includes giving the patient the opportunity to take an active role in their therapy and care through shared decision-making. Behaviour change, through patient education, is a key component in improving health outcomes.

7.2.2. Behaviour change

Once diagnosed, CVD is a lifelong condition primarily managed by the patient. Taking a patient-centred approach (see *Section 3*) is needed when supporting patients in behaviour change. The Behaviour Change Wheel model outlines a taxonomy of behaviour change techniques that can be used, where efficient interventions should include setting goals and planning actions, followed by self-monitoring and feedback, and should include social support. These actions should be targeting the patient's capability, opportunity, and motivation of behaviour change (COM-B).[236,237] The patient's capability includes their available knowledge, skills, and capacity to initiate change, while the patient's opportunity includes external factors that allow such engagement. The COM-B system is central to the Behaviour Change Wheel model that connects the conditions for behaviour change with intervention functions and behaviour change techniques.[237] Targeting more than one behaviour is beneficial for behavioural-change interventions. A systematic review and meta-analysis showed that interventions seeking to change multiple behaviours together improved diet, physical activity, medication adherence, and alcohol consumption.[238] Changing multiple health behaviours is relevant in CR.

Several techniques can be used. Motivational interviewing is a pragmatic approach to help people change behaviours and is based on encouraging patients to take an active role in their therapy.[239] Enhancing internal motivation and supporting self-efficacy are central pillars. In motivational interviewing, the intervention aims to increase motivation by setting realistic, measurable goals alongside self-monitoring to reduce targeted risk factors. For example, trackers can be used to monitor physical activity (see *Sections 7.4* and *8.2*),[240] and the frequency and duration of tobacco use for smoking cessation (see *Section 7.7*), and food diaries can be used to overview nutritional intake (see *Section 7.6*). Motivational interviewing is also based on principles including enhancing internal motivation, developing a collaborative relationship between patient and healthcare provider, and drawing on patient resources and motivation.[239]

Interventions that improve physical activity (*Section 7.4*), diet (*Section 7.6*), or smoking cessation (*Section 7.7*) include behaviour change techniques such as goal setting, feedback on behaviour, and information about health consequences. Digital prompts have also been shown to be effective, as they improve medication adherence.[237] In a large umbrella review including 865 000 individuals with non-communicable diseases, specific intervention components that are effective and should be prioritized include using a credible source, graded tasks, human coaching, and personalization. These are to be used in addition to goals and planning, feedback and monitoring, social support, and digital prompts.[241]

7.2.3. Education

Patient education, defined as an evidence-based, planned, patient-centred intervention, plays an important role in promoting behaviour change. As a core component of CR, patient education spans the CR continuum, commencing as early as possible following diagnosis (acute hospital-based rehabilitation), and extending into long-term care including maintenance of follow-up. Education on the benefits of attending CR, including what to expect from the programme, is pivotal to engage patients and improve enrolment to CR.[242] Educational topics which typically include exercise, prescription, nutrition, medication adherence, risk factor management, psychosocial well-being, and secondary preventive strategies can be delivered in a variety of ways. Written material (booklets, information cards, and diaries for self-monitoring) and videos can be used in combination with clinical encounters, as well as practical workshops on blood pressure measurement or glycaemic control in order to enhance self-management skills. Increasingly, digital solutions are used for delivering educational material and messages/prompts online.[243] Patient education can be delivered in a variety of settings: in-hospital, outpatient, or home-based digital formats (see *Sections 8* and *9*).

A systematic review and meta-analysis provided evidence for initiating secondary prevention education before hospital discharge. Forty-three trials were included in the systematic review with variations in intervention mode of delivery, duration, and frequency of follow-up. However, 32 trials of 6057 participants were included in the meta-analysis showing that education initiated in hospital increased knowledge and quality of life, and decreased risk of readmissions. In-hospital education also resulted in small but significant improvements in low-density lipoprotein cholesterol (LDL-C), blood pressure, CR attendance, and medication adherence.[244] In a Cochrane review, stand-alone patient educational interventions have shown no benefits for total mortality, morbidity, and hospitalization, although some evidence suggests that education-based interventions may reduce fatal/non-fatal CVD events and/or improve HRQoL.[245,246] However, patient education should coexist with other components of CR such as exercise training and psychological therapy reinforcing the multimodal nature of effective CR.[245] This review did not evaluate the intensity of educational therapy or the relative effect of intervention duration. A more recent systematic review and meta-analysis including close to 25 000 patients showed that patient education improved all behaviours studied, including the likelihood of quitting smoking, medication adherence, physical activity and exercise participation, healthy dietary behaviours, and disease knowledge, all at both <6 and 6–12 months follow-up. Furthermore, longer educational programmes (≥3 months) improved disease knowledge and physical activity more than shorter programmes. Patients who improved their healthy dietary habits in the short term were three times more likely to have a healthy diet after education. The likelihood of sustaining medication adherence and physical activity more than doubled.[247] This is important since the effectiveness of treatment and treatment Guidelines are only as good as patient adherence. For example, if patients are uninformed about why, how, and when to take their medications, prescribing the medications is of lesser use. This is also the case for lifestyle advice requiring behaviour change (see *Section 7.2.2*). Patient education can also cover broader topics, such as the importance of vaccination.[248]

Patient education is also important for psychological well-being. A systematic review and meta-analysis showed that patient education for secondary prevention in patients with coronary heart disease (CHD) improved anxiety and depression symptoms in both short- (<6 months) and long-term follow-up (6–12 months), regardless of intensity. Patient education reduced clinical depression by 35% and anxiety by 60%. Longer educational programmes (>3 months) reduced depression symptoms, but this was not the case for anxiety.[249] Individualized patient education has also been found to reduce anxiety and depression in patients after cardiac surgery[250] and in patients with AF on oral anticoagulant therapy.[251] Further, in patients after cardiac surgery, educational interventions have shown favourable effects on readmission rates.[252] In patients with ICDs, psycho-educational interventions improved physical aspects of quality of life. The educational interventions included CBT, problem-solving, and ICD-specific education and recovery management, as well as relaxation training.[252]

7.2.4. Health literacy

Patient education aims to change behaviour and consequently improve health status. However, a major barrier to effective patient education can be the gap between the patient's health literacy and the educational resources used, including medical language. Health literacy is defined as the knowledge, confidence, and comfort to access, understand, appraise, remember, and use information about health.[253] Health literacy is a pre-requisite for patients to self-manage their health, and low health literacy associates with poor outcomes. A scientific statement from the American Heart Association on health literacy and CVD[254] identified and addressed five challenges:

(i) individuals with limited health literacy experience challenges with accessing healthcare services;
(ii) educational material includes technical language and lacks illustrations to make the message comprehensive;
(iii) patient–provider communication is hampered by barriers such as use of medical and academic language. Patients with low health literacy may not ask fundamental questions;
(iv) patients must comply with complex treatment regimens. For example, medication adherence requires an understanding of dosage and timing, dietary choices, symptoms, and side effects; and
(v) language and cultural barriers often result in poor communication and health literacy challenges, particularly among refugees, immigrants, and individuals with limited language proficiency.

A systematic review and meta-analysis showed that low health literacy significantly associates with increased mortality and hospital readmission, and decreased quality of life in patients with CVD.[255] Key aspects of health literacy have also been associated with behavioural and psychological risk factors. One large cohort study showed that for each one-unit better score on health literacy scales, weekly physical activity was 12–20 intensity-adjusted minutes higher, and the odds of being a non-smoker were 24%–72% higher.[256]

The pan-European survey, European Action on Secondary and Primary Prevention through Intervention to Reduce Events (EUROASPIRE V), describes a variety of health literacy levels across ESC Member States. Among its key messages is the need to give patients accessible health information that can be understood across different health literacy levels, and to provide support so that patients can self-manage their lifestyle and medication regimes more effectively.[257]

Interventions to foster empowerment through health literacy are needed. A review synthesized the evidence on interventions to strengthen health literacy for secondary prevention of CAD and found them to include:

(i) building social support by involving partners in education (can effectively reduce depression, increase knowledge, and improve physical activity);
(ii) including peers (may decrease anxiety, increase self-efficacy, and improve health behaviours);
(iii) using a teach-back method, which helps patients understand information (and associates with reduced hospital readmissions); and
(iv) providing structured follow-up support (may improve the appropriate use of health services and reduce readmissions).[258]

Concerns regarding health literacy arise when delivering CR digitally. The digital divide—i.e. the uneven distribution of internet access and devices—is concerning in the era of increasing digitalization of health services. Concerns also exist about the digital literacy needed to make use of the devices and the information flow. In digital CR programmes, care should be taken to accommodate steps to increase digital health literacy. This also concerns development of a health literate organization. Cardiac rehabilitation centres should make information accessible and understandable, and support patients in navigating the healthcare system. Involving patients in co-designing services and materials can ensure that communication is clear and inclusive.[259,260]

7.2.5. Communication techniques

Effective communication of health information is essential yet often difficult. It is estimated that 40%–80% of health-related information communicated to patients is immediately forgotten.[261] Teach-back is a communication technique that embeds health literacy, helping patients both understand

and remember information. This well-defined and evidence-based communication technique has been found to be effective across a wide range of settings and populations.[262] It helps to evaluate the effectiveness of an educational session and could also have a role in shared decision-making. Teach-back involves asking patients to explain in their own words the key messages in what the health provider has just told them. Any misunderstandings are then clarified by the health provider and understanding is checked again. This process continues until the patient can correctly recall the key information that was given. It is suggested to divide the information into shorter sections, have the patient 'teach-back', and gently correct if the patient misunderstands, before moving to the next section (*Figure 9*). Using teach-back in digital health interventions can be done when combining the digital health intervention with face-to-face or video consultations. Further, the teach-back technique can also be used in the written digital programme by including check questions at the end of each section for self-testing. Questions can be multiple choice, where patients can try again until they have all the correct answers.

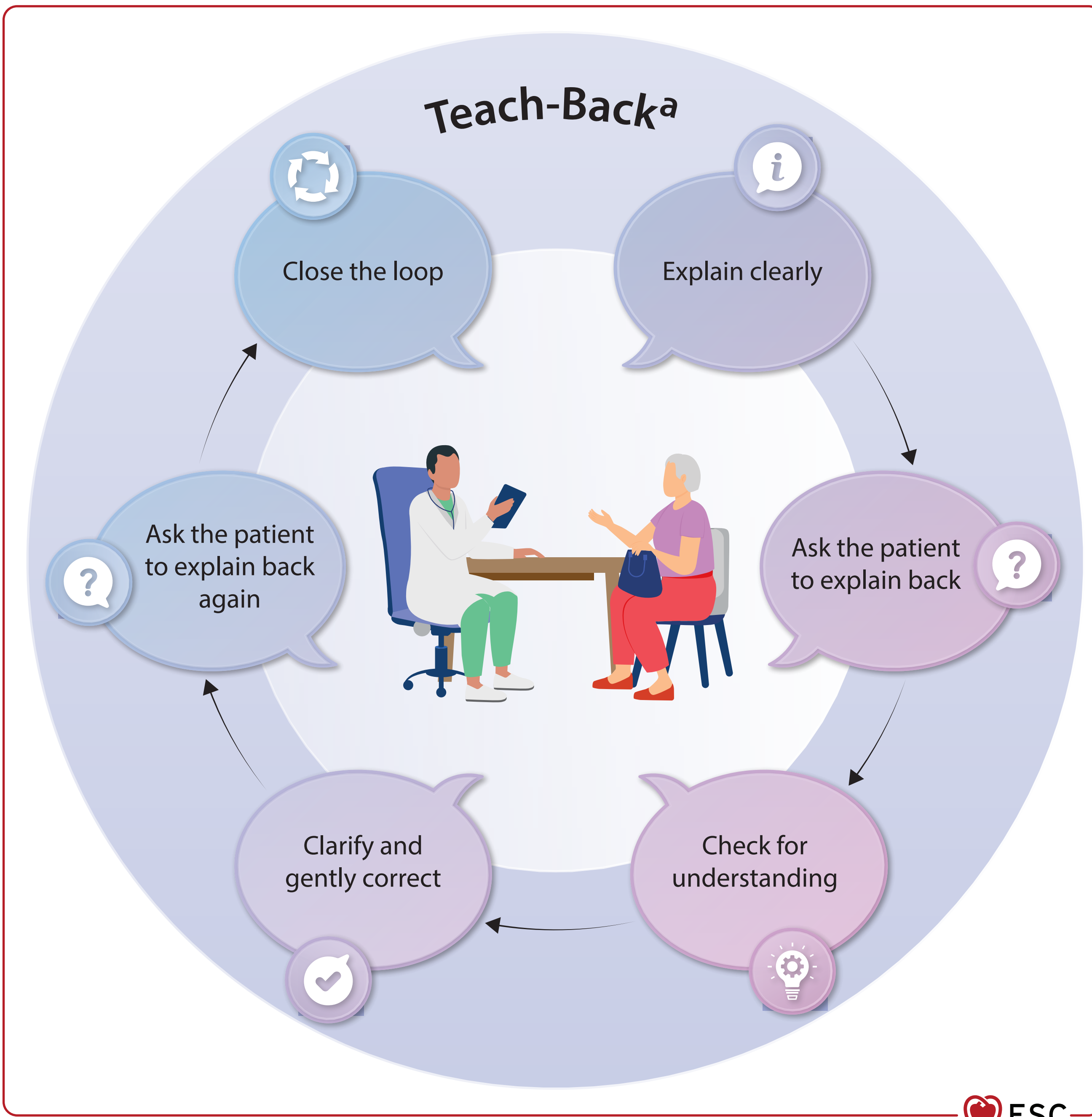

Figure 9 The Teach-Back method in cardiac rehabilitation education. [a]Helps improve understanding and self-care management (Class IIb).

Recommendation Table 14 — Recommendations for self-management, behaviour change, and education (see Evidence Table 14)

Recommendations	Class[a]	Level[b]
Self-management strategies using behaviour change techniques including setting goals and planning, (self-) monitoring and feedback, and psychological and social support is recommended for patients with cardiac diseases to increase physical activity, HRQoL, medication, and healthy lifestyle adherence, and reduce risk factors.[237,263–265]	I	B1
Goal-specific patient education including disease management and risk factor modification is recommended for patients with cardiac disease to improve health behaviours, disease knowledge, and HRQoL.[245,247,258,266]	I	B1
Taking health literacy and digital health literacy into account, and establishing interventions to strengthen health literacy, is recommended for patients with cardiac disease to improve risk factor management and increase quality of life.[254,255,257,258]	I	B2
Educational interventions should be considered in patients with CAD and AF to reduce mental functioning (anxiety and depressive symptoms).[249,251]	IIa	B2
Psycho-educational interventions may be considered in patients with an ICD to improve their HRQoL.[252]	IIb	B2
The teach-back method may be considered for patients with cardiac disease to help patients understand information and improve self-care management.[262]	IIb	C

AF, atrial fibrillation; CAD, coronary artery disease; HRQoL, health-related quality of life; ICD, implantable cardioverter defibrillator.
[a]Class of recommendation.
[b]Level of evidence.

7.3. Optimizing cardiovascular pharmacotherapies

Despite robust clinical trial evidence and clear guideline recommendations (*Table 6*), for a significant proportion of patients—particularly those who have had coronary revascularization or who are living with HF—these Guidelines remain under-used and optimal guideline-directed medical therapies are not given. Many patients do not receive these therapies, are prescribed suboptimal dosages, or fail to adhere to their prescribed regimens.[267,268] The cross-sectional EUROASPIRE V survey, conducted across 131 centres in 81 regions within 27 European countries, revealed that following an ACS, most patients missed the recommended targets for blood pressure, LDL-C, and glucose levels.[269] Similarly, a multinational study of patients at high and very high risk of CVD found that only 31% achieved the LDL-C goals set in the *2019 ESC/EAS Guidelines for the management of dyslipidaemias*.[270]

Table 6 The impact of guideline-directed pharmacotherapy on frequent conditions in cardiac rehabilitation

Guideline-directed pharmacotherapy in patients after ACS or with CCS improves cardiovascular risk factor profile and reduces MACE and all-cause mortality.[14,15]
Guideline-directed pharmacotherapy in patients with HF reduces MACE and all-cause mortality.[16,271]
Guideline-directed pharmacotherapy in patients with AF reduces risk of AF burden and recurrence, as well as thromboembolic events.[138]
Guideline-directed pharmacotherapy in patients with cancer during or after cardiotoxic therapies improves cardiovascular risk factor profile and reduces the risk of HF development and other cancer therapy-related complications.[17]
Guideline-directed pharmacotherapy in patients with obesity, diabetes, hypertension, dyslipidaemia, or immune-related rheumatic diseases improves risk factor control and reduces MACE and all-cause mortality.[25,174–177]

ACS, acute coronary syndrome; AF, atrial fibrillation; CCS, chronic coronary syndromes; CR, cardiac rehabilitation; HF, heart failure; MACE, major adverse cardiovascular event.

Patients with musculoskeletal diseases, particularly those with inflammatory joint diseases and other rheumatic immunological diseases, can often receive suboptimal doses of lipid-lowering treatment, which can mean LDL-C targets are missed.[272–274] This suboptimal prescribing may be improved during CR.

As patients with AF are at risk of ischaemic stroke, providing face-to-face education during CR may enhance their medication compliance and medical-compliance behaviour for anticoagulant and antiarrhythmic medication, as well as enhance their quality of life.[275] The effects of improving medical adherence on CVD outcome are currently uncertain, but the results from the STEEER-AF (Stroke prevention and rhythm control therapy: evaluation of an educational programme of the ESC in a cluster-randomized trial in patients with atrial fibrillation) will soon provide more knowledge.[276,277]

A recent EAPC clinical consensus document offers guidance on how to optimize guideline-directed medical therapies for the secondary prevention of CVD.[278] While the scientific evidence is still evolving, the structure of CR provides an ideal framework for educating on guideline-directed medical therapies and optimizing pharmacotherapies (*Figure 10*). This is particularly relevant where new evidence challenges established assumptions, such as data from a recent meta-analysis that suggests no reduction in mortality, recurrent MI, or HF with beta-blockers after recent MI in patients with preserved LV ejection fraction and no other indication for treatment.[279] Cardiac rehabilitation offers close, long-term patient supervision, enabling personalized adjustments to be made to medications based on laboratory results, vital signs, and patient-reported symptoms. This approach contributes to the improved control of cardiovascular risk factors and better clinical outcomes.[280,281]

This approach is particularly crucial for patients with HF, for whom up-titrating guideline-directed medical therapies is a significant challenge due to factors such as tolerability, comorbidities, and the need for careful monitoring.[282]

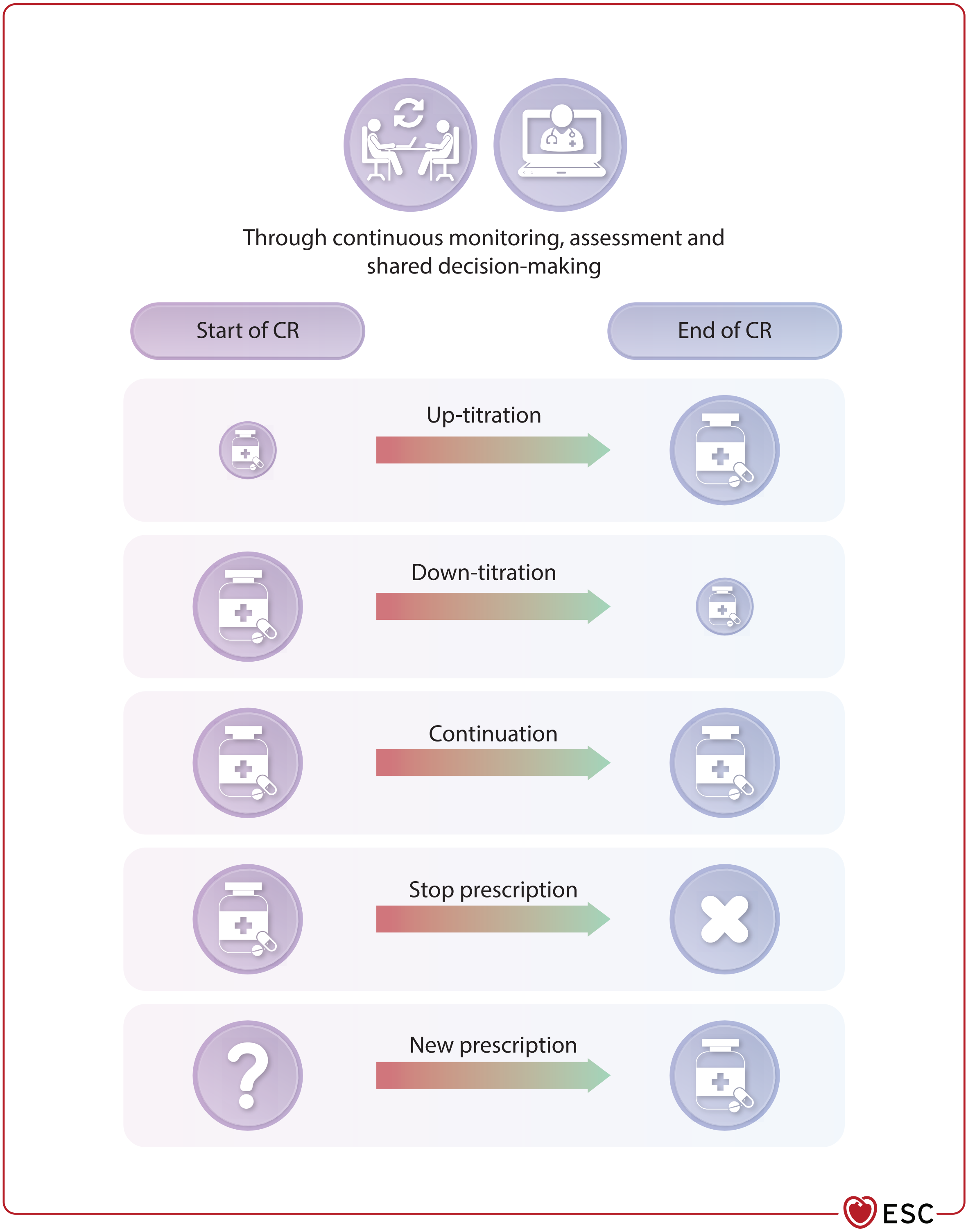

Figure 10 Framework for guideline-directed pharmacotherapy during cardiac rehabilitation. CR, cardiac rehabilitation.

The STRONG-HF (Safety, Tolerability and Efficacy of Rapid Optimization, Helped by NT-proBNP Testing, of Heart Failure Therapies) trial showed that an intensive treatment strategy involving rapid up-titration of guideline-directed medical therapies and close follow-up after admission for decompensated HF was well accepted by patients. This approach effectively reduced symptoms, improved quality of life, and lowered the risk of 180-day all-cause mortality or HF readmission compared with usual care.[283] Early CR following an episode of decompensated HF event provides a valuable opportunity to monitor these patients closely, promptly identify signs of congestion, maintain euvolaemia through timely diuretic adjustments, and continue up-titrating guideline-directed medical therapies.[282] In the context of CR for older adults, who often present with polypharmacy[284] and frailty, effective medication management may include medication reconciliation and deprescribing. This is a key process that can help to ensure patient safety, improve adherence, and optimize clinical outcomes.

Education on guideline-directed pharmacotherapies should be considered in all patients attending CR to improve up-titration, adherence, persistence, reconciliation, deprescribing, cardiovascular risk-factor profile, and outcomes. In addition, periodical medication reconciliation and deprescribing should be exercised.

Despite the long-standing recognition of issues related to sex and gender, evidence continues to demonstrate persistent sex disparities in the management of CVD. Sex disparities in cardiovascular medication are well documented with women often receiving less guideline-recommended therapy and facing more barriers to optimal care compared with men. In a nationwide analysis in 175 187 patients who were hospitalized due to ST-segment elevation MI, antiplatelet drugs and/or oral anticoagulation, beta-blockers, angiotensin-converting-enzyme inhibitors/angiotensin receptor blockers, and statins were prescribed less often in women, although the prognosis improved with increasing these drugs.[285] The most recent REBOOT (Treatment with Beta-Blockers after Myocardial Infarction without Reduced Ejection Fraction) trial confirmed the issue of underprescription in women.[286] In a recent cohort of patients who underwent a revascularization procedure, being a female was an independent predictor of significantly lower likelihood of reaching an LDL-C <70 mg/dL (1.8 mmol/L) at follow-up.[287]

The disparities in the initiation of medication may be related not only to healthcare providers, but also to women themselves. Women have a lower perceived risk of CVD than men and demonstrate lower adherence.

Moreover, CR is an opportunity for surveilling patients with cancer undergoing cardiotoxic antineoplastic drug therapy to improve cardiovascular risk profile, to detect early any eventual cardiac damage, and to optimize cardioprotective therapy.

Recommendation Table 15 — Recommendations for optimization of cardiovascular pharmacotherapies (see Evidence Table 15)

Recommendations	Class[a]	Level[b]
Using CR as a framework to optimize guideline-directed pharmacotherapies is recommended in all patients with CR indication to improve health outcomes.	I	C
Education on guideline-directed pharmacotherapies should be considered in all patients attending CR to improve adherence, cardiovascular risk factor profile, and outcomes.[280,281]	IIa	B1

CR, cardiac rehabilitation.
[a]Class of recommendation.
[b]Level of evidence.

7.4. Physical activity and sedentary behaviour counselling

Physical activity and exercise are often used interchangeably, even though these terms differ. Detailed definitions are given in *Table 7*.

Counselling on physical activity and reducing sedentary behaviour is a cornerstone of CR, complementing exercise training. This counselling provides patients with personalized advice, support, and strategies to foster the adoption and long-term maintenance of an active, healthier lifestyle. It should align with the *World Health Organization 2020 guidelines on physical activity and sedentary behaviour*[290] (see *Figure 11*). Physical activity counselling as part of CR aims to foster the development of sustainable physical activity habits and avoidance of sedentary behaviour that contributes to long-term cardiovascular health.[291,292] These Guidelines emphasize the role of physical activity and structured exercise training as key interventions to improve health outcomes. This should be distinguished from participation in sports, which is primarily recreational and should be considered based on individual preferences and clinical appropriateness relative to the underlying cardiovascular condition. For detailed guidance on sports participation in individuals with CVD, reference is made to the *2020 ESC Guidelines on sports cardiology and exercise in patients with cardiovascular disease*.[18]

Sedentary behaviour is strongly linked to adverse cardiovascular outcomes, with particularly pronounced impacts on HF and cardiovascular mortality. Notably, even physically active individuals with high sedentary time are at an elevated risk of

Table 7 Definitions of physical activity, exercise, and sedentary behaviour

Physical activity	Physical activity is defined as any bodily movement produced by skeletal muscles that results in energy expenditure. This includes everyday activities such as walking, gardening, cleaning, or playing.[288]
Exercise	Exercise is physical activity that is planned, structured, repetitive, and purposeful, in the sense that improving or maintaining one or more components of physical fitness is an objective.[288]
Sports	Sports are physical activities that involve one or more components such as skill, power, endurance, or a combination of these. They vary in intensity of exercise and can be performed at an amateur or professional level, often within structured rules, for leisure or competitive purposes.[18]
Physical inactivity	A physical activity level insufficient to meet present physical activity recommendations.[289]
Sedentary behaviour	Sedentary behaviour is any waking behaviour characterized by an energy expenditure ≤1.5 metabolic equivalents, while in a sitting, reclining, or lying posture.[289]

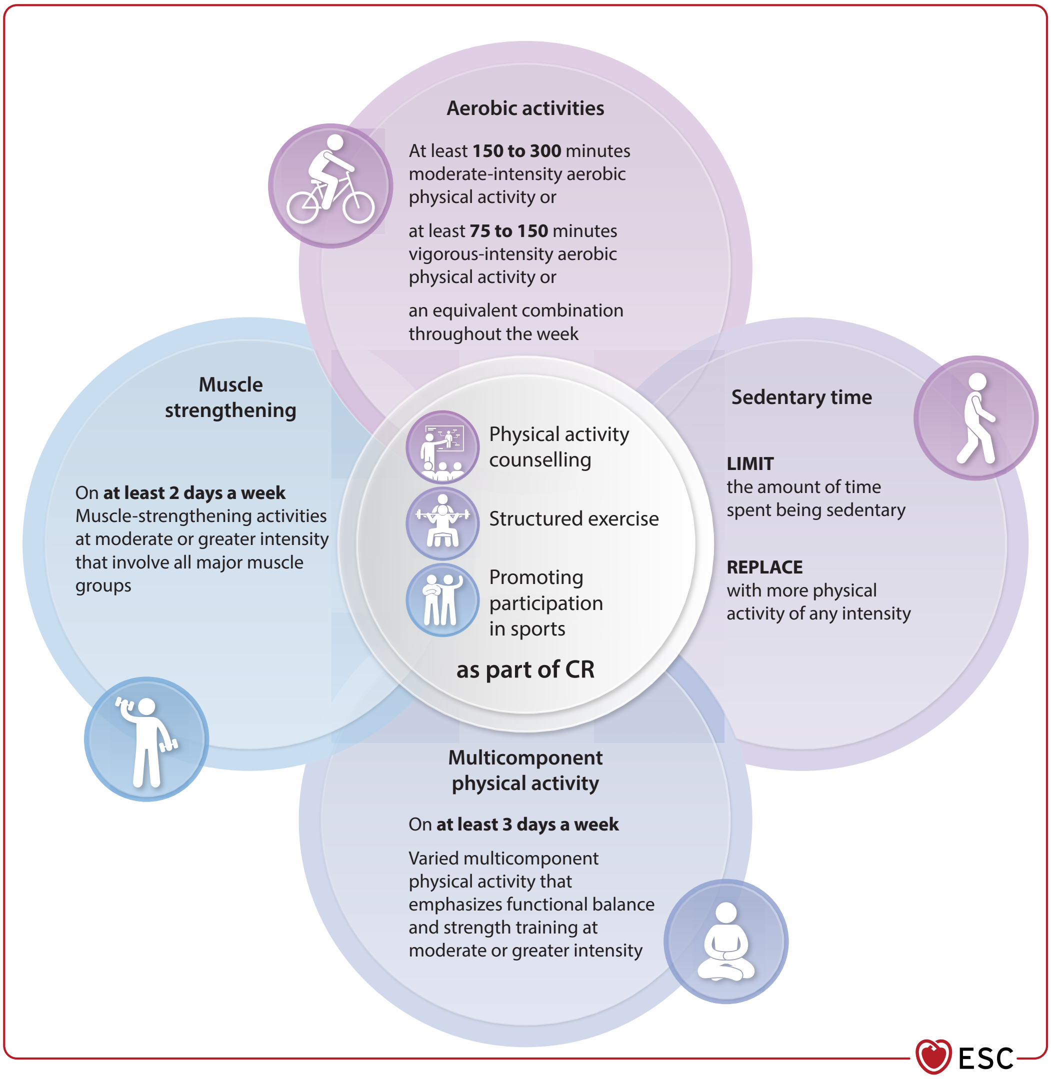

Figure 11 Physical activity and sedentary behaviour recommendations. CR, cardiac rehabilitation. Adapted from Bull *et al.*[290].

cardiovascular events. These findings highlight the importance of addressing sedentary behaviour as a distinct and critical factor in cardiovascular health, emphasizing the need for interventions to reduce sedentary time, even in physically active individuals.[293]

Effective physical activity and sedentary behaviour counselling begins by thoroughly assessing the patient's physical and cardiovascular status, including addressing barriers to physical activity. Many patients with cardiac disease encounter challenges to regular physical activity, such as fear of aggravating their condition, fatigue, lack of motivation, or physical limitations.[294] Counselling should directly address these barriers by providing practical solutions and building confidence in the patient's ability to safely participate in physical activity.[295]

7.4.1. Counselling techniques and strategies

Setting realistic, attainable goals is essential for motivating patients to engage in physical activity.[296,297] Short-term goals, such as walking a certain distance or increasing physical activity by 5–10 min per session, can help patients build confidence. A dose–response analysis showed that an increase of 500–1000 steps per day was associated with lower all-cause mortality and cardiovascular events.[298] Long-term goals should focus on lifestyle changes and regular engagement in physical activity. This shift from short-term achievements to lasting lifestyle changes is essential for enhancing HRQoL. By helping patients establish routines they can maintain, we enable them to develop a habit of regular physical activity that aligns with their personal goals and health needs.

