IRISH ASSOCIATION OF CARDIAC REHABILITATION

Irish Association of Cardiac Rehabilitation

Guidelines for Cardiac Rehabilitation 2025

Contents

Foreword

As Chair of the guideline development group (GDG), I wish to thank all the members for making my role so easy. It was a pleasure to see how individuals representing the core cardiac rehabilitation (CR) disciplines worked collaboratively with a spirit of openness and critical rigour to ensure that the recommendations are underpinned by robust evidence. The method employed was transparent and rigorous with the subsequent guidelines reflecting a synthesis of contemporary international CR guidelines.

CR exemplifies the scientific-practitioner role: the practice of CR is based on scientific evidence. As scientific evidence emerges and accumulates to document the benefits of new practices, CR will continue to evolve to best meet the needs of patients living with heart disease. Patient outcomes are optimised when evidence-based practices are implemented; implementation requires appropriate leadership and resource allocation. The Irish Association of Cardiac Rehabilitation (IACR) has consistently demonstrated leadership in promoting best practice to ensure patients receive the highest quality supports and continues to advocate for resources to support CR services. Finally, the spirit of generous collaboration demonstrated by the GDG members illustrates the core values of the collegial supportive multidisciplinary approach to CR practice.

David Hevey

Preface

Cardiovascular disease (CVD) remains the leading cause of morbidity and mortality worldwide, with a growing population living with chronic manifestations of this condition. Concurrently, significant progress has been made in the management of other chronic cardiac conditions, including heart failure and valvular disease. However, despite advancements in medical therapeutics, recurrence rates among patients with CVD, heart failure, and valve disease remain high. Consequently, comprehensive efforts aimed at secondary prevention, accelerated recovery, and enhancement of physical function and quality of life are integral to the long-term management of individuals living with heart disease.

CR is a comprehensive, medically supervised and structured programme of care designed to optimise the health of individuals with CVD. Extensive evidence underscores its effectiveness in significantly reducing cardiovascular mortality, hospital admissions, and non-fatal myocardial infarctions (MI), and improving quality of life.[1] As well as being cost-effective, the benefits of CR have been shown to extend to broader patient groups, including those living with heart failure, arrhythmias, and valvular conditions.[1–3] Furthermore, research highlighting the value of individual CR components, demonstrate that comprehensive CR leads to reductions in both all-cause

mortality and the need for revascularisation.[4] Collectively, this decades-spanning body of research firmly establishes CR as a cornerstone of cardiovascular care.

Since the IACR guidelines were last published in 2013[5], major international CR guidelines have undergone substantial revisions.

This fourth edition of IACR guidelines builds on the previous iteration by applying a more systematic and fully documented methodology, synthesising current international CR guidelines and providing recommendations for CR based on the strongest possible evidence. Thus, IACR (2025) guidelines provide a comprehensive, evidence-based framework for CR delivery in Ireland.

This resource is intended to provide best practice guidance to assist CR providers as they support patients transitioning from the acute phase of cardiac disease to long-term management. The medical, physical, and psychosocial aspects of heart disease are comprehensively addressed through a specific set of core components.

The GDG achieved this by conducting a systematic review of key guidelines published since 2013 and extracting and evaluating recommendations based on their strength and level of evidence. These were compiled into a decision matrix and critically appraised to identify contextually appropriate elements for the Irish healthcare setting. Where existing guidelines lacked detail, additional sources were consulted. Interdisciplinary input was maintained throughout to ensure clinical relevance and breadth of expertise.

This approach enabled the GDG to integrate the strengths of multiple guidelines, resulting in a robust and operational framework to support the effective delivery of CR services in Ireland. The links between recommendations and supporting evidence are easy to locate, with references provided throughout the document (Refer to page 88).

Importantly, the GDG comprised multidisciplinary experts in CR, encompassing all relevant professional domains. Essential input from patient representatives was also incorporated, and the document underwent rigorous external international peer review (Appendix A, Table 2). All contributing authors worked on a voluntary basis and declared no potential conflicts of interest with respect to the authorship and/or publication of these guidelines.

Fundamentally, this document provides a detailed, step-by-step guide to the key components of modern CR, outlines how they should be implemented, and defines the standards to be met throughout CR. Where fully implemented, CR programmes will align with best international standards and guarantee the delivery of high-quality CR.

Finally, adequate resourcing of services remains essential to ensure that all CR programmes can deliver fully comprehensive CR (with all core components), thereby improving cardiovascular health, quality of life and survival. Without sustained investment, the established benefits of CR cannot be fully realised.

Executive Summary

The principal recommendations are summarised on page 8 and align with the patient journey to maximise usability and optimise care. Corresponding reference numbers direct the reader to detailed guidance within the main body of the document, with rationale for each element. Further detailed methodological and procedural aspects are included in the Appendices.

All recommendations are grounded in a patient-centred approach, balancing optimal interventions with accessibility and patient preference, including personalised goal-setting and shared decision-making. Tailored guidance for specific populations and patient demographics is also offered. Systematic patient identification and referral strategies further strengthen inclusivity.

Importantly, the roles and complementary expertise of all members of the multidisciplinary team (MDT) are defined and emphasised, reflecting the complex, multifaceted nature of contemporary state-of-the-art CR. Pathways for specific interventions and referral criteria for selected CR participants are also clearly outlined.

The IACR (2025) guidelines further introduce evidence-based quality indicators, including patient-reported outcome measures (PROMs), to evaluate and monitor CR programme performance. These indicators are aligned with international standards such as CR centre accreditation, providing a structured framework for audit and continuous quality improvement, and facilitating closure of the evidence–practice gap in CR delivery.

Summary of IACR Guideline Recommendations 2025

Referral and Inclusion Criteria		
Referral to CR	Healthcare professionals (HCPs) should proactively promote cardiac rehabilitation (CR) and ensure automatic referral of all eligible patients to a CR programme as part of standard post-event or post-intervention care. Referrals must be timely, efficient, and triaged based on clinical priority informed by evidence-based risk stratification and individual patient factors.	**5.0**
Inclusion Criteria	CR should be offered to individuals with the following primary cardiac conditions: • Myocardial infarction (MI) • Coronary artery bypass grafting (CABG) • Percutaneous coronary intervention (PCI) • Stable chronic heart failure (CHF) • Chronic coronary syndrome (CCS) • Cardiac transplantation • Valve replacement or repair • Cardiac arrest Other conditions are considered eligible as detailed in section 5.9	**5.9**
Early CR – Phases 1 and 2		
Phase 1 CR: In-hospital patient assessment, education and engagement	To initiate and support patient engagement in CR, all eligible individuals should be contacted and assessed by a CR team member during their inpatient stay (or by another inpatient HCP trained and tasked with these responsibilities).	**6.1**
Phase 2 CR: Early out-patient assessment, education and engagement	All eligible individuals should be offered timely, individually tailored Phase 2 CR follow-up to enhance continuity of care, including education, advice, and referral to appropriate services. Transition to Phase 3 should follow promptly.	**6.2**

CR Human Resources and Infrastructure		
CR Multidisciplinary Team (MDT) composition	Minimum human resources required for the CR MDT should include: • Medical Director / Cardiologist • Nurse (Clinical Nurse Specialist/Advanced Nurse Practitioner[46]) • Exercise specialist • Dietician • Psychologist • Administrative support CR should be led by a CR Coordinator[46] Access to additional professionals may be necessary to ensure optimal input - refer to section 7.2	**7.2**
CR Infrastructure	IACR endorses the space and equipment standards for safe, effective CR as outlined in the European Association of Preventive Cardiology (EAPC) 2021 CR position statement.[6]	**7.3**
CR Core Components		
CR Core Components	CR programmes must contain the following service components: • Individual patient evaluation, risk factor identification and risk assessment. • Physical activity counselling • Prescription of aerobic and resistance exercise training • Nutritional counselling • Management of weight and body composition. • Lipid management • Blood pressure (BP) monitoring and management • Tobacco cessation support (including e-cigarettes) • Vocational support • Psychosocial management	**7.4**
Expected Outcomes	A patient-centred, guideline-directed plan should be formulated to ensure a safe and personalised CR programme. This should be aligned with the EAPC (2021) position paper on comprehensive cardiovascular rehabilitation, integrating all key CR programme components to optimise outcomes.[7]	**7.5**

Phase 3 CR: Early outpatient supervised CR sessions		
Initial CR Assessment	An initial individualised assessment of the patient should be carried out and documented prior to commencing Phase 3 CR exercise training as described in section 8.1.	**8.1**
Assessment of Cardiorespiratory Fitness and Functional Capacity Tests	Prior to commencing exercise training (ET) in Phase 3 CR, an individual symptom limited functional capacity test should be completed, with careful selection of the exercise test modality and protocol to ensure a safe, tailored ET prescription. • Cardiopulmonary exercise testing (CPET) is the recommended gold standard for assessing exercise capacity; if unavailable, a 12-lead ECG monitored treadmill (or cycle ergometer) exercise test should be used. • If CPET or treadmill exercise test (TMET) is not available, a walking test such as the six minute walk test (6MWT), or the incremental shuttle walk test (ISWT) should be performed, but only as a necessary alternative.	**8.2**
Risk Stratification	Participants in exercise-based CR programmes should be risk-stratified for cardiac events in accordance with the American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR) guidelines (2021)[8] (Appendix E).	**8.3**
Exercise Prescription	• The exercise prescription should be derived from an initial functional capacity test, ideally an ECG treadmill exercise test utilising the heart rate reserve (HRR) (Karvonen) formula.[9] • The ET intensity may vary between 40–80% of HRR, depending on the patient profile and their stage of progression through the programme. • A Rate of Perceived Exertion (RPE) scale should be employed throughout CR, with an ET intensity of 'moderate to somewhat hard' being represented by 12-14 on the Borg RPE scale (or 3–4 on the Modified Borg RPE scale)[10,11] (Appendix C).	**8.4**
Exercise Dose	An absolute minimum of 12 supervised ET sessions should be offered in CR programmes (due to the association with lower all-cause mortality), but a higher number of sessions is associated with superior outcomes.	**8.5**
Monitoring and Supervision during Exercise Training	• A focused pre-exercise assessment should be conducted to evaluate the risk of a cardiac event before starting ET. • Pre-exercise session checks include monitoring symptoms, blood pressure (BP), heart rate (HR), and medication adherence.	**8.6**

	• BP measurements should be taken before and after each ET session until an appropriate BP response has been demonstrated. • Encourage ongoing patient-clinician communication during sessions. • Group ET should be delivered in an appropriately equipped dedicated CR gym space, supervised by CR-HCPs, with knowledge and expertise of exercise physiology in the setting of cardiovascular disease. • AACVPR (2021)[8] guidance on both staff-patient ratio and ECG telemetry monitoring is endorsed by the IACR (Appendix F). Telemetry monitoring is recommended for all patients for a minimum of 3-6 exercise sessions.	
Supervised Exercise Training	• Supervised ET sessions should take place at least twice weekly, for a minimum of one hour in duration. • All supervised ET sessions should include a minimum warm-up and cool down period of 10 minutes appropriate to each patient's clinical status. • The conditioning phase of ET (aerobic and resistance) should last for a minimum of 40 minutes in total per session. • The exercise prescription should be progressed according to individual patient clinical factors and goals. • Resistance training should be incorporated into ET sessions (see AACVPR 2021[8] guidance contained in Appendix H).	**9.2** **9.3** **9.4** **9.5**
Enhancing safety in CR and criteria for terminating exercise training	• Each CR programme must develop and implement site-specific emergency protocols. • Patient safety is enhanced by pre-exercise screening, qualified competent supervision, and timely access to emergency equipment. • Exercise termination criteria should follow JSC/JACR (2023) guidelines.[12]	**9.6**
Education, Health Behaviour Change and Risk Factor Management		
Educational Interventions	• Educational interventions during CR are required to support effective patient self-management. • Such person-centred interventions should be evidence-based and adapted to the individual characteristics of each patient (*e.g.* health status and health literacy). • Family members and caregivers should be included when possible.	**10.1**
Lifestyle Modification	• Lifestyle interventions should continue throughout CR and should be delivered by CR-HCPs with training in evidence-based behaviour change techniques (BCTs). • Technology-based interventions should also be considered.	**10.2**

Nutritional Counselling	Every CR participant should have access to a registered dietitian who can complete a nutritional assessment followed by education and nutritional counselling specific to that patient's needs.	**10.3**
Management of Weight and Body Composition	• All patients require assessment of BMI and waist measurement (*i.e.* abdominal circumference) at CR entry and exit. • Behavioural interventions should be delivered, monitored and reviewed during CR. • In patients with severe obesity (and/or refractory to lifestyle changes) a referral to an obesity specialist should be considered.	**10.4**
Alcohol Consumption Counselling	• All patients should be screened for alcohol consumption with findings documented. • Brief tailored interventions should be delivered to encourage reduction in excessive alcohol intake with referral to a specialised service if required.	**10.5**
Tobacco Cessation Support	• All CR-HCPs should assess and document individuals' smoking behaviour. • A brief personalised intervention is offered together with multi-modal support. • The discussion/outcome should be documented. Referral to specialist smoking cessation services if required and when agreed.	**10.6**
Physical Activity Counselling	• Both physical activity (PA) levels and sedentary behaviour should be evaluated in CR. • Tailored advice, education and behavioural support should be provided to encourage increased PA and a reduction in sedentary time. • Patients should be advised to exercise for a minimum of 150 minutes per week (and up to 300 minutes) depending on the individual profile, and modified to comorbidities (*e.g.* frailty, clinical status). • Return to recreational sporting activities should be a collaborative process involving careful individual evaluation including echocardiogram, exercise stress testing and full participation/monitoring in the phase 3 CR ET programme.	**10.7**
Medical Risk Factor Management		
Blood Pressure Management	• Blood pressure should be assessed and managed in accordance with the European Society of Cardiology guidelines (2024).[13] • For patients with CVD a BP treatment target of 120–129/70–79 mmHg is recommended provided treatment is tolerated.	**10.8**

Lipid Management	• Lipid modification to reduce cardiovascular risk and management of dyslipidaemia should be in accordance with ESC guidelines.[14,15] • Patients with established ASCVD should be prescribed high-intensity statins as tolerated, with a target LDL-C reduction of ≥50% from baseline and an LDL-C goal of <1.4 mmol/L.[14,15] • Non-statin therapies with proven cardiovascular benefit—used alone or in combination—are recommended for patients who cannot take statins or who do not reach their LDL-C target despite being on the maximally tolerated statin dose.[15]	**10.9**
Diabetes	• All CR patients should be screened for diabetes using HbA1c and referred onward for clinical management if pre-diabetes or diabetes is diagnosed. • During CR patients with diabetes should receive patient-centred care to improve diabetes knowledge, glycaemic control and disease self-management. • Management of blood glucose, BP and lipid levels are adapted according to international best practice guidelines including the ESC guidelines for the management of CVD in patients with diabetes (2023).[14]	**10.10**
Medication Management	• Initial CR assessments should include documentation of current medications, including non-prescribed products. • A reconciliation process should compare documented medications with the patient's self-reported usage, with any discrepancies investigated and clarified. • Secondary prevention medications will be optimised as per available guidance and up titrated during CR in collaboration with the primary and secondary care physicians. • Patient beliefs about medication should be assessed, and educational interventions targeting adherence should be delivered throughout CR by the MDT, preferably in addition to a formal education session on medication adherence.	**10.11**
Psychosocial Management		
Psychosocial Management	• All CR patients should be screened for psychosocial risk factors (particularly depression) at CR entry and exit. • As part of a stepped-care pathway, patients should be offered multi-modal behavioural interventions, integrating health education, physical exercise and psychological support. • All patients should be offered a package of psychological care, based on a cognitive behavioural model (*e.g.* stress management and relaxation training) as an integral part of CR. Cognitive Behaviour Therapy (CBT) should be the first choice of psychological intervention for patients in CR with depression or anxiety.	**11.0**

	• Patients with persistently elevated depressive symptoms should have access to an appropriately trained mental health professional.	
Post CR Evaluations and CR Discharge Pathways		
End of Programme Assessment Progress Review	At the conclusion of the CR programme there should be a formal re-assessment tailored to the individual's original risk profile.	**12.1**
Post CR Assessment of Cardiorespiratory Fitness and Functional Capacity Test	Upon CR completion, cardiorespiratory fitness should be reassessed using the same validated test administered during the initial assessment to evaluate both patient progress and programme effectiveness.	**12.2**
CR Discharge/ Progress Report	At CR exit, a comprehensive summary of the patient's progress should be prepared by the CR team and forwarded to the patient's General Practitioner (GP) and referring Consultant to ensure continuity of care and support ongoing secondary prevention.	**12.3**
Phase 4 CR (Maintenance of Ongoing CR Activities)		
Phase 4 CR	Strategies for long-term maintenance of lifestyle changes (including exercise) should include: signposting patients (and families) to relevant resources *e.g.* community exercise programmes and activity groups; cardiac patient support groups; and community-based tobacco cessation, dietetic/weight management and counselling services	**12.4**
Alternative Models of CR Delivery		
Alternative CR Models	• Alternative CR models, such as home-based CR, should be considered as an alternative for those who cannot participate in centre-based CR. • All CR programmes, regardless of delivery method or setting, should align with the CR standards described in this guideline, and include all CR core components.	**13.0**
Programme Quality Assessment and Audit		
CR Programme Quality	Data obtained from CR outcome measures should be systematically recorded for each patient to inform future quality improvement initiatives to address gaps in care.	**14.0**