Achieving successful physical activity counselling requires addressing both psychological and physical barriers.[296,299] For individuals who fear exercise due to cardiac symptoms, a gradual, supervised increase in intensity helps show that physical activity is safe and manageable.[300] For those with low motivation, integrating enjoyable activities, social support, and group-based exercise sessions can improve adherence and foster long-term engagement with physical activity.

Counselling should be approached in a non-judgemental, non-directive, and open manner, applying the principles of Open questions, Affirmations, Reflections, and Summaries (OARS) to support the development of a trusting and empathetic relationship.[239] These techniques help patients explore their own motivations and barriers, and empower them to make informed decisions aligned with their values and context.

Regular monitoring of physical activity, either through wearable devices or self-reported logs, can help track progress and provide feedback to both the patient and healthcare providers.[301–303]

After the structured phase of CR, maintaining regular physical activity is critical for long-term cardiovascular health.[304,305] Patients should be counselled on practical strategies to incorporate physical activity into daily life at work, at home, and during leisure time. Examples include walking instead of driving short distances, using stairs, performing household chores, or engaging in hobbies such as gardening or dancing. It is never too late to adopt an active lifestyle, even in patients with established CAD.[306]

The WHO stresses balancing periods of inactivity with regular movement and recommends integrating more physical activity into daily routines to improve overall health and reduce the risks associated with prolonged sedentary behaviour.[290] Sedentary behaviour, including prolonged sitting, screen time, or lying down (outside of sleep), should be limited as it associates with an increased risk of CVD, cancer, and mortality.

Educating patients about the benefits of physical activity and the risks associated with a sedentary lifestyle is crucial.[307] Information should be provided on the types of exercise that are safe and effective for improving cardiovascular health.[308] Education should also address common concerns and misconceptions, such as the fear of exercise-induced cardiac events. Supporting networks, such as community exercise programmes or peer groups, can help patients stay motivated after completing CR.

Recommendation Table 16 — Recommendations for physical activity counselling and sedentary behaviour (see Evidence Table 16)

Recommendations	Class[a]	Level[b]
Use of activity trackers is recommended as part of CR in patients with cardiac disease to significantly increase daily step count and physical activity level.[301,302]	I	B1
Preserving or adopting an active lifestyle during CR is recommended in patients with CAD to reduce the risk of cardiovascular and all-cause mortality.[306]	I	B2
Physical activity and sedentary behaviour counselling, ideally aligned with the WHO Guidelines, is recommended in all patients undergoing CR to maintain an active lifestyle after CR.[290,291]	I	C
Reducing sedentary time should be considered in all individuals undergoing CR to decrease the risk of adverse cardiovascular outcomes and cardiovascular mortality.[293]	IIa	B2

CAD, coronary artery disease; CR, cardiac rehabilitation; WHO, World Health Organization.
[a]Class of recommendation.
[b]Level of evidence.

7.5. Exercise training

Exercise training is strongly recommended as a key component of CR programmes, as it consistently leads to improvements in physical functioning such as walking capacity or aerobic capacity (VO_2peak), in every indication for CR (see *Section 5*): an impact that cannot be achieved by pharmacotherapy only. As physical functioning (including muscle strength and endurance, and exercise capacity) predicts prognosis in patients with various kinds of CVD,[309] exercise training indeed significantly reduces mortality, hospitalizations, or major adverse cardiovascular events (MACEs) in several indications for CR, specifically ACS, CCS, and HF.[53,310] Patients with AF or valvular disease (with surgery) benefit significantly from exercise training as part of CR. More recently, studies have confirmed that exercise training, alone or as part of a CR programme, is recommended for patients with congenital heart disease to improve cardiorespiratory fitness and muscle strength and may be considered to improve physical activity levels, and HRQoL.[58,134,135,311] During or after cancer therapy, exercise training is recommended to improve physical fitness and reduce fatigue, particularly among patients at high risk of experiencing cardiotoxicity.[161,162,165,167,312–315] Exercise as part of CR (defined as structured aerobic, resistance, and/or flexibility training, and including HIIT) has been shown to improve anxiety, depressive symptoms, physical activity, cardiorespiratory fitness, muscle strength, HRQoL, and survival.[161,162,316] Benefits achieved through exercise as part of CR persist for months post-intervention in cancer survivors and resulted in significantly longer disease-free and overall survival.[161,316] In studies examining the impact of exercise training in heart disease, most often cycling, (treadmill) walking, gymnastics, and/or dynamic resistance exercises were applied. Although alternative exercise forms (e.g. Nordic walking and dancing) are sometimes available, these do require further examination for confirmation of their clinical effectiveness.[317]

Importantly, CR clinicians and healthcare professionals should adhere to exercise prescription Guidelines or recommendations as previously formulated, based on the FITT-VP (frequency, intensity, time, type, volume, and progression) principle.[18,25,52,162,165] The basic components of exercise prescription (modalities)[18] are given in the Supplementary data online, *Table S6*. Before prescribing exercise as part of CR, it is essential to perform a comprehensive functional assessment (not solely based on VO_2peak) (see *Section 7.1*) to ensure the safety (see *Section 4*), appropriateness, and individualization of the training programme.

As shown in *Table 8*, general exercise recommendations (with a detailed prescription of frequency, duration, intensity, and type of exercise) have been formulated for patients with CCS or chronic HF and can be considered as a reference frame for exercise prescription (with lower and upper limits for the different exercise modalities). In patients with CCS, the combination of endurance and resistance exercise training is proposed, while in patients with chronic HF, the combination of endurance, resistance, and inspiratory muscle training is proposed, when tolerated. In patients with heart disease, the majority of each exercise session consists of endurance exercises (e.g. two-thirds of the total exercise bout duration), while resistance exercises are added on top of these endurance exercise (e.g. making up one-third of the total exercise bout duration). In general, an

Table 8 **General exercise prescriptions for acute coronary syndrome, chronic coronary syndromes, and chronic heart failure**

	ACS and CCS	Chronic HF
Endurance exercise		
Frequency	≥3 up to 5 days per week	Up-titrating from 2–3 to 3–5 days per week
Session duration	30–60 min	Up-titrating from 15–30 to 45–60 min
Intensity	Moderate and moderate-to-high[a]	Moderate[a] and moderate-to-high, but low[b] in selected patients
Weekly energy expenditure (exercise volume)	1000–2000 kcal/week	>1000 kcal/week
Resistance exercise		
Frequency	≥2 days per week	≥2 days per week
Number of sets/repetitions	≥2 sets per large muscle group, 12–15 repetitions per set	Up-titrating to ≥2 sets per large muscle group, 8–15 repetitions per set
Intensity	30%–70% 1RM for upper extremities 40%–80% 1RM for lower extremities	Up-titrating to 40%–60% 1RM
Inspiratory muscle training		
Frequency	ND	3–5 times per week up to daily exercise
Session duration	ND	20–30 min
Intensity	ND	Up-titrating from 30% to 60% of maximal inspiratory pressure

1RM, one-repetition maximum; ACS, acute coronary syndrome; CCS, chronic coronary syndromes; HF, heart failure; HRR, heart rate reserve; ND, no data; RPE, rating of perceived exertion; VO_2peak, peak oxygen uptake; VT1/2, ventilatory threshold 1/2; Wpeak, cycling power output.

[a]Moderate (up to high depending on mode of exercise) = 45%–85% VO_2peak, 50%–70% of Wpeak (above the first ventilatory threshold), 55%–90% HRpeak, 40%–85% HRR, or 12/20–17/20 of the Borg RPE Scale.

[b]In patients with a low exercise capacity, recent haemodynamic decompensation or high exercise-related risk, start at a level as low as 40% VO_2peak. Then gradually increased to VT1 (50%–60% VO_2peak), which is the safest point. Then, if well tolerated, intensity may increase close to VT2 (65%–90% VO_2peak).

exercise intervention, or active mobilization, should start as early as possible, but after confirmation of sufficiently medical stability of the patient (see *Section 4*). The median duration of exercise programmes is commonly reported to be 3–4 months; however, heterogeneity exists across studies.[8,9] Evidence indicates a dose–response relationship between CR sessions and MACEs, with greater benefits observed with increasing the number of sessions. No lower threshold or ceiling effect was identified, suggesting that higher CR doses consistently confer greater risk reduction.[207] Following completion of CR, patients are encouraged to continue exercise in a self-managed manner to maintain the beneficial effects achieved.

However, to achieve personalized exercise intervention, as part of CR, it is vital to tailor the exercise modalities to the personal goals, medical needs, capabilities, and phenotype of the patient, as explained below (*Figure 12*).

First, it is important to set the initial intensity of endurance and resistance exercise appropriately (*Figure 13*). Cardiopulmonary exercise testing and assessing the one-repetition maximum are the most appropriate assessments for this purpose. Under certain circumstances, when cardiopulmonary exercise testing is not available and when exercise training is performed at lower intensities (and therefore lower risk), a submaximal exercise test may be considered as an alternative.

In previous Guidelines, the use of a fraction of the peak effort [e.g. % peak heart rate (HRpeak), % heart rate reserve (HRR), % VO_2peak] was often proposed as a method for setting the endurance exercise intensity. However, when exercising at the same % HRpeak or %VO_2peak, acutely induced physiological responses [e.g. blood lactate, heart rate, oxygen uptake (VO_2)] show a high interindividual variability, while exercising at (a fraction of) the ventilatory threshold induces a more homogeneous/similar physiological response between individuals. This applies to cycling and walking exercises, but also to other endurance exercise modes (e.g. rowing).[318] The use of %HRpeak, %HRR, or %VO_2peak thus increases the risk of misclassifying the exercise intensity domain (based on Guidelines) in which a subject actually exercises. Moreover, exercise training based on the ventilatory threshold improves VO_2peak and metabolic risk more than exercise training based on the percentage of peak effort, at least in healthy people.[319]

Using the general metabolic equivalent scales for classifying the endurance exercise intensity (i.e. <3 = low-intensity exercise, 3–6 = moderate-intensity exercise, or >6 = high-intensity exercise) is also discouraged: these metabolic equivalent-scale classifications correlate very poorly with truly elicited physiological responses during exercise [e.g. VO_2 or heart rate at ventilatory threshold 1 and 2 (VT1 and VT2), %VO_2peak], and for most patients with CVD exercising at a metabolic equivalent of 4–6 would be supramaximal.[320]

Therefore, to set the intensity of endurance exercise, the use of the ventilatory thresholds is preferred over using a fraction of peak effort (e.g. %HRpeak, %HRR, %VO_2peak).[219] However, in many CR facilities, gas-exchange analysis during exercise testing is unavailable, because of logistic/financial constraints. In its absence, the ventilatory thresholds can be predicted with great accuracy from simple outcomes obtained during maximal exercise testing [i.e. resting (HRrest) and HRpeak], for which the following formulae can be used:

$$\text{Heart rate at VT1} = 4.866 + (0.405 \times HRpeak) + (0.542 \times HRrest);$$
$$\text{Heart rate at VT2} = -2.606 + (0.773 \times HRpeak) + (0.254 \times HRrest).$$
[321]

For setting the intensity of resistance exercise during training sessions, the percentage of one-repetition maximum for each muscle group targeted is strongly encouraged. However, in patients with heart disease the load–repetition relationship for resistance training, such as a 10-repetition maximum, may be more appropriate to be assessed (e.g. to avoid Valsalva manoeuvre during strength testing).[219] Subsequently, prediction equations[322]

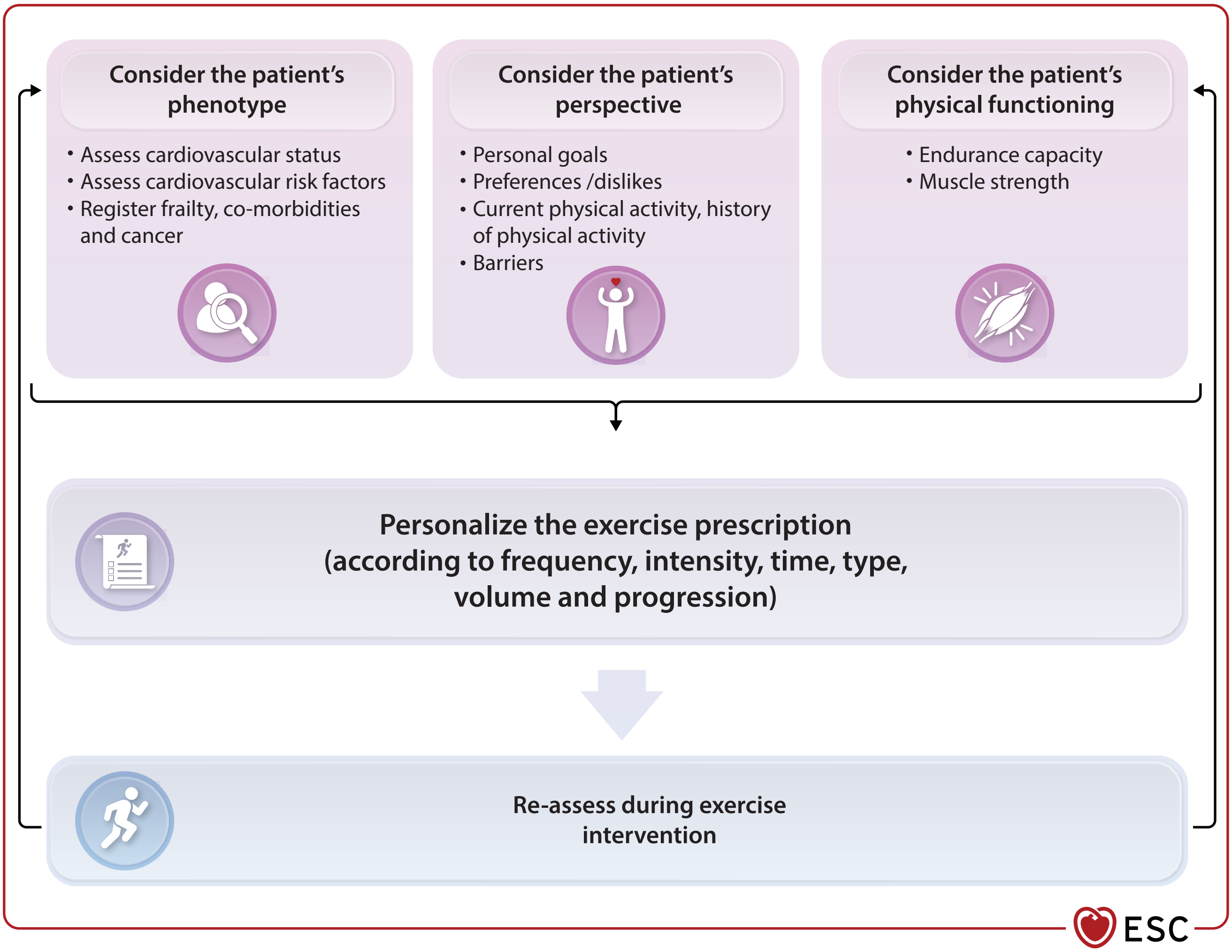

Figure 12 Practical approach in tailoring the exercise prescription. Inflammation can be evidenced by blood high-sensitivity C-reactive protein content.

are available to estimate the one-repetition maximum (from which a percentage can be used for exercise prescription) from these multiple repetition maximum tests.

Notwithstanding the recommendation to objectively set the endurance exercise intensity (e.g. based on ventilatory thresholds) or resistance exercise intensity (e.g. based on % one-repetition maximum), it remains important to further assess the patient's subjective sensations during the exercise bouts. For this purpose, the Borg Rating of Perceived Exertion Scale (6–20 scale) or Talk Test can be used for endurance exercise training, and the OMNI Resistance Exertion Scale (OMNI-RES) for resistance exercise training.[323,324] This allows the exercise intensity to be further refined for every CR participant and to appropriately increase the exercise intensity during the course of the CR programme. Such subjective additional exercise intensity setting methods are of particular use at the start of CR, or after adjustment of the exercise intensity. After this stage, these subjective methods can be used less frequently but still on a regular basis (e.g. once per week). A regular reassessment of exercise intensity is crucial, and subjective measures provide a practical tool for this purpose, as improvements in physical fitness (e.g. VO_2peak, muscle strength) and shifts of the ventilatory thresholds (e.g. VT1 and VT2) can be expected during exercise intervention. In particular, in the case of chronotropic incompetence (which is more common in patients with chronic HF), the (re-) evaluation of the heart rate–workload relation is advised: this relation, as well as the HRpeak, can change significantly during an exercise intervention in these patients.[325]

Second, because the aim of exercise training is not only to improve physical functioning (i.e. endurance capacity and muscle strength), but also to improve the entire cardiovascular risk profile (i.e. including blood pressure, glycaemic control, body composition, and blood lipid profile), exercise modalities should thus be adjusted according to the cardiovascular risk profile. Indeed, when improvements in blood pressure, glycaemic control, body composition, and blood lipid profile are desired, significantly different exercise volumes, intensities, and types should be preferred (*Table 9*). However, to optimally target some cardiovascular risk factors, a too great or high volume or frequency of exercise

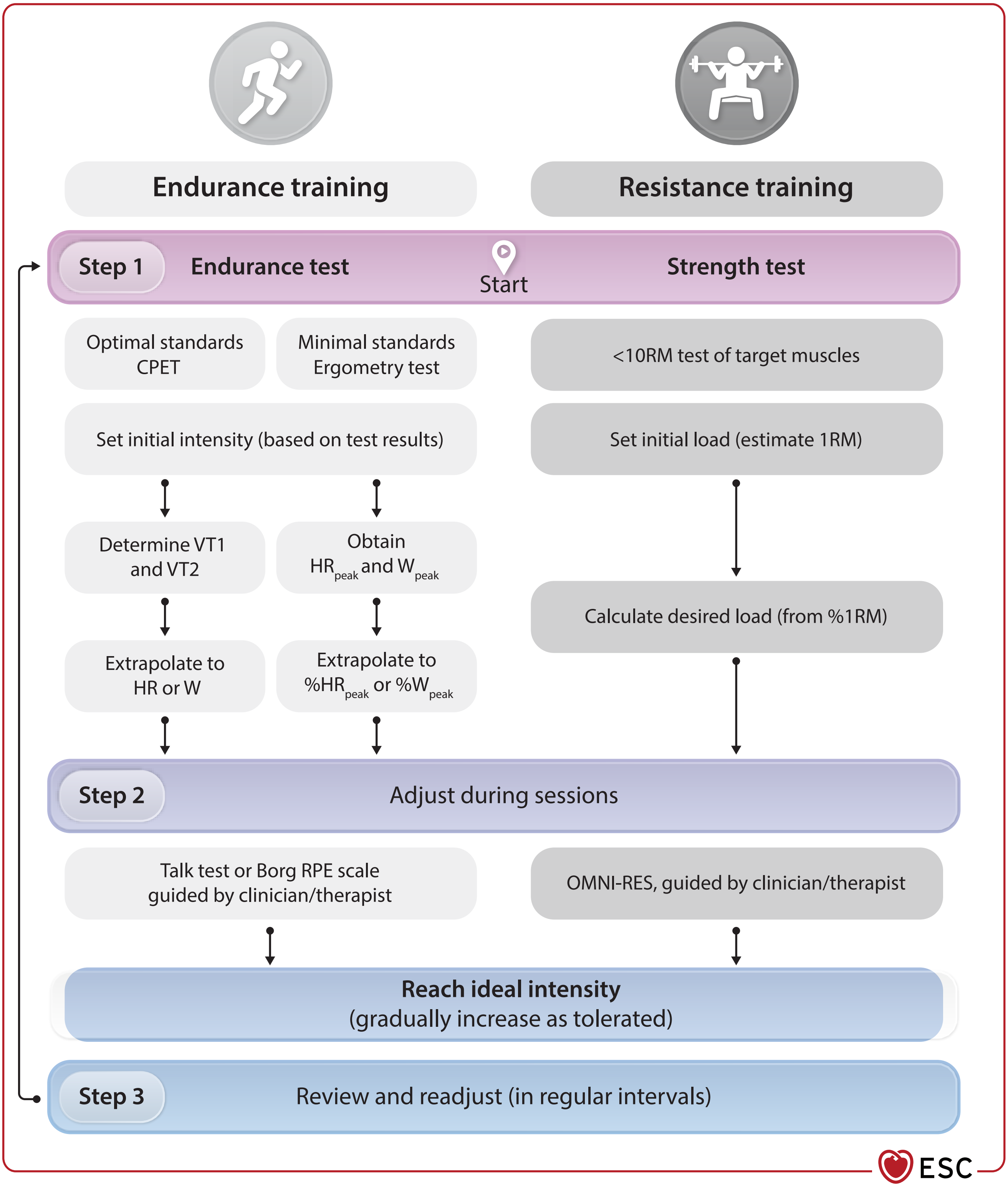

Figure 13 Setting the exercise intensity in cardiac rehabilitation. 1RM, one-repetition maximum; 10RM, ten-repetition maximum; CPET, cardiopulmonary exercise testing; HR, heart rate; HRpeak, peak heart rate; OMNI-RES, OMNI Resistance Exertion Scale; RPE, rating of perceived exertion; VCO_2, carbon dioxide production; VE, ventilation; VO_2, oxygen uptake; VT1/2, ventilatory threshold 1/2; W, watts; Wpeak, cycling power output.

could be required for some patients, particularly at the start of CR. In such cases, it is fundamental to apply shared decision-making with the patient, and to agree on how to progress towards the most ideal exercise prescription (if feasible in the longer term).

Increasing physical activity without carefully selecting exercise modalities (i.e. stimulating walking by physical activity trackers) in patients with cardiometabolic disease has been shown to be insufficient to improve most cardiovascular risk factors or biomarkers of cardiometabolic disease.[326,327] On the contrary, if targeting endurance exercise capacity and muscle strength, then using greater intensities of exercise and adding resistance exercises as well as endurance exercise[328] is generally more effective. If trying to reduce fat mass and improve the blood lipid profile, then greater volumes (i.e. weekly energy expenditure) of endurance exercise are more effective.[329,330] When targeting hypertension, aerobic exercise training should be preferred as the first choice of exercise intervention,[331] which could be complemented by isometric resistance exercise training (e.g. wall-sit squat),[332] although the evidence base for the latter exercise type remains to be substantiated.[333] To improve glycaemic control (in type 2 diabetes), a high exercise frequency and high volume of dynamic resistance training (>21 sets) is of key importance.[334,335] All these different exercise modalities and options, in accordance with the patient's phenotype (including cardiovascular risk, prevalent CVDs, physical fitness, and medication intake), have been brought together in a digital decision-support and training system named the Exercise Prescription in Everyday practice and Rehabilitative Training (EXPERT) tool.[336,337]

In contemporary CR, particularly the application of HIIT and high-intensity dynamic resistance training is heavily debated. During the last decade, evidence has been accumulating that HIIT is more effective than moderate-intensity continuous endurance training at improving VO_2peak or peak workload capacity in patients with CCS, chronic HF, or after HTx, or at least can be more time-efficient (inducing a similar increase in VO_2peak with a shorter exercise duration, thus being isocaloric).[338–340] However, the clinical application of HIIT in current CR is limited by equivocal evidence on which HIIT protocol is most effective (i.e. intensity, duration, and number of high-intensity exercise parts), and by a lack of safety outcomes in unsupervised settings (e.g. fully home-based settings). Hence, it is reasonable to adhere to the HIIT-modalities as stated previously,[341] and to apply this exercise type in supervised settings in medically cleared patients.

As well as endurance exercise training, resistance exercise training is often recommended in CR. In patients with CCS and chronic HF, combined endurance-resistance training significantly more effectively improves VO_2peak and lean body mass than does endurance training only.[328] In patients with heart disease, it may be considered to gradually increase the number of exercises, sets, and repetitions in the first few weeks of CR to allow the patient to familiarize themselves with these exercises (as most patients are not accustomed to these exercises). In healthy older individuals, resistance training with greater intensities (70%–79% of one-repetition maximum) has been shown to more effectively improve muscle strength than resistance training of lower intensities. In current CR position statements, however, resistance training of lower intensities (up to 60% of one-repetition maximum) are proposed. Even though studies in CR found no superior effects of high-intensity resistance training vs lower-intensity resistance training on changes in VO_2peak in patients with chronic HF or CCS (but superior effects on muscle strength in patients with CCS), the widely upheld belief that high-intensity resistance training leads to a greater cardiodynamic stress (i.e. greater rise in blood pressure or cardiac output), and thus is more dangerous, has been disproved in several studies.[342,343] Moreover, studies directly comparing high-intensity resistance training with lower-intensity resistance training in CR reported no greater adverse event rate in the high-intensity resistance training (HI-RT) group.[344,345] However, although studies examining the impact of HI-RT have included patients with heart disease and hypertension, an extensive safety analysis has not yet been executed specifically targeting patients with uncontrolled hypertension or very high blood pressure. As a result, caution is advised in these individuals. Hence, it seems fair to conclude that when high-intensity resistance training is indicated in a patient with CVD, such exercises can be done under close supervision/monitoring by an exercise specialist, and particular attention should be paid in patients with uncontrolled hypertension or very high blood pressure.

The impact of inspiratory muscle training in CR has been studied in great detail in the last decade: studies discovered that inspiratory muscle training as a solo intervention is effective in improving VO_2peak in patients with chronic HF (see *Table 9*). However, the added benefit of inspiratory muscle training as well as endurance training on VO_2peak remains to be clarified in these patients.[346–349] On the other hand, it has been shown that the addition of inspiratory muscle training on top of endurance and resistance training does lead to greater improvements in HRQoL, circulatory power, and dyspnoea scores in patients with chronic HF.[349,350]

In patients recovering from cardiothoracic surgery (i.e. CABG surgery) but with sufficient cardiodynamic stability (e.g. normal heart rate and blood pressure response to active mobilization, and absence of major ECG abnormalities or myocardial ischaemia), it is important to start early active mobilization (i.e. endurance exercise) as this leads to greater improvements or preservation of VO_2peak in these individuals.[351] In addition, in patients recovering from an acute MI, early exercise training is recommended as it positively affects myocardial remodelling and function restoration: an earlier start (within 1 week after acute MI) and prolonged participation (>3 months) predicts greater benefits.[352]

Third, when attempting to offer a personalized exercise intervention in patients with CVD, it is important to consider the patient's capabilities and personal goals. In general, patients with (severe) chronic HF or valvular heart disease, or those who have undergone major cardiothoracic surgery (e.g. CABG, HTx) usually have a significantly reduced functional capacity (including reduced endurance capacity or muscle strength); hence, reducing the starting volume and intensity of exercise is warranted. In very weak patients, (additional) electrical muscle stimulation can also be considered (as a start-up of an exercise intervention). Such stimulation leads to significant improvements in muscle strength, VO_2peak, walking capacity, and quality of life in patients with advanced heart disease (e.g. chronic HF), although close supervision and specific safety measures should be taken into account in patients wearing a CIED.[353–355] The reverse is also true: for patients with a (very) high premorbid endurance exercise capacity or muscle strength (e.g. athletic patients with a pacemaker or ICD), volumes and intensities of exercise that are too low should be avoided (to prevent boredom or lack of challenge). In addition, in the first weeks or months of CR, exercise training is done to improve cardiovascular risk and functional capacity, but as the CR programme progresses it should be tailored according to the patient's daily life needs (i.e. shift to functional exercise training). When evaluating changes over time in functional capacity, it is important to consider the minimal clinically important differences (MCIDs) for the outcome assessments (see Supplementary data online, *Table S7*).

Table 9 Exercise modalities to target different cardiovascular risk factors or functional capacity in cardiac rehabilitation

CVD risk factor	Adjustment in exercise prescription
Obesity	Exposing to an appropriate exercise volume (250–420 min per week to reach >2000 kcal per week) for a clinically relevant and detectable (visceral) fat mass loss.[329] In the case of a hypocaloric diet, the incorporation of resistance exercise training for the large muscle groups (of a moderate intensity) should be considered to preserve muscle mass.[356]
Hyperglycaemia (in type 2 diabetes)	Exposing to an appropriate weekly exercise frequency (≥5 days per week) for a greater reduction in HbA1c.[334]
	Exposing to appropriate sets of resistance exercise (≥21 sets per week) for a greater reduction in HbA1c.[335]
Arterial hypertension	Exposing to an appropriate exercise session duration (>30 min per session, which can be split into smaller parts with short few minute breaks).[357]
	Exposing to an appropriate intensity of endurance exercise (at least moderate intense).[357]
	Exposing to appropriate sets of resistance exercise (≥8 sets per session).[331]
Dyslipidaemia	Exposing to aerobic or combined (aerobic and resistance) training for a meaningful reduction of total cholesterol and LDL-C. To lower total cholesterol, a greater exercise frequency is advised.[330]
Frailty	Resistance exercise training of the large muscle groups (of at least a moderate intensity) should be incorporated, next to endurance exercise training. Moreover, balance exercises bring merit to the prevention of falls.[358]
Lowered endurance capacity	Exposure to an appropriate exercise volume, at 3–6 months: • In patients with HF: every increment in weekly exercise energy expenditure by >460 kcal associates with a mean increase in VO_2peak by 2.6 mL/kg/min ($P < .05$).[359] • In patients with CAD: a greater total energy expenditure relates significantly to greater improvements in exercise capacity [effect size: 0.91 mL/min/kg per 100 J/kg ($P < .01$)].[360]
	Adding resistance training alongside endurance training leads to greater improvements in VO_2peak in patients with CAD.[328]
	Apply high-intensity interval training in selected patients and under close supervision for a greater, or more time-efficient increase in VO_2peak.[338,339]
Lowered muscle strength	Exposure to appropriate resistance exercise intensity significantly affects muscle strength, with the largest effect sizes for intensities of 70%–79% of the 1RM (corresponding to 6–8 repetitions per set).[361]
Hyperglycaemia (in type 1 diabetes)	Multicomponent exercises (which is the combination of endurance with resistance exercises) are the most effective to reduce HbA1c.[362] For these multicomponent exercises, a significant HbA1c reduction is observed starting at 52 MET-min/week, reaching the MCID (≥0.5%) at 160 MET-min/week, and peaking at 1500 MET-min/week.[362]

1RM, one-repetition maximum; CAD, coronary artery disease; CVD, cardiovascular disease; HbA1c, glycated haemoglobin; HF, heart failure; LDL-C, low-density lipoprotein cholesterol; MCID, minimal clinically important difference; MET, metabolic equivalent; min, minutes; VO_2peak, peak oxygen uptake.
All evidence in this table was exclusively derived from meta-analyses.

Recommendation Table 17 — Recommendations for exercise training (see Evidence Table 17)

Recommendations	Class[a]	Level[b]
All patients with an indication for CR		
Exercise prescription (e.g. intensity, volume, type) should be tailored to the patient's cardiovascular risk profile (e.g. blood pressure, fat mass, blood lipid profile, and glycaemic control) and physical functioning (e.g. VO_2peak, muscle strength), while considering patient preferences in all patients undergoing CR to ensure safety and increase the clinical effectiveness.[328–331,334,335,338,339,357,360,361]	IIa	B2

Continued

Patients with acute and chronic coronary syndromes		
Exercise training, as part of CR, is recommended in patients after ACS or with CCS to reduce cardiovascular mortality, MI, and all-cause hospitalization.[310]	I	A
Exercise training, as part of CR, is recommended in patients after ACS or with CCS to improve mental functioning (anxiety and depression),[363] HRQoL,[310] physical functioning (VO_2peak),[364] and to lessen healthcare costs.[310]	I	B1
Resistance exercise training in addition to endurance exercise training during CR is recommended in patients after ACS or with CCS to achieve greater improvements in physical functioning (VO_2peak).[365]	I	B1
Commencing exercise training or active mobilization, as part of CR, as soon as possible (possibly within 4 weeks) is recommended in patients after cardiothoracic surgery (e.g. CABG surgery) to improve or preserve physical functioning (6MWT and VO_2peak).[351]	I	B1
Early exercise training should be considered in patients recovering from an acute MI to improve LV remodelling.[352]	IIa	B2
As part of CR, high-intensity interval training may be considered a more effective or time-efficient alternative, when compared with moderate-intensity continuous endurance training in patients after ACS or with CCS to improve physical functioning (VO_2peak).[365]	IIb	B1
Patients with heart failure, heart transplantation, and ventricular assist device		
Exercise training, as part of CR, is recommended in patients with stable chronic HF to reduce all-cause hospitalization in the short term (<12 months),[53] and to improve HRQoL[53] and physical functioning (VO_2peak).[93,366]	I	B1
Exercise training, as part of CR, is recommended in heart transplantation recipients to improve physical functioning (VO_2peak).[54,340]	I	B1
Exercise training, as part of CR, is recommended in ventricular assist device recipients to improve physical functioning (VO_2peak or walking capacity) and HRQoL.[101–103]	I	B1
Exercise training, as part of CR, should be considered in patients with decompensated HF as early as possible (during hospital admission, but with sufficient stabilization) to reduce all-cause hospitalization and to improve physical functioning (walking capacity).[98]	IIa	B2
As part of CR, high-intensity interval training may be considered more effective, or more time-efficient than moderate-intensity continuous endurance training in patients with chronic HF to improve physical functioning (VO_2peak).[367]	IIb	B1
Patients with valvular heart disease		
Exercise training, as part of CR, should be considered in patients with aortic valve disease (treated by SAVR or TAVI) or any valve disease (treated by surgery or percutaneously) to improve physical functioning (6MWT and/or VO_2peak).[57,113,368,369]	IIa	B2
Patients with congenital heart diseases		
Exercise training, as part of CR, is recommended in patients with congenital heart disease to improve physical functioning (VO_2peak and muscle strength).[134,135]	I	B1
Exercise training, as part of CR, may be considered in patients with congenital heart disease to improve physical activity levels[311] and HRQoL.[58]	IIb	B2
Patients with arrhythmias and CIEDs		
Exercise training, as part of CR, is recommended in implantable cardioverter defibrillator recipients to improve physical functioning (VO_2peak) and reduce the incidence of shocks.[147,370]	I	B1
Exercise training, as part of CR, is recommended in CRT device recipients to improve physical functioning (maximal workload and VO_2peak) and HRQoL.[371]	I	B1
Exercise training, as part of CR, may be considered in patients with AF to reduce AF symptom burden, AF recurrence, and improve HRQoL, and physical functioning (VO_2peak).[59]	IIb	B2
Patients with cardiomyopathies		
Exercise training, as part of CR, should be considered in patients with stable hypertrophic cardiomyopathy to improve physical functioning (VO_2peak), mental functioning (anxiety, depression), and HRQoL.[156,158,372]	IIa	B1
Patients with cancer and cardiotoxic therapies		
Exercise training is recommended in patients during or after cancer therapy, particularly in those at increased risk of cancer treatment-related cardiovascular toxicity, to improve physical functioning (VO_2peak, walking capacity),[161,162,165,312–314,373] enhance HRQoL[161,162,165,167,312–314], reduce fatigue, and improve disease-free and overall survival.[312,315,316]	I	B1
Centre-based CR may be considered in cancer survivors exposed to cardiotoxic cancer treatment and/or with previous cardiovascular disease to increase adherence to exercise training.[374]	IIb	B2

6MWT, six-minute walk test; ACS, acute coronary syndrome; AF, atrial fibrillation; CABG, coronary artery bypass graft; CCS, chronic coronary syndromes; CIED, cardiac implantable electronic device; CR, cardiac rehabilitation; CRT, cardiac resynchronization therapy; HF, heart failure; HRQoL, health-related quality of life; LV, left ventricular; MI, myocardial infarction; SAVR, surgical aortic valve replacement; TAVI, transcatheter aortic valve implantation; VO_2peak, peak oxygen uptake.
[a]Class of recommendation.
[b]Level of evidence.

7.6. Nutrition and body composition management

7.6.1. Promoting a healthy diet

There is broad consensus that the quality of nutrition plays a critical role in mitigating CVD risk.[375–379] The importance of promoting healthy eating habits for both primary and secondary prevention of CVD has been highlighted in recent clinical consensus statements, including one from the EAPC,[380] and another jointly issued by EAPC and the Association of Cardiovascular Nursing & Allied Professions of the ESC.[381] When the patient has no body composition abnormalities (such as excess adiposity or reduced muscle mass), nutrition interventions typically promote heart-healthy diets, which prioritize improving cardiovascular health rather than creating large calorie deficits or increasing daily protein intake.[379,380]

An ideal cardioprotective diet prioritizes whole, nutrient-dense foods such as fruits, vegetables, whole grains, legumes, nuts, seeds, low-fat dairy, lean poultry, fish, and olive oil. Simultaneously, it limits the intake of refined carbohydrates, added sugars, red and processed meats, saturated fats, and sodium, which associate with increased CHD risk and higher mortality.[380,382] The Mediterranean and low-fat diets, in particular, have been shown to significantly reduce the risk of cardiovascular events and all-cause mortality.[383,384]

Expected outcomes from nutrition counselling during CR include adherence to prescribed dietary recommendations, a basic understanding of calorie requirements and nutrient balance (including fats and cholesterol), and the development of strategies to address eating behaviour challenges. However, data linking nutrition interventions during CR to sustained improvements in clinical outcomes remain limited.[382,385] A small number of RCTs suggest that more intensive nutrition interventions that include personalized dietary plans, additional counselling sessions, cooking demonstrations, and patient support systems can improve short-term dietary CVD outcomes in patients undergoing CR.[382,385] Despite these promising findings, significant research gaps persist regarding the long-term efficacy and scalability of high-quality nutrition interventions in CR settings.[385]

7.6.2. Alcohol cessation

The relationship between alcohol consumption and CVD remains complex and multifaceted. It is influenced by dose, drinking pattern, beverage type (fermented vs distilled), and the specific clinical context of CVD. However, most available data are observational and prone to bias, limiting causal inference.[386] The *2021 ESC Guidelines on cardiovascular disease prevention in clinical practice* recommend limiting alcohol consumption to a maximum of 100 grams of pure alcohol per week—approximately one standard drink per day—for both men and women.[25] Intake above this threshold is associated with reduced life expectancy. While some observational studies have suggested cardioprotective effects at low levels of alcohol intake, recent analyses—including Mendelian randomization studies—have questioned these findings. Any potential benefit must be weighed against well-established risks, including cancer, hypertension, and stroke.[25,386,387]

Data from a meta-analysis of 45 cohort studies demonstrated a J-shaped relationship between alcohol consumption and the risk of cardiovascular events—the lowest risk was observed with moderate consumption (10–40 g of alcohol per day), particularly among individuals aged 41–65 years without comorbidities. In men with ≥3 comorbid conditions, no protective effect was observed at any level of alcohol intake.[388] A separate meta-analysis including 1.57 million participants found that moderate wine consumption (1–4 servings per week) was associated with a reduced risk of cardiovascular mortality. However, this protective association was not observed for beer or spirits.[389]

On the other hand, alcohol intake is linearly associated with increased blood pressure, with no identifiable safe threshold.[388] Moreover, alcohol is classified as a Group 1 carcinogen by the International Agency for Research on Cancer.[390] According to the American Society of Clinical Oncology, there is no safe level of alcohol consumption, as even light drinking increases cancer risk.[391]

According to the Scientific Statement of the EAPC and the Association of Cardiovascular Nursing & Allied Professions of the ESC, the impact of alcohol on CVD risk is influenced not only by dose and drinking pattern, but also by the type of alcoholic beverage (fermented vs distilled), age, sex, and the clinical subtype of CVD. Wine—particularly red wine—may exert more favourable metabolic effects due to its content of bioactive compounds. However, generalized recommendations are insufficient; a personalized approach based on current scientific evidence and comprehensive individual risk assessment is essential.[381,392]

7.6.3. Nutritional counselling

Nutritional counselling is an essential component of CR, focusing on implementing a cardioprotective diet and addressing obesity and low muscle mass conditions in patients with cardiac diseases.[52,174,380,393] Nutritional counselling should be tailored to the individual patient's needs and cultural preferences and may include nutritional education as well as targeted interventions, behaviour change models, and adherence strategies (*Table 10*).[52,380,382] It thus has strong synergies with exercise training (*Section 7.5*); physical activity and sedentary behaviour counselling (*Section 7.4*); and self-management, behaviour change, and education (*Section 7.2*).

Nutritional status plays an important role in the prognosis of patients undergoing CR. Malnutrition is commonly observed in patients with CVD, especially among those hospitalized for HF, where its prevalence is alarmingly high.

Table 10 Key messages and best practices for the promotion of effective nutritional counselling in cardiac rehabilitation

Involve a dietitian trained in medical nutrition therapy in the care of CR patients with complex needs (e.g. obesity, malnutrition, multiple comorbidities) as identified by the referring provider.[382,399,400]
Conduct a detailed assessment of the patient's dietary habits, including daily caloric intake, content of fat, sodium and other relevant nutrients, preferred food sources of nutrients, number of meals, cooking habits, and alcohol consumption.[382,399]
Assess and monitor nutritional status and dietary habits throughout CR, beginning at the initial intake and continuing at regular intervals during the programme.[382,399]
Deliver individualized nutrition education and interventions, with at least three nutrition-focused sessions.[382,399]
Adapt caloric intake based on expected energy expenditure during the CR programme, ensuring synergy with exercise training.[382,399]
Develop personalized nutritional plans that suit the patient's daily life and preferences.[382,399]
Healthcare providers involved in nutrition interventions should be trained in behaviour change techniques.[382,399]
Encourage and support long-term behavioural changes to promote healthy eating habits.[380]
Educate patients and their caregivers on the importance of nutrition in cardiovascular risk factor management, with a focus on their specific comorbidities.[382,399]
Provide education on dietary goals, including information on macronutrients (proteins, carbohydrates, and fats), micronutrients (vitamins and minerals such as sodium), and the water content of common foods.[380,381]
Offer individualized support tailored to the patient's beliefs and preferences.[382,399]
When possible, provide cooking classes for patients and caregivers to enhance practical nutrition knowledge.[380]
Encourage patients to identify a 'supporter' or 'coach' (e.g. a family member or friend) to accompany them in nutritional counselling and intervention sessions for additional reinforcement.[380,399]

CR, cardiac rehabilitation.
The key messages in this table are based on the following studies: Vassiliou *et al*.,[380] Lara-Breitinger *et al*.,[382] and Aggarwal *et al*.[399]

Studies show that ∼60%–69% of patients with chronic HF are malnourished, and this correlates with an increased risk of mortality and rehospitalization.[394] Identifying and managing malnutrition early is therefore critical to improving outcomes in CR, as malnutrition influences patients' physical function and overall recovery trajectory.[394,395] Nutritional education may include information on macronutrients (proteins, carbohydrates, and fats), micronutrients (vitamins and minerals such as sodium), and the water content of common foods, along with guidance on how these elements align with the patient's personalized dietary goals (*Figure 14*).

Effective validated assessment tools, such as the Mini Nutritional Assessment (MNA) and its shorter form, the MNA-SF, are used to screen for malnutrition in CR settings. A study involving 336 patients in Phase II CR found that 47% were either malnourished or at risk of malnutrition, and that the MNA is useful in screening for malnutrition in patients undergoing CR.[396] Another study found that malnutrition risk significantly associated with diminished physical function, as measured by the Barthel Index, further supporting the need for early nutritional assessment and support to optimize functional recovery in CR.[395] Poor nutritional status can also worsen overall prognosis in CR, potentially increasing in-hospital mortality risk during rehospitalization.[397,398]

Overall, integrating comprehensive nutritional assessment and management into CR programmes can help mitigate the impact of malnutrition on patients' outcomes, reduce complications, and improve quality of life.

Body composition plays fundamental roles in cardiovascular health and significantly influences clinical outcomes in CR. Both obesity and low muscle mass conditions present distinct risks that can worsen patient prognosis. Specific definitions and diagnosis criteria for low muscle mass conditions and obesity phenotypes (malnutrition,[401] sarcopenia,[402] cachexia,[403] sarcopenic obesity,[404] pre-clinical obesity, and clinical obesity)[405] are outlined in the Supplementary data online, *Table S8*.

In CR, the primary objective of managing body weight and composition is to optimize body composition parameters or address body composition abnormalities. This approach aims to enhance cardiovascular function, minimize complications, and enhance patients' quality of life.

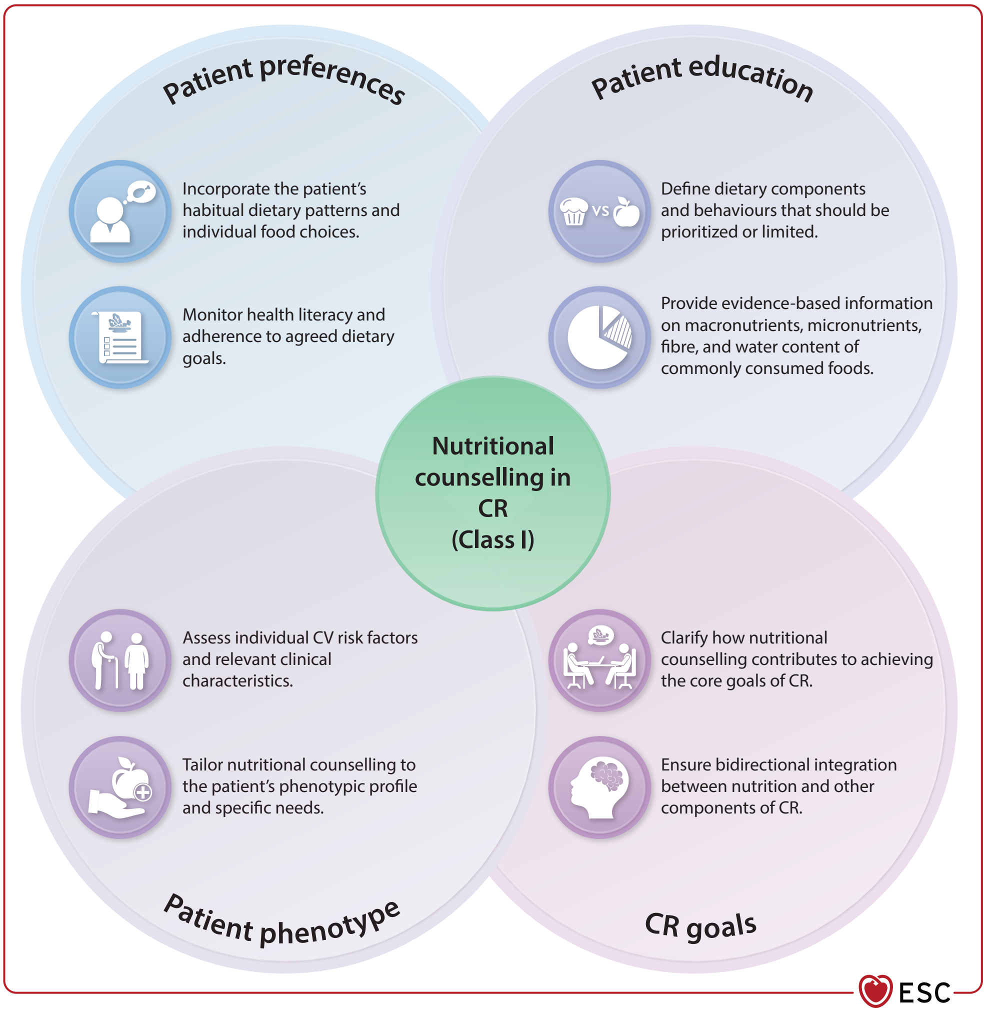

Figure 14 Education on nutritional intake. CR, cardiac rehabilitation; CV, cardiovascular.

7.6.4. Body composition assessment

Assessing body weight and composition accurately is essential for care goal setting and developing effective intervention strategies in CR. Since advanced techniques for body composition analysis are not widely available in most CR settings, simple and accessible tools such as body mass index (BMI), anthropometric measurements, and questionnaires serve as practical screening methods. While these do not measure body composition directly, they can effectively identify individuals with potential abnormalities. If more advanced techniques are available (e.g. bioelectrical impedance analysis), they can more precisely evaluate body composition changes and enhance tracking of CR effectiveness in individual patients.

The most commonly used and widely accepted tool for assessing body weight status in clinical practice is BMI. Body mass index is not a direct measure of body composition but is commonly used as a simple screening tool for categorizing body weight. According to the WHO Guidelines, BMI classifications are as follows: normal weight is defined as a BMI of 18.5–24.9 kg/m², overweight as 25–29.9 kg/m², and obesity is further divided into three classes. Class I (moderate obesity) is a BMI of 30–34.9 kg/m², Class II (severe obesity) is 35–39.9 kg/m², and Class III (very severe or morbid obesity) is a BMI of 40 kg/m² or higher.[406] It should be noted that BMI thresholds may differ across populations, with population-specific cut-off values proposed in some regions, including Asian populations. However, commonly used BMI cut-off values for diagnosing obesity have high specificity when compared with direct measures of adiposity, but low sensitivity for identifying adiposity, failing to detect excess body fat in approximately half of affected individuals.[407,408] This limitation reduces its effectiveness for accurately assessing cardiovascular risk.[409] While individuals with a high BMI are most likely to have obesity and those with a low BMI may have low muscle mass conditions, individuals classified as overweight or even within the normal weight range may still present with body composition abnormalities that may require specific changes to CR interventions (*Figure 15*).

In addition to BMI, several other anthropometric and functional tools are commonly used to assess body composition and related risk in clinical practice. For clarity and conciseness, a detailed overview of these methods, including waist circumference, waist-to-hip ratio, waist-to-height ratio, body roundness index, the SARC-F (Strength, Assistance with walking, Rise from a chair, Climb stairs, and Falls) questionnaire, handgrip

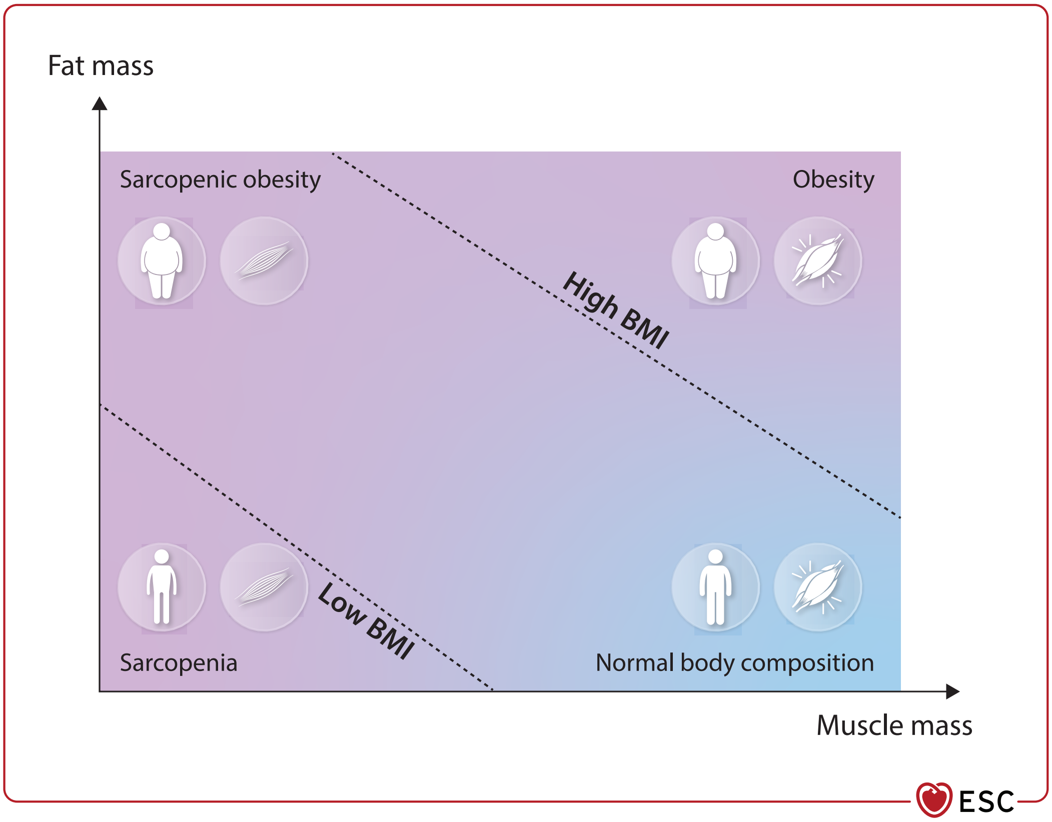

Figure 15 Matrix of body composition abnormalities and limitations of body mass index. BMI, body mass index. Pink areas indicate that body composition abnormalities (obesity, sarcopenic obesity, and sarcopenia) may occur irrespective of BMI. The diagnosis of sarcopenia and sarcopenic obesity is based on body composition measurements (e.g. appendicular lean mass by dual X-ray absorptiometry) and requires assessment of muscle function (e.g. muscle strength) (see Supplementary data online, *Table S8*).

strength, and advanced imaging techniques, is provided in the Supplementary data online, *Section S3.2*.

7.6.5. Strategies for managing obesity

Effective obesity management goes beyond correcting positive energy balance and necessitates structured, multifaceted interventions tailored to individual needs and clinical profiles.[410] The management of obesity, as well as its impact on different CVD manifestations, has recently been summarized in an ESC clinical consensus statement.[174]

According to the EUROASPIRE V study, more than 80% of patients with CAD were either overweight or obese, with nearly 40% meeting the criteria for obesity (BMI ≥ 30 kg/m²), highlighting the substantial prevalence of excess weight in the CR population.[269] Weight loss during CR is often modest (<2%–3% of body weight), owing to a combination of biological, behavioural, and systemic factors.[411] Nutrition interventions typically promote heart-healthy diets, which prioritize improving cardiovascular health rather than creating calorie deficits. Exercise interventions are general, often focusing on low-volume moderate-intensity exercise rather than exposing the patient to an exercise volume appropriate for a clinically relevant fat mass loss (see *Section 7.5*). Stress, depression, and anxiety after an acute cardiac event or intervention may promote emotional eating and can hinder weight loss. Some cardiac medications, such as beta-blockers, may slow metabolism or increase appetite. Limited programme duration, usually 12 weeks or less, may not allow for sustained behaviour change. Finally, achieving weight loss requires sustained changes in multiple behaviours (e.g. eating habits, physical activity, and sleep), which can be overwhelming for patients already managing a cardiac condition, particularly if competing priorities, such as smoking cessation or medication adherence, may take precedence.

Evidence strongly supports structured, multimodal lifestyle interventions for reducing weight in people with obesity, particularly those focusing on improved nutrition (with or without meal replacements) and increased physical activity.[410] Dietary interventions typically target reduced caloric intake through a 500–750 kcal per day energy deficit, which should be individualized based on body weight and activity level.[174,412] This deficit can be achieved through various strategies, including portion control, reducing ultra-processed foods and sugar-sweetened beverages, limiting alcohol consumption, and increasing fruit and vegetable intake.[174,412]

The choice of a healthy eating approach can be tailored to individual preferences, metabolic risk factors, and potential for long-term adherence. Studies lasting <2 years have shown successful weight reduction of 5%–10% through various nutritional approaches, including low-fat vegan, vegetarian, lowcarbohydrate, and Mediterranean diets.[412] A meta-analysis comparing dietary macronutrient patterns and programmes for reducing weight and cardiovascular risk factors found that most dietary patterns achieved similar modest short-term weight loss (within 6 months) and improved cardiovascular risk factors. However, these effects generally diminished at 12 months, while the Mediterranean diet showed more sustained benefits.[413]

Cardiac rehabilitation provides an optimal window of opportunity to start or resume weight-loss therapy, especially in cases where previous attempts before a cardiac event have failed. Alongside established diet and exercise interventions (*Section 7.5*), incorporating behavioural weight-loss strategies (*Section 7.2*) can enhance the effectiveness and sustainability of weight-loss outcomes. These interventions may be integrated into CR or offered as a follow-up programme.[414,415]

Furthermore, growing evidence supports the efficacy and safety of entero-pancreatic hormone-based treatments, such as glucagon-like peptide receptor agonists (GLP-1 RA) and dual GLP-1/gastric inhibitory peptide receptor agonists. These treatments, when combined with lifestyle interventions, can promote weight loss of 15%–24% of body weight,[416] thus improving prognosis. A recent systematic review of GLP-1 RA treatments, which included 24 RCTs and 94 547 participants with and without diabetes, reported a significant reduction in MACE and all-cause mortality compared with placebo (13% and 12%, respectively, in the overall population).[417] The largest study in this review, the SELECT (Semaglutide Effects on Heart Disease and Stroke in Patients With Overweight or Obesity) trial, enrolled 17 604 patients with CVD.[418] Pharmacotherapy should therefore be started early during CR as an adjunct to diet and exercise for patients with a BMI >27 kg/m² and weight-related comorbidities or obesity.[415] In addition, in selected high-risk individuals with severe obesity, bariatric surgery may be considered as part of a comprehensive weight management strategy. Evidence supports its role in reducing cardiovascular and all-cause mortality in this population.[174,419]

Moreover, the CR setting provides a valuable opportunity to address adverse effects and treatment-related challenges associated with GLP-1 RA treatment, particularly regarding long-term tolerability and muscle health. Data from a large real-world database of patients who had started GLP-1 RA therapy (195 915 participants; 59% female, 90% with diabetes, and 10% with obesity) reveal that up to 50% of patients had discontinued GLP-1 RA treatment within 1 year, primarily due to side effects, and particularly those from vulnerable and high-risk populations.[420] In addition, weight-loss therapy, whether lifestyle- or pharmacological-based, has been linked to a significant reduction in lean mass. In GLP-1 RA clinical studies, muscle loss accounted for 25%–39% of the total weight lost over 36–72 weeks.[421,422] This raises questions about whether such reductions represent an adaptive or maladaptive response to weight loss.[423]

These findings underscore the critical need for a comprehensive approach to weight-loss therapy, particularly in high-risk groups. Combining pharmacological interventions with education, a protein-rich diet, and resistance or mixed exercise regimens is essential to improve sustainability, to mitigate the risk of sarcopenic obesity (see *Section 7.6.7*), and to maintain muscle health in vulnerable populations.[356,415,424] A summary of the strategies for optimizing body composition in CR for patients with obesity is presented in *Figure 16*.