Cardiac Disease Populations		
Specific Cardiac Disease Populations	• Certain disease-specific populations (*e.g.* chronic coronary syndrome, cardiac surgery, surgical repair of the aorta, heart failure, LVAD, cardiac transplant, implantable device, SCAD) can be appropriate candidates for enrolment in CR. • Specialised input and careful consideration are often necessary to ensure the programme is appropriately tailored to meet their unique needs.	**15.0**
Specific Demographic Populations		
Gender **Older Persons** **Race, Language and Culture**	• To promote CR enrolment and sustained participation, and to enhance secondary prevention outcomes, it is essential to consider gender, age, cultural background, and language-specific factors. • Where feasible, CR programmes should be tailored to provide individualised interventions and ensure access to appropriate resources that address the diverse requirements of distinct demographic cohorts.	**15.9** **15.10** **15.11**

Tables and Figures

Abbreviations

Abbreviations	Terms
AACVPR	American Association of Cardiovascular and Pulmonary Rehabilitation
ACRA	Australian Cardiovascular Health and Rehabilitation Association
AED	Automated External Defibrillator
AF	Atrial Fibrillation
AHA	American Heart Association
ANP	Advanced Nurse Practitioner
ASCVD	Atherosclerotic Cardiovascular Disease
BACPR	British Association of Cardiovascular Prevention and Rehabilitation
BCT	Behavioural Change Technique
BP	Blood Pressure
BPM	Beats per Minute
BMI	Body Mass Index
CABG	Coronary Artery Bypass Grafting
CAD	Coronary Artery Disease
CBCR	Centre-Based Cardiac Rehabilitation
CBT	Cognitive Behavioural Therapy
CCL	Cardiac Catheterisation Laboratory
CCS	Chronic Coronary Syndrome
CHF	Chronic Heart Failure
CHO	Carbohydrate
CIED	Cardiac Implantable Electrical Devices
CM	Cardiomyopathy
CNSp.	Clinical Nurse Specialist
CPET	Cardiopulmonary Exercise Test

CR	Cardiac Rehabilitation
CRF	Cardiorespiratory Fitness
CRT	Cardiac Resynchronisation Therapy
CR-HCP	Cardiac Rehabilitation Healthcare Professional
CVD	Cardiovascular Disease
CVIS	Cardiovascular Information Management System
DOH	Department of Health
EAPC	European Association of Preventive Cardiology
ESC	European Society of Cardiology
ET	Exercise Training
ETT	Exercise Tolerance Test
EST	Exercise Stress Test
GDG	Guideline Development Group
GDMT	Guideline Directed Medical Therapy
GP	General Practitioner
HBCR	Home Based Cardiac Rehabilitation
HCP	Healthcare Professional
HIIT	High Intensity Interval Training
HIQA	Health Information and Quality Authority
HR	Heart Rate
HRR	Heart Rate Reserve
HSE	Health Service Executive
LDL-C	Low Density Lipoprotein Cholesterol
IACR	Irish Association of Cardiac Rehabilitation
ICCPR	International Council of Cardiovascular Prevention and Rehabilitation
ICD	Implantable Cardioverter Defibrillator
IHD	Ischaemic Heart Disease

ISWT	Incremental Shuttle Walk Test
JCS/JACR	Japanese Circulation Society/ Japanese Association of Cardiac Rehabilitation
LVAD	Left Ventricular Assist Device
MACE	Major Adverse Cardiovascular Event
MAP	Managed Access Protocol
MCR	Maintenance Cardiac Rehabilitation
MDT	Multidisciplinary Team
MECC	Making Every Contact Count
METs	Metabolic Equivalents
MI	Myocardial Infarction
NRT	Nicotine Replacement Therapy
OTC	Over the Counter
PA	Physical Activity
PAD	Peripheral Arterial Disease
PCI	Percutaneous Coronary Intervention
PCSK9 mAbs	Proprotein Convertase Subtilisin/Kexin Type 9 Monoclonal Antibodies
POC	Point of Care
PSRF	Psychosocial Risk Factor
PTSD	Post-traumatic Stress Disorder
QI	Quality Improvement
RCT	Randomised Controlled Trial
RM	Repetition Maximum
ROM	Range of Movement
RPE	Rate of Perceived Exertion
RPP	Rate Pressure Product
RT	Resistance Training
SCAD	Spontaneous Coronary Artery Dissection

SES	Socioeconomic Status
SPM	Secondary Prevention Medications
SPPB	Short Physical Performance Battery
SMT	Stress Management Training
TMET	Treadmill Exercise Test
TUG	Timed Up and Go
T2DM	Type 2 Diabetes Mellitus
WHO	World Health Organisation
6MWT	Six-Minute Walk Test

IACR Guidelines for Cardiac Rehabilitation 2025

1.0 Guideline Statement

The Irish Association of Cardiac Rehabilitation (IACR) is committed to providing patients engaged in CR with comprehensive, high-quality, and safe care, which is guided by best evidence and aligned with current national and international clinical guidelines.

2.0 Guideline Purpose

2.1 This guideline document has been developed to provide a framework for CR-HCPs with appropriate clinical experience and qualifications, to deliver a high quality, person-centred, and evidence-based CR service. It represents a summary of the scientific evidence and best-practice recommendations for CR programme delivery and is issued with the intention that all patients attending Irish CR services can expect consistency and continuity in the quality of their care, regardless of location or setting.

2.2 Whilst guidelines can provide an important framework for the planning and implementation of CR programmes, the individual variability of patients, and clinical judgement regarding same, needs to be taken into account to ensure optimal outcomes.[15]

2.3 In the main, this document considers the sequence of activities and recommendations that follow the patient's journey through a CR programme. Each component of CR will be detailed with supplementary information available in the appendices.

2.4 The IACR last issued CR guidelines in 2013.[5] For detailed information on the methodology underpinning the development of this 2025 IACR CR Guidance, refer to Appendix A.

3.0 Standards and Scope

3.1 Standards: A core principle of these guidelines is the alignment of patient, clinical, and organisational objectives with the highest quality available evidence and clearly defined core components, as informed by all relevant CR guidelines.

3.2 CR programmes should be delivered in line with the six domains of quality set out by the Institute of Medicine (2001).[16]

- *Safety:* avoiding harm to service users and staff.
- *Timely:* providing care within an appropriate timescale to avoid harmful delays
- *Effective:* providing services that benefit patients based on scientific evidence
- *Efficient*: avoiding any waste that does not add value to the patient.
- *Equitable*: providing care that does not vary in quality because of personal characteristics.
- *Patient centred:* providing care that is respectful and responsive to patient's values and needs.

3.3 Scope: HCPs with demonstrable competencies in cardiac care, exercise training, education and risk factor management, who currently manage and deliver CR.

4.0 Definitions

4.1 CR is a medically supervised specialised programme with a multidisciplinary approach to deliver comprehensive and holistic patient care for a range of cardiovascular conditions 'so that patients, by their own efforts, preserve or resume optimal functioning in their community and through improved health behaviour, slow or reverse progression of disease'.[17,18]

4.2 Best practice, contemporary CR is multifactorial and must include the following core components to be classified as CR: patient assessment; management and control of cardiovascular risk factors; physical activity counselling; prescribed ET under clinical supervision; dietary advice and counselling, psychosocial management; and vocational support.[6–8,12,19–25]

4.3 CR is usually considered in four phases:

- Phase 1: in-hospital patient assessment, education and engagement
- Phase 2: early outpatient assessment, education and engagement (2–6 weeks).
- Phase 3: early formal supervised outpatient exercise, education and risk factor management programme.
- Phase 4: Maintenance of ongoing CR activities.

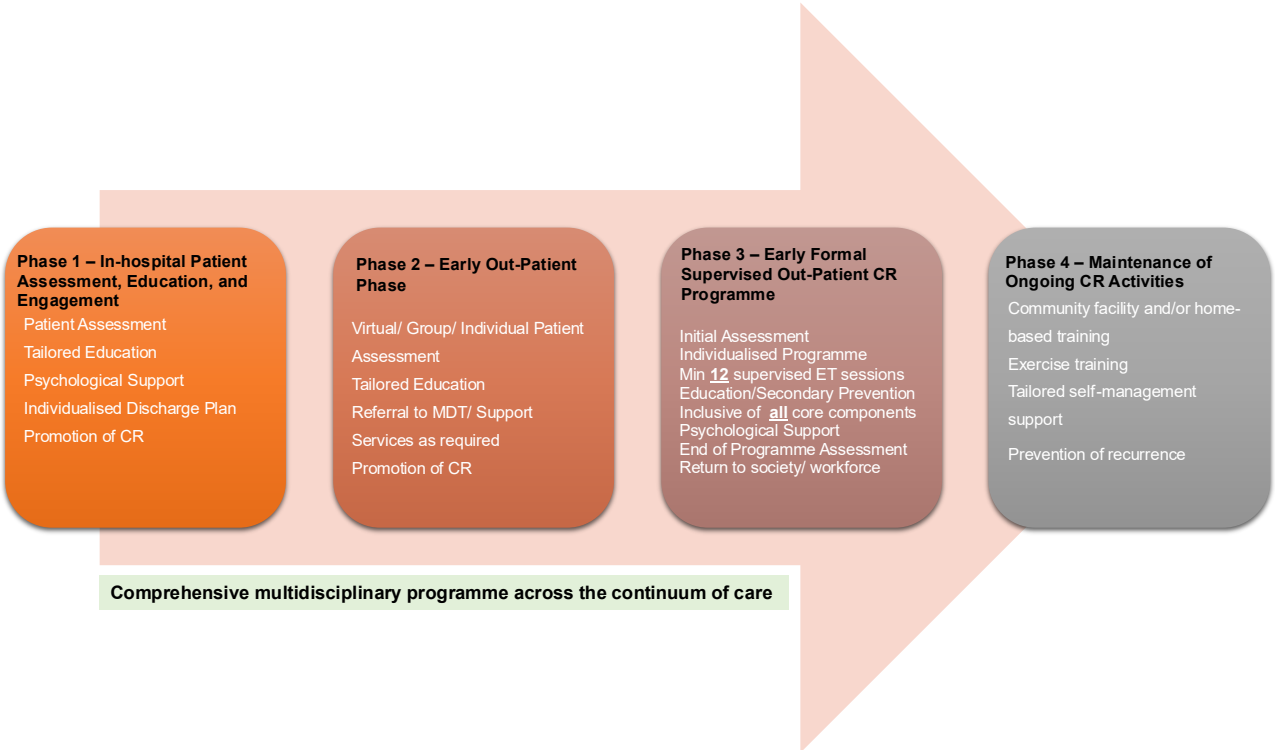

Figure 1 Phases of CR. CR, Cardiac rehabilitation; MDT, multidisciplinary team; ET, exercise training.

4.4 The unqualified term 'Cardiac Rehabilitation' generally refers to the Phase 3 outpatient CR programme that delivers personalised, supervised care organised in a group setting and takes place over a period of weeks. This is a complex, multifaceted and multidisciplinary programme involving exercise training, risk factor modification, education and psychological support and according to the ESC is a Class 1A recommendation for patients with coronary heart disease and heart failure.[26]

5.0 Referral Pathways: Inclusion Criteria; Exclusion Criteria and Contraindications to Exercise Testing and Training

5.1 There are profound individual and societal benefits that can accrue from CR participation, including, but not limited to, reduced morbidity, reduced cardiac deaths, reduced hospital admissions and increased mental wellbeing and quality of life.[1] Although a wide range of cardiac diagnoses qualify for CR (see below), scarce resources may dictate that timing of CR enrolment and/or participation be prioritised for those patient populations shown to most benefit.

5.2 There is no upper age restriction for participation in CR.

5.3 In hospitals with a cardiac catheterisation laboratory (CCL), standing orders should be put in place so that all patients who are post-MI and/or post-PCI are referred automatically to the CR service from the procedure lists. While all eligible patients should be given the opportunity to participate in CR, their individual suitability for exercise training (ET) must be assessed prior to commencing the exercise programme. In hospitals without a CCL, the discharge pathway for angiography should include CR referral.

5.4 Referrals can be accepted in a variety of ways (*e.g.* electronically or written), but this process needs to be timely and efficient.[25]

5.5 Referrals are generally accepted from the following sources:
- Consultant Cardiologist / Team or Cardiothoracic Surgeon / Team
- Heart Failure Service
- Tertiary Referral Centres
- External CR Centres
- Primary Care Providers

5.6 Referrals are assessed by the CR Coordinator or other suitably qualified CR healthcare professional (CR-HCP). Referrals should be triaged on a priority basis, according to the evidence base and individual circumstances. For example, patients referred to CR following cardiac arrest or myocardial infarction (MI) will have a higher priority. Similarly, where a patient's return to employment is dependent on CR participation, this will also be a significant consideration.

5.7 It is the responsibility of all HCPs to promote the benefits of attending and completing a CR programme to appropriately identified patients in their care.[8,12,19,24,27]

5.8 CR Non-Participation: Reasons for non-participation are many but may include severe dementia, terminal illness, and patient refusal. All cases of non-participation, including

the underlying reasons, must be clearly recorded and communicated to the referring Consultant and GP. Thorough documentation also facilitates clinical audit processes, which can drive quality improvement initiatives and contribute to optimising CR programme design and accessibility.[24]

5.9 **Inclusion Criteria.** There is broad international consensus across CR guidelines regarding eligibility for CR.[7,8,19,21,23,24,28–32] The following inclusion criteria have been adopted by IACR:

- Myocardial Infarction (MI)
- Coronary Artery Bypass Graft (CABG) surgery
- Percutaneous Coronary Intervention (PCI)
- Stable Chronic Heart Failure (CHF)
- Cardiac Transplantation
- Valve Replacement/Repair
- Cardiac Arrest

In addition, other conditions considered eligible include:

- Chronic Coronary Syndrome (CCS)
- Cardiomyopathy (CM)
- Implantable Cardioverter Defibrillator (ICD)
- Insertion of Cardiac Pacemaker (with one or more other inclusion criteria)
- Left Ventricular Assist Device (LVAD)
- Spontaneous Coronary Artery Dissection (SCAD)
- Congenital Cardiac Repair (Adults)
- Open repair of Acute Aortic Dissection

Plus, if appropriately resourced

- Atrial fibrillation (AF)
- Stroke (independently mobile and under the supervision of the stroke team)
- Peripheral Arterial Disease (PAD)
- Patients at high risk of coronary artery disease (CAD)

5.10 **Exclusion Criteria (Exercise Testing and Training)**

While CR participation is widely beneficial, all patients using healthcare services should consistently receive the safest care possible, with an emphasis on proactively identifying risks to patient safety.[33]

5.11 Internationally, AACVPR and JCS/JACR guidelines are notable for detailed guidance on the absolute and relative contraindications for exercise testing, with the AACVPR providing some additional information.[8,12] IACR endorse the following absolute and relative contraindications for exercise testing and training, based on AACVPR (2021)[8] CR guidelines:

5.12 **Absolute Contraindications**

- Recent symptoms and/or change in the resting ECG suggesting ischaemia.
- Recent MI (within 2 days) or another acute cardiac event.

- Unstable angina.
- Uncontrolled cardiac arrhythmia causing symptoms or haemodynamic compromise.
- Acute endocarditis.
- Symptomatic severe aortic stenosis.
- Decompensated symptomatic heart failure.
- Acute pulmonary embolus or pulmonary infarction.
- Acute non cardiac disorder that may affect exercise performance or may be aggravated by exercise (*e.g.*, infection, renal failure, thyrotoxicosis).
- Acute myocarditis or pericarditis.
- Physical disability/impairment that would preclude safe and adequate exercise performance.
- Inability to obtain consent.

5.13 **Relative Contraindications***

- Untreated left main coronary stenosis or equivalent.
- Severe stenotic valvular heart disease.
- Electrolyte abnormalities
- Tachyarrhythmias or bradyarrhythmias including uncontrolled sinus tachycardia at rest.
- Atrial fibrillation with rapid uncontrolled ventricular rate.
- Hypertrophic obstructive cardiomyopathy with peak resting left ventricular outflow gradient of >25mmHg.
- Mental impairment leading to inability to cooperate with testing.
- High degree atrioventricular block.
- Known chronic aortic dissection.
- Severe resting arterial hypertension (Systolic BP ≥200mmHg or diastolic BP ≥110mmHg).

In addition, the following should also be considered

- Hypoglycaemia (<4mmol/L) or uncontrolled resting blood glucose (>16.6mmol/L, or >13.9mmol/L if ketones are present in urine.[8,34] Point of care (POC) ketone testing by finger prick is now widely available in healthcare settings

**Contraindications can be superseded if benefits outweigh risks of exercise*

IACR Recommendation 5: Referral Pathways and Safety Considerations

HCPs should proactively promote CR and ensure automatic referral of all eligible patients as part of standard post-event/interventional care. Referrals must be timely, efficient, and triaged based on clinical priority, informed by evidence-based risk stratification and individual patient factors. Patient suitability for ET must be assessed prior to CR to ensure a safe and tailored exercise prescription. IACR endorses the absolute and relative contraindications for exercise testing and training as outlined by AACVPR (2021)[8], which should be applied consistently to ensure participant safety.