7.6.6. Strategies for managing low muscle mass conditions

Low muscle mass conditions, such as sarcopenia and cachexia, have significant negative implications and are associated with worse outcomes in patients with CVD, including HF, CCS, aortic valve replacement, and those undergoing cardiac surgeries.[393,425,426] For these patients, targeted nutritional strategies are essential to promote recovery and improve clinical outcomes. Increasing caloric intake with nutrient-dense foods is fundamental for weight gain and recovery in malnourished individuals. In those entering CR with low body weight and muscle mass—who are often inactive—energy and protein requirements may be higher during exercise interventions. Therefore, careful monitoring is crucial to ensure adequate intake in this vulnerable subgroup. The management of sarcopenia in the context of CVDs has recently been summarized in a Scientific Statement of the EAPC.[427]

The recommended daily energy intake for older adults is ∼30 kcal per kg of body weight.[428] However, this should be individually adjusted based on nutritional status, physical activity level, disease burden, and tolerance.[428] To ensure adequacy, energy intake should be monitored by tracking body weight while considering factors such as water retention or losses, with adjustments made accordingly.[428]

Protein intake of at least 1 g/kg body weight per day is suggested for healthy older adults, while 1.2–1.5 g/kg per day is recommended to support muscle maintenance and growth, particularly in those with acute or chronic illness.[427,428] In cases of severe illness, injury, or significant malnutrition, protein needs may rise to 2.0 g/kg per day to optimize muscle preservation and facilitate recovery.[428] Protein intake should always be tailored to each patient's specific needs and clinical condition.[428,429]

Given the multiple potential causes of poor intake and malnutrition in older adults, a systematic assessment using checklists and subsequent diagnostic evaluation is recommended.[428] For those unable to meet their nutritional requirements through diet alone, oral nutritional supplements can provide additional protein and calories in a convenient form.[427,428] Previous studies have also shown benefits of oral nutritional supplements on the 6MWT, HRQoL, and muscle mass increases in patients with HF and low muscle mass conditions.[430,431]

Low muscle mass conditions are modifiable and can revert to a normal state with early intervention. A multimodal approach—targeting appetite improvement, reduction of inflammatory responses, increased caloric intake, and exercise training to enhance exercise capacity and quality of life—is a promising therapeutic strategy for these conditions.[432] The first step in managing any patient with low muscle mass conditions is to ensure that pharmacological treatment is optimized, as certain medications can directly influence body weight.[393,426,433] An essential component of management is providing general nutritional advice and counselling as a foundation. Subsequently, nutritional recommendations should be tailored to the specific needs of patients with low muscle mass conditions and be evidence-based.

Exercise training should be adapted accordingly, particularly in patients with reduced muscle strength, as these patients may require higher intensities of resistance training to achieve optimal benefits (see *Section 7.5*). A randomized trial in older women with chronic HF demonstrated that a 10-week high-intensity resistance training programme significantly improved

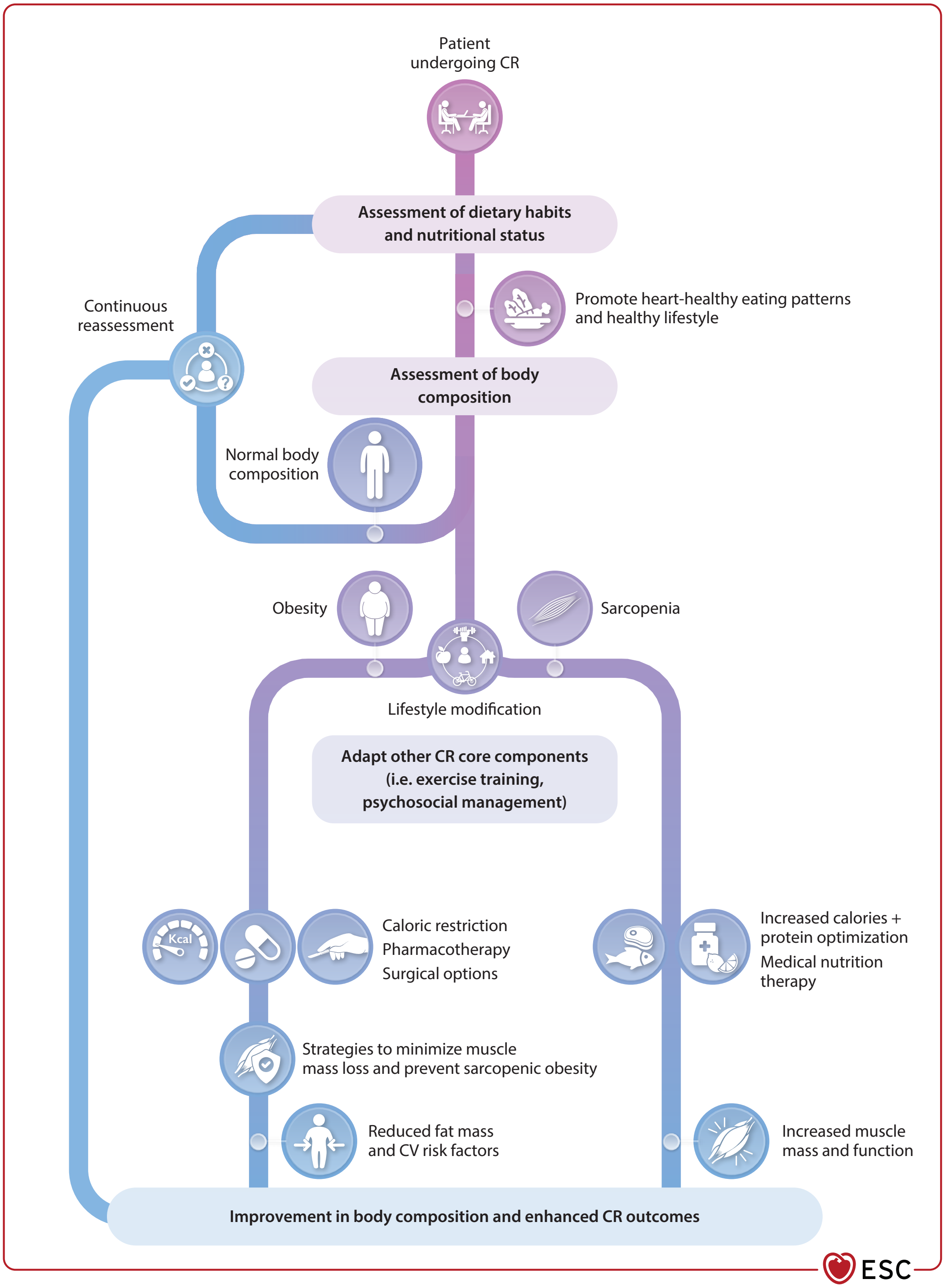

Figure 16 Strategies for optimizing body composition in cardiac rehabilitation. CR, cardiac rehabilitation; CV cardiovascular.

muscle strength, endurance, functional capacity, and muscle fibre composition compared with stretching exercises.[434]

When dietary intake and oral nutritional supplements fail to meet a patient's nutritional needs, medical nutrition therapy—such as enteral or parenteral nutrition—may be necessary. This approach is particularly relevant for patients with severe malabsorption or gastrointestinal complications. Finally, patients with low muscle mass conditions in the context of CVD may benefit from several pharmaceutical options. Such interventions should be explored only when conventional treatment methods prove insufficient and when a multidisciplinary team—including non-cardiovascular specialists such as endocrinologists—is involved in the decision-making process.[426,435]

7.6.7. Sarcopenic obesity

In some individuals, both conditions—obesity and low muscle mass—may coexist, a phenotype referred to as sarcopenic obesity.

Sarcopenic obesity is defined by the coexistence of obesity, characterized by excessive body fat, and sarcopenia, defined as low skeletal muscle mass with impaired muscle function.[404] It should be recognized as a distinct clinical condition, separate from obesity or sarcopenia alone.[404] Importantly, assessing sarcopenia in individuals with obesity requires adapting measurement methodologies: considering relative or adequate muscle mass by normalizing skeletal muscle mass to body mass.[404] However, the diagnosis of sarcopenic obesity is inconsistent, owing to variations in criteria, prevalence, and associated outcomes. Multiple body composition assessment techniques exist, but age-, sex-, and ethnicity-specific cut-offs are needed: these are not always available across all clinical settings.[404,436] In response, the European Society for Clinical Nutrition and Metabolism (ESPEN) and the European Association for the Study of Obesity (EASO) have begun efforts to standardize the diagnostic approach for sarcopenic obesity.[404]

Regardless of the definition used, sarcopenic obesity is associated with increased mortality, morbidity, and geriatric syndromes.[437] It significantly raises the risk of CVD [HR, 1.39; 95% confidence interval (CI), 1.16–1.67], heart disease (MI, angina pectoris, CHD, HF, or other clinically recognized cardiac conditions) (HR, 1.36; 95% CI, 1.10–1.67), and stroke (HR, 1.40; 95% CI, 1.02–1.92) compared with individuals with normal body composition.[438] In patients with type 2 diabetes, sarcopenic obesity is an independent risk factor for major CVD events, including stroke, MI, revascularization procedures, and CVD-related mortality.[439] Additionally, sarcopenic obesity assessed by pre-operative computed tomography strongly predicts poor muscle function and increased all-cause mortality in patients undergoing cardiovascular surgery.[440]

The therapeutic objectives in sarcopenic obesity are to reduce excess adiposity while preserving or enhancing muscle mass and strength. This requires a careful balance of nutritional restriction and anabolic support through resistance training and adequate protein intake.[437] Pharmacological agents such as GLP-1 RAs may be considered as adjuncts in selected individuals, particularly when integrated with interventions to maintain muscle mass.[437]

Recommendation Table 18 — Recommendations for nutritional and body composition management (see Evidence Table 18)

Recommendations	Class[a]	Level[b]
Nutritional counselling tailored to individual comorbidities and needs is recommended for all patients undergoing CR to promote a healthy diet and to improve short-term outcomes such as dietary adherence, weight reduction, and lipid profile improvement, as part of a multidisciplinary approach.[379,382,385]	I	B1
A healthy dietary pattern such as the Mediterranean diet and low-fat diets is recommended for patients undergoing CR to lower the risk of cardiovascular events and all-cause mortality.[383,384]	I	B1
Comprehensive (including diet, exercise, and behavioural) weight-loss interventions are recommended in patients with overweight or obesity undergoing CR to improve body composition, and to reduce MACE and all-cause mortality.[174,356,414,441–443]	I	B1
Implementing preventive strategies to minimize muscle mass loss is recommended in patients undergoing weight-loss therapies during CR to preserve functional and metabolic health.[174,424,444,445]	I	C
GLP-1 RA in addition to lifestyle measures should be considered in patients with a BMI $\geq$ 27 kg/m^2 (plus high cardiovascular risk or established atherosclerotic cardiovascular disease) or obesity to reduce body weight, MACE, and all-cause mortality.[417]	IIa	A
Nutritional interventions (including protein-rich diets and/or oral nutritional supplements) should be considered in older patients at risk for or with low muscle mass conditions like malnutrition or sarcopenia undergoing CR to improve nutritional and functional outcomes.[393,429,446]	IIa	B1
Referring to bariatric surgery after CR should be considered in patients with a BMI $\geq$ 35 kg/m^2 (particularly in cases where interventions for weight reduction have not resulted in sustained weight loss) to reduce MACE and all-cause mortality.[419]	IIa	B2
Screening for malnutrition, sarcopenia, and sarcopenic obesity according to established protocols should be considered in patients undergoing CR to detect the conditions early and initiate treatment.[393,402,404,447]	IIa	B2
Body composition assessment should be considered in all patients undergoing CR to identify body composition abnormalities.[174,404]	IIa	C
Monitoring of unintentional weight loss, especially if exceeding 5%, should be considered in patients with HF undergoing CR to detect and counteract on disease-related cachexia.[448,449]	IIa	C

Continued

BMI, body mass index; CR, cardiac rehabilitation; GLP-1 RA, glucagon-like peptide receptor agonist; HF, heart failure; MACE, major adverse cardiovascular event.
[a]Class of recommendation.
[b]Level of evidence.

7.7. Smoking cessation

7.7.1. The relevance of smoking cessation for cardiovascular health

Smoking is a major and modifiable risk factor for CVD, contributing to the development and exacerbation of conditions such as CAD, HF, stroke, and peripheral arterial occlusive disease.[450] Even minimal exposure to tobacco smoke greatly increases the risk of CVD; e.g. passive smoking carries a 1.3-fold increased risk of CAD.[451] In women, the risk of developing CAD due to smoking is 25% higher than in men.[452] Implementing anti-smoking laws in communities and workplaces has been shown to reduce the incidence of acute MI by 20% within 12 months, with this effect becoming more pronounced over time.[453]

Stopping smoking decreases the risk of disease progression, morbidity, and mortality in all patients, regardless of the presence of CVD.[454] A cohort study of 8770 participants showed that compared with current smokers, former heavy smokers who had quit within 5 years had a lower risk of incident CVD [hazard ratio (HR), 0.61; 95% CI, 0.49–0.76].[455] Further, a meta-analysis of 503 905 participants aged >60 years found that smoking advanced cardiovascular mortality by 5.5 years, with risk increased by 2.07-fold for current smokers and by 1.37-fold for former smokers. These results show the beneficial effects of smoking cessation in older adults.[456]

Incorporating comprehensive, patient-centred smoking cessation strategies into CR programmes should be a top priority to optimize patient recovery, minimize complications, and enhance overall quality of life (*Figure 17*).

A meta-analysis of cohort studies of patients with CAD showed that stopping smoking reduced the relative risk of death by 36%.[457] Moreover, stopping smoking enhances the benefits of other CR components, such as exercise training, pharmacotherapy, and dietary modifications.

Newer forms of cigarettes, such as electrically heated cigarettes and e-cigarettes, differ from traditional cigarettes; however, the aerosols they emit contain harmful substances that have been associated with adverse health effects, including increased cardiovascular risk. These products should therefore be avoided.[458] With the growing use of e-cigarettes and other alternative nicotine products, CR programmes should address their potential harms in smoking cessation counselling, by emphasizing the goal of complete nicotine cessation and guiding the transition away from all forms of tobacco use.[459] Short-term use of e-cigarettes, however, may be considered in controlled settings to support smoking cessation.[460]

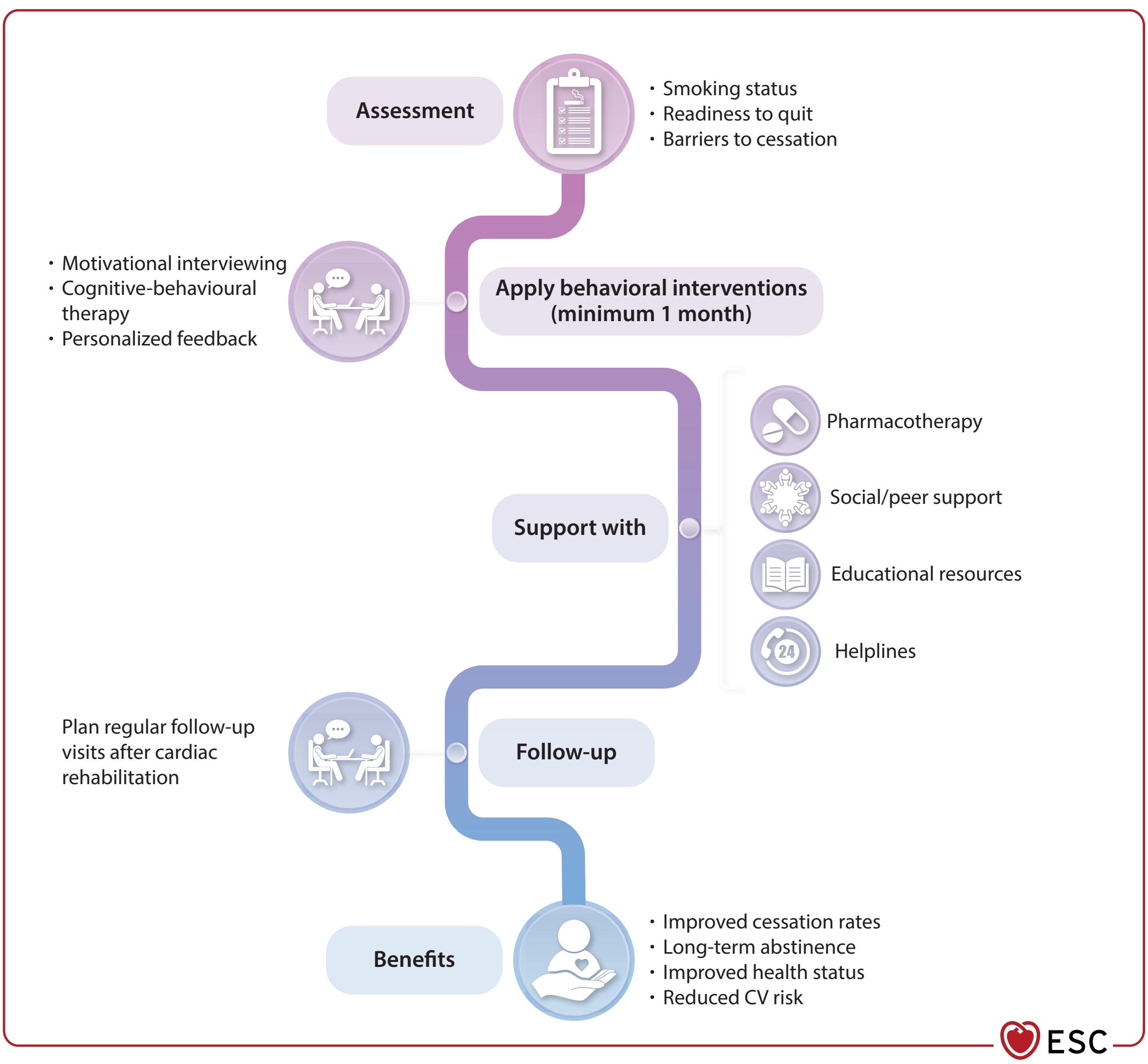

Figure 17 Comprehensive smoking cessation in cardiac rehabilitation. CV, cardiovascular.

7.7.2. Assessing smoking status and readiness to quit

Effective smoking cessation interventions begin by comprehensively assessing the patient's smoking history and current tobacco use. This includes determining:

- the type of tobacco products used (cigarettes, cigars, e-cigarettes, smokeless tobacco);
- the frequency and duration of smoking;
- the level of nicotine dependence;
- the number of previous quit attempts and strategies used; and
- the motivation to quit, gauged through the Five Stages of Change [i.e. pre-contemplation (not considering quitting), contemplation (considering quitting), preparation (getting ready to quit), action (actively trying to quit), and maintenance (sustaining abstinence)].[461]

Smoking cessation interventions are well suited to CR programmes, and usually comprise behavioural therapeutic approaches, telephone support, and self-help material that either focus on smoking cessation alone or include other risk factors (e.g. obesity, inactivity, and smoking). Combining behavioural counselling, pharmacotherapy, and follow-up support should also be considered.[462,463] Importantly, patients and healthcare providers should be having open, non-judgemental discussions about the patients' smoking habits, and healthcare providers should assess barriers to stopping, such as stress, weight gain concerns, or lack of social support.[464] Understanding a patient's readiness to quit allows interventions to be tailored to their individual needs and enhances the likelihood of success. Patients with depression or underlying lung disease may face additional barriers to cessation and often require more intensive or specialized support.

A comprehensive, patient-centred approach with ongoing follow-up can help patients achieve and maintain smoking cessation, improve cardiovascular health, and enhance their overall quality of life.[465,466]

7.7.3. Behavioural interventions

Behavioural interventions form the cornerstone of smoking cessation strategies in CR. Techniques such as motivational interviewing, cognitive behavioural therapy (CBT), and personalized feedback are effective in helping patients quit smoking.[466] Motivational interviewing addresses the ambivalence many smokers feel about quitting by enhancing their intrinsic motivation to change.[463] Interventions that combine psychological and social support components have shown promise for improving outcomes in patients with cardiac conditions.[463,467] A Cochrane review found psychosocial smoking cessation interventions to effectively promote abstinence up to 1 year in patients with congenital heart diseases.[467] With higher quit rates shown with more intensive interventions, it is recommended that smoking cessation interventions should be at least 1 month in duration.[463,467,468]

7.7.4. Pharmacological interventions

Pharmacological aids, including nicotine-replacement therapy, bupropion, and varenicline, support smoking cessation by alleviating withdrawal symptoms and reducing nicotine cravings.[469–471] Combining pharmacotherapy with behavioural interventions increases the likelihood of successful smoking cessation.[470,471]

7.7.5. Follow-up visits

A supportive environment within CR programmes is essential for smoking cessation. This includes regular follow-up visits, peer-support groups, and access to resources such as helplines and educational materials. Social support from healthcare providers and peers can enhance motivation and provide the necessary tools to overcome challenges during quit attempts.[467,472]

Recommendation Table 19 — Recommendations for smoking cessation (see Evidence Table 19)

Recommendations	Class[a]	Level[b]
Smoking cessation intervention is recommended as an integral component of CR with the goal to improve health status and to reduce cardiovascular risk.[464–466,473]	I	A
Pharmacotherapy, including nicotine-replacement therapy, varenicline, bupropion, or cytisine is recommended for patients who smoke and are participating in CR to enhance smoking cessation rates.[469,471,474,475]	I	A
Structured behavioural counselling, as part of CR, either individual or group-based, to all smokers is recommended to help patients to quit smoking and manage cravings.[466]	I	B1
Comprehensive smoking cessation programmes that include behavioural counselling, pharmacotherapy, and ongoing support are recommended as part of CR to increase smoking cessation rates and improving cardiovascular outcomes.[462,463]	I	B1
Tailoring educational interventions to the CV risk factors and comorbidities of patients undergoing CR is recommended to maximize relevance and impact of smoking cessation interventions.[464,466,476]	I	C
Support networks during the quitting process and regular follow-up appointments after completion of the smoking cessation programme should be considered for patients undergoing CR to provide additional motivation and continued support.[477,478]	IIa	B2
Psychosocial smoking cessation interventions, as part of CR, may be considered in patients with CAD to promote long-term abstinence from smoking.[467]	IIb	B2
E-cigarettes may be considered as an aid to quit tobacco smoking, but it is advisable to limit their use and avoid simultaneous use with conventional cigarettes due to unknown long-term effects.[460]	IIb	C

CAD, coronary artery disease; CR, cardiac rehabilitation.
[a]Class of recommendation.
[b]Level of evidence.

7.8. Psychosocial management

Psychosocial management is a core component of CR that aims to reduce the impact of psychological and social stressors after having a cardiac event.[25,479–481] Experiencing psychological distress (i.e. depression and anxiety) after a cardiac event is common and associates with a poorer prognosis. A meta-analysis of patients with cardiac conditions estimated their global prevalence of depression to be 31.3%, anxiety to be 32.9%, and stress to be 57.7%.[482] Additionally, a bidirectional relationship exists between mental functioning and heart disease. For example, patients with heart disease have a 1.79-fold increased risk of depression, while patients with depression have a 1.63-fold increased risk of heart disease, independent of shared risk factors including socio-economic status, lifestyle, BMI, statin use, and serum lipids.[483] Psychological distress can also reduce CR adherence. A large cohort study ($n = 5908$) found that adults with moderate symptoms of depression (24% vs 13%), anxiety (32% vs 23%), or stress (18% vs 10%) were less likely to adhere to CR than those with normal to mild symptoms ($P < .001$).[484] These data highlight the significance of effective psychosocial management after a cardiac event to optimize a patient's physical and mental well-being.

In CR it is important to adopt a person-centred approach to care which focuses on individual needs, preferences, and goals, shifting from a disease-focused approach to one that empowers patients to actively participate in their recovery.[481] This can also help to identify those at greatest risk of psychological distress, which can be achieved through brief, validated screening assessment tools [i.e. Cardiac Distress Inventory short form (CDI-SF)[485–488] and the Center for Epidemiological Studies Depression Scale (CES-D)],[489] the Generalized Anxiety Disorder 7-item and 2-item scales (GAD-2; GAD-7),[490] the Hospital Anxiety and Depression Scale (HADS),[491] and the Patient Health Questionnaires (PHQ-2; PHQ-9).[492] Studies using tools such as these have shown that patients with high psychological distress were at a 28% greater risk of incident CVD than patients with low or no distress.[233] Rapid screening has been identified as an efficient approach to understanding an individual's overall CVD risk profile.[233] In CR, psychological screening can identify the most appropriate treatment to manage the psychosocial health of a patient. Importantly, at least in some countries, psychological interventions can be delivered by CR clinicians trained by a mental health specialist, and simple steps can be taken to incorporate screening, patient education, and referral into CR.[493]

To ensure a holistic approach to CR, social isolation and linking the patient to community and social supports are also necessary to improve a patient's overall well-being and promote successful rehabilitation.[481,494] A Cochrane review of 21 studies ($n = 2591$) found the addition of psychosocial interventions to standard CR, as well as stand-alone psychological interventions, reduced depression, anxiety, and improved HRQoL in patients with heart disease CR.[495]

Psychosocial management involves using psychological interventions to modify behaviour, thoughts, feelings, and/or social support interventions, and can be delivered by mental health professionals or CR workers trained in their delivery.[495] A broad range of psychological and social interventions (*Figure 18*) exist that are well suited to patients who have experienced a cardiac event. They include psychological counselling, psycho-education, psychosocial interventions, mindfulness, and CBT, and vary in content and length—from brief to more intensive—depending on patient need and preference.

Evidence shows that CBT is one of the most effective methods for the psychosocial management of patients with heart disease.[481,496–499] Cognitive behavioural therapy gives patients strategies to reduce cardiovascular risk factors through changing problematic thinking patterns, improving emotional coping strategies, reducing stress, and facilitating behaviour change. Several meta-analyses have shown that CBT reduces psychological and physical risk factors including depression and anxiety in patients with HF,[496] ICDs,[499] and CAD,[498] even when provided online.[500] Further, a meta-analysis of patients with CHD (22 studies; $n = 4991$) found that CBT improved symptoms of depression, anxiety and stress, BMI, and HRQoL.[498] A large-scale trial found that CBT reduced the risk of recurrent CVD by 41% and recurrent acute MI by 45% in patients with CAD.[497] Furthermore, an RCT showed that online CBT led to large improvements in HRQoL in patients with symptomatic paroxysmal AF and reduced healthcare use.[146] CBT can be included as a part of CR to:

- reduce anxiety, depression, stress, and anger;
- achieve healthy lifestyle modification (e.g. smoking, diet, exercise);
- reduce blood pressure though relaxation techniques;
- improve medication compliance; and
- enhance overall HRQoL.

A recent Cochrane review found that psychological interventions reduced depression, anxiety, and increased HRQoL in patients with CAD and HF.[495] This review, which included a range of psychological interventions, recommended tailoring psychosocial management toward a more personalized approach to care; one that considers individual patient needs, values, and preferences.[495]

Mindfulness-based interventions typically combine meditation and breathing practices to cultivate awareness by encouraging patients to pay attention to the present moment. Such interventions have shown to be beneficial across a range of conditions including heart disease.[501–503] Mindfulness-based interventions are known to improve the regulation of the autonomic nervous system—which can decrease blood pressure, cortisol, and heart rate and slow disease progression—and are thus well suited to patients with heart disease.[481,501,504] Meta-analyses have shown that mindfulness-based interventions have beneficial effects on psychological and physiological outcomes across a range of cardiac conditions (e.g. CAD, HF, and CVD), including in reducing depression, anxiety, and stress.[502,503] Mindfulness-based interventions are low-cost, low-risk, and easily applicable treatments for reducing psychological and physical stressors in patients attending CR.

Cardiac rehabilitation plays an integral role in helping patients return to work after a coronary event; a decision often influenced by demographic, social, physical, and psychological factors. The psychosocial management of these patients is predominantly counselling, which commonly includes health education, stress management, relaxation strategies, social supports, and physical exercise.[505] To facilitate an early return to

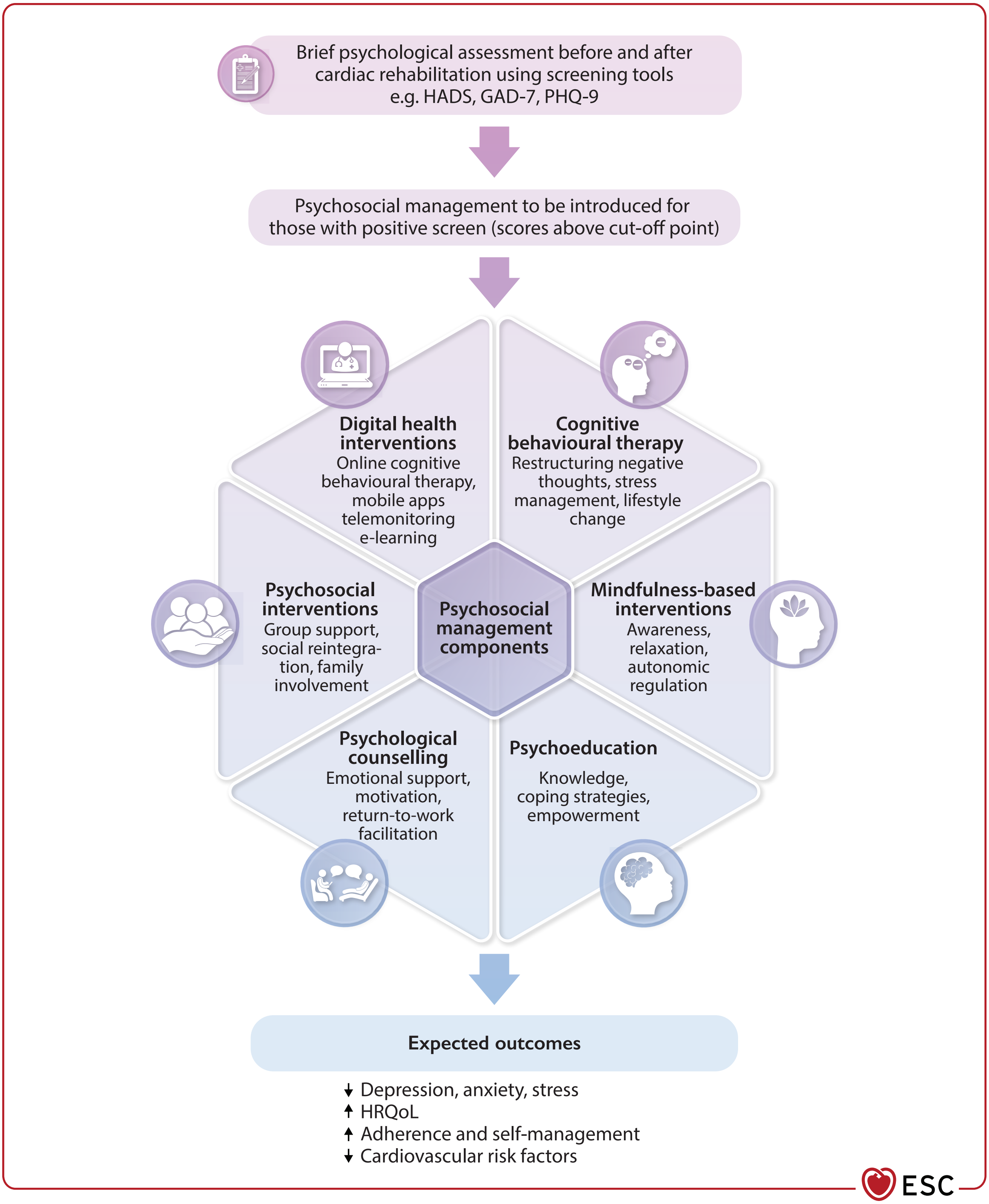

Figure 18 Options for psychosocial management in cardiac rehabilitation. GAD-7, Generalized Anxiety Disorder 7-item; HADS, Hospital Anxiety and Depression Scale; HRQoL, health-related quality of life. PHQ-9, Patient Health Questionnaire-9.

work, family involvement, agreement on a return-to-work plan, and identifying and addressing depression and stress-related issues are recommended.