6.0 Early Cardiac Rehabilitation: Phases 1 and 2

6.1 Phase 1: In-hospital patient assessment, education, and engagement

CR begins in the inpatient setting, which is a particularly vulnerable period for patients. Phase 1 CR addresses important gaps in care reported by Irish inpatients such as discussing health-related concerns, the purpose of medications and providing understandable information for patients to self-manage their condition post-discharge.[35] Education provided in Phase I has been shown to improve quality of life and reduce the risk of hospital readmissions.[36] Importantly, CR enrolment rates are significantly higher when a face-to-face inpatient intervention is delivered by a HCP.[37]

6.1.1 Where human resources allow, a CR-HCP should visit CR-eligible patients during their inpatient stay to conduct an initial consultation and to provide support.[6,8,12,19,21,22,27,29,32] If in-hospital consultation is not possible, patient contact should be made as soon as possible after discharge.[29]

6.1.2 During this consultation the patient's cardiac diagnosis is discussed and information (with associated educational materials) is provided on:

- Heart disease
- Symptom management (*e.g.* chest pain) and the use of GTN spray as appropriate
- The rationale for cardioprotective medications and the importance of medication adherence.[8,12,28,32]

A collaborative approach should be taken to support the patient in identifying cardiac risk factors and formulating an individualised discharge plan for self-management including lifestyle factors such physical activity, exercise and diet.[8,12,28] The patient's baseline exercise habits and general physical functioning are assessed, and a rationale is provided for a progressive home exercise programme with adherence to same encouraged.[6,8,12,19,21,28] An individual exercise plan for the post discharge period should be provided to the patient. This plan should take account of the patient's baseline exercise habits, cardiac diagnosis and inpatient journey (*i.e.* relative level of complexity).

6.1.3 This consultation also represents an important opportunity to conduct a brief intervention for smoking cessation where appropriate. All necessary supports, such as nicotine replacement therapy (NRT), should be put in place before discharge, along with a referral for follow-up with the community smoking cessation officer.[27,32]

6.1.4 Referrals to other multidisciplinary team (MDT) members (*e.g.* dietician, social worker, psychologist) may also be made as appropriate.[8,24,28,32] It is also helpful to establish availability of resources after discharge.

6.1.5 Written and verbal information should be provided regarding advice on returning to driving and work.[27,32]

6.1.6 Future treatments, interventions and follow-up appointments should also be discussed.[8,27,28,32]

With regard to CR specifically, its purpose and benefits should be clearly explained, and participation should be strongly promoted.[8,12,19,22,24,27,28] The enrolment process should also be discussed and any barriers to CR attendance should be identified and addressed. CR-HCPs should elicit any questions the patient may have before providing contact details and supporting educational materials related to CR. Where the patient is unable to attend centre-based CR (CBCR), home-based CR (HBCR) may be considered as a reasonable alternative.[6–8,12,19,20,24,28,31,32,38,39]

Further guidance on Phase 1 interventions to promote CR utilisation can be found here: https://globalcardiacrehab.com/CR-Utilization

IACR Recommendation 6.1: Phase 1 CR

To initiate CR and support patient engagement, all eligible individuals should be contacted and assessed by a CR team member during their inpatient stay (or by another HCP trained and tasked with these responsibilities). If this is not feasible, this intervention should occur promptly following hospital discharge.

6.2 Phase 2: Early outpatient assessment, education and engagement

Phase 2 CR continues the process of supportive contact, information provision, advice and assessment through phone consultations and/or outpatient visits. The process of identifying referrals to other supportive services (*e.g.* smoking cessation, heart failure, primary care teams) that commenced in Phase 1, continues at this stage. Ideally, the patient should be transitioned to phase 3 CR as quickly as their cardiac diagnosis and condition allows. Every day of delay in commencing Phase 3 CR has been shown to reduce the likelihood the patient will participate by 1%[40], and each day of delay is further associated with a reduction in the benefits of CR participation.[41]

6.2.1 Family members/carers may influence CR participation and can be included if the patient wishes.[24,32]

6.2.2 Patients are allocated an appointment, on a priority basis (from the waiting list), to attend a group introductory education session(s). Alternatively, a patient may receive an individual appointment where their progress and any issues arising may be addressed. Whether group-based or individual, the format should be flexible to offer opportunities for patients to address individual concerns that they may have. Important early outpatient clinical assessments can be undertaken, however briefly, regarding symptoms, wound healing, medication adherence and blood pressure. These sessions may also be conducted virtually where appropriate.

6.2.3 The education session(s) are facilitated by the MDT and should include an overview of CVD, treatments, medications, symptom management, healthy eating, and the role of exercise in treating heart disease.

6.2.4 Arrangements for the Phase 3 CR outpatient programme are made (or confirmed). Where possible, patient preference should inform CR scheduling as this has been shown to impact CR adherence, and barriers which may impede CR participation (*e.g.* such as travel distance) should be identified and addressed.[42,43] In line with national health policy, IACR continues to endorse 'Outreach' CR programmes which bring comprehensive CR closer to the patient's community.[44,45]

6.2.5 A 'face to face' phase 2 session also provides an informal opportunity for the CR-HCP to make an early assessment of the type of exercise test and ET that will be most suitable for the individual patient. The individual exercise plan provided during phase 1 should be reviewed and adjusted if necessary, reinforcing the importance of daily exercise.

6.2.6 Phase 2 CR represents a crucial opportunity to support patients referred to Phase 3 CR, but who are unable to attend (irrespective of the CR modality offered). Where this occurs, it is important to ensure that a follow-up appointment in the Cardiology out-patients clinic has been arranged. A further individual consultation may be arranged with a CR-HCP if indicated or requested (*e.g*. for symptom assessment, risk factor management, psychological care). These patients should also be signposted to the additional services as appropriate (*e.g*. smoking cessation support).

IACR Recommendation 6.2: Phase 2 CR

All eligible individuals should be offered timely and individually tailored Phase 2 CR follow-up to enhance continuity of care, including education, advice, and referral to appropriate services. Transition to Phase 3 CR should follow promptly.

7.0 Phase 3: Core Components, Programme Requirements and Expected Outcomes

7.1 Core Components

The European Association of Preventive Cardiology (EAPC) has outlined the core components that should apply to all CR programmes in addition to minimal and optimal process-based metrics.[6,7,46] Furthermore, a recent update by the American Heart Association (AHA) and AACVPR on core components of CR reiterates that 'for a program to be classified as CR it must be medically supervised and all core components must be included'.[20]

Programme Requirements

7.2 Human Resources

A multidisciplinary team (MDT) is critical for the successful delivery of cardiovascular care[47] and there is consensus across international guidelines that a multidisciplinary approach is also required to achieve the goals of CR.[6–8,12,19,21–24,27,28,31,38] Ultimately it is the responsibility of the CR medical director to ensure that each CR programme is adequately resourced to produce high-quality CR outcomes, and this cannot be achieved without appropriately qualified staff.[6–8,19,24] CR programmes (and ET sessions) must be supervised at all times by expert practitioners 'with appropriate expertise in CVD pathophysiology' who are 'immediately available to provide consultation or handle emergencies'.[8,19,20]

Each MDT member provides an important contribution to the effective cardiovascular care of patients[48–53]. CR teams should be led by an appropriately qualified CR Coordinator[44,54] who is both an expert in CVD management as outlined above and has the appropriate skills to ensure optimal utilisation of individual specialist services available within the MDT[54]. Nurse-coordinated programmes can increase the effectiveness of CR[6]. The recent National Review of Cardiac Services placed a particular emphasis on the essential role of the psychologist forming part of the MDT[44], and a registered dietitian is also a necessity.[8,12,24,25]

Exercise prescription for cardiac patients should be delivered by exercise specialists (*e.g.* physiotherapist, exercise physiologist, CR nurse with specialised training)[12,32,56] with extensive experience in caring for patients with CVD, supported and validated by CR cardiologists, who bear the responsibility for patients' safety.[6] In addition, the physiotherapist provides important expertise in identifying special considerations for prescribing exercise and physical activity, including musculoskeletal assessment and treatment, frailty evaluation, and balance assessment—each of which play a crucial role in preventing injuries associated with weight-bearing exercise.

IACR Recommendation 7.2: CR MDT composition

Minimum human resources required for the CR MDT should include:

- **Medical Director/Cardiologist**
- **Nurse (Clinical Nurse Specialist/Advanced Nurse Practitioner[44])**
- **Exercise Specialist**
- **Dietician**
- **Psychologist**
- **Administrative assistant**

CR should be led by a CR Coordinator[46]

Optimally, important input should also be provided by:

- **Pharmacist**
- **Smoking Cessation Officer**

In addition, access where appropriate to:

- **Social Worker**
- **Occupational Therapist**
- **Psychiatrist**
- **Other specialised healthcare (*e.g.*, diabetologist, lipid clinic, obesity management)**
- **Vocational Counsellor**

7.3 Facilities

In terms of facilities, AACVPR (2021), AHA/ACCVPR (2024)[8,20] and EAPC (2021)[6] outline the requirements for an exercise-based CR programme:

7.3.1 A dedicated consultation area that provides confidentiality of patient records and patient privacy.

7.3.2 Dedicated facilities for exercise training which meet the requirements for the activities and services provided and the unique needs of patients. There must be emergency access to all patient areas, and floor space must allow easy access of personnel and equipment (Refer to Appendix B for further detail on facilities and equipment).

7.3.3 Patients should have access to toilet and changing facilities.

7.3.4 Equipment for assessment of the patient (blood pressure sphygmomanometer, 12-lead ECG, pulse oximetry, glucometer).

7.3.5 Continuous cardiac monitoring equipment (*e.g.* ECG telemetry).

7.3.6 Various Aerobic and Resistance Exercise Equipment, of which treadmills will provide the greatest utility.

7.3.7 Emergency Equipment (including an AED / Manual Defibrillator) and a regularly tested telephone and emergency call system should be available in all exercise areas as well as an emergency phone list available at all phones.[6,8]

7.3.8 It is the responsibility of the Medical Director and CR Coordinator to establish emergency response protocols appropriate to the facility and setting where CR is being provided.[8,21]

7.3.9 Access to exercise stress testing and to diagnostics *e.g*. 24-hour ABP monitoring, Holter monitoring.[6]

IACR Recommendation 7.3: CR Infrastructure

IACR endorses the specific space and equipment required to deliver safe, functional and effective CR as recommended in the EAPC (2021)[6] CR position statement.

7.4 Service Components

The AHA/ACCVPR (2024)[8] and EAPC (2021)[6] outline the components of a comprehensive exercise-based CR programme.

IACR Recommendation 7.4: CR Core Components

CR programmes must contain the following service components:

- **7.4.1 Individual patient evaluation, risk assessment and risk factor identification**
- **7.4.2 Physical activity counselling**
- **7.4.3 Prescription of aerobic and resistance exercise training.**
- **7.4.4 Nutritional counselling**
- **7.4.5 Management of weight and body composition**
- **7.4.6 Lipid management**
- **7.4.7 Blood pressure (BP) monitoring and management**
- **7.4.8 Tobacco cessation support (including e-cigarettes)**
- **7.4.9 Vocational support**
- **7.4.10 Psychosocial management**

7.5 Expected outcomes

The components outlined in 7.4 above should result in the following outcomes:[7]

7.5.1 An individualised guideline-directed plan should be formulated for a specific disease and a specific patient to ensure a safe, tailored CR programme.

7.5.2 Physical activity: Increased participation in domestic, occupational and recreational activities; increased independence and psychological well-being; improved physical activity and reduced sedentary time with the aim of accumulating ≥ 150 minutes of exercise per week.[55]

7.5.3 Exercise Training:

Aerobic training: Increased cardiorespiratory fitness (CRF) as measured by functional capacity testing i.e. increased peak oxygen uptake/METs by ≥15%.[20] Increased estimated exercise session peak metabolic equivalent by ≥40% from third to last exercise session. Increased 6-minute walk distance by ≥10%.

Resistance training: Increased muscular endurance and strength (measured by increased repetitions/time/weight), by at least 5–10%. Reduction of symptoms and attenuated physiological responses, with improved psychological well-being.

7.5.4 Nutritional counselling: Improvements in risk factors associated with unhealthy or inadequate diet. Informed regarding the potential benefits of the Mediterranean Diet. Greater ability to make healthy food decisions independently as evidenced by improved responses to nutrition questionnaire (*e.g.* Mediterranean Diet Assessment Tool)[56].

7.5.5 Weight management: If the patient has obesity (BMI>30) or is overweight (BMI 25–29.9), reduction of 5–10% of body weight in 6 months and modification of associated risk factors.

7.5.6 Lipid management: Expected outcomes are according to the individual risk level and LDL-C. For very high-risk cardiovascular disease target LDL-C is <1.4mmol/L or initially at least a reduction of >50% from baseline.[26,57]

7.5.7 Blood pressure monitoring and management: Target daytime 'office' resting BP is ≤ 130/80. For those with CVD and a confirmed baseline BP of ≥130/80, the recommendation is to treat with BP-lowering therapy, with a recommended treatment target BP of 120–129/70–79 mmHg, provided treatment is tolerated.[12] More lenient BP targets can be considered in persons with symptomatic orthostatic hypotension, those aged 85 years or over, those with moderate-to-severe frailty, or limited life expectancy.[13]

7.5.8 Diabetes management: the goal for HbA1c in the presence of CVD in those with diabetes is <53mmol/mol but hypoglycaemia should be avoided. This goal will vary depending on a range of factors including medication regime and tolerance, duration of diabetes, co-morbidities, age/life expectancy, known complications, hypoglycaemia awareness and individual considerations.[14] In patients with type 2 diabetes (T2DM) with long diabetes duration, co-morbidities or short life expectancy, the HbA1c target should be relaxed to <69 mmol/mol.[14]

7.5.9 Tobacco cessation (including e-cigarettes): long-term abstinence.

7.5.10 Vocational support: return to prior activities as individually appropriate.

7.5.11 Psychosocial management: Reduction in clinically elevated psychological distress (anxiety, depression) and improved health-related quality of life as indicated by validated measures *e.g.,* GAD-7[58]; PHQ-9[59].

7.5.12 Expected and actual outcomes should be documented and evaluated on an individual basis.

IACR Recommendation 7.5: Core Components and Expected Outcomes

A patient-centred, guideline directed plan should be formulated to ensure a safe and personalised CR programme. This should be aligned with the 2021 EAPC position paper[7] on comprehensive CR, integrating all key CR programme components to optimise outcomes.

8.0 Phase 3 CR Initial Assessment, Exercise Prescription, Monitoring and Supervision

8.1 Initial CR Assessment

8.1.1 All CR guidelines recommend that an initial individualised assessment of the patient should be carried out and documented prior to commencing Phase 3 CR ET.[7,8,12,19,21,22,27–32,38] This may be conducted by an individual CR-HCP or ideally on a multidisciplinary basis (as resources allow) with each CR-HCP assessing their own specialist area.

The pre-CR assessment is an opportunity for discussion of a patient's history, providing context to their risk factors and enabling collaborative planning and, ultimately, patient goal-setting. Various CR guidelines outline targets that are objective and clear,[7,8,23,24,27–32] and while these should be communicated, the patient must also be empowered to set their own individualised goals for specific lifestyle changes and risk factor modification.[7,8,22–24,27–32,38]

The initial CR assessment and documentation should include the following important components:[7,8,19,22,24]

8.1.2 Collect demographic information and assess social determinants of health to support the identification of available resources.

8.1.3 Medical history, including pre-intervention symptoms, current health status and active symptoms, if any.

8.1.4 Exercise habits (baseline / current), exertional symptoms, exercise plan advice. This should build on guidance previously provided in phases 1 and 2.

8.1.5 A musculoskeletal history of any orthopaedic issues, back pain or other physical limitations should be ascertained. A falls history should also be taken, with further balance and frailty assessment as required. Given that an individual's ability to balance will be an important component of many of the physical activities undertaken in CR, assessments such as the Berg Balance Scale should be employed at this stage if indicated.[60] Assessment of hand grip strength (using a dynamometer) is also a useful indicator of reduced muscle strength and frailty.

8.1.6 Review of other behavioural risk factors: smoking history and current status, adherence to cardioprotective diet, weight and body composition.

8.1.7 Medical risk factor management: establish current control of blood pressure, lipids and glucose (HbA1c), use of and adherence to cardioprotective therapies.

8.1.8 Medications must be recorded from a valid prescription or from recently dated medication boxes or monitored dosage systems (*e.g*. medication blister packs).

8.1.9 Psychosocial health: depression, anxiety, social support, psychological stress, illness perceptions, quality of life and sexual wellbeing. Use of psychosocial screening tools and health-related quality of life measures is strongly recommended.

Several domains assessed by questionnaire may be completed by the patient in advance of the initial CR assessment, as appropriate. This allows for early discussion with the patient, with further evaluation and referral for psychological support as required.

8.1.10 Initial observations: heart rate, ECG review, resting blood pressure (plus sitting/standing BP if clinically indicated); SpO_2 on pulse oximeter; height; weight; abdominal circumference; ± temperature.

8.1.11 Blood testing: routine biochemical assay should be reserved at the initial CR assessment or early in phase 3 CR, including full blood count, electrolytes, renal and liver function, glucose/HbA1c, and cholesterol profile.[7,8] Results of blood tests taken prior to commencing phase 3 CR may also be used if sufficient time has elapsed since discharge for the patient to be well established on the discharge medication prescription.

8.1.12 Brief interventions targeting behaviour modification and risk factor management should continue throughout phase 3 CR, with informal or formal counselling time allocated outside of the group setting as necessary.[7,8,24]

IACR Recommendation 8.1: Initial CR Assessment

An initial individualised assessment of the patient should be carried out and documented prior to commencing exercise training in CR.