Digital health interventions can improve reach and access to comprehensive CR by delivering psychosocial management online. Digital health interventions use information or communication technologies to achieve health outcomes, e.g. mobile apps, wearables, telemonitoring, text messaging, and online courses. A meta-analysis showed digital health interventions reduced depression and anxiety in patients with CAD and HF; mobile apps using cognitive behavioural approaches and telemonitoring are recommended for the greatest impact.[506] A distinct advantage of digital health interventions is that they can offer options for a range of psychosocial interventions dependent on patient preference, delivered by CR staff, i.e. nurses, and are relatively low-cost.[500,507,508] Digital health interventions offer readily accessible, cost-effective alternatives to traditional CR programmes, with potential for maintaining long-term healthy behaviours.

Additionally, pharmacological treatments, such as antidepressants, can be a safe and effective treatment for depression in individuals with heart conditions. However, careful consideration of potential cardiac side effects is important. For example, some antidepressants, e.g. certain tricyclic antidepressants may have adverse cardiovascular effects, while selective serotonin reuptake inhibitors are generally considered safer for patients with heart disease.[509,510] Further, a lack of evidence on interactions between psychiatric medications and CVD treatments complicate this management and need to be clarified in future research.

Approximately one in three patients with heart disease experience psychological distress, which is often linked to a poor prognosis.[483,484] Tailoring psychosocial management to individual patient needs is recommended to reduce their overall cardiovascular risk and improve their HRQoL.

Recommendation Table 20 — Recommendations for psychosocial management (see Evidence Table 20)

Recommendations	Class[a]	Level[b]
Psychological interventions are recommended for patients with CAD and HF to improve mental functioning (reduce anxiety and depressive symptoms) and improve HRQoL.[495]	I	B1
Cognitive behaviour therapy is recommended for patients with CAD, HF and patients who had been implanted with an ICD to improve mental functioning (depression, anxiety, HRQoL) and reduce cardiovascular risk.[496–499]	I	B1
Psychological screening (i.e. depression, anxiety) is recommended for comprehensive risk assessment in patients with heart disease to guide appropriate referral, intervention, and management.[233]	I	C
The use of telemonitoring systems and computer/cell phone-based psychosocial education and training should be considered in patients with CAD and HF to reduce anxiety and depression symptoms.[506]	IIa	B1
Psychological counselling should be considered in patients with CAD to increase short-term potential for return to work.[505]	IIa	B2
Mindfulness-based interventions should be considered in patients with CAD to reduce depression, anxiety, stress, and blood pressure.[502,503]	IIa	B2
Antidepressive treatment with an SSRI should be considered in patients with CHD and moderate-to-severe major depression to improve depression symptoms.[510]	IIa	B2

CAD, coronary artery disease; CHD, coronary heart disease; HF, heart failure; HRQoL, health-related quality of life; ICD, implantable cardioverter defibrillator; SSRI, selective serotonin reuptake inhibitor.
[a]Class of recommendation.
[b]Level of evidence.

7.9. Sexual counselling

Sexual dysfunction is highly prevalent in patients with cardiac conditions. Sexual dysfunction occurs when adults experience difficulties in engaging in personally satisfying, non-coercive sexual activities, which can be classified into various physiological and psychological disorders.[511,512] The global prevalence of sexual disorders in patients with cardiovascular conditions has been estimated to be 62.6%.[513] Erectile dysfunction and CVD share risk factors, i.e. hypercholesterolaemia, hypertension, diabetes, sedentary lifestyle, smoking, and depression, and have a similar pathophysiological disease process: both are likely caused by endothelial dysfunction and atherosclerosis. Erectile dysfunction is considered to precede major cardiovascular events such as MI and CAD because atherosclerotic plaques occlude smaller arteries first;[514,515] however, bidirectional associations have been shown.[515,516]

Further, the use of medications to treat erectile dysfunction are common (e.g. Sildenafil), while these are generally safe for those with stable heart conditions, it is important to assess individual cardiac risk and discuss potential interactions with other medications.[517,518]

Erectile dysfunction is an independent predictor of CVD and associated outcomes.[514] In patients with CVD, a meta-analysis confirmed men with erectile dysfunction had a 1.55-fold increased risk of MI, a 1.45-fold increased risk of CVD, a 1.50-fold increased risk of CHD and cardiovascular-related mortality, and a 1.25-fold increased risk of all-cause mortality compared with those without erectile dysfunction.[515] Although more commonly reported in males, sexual dysfunction is equally concerning for females. Another meta-analysis found that women with CVD, compared with those without CVD, are at greater risk of developing sexual dysfunction (1.51-fold), which increased to a 2.07-fold greater risk for those with MI.[519] In consideration of the associations between sexual dysfunction and CVD, these data emphasize the importance of screening for sexual dysfunction in those with existing cardiac disease.[515,519] Due to a lack of relevant knowledge, patients with cardiac conditions commonly fear that sexual activity may trigger another event.[520,521] Sexual rehabilitation programmes aim to improve sexual satisfaction and facilitate a timely return to normal sexual activities after a cardiac event. A comprehensive sexual rehabilitation programme, which typically comprises a combination of counselling, psycho-education, and physical exercise (i.e. pelvic floor muscle training) to improve patients' outcomes across a range of cardiac conditions can be recommended for those in need. A meta-analysis concluded that sexual rehabilitation effectively improves sexual dysfunction in patients with CAD, CABG, or MI.[522] However, four of the five studies included in the meta-analysis were male-only studies, and there is limited evidence on women's sexual dysfunction in interventional studies.[519]

Sexual counselling, on its own, has been shown to improve sexual functioning and satisfaction in men and women with heart disease.[523–525] Topics discussed in sexual counselling (see *Figure 19*) include misconceptions about sexual activity and heart disease, when to resume sexual activity, warning signals during sexual activity, and the effects of mental health and cardiac medications on sexual function; this supports the patient in achieving sexual well-being.[520] Important considerations for women include medicines with teratogenic (birth defect-causing) potential and the need for pre-conception counselling if such medications are discontinued. This includes discussing the safety of hormonal contraceptive use (i.e. those containing oestrogen), which may increase the risk of cardiovascular events.[526,527]

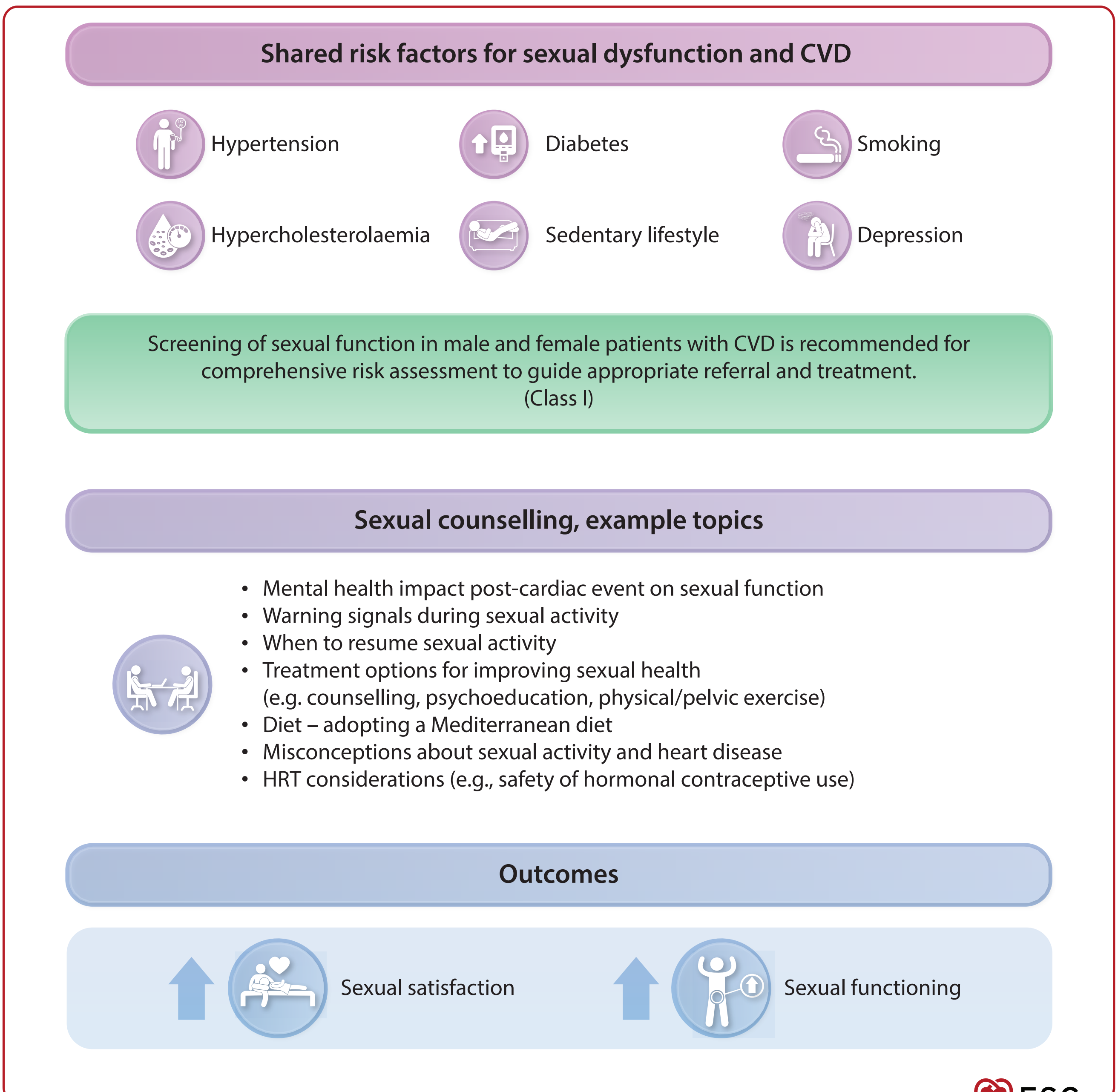

Figure 19 Sexual dysfunction in cardiovascular disease: shared risk factors, sexual counselling, and outcomes. CVD, cardiovascular disease; HRT, hormone replacement therapy.

Hormone replacement therapy in women with CVD remains a nuanced topic with recent research emphasizing the importance of timing, formulation, and individual risk factors. Hormone replacement therapy can be considered for symptom management in appropriately selected women.[528] Cardiac rehabilitation programmes are well-placed to integrate routine screening and introduce sexual health counselling to reduce cardiovascular risk.[529,530]

Physical activity, a key component of CR, has been shown to improve erectile function. A review of physical activity and erectile dysfunction in men with CVD found that an overall weekly exercise dose of 160 min for 6 months contributed to a decrease of erectile dysfunction. To decrease erectile dysfunction, 40 min of aerobic exercise of moderate to vigorous intensity is recommended four times per week.[531]

Adopting a Mediterranean diet has also shown promise in improving erectile performance.[532] Nutritional counselling is another important component of CR. Clinical trials and epidemiological studies have identified that the Mediterranean diet's health benefits stem from its anti-inflammatory and vasoprotective properties.[533,534] A study of 150 middle-aged men with chronic HF found that greater adherence to the Mediterranean diet was associated with enhanced erectile performance.[532]

The multifaceted nature of CR programmes—through lifestyle modification and cardiovascular risk reduction—has been shown to reduce vascular erectile dysfunction.[535,536] A meta-analysis concluded that adhering to CR significantly improved erectile dysfunction in individuals with cardiovascular conditions.[535] Telerehabilitation,[537] designed to increase the uptake of and involvement in CR, has also shown efficacy in increasing sexual function in patients with HF.

Recommendation Table 21 — Recommendations for sexual counselling (see Evidence Table 21)

Recommendations	Class[a]	Level[b]
Screening of sexual function in male and female patients with CVD is recommended for comprehensive risk assessment to guide appropriate referral, treatment.[515,519]	I	B2
Sexual rehabilitation should be considered in male and female patients with CVD and sexual dysfunction to improve sexual functioning.[522]	IIa	B2
Promoting physical activity should be considered in patients with CAD undergoing CR to improve erectile dysfunction.[531]	IIa	B2
CR should be considered in patients with chronic HF, CAD, MI, or CABG to improve erectile dysfunction.[535]	IIa	B2
Sexual counselling as part of CR should be considered in cardiac patients to improve sexual functioning and satisfaction.[524,538]	IIa	C

CABG, coronary artery bypass graft; CAD, coronary artery disease; CR, cardiac rehabilitation; CVD, cardiovascular disease; MI, myocardial infarction.
[a]Class of recommendation.
[b]Level of evidence.

7.10. Managing frailty and comorbidities related to cardiovascular risk

Before starting CR, frailty and relevant comorbidities must be thoroughly evaluated (see *Section 7.1*). This includes assessing the severity and stage of the conditions, as well as evaluating musculoskeletal limitations,[539] inflammatory disease activity, cancer disease activity, and determining frailty status.[173,191] If any of these conditions are present, they should be considered when setting care goals and designing the personalized CR programme. A multidisciplinary team, as outlined in *Section 6.2*, is mandatory for developing an individualized care plan that is tailored to the individual's needs and abilities. The multidisciplinary team should identify frailty and relevant comorbidities, harmonize care with disease-specific rehabilitation protocols, and customize the programme according to individual care goals and the presence of these conditions when developing a personalized CR programme (*Figure 20*).

Frailty, obesity, diabetes, hypertension, dyslipidaemia, and OSAS should be managed according to established scientific statements and recommendations.[173–178] Although data suggest that CR may be most beneficial for physically frail patients with CVD,[229] patients with poor functional status are less likely to attend CR.[230] Frailty must be addressed with a multimodal rehabilitation approach including balance training, strength exercises, and nutritional support.[173,540]

The CR programmes should be harmonized with recommendations for rehabilitation in chronic obstructive pulmonary disease, CKD, rheumatoid arthritis, stroke, PAD, and cancer,[198–203] and customized based on the patient's functional capacity, comorbidities, and any limitations in mobility or strength. Patients with comorbid conditions, especially chronic obstructive pulmonary disease, CKD, musculoskeletal diseases, and cancer, may require more frequent monitoring during CR sessions. This includes monitoring vital signs such as heart rate, blood pressure, ECG, oxygen saturation, and symptoms such as breathlessness or fatigue. Patients with CKD may need extra supervision to manage fluid and electrolyte imbalances.[195,204,541,542] Exercise intensity and duration should progress gradually, particularly for frail patients or those with severe comorbidities. Low-impact aerobics and strength exercises, tailored to the musculoskeletal limitations are recommended in patients with osteoarthritis or other musculoskeletal conditions.[539] Patients should receive education about how their comorbid conditions interact with their heart health. Teaching self-management techniques, how to recognize symptoms of exacerbation (e.g. in chronic obstructive pulmonary disease or CKD), and lifestyle changes to address obesity, diabetes, hypertension, OSAS, or inflammatory diseases can empower patients to actively engage in their rehabilitation.

Comorbidities can increase the psychosocial burden, including depression and anxiety, which may affect adherence to CR.[543,544] Providing mental health support, counselling, and peer group involvement can help improve engagement and outcomes.

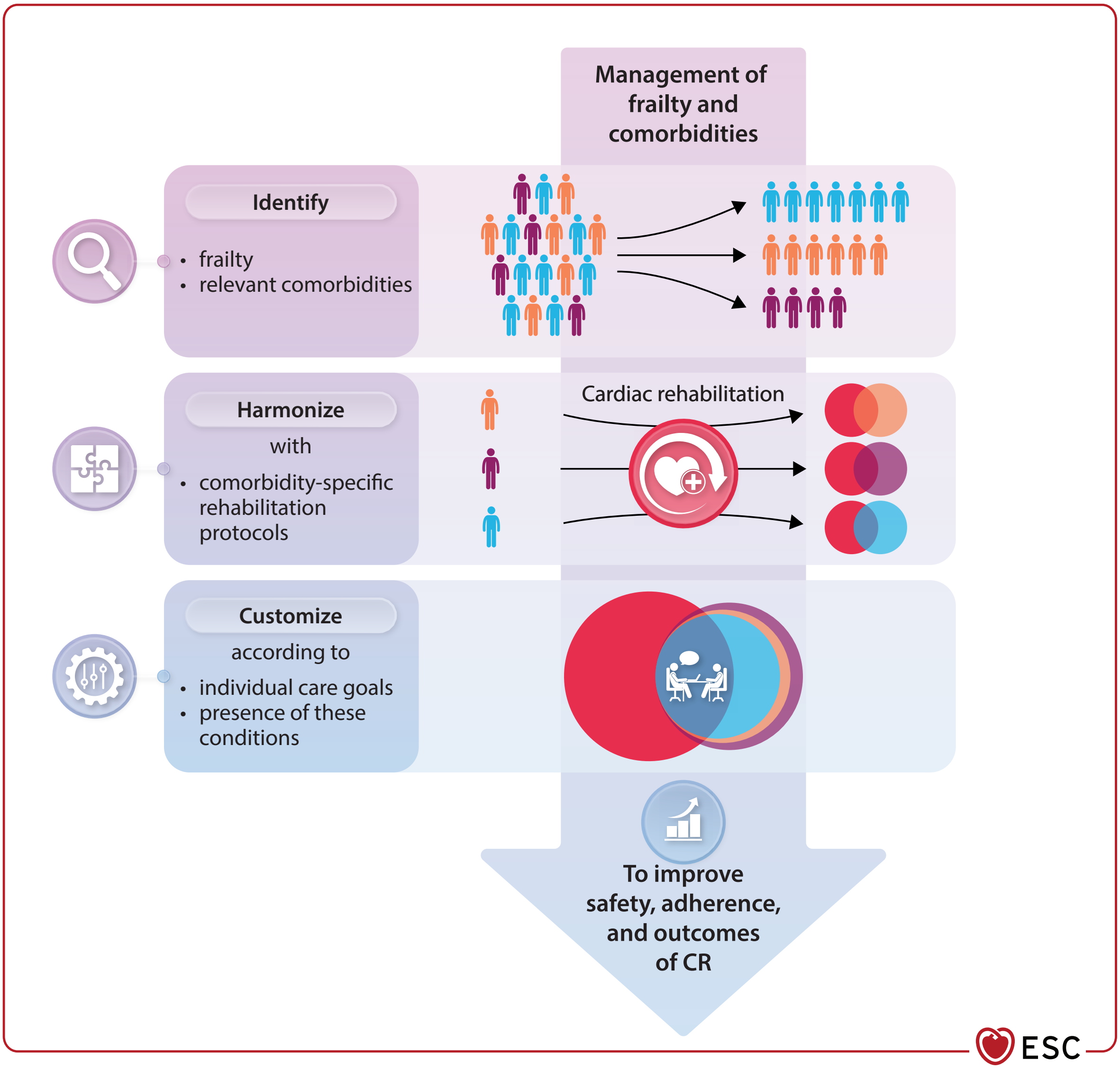

Figure 20 Managing frailty and comorbidities in cardiac rehabilitation. CR, cardiac rehabilitation. Different phenotypes (based on frailty or comorbidities) are represented in different colours.

Recommendation Table 22 — Recommendations for the management of frailty and comorbidities during cardiac rehabilitation (no Evidence Table available)

Recommendations	Class[a]	Level[b]
Management of cardiovascular risk factors like obesity, diabetes, hypertension, dyslipidaemia, and OSAS as part of CR is recommended in patients with cardiac diseases and these conditions to improve health outcomes.[174–178]	I	C
CR is recommended in patients with frailty or comorbidities to be tailored to each patient's specific condition and managed in a multidisciplinary team to ensure safety, effectiveness, and adherence.	I	C
CR is recommended to be harmonized with disease-specific rehabilitation protocols in patients with cardiac diseases and chronic obstructive pulmonary disease, CKD, chronic inflammatory disease, stroke, musculoskeletal disorders, PAD, or cancer to maximize improvements of health outcomes.[198–204]	I	C
Management of frailty as part of CR should be considered in frail patients with cardiac disease to improve frailty status and physical health outcomes.[191]	IIa	B2

CKD, chronic kidney disease; CR, cardiac rehabilitation; OSAS, obstructive sleep apnoea syndrome; PAD, peripheral arterial disease.
[a]Class of recommendation.
[b]Level of evidence.

7.11. Counselling on environmental cardiovascular risk factors

Beyond traditional cardiovascular risk factors and genetic predisposition, a growing body of evidence highlights the significant impact of environmental stressors, such as air pollution, noise exposure, artificial light at night, climate-related events (e.g. extreme heat, desert storms, and wildfires), and neighbourhood factors,[545] on an individual's cardiovascular risk.[546–549] The concept of the exposome, which explores how exposure to environmental risk factors alters central biochemical pathways and impacts health, has recently been reviewed.[550]

Given that some environmental stressors are modifiable, much like cardiovascular risk factors, CR should involve thoroughly assessing an individual's environmental conditions and provide counselling on preventive measures.[551] Patients can reduce their exposure to air pollution by limiting outdoor activities during high-pollution periods, using air purifiers indoors, and avoiding heavy traffic areas, particularly when doing physical activities.[546,548] To mitigate noise pollution, strategies include using soundproofing measures at home and wearing noise-cancelling devices in loud environments.[549] Reducing exposure to artificial light at night can be achieved by using blackout curtains, dimming lights in the evening, and minimizing screen time before bedtime, which supports better sleep and overall heart health.[549] In hot climates, patients should stay hydrated, avoid outdoor exertion during peak-heat hours, and seek cool, shaded spaces, or air-conditioned environments.[548]

Recommendation Table 23 — Recommendations on environmental cardiovascular risk factors (no Evidence Table available)

Recommendations	Class[a]	Level[b]
Counselling on environmental stressors (pollutants in the air, noise exposure, artificial light at night, extreme climates) and advising on preventive measures as part of CR should be considered in all patients with heart disease to reduce their cardiovascular risk.[546–550]	IIa	C

CR, cardiac rehabilitation.
[a]Class of recommendation.
[b]Level of evidence.

7.12. Interventions to enhance return to work

Interventions aimed at facilitating return to work represent a critical component of the rehabilitation process for patients with CVD, particularly given that reintegration into the workforce is frequently identified as a central goal within CR programmes. Returning to work following a coronary event is often a key aspect of the overall psychosocial adjustment and recovery process, particularly in younger patients (e.g. aged <50 years). However, successful reintegration into the workforce is not determined solely by clinical or physical status. Rather it is shaped by a range of interrelated factors, including demographic, social, and psychological aspects. Recognizing and addressing these multifactorial influences is essential for the development of effective, individualized rehabilitation strategies.[505]

A meta-analysis suggests that participation in comprehensive CR is associated with an increased likelihood of return to work following a coronary event, although the effect is generally modest [66% (60%–71%)] in CR participants vs 58% (47%–68%) in non-participating controls.[552] Cardiac rehabilitation programmes that integrate both exercise training and counselling appear to reduce the time required for patients to resume employment and may enhance employment rates, especially within the first 6 months after the cardiac event. Ideally, exercise programmes should integrate, or progress to, actual job-related activities. Subgroup analyses stratified by duration of CR or follow-up revealed no significant differences in return-to-work prevalence at 1 year or beyond. Additionally, return-to-work rates were found to be lower among individuals engaged in physically demanding occupations (e.g. blue-collar jobs) compared with those in less physically intensive roles (e.g. white-collar jobs), suggesting that the nature of occupational demands plays a critical role in post-rehabilitation work reintegration.[552]

A comprehensive approach seems essential to stimulate the return to work as evidence shows that CR programmes combining exercise training and counselling are more effective in facilitating return to work following an acute coronary event than interventions based solely on education and counselling.[553] Despite this, return to work was frequently assessed as a secondary outcome in the included studies, often leading to inadequate reporting and limiting the overall strength and interpretability of the evidence. This highlights the need for future research to prioritize return to work as a primary outcome and to adopt rigorous methodological designs and standardized reporting practices to generate more robust and clinically applicable evidence in this field.

Recommendation Table 24 — Recommendations for interventions to enhance return to work (see Evidence Table 24)

Recommendations	Class[a]	Level[b]
Combined interventions including counselling and exercise training should be considered in patients with an indication for CR to increase return to work.[552,553]	IIa	B2

CR, cardiac rehabilitation.
[a]Class of recommendation.
[b]Level of evidence.

8. Telehealth, telemedicine, and mobile health in cardiac rehabilitation

Telehealth includes telemedicine clinical services as well as non-clinical services such as training and patient education; it encompasses video visits, phone calls, online communication, and management of patient data, and may be delivered synchronously or asynchronously. Telemedicine refers to technology-based platforms that deliver clinical services

Table 11 Terms and mode of delivery of cardiac telerehabilitation programmes

Telehealth (or web-based digital health)
Telehealth or web-based digital health utilizes internet-enabled platforms and web technologies to provide access to health services, information, monitoring, and communication between patients, healthcare providers, and health systems. It encompasses web applications for electronic health records, telemedicine services, remote patient monitoring, health education, appointment scheduling, and secure messaging, enabling a more accessible, efficient, and patient-centred healthcare.
Mobile health (mHealth)
mHealth is the use of smart devices (smartphones, tablets, etc.) and health-based software apps for continuous monitoring of several different health parameters (including heart rhythm, activity, temperature, and oxygen saturation). mHealth devices and apps can encourage healthier lifestyle behaviours and provide healthcare professionals with patient's personal health records to be integrated and used during teleconsultation.
Teleconsultation
Teleconsultation refers to a real-time interaction between a patient and their healthcare provider, typically involving a live, two-way video conference, but it can be conducted via telephone or supported through email or SMS communication.
Asynchronous consultation
Asynchronous consultation is the electronic delivery of a patient's health document outside of real-time, generally used between different healthcare providers.
Remote patient monitoring
Remote patient monitoring is the collection of a patient's health data from their residence, electronically sent to a healthcare professional (provider, nurse, etc.) for monitoring and review. Such health data can be obtained from implantable or wearable devices, in continuous or discontinuous mode.

mHealth, mobile health; SMS, short message service.

Table 12 Challenges and obstacles facing telemedicine and mobile health use in cardiac rehabilitation

Limited information about evidence, validation, safety, and security of mHealth devices, including wearable devices, apps, and virtual platforms.[37]
Digital literacy and disparities of access to digital technology, particularly among elderly and frail patients.[38–40]
Privacy, digital data safety, and protection data.[37,40]
Lack of standardized digital infrastructure, both at the hospital level and at patients' homes.
Insufficient and heterogeneous professional training relative to telemedicine and mHealth.
Lack of validated interned-based virtual platforms to manage feedback and counselling provided by healthcare professional to patients.
Limited evaluation of cost-effectiveness of CTR.
Lack of reimbursement fare and fees related to telemedicine and CTR care.
Limited and heterogenous awareness about safety, privacy, and medico-legal issues related to CTR.
Limited integration of CTR in routine/standard medical care.
Differences in national regulations and implementation of CTR.

CTR, cardiac telerehabilitation; mHealth, mobile health.

remotely to patients at distant sites to improve access, adherence, continuity of care, and cost-effectiveness. Telemedicine has a well-documented positive impact in reducing the need of patient displacement and optimizing hospital resource use.[554] Mobile health (mHealth) involves care delivered via internet-based and/or mobile applications supported by wearable devices that can be processed by emerging computational methods such as artificial intelligence (AI) or neural networking.[29] We provide a synoptic table with the definition of terms and modalities currently utilized in CTR programmes (see *Table 11*), since they are not yet utilized univocally in the literature.[555]

Data on efficacy and feasibility of CTR in cardiovascular patients are currently emerging in different clinical settings.[237,556] However, there is a wide heterogeneity both in the behaviour change techniques, in the intervention characteristics, and in the mode of delivery utilized in CTR programmes. More than one mode of delivery (web-based, smartphone applications, phone calls, teleconsultations) were generally implemented in CTR programmes, with an average of 2.6 modes of delivery.[237]

In a recent meta-analysis, including 14 RCTs involving 2869 CHD patients, when compared with usual care, participation in CTR showed significant improvement in functional capacity {6MWT distance [mean difference (MD), 25.58 m; 95% CI, 14.74–36.42]; daily step count [MD, 1.05 K(1000); 95% CI, 0.36–1.75], and exercise habits [odds ratio (OR), 2.28; 95% CI, 1.30–4.00]}; depression scores (standardized MD, −0.16; 95% CI, −0.32 to 0.01) and quality of life [short-form mental component summary (MD, 2.63; 95% CI, 0.06–5.20); and physical component summary (MD, 1.99; 95% CI, 0.83–3.16)]. Differences in the characteristics of CTR programmes may have contributed to the wide variation in efficacy observed.[556]

Telemedicine programmes that combine remote monitoring and virtual consultations may reduce short-term cardiovascular hospitalizations and mortality, particularly among patients with HF. In a recent meta-analysis, including 34 studies [13 269 patients with 6620 (50%) receiving telemedicine], combined remote monitoring and consultation for patients with HF was associated with a reduced risk of cardiovascular-related mortality [relative risk (RR, 0.83; 95% CI, 0.70–0.99; $P = .036$] and hospitalization for a cardiovascular cause (RR, 0.71; 95% CI, 0.58–0.87; $P = .0002$), although most studies had a relatively short-term follow-up.[557]

See *Figure 21* for an overview of the expected benefits of telemedicine and digital technologies in CR.