This must include:

- Demographic Information
- Medical History
- Exercise History
- Musculoskeletal History
- Lifestyle and Medical Risk Factors
- Medications
- Psychological Health status
- Vital Signs
- Relevant Blood Test Results

8.2 Assessment of Cardiorespiratory Fitness and Functional Capacity Tests.

8.2.1 Cardiorespiratory fitness (CRF) should be assessed before a patient begins an exercise-based CR programme.[7,8,12,19,21,22,24,27,28,30,38] CRF is optimally obtained from a maximal exercise test using a metabolic system (Cardiopulmonary Exercise Test or CPET) that determines maximal oxygen uptake (VO_2 max or peak VO_2). While there is an acknowledgement in the guidelines reviewed that CPET is the gold standard form of exercise testing,[7,8,12,19,22,27] these facilities are not widely available in the Irish healthcare system. CRF, therefore, is frequently estimated from the work rate achieved on a standardised exercise test (peak speed/gradient on a treadmill or peak watts on a cycle ergometer). CRF can be expressed as a MET (metabolic equivalent of task) level achieved; this term is convenient for making activity recommendations because most activities have an approximate MET level ascribed to them.[8,12]

8.2.2 Assessment should include an objective clinical measure of exercise performance.[7,8,12,19,21–24,27,28,31,38] This is separate to the assessment of physical activity status (including leisure time physical activity, daily sitting, or sedentary time).[7,8,24,28,38]

8.2.3 The exercise test modality and protocol should be carefully selected and individualised. A patient may have musculoskeletal, orthopaedic, neurodegenerative, or other medical disorders that may affect their performance, potentially compromise their safety and ultimately limit the utility of the test.[7,8,12,22,24,28]

8.2.4 As far as is possible, a 12-lead ECG-monitored treadmill exercise stress test (EST) or a bicycle ergometer test should be used.[7,8,12,19,21,24,27,28,38] Treadmill exercise is the predominant modality utilised in Ireland (and elsewhere), with recognition that untrained subjects typically terminate cycle exercise due to quadriceps fatigue at a level of VO_2 significantly below their treadmill peak VO_2.[61] Continuous monitoring of the 12 lead ECG, along with accompanying haemodynamic and symptom responses, can reveal manifestations of myocardial ischaemia, dysrhythmias, or other exertion related abnormalities.[8]

8.2.5 AACVPR (2021)[8] guidelines provide the most detail on the practical aspects of exercise testing and they note the following:

- The exercise test may be submaximal or maximal with respect to the effort required.
- Symptom limited tests are designed to continue until the patient demonstrates signs and symptoms that require termination of exercise.
- It is most important that the test protocol be selected according to the individual patient-estimated physical fitness based on age, underlying disease and current activity level.
- Patients deemed to be at higher risk (*e.g.* recent history of dysrhythmia or symptoms during low levels of effort) should be tested using a less aggressive protocol.
- Protocols must be adapted as necessary for clinical exercise testing and should include a low-intensity warm-up phase followed by progressive, continuous exercise in which the demand is elevated to an individual's maximal level.[8,11]

- Treadmill testing provides a more common form of physiological stress (*i.e.* walking) with patients more likely to attain a higher oxygen uptake and heart rate. The most frequently used stepped treadmill protocols are the Bruce, modified Bruce and the Naughton protocol.[11]

- Stationary cycling may be unfamiliar to many patients, and its success as a testing tool is highly dependent on patient motivation. Thus, the test may end before the patient reaches a true cardiopulmonary end point.[62]

- The exercise component of a symptom limited test should last approximately 8 to 12 min. Low level ramps or protocols that increase metabolic demand by 1 MET per stage are appropriate for high-risk patients with functional capacities less than 7 METs; metabolic demands ≥ 2METs per stage may be appropriate for low to intermediate risk patients with functional capacities ≥7 METS.

- Exercise capacity can be reasonably estimated for functional purposes from both treadmill and cycle workloads.

- Before exercising, patients should be familiar with the symptom rating scales (*e.g.*, Borg or Modified Borg Scales).[8,11]

- A high-quality ECG tracing should be obtained during an exercise test.[8,11]

- HR and BP should be measured, and an ECG should be recorded regularly during the test (*e.g.*, each minute or each stage), at peak exercise, and regularly through at least 6 minutes of recovery. Monitoring should continue into the recovery period until HR, BP, symptoms, and ECG changes stabilise. It can also be helpful to assess the individual's RPE regularly during the exercise test and at peak exercise. Throughout the test, the ECG should be continuously monitored for dysrhythmias and any changes suggestive of myocardial ischaemia.[8,11]

- During the test and post exercise recovery, the individual must be continually monitored for symptoms, such as light-headedness, angina, dyspnoea, claudication, and fatigue. In the case of chest pain that is suspected to be angina the timing, character, magnitude, and resolution should be described. The appearance of symptoms should be correlated with HR, BP, and ECG abnormalities (when/if present).[8,11]

- Exercise tolerance tests are useful in the detection of ischaemia for diagnostic and management purposes. Abnormalities in exercise capacity, HR, BP, and exercise ECG are important findings.

- Stopping a test before maximal effort or a clinical end point underestimates peak exercise capacity. Although some clinicians accept 85% of age-predicted HRmax as sufficient to detect ischaemia, age-predicted HR is unreliable, and test sensitivity improves when HR exceeds this threshold.[11]

8.2.6 The CPET, EST, or bike ergometer tests are strongly recommended across international guidelines.[7,8,12,19,21,22,24,27,28,30,38] Where one of these tests cannot be performed, alternative suggestions for evaluating functional capacity are provided across the guidelines but at a lower level of recommendation.

The 6-minute Walk Test (6MWT) is widely recognised across guidelines as a surrogate of exercise capacity when standard treadmill or cycle testing is not available.[7,8,12,21,22,24,27,28,38] The 6MWT is not useful in the objective determination of myocardial ischaemia and is best used in a serial manner to evaluate changes in functional capacity with training over time.[8] A patient's CRF may also be underestimated due to the self-paced nature of a 6MWT.[20] Although infrequent, if the patient cannot undergo any treadmill or bicycle test, then the 6MWT or incremental shuttle walk test (ISWT) should be performed[21,24,28,38], but only as a necessary alternative.[7,21]

8.2.7 The ISWT is less widely suggested as another exercise test option and is cited in some guidelines.[12,24,28] Step Tests are mentioned in UK[24] and Brazilian[19] CR guidelines as an alternative test. Exercise tests should ideally provide a common form of physiological stress such as walking, which is the main form of physical activity performed throughout the day.[8,20]

8.2.8 For frail patients or those unable to walk, the Short Physical Performance Battery (SPPB) or other chair-based tests should be considered.[7,12] Assessment of balance using the Berg Balance Scale[60] should be utilised where indicated (see 8.1.5). Other tools for frailty assessment may include: walking speed (gait speed test), timed up-and-go (TUG) test, PRISMA-7 questionnaire, and Frail Score.[7] Handgrip tests using dynamometers can also serve as a proxy for overall muscle strength.[12]

8.2.9 Exercise ECG stress test results must be reviewed by the Clinical Nurse Specialist (CNSp)/Advanced Nurse Practitioner (ANP), Medical personnel, or other such team member with the appropriate knowledge and experience of interpreting ECGs and cardiovascular responses to exercise. If significant abnormalities are present (*e.g.* suspicious symptoms, ischaemic ECG changes, abnormal BP / HR response), the Cardiology team/referring Consultant must be alerted to same, and if deemed necessary, the patient's participation in the group ET sessions may be postponed in the interim.

8.2.10 CR-HCPs involved in exercise testing should familiarize themselves with the ACCVPR (2021)[8] and ACSM (2025)[11] guidelines on exercise testing which are comprehensive reference resources.

IACR Recommendation 8.2: Assessment of Cardiorespiratory Fitness and Functional Capacity Tests

Prior to commencing ET in CR, an individual symptom-limited functional capacity test should be completed, with careful selection of the exercise test modality and protocol to ensure a safe, tailored exercise prescription. CPET is the recommended gold-standard for assessing exercise capacity, but if unavailable, a 12-lead ECG-monitored treadmill EST (or cycle ergometer test) should be used. If this is not possible, a walking test (*e.g.* 6MWT or ISWT) should be performed, but only as a necessary alternative.

8.3 Risk Stratification

8.3.2 There is consensus among international CR guidelines that all patients entering CR should be assessed individually for the risk of the occurrence of adverse events during exercise. However, few guidelines outline a formal and defined risk stratification process with the AACVPR providing the most detail.[8,19]

8.3.3 To complete a detailed risk stratification process, patients must be individually assessed, a clinically relevant echocardiogram must have been performed (*i.e*. post event), and an ECG-monitored exercise test must be conducted.[8]

8.3.4 The risk stratification process categorises patients into high, moderate, and low risk according to exercise test and non-exercise test findings[8] (Appendix E).

8.3.5 Patients with limited exercise test data, particularly with abnormal resting ECGs (*e.g.* presence of left bundle branch block, ventricular paced rhythms) should be cautiously risk stratified with a conservative initial exercise prescription employed.[8]

8.3.6 Patients should be reclassified as they progress through the programme but may remain in the high-risk classification indefinitely (*i.e.* requiring direct supervision of physical exercise) depending on events and progress.[19]

IACR Recommendation 8.3: Risk Stratification

Individuals participating in an exercise-based CR programme should be risk stratified for potential cardiac events during exercise in accordance with AACVPR (2021) guidelines[8] (Appendix E).

8.4 Exercise Prescription

8.4.1 AACVPR (2021)[8] list the following considerations for the prescription of exercise and physical activity:

Safety Factors: Clinical history; risks associated with CVD progression or instability; ischaemic and angina thresholds; cognitive and psychological impairment.

Associated Factors: Vocational or avocational requirements; orthopaedic limitations; previous and current activities; personal health and fitness goals.

8.4.2 The ET prescription should be tailored to the participant's baseline fitness, severity of cardiac disease and comorbid conditions.[8,22,28] Patients should be offered individual guidance and supported to co-produce an individualised plan with the overall aim to reduce sedentary behaviour, increase overall energy expenditure and improve physical fitness.[24]

8.4.3 The initial ET prescription should be based on the baseline functional capacity test which should be a CPET or graded treadmill exercise test and should be conducted on regular medications. Ideally a symptom limited maximal or sub maximal effort, should be

achieved on the exercise test. If this is not possible (*e.g.* patient is anxious and stops the test early), this limitation will significantly influence the subsequent exercise prescription.

8.4.4 The most frequently recommended formula across international guidelines for prescribing exercise is the heart rate reserve (HRR) formula[9], with 40–80% the most common range.[7,8,12,19,22,63] For the majority of patients, 50–70% will be a suitable prescription, but for those with low physical function (or low LVF) 40-60% might be used, while for those with higher functional capacity, 50-80% might be more appropriate.[19] AACVPR (2021)[8] state that relative training intensity may vary between 40% and 80% of maximum HRR, depending on the patient profile and their stage of progression[64] during the CR programme.

8.4.5 The peak heart rate (HR) formula is presented as an alternative formula in some guidelines with differing prescription ranges suggested, such as 70-85% of peak HR for moderate intensity,[19] or 50-80% for moderate continuous endurance training.[7] In Japan where CPET is commonly used, it is recommended that moderate-intensity exercise intensity be prescribed for patients with CVD at 40–60% of peak VO2 (and 40–60% of HRR).[12] Age-predicted maximal heart rate equations to calculate exercise intensities should generally be avoided due to the wide range of discrepancies between age-predicted and measured maximal heart rates.[11]

8.4.6 It is important to note that where it is judged the peak HR on the exercise test was not a true reflection of the patient's true maximum HR (*e.g.* the test is stopped for a reason other than a symptom limited maximal effort being achieved), then other inputs may have to be employed in the exercise prescription with the use of Rate of Perceived Exertion (RPE) scales being particularly important.[11]

8.4.7 RPE is generally used in CR to guide the exercise prescription with the Borg RPE (6–20) scale[10,11] being the most commonly cited example (Appendix C). Varied guidance is offered as to what level of the Borg scale patients should exercise at to achieve a moderate intensity ranging from between 12-16[8,22], 11–14[28], 12–14;[7] 11–16;[31] and 11–13.[12] In terms of exercise intensity, 'moderate to somewhat hard' is represented by 12-14 on the Borg scale (or 3–4 on the modified Borg scale).[65]

8.4.8 The significant inverse relationship between CRF and mortality risk is demonstrated both in general populations[66–68] and more specifically in patients with coronary disease.[69,70] For CRF improvements to occur, an exercise prescription and programme must work the body systems harder than they are normally accustomed to work, *i.e.,* the concept of overload.[71]

8.4.9 The aim of the exercise prescription is to achieve a safe but therapeutic level of ET, and the exercise prescription should be considered as analogous to prescribing and administering a medication. The main components of the FITT-VP principle in exercise, namely, Frequency, Intensity, Time, Type, Volume and Progression are considered in the ET section below.

8.4.10 While aerobic endurance training represents the basis of any exercise prescription in patients with CVD, the particular mode, and characteristics of ET that will be most

suitable vary for different patient populations.[7] For example, for people with diabetes, a higher exercise frequency can be more beneficial for glycaemic control, whereas for patients with peripheral arterial disease (PAD) claudication, the type of exercise is important, with walking likely to be more beneficial than cycling.[7]

IACR Recommendation 8.4: Exercise Prescription

Exercise Prescription should be derived from an initial functional capacity test (ideally an ECG treadmill exercise test) utilising HRR. Training intensity may vary between 40–80% of HRR, depending on the patient profile and stage of progression. RPE should be employed throughout CR, with an exercise intensity of 'moderate to somewhat hard' represented by RPE of 12-14 (Borg) or 3–4 (Modified Borg) respectively.

8.5 Exercise Training Dose

8.5.1 ET dose is a complex stimulus involving not only attendance but actual duration and intensity of exercise in each exercise session accumulated across all sessions of an intervention.[72]

8.5.2 The 'dose' of ET required for optimal benefit remains a subject of debate and is specifically detailed in various CR guidelines.[7,8,12,21,29,30,38] A minimum dose of 12 or more supervised ET sessions (12-35) is associated with lower all-cause mortality, with each additional session attended being associated with a 2% reduction in cardiovascular events, whereas up to 36 sessions may be required to reduce percutaneous coronary interventions.[73,74]

8.5.3 International CR guidance for ET dose varies from 12 to 36 sessions**.** AACVPR (2021)[8] and LLKardReha-DACH (2021) guidelines[38] recommend 36 sessions, whereas EAPC[7] recommend a minimum of 24 sessions, with 36 sessions considered optimal.[6,21] The LLKardReha-DACH (2021) guidelines provide additional detail in terms of actual volume of exercise recommending that a minimum of 1000 minutes of ET should be completed during CR.[30] Regarding the number of supervised CR ET sessions per week, 2–3 times per week is the most commonly recommended frequency.[7,8,12,21,28,29]

8.5.4 The exercise prescription for patients is an individualised plan and therefore the number of prescribed ET sessions should be adjusted according to the patient profile.

8.5.5 Patients with a relatively high baseline CRF (≥10 METs) may benefit from the minimum exercise dose (12 sessions), whereas patients with a low baseline functional capacity may require a greater number of sessions than typically delivered in a standard CR programme. This can be determined by the CR exercise specialist or CNSp[12,32] in collaboration with the patient.

IACR Recommendation 8.5: Exercise Training Dose

An absolute minimum of 12 supervised exercise training sessions should be offered during CR (due to the association with lower all-cause mortality), however a greater number of sessions is associated with superior outcomes. Broader international CR guidance recommends 24 to 36 sessions.

8.6 Monitoring and Supervision Requirements (including continuous ECG monitoring with telemetry)

A variety of modalities are employed to monitor patients during CR ET sessions which are outlined below. While ECG monitoring with telemetry is used widely, the number of ET sessions it should be employed for remains a subject of debate. There is also evidence to suggest that ECG monitoring is associated with patient satisfaction,[75] and notably, a national multi-centre study in Ireland demonstrated that patients highly prioritise the role of telemetry during CR ET sessions and may derive significant psychological benefits from same.[76]

8.6.1 A variety of modalities are employed to monitor patients before, during and immediately after ET.[7,8,28,31] These include but are not limited to:

- A focused pre-exercise interview (symptoms, well-being, adherence to medications)
- visual observation for signs of effort intolerance
- ECG/HR monitoring with telemetry
- BP at any stage of ET
- patient rate of perceived exertion (RPE)
- continuous two-way communication between supervising staff and patients.

8.6.2 Group-based ET sessions should take place in a suitably equipped gym.[6,8,12,19,21,27] Patients benefit from access to a range of specialists, however clinicians delivering ET should be able to demonstrate that they have the necessary knowledge, skills and competencies.[6,19,24,32,38] Exercise sessions should be supervised by two CR-HCPs with expertise in the physiological effects of exercise in people with CVD.[6,20] At least one of these clinical personnel must be present in the gym at all times, with two clinical personnel present in the CR unit while ET sessions are ongoing.[6,21]

8.6.3 The continuous on-site presence of a cardiologist during ET sessions is not routinely required. Nevertheless, the cardiologist must remain in close proximity, be readily contactable, and be available to promptly evaluate and manage any complications, as well as to address training-related or clinical queries, including considerations regarding adjustments to pharmacological therapy. In circumstances where a cardiologist is not physically present, suitably qualified health professionals with demonstrated competence in ECG interpretation must always be present on site. Additionally, personnel trained in emergency response must be immediately accessible, with appropriate equipment available for the management of medical emergencies.[6]

8.6.4 Continuous ECG monitoring with telemetry is employed during ET to detect arrhythmias, monitor compliance with the exercise prescription, and increase patient confidence for independent activity.[8] IACR concurs with recent AHA/AACVPR guidance which states that continuous ECG telemetry and BP monitoring add value to CR, especially in high risk or symptomatic patients.[6–8,19–21] However, as exercise is safe in general the number of sessions it should be employed for remains a matter of clinical judgement. A minimum of 3–6 sessions for all patients is recommended[8], with clinical judgement and patient progress ultimately determining the supervision required thereafter (Appendix F)

8.6.5 An appropriate staff-to-patient ratio to ensure safety will need to account for the increasing age and complexity of contemporary CR patients.[8,21] The optimal number of patients per group will be determined by various factors which include but are not limited to the following:

- The number and experience of supervising CR-HCP's.
- The level of patient dependency across the group (*e.g.* greater frailty and decreased baseline mobility necessarily entails a higher level of supervision).
- More intense clinical supervision is required for patients deemed to be at a higher level of risk, who exhibit new or potentially deleterious arrhythmias, or who experience a change in health status.
- The equipment available for exercise classes (*i.e.* both exercise and monitoring equipment).
- The stage of CR (*e.g.* first week versus final week).