Mobile health solutions have the potential to improve self-management and clinical care. However, information about evidence, safety and security of mHealth devices may be hard to obtain and consensus is lacking on the level of required evidence.[555]

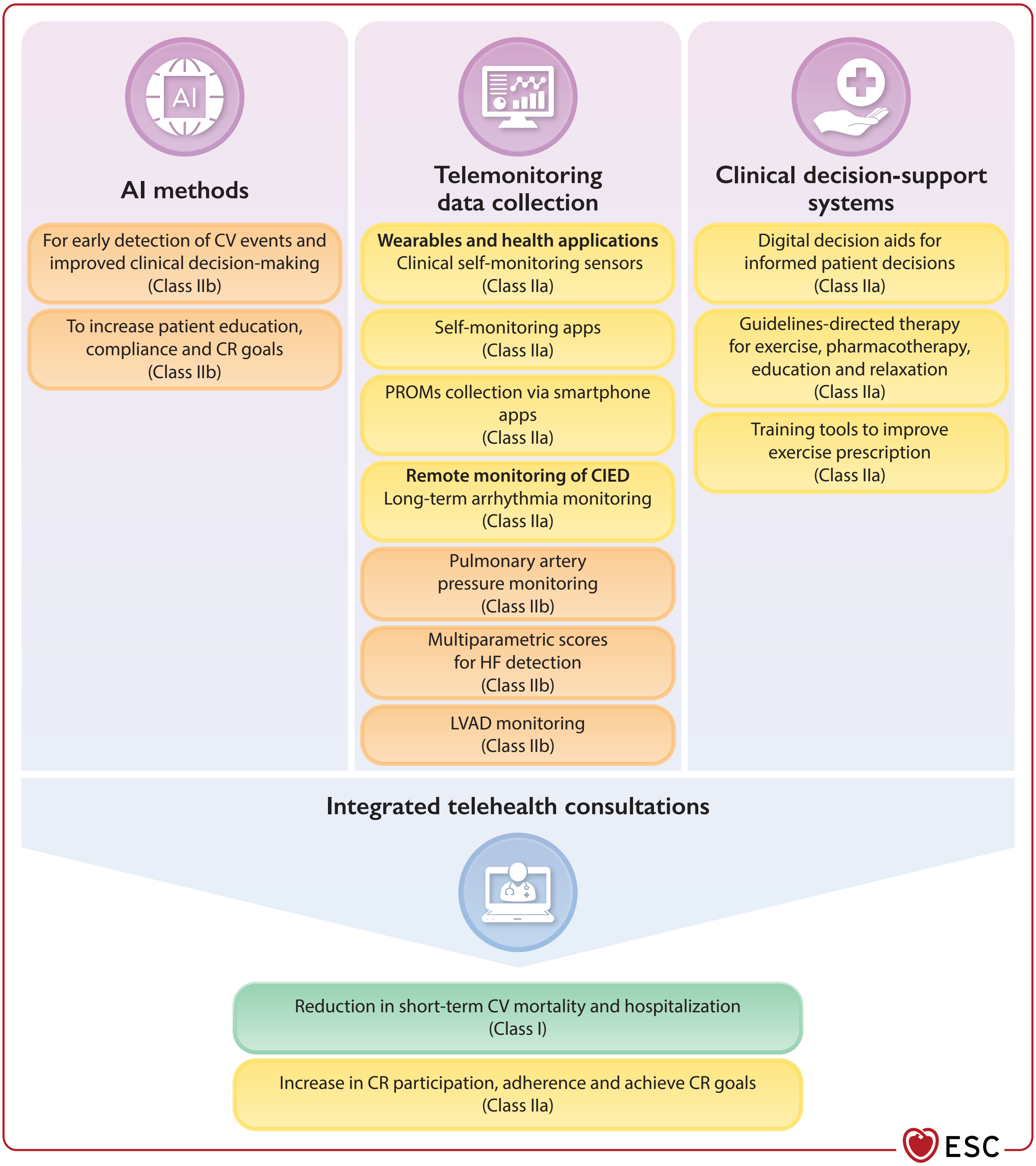

Figure 21 Use and benefits of telemedicine to achieve better cardiac rehabilitation outcomes. AI, artificial intelligence; CIED, cardiac implantable electronic device; CR, cardiac rehabilitation; CV, cardiovascular; HF, heart failure; LVAD, left ventricular assist device; PROM, patient-reported outcome measure.

One of the major potential barriers in the implementation of mHealth is digital illiteracy and disparity of access to digital technology, particularly among elderly and frail patients, in whom several studies showed that even the use of smartphones may represent an obstacle to teleconsultation and telemonitoring.[558–560]

Another major challenge relates to the privacy and sharing of digital data collected by mHealth, as concerns about patient confidentiality, privacy, and security consistently affect the adoption of mHealth devices.[561] Other difficulties include the limited availability and high cost of validated wearable devices, as well as the lack of reliable apps and virtual platforms to support data exchange and communication between patients and healthcare professionals.[555] Finally, the limited data regarding cost-effectiveness, the medico-legal aspects, and the reimbursement modalities impair the implementation of mHealth in general medical practice (*Table 12*). The development of digital-specific outcome measures, such as patient engagement metrics, digital adherence rates, and usability scores, in addition to traditional CR outcomes may strengthen the evidence of effectiveness and the implementation of CTR.

8.1. Telehealth consultation and telemonitoring

Teleconsultation enables real-time communication between patients and healthcare providers, to discuss symptoms, receive advice, or adjust treatment plans via digital communication tools, such as video calls, phone calls, or messaging platforms. Teleconsultation is especially useful for managing chronic conditions, maintaining the patient–provider relationship without the need for in-person visits, while ensuring quality and timely healthcare delivery.[29] Despite logistical limitations, teleconsultation plays a crucial role in delivering care in challenging settings, such as rural or remote areas,[562] or during health crises such as the COVID-19 pandemic.[558,560]

Telemonitoring in CR involves the remote supervision of patients' cardiovascular status and physical activity using digital technologies. It enables continuous data exchange between patients and healthcare providers, allowing timely feedback, early detection of complications, and personalized exercise adjustments.

During telemonitoring in CR, various physiological and behavioural parameters can be recorded to assess patient progress and safety, including heart rate and rhythm (by ECG or by wearable sensors), blood pressure (by cuff-based or cuffless devices), oxygen saturation (SpO_2), respiratory rate, physical activity level (steps, distance, energy expenditure), body weight and body composition, blood glucose levels (in patients with diabetes), symptoms, and perceived exertion (via patient-reported data). These parameters enable clinicians to evaluate cardiovascular response, adjust rehabilitation plans, and detect early signs of deterioration.[30]

Teleconsultation combined with telemonitoring has become a vital component of CR, enhancing accessibility, continuity of care, and overall patient engagement.[563] Through virtual platforms, patients can connect with healthcare providers through video calls or secure messaging, enabling regular follow-ups and adjustments to their rehabilitation programmes without frequent in-person visits. Also, through telehealth platforms, exercise regimens, dietary guidance, and medication schedules can be customized based on individual patient data. This continuous engagement ensures that rehabilitation is tailored to patients' evolving needs, which promotes better adherence and outcomes.[564] Telehealth consultation is particularly beneficial in patients with HF, in whom multiparametric data are also obtained through remote monitoring of implantable devices (CIEDs or LVADs). This can provide accurate and updated information on patients' evolution, allowing timely adjustment of treatment and activity programmes and effectively reducing cardiovascular-related mortality and hospitalization.[557] Telehealth consultation is an attractive approach to enhance adherence and quality of life in younger patients with heart disease or those living with congenital heart disease, offering easier access to personalized plans, flexibility, and accessibility.[565]

In addition to clinical supervision, telehealth consultations provide education and emotional support, offering guidance on lifestyle modification, diet, and stress management essential for long-term cardiovascular health, including the use of internet-based CBT to reduce anxiety and depression.[500]

Recommendation Table 25 — Recommendations for telehealth consultation and telemonitoring (see Evidence Table 25)

Recommendations	Class[a]	Level[b]
Telehealth consultation combined with telemonitoring is recommended in patients with HF to reduce short-term cardiovascular-related mortality and hospitalization.[557]	I	B1
Telehealth consultation should be considered in all patients undergoing CR to increase enrolment, adherence, and completion of CR.[564]	IIa	B2

CR, cardiac rehabilitation; HF, heart failure.
[a]Class of recommendation.
[b]Level of evidence.

8.2. Mobile-health applications and wearable devices

Mobile-health and web-based applications are vital in CR, enabling continuous monitoring and personalized care.[29] Wearable devices, such as smartwatches and fitness trackers, track vital signs such as heart rate, blood pressure, and physical activity, syncing data with mobile apps. The integration of self-operated digital wearable sensors in CR programmes is a promising approach to improving CR outcomes.[291,556,566–568]

Wearable sensors can provide simultaneous continuous, real-time monitoring of physiological parameters such as ECG, activity levels, temperature, blood pressure, oxygen saturation, and sleep.

Remote blood pressure monitoring enables continuous tracking of patients' cardiovascular health outside clinical settings. Using connected devices, readings are automatically transmitted to healthcare providers for review. According to a recent network meta-analysis, telemonitoring and home-based blood pressure monitoring may be more useful in controlling blood pressure as compared with usual care management alone.[569] Cuff devices provide accurate, periodic measurements, while cuffless sensors enable continuous, non-invasive monitoring through wearable or implantable systems. Cuffless blood pressure monitors are heterogeneous in measurement principle, intended use, functions, and calibration, and have special accuracy issues requiring different validation than classic cuff blood pressure monitors. To date, there are no generally accepted protocols for their validation to ensure adequate accuracy for clinical use.[570]

Remote monitoring capabilities enable healthcare providers to oversee patients' conditions without frequent in-person visits, remotely track patients' progress, and adjust rehabilitation plans, while making the process more convenient and cost-effective. Self-operated wearable sensors promote patient engagement, offering real-time feedback on physical activity and health metrics, helping to adjust behaviours to meet goals. This allows patients to monitor their progress and receive medication and exercise reminders.

Artificial intelligence methods applied to mobile health technology can ultimately enhance the precision, personalization, and efficiency of CR programmes. This improves patient engagement, adherence, and promotes safer, more effective recovery for patients with cardiac conditions. A detailed description of different wearable sensors is provided in the Supplementary data online, *Section S4.1* and *Table S9*.

8.2.1. Smartphone-based multiparametric recording systems in cardiac rehabilitation

Smartphone-integrated wearable sensors enable continuous, real-time monitoring of key physiological parameters in CR.[568] These systems track heart rate, blood pressure, oxygen saturation, physical activity, and sleep, by direct or indirect modes of measurement, and transmit monitored data via smartphone applications to provide rapid insights into patient status and rehabilitation progress.

Smartphone-based multiparametric recording systems enhance CR by increasing patient engagement and enabling rapid, personalized feedback. Continuous data transmission allows healthcare providers to remotely monitor progress, adjust rehabilitation plans, and deliver timely interventions. This approach supports personalized care and may improve rehabilitation outcomes and safety in patients with cardiac disease.

8.2.2. Smartphone apps for self-monitoring in cardiac rehabilitation

Smartphone apps are essential in CR, offering accessible tools to support recovery, deliver personalized exercise programmes, track vital signs, and monitor progress, thereby enhancing patient engagement and adherence. Smartphone apps often include additional features such as medication reminders, educational content, and telehealth capabilities to keep patients informed and motivated.

Telehealth consultations connect patients with healthcare providers, allowing real-time support and adjustments to rehabilitation plans. Continuous communication between patients and healthcare providers helps in achieving better and safer CR goals.[291,566–568] These real-time data offer insights into health trends, facilitating informed and personalized decision-making about lifestyle and medical care.

Apps for PROs have been shown to enhance CR goals in patients with cardiac conditions.[49] Many self-monitoring apps incorporate educational content and interactive tools to help users understand their health conditions and the impact of their habits, offering motivational support through progress tracking and virtual rewards, and encouraging users to stay committed to their health goals.

8.2.3. Incorporating artificial intelligence methods in cardiac rehabilitation

Artificial intelligence methods applied to CR can enhance the precision, personalization, and efficiency of treatment programmes.[571] Artificial intelligence's ability to analyse vast amounts of data rapidly and accurately makes it an invaluable tool in developing more effective rehabilitation strategies. These technologies enable real-time interpretation of physiological data, predictive risk assessment, and tailored treatment planning.

Wearable devices continuously capture physiological parameters such as heart rate, movement, and sleep patterns, providing data that drive AI algorithms to generate clinically actionable insights and enable remote, proactive patient management. However, challenges remain, including data privacy, algorithm bias, limited battery and processing capacity, and the need for clinical validation.[572]

Another key application is predictive analytics, where AI analyses patients' data, including medical history and real-time health metrics from wearable sensors, to predict potential health risks and complications. This allows healthcare providers to address issues pro-actively, improving patients' outcomes and reducing hospital readmissions.

Artificial intelligence personalizes CR by optimizing exercise, diet, and medication plans to individual needs. Machine-learning models identify the ideal exercise intensity and duration, enhancing engagement and programme effectiveness. Real-time monitoring of vital signs enables early detection of anomalies and timely intervention, improving care, and reducing clinic visits.

Furthermore, AI improves data management with natural-language processing to extract insights from clinical notes and unstructured data, aiding decision-making, and keeping healthcare providers informed of the latest developments. Artificial intelligence-driven chatbots and virtual assistants offer 24/7 patient support, answering questions, reminding patients about medications, and providing heart health education. This constant support fosters adherence to rehabilitation programmes and medications, ultimately increasing patient empowerment.

Recently, the European Union's AI Act [Regulation (EU) 2024/1689] has established harmonized rules for the development and use of AI systems, emphasizing safety, transparency, and accountability.[573] This entails rigorous risk assessments, adherence to data quality standards, and ensuring human oversight to maintain patient safety and trust. Aligning with the AI Act, healthcare providers can effectively integrate AI into CR, enhancing patients' outcomes while upholding ethical standards.

Recommendation Table 26 — Recommendations for health applications and wearable devices (see Evidence Table 26)

Recommendations	Class[a]	Level[b]
Self-operated digital wearable sensors (recording ECG) and measuring of level of physical activity, blood pressure (only when using cuffed devices), oxygen saturation should be considered in patients with cardiac diseases undergoing CR to achieve better CR goals.[291,566–568]	IIa	B1

Continued

Smartphone apps for self-monitoring should be considered in patients with cardiac diseases undergoing CR to achieve better CR goals.[291,566–568]	IIa	B1
Smartphone apps for PRO should be considered in patients with cardiac diseases undergoing CR to achieve better CR goals.[49]	IIa	C
Incorporation of AI methods may be considered in CR delivery, for early detection of cardiac events, and improved clinician decision-making.[571]	IIb	C
AI methods may be considered in patients undergoing CR to increase patient's education and compliance and better achieve CR goals.[571]	IIb	C

AI, artificial intelligence; CR, cardiac rehabilitation; ECG, electrocardiogram; PRO, patient-reported outcome.
[a]Class of recommendation.
[b]Level of evidence.

8.3. Clinical decision-support systems

Digital decision-support systems in CR assist both patients and clinicians in evaluating treatment options and related considerations.

The use of digital decision-support aids has been shown to enhance patients' understanding of their condition and the available therapies, improve the accuracy of risk perception, and reduce decisional conflict.[574] Importantly, their use does not appear to increase clinicians' workload, with consultation times remaining similar whether or not such aids are used (MD, −2.97 min; 95% CI, −7.84 to 1.90 for preparatory use; MD, 1.50 min; 95% CI, 0.79 to 2.20 for use during consultations). Further evidence is required to determine whether these tools improve treatment adherence or reduce healthcare costs and adverse events.

For healthcare professionals, the use of digital decision-support aids in CR centres[575] and health centre clinics[576] has been shown to increase adherence to guideline recommendations for patient education, medication prescription, and relaxation therapy, while the impact on exercise prescription/therapy was only borderline significant. It is well-known that for patients with, or at elevated risk of, CVD exercise prescriptions are heterogeneous among healthcare professionals.[577–579] The same patient may receive significantly different exercise prescriptions when consulting different caregivers, and the prescriptions can misalign with current recommendations.[579] Hence, exercise prescriptions in CR have significant room for improvement. Although digital decision-support training systems are known to enhance clinicians' and other healthcare professionals' skills in prescribing exercise,[580] this knowledge does not automatically translate to improved exercise prescription in clinical CR practice, likely due to organizational and logistical barriers, such as time constraints and limited resources.[581,582]

Recommendation Table 27 — Recommendations for clinical decision-support systems (see Evidence Table 27)

Recommendations	Class[a]	Level[b]
Clinically validated digital decision aids should be considered in patients with cardiovascular disease to improve the participants' knowledge, accuracy of risk perceptions, and decrease decisional conflict related to feeling uninformed.[574]	IIa	B1
Digital decision-support systems should be considered by healthcare professionals or clinicians to increase the concordance with guideline-recommended therapeutic decisions for exercise, pharmacotherapy, education therapy, and relaxation therapy in CR.[575,576]	IIa	B1
Digital decision-support training tools should be considered to improve exercise prescription skills among CR healthcare professionals or clinicians.[580]	IIa	C

CR, cardiac rehabilitation.
[a]Class of recommendation.
[b]Level of evidence.

8.4. Implantable devices and sensors

Cardiac implantable electronic devices and sensors may offer advantages during CR, continuously tracking heart rate and rhythm, and detecting early signs of HF decompensation. These devices transmit data wirelessly, enabling remote monitoring and timely medical interventions. Real-time insights allow healthcare providers to personalize rehabilitation programmes and enhance patients' engagement, ensuring a safer and more effective recovery for patients with complex cardiac conditions. Integrating long-term monitoring of implantable devices represents a modern, technology-driven approach to CR, though effective implementation requires close co-ordination between electrophysiology, HF, and rehabilitation teams, which is often challenging in routine practice.

8.4.1. Remote monitoring of cardiac implantable electronic devices

Long-term monitoring of cardiac arrhythmias detected by CIEDs, including ICDs, cardiac resynchronization therapy devices, pacemakers, and implantable loop recorders or cardiac monitors, plays a central role in evaluating and managing patients with CIEDs undergoing CR.[583] Cardiac implantable electronic devices continuously record heart rhythms, detecting arrhythmias such as AF, ventricular tachycardia, and other conduction abnormalities. Through wireless data transmission, remote monitoring enables early arrhythmia detection and real-time assessment, supporting timely therapeutic adjustments and reducing the need for in-person visits.[584] Integrating CIEDs monitoring as part of CR enables personalization of programmes according to each patient's cardiac condition and progress. Exercise intensity can be adjusted based on real-time heart rate and rhythm data, thereby improving both safety and effectiveness.

8.4.2. Heart failure monitoring from cardiac implantable electronic devices

Multiparametric scores derived from remote monitoring of CIEDs are novel valuable tools for managing patients with HF during CR. These scores integrate data from multiple parameters, including heart rate variability, intrathoracic impedance, physical activity, respiratory rate, and arrhythmia burden. By combining these metrics, multiparametric scores provide an early warning system for HF decompensation, allowing timely interventions such as medication adjustments or changes to exercise regimens.[585] Integrating these scores into CR ensures a personalized and adaptive rehabilitation process, improving patient engagement and long-term HF management.

Artificial intelligence algorithms for remote monitoring continuously analyse patient data to identify subtle changes in vital signs that may indicate worsening cardiac health. By alerting healthcare providers promptly, interventions can be made at the earliest stage. This proactive technology-driven approach may reduce hospitalizations, enhance patient safety, and ultimately optimize CR outcomes.

8.4.3. Left ventricular assist devices

Left ventricular assist devices are critical for patients with advanced HF, offering mechanical support to maintain cardiac output. Left ventricular assist devices provide continuous, detailed data on flow rates, pump speed, and pulsatility index, reflecting cardiac function and device performance. Telemonitoring allows these data to be transmitted in real time to healthcare providers, facilitating early detection of device-related complications such as pump thrombosis or driveline issues, and physiological changes including fluid overload or arrhythmias.

Integrating LVAD telemonitoring into CR enhances safety, efficiency, and individualization by ensuring that exercise intensity and activities remain within device-specific parameters. Continuous feedback strengthens patient confidence and adherence to rehabilitation plans. Overall, telemonitoring in LVAD-supported patients promotes proactive management, reduces complications, and contributes to safer, more effective recovery.[586]

8.4.4. Pulmonary artery pressure monitoring

Pulmonary artery pressure monitoring using implantable pulmonary haemodynamic sensors offers valuable insights for evaluating and managing patients with HF undergoing CR. These sensors, such as the CardioMEMS device, provide continuous, real-time data on pulmonary artery pressure which is a key parameter in assessing fluid status and cardiac function in patients with HF. A recent randomized clinical trial [Remote haemodynamic monitoring of pulmonary artery pressures in patients with chronic heart failure (MONITOR-HF)] evaluated the role of remote haemodynamic monitoring of pulmonary artery pressures by a CardioMEMS device in 348 patients with chronic HF.[587] In this study, haemodynamic monitoring substantially improved quality of life and reduced HF hospitalizations in patients with moderate-to-severe HF treated according to contemporary Guidelines.

Integrating pulmonary artery pressure monitoring into CR allows for precise and personalized management of HF. By tracking changes in pulmonary pressures, healthcare providers can detect early signs of decompensation, such as fluid overload or worsening ventricular function, enabling timely adjustments to medications, dietary restrictions, or exercise regimens. This proactive approach minimizes hospitalizations, improves functional capacity, and optimizes outcomes during CR.

For patients, pulmonary artery pressure monitoring enhances safety during exercise training by ensuring that activities are done within tolerable haemodynamic limits. Real-time feedback helps to prevent over-exertion and guide the intensity of physical activity, promoting effective and safe rehabilitation.

Incorporating data from remote monitoring of implantable pulmonary artery pressure sensors into CR programmes fosters continuous oversight, permits prompt interventions, improves patients' engagement, and reduces the need for frequent clinic visits. This approach significantly enhances HF management and contributes to better rehabilitation outcomes and improved quality of life.[588]

Recommendation Table 28 — Recommendations for implantable devices and sensors (see Evidence Table 28)

Recommendations	Class[a]	Level[b]
Using data from long-term remote monitoring of CIEDs (pacemakers, ICDs, CRT-D/P, and ICMs) should be considered in the evaluation and management of patients with CIEDs during CR to better achieve CR goals.[583]	IIa	C
Multiparametric scores for HF detection derived from telemonitoring of CIEDs may be considered for the management of patients with HF during CR to better achieve CR goals.[583]	IIb	C
Using data from LVAD may be considered in the evaluation and management of patients with LVAD during CR to better achieve CR goals.[583]	IIb	C
Using data from pulmonary artery pressure monitoring obtained by implantable pulmonary haemodynamic sensors may be considered in the evaluation and management of patients with HF with implanted pulmonary sensors during CR to better achieve CR goals.[588]	IIb	C

CIED, cardiac implantable electronic device; CR, cardiac rehabilitation; CRT-D/P, cardiac resynchronization therapy and defibrillator/pacemaker; HF, heart failure; ICD, implantable cardioverter defibrillator; ICM, implantable cardiac monitor; LVAD, left ventricular assist device.
[a]Class of recommendation.
[b]Level of evidence.

9. Delivering cardiac rehabilitation

9.1. Modes of cardiac rehabilitation delivery

Phase II CR can be delivered using various sites, durations, and modes of care (*Figure 22*). Currently, no uniform definition exists for CR delivered outside of a clinical centre. Various terms are used, including home-based CR,[93,563,589,590] telehealth CR,[591] technology-enabled CR,[93] and CTR.[30] Hybrid forms of delivery are also used.[93,567] These terms reflect the growing use of telemedicine and digital technologies to enhance or enable CR delivery in multiple formats: (i) as a supplement to centre-based CR; (ii) through real-time virtual CR sessions; and (iii) for remote CR.[29]

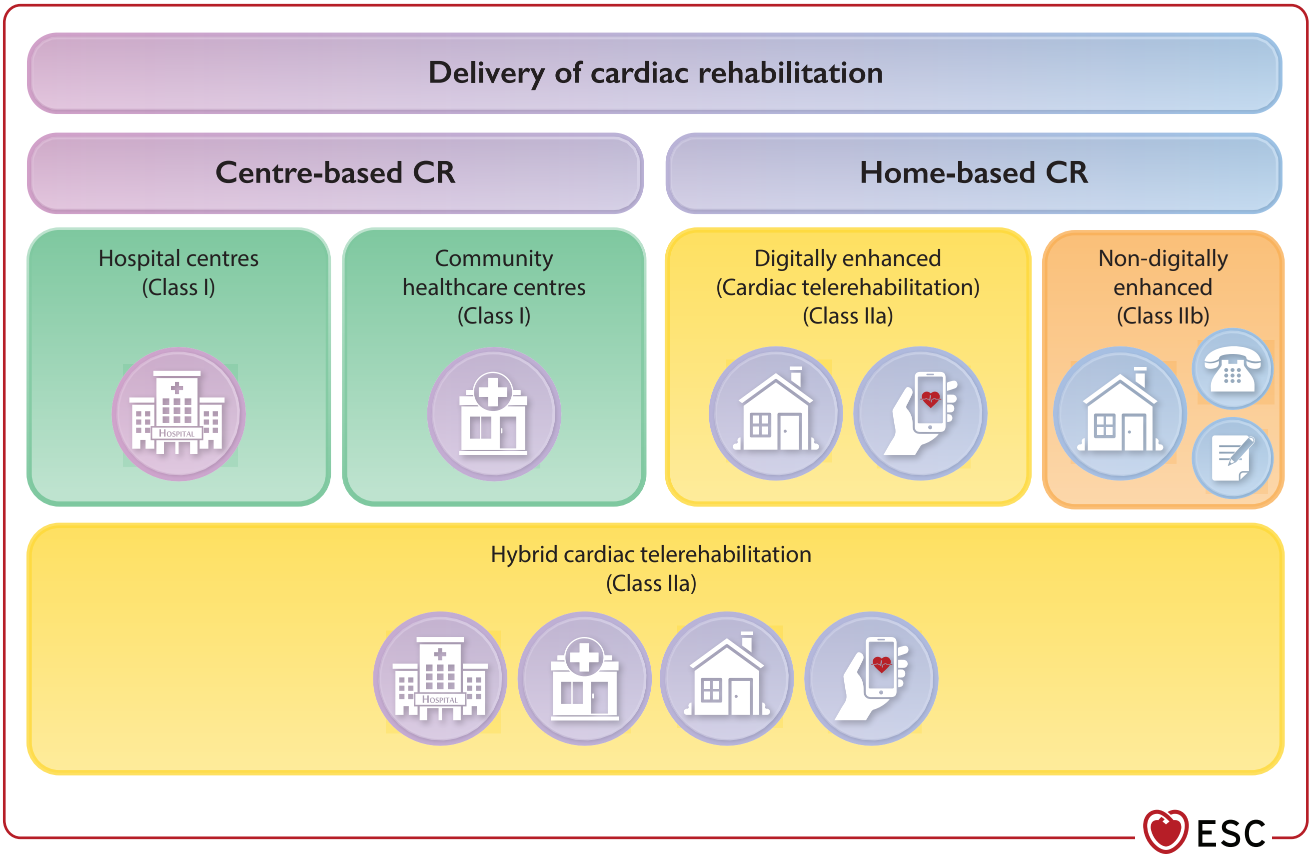

Figure 22 Modes of cardiac rehabilitation delivery. CR, cardiac rehabilitation. Centre-based CR includes both inpatient and outpatient departments.

Overall, the field is shifting toward a patient-centred hybrid model that combines elements of both in-person, virtual, and remote CR to overcome the challenges of centre-based CR, to better meet individual patient needs, and to enhance health equity.[29,592] The durations of CR programmes should be individually tailored based on the patients' clinical profile, functional status, and medical needs. Regardless of the mode of delivery, the minimum standard of outpatient CR programmes is 24 sessions, typically structured over 12 weeks with two sessions per week.[24]

In these Guidelines, we use the term CTR to encompass home-based delivery formats that utilize telemedicine and telehealth services, together with digital technologies (as defined in *Section 8*), to deliver the CR core components.[29,30] Hybrid CTR is a combination of centre-based and home-based CR. Importantly, home- or community-based programmes should be seamlessly integrated with a CR centre and leverage telemedicine, telehealth services, and/or digital technologies, ensuring alignment with EAPC standards for supervised CR.[24] Central to these standards is maintaining the delivery of the recommended CR core components regardless of the CR delivery model.

9.1.1. Centre-based cardiac rehabilitation

In traditional centre-based CR, patients attend in-person sessions at a healthcare facility (hospital or in the community) for all core components of the programme, and the interaction with the healthcare professional is always synchronized, which means that the patient and the healthcare professional meet at the same time at the same place. The availability of inpatient and outpatient CR programmes varies between countries, owing to different health policies and different health system structures.[24,593]

9.1.2. Home-based cardiac rehabilitation

Home-based CR refers to the structured delivery of the CR core components outside of the traditional centre in the patients' home environment. This is distinct to encourage patients to engage in lifestyle modification on days when they are not present at centre-based CR.[563] Home-based CR can be delivered with and/or without telerehabilitation.