An optimal ratio of one exercise specialist for 5–10 low- or intermediate-risk patients/session is suggested. The ratio for high-risk patients should be higher, optimally one CR-HCP to 2–3 patients, according to patient's risk severity.[6]

8.6.6 BP readings should be taken for a sufficient number of sessions to establish that individual patient readings are within target guidelines and that there are no safety issues with respect to BP changes in response to exercise. There are no current recommendations relating to the frequency of BP measurements and for how long they should be maintained.[8] Optimally, this should continue until a safe and appropriate exercise response during ET has been demonstrated.

IACR Recommendation 8.6: Exercise Training – Monitoring and Supervision

A focused assessment should be conducted to evaluate the risk of a cardiac event before starting ET. Pre-exercise session checks include monitoring symptoms, BP, HR, and medication adherence. BP should be measured before and after each exercise session until an appropriate BP response has been demonstrated. Group ET should be delivered in an appropriately equipped dedicated CR gym space, supervised by CR- HCPs with knowledge and expertise of exercise physiology in the setting of CVD. AACVPR (2021)[8] guidance on both staff-patient ratio and ECG telemetry monitoring is endorsed by IACR (Appendix F) with telemetry monitoring recommended for all patients for a minimum of 3-6 exercise sessions.

9.0 Phase 3 CR Exercise Training (ET) Session

9.1 Pre Exercise Training Assessment

9.1.1 A full orientation must be given to a patient (or group of patients) on their first day of CR ET, including but not limited to, instruction on how to exercise and safely use the exercise equipment, and the importance of reporting any symptoms or adverse feelings both prior to and during the ET sessions. Symptoms typically might include angina-like symptoms, light headedness or dizziness, irregular heart rate or palpitations, abrupt weight gain, and shortness of breath. Patients should also be advised not to attend ET sessions (and not to exercise) if they have any signs or symptoms of acute infection. (Appendix G provides an example of an orientation checklist).

9.1.2 On the first day of the ET sessions, the purpose of telemetry monitoring is explained to patients, and instruction is provided on the care of the units. Each patient is provided with a disposable telemetry monitor holder which can be used for the duration of CR and they receive instruction on attaching the telemetry electrode leads.

9.1.3 Patients should be encouraged to report any signs of redness or inflammation at the electrode site. If a reaction occurs the electrode type and position will need to be changed.

9.1.4 BP readings should initially be taken both before and after ET sessions to assess BP control, safety for and response to exercise training.[7,8,19] A reduction in BP after ET is common so a more cautious ET prescription should be employed when pre-ET BP readings are in the lower range of normal until a safe response to ET has been established. Additional BP readings should be taken during ET if indicated (*e.g.* elevated reading pre-exercise; previous abnormal readings with exercise; symptoms during exercise; abnormal ECG findings on telemetry).

9.1.5 ET is contraindicated in all patients with a resting systolic blood pressure (SBP) >200mmHg and/or diastolic blood pressure (DBP) >110mmHg, and ET must stop if BP rises above 250mmHg systolic or 115mmHg diastolic during exercise training.[8]

9.1.6 Patients who have symptoms attributable to either high or low BP should not be allowed to commence ET and should be referred for medical evaluation.[8,19]

9.1.7 Although there is evidence for improved confidence and patient satisfaction with telemetry/heart rate monitoring[75,76], proactive efforts should be made to de-escalate individual heart and BP monitoring when clinically appropriate, to help ensure 'normalisation' of the exercise experience post-CR.[8]

9.1.8 Blood glucose check: Patients with diabetes who are prescribed insulin (particularly rapid acting or intermediate action insulin), or oral agents that increase hypoglycaemia risk (*e.g.* sulfonylureas such as Glicazide) should have a blood glucose check before and after ET.[8] This cohort should also be advised to bring their own glucometer and to perform these checks with any significant physical activity. Like BP monitoring, this measure can be de-escalated if a consistent safe response to ET is established.

9.1.9 As discussed in contraindications to ET (Refer 5.12, 5.13), ET should be avoided with hypoglycaemia (<4mmol/L) or uncontrolled resting blood glucose (>16.6mmol/L or

>13.9mmol/L if ketones are present in urine.[8,77] Point of care ketone testing by finger prick is widely available now in healthcare settings. Patients with a pre-exercise training blood glucose of <5.5mmol/L may need to ingest some added carbohydrate (CHO) prior to ET, depending on whether they can adjust their insulin dose along with the timing, intensity and duration of exercise training.[77]

9.1.10 While patients with diabetes are advised to bring their own carbohydrate snack or glucose source, a glucose-containing beverage (*e.g.* LIFT juice, soft drink, sports drink) should always be available in the CR unit.

9.2 Warm Up

9.2.1 ET commences with a period of low intensity, graduated warm-up exercise which creates sufficient blood flow to ensure the key organs are optimally prepared (metabolically, thermally, neurologically) for the controlled stresses of an effective ET session. Patients should be instructed on the importance of warming -up from both a comfort and a safety perspective.

9.2.2 A 5-10 minute period for both the warm-up and cool-down is recommended.[12,22] The exact time period required for warm-up will be directly related to the patient's baseline fitness and the planned time and intensity of the exercise session, ranging from 5–15 minutes (averaging 10 minutes). Although less common in the revascularisation era, patients with predictable exertional angina in particular, should be educated as to the benefits of a slow, progressive warm-up.

9.2.3 Warm-up should include pulse raising activities that are appropriate in content to the activities being performed in the conditioning phase but commencing at a low level both in the form of resistance and intensity or speed (*i.e*. Start low and slow'). Other forms include graduated walking or light calisthenics. Stretching may be included for flexibility and range of motion benefits, if time allows, but is not an essential warm-up activity as stretching is unlikely to reduce the risk of lower limb injury.[78–80] Appendix I contains AACVPR (2021) guidance on flexibility exercise prescription.[8]

9.3 Cardiorespiratory Endurance Training

9.3.1 Cardiorespiratory endurance training is the foundation of any ET routine for patients with CVD and is the main component of the conditioning phase of the ET session.

9.3.2 There must be continuous monitoring of the patient during ET by at least one CR team member using visual observation for signs of effort intolerance, ECG monitoring, verbal feedback and patient RPE.[7,8,12,21,22]

9.3.3 RPE scales used include the Borg (6–20) and the Modified Borg (0–10) scales respectively[11] (Appendix C). All patients should receive education on the RPE scale on the first day of their exercise programme. Participants are encouraged to mostly exercise at a moderate intensity, equivalent to 'moderate to somewhat hard' *i.e.* 12–14 on the Borg scale (or 3–4 on the modified scale). ET intensity may vary (higher or lower) during a session with patient fatigue a factor as the exercise session progresses.

9.3.4 The FITT-VP model for exercise conditioning is recommended in some CR guidelines and remains a useful formula for a patient's individualised exercise programme.[7,20] Namely, ET is prescribed according to:

- **F**requency (how many sessions per week)
- **I**ntensity (how hard to exercise)
- **T**ime (duration of the exercise training)
- **T**ype (modality of exercise training)
- **V**olume (the total amount or dose of exercise)
- **P**rogression (the rate of increasing the dose of exercise)

9.3.5 **F**requency: there is no consensus in the CR guidelines reviewed regarding the number of supervised CR ET sessions per week. Recommendations range from at least once [28] to four times[8] per week. One national guideline recommends 3-5 times a week.[22] with 2–3 times per week the most commonly recommended frequency.[7,8,12,21,28,29]

9.3.6 **I**ntensity: The ET prescription has been discussed in detail above (section 8.4). In the majority of patients with CVD, the most reliable approach to determining aerobic exercise intensity involves assessing ventilatory threshold 1 (VT1) and ventilatory threshold 2 (VT2) during CPET, particularly by identifying the lowest point in ventilatory equivalents for oxygen (VE/VO_2) and carbon dioxide (VE/VCO_2) relative to work rate.[81] A significant limitation in Ireland is that no CR centre currently has access to CPET. As an alternative, Hansen *et al*.[81] recommend estimating exercise intensity using percentages of peak workload (% Wpeak) or peak heart rate (% HRpeak), along with subjective tools such as the Borg Rating of Perceived Exertion and the 'talk test'. Patients are encouraged, with feedback, to exercise within their HR training range. The relative training intensity may vary between 40% and 80% of maximal HRR, starting at a lower intensity and progressing to a higher intensity as patients adapt.[8,22] As noted previously, it may be necessary to adjust the ET prescription where true maximal exercise data is not available. The rate of progress will be dependent on multiple individual factors including baseline fitness, patient motivation and orthopaedic limitations.

Evidence increasingly shows that high intensity interval training (HIIT) (≥85% VO_2peak, ≥85% HRR, or ≥90% HRpeak with lower-intensity intervals) improves CRF more than moderate-intensity continuous training in patients with CVD. However, a firm recommendation for HIIT is not yet possible due to limited evidence of improved prognosis and uncertain long-term adherence.[7]

9.3.7 **T**ime: The guidelines reviewed recommend that ET sessions should last for a minimum of 20-60 minutes[7,8,12,19,22] ranging up to 45-60 minutes.[7,8,12,19,31] EAPC (2021)[7] recommend a duration of at least 20–30 minutes but preferably 45–60 minutes per session. Warm-up/cool down should not be considered part of the conditioning phase. As elements of the FITT-VP prescription are modified (*e.g.* an increase in exercise training duration), it is prudent to assess the adaptation before progressing further.[7]

9.3.8 **T**ype: Rhythmic, larger muscle group activities should be employed such as walking, cycling, stair climbing, elliptical trainers, and other arm or leg ergometers that allow controlled movement and a consistent intensity of exercise.[7,8] The general goal is to progress to at least 30 minutes of continuous aerobic endurance training. However,

patients with lower fitness or other limitations may follow an intermittent (*i.e.* interval) exercise regimen where the training time is broken into shorter periods, interspersed with active recovery. On the spot rhythmic aerobic exercises may also be used, with the addition of light dumbbells as appropriate.[22]

9.3.9 Providing more variety of aerobic stations can potentially work a greater number of muscles groups thereby promoting something closer to a full body workout. However, there should also be recognition that walking is the predominant exercise modality for most CR patients.[20] The ability to vary speed and inclines (even declines) on treadmill machines ensures that they can be suitably adapted to all mobile participants and therefore should ideally form a significant part of the total time devoted to aerobic endurance training.

9.3.10 **V**olume: Exercise volume is the product of Frequency, Intensity and Time of exercise.[11] As noted above (8.4.1) a higher volume or dose of exercise achieved in CR is associated with improved health outcomes.[74] It is important that the volume of exercise is progressed as individually tolerated by patients during ET sessions, and that patients are also educated to progressively increase their exercise and physical activity outside of their structured CR programme.[7,8,12,21,38] Patients should be advised to use an exercise diary to monitor their overall weekly exercise volume. For further information on volume of aerobic ET to optimise outcomes in CR refer to the official statement from the AACVPR.[82]

9.3.11 **P**rogression: An individual's rate of progression during ET will depend on their health status, baseline physical fitness, response to ET and the agreed goals for the programme.[11] Given the heterogeneity of the CR population, it is important that all components of the ET prescription should be developed specifically for each individual patient.[8,64] In order to maintain ET adherence and prevent complications such as exercise-related injuries, it is recommended to start with low-intensity/shorter-duration exercise and gradually increase.[12] Although baseline fitness in CR participants varies greatly, with a suitable prescription, all should be capable of progressing the elements of frequency, intensity, time and therefore crucially, volume.

9.3.12 While an air-conditioned gym is recommended for CR ET sessions, it is important to remind patients to always adjust their ET levels according to the prevailing environmental conditions.[8,19]

9.4 Resistance (Strength) Training:

Resistance (strength) training (RT) plays an important role in optimising exercise prescription, and muscle strength training combined with aerobic training has greater effects on CRF and body composition than aerobic training alone in patients with CAD.[83,84]

9.4.1 Once the patient has been established on the cardiorespiratory endurance training programme, then RT should be introduced as an additional part of the conditioning phase.[7,8,12,19,21–23,27,28,31,32,38] RT is recommended across all international CR guidelines as an important component of CR.[7,8,12,19,21–23,27,28,31,32,38]

9.4.2 Prescribed and supervised RT enhances muscular strength and endurance, functional capacity, independence, and quality of life.[8,85] Other potential benefits of RT for fitness and health include improved body composition, cardiovascular structure and function, and cardiac risk modification.[8,85] RT can also increase lean body mass, improve insulin sensitivity, prevent falls, improve self-efficacy, and both prevent and manage chronic diseases such as low back pain and obesity.[12]

9.4.3 While RT is a relatively safe activity, it is an unfamiliar exercise for many CR participants, and therefore both group and individualised instruction on technique is essential, along with ongoing supervision.[8,30,38] Although high-intensity RT has been associated with excessive BP elevation, this is less of a concern with low- to moderate-intensity RT.[8]

9.4.4 Key instructions for patients should include starting with a low resistance, good body posture, correct breathing technique and avoidance of the Valsalva manoeuvre.[8] The RT phase should be conducted following the main endurance training phase after a partial cool down.[63] An advantage of this programming is that it is allows time for HR reduction and lowering of the rate pressure product (RPP) (systolic BP x HR) in advance of the RT phase.[63] RPP is a surrogate for myocardial oxygen uptake and ranges from the 10th percentile value of 25000 to a 90th percentile value of 40000 at peak exercise.[86] This reduction is important because a lower HR and RPP at the transition point decreases myocardial oxygen demand, thereby promoting haemodynamic stability and reducing the likelihood of provoking ischaemia or arrhythmias.

9.4.5 An individual's baseline muscular strength will determine the level of resistance at which they should commence RT. A one repetition maximum (1RM) is not recommended for a baseline assessment.[12] A multiple RM (6RM to 15 RM) assessment may be used but in everyday practice, starting with a low resistance and increasing as tolerated is likely the safest and most comfortable method for the patient.[8,12,31]

9.4.6 Special consideration should be given to patients with a history of hypertension or hypotension, recent cardiac surgery, significant left ventricular impairment, peripheral vascular disease, arrhythmia or other concerning symptoms.[7,8,12,19,30,38]

9.4.7 At the time of exercise initiation, it is recommended to start with an intensity of 10–15 repetitions without significant fatigue,[8,12,31] for 1 to 3 sets of repetitions depending on stage of progression. Multi-gym resistance equipment can be used for various exercises including leg extensions, chest press, lateral pulldowns, bicep curls and tricep pushdowns. These resistance stations, with easily adjustable weights, facilitate a controlled increase in load over the programme duration. 'Free' weights/dumbbells can also be used along with other free techniques such as controlled squats or wall presses.[8] RT can also be performed with elastic bands, small weights or other objects, or using the patients' own body weight.[12,22,31]

9.4.8 For further detailed guidance on RT, please refer to AACVPR (2021)[8] guidelines including Patient Selection Criteria for Participation in a Resistance Training Programme (Appendix H).

9.5 Cool Down

9.5.1 The ET session should end with a period of cool down.[12,22,31] There are a variety of systemic changes after a period of exercise including reduced venous return; prolonged exercise-related HR elevation; systemic vasodilation and reduced peripheral resistance; reduced blood plasma volume; reduced coronary circulation. Due to these and other factors, it is generally accepted that there is an increased risk of hypotension, ischaemia and arrhythmias after exercise. Hypotension post-exercise, both symptomatic and asymptomatic, is common and CR-HCPs must be vigilant for these episodes.[8,19]

9.5.2 In a pre-revascularisation era survey of CR programmes, 72% (44/61) of the serious complications (cardiac arrest, MI) reported during ET occurred during the warm-up and cool down/tapering phases of the exercise sessions.[87]

9.5.3 A graded cool-down is likely to reduce the incidence of complications. Cool-down exercise should be the reverse of the warm-up in most respects, aiming to gradually return the cardiorespiratory system to near resting levels within 10 to 15 minutes, with 10 minutes being the minimum suggested by the ACPICR (2023)[63] The duration of the cool-down can be moderated according to the duration of the conditioning component (*i.e.* a shorter/longer cool-down for a shorter/longer conditioning phase).

9.5.4 Exercise effort should be gradually decreased during the cool-down as per the individual's exercise prescription. Stretching can be incorporated into the cool down period if time allows.[63]

9.5.5 Telemetry monitoring in the early sessions of Phase 3 CR ET (ref 8.6) must be continuous and should continue until after the cool-down has been completed. At that point, if heart rhythm and haemodynamic monitoring are stable, the telemetry unit can be removed for cleaning. Patients are advised that all electrodes must be removed.

9.5.6 BP (and blood glucose) must be measured at each session after the cool-down until a safe and appropriate exercise response during exercise training has been demonstrated.[7,8,31]

9.5.7 If the patient has any abnormal signs, measures or symptoms post-ET, they should be advised to remain in the CR unit for observation and medical review if necessary.

9.5.8 Maintain supervision following ET sessions including periodic checks of shower or locker room facilities, until all patients have vacated the facility.[8]

9.5.9 All exercise and monitoring equipment should be cleaned after patient use as per local and national infection prevention and control guidelines.