9.1.3. Cardiac telerehabilitation

In the full CTR model, traditional centre-based CR is entirely replaced by virtual and/or remote rehabilitation services, delivered at the patient's home or using community resources. However, essential elements such as patient assessment, risk stratification, and pre-exercise screening are still recommended to be done in person at a CR centre.[30] The dedicated CR team is always responsible for, and leads, the CR programme, regardless of whether it is centre-based, hybrid, or CTR. Two main models of interaction are used in CTR: synchronous and asynchronous.

Synchronous or virtual CR involves real-time interaction between the patient and healthcare professional during the core components of the programme, such as a live video connection between a physiotherapist and patient during exercise sessions. This approach enables close follow-up and highly personalized care and feedback, making it particularly suitable for high-risk populations. However, evidence regarding its effectiveness is limited, and it is assumed that synchronous monitoring may increase healthcare professionals' workload and associated costs, although no comparative data are available to support this assumption.

In asynchronous or remote CR, patient data related to the core components of CR are reviewed intermittently, either at scheduled times or in response to alerts. This approach can be enhanced by integrating clinical decision-support tools and digital companions to provide personalized feedback, reminders, and guidance, supporting patients' self-management and adherence to rehabilitation goals. Asynchronous interactions are considered less labour-intensive and more cost-effective, enabling large patient groups to be followed up simultaneously. However, most studies on this method have focused on stable, low-risk patients.[594]

9.1.4. Home-based cardiac rehabilitation without digital support

Models of home-based CR (without CTR) vary widely, ranging from telephone contacts by the multidisciplinary team, to home visits and the provision of self-management tools, such as heart rate and blood pressure monitors, and educational resources.[563,589] Although there is growing evidence to support the use of home-based CR, the quality and strength of this evidence is low mainly due to inconsistent reporting of outcomes and heterogeneity in the components, duration (1 to 6 months), and frequency of home-based CR interventions (1 to 5 sessions per week).[589] Beyond the potential benefits in improving CR participation, home-based CR may promote increased lifelong self-management due to its non-time-limited nature, greater emphasis on self-monitoring and promotion of lifestyle behaviour change within the patient's own environment.[563] To optimize the potential benefits of home-based CR these Guidelines support the use of hybrid models that combine elements of both centre- and home-based CR including CTR.

9.1.5. Hybrid cardiac telerehabilitation

Various hybrid CTR models also exist. A content-selection hybrid model involves delivering certain core components at the CR centre and delivering others remotely or virtually. The decision on which components to deliver remotely or virtually can be tailored through shared decision-making, allowing for flexibility based on the patient's progress and evolving needs. Compared with CTR, hybrid CTR can also include patients with higher risk profiles. A full-content hybrid model contains all the core components described in *Section 6*. These components are delivered either virtually, remotely, or in-person, using one of two approaches: the add-on model, in which patients engage in a combination of virtual, remote, and centre-based sessions; or the transition model, in which patients begin with centre-based sessions for several weeks before transitioning to a full CTR programme.[595]

9.2. Selection criteria for cardiac rehabilitation delivery modes

Selecting a CR programme should involve shared decision-making that considers the patient's preferences, clinical needs, and the available infrastructure and resources.

9.2.1. Inpatient vs outpatient centre-based cardiac rehabilitation

Inpatient CR programmes should normally be reserved for patients with high-risk profiles or unstable clinical conditions. Such patients may include those with severe complications after ACS, cardiac surgery, or percutaneous (coronary or valvular) interventions, particularly in the presence of a reduced LV ejection fraction; those with advanced HF [New York Heart Association (NYHA) class III or IV] and/or requiring intermittent or continuous drug infusion, and/or mechanical support, and/or after device implantation; and those who have recently undergone HTx. Inpatient rehabilitation in the setting of advanced HF not only facilitates recovery but also provides an opportunity to optimize medical therapy and manage comorbidities.[596] The STRONG-HF trial showed that high-intensity care, consisting of rapid up-titration of guideline-directed medical therapy and close follow-up, reduced all-cause death or HF readmission at 180 days compared with usual care.[283,596] Inpatient CR is particularly well suited to addressing concerns about drug-related adverse events outweighing benefits in the sickest and frailest patients.[597] Elderly or frail patients may derive significant benefit from a structured inpatient CR programme. The REHAB-HF (Rehabilitation Therapy in Older Acute Heart Failure Patients) RCT showed that early, transitional, tailored, and progressive rehabilitation interventions in hospitalized patients with decompensated HF improved physical function, exercise capacity, and HRQoL.[598] The multidisciplinary nature of inpatient rehabilitation makes it an ideal setting for patients who have undergone LVAD implantation and for some heart transplant recipients with high levels of deconditioning, functional impairment, and multiple clinical and psychological needs. Here, they can receive comprehensive therapy to improve their functional status under close medical supervision.[599]

9.2.2. Centre-based cardiac rehabilitation vs cardiac telerehabilitation

In patients with CHD (including those with ACS and CCS, post-PCI, and post-CABG), as well as in patients with chronic HF, emerging evidence from systematic reviews and meta-analyses suggests that CTR is an effective and safe alternative to centre-based CR for improving indicators of functioning, HRQoL, and cardiovascular risk factor control.[93,567,589–591] In the most recent Cochrane systematic reviews on CR for patients with CHD, meta-regression analysis indicated that the benefits in outcomes were consistent irrespective of the mode of delivery.[8,53] On the other hand, a recently published network meta-analysis on CR in patients with CAD (36 RCTs, 3534 participants) found that centre-based CR was associated with improved HRQoL and reduced depressive and anxiety symptoms, while the effectiveness of exercise was considerably reduced when delivered by home-based interventions.[600] Overall, comparing the effectiveness of centre-based CR and CTR is challenging due to the CTR trials' relatively small sample sizes, limited follow-up durations (up to 12 months), and the variability in interventions and comparators across studies.

A recent umbrella review in patients with CHD included 13 systematic reviews (10 of which were meta-analyses), encompassing 132 primary studies with 1016–6773 participants (overlap 0%–45%), done in 28 countries and published between 2015 and 2021.[591] Among these systematic reviews, nine reported solely on telehealth interventions, while four included additional mHealth interventions, and two incorporated web-based interventions. The comparators used in these reviews were centre-based CR in five cases, mixed comparators (centre-based CR or usual care) in three, and usual care in three. Systematic reviews involving CTR with mHealth or web-based interventions have found that CTR significantly enhances exercise capacity compared with control interventions. Additionally, reviews reporting on CTR with mHealth interventions have shown superior control of cardiovascular risk factors compared with control interventions (see Supplementary data online, *Table S10*).

A systematic review comparing full CTR, hybrid CTR, and control interventions without use of telehealth services or digital technologies in patients with CHD included 28 RCTs with a total of 2662 participants.[567] Meta-analysis showed that full CTR had a slightly superior effect on exercise capacity than control interventions. Additionally, both full CTR and hybrid CTR were found to be comparable with control interventions in terms of HRQoL, cardiovascular risk factor control, and participation rates. Adherence to remotely delivered programmes was high (87%). Regarding safety, only 43% of the studies recorded adverse events, and no information was available about the causes of these events, particularly whether they were linked to CTR interventions or other factors.[567] Notably, a recent systematic review of nine RCTs analysed adverse events in patients with CHD undergoing CTR.[601] Only one trial reported severe adverse events, with a low incidence of one event per 23 823 patient-hours.[601]

A systematic review evaluating the effectiveness of CTR in patients with HF included 16 studies with a total of 4557 participants.[590] Twelve studies compared CTR with usual care, while only four small studies (403 participants; 9% of patients) compared CTR with centre-based CR. The results indicated that compared with usual care, CTR significantly improved exercise capacity, 6MWD, HRQoL, and reduced hospital readmission rates. No significant differences were observed between CTR and centre-based CR for these health outcomes.

A larger systematic review and network meta-analysis including 139 RCTs with a total of 18 670 participants compared centre-based, full CTR (home-based), hybrid CTR, and technology-enabled CR in patients with HF.[93] Of the 139 trials, 80 were centre-based vs usual care, and 35 were CTR vs usual care, followed by nine hybrid CTR vs usual care, seven technical-enabled vs usual care, four centre-based vs CTR, three centre-based vs technology-enabled, and one hybrid CTR vs CTR. All delivery modes meaningfully improved exercise capacity, surpassing the MCID (1 mL/kg/min) (see Supplementary data online, *Table S7*) for mean changes in VO_2peak (MD, 1.76–3.10 mL/kg/min). All modes, except technology-enabled CR, exceeded the MCID (30 m) for the 6MWD (MD, 37–85 m). Furthermore, all delivery modes exceeded the MCID (−5 points) for the Minnesota Living with Heart Failure Questionnaire (MLHFQ) (MD, −8.8 to −10.4 points), with CTR surpassing the MCID (5 points) for the Kansas City Cardiomyopathy Questionnaire (KCCQ) (MD, 20.6 points). However, only centre-based CR significantly reduced HF-related hospitalizations and mortality by ∼60% compared with usual care. The surface under the cumulative ranking scores showed that hybrid CTR had the highest probability of being ranked first for improving 6MWD (94.6%), centre-based for improving VO_2peak (90.5%), technology-enabled CR for improving MLHFQ (70.6%), and CTR for improving KCCQ. There was evidence of network heterogeneity ($I^2 > 95\%$), but not of incoherence.[93]

Other patient populations, such as those with valvular heart disease,[566] congenital heart disease,[58] AF,[59] CIEDs,[61] and patients with cancer undergoing cardiotoxic therapies,[602] are less well studied. However, it is reasonable to assume that the comparability of different CR delivery strategies observed in patients with CAD and HF could extend to these groups. Notably, 15 out of 20 RCTs in the latest Cochrane systematic review on CR for AF employed either CTR or hybrid CTR. Overall, the intervention showed benefits including enhanced functioning and improved HRQoL, and reductions in AF recurrence, symptom burden, and episode duration.[59] Additionally, a recent systematic review in adult survivors of cancer, encompassing 10 RCTs with 1510 participants, compared telehealth exercise-based cancer rehabilitation with usual care. The results indicated that telehealth rehabilitation effectively enhanced functioning and physical activity levels. Most participants had received cardiotoxic chemotherapy or radiotherapy and would qualify for a cardio-oncology CR programme.[602]

Recommendation Table 29 — Recommendations for the delivery of cardiac rehabilitation (see Evidence Table 29)

Recommendations	Class[a]	Level[b]
Centre-based CR is recommended in patients with an indication for CR to improve health outcomes.[53,113,310,600]	I	B1
Inpatient CR is recommended in high risk and/or clinical unstable patients with cardiac diseases[c] to improve physical and mental functioning, optimize medical therapy, and manage comorbidities.[52,598,599]	I	C
CTR or hybrid CTR should be considered as alternatives to centre-based CR in patients with acute and chronic coronary syndromes (including those post-PCI or post-CABG) to improve physical functioning (exercise capacity), HRQoL, and risk factor control.[556,567,589,591,603]	IIa	B1
CTR or hybrid CTR should be considered as alternatives to centre-based CR in patients with HF to improve physical functioning (exercise capacity and 6MWD) and HRQoL.[93,590]	IIa	B1
CTR or hybrid CTR should be considered in adult patients with congenital heart disease and impaired cardiorespiratory fitness to improve physical functioning (exercise capacity, BMI) and HRQoL.[58]	IIa	B2
CTR or hybrid CR should be considered as alternatives to centre-based CR in patients with AF to improve functioning and HRQoL, as well as to reduce AF recurrence, symptom burden, and episode duration.[59]	IIa	B2

Continued

CTR or hybrid CR should be considered as alternatives to centre-based CR in patients with cancer during or after cardiotoxic therapies to improve physical functioning (VO_2peak and physical activity levels).[602]	IIa	B2
Patient-centred CR, integrating various modes of delivery (face-to-face, virtual, and/or remote), should be considered for all patients with a CR indication, to improve participation (enrolment and adherence), better meet patients' needs, and promote health equity.[29,592]	IIa	C
Home-based CR without support of digital technologies may be considered as an alternative to centre-based CR in non-high-risk patients with an indication for CR to improve health outcomes.[589,604]	IIb	B1
CTR or hybrid CR may be considered as alternatives to centre-based CR in patients with valvular heart disease after interventional or surgical therapies to improve physical functioning (exercise capacity) and HRQoL.[566]	IIb	B2
CTR or hybrid CR may be considered as alternatives to centre-based CR in patients with CIEDs (particularly those with ICD functionality) to improve physical functioning (exercise capacity) and reduce alerts from remote monitoring.[61,147,605,606]	IIb	B2

6MWD, six-minute walking distance; ACS, acute coronary syndrome; AF, atrial fibrillation; BMI, body mass index; CABG, coronary artery bypass graft; CIED, cardiac implantable electronic device; CR, cardiac rehabilitation; CTR, cardiac telerehabilitation; HF, heart failure; HRQoL, health-related quality of life; ICD, implantable cardioverter defibrillator; NYHA, New York Heart Association; PCI, percutaneous coronary intervention; VO_2peak, peak oxygen uptake.
[a]Class of recommendation.
[b]Level of evidence.
[c]Patients with severe complications after ACS, cardiac surgery, or percutaneous interventions, either coronary or valvular, particularly in the presence of a reduced left ventricular ejection fraction; patients with advanced HF (NYHA III or IV) and/or requiring intermittent or continuous drug infusion and/or mechanical support and/or after device implantation; recent heart transplant recipients.

10. Improving cardiac rehabilitation participation

Cardiac rehabilitation is consistently under-used globally. Surveys across several countries show that between 9% and 50% of eligible patients, including those with a diagnosis of CAD currently participate in CR.[28,607–609] In comparison with other CVD secondary prevention treatments, referral to CR is one of the least well-implemented treatments.[610,611] Use of CR involves *patient enrolment*, defined as patient attendance at a first visit; *programme adherence*, defined as the percentage of total prescribed sessions attended; and *programme completion*, defined as attending an end-of-CR-programme assessment.[612]

Barriers to CR use are multifaceted, and they can be broadly summarized at four levels: the individual, the programme, the clinician, and the health system.[31,610] An overview of these barriers is presented in *Figure 23*. While these barriers pertain to low- and middle-income countries, they are also relevant to high-income countries. To address these barriers, these Guidelines recommend several interventions for improving enrolment and adherence to CR.

10.1. Increasing access

Although diverse interventions can enhance participation in CR, their success relies on adequate programme availability and capacity to enable timely referral. European survey data show that while CR is available in 91% of European countries, only one place is available for every seven patients in need, requiring an estimated additional three million places annually to meet demand.[26] Consistent with European data, global CR capacity remains insufficient, with only one in 18 patients having access and referral or attendance rates at CR varies widely among countries (4.5%–71.1%).[26,609] Recent data from the United States of America suggest that differential access to CR centres accounts for a substantial portion of the geographic variation in CR use, and that areas with the highest density of CR programmes have the lowest wait times.[609] Similarly, European survey data show a moderate yet significant association between CR uptake and programme availability.[613] Therefore, increasing the availability of CR, ensuring that it is reimbursed in the same way as other guideline-recommended secondary prevention treatments is essential to improve timely access to it. The International Cardiovascular Prevention and Rehabilitation global audit of CR highlights that countries that have the best densities of CR, e.g. Canada, Switzerland, and the United Kingdom, also have policies for reimbursing CR services.[609,614] Moreover, regression analysis from the United Kingdom National Audit of CR suggests that improving timely access could increase enrolment by 14.3% and completion by 1.9%.[615]

10.2. Improving enrolment

Systematic referral procedures, combining automatic referral with a health professional's recommendation, significantly increase enrolment in CR.[242,616] Automatic referral strategies typically use electronic medical records to prompt or directly transmit referrals to CR programmes, although paper-based referral forms integrated into standardized discharge planning can also be effective. As a lack of physician referral is a common barrier to CR, particularly in low- and middle-income countries, implementing automatic referral systems may help overcome this challenge, ensuring timely referrals while optimizing clinicians' workflow.[617,618] In a large, multicentre, observational study that included 2635 inpatients with CAD, automatic referral combined with liaison with a health professional increased CR use (OR, 8.41; 85.8% referral, 73.5% enrolment), followed by automatic only (OR, 3.27; 70.2% referral, 60.0% enrolment), and liaison only (OR, 3.35; 59.0% referral, 50.6% enrolment), compared with usual referral (32.2% referral, 29.0% enrolment).[619] These findings emphasize the importance of direct health professional and patient contact during referral. When health professionals actively endorse CR and encourage patients to attend it—ideally face-to-face and with education on its benefits and what to expect—this significantly associates with higher enrolment to CR.[242,620–622] Patient perspectives from qualitative studies highlight the value of this endorsement,[242] suggesting that it may help overcome the lack of awareness of CR: one of the most frequently cited barriers to CR use among patients who

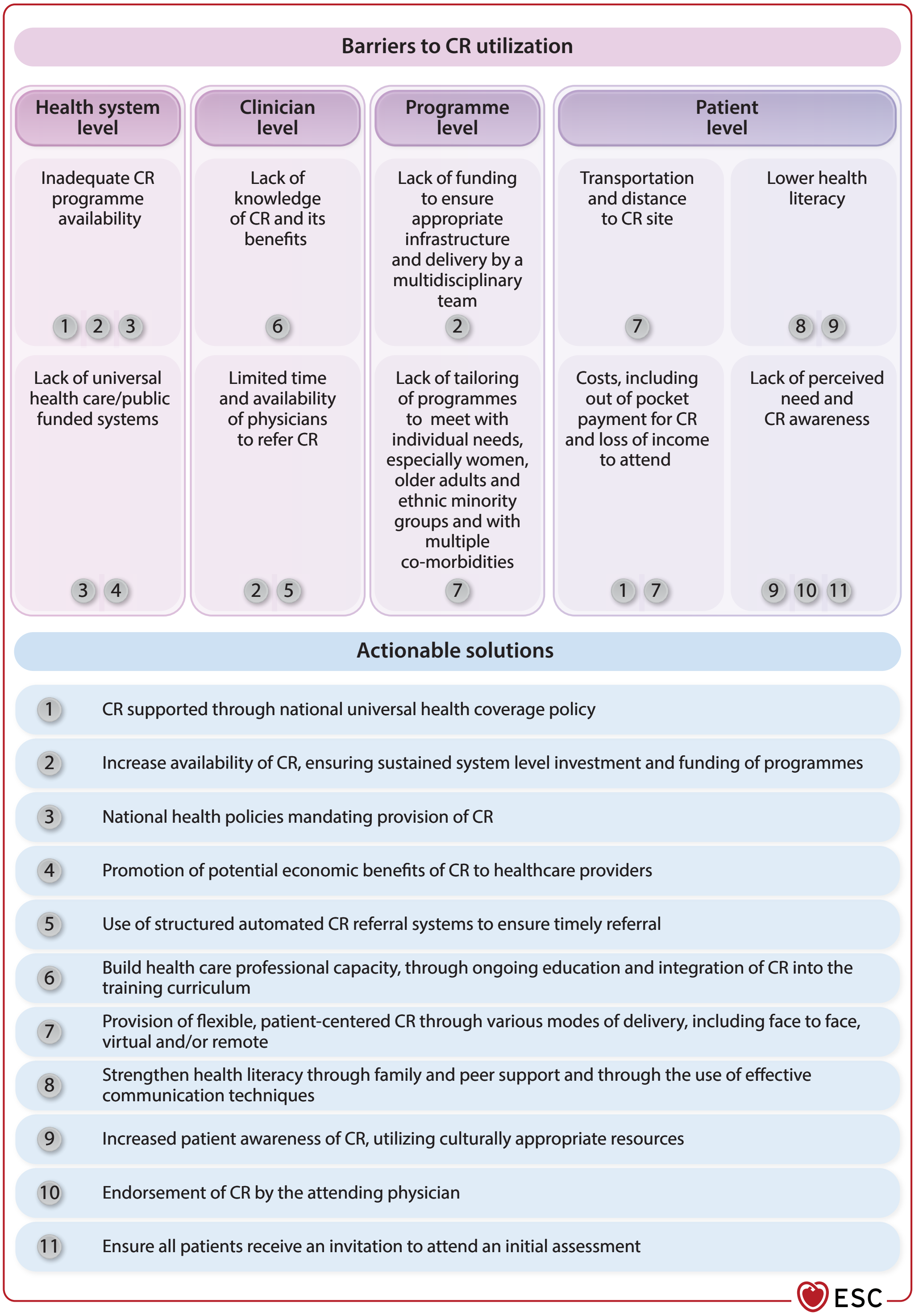

Figure 23 Barriers to cardiac rehabilitation access and actionable solutions. CR, cardiac rehabilitation. Adapted with permission from Taylor *et al.*[31]

have not completed it.[623] In addition to the aforementioned referral strategies, receiving an invitation to attend an initial assessment for CR has been identified as an important determinant of CR use among both men and women (OR, 4.223 men; OR, 4.033 women; $P < .05$).[620] This assessment provides an opportunity for person-centred dialogue, which enables personal goals to be identified, barriers to use to be explored, and a tailored plan that meets with individual needs and preferences for participation in CR to be developed.[242]

To optimize CR utilization, greater emphasis is needed on offering patients choice regarding how, when, and where they can access CR. A Cochrane systematic review showed that offering hybrid CR and using CTR in home-based settings were associated with increased CR use.[612] Offering such alternative models may help address patient barriers such as inconvenience (travel and distance to the CR site), and may also increase the capacity of existing centre-based programmes.[609] In addition, this review identified that theory-based interventions (e.g. motivation letters), and those that used structured telephone calls or visits after discharge improved CR use. However, the specific components and mechanisms underlying these interventions were often insufficiently described, limiting their replicability. Furthermore, heterogeneity across studies meant that the certainty of the evidence for these interventions was low for enrolment and moderate for adherence and completion.[612]

10.3. Adherence

Global studies show that patients' adherence to CR differs considerably between countries, with rates ranging from 4% to 62%.[608,624,625] Common barriers to adherence and completion include lack of perceived need and awareness of CR, physical problems (fatigue and pain due to exercise),[625] a preference for exercising at home independently, work conflicts, and a lack of programme personalization.[626–628] Among enrolling women, the greatest barriers to session adherence are distance, transportation, and family responsibilities.[627] These barriers underline the need for greater education and more personalized solutions to improve CR adherence and completion.[627]

A meta-analysis evaluating interventions to promote patients' CR use and adherence, found moderate evidence that such interventions are effective, particularly when delivered remotely.[621] Therefore, offering CTR or hybrid CR programmes may promote greater adherence.

In a further meta-analysis comparing home-based and centre-based CR, 19 studies reported adherence outcomes.[589] Nearly half (n = 9) found no significant difference in the level of adherence between groups, six studies favoured home-based CR, one reported superiority of centre-based CR, and in three studies statistical comparison was not possible.[589]

Telerehabilitation and mobile technology have the potential to overcome access barriers and support CR delivery, representing valuable tools for promoting adherence. A meta-analysis including 14 RCTs showed that smartphone-assisted CR, significantly enhanced patients' treatment adherence compared with conventional CR/usual care.[629] In another meta-analysis, the adherence of patients using mobile applications was 1.4 times higher than in controls.[630]

10.4. Under-represented population groups in CR

Rates of CR participation are disproportionately low among women, members of ethnic minority groups, older adults, those of lower socio-economic status, and those with multiple comorbidities.[31,623,628,631] Outcomes from a recent systematic review showed a small but growing body of evidence that tailoring CR to meet with women's needs and preferences, e.g. offering alternative models of exercise, female-focused CTR sessions, and psychosocial support, may help improve CR use.[632] This is particularly important for younger women (<55 years) with causes of MI that are not typical, for example, spontaneous coronary artery dissection (SCAD).[77,633] These findings are supported by systematic Cochrane review evidence, which showed that trials (n = 3) supporting gender-tailored programmes with a motivational orientation can help improve CR use among women.[612] However, further research is needed to establish which features of women-tailored CR associate with greater enrolment, adherence, and completion. For older adults, the same Cochrane review identified three trials showing that peer navigation and post-discharge support may help improve enrolment, and that group sessions may increase CR completion. Peer navigation refers to the role of trained laypersons in educating and supporting patients about CR. For patients with low socio-economic status, one study in this review showed that patients who received financial incentives completed more sessions and were almost twice as likely to complete CR as those in the control group.[634] However, evidence on interventions to enhance CR utilization among diverse ethnic and socio-economic groups remains limited.[612] Further research is needed to evaluate interventions to promote CR use among these populations.

Recommendation Table 30 — Recommendations for improving cardiac rehabilitation participation (see Evidence Table 30)

Recommendations	Class[a]	Level[b]
Endorsement of CR by the attending physician and other health professionals is recommended for patients with an indication for CR to improve enrolment.[242,620–622]	I	B2
Automatic referral, encompassing electronic tools and accompanied by an individual discussion with a health professional is recommended for patients with acute and chronic coronary syndromes to improve enrolment.[242,617,622]	I	B2
Receiving an invitation to attend an initial assessment for CR is recommended for patients with ACS and CCS to improve enrolment.[617]	I	B2
Increasing the availability of CR programmes is recommended for patients with an indication for CR to improve access and enrolment.[607,609,613]	I	C
Tailoring CR to women should be considered for women with ACS and CCS, spontaneous coronary artery dissection and HF to improve enrolment and adherence.[77,564,632]	IIa	B1
CTR or hybrid CTR should be considered as alternatives to centre-based CR in patients with ACS and CCS, myocardial revascularization, or chronic HF to improve enrolment and adherence.[556,567,589,591,603]	IIa	B1
Person-centred, theory-based behavioural interventions that focus on addressing barriers to CR and increasing motivation may be considered for patients with an indication for CR to improve enrolment.[242]	IIb	B2

ACS, acute coronary syndrome; CCS, chronic coronary syndromes; CR, cardiac rehabilitation; CTR, cardiac telerehabilitation; HF, heart failure.
[a]Class of recommendation.
[b]Level of evidence.

11. Considering sex, ethnicity, and age in cardiac rehabilitation

11.1. Sex and ethnic differences in access, uptake, adherence, and effectiveness of cardiac rehabilitation

Despite the proven benefits of CR, significant sex and ethnic differences exist in referral, access, uptake, adherence, and effectiveness of CR programmes, and these influence outcomes.

11.1.2. Sex differences and similarities in CR

Referral to CR is substantially lower in women, with particularly low rates reported for certain conditions such as Takotsubo cardiomyopathy.[635–637] Women participating in CR are typically older than men, more likely to be widowed, and present with greater functional limitations.[638,639] Adherence is also lower, largely due to caregiving responsibilities, transportation barriers, financial constraints, and a higher burden of anxiety and depression following cardiovascular events.[77,623]

Women are less likely to receive guideline-recommended treatment following acute coronary events, including pharmacological therapy and invasive evaluation,[286,640] and are less likely to achieve LDL-C targets.[285,287,640]

Although CR is clinically effective in both sexes,[35,641,642] some studies suggest smaller improvements in exercise capacity among women.[643] Evidence on sex-specific effects of CR on clinical outcomes across different cardiovascular diagnoses remain limited,[644] particularly for conditions that predominantly affect women, such as SCAD, ischaemia with non-obstructive coronary arteries, and ACHD.

Tailored strategies that enhance access, flexibility, and psychosocial support are key to improving CR participation among women.[645] Further research should define the most effective components of women-centred CR to optimize outcomes (*Table 13*).

Table 13 **Proposed actions to improve the disparities in cardiac rehabilitation**

Area of disparity	Proposed actions
Referral[632,646]	• Training of providers to recognize gender-specific barriers and emphasize the importance of CR for women; • Informing women about the benefits of CR early during hospitalization or outpatient visits; • Offering transportation assistance or telerehabilitation options; • Streamlining of referral processes; • Incorporating automatic referral triggers in electronic health records for eligible women; • Partnering with community organizations: reaching women through community centres, faith-based organizations, and support groups; • Using female ambassadors or peer mentors to encourage participation; • Regularly monitoring referral and attendance rates by gender; and • Using data to identify gaps and implement targeted interventions.
Adherence[647]	Tailoring CR programmes by: • offering flexible scheduling; • childcare support; • mental health resources; and • supervised home-based CTR.
Effectiveness[646]	Personalized interventions considering sex-specific risk factors, health needs, and preferences, e.g. women-focused CR programmes.

CR, cardiac rehabilitation; CTR, cardiac telerehabilitation.

11.1.3. Ethnicity differences and similarities in CR

In the United States of America, CR participation is lower among Black patients than among White patients, largely due to lower referral rates, a disparity that persists after adjustment for socio-economic factors.[623,648] Reported barriers include perceived discrimination, limited information about CR, and negative healthcare experiences.[648] Among South Asian ethnic minorities, language difficulties, cultural beliefs, and prior negative interactions with healthcare providers may hinder participation.[649] In Europe, available data show weaker associations between ethnicity or migration status and CR attendance, but detailed evidence remains limited.[650] Cultural background and socio-economic context should nevertheless be considered to enhance CR accessibility and adherence for all patient groups.

11.2. Age differences in access, uptake, adherence, and effectiveness of cardiac rehabilitation

11.2.1. Access and uptake

Older adults are under-represented in CR despite a higher prevalence of CVD, partly due to clinician assumptions, not supported by available evidence, that they are less likely to benefit compared with younger patients.[651] Logistical barriers, including reduced mobility, limited transportation, and lack of caregiver support, further restrict CR access among older adults.[652] Socio-economic factors, such as fixed incomes and reduced access to private healthcare options, further exacerbate these barriers. Cultural and gender differences intersect with age, as older women remain particularly under-represented in CR.[310]

Among younger patients (<55 years), CVD often has a greater impact on life goals, routines, and identity, leading to psychological distress, social isolation, and work- and family-related challenges which in turn can reduce HRQoL and treatment adherence.[645,653]

Risk factor profiles differ between younger and older patients with CVD. Younger patients more often present with adverse lifestyle-related risk factors, including smoking, obesity, and dyslipidaemia, alongside psychosocial stressors, a strong family history of premature CVD, and non-classical factors such as inflammation, genetic predisposition [e.g. high lipoprotein (a)], and drug abuse, in addition to conventional factors.[645,653–660]

Young adults are less likely than older patients to participate in CR, partly due to the perception that CR is intended for older individuals, as well as logistical barriers related to work, study, and family responsibilities.[653] A lack of age-appropriate tailored CR programmes, particularly with limited use of digital tools and psychosocial support, further restricts participation.[653] Effective CR for younger individuals should therefore adopt flexible and personalized approaches that address age-specific needs and support sustained engagement.