IACR Recommendation 9.0: Exercise Training

Supervised ET sessions should take place at least twice weekly, for a minimum of one hour in duration. All ET sessions should include minimum warm-up and cool-down periods of 10 minutes respectively, tailored to each patient's clinical status. The conditioning phase of ET (aerobic and resistance) should be a minimum of 40 minutes duration per session and the exercise prescription should be progressed according to individual patient clinical factors and goals. Resistance training should be incorporated into CR as per AACVPR (2021)[8] guidance (Appendix H).

9.6 Enhancing Safety including Criteria for Terminating Exercise Training

9.6.1 There are both cardiac specific and general risks associated with ET and some guidance is offered in the CR guidelines reviewed on when to terminate exercise.[8,12] For example, patients with residual coronary ischaemia may be at higher risk of acute coronary syndrome or ventricular arrhythmias, whereas more general risks associated with ET sessions are slips, trips, falls and fractures.[12] Older patients also often have orthopaedic issues of the lumbar spine or lower limb joints, which can be exacerbated by exercise.

9.6.2 Regarding the cardiac risks, all CR -HCP responsible for direct patient care, during either ET or education sessions, should complete BLS and/or ACLS training along with the periodic re-training required. There should also be ready access to suitable monitoring and resuscitation equipment, including a defibrillator (as well as maintenance of such equipment) and appropriate medications.[8]

9.6.3 An emergency plan for responding to adverse events should be maintained and regular mock emergency practice and critique sessions for all CR - HCP should be provided. Maintaining physician standing orders for potential emergent and non-emergent medical events should also be considered.[8]

9.6.4 Each patient must be screened for any issues before each ET session. This can be a brief assessment while doing screening observations (*e.g.* HR, rhythm, BP).[7,8] Patients should be educated to always report any signs and symptoms of active infection and to not exercise if these are present. Refer to 8.6.1 for monitoring during ET sessions.

9.6.5 The criteria for terminating ET should be considered according to absolute and relative criteria based on the patient's condition, comorbidities, and medications. The Japanese Circulation Society/ Japanese Association of Cardiac Rehabilitation CR Guidelines (2022) provide helpful guidance in this regard and are outlined in Table 1.[12]

9.6.6 ET should be terminated immediately not only when the patient fails to perceive or acknowledge potentially hazardous symptoms during exercise (e.g. when they do not respond sufficiently to verbal prompts during exercise), but also when medical personnel, for any reason, are unable to objectively determine whether a dangerous situation is present.[12]

9.6.7 Policies and procedures should be developed to address the delivery of emergency cardiac care when providing CR in alternative settings (*e.g*. home or community settings). These are subject to oversight by the CR Director and CR Coordinator.[8,19,21]

IACR Recommendation 9.6 : Enhancing Safety Including Criteria for Terminating Exercise Training

Each CR programme must develop and implement site-specific emergency protocols. Patient safety is enhanced by pre-exercise screening, qualified competent supervision, and timely access to emergency equipment. ET termination criteria should follow JSC/JACR (2022)[12] guidelines.

Criteria for Terminating Exercise Training (JCS/JACR, 2022) [12]
Absolute Termination Criteria
Patient wishes to terminate exercise
Patient is expected to be unable to detect dangerous symptoms during exercise, or patient has deteriorating consciousness
Incidence of cardiac arrest, severe bradycardia, fatal arrhythmia (ventricular tachycardia, ventricular fibrillation), or where these cannot be ruled out
Sudden deterioration of vital signs or appearance of perceived symptoms (severe chest/abdominal/back pain, epileptic seizure, loss of consciousness, hypotension, severe joint/muscle pain)
On ECG, ST-segment elevation ≥1mm in the induction without Q wave (other than AVr, V1 induction)
Accidents (falls, trauma, equipment failure)
Relative Termination Criteria
Worsening of perceived chest symptoms or other symptoms (e.g. hypoglycaemic attack, arrhythmia, dizziness, headache, leg pain, severe fatigue, poor mood, joint or muscle pain) at the same intensity or with a decrease in exercise intensity
Transcutaneous arterial oxygen saturation drops to less than 90%, or decrease of 5% or more from rest
New arrhythmia or ST depression ≥1 mm on ECG
BP decreased (SBP <80mmHg) or increased (SBP ≥250 mmHg, DBP ≥115mmHg)
Appearance of bradycardia (HR ≤ 40 bpm)
If patient is judged to be unable to follow instructions during exercise, or it is difficult to continue exercise training due to the risk of falling.

Table 1 Criteria for Terminating Exercise Training

BP, blood pressure; SBP, systolic blood pressure; DBP, diastolic blood pressure; HR, heart rate; bpm, beats per minute

10.0 Education, Health Behaviour Change and Risk Factor Management

Comprehensive CVD education and risk factor management including health factors (*e.g.* blood pressure, lipid levels, diabetes, weight) and health behaviours (*e.g.* physical activity, diet, sleep, avoidance or cessation of unhealthy behaviour [*e.g.* vaping, smoking, marijuana, cocaine, opioids]) are the cornerstone of a multidisciplinary CR programme.[6–8,20,23–25,28–32,38] Moreover, most patients attending CR report unmet informational needs, albeit these informational priorities differ for each patient.[88] Tailored education is thus recommended for all patients attending CR.[6–8,12,20–25,27–32,38] The use of online platforms and technologies can be particularly useful in extending the reach of the CR education component to those who find it challenging to attend the in-person sessions.[89,90] Virtual education may be delivered through live online instruction, pre-recorded videos, or other digital materials, ideally followed by structured discussion. Reliance solely on videos or written resources without subsequent interaction with a CR-HCP constitutes a minimal approach to patient education, as methods such as direct instruction, successive relearning, and teach-back are demonstrably more effective.[89] Wearable technologies can also be useful both as a motivational tool and to more objectively assess progress.

10.1 Educational Interventions / Formal Education Sessions

10.1.1 Key aims of the CR educational component are to increase knowledge and to optimise patients' perception of control over their condition through improved understanding of risk factor modification.[8,38]

10.1.2 Educational interventions should be theoretically underpinned, evidence-based and delivered by appropriately trained staff. By increasing self-efficacy, restoring confidence, improving health behaviours and reducing distress, patient education empowers patients to self-manage their condition effectively.[91,92]

10.1.3 For patients to be sufficiently motivated to engage in behavioural change, it is important that they have a clear understanding of their cardiac condition. Education and information provision require careful communication in order to empower patients to manage their own disease.[6–8,12,19,24,27–29,31,32,38]

10.1.4 Group education sessions targeting various aspects of heart disease must be allocated formal time in the CR programme timetable.[6,29,38] Clear information in plain language should be used, according to the characteristics and literacy of the patient.[6,24]

10.1.5 Education should be patient-centred to facilitate shared decision-making towards the achievement of personal rehabilitation goals. CR-HCPs should ascertain existing levels of knowledge and health literacy to determine the type of communication needed, and tailor information effectively to suit both individuals and groups during CR.[7,8,12,24,28,29,31,38] Education should also be adapted to meet the specific needs of the patient in the context of their family, and account for factors such as age, culture and lifestyle.[8,24,28,29,31]

10.1.6 CR education (individual and group) should be delivered discursively, with regular contact between staff and patients allowing opportunities for content to be expanded upon or reinforced such as during CR exercise sessions.[24,93] Family members and caregivers should be included when possible.[8,24,31,32]

10.1.7 Educational content provided during CR may include:[7,8,12,19,21,23,24,27–29,31,32,38]

- Anatomy/ physiology of the heart, treatments and symptom management.
- Risk factor modification for secondary prevention (including vaccination[94] and oral hygiene)[95]
- Physical activity counselling (*e.g.* strategies to increase self-directed physical activity and reduce sedentary behaviour).
- Tobacco cessation and relapse prevention.
- Nutritional counselling (including alcohol intake assessment and weight management)
- Diabetes Management (*e.g.* diabetes knowledge and strategies to improve glycaemic control).
- Medication education (pharmacist): including strategies to optimise medication adherence.
- Psychosocial and Stress Management.
- Maintaining lifestyle changes post-CR.
- Sexual activity and cardiovascular health.
- Returning to work, driving and transportation.

10.1.8 Education sessions should be conducted by the appropriate member of the MDT (*i.e.* nurse, physiotherapist, dietician, pharmacist, psychologist) but this is dependent on resourcing. Where the appropriate MDT member is not available, a CR-HCP, with sufficient training and knowledge, may deliver various group education sessions with reference to their scope of practice.[8,23,24,28,31]

10.1.9 The Information Needs in Cardiac Rehabilitation short version (INCR-S) is the only available validated and current scale to assess the informational needs of patients with heart disease[96] and may be used to inform educational interventions in CR.

IACR Recommendation 10.1: Educational Interventions

Educational interventions during CR are required to support effective patient self-management. These person-centred interventions should be evidence-based and adapted to the individual characteristics of each patient (*e.g.* health status and health literacy). Family members and caregivers should be included when possible.

10.2 Lifestyle and Behaviour Modification

Lifestyle modification is effective for cardiovascular risk reduction and represents an essential aspect of CR programming.[97–99]

10.2.1 While the patient's baseline CR assessment allows time for discussion of risk factors, individual planning, goal-setting and ongoing individual counselling, interventions that target lifestyle modification should continue throughout CR.[8,24] Time should be allocated formally or informally to behavioural counselling outside of the group setting as necessary.

10.2.2 CR-HCPs should have training in health behaviour change counselling skills[8] such as motivational interviewing and MECC (Make Every Contact Count).[93] To support lifestyle modification, CR programmes should:

- Address behaviours and issues, during Phase 1 CR (inpatient period) that may hinder CR attendance (*e.g*. smoking, depression, lack of social/financial support).[8]
- Employ lifestyle interventions and key behaviour change techniques (BCTs) which are underpinned by an up-to-date psychological evidence-base[7,8,24,27,32]. Such BCTs may include:
  - Eliciting patients' understanding of their condition and optimising their perception of control.[24,100,101]
  - Interventions to improve self-efficacy.
  - Psychoeducation (goal-setting, self-monitoring) to facilitate adherence to physical activity.
  - Developing action plans for risk factor modification.
  - Providing resources for objective measurement of progress toward goals (*e.g.* logs, pedometers).[7,8,24]

10.2.3 Goal-setting should be done collaboratively with the patient, and their family member as appropriate.[24] Where possible, patients should have choice in what supports they will access to facilitate health behaviour change (*i.e.* hospital-based / home-based / hybrid CR model).[24] Technology-based interventions (*i.e.* telephone counselling, and use of consumer-based wearable activity trackers) should be considered to increase physical activity participation.[7,8,32,89,90]

10.2.4 While there is no single definitive tool for lifestyle modification, a range of interventions have been shown to improve health behaviour changes and may be employed as required during CR.[8] For example, many of the CVD risk factors discussed in more depth below may be modified by relatively simple changes in dietary intake and physical activity.

IACR Recommendation 10.2: Lifestyle Modification

Lifestyle modification interventions should continue throughout CR and should be delivered by CR-HCPs with training in evidence-based behaviour change techniques (BCTs). Technology-based interventions should also be considered.

10.3 Nutritional Counselling

Dietary modification is an essential component of secondary prevention of cardiovascular disease and patients consistently prioritise the nutritional counselling component of CR programming.[96,102,103] CR Coordinators similarly prioritise nutritional care,[104] and there is evidence to suggest that patients who receive nutritional counselling during CR have better outcomes than those who do not.[105]

All members of the MDT have a vital role in supporting patients to make and maintain changes in their eating habits, and should liaise together effectively[52] For example, patient motivation is a determining factor in achieving nutritional goals, and specific psychological interventions may be effective for dietary modification in patients with CVD.[106] However, only a qualified dietitian can provide individualised medical nutrition therapy to CR patients with complex co-morbidities (*e.g.* frailty, sarcopenia, cachexia).[6,7]

As other CR-HCPs may have more opportunities to support nutrition-related behaviour change than a dietitian, additional training to support the delivery of optimised dietary interventions may be beneficial.[104]

10.3.1 A registered dietitian forming part of the MDT in CR is a necessity.[8,12,22,23]

10.3.2 Nutritional care in CR includes assessment, identification of relevant target eating habits and behaviours (*e.g.* alcohol intake), goal-setting, nutrition education, evaluation, goal modification, and re-evaluation until discharge.[7,8,12,22–24,28,29,31,32]

10.3.4 Assessment should also include analysis of daily caloric intake and dietary content of fat, saturated fat, sodium and other nutrients.[7,8,12,22–24,28,29,31,32]

10.3.5 The focus of dietary education should be on supporting healthy dietary choices to reduce total CVD risk and improve body composition. This can be provided using various modalities, whether individually or in groups, in-person or remotely.[8,20,22–24,32,38]

10.3.6 CR-HCPs should adopt a flexible dietary approach focusing on dietary patterns rather than specific diet plans or specific nutrients.[8,23,24,28,31]

10.3.7 Advice should be tailored to the individual reflecting their culture, needs, capabilities and co-morbidities,[7,8,12,24,28,29,31,32,52] coupled with practical support to help the patient achieve and adhere to a prescribed dietary pattern. Family members should also be included in nutritional interventions where possible.[7,29]

10.3.8 Effective BCTs should be employed by the CR-HCP as appropriate.[7,8]

10.3.9 Both AACVPR (2021)[8] and EAPC (2021)[7] guidelines provide specific detail on the recommended nutritional targets and goals. For further information refer to Appendix J. Additionally, for dietary guidance for CR participants with specific medical conditions (including heart failure, stroke, cardiac surgery, cardiac transplant, peripheral artery disease) please refer to EAPC (2021)[7]guidelines.

IACR Recommendation 10.3: Nutritional Counselling

Every CR participant should have access to a registered dietitian who can complete a nutritional assessment followed by education and nutritional counselling specific to that patient's needs.

10.4 Management of Weight and Body Composition

Obesity is an independent risk factor for the development and progression of CVD,[107,108] and approximately 80% of individuals attending CR are overweight or obese.[109] Although body fat to lean mass ratio (*i.e.* body composition) is associated with CVD risk more closely than weight or body mass index,[20] standard CR programmes have limited effects in reducing weight or improving body composition.[108,110,111] Highly focused and effective weight loss strategies within CR are needed to produce these improvements,[108,112,113] which are dependent on provider competency and programme resources.[111]

Despite the complexity of obesity management, CR is an ideal time to capitalise on a patient's motivation for health behaviour change, where a lifelong approach to cardiovascular health should be promoted, encouraging regular physical activity (with both aerobic and resistance training) and a healthy BMI.[24] The full range of behavioural, medication and/or surgical interventions should be considered for the long-term management of obesity,[38,107,114] and the expertise of the CR MDT can be leveraged to provide targeted weight management support. For example, for overweight/obese individuals attending CR, behavioural weight loss classes and setting a weight goal leads to more weight loss than goal-setting alone.[115] Furthermore, CR participants with obesity have poorer psychological health at baseline coupled with smaller improvements and thus may benefit from more intensive support during CR, with attention paid to reducing weight bias and stigma.[111,116–118]

10.4.1 All patients should have a baseline assessment of their dietary habits, including adherence to a cardioprotective diet and measurement of their weight, BMI and waist circumference.[7,8,12,19,21–24,27–32,38] Waist circumference should be measured as per NICE recommendations[24] (Appendix D). Baseline CR assessment should identify underweight, overweight, obesity and central adiposity, and patients should be advised to monitor their BMI and abdominal circumference periodically.[8,23,24,27–29,31,32,38]

10.4.2 Weight management interventions in CR should be targeted to patients whose weight and body composition place them at increased risk for, or exacerbation of, cardiometabolic disease, including CHD, diabetes mellitus, hypertension, and dyslipidaemia.[8,28,31,32,38]

10.4.3 BMI categories used to classify underweight, healthy weight, overweight and obesity must be specific for different ethnicities.[24]

10.4.4 Dietary advice should be personally tailored, and should reflect the individual's culture, needs, capabilities and co-morbidities, coupled with support to help them achieve and adhere to a prescribed dietary pattern.[24,28,29,31,38]

10.4.5 Weight maintenance may also be an important goal to support, particularly in patients who have recently stopped smoking, as this is associated with weight gain.[110] Accordingly, CR audit outcomes should be adjusted for patients who quit smoking concurrent with starting CR.[7,24]

10.4.6 Lifelong regular physical activity is a key aspect in maintaining a healthy BMI throughout the life course, and an exercise prescription specifically targeting weight loss during CR should also be considered.[7,24,31,38,108]

10.4.7 Collaboration with a hospital-based weight loss programme with a psychologist with expertise in weight management may be necessary.[7]

10.4.8 In those patients who are at risk of malnutrition or malnourished (as determined through Malnutrition Universal Screening Tool - MUST) nutrition support should be provided by a registered dietitian and should be prioritised over making cardioprotective diet changes.[24]

10.4.9 Where the MDT is unable to provide the required level of dietary and/or psychological support for patients with severe obesity it may be appropriate to refer to specialist services.[24,25,32]

IACR Recommendation 10.4: Management of Weight and Body Composition

All patients require assessment of BMI and waist measurement (*i.e.* abdominal circumference) at CR entry and exit. Behavioural interventions should be delivered, monitored and reviewed during CR. In patients with severe obesity (and/or refractory to lifestyle changes) a referral to an obesity specialist should be considered.

10.5 Alcohol Consumption Counselling

Excessive alcohol use is a risk factor for most cardiac diseases due to its known cardiotoxic effects, particularly in large doses.[119] One in five hospitalised patients with CVD report unhealthy drinking, and a significant number report intentionally increasing alcohol intake due to its perceived health benefits.[120,121] Moreover, binge drinking in the year following an ACS, even less than once per month, is associated with worse clinical outcomes.[122] There is also evidence to suggest that consuming more than 7 units per week is associated with worsening pre-heart failure or progression to symptomatic heart failure.[123] In addition to cardiovascular issues, the alcohol attributable deaths from cancer, road injuries, self-harm, and other causes, have led to the conclusion that for optimal health outcomes it is recommended to avoid alcohol consumption.[124]

10.5.1 All patients should be assessed for alcohol consumption.[7,8,27,28] Patients are encouraged to give accurate information and assured that responses will remain confidential.

10.5.2 Current Irish guidance on alcohol consumption is as follows:[125]
- <17 units per week (170g Alcohol) for males.

- <11 units per week (110g Alcohol) for females.
- 2-3 alcohol free days per week.
- Avoid consumption of more than 6 standard drinks (units) on any one occasion.

Less than the upper limit of alcohol consumption is advised for patients with hypertension,[13] and for triglyceride reduction.[57]

10.5.3 Alcohol abstinence is recommended in cases of alcohol induced cardiomyopathy[126] and severe hypertriglyceridaemia.[57]

10.5.4 Screening and brief intervention tools such as CAGE may be considered.[8]

10.5.5 Brief advice/counselling should be offered to encourage reduction of excessive alcohol intake by patients,[7,12,28] with sustained support offered through CR using the MECC framework.[93]

10.5.6 Referrals should be made to specialised services (*e.g.* alcohol liaison nurse) where indicated with notification to the GP.[28]

IACR Recommendation 10.5: Alcohol Consumption Counselling

All patients should be screened for alcohol intake with findings documented. Brief tailored interventions should be delivered to encourage reduction of excessive alcohol consumption with referral to specialised services if required.

10.6 Tobacco Cessation Support

Smoking remains a primary modifiable risk factor for CVD and appears to accelerate the aging of the cardiovascular system, creating unhealthy states that are typically observed only in those of higher chronological age.[109,127] Use of e-cigarettes is also associated with an increased risk of MI.[128] In Ireland, 36% of MI patients are smokers at the time of their heart attack (twice the national smoking rate), and present on average eleven years younger than patients who have never smoked.[129]

Conversely, smoking cessation is associated with a decreased risk of secondary CVD events (regardless of post-cessation weight gain) and improvements in quality of life.[130–132] CR has also been shown to be effective in improving smoking cessation.[133,134] However, smokers are less likely to attend CR[109] and due to their greater psychosocial burden may require intensified support to increase their chances of quitting[109,135,136] Smoking cessation strategies, such as brief interventions by CR-HCPs, individual or group counselling, personalised written material, and pharmacological therapy (nicotine replacement therapy, bupropion, and varenicline) are proven to be effective.[131,137]

10.6.1 Smoking is a critical risk factor to address, and CR-HCPs should screen for usage of electronic cigarettes and other nicotine containing products as well as tobacco use. [7,8,12,19,21–24,27–29,31,32,38]

10.6.2 All patients identified as active or recent (within 30 days of enrolment) tobacco users at CR enrolment should receive a brief intervention.[7,8,12,21,23,24,27–29,31,32] A structured approach such as "Ask," "Advise" and "Act/Arrange," is recommended.[7,28,138]

10.6.3 For those currently not ready to quit tobacco, consistent education should be provided with the aim of moving the patient from the pre-contemplation to contemplation or preparation stage of change.[8]

10.6.4 Assess for psychosocial risk factors (PRFs) that may impede successful quitting.[7]

10.6.5 Sustained support should be offered throughout the course of CR using the Making Every Contact Count (MECC) Framework.[93]

10.6.6 Smoking cessation strategies provided should include individual or group counselling, personalised written material, behavioural support, telephone contact and all forms of NRT.[6,7,23,24,28–30,32,38]

10.6.7 Referral to specialist smoking cessation services (*e.g.* HSE Tobacco Cessation Support Programme) should be considered where necessary and appropriate.[7,21,24,28,29,32]

10.6.8 All current smokers attending CR should be offered tobacco cessation pharmacotherapy (*e.g.* varenicline, bupropion) and should be referred to a physician or registered nurse prescriber for same. This can also be helpful for patients unready to quit but willing to reduce smoking.[7,8,22,23,28,29,31]

10.6.9 Smoking cessation interventions should include contact for more than 4 weeks.[23,27,32]

10.6.10 Patients attempting to quit tobacco should be helped to maintain weight during CR, as they are more likely to gain 3-5kg over the initial 3-12 months.[7]

10.6.11 Offer assistance to avoid passive smoking which may be aided by carbon monoxide (CO) monitoring.[7]

IACR Recommendation 10.6: Tobacco Cessation Support

All CR-HCPs should assess and document individuals' smoking behaviour. A brief personalised intervention is offered together with multi-modal support. This discussion/outcome should be documented, with referral to specialist smoking cessation services if required and when agreed.

10.7 Physical Activity (PA) Counselling

'Physical activity' (PA) is defined as bodily movement which requires energy expenditure. Exercise is a subcategory of PA.[55] There is extensive evidence to suggest that physical inactivity is a primary risk factor for CVD.[139–141] Physical inactivity leads to a higher incidence of CVD and is also associated with higher mortality, rates of reinfarction, stroke,[142] and other cardiovascular conditions.[143–145] The relationship between CVD risk and levels of PA is inverse, graded and modifiable.[145,146] Thus, increasing PA and CRF, in addition to reducing sedentary time are important CR goals.[7,8,12,19–21,24,27,28,31,32,38]

While PA is the behaviour that most impacts CRF, increased PA may not lead to improved CRF in all individuals. Patients overestimate PA levels during CR[147] and psychological factors such as exercise anxiety and/or kinesiophobia are also highly prevalent in cardiac patients which may impede engagement with CR.[148] It is critically important that CR-HCPs are effective in supporting patients to increase PA levels and remain physically active after CR,[149] and this may be aided using behaviour change techniques (BCTs) and technology where appropriate.[150]

10.7.1 A detailed evaluation of PA including volume, intensity, type, sedentary time, preferences, goals, and occupational/recreational needs should be conducted during the initial CR assessment.[7,8,19,21,23,24,27,28,31,32,38]

10.7.2 Self-report assessment tools that may be useful include the long format international physical activity questionnaire or IPAQ.[8,151] However, no physical activity questionnaires have been validated in the CR setting.[8,152] Alternatively, data from patients' own wearable activity monitors may be considered (*e.g.* pedometers, accelerometers), however the device needs to be worn correctly for 12 hours a day over 4 days to obtain the minimum data required to accurately determine PA.[8]

10.7.3 Patients should be educated regarding strategies to increase general PA and reduce sedentary behaviour.[7,8,21–24,27,28,31,32]

10.7.4 Explore the patient's capability, opportunities and motivation for behaviour change regarding increasing levels of PA.[7] Psychoeducation (*e.g.* goal-setting, self-monitoring) should be considered for CR patients to facilitate adherence to PA,[7,8,23,32] as well as strategies for relapse prevention.[7,24]

10.7.5 Patients should be supported in setting achievable personal goals, overcoming potential barriers to increasing PA and maintaining these benefits.[7]

10.7.6 A prescription for PA should be tailored to meet the individual's needs, preferences and goals identified during the CR assessment. Consideration should also be given to clinical status, preexisting conditions (*e.g.* musculoskeletal) and comorbidities, with appropriate modifications made to PA recommendations.[7,8,12,19,21,23,24,27–32,38] The personalised plan should include activities of daily living, physical activity, and structured exercise to reduce sedentary behaviour, increase energy expenditure, and improve CRF.[24]

10.7.7 Generally, the training volume to be recommended is a <u>minimum</u> of 150 minutes aerobic exercise of moderate intensity or 75 minutes a week of vigorous intensity accumulated

over the week.[7,19,20,23] This may be increased to 300 minutes depending on tolerance, adaptation, preference and clinical status.[7,8,20,23,55]

10.7.8 Where a patient is unable to engage in walking or cycling-based activities CR-HCP should support them (and carers) to facilitate alternatives such as chair-based exercise, wheelchair ambulation or other non-weight bearing options such as aqua aerobics or moderate intensity floor-based calisthenics.[7]

10.7.9 Individuals should also be encouraged to find some activity that they enjoy and/or can be incorporated into their daily routines,[7] to minimise sedentary time by active travelling (cycling or walking), taking breaks from extended periods of sitting, and reducing screen time.[7,8]

10.7.10 Patients should receive guidance to cope with adverse effects (*e.g.* excessive shortness of breath)[7].

10.7.11 For patients with CVD wishing to return to recreational sports activities, there is an acknowledgement of the need to strike a balance between the extensive benefits of exercise, a small risk of sudden death, and the patient's goals for fitness and ongoing participation in relatively strenuous exercise[153] According to ESC guidelines on Sports Cardiology and Exercise in patients with CVD, a planned return to sporting activity should be a collaborative process, but one grounded in careful individual evaluation including echocardiogram, CPET/12-lead ECG exercise stress testing and full participation/monitoring in a structured outpatient CR exercise training programme.[153] The rate of progression will be dependent on the individual risk profile, *i.e*. residual ischaemia versus fully revascularised, history of arrhythmia, and left ventricular function.

IACR Recommendation 10.7: Physical Activity Counselling

Both PA levels and sedentary behaviour should be evaluated in CR. Tailored education and behavioural support should be provided to increase PA and reduce sedentary time. Patients should be advised to exercise for a minimum of 150 minutes per week (and up to 300 minutes) depending on the individual profile, and modified to comorbidities (*e.g.* frailty, clinical status). Return to recreational sporting activities should be a collaborative process involving careful individual evaluation including echocardiogram, EST and full participation/monitoring during CR.

Medical Risk Factors

10.8 Blood Pressure Management

A core component of CR focuses on evaluation, intervention and monitoring of BP, and achievement of BP targets by CR programme discharge is a key outcome recommended across international guidelines.[7,8,12,19,21–24,27–29,31,32,38]

A cornerstone of hypertension management is lifestyle change (*e.g.* diet, exercise, smoking cessation, stress management) which is emphasised in CR.[13,154,155]

CR is shown to be highly effective in the control of BP[154,156] and provides an opportunity to identify and appropriately care for patients with apparent treatment resistant hypertension.[157]

10.8.1 It is recommended that all patients have BP assessed using high quality measurement techniques at the initial CR assessment.[8] However, obtaining an accurate BP measurement in the hospital or 'office' environment can be challenging. Initial elevated readings should be confirmed on at least two subsequent visits over a period of 1 to 2 weeks (unless systolic BP is >180 mm Hg or diastolic BP is >110 mm Hg which requires more urgent action). Other methods of measuring BP include home BP monitoring or a 24-hour ambulatory blood pressure monitor (ABPM).[8,13,24,25]

10.8.2 It is recommended that CR-HCPs review the 2024 ESC guidelines for the management of elevated blood pressure and hypertension for the full comparison of methods and BP ranges.[13] To maintain monitor accuracy, it is important that a regular servicing and calibration regime for all BP monitors is maintained through local Biomedical departments.

10.8.3 BP measurement with atrial fibrillation (AF): automatic devices are not validated for BP measurement in patients with AF and will record the highest individual systolic pressure wave form rather than an average of several cardiac cycles. This will lead to overestimation of BP. Manual BP measurement is recommended.[13]

10.8.4 While ESC (2024) guidelines still define hypertension as a systolic office BP > 140mmHg or an office diastolic BP of >90mmHg, a new BP category called 'Elevated BP' has been introduced.[12] Elevated BP is defined as an office systolic BP of 120–139 mmHg or diastolic BP of 70–89 mm.[12] **For patients with CVD and a confirmed baseline BP of ≥130/80, the recommendation is to treat with BP-lowering therapy, with a recommended treatment target BP of 120–129/70–79 mmHg, provided treatment is tolerated.**[13] More lenient BP targets may be considered in persons with symptomatic orthostatic hypotension, those aged 85 years or over, or those with moderate-to-severe frailty, or limited life expectancy.[13]

10.8.5 Lifestyle advice provided in CR for BP management should include salt restriction, moderation of alcohol consumption, tobacco cessation, high consumption of vegetables and fruits, weight reduction and/or maintaining an ideal body weight, and regular physical activity.[7,8,12,13,21,23,24,27–29,31,32,38]

10.8.6 Patients with a resting BP higher than 160/100 mmHg or with target organ damage (*e.g.* left ventricular hypertrophy, retinopathy, nephropathy) are advised to optimise anti-hypertensive therapy for better BP control before starting or resuming ET, or to reduce training intensity until better BP control is achieved.[19] Patients with hypertension should be referred for medical evaluation and further management/ medication optimisation as per ESC guidelines.[13]

IACR Recommendation 10.8: Blood Pressure Management

BP should be assessed and managed in accordance with ESC (2024) guidelines.[13] Patients with CVD and a confirmed baseline BP of ≥130/80, should be considered for BP-lowering therapy, with a treatment target BP of 120–129/70–79 mmHg, provided treatment is tolerated. For individuals with frailty, advanced age, or other clinical vulnerabilities, more lenient BP targets may be appropriate, balancing the potential benefits of therapy with safety and tolerability.

10.9 Lipid Management

A minority of secondary prevention patients in Ireland achieve LDL-C targets in standard care, however there is evidence that they may be more likely to do so while enrolled in CR.[158,159] CR participation is shown to be effective with respect to improving lipid levels.[160,161]

10.9.1 A high-intensity statin should be prescribed, as tolerated, for all patients with established atherosclerotic cardiovascular disease (ASCVD). [7,14]

10.9.2 For treatment-naïve patients hospitalised with acute coronary syndrome (ACS) who are unlikely to meet LDL-C goals on statin therapy alone, initiating combination therapy with a high-intensity statin and ezetimibe during the index admission should be considered.[162]

10.9.3 For secondary prevention in very-high-risk patients, an LDL-C reduction of ≥50% from baseline and an LDL-C goal of <1.4 mmol/L are recommended.[7,14]

10.9.4 For patients with ASCVD who experience a second vascular event within 2 years (not necessarily of the same type as the first event) while taking maximally tolerated statin therapy, an LDL-C goal of <1.0 mmol/L may be considered.[14,15]

10.9.5 There is no goal for triglycerides, but <1.7 mmol/L indicates lower risk and higher levels indicate a need to look for other risk factors.[7]

10.9.6 Blood tests should be conducted early in phase 3 CR and if necessary, repeated later in the programme (see 8.1.11 for details). If there are recent blood results available, generally post discharge from hospital, that reflect the new or current medication prescription, it may not be necessary to do baseline blood tests.[7,8,26,31]

10.9.7 Fasting is not routinely required for determination of a lipid profile[7,57,163] however there remains a role for fasting profiles as a comparator, particularly where triglycerides are significantly elevated on a non-fasting profile. If the lipid profile, and LDL-C in particular, is not at target or a lipid lowering medication adjustment has been made in the interim, blood tests should be repeated within the appropriate timeframe.

10.9.8 Education regarding a lipid lowering diet, the importance of exercise, in addition to the rationale and evidence for statin therapy to promote medication adherence, should be delivered during the CR programme.[7,8,20,22,24,28]

10.9.9 For patients who are unable to tolerate statin therapy, or who do not achieve their LDL-C target during the course of CR management, further intensification and optimisation of lipid-lowering therapy is indicated.[57,162] This may necessitate the addition of non-statin agents, such as a PCSK9 mAbs or bempedoic acid, either as monotherapy or in combination with the maximally tolerated statin dose.[57,162] In Ireland, reimbursement for agents such as PCSK9 mAbs and bempedoic acid is governed by a Managed Access Protocol (MAP), which specifies the eligibility criteria that must be met to receive reimbursement support.

IACR Recommendation 10.9: Lipid Management

Lipid modification to reduce cardiovascular risk and management of dyslipidaemia should be in accordance with ESC guidelines.[57,162] Patients with established ASCVD should be prescribed high-intensity statins as tolerated, with a target LDL-C reduction of ≥50% from baseline and an LDL-C goal of <1.4 mmol/L.[57,162] Non-statin therapies with proven cardiovascular benefit — used alone or in combination — are recommended for patients who cannot take statins or who do not reach their LDL-C target despite being on the maximally tolerated statin dose.[162]

10.10 Diabetes

10.10.1 Guidelines recommend systematic screening for diabetes in all patients with CVD.[7,8,12,19,24,28,31,32,38] All patients referred to CR should be screened for diabetes using glycated haemoglobin (HbA1c).[7,12,22,24,28] Those in the pre-diabetes (43-47 mmol/mol), or diabetes range (two HbA1c measures ≥ 48 mmol/mol, at intervals) should be referred to the referring consultant/GP. Lifestyle advice regarding weight management, physical activity, nutrition, blood glucose monitoring / management and self-management should be delivered during CR.[7,8,12,19,24,28,31,32,38]

10.10.2 According to ESC guidelines on the management of CVD in the presence of diabetes, glucose control in individuals with diabetes at high CV risk is a complex area and current evidence indicates the need to address multiple glycaemic measures, including personalising HbA1c targets, minimising hypoglycaemic exposure, and limiting glucose variability.[14]

10.10.3 The general goal for HbA1c with a diagnosis of diabetes, in the presence of CVD, is <53mmol/mol but hypoglycaemia should be avoided. This goal will vary depending on a range of factors including medication regime and tolerance, duration of diabetes, co-morbidities, age/life expectancy, known complications, hypoglycaemia awareness and individual considerations. According to the ESC, it is a class 1A recommendation to apply tight glycaemic control (HbA1c <53mmol/mol) to reduce microvascular complications but hypoglycaemia should be avoided.[14] In patients with type 2 diabetes (T2DM), with long diabetes duration, co-morbidities or short life expectancy, the HbA1c target should be relaxed to <69mmol/mol. Priority should also be given to agents with proven cardiovascular benefit and low hypoglycaemic risk.