11.2.2. Adherence

Adherence to CR is often lower among older adults due to physical and psychological limitations, comorbidities, and cognitive decline; however, adherence improves when programmes are adapted to their needs. Supervised home-based CR, with or without digital enhancement, can improve adherence by reducing physical and logistical barriers and increasing flexibility.[563]

11.2.3. Effectiveness

Older adults who complete CR achieve significant benefits, including improved physical fitness, psychological well-being, and reduced cardiovascular mortality and hospital readmissions, contributing to greater independence and quality of life.[661] The effectiveness of CR in older adults depends on age-appropriate adaptations, such as lower-intensity exercise, gradual progression, and simplified educational content.[662]

Psychological support is essential across age groups to improve CR adherence and effectiveness. Managing anxiety and depression, and promoting social interaction through group-based sessions, enhances engagement and motivation.[651]

11.3. Personalizing cardiac rehabilitation to better address sex-specific aspects

Personalizing CR to address sex-specific differences is essential in modern cardiac care. Traditional one-size-fits-all models may overlook biological, psychosocial, and behavioural distinctions between men and women. Tailored rehabilitation protocols improve individual outcomes and overall quality of care.[663–666]

Biological and behavioural differences between men and women further highlight the need for individualized approaches to optimize outcomes.[664,667] Post-menopausal women may be susceptible to blood pressure elevations and lipid disorders, whereas men may respond better to higher training intensities. Adapting exercise type and intensity to these sex-specific factors can help optimize outcomes.[35,668] In addition, sex-specific educational content tailored to women's health experiences and knowledge levels can improve patient understanding and adherence to rehabilitation protocols, thereby optimizing CR outcomes.[667]

Psychosocial factors differ between sexes and influence CR outcomes. Women more often experience depression, anxiety, and social isolation after cardiac events, underscoring the importance of psychological support, flexible scheduling, remote options, and family involvement to improve adherence.[669,670] Individuals with severe mental illness face additional barriers, such as cognitive impairment and poor integration of mental and physical healthcare, requiring targeted strategies to enhance engagement.[494]

Socio-cultural factors, including gender roles, family responsibilities, and religious beliefs, influence access to, and participation in, CR. Understanding these contexts is essential for effective patient engagement. Flexible programme structures and social support can help overcome domestic and cultural barriers, particularly among women.[77,670]

11.4. Personalizing cardiac rehabilitation to better address age-specific aspects

Personalized and tailored CR for older adults should address physical, psychological, and social challenges to enhance access, adherence, and outcomes. Flexible programme delivery and technology-based solutions should be considered to meet the diverse needs of older adults. Supervised home-based and hybrid CR models, may offer comparable benefits to centre-based programmes while reducing logistical barriers and allowing greater scheduling flexibility.[652] Cardiac telerehabilitation and wearable devices further enhance accessibility by enabling remote monitoring, real-time feedback, and timely clinical support, improving adherence and engagement.[671]

Exercise programmes for older adults should be adapted to age-related limitations, such as sarcopenia and reduced cardiovascular capacity, with low-to-moderate-intensity aerobic and resistance training and gradual progression to enhance safety, physical function, and independence. Group-based programmes may further improve adherence by promoting social interaction, peer support, and psychological well-being.[672]

Older adults frequently experience depression, anxiety, and cognitive decline, highlighting the need for tailored psychological support. Cognitive behavioural interventions can reduce distress and improve mental health,[651] while educational materials adapted for cognitive impairment enhance understanding and retention.

In older adults, tailored dietary counselling should address common comorbidities while ensuring adequate nutrition with high-protein diets supporting muscle recovery and reduced sodium and fat intake improving cardiometabolic outcomes.[563]

Integrated care models involving multidisciplinary teams are essential for delivering comprehensive support to older adults. In addition to the core team members (see *Section 6.2*), the inclusion of geriatricians is partly important to address the complex, age-related medical, functional, and psychosocial needs of this population.

12. Patients' perspectives on long-term management after cardiac rehabilitation

While achieving satisfaction during the rehabilitation phase is important, the goal of CR is to prepare patients for long-term health and reduce the risk of future cardiac events. This involves equipping patients with the necessary tools, knowledge, and confidence to embrace sustainable secondary prevention strategies. A key component of this preparation is facilitating long-term behavioural lifestyle changes, including adopting a cardiovascular healthy diet, engaging in regular physical activity, increasing medication adherence, and avoiding harmful habits such as smoking and tobacco use. Rehabilitation programmes are most effective when they provide practical, actionable advice tailored to individual needs, preferences, and cultural norms. For example, to ensure long-term adherence to these changes, dietary recommendations should account for cultural food practices, while exercise regimens should be adaptable to the patient's fitness levels, interests, and physical and mental capabilities. Another cornerstone of preparing patients for long-term secondary prevention is developing self-management skills. Teaching patients how to recognize the warning signs of cardiac complications, manage their medication use, and monitor their symptoms helps foster independence and reduces their reliance on healthcare providers.[673] Digital tools, such as mobile apps or wearable devices, can support self-management by tracking progress and reminding patients of their goals to stay on course with their health plans. Additionally, the 'better in, better out' approach prepares patients for potential cardiac interventions or events by addressing risk factors and optimizing health beforehand, so patients are better prepared for recovery. This proactive approach not only enhances recovery outcomes but also aligns with the overarching goal of secondary prevention, emphasizing that health maintenance should begin as early as possible, even before a cardiac crisis occurs.

Building psychological resilience is equally vital in long-term secondary prevention. Many patients face lingering fears of experiencing another cardiac event, which can undermine confidence and motivation. Providing emotional support through counselling, peer-support groups, or individualized strategies can help patients rebuild trust in their bodies and their ability to recover. Positive reinforcement, such as celebrating own-set milestones, further reinforces a sense of progress and accomplishment. Tailored care is crucial for secondary prevention. A one-size-fits-all approach is insufficient, as it fails to account for the diversity of cardiac conditions and patients' circumstances. Programmes must differentiate between the unique needs of patients recovering from heart transplant, CAD, or MI, as these groups have distinct challenges and different recovery trajectories. Addressing these specificities ensures that care remains relevant and effective. Additionally, incorporating occupation-specific training ensures that rehabilitation is practical and relevant to the patient's daily life. Stratifying care to reflect these differences ensures that rehabilitation remains effective and relevant to each patient's specific needs.

To further support long-term adherence and to enhance sustainability, rehabilitation programmes should integrate seamlessly into patients' everyday routines. For example, exercises can be adapted to simulate real-life tasks, such as lifting groceries, climbing stairs, or walking long distances. This approach makes rehabilitation more practical and aligns closely with patients' goals. Encouraging the involvement of family members further supports long-term adherence to lifestyle changes by creating a supportive environment for the patient. Ongoing support and follow-up are vital to maintaining momentum after formal rehabilitation ends. Regular check-ins with healthcare providers can reinforce healthy habits and address emerging challenges. Remote or community-based resources, such as classes or practices, also provide continuity, especially for patients who may not have easy access to specialized facilities.

Planning ahead is important, particularly for people living with chronic conditions such as HF, where symptoms and priorities may change over time. Advance care planning can help clarify what matters most (daily functioning, independence, symptom relief, safety), support understanding of possible future scenarios, and identify a preferred substitute decision-maker if needed. When these conversations take place early, while patients are stable and supported, they can reduce uncertainty, ease the burden on relatives, and help ensure that future care remains aligned with personal values rather than being shaped by crisis decisions.

Finally, addressing knowledge gaps is vital for motivating patients to prioritize secondary prevention. Many patients do not fully understand how lifestyle changes directly impact their long-term health. Clear communication about the benefits of sustained effort, combined with practical tools for implementation, empowers patients to remain proactive in their care. By focusing on behaviour change, self-management, tailored care, and ongoing support, CR programmes can effectively prepare patients for lifelong health. This preparation not only reduces the risk of recurrence but also enhances overall quality of life by equipping patients with the knowledge and strategies to safely manage their physical activities—including appropriate modifications to sports or other strenuous efforts.[674] The benefits of rehabilitation, therefore, extend far beyond the clinical setting.

13. Key messages

The European Alliance for Cardiovascular Health highlights the crucial role of CR in improving cardiovascular health across Europe. Cardiac rehabilitation has become a key component in the comprehensive care of patients with cardiac diseases and is a recommended treatment to effectively implement preventive strategies. It also enhances physical and mental functioning, HRQoL, and other important health outcomes (e.g. cardiovascular risk factors), and clinical outcomes (e.g. reduced rehospitalization rates or mortality).

Patients' perspectives on cardiac rehabilitation: Effective CR equips patients with practical tools, personalized guidance, and emotional support to foster long-term health, behaviour change, and self-management. Success depends on tailoring interventions to individual needs, building psychological resilience, integrating rehabilitation into daily life, and ensuring continued support beyond the structured programme. This integrated, patient-centred approach maximizes the impact of CR across diverse and often complex patient populations.

The rationale for cardiac rehabilitation: who benefits, what it achieves, and why it matters: Cardiac rehabilitation has evolved from exercise-based therapy to a comprehensive, multidisciplinary intervention that improves clinical outcomes, and quality of life, as well as physical and mental functioning across diverse cardiac populations. Early initiation, individualized delivery, and inclusion of psychosocial, educational, and lifestyle components are essential for maximizing safety, effectiveness, and cost-efficiency.

Indications for cardiac rehabilitation: Cardiac rehabilitation is recommended across a broad range of cardiac conditions, including patients with ACS, CCS, chronic HF (both HFrEF and HFpEF), advanced HF, and LVAD, after HTx, and for patients early after an episode of decompensated HF. Emerging evidence suggests it effectiveness in patients after SAVR or TAVI, ACHD, AF, CIEDs, and patients with cancer undergoing cardiotoxic therapies. Importantly, comorbidities and frailty are no reasons to withhold CR from those patients.

Quality standards of cardiac rehabilitation: Implementing CR according to the EAPC-defined structure, process, and outcome-based quality metrics is recommended across all European countries to enhance standardization and ensure high-quality care. A co-ordinated, multidisciplinary CR team, and a collaborative approach to care are essential for delivering holistic, patient-centred care. Ongoing training and communication ensure programme quality and effectiveness.

Core components of cardiac rehabilitation

Patient assessment: A comprehensive, patient-led baseline assessment and multidimensional risk stratification are foundational to designing a personalized CR programme that addresses the medical, functional, psychosocial, and lifestyle needs of each patient.

Self-management, behaviour change, and education: Empowering patients through structured self-management strategies and tailored education is essential in CR. Behaviour-change techniques, health literacy support, and psycho-educational interventions enhance health and quality of life while reducing cardiovascular risk factors.

Optimizing cardiovascular pharmacotherapies: Cardiac rehabilitation offers a unique framework for optimizing guideline-directed pharmacotherapy across a wide range of CVDs and comorbidities. This includes up- and down-titration, deprescribing, and improving adherence to therapies. Education, regular medication reconciliation, and personalized adjustments during CR enhance risk factor control, reduce MACE and mortality, and address persistent sex disparities in pharmacological care.

Physical activity and sedentary behaviour counselling: Use behavioural counselling, goal setting, and physical activity trackers to promote an active lifestyle and reduced sedentary time in patients undergoing CR. Patients benefit from improved functioning, PROs, and reduced cardiovascular mortality.

Exercise training: Tailored exercise training is a central, evidence-based component of CR and should be personalized to patients' cardiovascular risk, physical function, and clinical profile. Exercise training improves physical and mental functioning, HRQoL, and reduces hospitalization and cardiovascular event rates across a wide range of cardiac populations.

Nutrition and body composition management: Provide tailored nutritional counselling and body composition management to patients undergoing CR to promote a healthy diet and reduce cardiovascular risk and mortality. In patients with obesity, comprehensive weight loss interventions with preventive strategies against muscle loss are essential to improve metabolic and functional health. Screening and monitoring for body composition abnormalities should be considered to guide nutritional interventions in those at risk of malnutrition or sarcopenia.

Smoking cessation: Comprehensive smoking cessation—including behavioural counselling, tailored education, pharmacotherapy, and follow-up support—is recommended as an integral part of CR to improve cardiovascular outcomes and promote long-term abstinence. Consider also support networks, psychosocial interventions, and regular follow-up appointments to provide continued support.

Psychosocial management: Psychological screening should be part of comprehensive risk assessment in CR to identify patients who may benefit from targeted interventions. Structured psychological therapies, such as CBT along with mindfulness-based approaches can reduce mental burden (e.g. anxiety, depression) and improve well-being. Telemonitoring and digital tools offer accessible options to support psychological functioning. Antidepressant therapy should be considered in patients with moderate-to-severe major depression.

Sexual counselling: Screening of sexual function integrated into CR to guide appropriate treatment and support shared decision-making. Consider sexual rehabilitation or counselling during CR to improve sexual function and satisfaction.

Managing frailty and comorbidities related to cardiovascular risk: Cardiac rehabilitation should include structured management of cardiovascular risk factors, frailty, and comorbidities, tailored to each patient's condition and delivered through a multidisciplinary approach. Harmonization with disease-specific rehabilitation protocols is recommended to improve health outcomes.

Counselling on environmental cardiovascular risk factors: Consider counselling on environmental stressors as cardiovascular risk factors (pollutants in the air, noise exposure, artificial light at night, extreme climates) during CR.

Interventions to enhance return to work: Facilitating return to work should be a targeted objective in CR, especially for younger patients. Combined interventions—including counselling and exercise training—should be considered to support timely and successful reintegration into the workforce.

Telemedicine and digital technologies in cardiac rehabilitation: Integrating digital tools such as wearable sensors, smartphone apps, and AI-supported systems into CR can enhance self-monitoring, personalize care, improve patient education and adherence, and support early detection of adverse cardiac events, ultimately helping to achieve better rehabilitation outcomes.

Delivering cardiac rehabilitation: Cardiac rehabilitation should be delivered through a patient-centred approach using centre-based, home-based CR, CTR, or hybrid models tailored to clinical risk, patient needs, and preferences. Cardiac telerehabilitation and hybrid CR should be considered effective alternatives to traditional models—improving functional outcomes, HRQoL, and access.

Improving cardiac rehabilitation participation: Cardiac rehabilitation remains globally under-used due to individual, systemic, and structural barriers. To enhance participation, a multifaceted approach is essential: automatic referral systems, early initiation, and physician endorsement improve enrolment; CTR and hybrid CR increase access and adherence; and tailoring interventions, particularly for women, older adults, and underserved groups, can address disparities. Expanding programme availability, offering personalized delivery modes, and using mobile and behavioural strategies are key to strengthening CR utilization

Considering sex, ethnicity, and age in cardiac rehabilitation: Cardiac rehabilitation must be personalized to address disparities in access, adherence, and outcomes related to sex, ethnicity, and age. Women, ethnic minorities, older adults, and younger patients face unique barriers—ranging from low referral rates and caregiving responsibilities to logistical and psychosocial challenges.

Tailored CR models—including flexible scheduling, home-based or hybrid formats, culturally sensitive care, and age-appropriate support—can improve participation and effectiveness. Addressing biological, psychological, and social differences is essential to ensure equitable, impactful rehabilitation for all patients.

Patients' perspectives on long-term management after cardiac rehabilitation: Cardiac rehabilitation aims to empower patients for lifelong cardiovascular health. Beyond short-term recovery, CR provides the tools, education, and motivationz needed to sustain behaviour change and manage risk factors.

Personalized self-management strategies, digital tools, emotional support, and ongoing follow-up foster adherence and confidence. By integrating CR into daily life and ensuring continuity, patients are better equipped to maintain heart-healthy behaviours long after the programme ends.

14. Gaps in evidence

Research recommendations and key endpoints are aligned with the new framework for developing and evaluating complex interventions (*Table 14*).[675]

Table 14 Gaps in evidence

Section	Evidence gap	Research recommendation	Key endpoints (health + process + implementation)
3.1—Patient satisfaction and expectations of cardiac rehabilitation programme components	Limited evidence of whether prehabilitation before planned cardiac procedures improves patient experience and outcomes.	Evaluate prehabilitation plus usual vs usual care alone in routine pathways.	Patient: satisfaction/experience; recovery (e.g. hospitalization, complications); functional capacity; HRQoL. Process: readiness/self-efficacy; adherence. Implementation: reach, acceptability, fidelity; cost/resource use.
3.2—Patient-reported outcome measures	Limited evidence on routine use of PROMs (physical + mental health) in CR and on how PROM feedback changes in care.	Co-design a CR core PROM set and test PROM-guided care pathways.	Measurement: feasibility/completion; validity/responsiveness. Care: shared decision-making; care changes triggered by PROMs. Health: symptoms, HRQoL, mental health (± events via linkage). Implementation: workflow burden, acceptability, reach/equity; cost.
4.2, 4.3, 4.4—Effectiveness, cost-effectiveness, safety of cardiac rehabilitation	Limited evidence on long-term effectiveness, safety, and cost-effectiveness of home-based CR, especially with multimorbidity.	Compare home-based, centre-based, and hybrid CR with long-term follow-up.	Health: MACE/hospitalizations, functional capacity, HRQoL. Safety: exercise/telemonitoring adverse events. Implementation: adherence, engagement, fidelity; reach for multimorbidity; costs.
4.3—Cost-effectiveness of cardiac rehabilitation	Limited contemporary evidence on cost-effectiveness of CR across settings and delivery models.	Embed robust economic evaluation in comparisons of CR delivery models.	Economic: cost per QALY, budget impact; healthcare use; workforce capacity. Health: HRQoL; clinical events. Implementation/equity: reach and differential uptake/effects by setting and socio-economic group.

Continued

5—Indications for cardiac rehabilitation	Limited evidence on optimal CR design and goal attainment for complex comorbidity (e.g. inflammatory joint disease, multimorbidity).	Develop and evaluate tailored multimorbidity CR pathways (including specialist input).	Goal attainment; functional capacity; condition-specific symptoms/function; HRQoL. Mechanisms: capability/opportunity/motivation; symptom barriers. Implementation: feasibility of tailoring, fidelity, acceptability; cost.
5—Indications for cardiac rehabilitation	Few CR studies in less common conditions/interventions (e.g. SCAD, INOCA, LVAD, total artificial heart) and in young adults and pregnancy.	Build multicentre cohorts/registries and run pragmatic trials in under-researched CR indications.	Feasibility/safety: recruitment, retention, and adverse events. Disease-relevant outcomes: symptoms, functional capacity, HRQoL; condition-specific events. Implementation/equity: reach in rare disease, young adult, and pregnancy pathways; cost.
5—Indications for cardiac rehabilitation	Insufficient evidence for CR in primary cardiomyopathies without arrhythmia or symptomatic heart failure.	Evaluate CR in primary cardiomyopathies, with explicit safety and self-management outcomes.	Functional capacity; symptoms/arrhythmia burden; HRQoL; self-management. Safety: exercise-related adverse events. Implementation: adherence/fidelity; acceptability; resource use.
5—Indications for cardiac rehabilitation	Insufficient evidence on CR effectiveness in cardiac autonomic disorders and syncope.	Conduct phased feasibility-to-evaluation studies of CR in patients with autonomic disorders and syncope.	Symptoms (frequency/severity); functional capacity; mental health; HRQoL. Mechanisms: autonomic measures where relevant. Implementation: feasibility, safety, acceptability; cost.
6—Quality indicators	Unclear which quality indicators and team compositions improve outcomes (including impact of integrating relevant specialists).	Define, test, and implement CR quality indicators and multidisciplinary models.	Indicators: validity, reliability, sensitivity to change; feasibility of routine capture. Care/process: delivery of core CR components, referral timeliness. Health/equity: functional capacity, HRQoL, events; costs.
7.1—Patient assessment	No agreed core psychological outcome set in CR; limited evidence on cultural/ethnic influences on adherence.	Develop a core psychological outcome set and evaluate culturally adapted adherence strategies.	Measurement: core set uptake; psychometrics/MCID where feasible. Health: depression/anxiety/stress; HRQoL. Implementation/equity: adherence, reach and acceptability across cultural/ethnic groups.

Continued

7.2—Self-management, behaviour change, and education	Limited evidence on digital tools for behaviour change and on health literacy-informed education effects on long-term outcomes.	Develop and evaluate digital and health literacy-informed education interventions with long-term follow-up.	Behaviour: physical activity/diet/smoking (as relevant) and engagement metrics. Health: HRQoL and risk factors (± events via linkage). Implementation/equity: acceptability, digital inclusion, reach; cost.
7.2—Self-management, behaviour change, and education	Evidence is limited on ACP embedded in CR for patients with chronic HF and other palliative trajectories (needs, acceptability, delivery, and impact on patient- and system-level outcomes).	Co-design and evaluate a structured ACP module integrated into CR (staff training, conversation prompts, documentation pathway, links to palliative care) vs usual CR.	Process: ACP discussion + documentation rates; palliative referral. Patient/caregiver: shared decision-making, decisional conflict, HRQoL, symptom burden, caregiver burden. Service: admissions/emergency department use, goal-concordant care; costs.
7.3—Optimization of cardiovascular pharmacotherapies	Limited evidence on how medication optimization (including polypharmacy management) interacts with CR outcomes in multimorbidity.	Test medication optimization and adherence support embedded in CR.	Medication: adherence/persistence; polypharmacy burden; adverse drug events. Risk factors: BP, lipids, HbA1c. Health: exercise tolerance, HRQoL, hospitalization. Implementation: workflow; cost.
7.4—Physical activity and sedentary behaviour counselling	Uncertain effects of sedentary time reduction and best integration of activity/sedentary counselling; limited evidence for digital support; unclear mediators of behaviour change.	Test integrated counselling models (with optional digital support) and evaluate key mediators.	Behaviour: device-measured sedentary time/breaks; physical activity. Health: BP, glycaemia, lipids, weight/body composition; functional capacity; HRQoL. Mechanisms: self-efficacy, motivation, and social support. Implementation: engagement, fidelity, equity; cost.
7.5—Exercise training	Uncertainty about optimal exercise prescription (HIIT parameters; resistance training type/intensity; safety in very high BP; prognostic impact of inspiratory muscle training; MCID for strength; link between strength change and outcomes).	Run comparative/optimization studies of exercise modalities and establish clinically meaningful strength change.	Exercise capacity (e.g. VO_2peak); muscle strength; CV risk factors; HRQoL. Safety: BP response and adverse events. Process: dose delivered/received, adherence; mechanism measures where relevant.
7.6—Nutrition and body composition management	Uncertainty on how to tailor nutrition counselling; which dietary patterns best target risk factors; benefit of body-composition-tailored CR; and how to prevent muscle loss during weight loss.	Evaluate tailored nutrition strategies and delivery modes, including muscle-preserving weight-loss approaches.	Diet adherence/quality; weight and body composition; BP/lipids/glycaemia; muscle mass/strength; HRQoL. Implementation/equity: feasibility, acceptability; cost.

Continued

7.7—Smoking cessation	Limited evidence on integrating smoking cessation into CR, relapse prevention, and tailoring to diverse barriers (mental health, low health literacy, multimorbidity).	Implement integrated cessation pathways and test relapse prevention supports (including digital follow-up).	Smoking: biochemically verified abstinence; relapse and sustained abstinence. Mechanisms: stress/mental health, health literacy, social support. Implementation/ equity: integration into workflow, reach; cost.
7.8—Psychosocial management	Unclear mechanisms and inconsistent evidence for psychosocial interventions; limited acceptability/cost-effectiveness data; under-representation of women and minorities; poor intervention description.	Specify programme theory, standardize reporting, and run adequately powered and diverse trials with economic evaluation (and hard endpoints where feasible).	Psychological outcomes; HRQoL; functional capacity; MACE/mortality where feasible. Mechanisms: stress physiology and behaviour of mediators. Implementation/ equity: acceptability, fidelity, reach; cost.
7.9—Sexual counselling	Limited evidence on acceptability and cost-effectiveness of sexual dysfunction screening/counselling in CR; women are under-represented.	Evaluate sexual health interventions including acceptability and cost-effectiveness, with targeted recruitment of women and diverse groups.	Sexual function and relationship outcomes; HRQoL; relevant CV risk markers. Implementation/ equity: uptake and acceptability (patients/ clinicians); cost.
7.10—Management of frailty and comorbidities related to cardiovascular risk	Limited tools and evidence to tailor CR and cardiovascular risk factor treatment for frailty/cognitive or mobility impairment.	Develop pragmatic frailty screening for CR, integrate frailty into risk prediction, and test intensity/treatment tailoring by frailty level.	Frailty and function; falls/ adverse events; HRQoL; hospitalization. Decisions: treatment intensity and harms/benefits. Implementation: feasibility and acceptability; cost.
7.11—Counselling on environmental cardiovascular risk factors	Limited evidence for interventions addressing environmental cardiovascular risks (e.g. pollution, noise, heat, environmental stressors) within CR.	Develop and evaluate environmental risk counselling/ mitigation components in CR pathways.	Exposure: objective proxies and perceived stressors. Health: symptoms, BP/ cardiometabolic markers; HRQoL; adherence. Implementation/equity: feasibility/acceptability; cost.
7.12—Enhance return to work	Return to work is often measured as a secondary outcome with inconsistent reporting.	Make return to work a primary outcome where relevant and use standardized measures.	Work: time to return, sustained employment, work ability/productivity. Health: HRQoL; rehospitalization. Implementation/equity: employer engagement; differences by occupation.
8—Telemedicine and digital technologies in cardiac rehabilitation	Uncertain benefits of wearables/ apps and telehealth consultations; unclear standardization and value of AI methods; limited evidence on European data governance, medico-legal, reimbursement, and cost-effectiveness.	Evaluate digital/CTR components with standardized protocols, and study governance, and implementation in European contexts.	Participation: enrolment, adherence, completion; goal attainment. Health: functional capacity, HRQoL. Safety: event detection and false alarms. Implementation: usability, data quality, privacy/ security; cost.

Continued

9—Delivery of cardiac rehabilitation	Limited long-term comparative evidence for centre-based, home-based, and telerehabilitation models; inconsistent reporting of fidelity/adherence; uncertain effectiveness in diverse groups.	Compare delivery models and prioritize inclusion of under-represented groups with transparent fidelity reporting.	Health: MACE/ hospitalization; functional capacity; HRQoL. Implementation/equity: reach, adherence, fidelity/ adaptation, patient experience. Economic: cost per QALY; budget impact.
10—Improving cardiac rehabilitation participation	Limited evidence on participation interventions (women-specific, culturally/socio-economically tailored); mechanisms/components and optimal flexibility are poorly described.	Co-design and test participation-enhancing features; improve reporting and assess flexible programme designs.	Participation: enrolment, adherence, completion (by sex, ethnicity, socio-economic group). Patient experience: barriers/ facilitators. Health: functional capacity, HRQoL. Implementation: reach, feasibility of tailoring; cost.
11—Sex, ethnicity, and age in cardiac rehabilitation	Older adults (especially ≥80 years), women, selected ethnicities and those with major comorbidity are under-represented; age-, sex-, ethnicity-appropriate protocols, cost-effectiveness, and long-term outcomes are unclear; barriers and psychosocial care in cognitive impairment are understudied.	Run inclusive multicentre studies with long-term follow-up and economic evaluation; develop age-, sex-, ethnicity-appropriate protocols; use qualitative work to refine psychosocial and accessibility components.	Functioning/mobility; cognition; HRQoL; rehospitalization; harms/ adverse events; costs. Implementation/equity: accessibility, supervision needs, caregiver burden; reach in patients aged ≥80 years and multimorbidity.
12—Long-term management after cardiac rehabilitation	Determinants of dropout and long-term non-adherence after CR are poorly understood; evidence for maintenance strategies is limited.	Identify predictors of long-term adherence and test maintenance interventions (booster sessions, peer/community support, and digital follow-up).	Sustainment: long-term adherence to lifestyle goals and engagement with support. Health: risk factors, HRQoL, events/ hospitalization. Implementation: determinants of dropout; sustainability; costs.
Cross-cutting—safety and harms reporting	Harms and adverse events are inconsistently defined and reported in CR and exercise trials, limiting safety conclusions.	Adopt a harmonized safety taxonomy and minimum reporting set for CR trials and registries.	Harms: exercise-related events, falls, arrhythmias, serious adverse events, device-related events; exposure denominators (dose/time).
Cross-cutting—implementation and equity	Limited evidence on implementation of determinants and on how to reduce inequities (digital divide, language, disability access).	Embed implementation frameworks and equity measures in CR research and service evaluation.	Implementation: reach, adoption, fidelity/ adaptation, acceptability, feasibility, sustainability; context determinants. Equity: differential reach/ outcomes; costs of implementation.

Continued

Cross-cutting—data interoperability and governance	Data interoperability and governance (consent, privacy, cybersecurity, AI transparency) are variably addressed, particularly for digital/CTR.	Develop interoperable data standards and governance of toolkits aligned with European regulations and test feasibility.	Data: completeness, interoperability, linkage success; consent/privacy metrics; cybersecurity incidents; user trust; legal/reimbursement readiness.

ACP, advance care planning; AI, artificial intelligence; BP, blood pressure; CR, cardiac rehabilitation; CTR, cardiac telerehabilitation; CV, cardiovascular; HbA1c, glycated haemoglobin; HF, heart failure; HIIT, high-intensity interval training; HRQoL, health-related quality of life; INOCA, ischaemia with non-obstructive coronary arteries; LVAD, left ventricular assist device; MACE, major adverse cardiovascular event; MCID, minimal clinically important difference; PROM, patient-reported outcome measure; QALY, quality-adjusted life year; RCT, randomized controlled trial; SCAD, spontaneous coronary artery dissection; VO_2, oxygen uptake.

15. Evidence tables

Evidence tables are available at *European Heart Journal* online.

16. Data availability statement

No new data were generated or analysed in support of this research.

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18. Appendix

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