10.10.4 In patients with obesity and T2DM, reducing weight is a cornerstone of treatment, with weight loss of >5% improving glycaemic control, lipid levels, and BP in overweight and obese adults with T2D.[14]

10.10.5 In general, patients with T2DM should follow nutritional recommendations that reduce body weight and improve metabolic control and outcomes. A Mediterranean-style eating pattern improves glycaemic control, lipids, and BP and is associated with greater benefit than a low-fat diet in patients with CVD.[164,165]

10.10.6 For people with diabetes receiving BP-lowering medications it is recommended to target SBP to 130 mmHg and <130 mmHg if tolerated, but not <120 mmHg. In older people (aged ≥65 years), a target SBP range of 130–139 mmHg is recommended.[13]

10.10.7 Home BP self-monitoring and 24-hour ambulatory blood pressure monitoring should be considered to assess BP and identify masked hypertension.[13]

IACR Recommendation 10.10: Diabetes

All CR patients should be screened for diabetes using HbA1c and referred onward for clinical management if pre-diabetes or diabetes is diagnosed. During CR patients with diabetes should receive patient-centred care to improve diabetes knowledge, glycaemic control and disease self-management. Management of blood glucose, BP and lipids are adapted according to ESC guidelines for the management of CVD in patients with diabetes.[14]

10.11 Medication Management

CR represents an ideal setting to ensure the effective management of guideline-directed medical therapy (GDMT), and CR participation has been shown to improve medication adherence.[166] Clinical pharmacist intervention is also strongly linked with improved cardiac outcomes through drug optimisation, avoidance of adverse events, medication reconciliation and patient education.[167] The majority of CR programmes in Ireland actively manage medicines during CR.[168]

Medication Reconciliation

10.11.1 The initial individual CR assessment should include documentation of current medication use.[7,8,24,28,29,31] Accurate and reliable medication reconciliation is required (*i.e.,* comparing what medicines the patient is currently taking to those prescribed), including supplements and over the counter (OTC) products. Any discrepancy should be investigated and clarified with the referring consultant, GP and community pharmacist**.**

10.11.2 Both primary-care and secondary-care providers should be advised of any interventions made.[24]

Medication Optimisation:

10.11.3 CR-HCPs (including a pharmacist, if possible) should ensure CR participants are receiving optimal cardioprotective medications.[7,8,12,22,24,28–31]

10.11.4 Cardioprotective medications should be prescribed in accordance with available guidance and up-titrated during CR to ensure that evidence-based dosages are achieved.[8,24,30]

10.11.5 Secondary prevention medications (SPMs) will be optimised in collaboration with the GP and secondary care physicians.[7,8,24,28–30,38]

Medication Adherence

Adherence to cardiovascular medications is crucial for risk reduction following a cardiac event, and medication non-adherence is consistently associated with poorer clinical outcomes and subsequent re-hospitalisations.[169,170] However, approximately one third of patients after a cardiac event are non-adherent, irrespective of the cardiac medication prescribed.[169,171] Unfortunately, cardiologists seldom correctly identify non-adherent patients,[172] and as yet the benefits of digital interventions (*e.g*. text messaging) for medication adherence in patients with CVD remain unclear.[173]

Accordingly, multidisciplinary CR programmes represent an appropriate and cost-effective setting for delivering structured and multi-component interventions targeting treatment adherence [166,171]

10.11.6 Patient's beliefs about medication (*e.g.* necessity, concerns) should also be assessed, and education regarding the importance of medication adherence should be delivered throughout the CR programme by the MDT encompassing nursing, pharmacy, medical and psychology.[7,8,12,23,24,27–32,38] Preferably a formal education session on medication adherence will be provided during CR.[7,28,29]

10.11.7 Strategies to enhance medication adherence may include:
- Simplifying dosing regimens where possible
- Using pill organisers or digital reminders
- Involving family or caregivers where appropriate
- Addressing barriers such as side effects, cost, or confusion.[171]

Specific prescription/ protocols can be found here: Secondary prevention through comprehensive cardiovascular rehabilitation: From knowledge to implementation. 2020 update. A position paper from the Secondary Prevention and Rehabilitation Section of the European Association of Preventive Cardiology | European Journal of Preventive Cardiology | Oxford Academic)[7]

IACR Recommendation 10.11: Medication Management

Initial CR assessment should include documentation of current medications, including non-prescribed products. Reconciliation should compare documented medications to self-reported usage, with discrepancies investigated and clarified. SPMs will be optimised as per available guidance and up titrated during CR in collaboration with primary and secondary care physicians. Patient beliefs about medication should be assessed, with educational interventions targeting adherence delivered throughout CR by the MDT, preferably in addition to a formal education session on medication adherence.

11.0 Psychosocial Management

The psychological impact of heart disease is considerable, and psychological distress is both highly prevalent in patients with CVD, and predictive of poorer CVD outcomes.[20,174] Anxiety, depression and insomnia affect approximately one-third of people with CVD, and up to one in four patients experience clinically significant levels of posttraumatic stress.[7,148,175–177]

Psychological interventions are shown to not only improve psychological distress and quality of life, but reduce cardiac events and hospitalisations.[178] The psychological component has also been shown to drive benefits achieved in CR.[179,180] Accordingly, the recent National Review of Cardiac Services recommends that all CR programmes should have a psychologist as part of the MDT in CR.[44]

Varying levels of psychological intervention may be provided during CR,[49,155,181–188] and patients should be treated as part of a stepped-care pathway, matching individual need to treatment intensity.[32,174] Psychological eHealth interventions (*e.g.* internet-based cognitive behaviour therapy) have also been shown to reduce depressive symptoms in patients with CVD.[189] However, technology access and remote psychiatric safety should be considered in virtual and remote delivery of psychosocial care.[20,89,90]

11.1 Assessment of Psychosocial Risk Factors

11.1.1 All CR patients should be screened for psychosocial risk factors (PSRFs) as they modify total CVD risk and impede health behaviour change.[6,7,22] Ineffective management of PSRFs may result in poorer health outcomes and quality of life.[6]

11.1.2 Clinically significant psychosocial distress should be identified using a combination of clinical interview and psychosocial screening instruments at CR entry, exit, and follow-up as appropriate.

11.2.3 Clinical interview may be broad and extend to several domains, and screening instruments should be reliable and validated in cardiac populations. Results should be recorded appropriately, and the presence or absence of depression in particular should be documented, as well as any actions taken for cases identified (*e.g.* onward referral).[8]

11.1.4 Psychosocial assessment should include:[8,20]

- Psychological distress (anxiety and depression)
- Stress (*e.g.* stress symptoms, work-related and family stress, and stressful life events).
- Social isolation, loneliness and/or low perceived social support.
- Health related quality of life.
- Alcohol and/or substance misuse[190]
- Use of external psychological/psychiatric management

- Where possible, the following PSRFs should also be identified:[6,7,24]
  - Post-traumatic stress symptoms
  - Anger / hostility
  - Illness perceptions and maladaptive coping
  - Sleep disturbance (insomnia and sleep apnoea)

- Sexual dysfunction.
- Cognitive impairment
- Other addictive behaviours

11.1.5 A trauma-informed approach[177] to conducting such assessments should be adopted to support recovery.[24,191]

11.1.6 Lower socioeconomic status (SES) patients have extremely high-risk factor profiles on CR entry, however those participating in CR show similar reductions in MACE and mortality.[192,193] Nonetheless low SES and social deprivation should also be considered as they may hamper CR engagement and recovery.[24,192–194]

11.1.7 CR-HCPs should be cognisant of how equality and sociocultural factors (*e.g.*, gender, language barriers)[41,195,196] may impact CR for each patient.[24,32]

11.1.8 For specific PSRFs a two-step assessment may be adopted whereby the patient is asked a single-item question (*e.g.* "how often have you been bothered by trouble falling or staying asleep or sleeping too much?") which may be followed up with a standardised questionnaire as appropriate (*e.g.*, Insomnia Severity Index).[7,197]

11.2 Interventions for Psychosocial Risk Factors (PSRFs)

11.2.1 CR offers an ideal setting to improve the psychosocial wellbeing of patients with CVD, particularly the normal range of emotional distress associated with a patient's precipitating cardiac event.[24] Each member of the MDT plays a significant role in achieving this objective.

11.2.2 CR-HCPs should ensure a therapeutic experience for patients during CR, where a positive and encouraging atmosphere leverages the psychosocial benefits of supervised exercise training and peer support.[8,20]

11.2.3 As part of a stepped-care pathway, patients should be offered multi-modal behavioural interventions, integrating health education, physical exercise and psychological support for managing PSRFs and coping with illness.[7,22,24,32]

11.2.4 All patients should be offered a package of psychological care, based on a cognitive behavioural model (*e.g.* stress management, cognitive restructuring, communication skills) as an integral part of CR.[22,32]

Psychoeducation

11.2.5 Structured small-group educational sessions should be available to all patients attending CR, with at least some sessions provided by the psychologist. These sessions should be interactive, with the shared component and group dynamic seen as key to the success of this intervention.[22,24]

11.2.6 Psychoeducational group sessions should be evidence-based and may cover topics such as:[8,20,23,27,28]

- Psychological adjustment to CVD (*e.g.* typical emotional responses).
- Managing depression, anxiety and anger.

- Stress and heart disease.
- Maximising social support and self-care.
- Sleep health[12,23]
- Illness perceptions and behavioural risk factors (*e.g.* treatment adherence, weight management)[106,115,198,199]
- Effective principles of health behaviour change (*e.g.* self-efficacy, goal-setting).
- The role of exercise in managing mental health.[200]
- Sex and intimacy[201]

Stress Management Training

11.2.7 The CR team should help patients increase awareness of how stress and improved stress management skills can positively impact physical and emotional health. Supervised relaxation training should be considered for CR patients to enhance recovery and contribute to secondary prevention.[32]

11.2.8 Where a practitioner psychologist is available, cardiac patients affected by stress should be considered for referral to psychotherapeutic stress management training (SMT), both to reduce stress symptoms and improve CVD outcomes.[7,23,31]

Individual Psychotherapy

11.2.9 All patients with mental health conditions require intensified support to improve adherence to lifestyle changes and medications.[7,22]

11.1.10 Patients identified with persistently elevated depressive symptoms should have access to appropriately trained mental health professionals capable of undertaking diagnostic interviews for depression; and who can provide collaborative, stepped depression treatment for those with a positive diagnosis.[31,32] Additionally, patients should be encouraged to adhere to CR to achieve the associated mental health benefits.[23,31]

11.2.11 The CR-HCP should also be able to recognise and refer patients who may benefit from a post-traumatic stress disorder (PTSD) specialist intervention.[24]

11.2.12 Where appropriately trained clinical (or practitioner) psychologists form part of the MDT, individuals with clinically significant psychological distress related to their cardiac event can be managed within the CR service.[24] Spouses or other family members may be included as appropriate.[7,15,24,27,32]

11.2.13 Cognitive Behaviour Therapy (CBT) should be the first choice of psychological intervention for patients in CR with depression, anxiety or insomnia, and may be considered to support cardiac patients with smoking cessation and symptom control.[7,32]

11.2.14 Where CR centres do not have a dedicated practitioner psychologist, individuals with clinically significant psychological distress (or signs of severe and enduring mental health problems), should have access to appropriately trained psychological practitioners in the community (*e.g.* Community Mental Health Team) and their GP should be informed.[20,24]

11.2.15 Where persistent significant sleep problems are identified (*e.g.* insomnia disorder) referral to a sleep specialist (*e.g.* psychologist) for cognitive behaviour therapy for insomnia (CBT-I) is recommended.[7,184]

11.2.16 All patients should have the opportunity to raise concerns about sexual activity and/or functioning.[24,28] Issues raised during CR should be integrated with psychosocial management and addressed through sexual counselling and/or medical management where indicated (*e.g.* cardiology clinic). Patients with longstanding or complex sexual health issues should be offered referral to a specialist.[24,202,203]

11.2.17 When appropriate, provide vocational support / work reintegration strategies to patients after an acute cardiac event.[23,24,28,32] For further detail on core competences for the psychosocial component in CR see BACPR (2025).[204]

Interdisciplinary Care

11.2.18 Referral to a psychologist for psychotherapy, medication and interdisciplinary care (*e.g.* psychiatrist) should be considered in the case of persistent and/or clinically significant symptoms of depression, anxiety or hostility.[7]

11.2.19 Patients with CVD and moderate-to-severe major depression should be considered for antidepressive treatment with an SSRI.[7] In patients with HF and major depression, SSRIs, SNRIs, and tricyclic antidepressants are not recommended.[7] Depression treatment, with psychotherapy and/or pharmacotherapy should be based on patient preference and availability, and treatment should be communicated with the CR team.[31]

Specialist Services and Onward Referral

11.2.20 CR-HCPs should be aware of patients with problems related to alcohol or substance misuse and offer referral to an appropriate resource (*e.g.* alcohol liaison nurse).

11.2.21 CR services are encouraged to establish agreed referral pathways to provide appropriate support to patients to improve or sustain psychosocial outcomes following completion of CR (*e.g.*, counselling services; Irish Heart Foundation Patient Support Network; carer support groups; phase 4 exercise programmes).[23,32]

IACR Recommendation 11: Psychosocial Management

All patients should be screened for PSRFs at CR entry and exit, and offered multi-modal behavioural interventions, integrating education, ET and psychological support during CR. A package of psychological care, based on a cognitive behavioural model (*e.g.* stress management and relaxation training) should be offered as an integral part of CR. CBT should be the first choice of psychological intervention for patients with depression or anxiety, and those with persistent depressive symptoms should have access to an appropriately trained mental health professional capable of undertaking diagnostic interviews for depression; and providing collaborative, stepped depression treatment for those with a positive diagnosis. Patients with distress beyond the scope of CR management should be referred for specialised evaluation and treatment and their GP should be informed.

12.0 Post Phase 3 Cardiac Rehabilitation Evaluations and Discharge Pathways

12.1 End of Programme Assessment and Progress Review

12.1.1 An end of programme assessment, following a similar structure to the pre assessment should be conducted.[7,8,12,19,21,24,27–29,31] As ongoing discussion, evaluation, and feedback should have taken place over the preceding weeks, the post-CR assessment will likely be briefer than the initial pre assessment but it is important that the following key areas are addressed: [7,8,12,19,21,24,27–29,31]

- Current health status and active symptoms, if any.
- Current exercise habits and future exercise plan.
- Lifestyle risk factors (*e.g.* smoking status, adherence to cardioprotective diet, weight and body composition) and future plan for managing same.
- Medical risk factor management: Assess BP, lipids and HbA1c results in relation to individual patient targets. As previously indicated, isolated BP measurements have limited value so the final BP evaluation should include an averaged number of readings.
- Assess adherence to pharmacotherapies and tolerance of same (*e.g.* side effect profile).
- Repeat and document results of any psychosocial screening instruments completed at CR entry.

12.1.2 The patient should be provided with a lay summary of their progress and updated exercise prescription upon completion of CR.[28] This personalised report should outline the patient's current lifestyle and medical risk factor status along with the relevant targets and brief comments/advice. An exercise plan and reminders regarding their nutritional plan should also briefly be outlined. This succinct summary has the dual purpose of summarising the individual's progress to date while also serving as a motivational tool for future actions. Where a patient requests information on their individualised exercise programme in the form of a summary letter for gym participation, this should be completed after the post-CR exercise test, thereby providing the most recent data for the exercise prescription.

IACR Recommendation 12.1: End of Programme Assessment and Progress Review

At the conclusion of CR there should be a formal re-assessment tailored to the individual's original risk profile (physical activity, diet and smoking as relevant), psychosocial health status, medical risk factors (BP, lipids and glucose) and use of cardioprotective therapies, together with long-term management goals.

12.2 Post CR Assessment of Cardiorespiratory Fitness and Functional Capacity Test

12.2.1 Post-CR exercise testing serves as a critical outcome measure. Assessment should incorporate objective clinical indicators of exercise performance.[7,8,12,19,21,23,24,27,28,31,38]

12.2.2 As with the pre-test, CPET is recognised as the gold standard exercise test but is not widely available. As far as is possible therefore, a 12-lead ECG monitored treadmill exercise stress test (EST) should be performed (see 8.2 above). Tests are scheduled and evaluated as for the pre-EST with a medical review indicated if there are significant abnormalities on the test. If a different exercise test, other than an EST, was utilised pre-CR then the same test should be performed post-CR.

12.2.3 One aspect of the EST result, the estimated MET level achieved, is an internationally recognised benchmark of patient progress. As discussed previously, an inverse relationship exists between CRF and mortality risk and for every 1 MET increase in exercise capacity, a 13% reduction in all-cause mortality has been demonstrated.[67] Improvement in estimated MET level achieved is an important marker for individual progress and a key audit indicator of the effectiveness of the CR service.[20]

IACR Recommendation 12.2: Post CR Assessment of Cardiorespiratory Fitness and Functional Capacity Test

Upon CR programme completion, cardiorespiratory fitness should be reassessed using the same validated test administered during the initial assessment to evaluate both patient progress and programme effectiveness.

12.3 CR Discharge/ Progress Report

To ensure long-term risk factor management and secondary prevention, it is crucial that GPs receive complete information on the care provided to patients during CR.[7,8,19,21,24,28,29,31,205]

12.3.1 The patient's progress during the phase 3 CR programme should be detailed on a final report or CR discharge summary. This report should include details from the patient's assessment(s), interventions conducted, and measured outcomes[7,8,19–21,24,28,29,31] and in particular:

- A description of the patient's behavioural risk factors (physical activity, diet, and smoking).
- Medical risk factors (BP, lipids, and glucose as relevant).
- Cardiac medications; and
- Long-term management goals.

12.3.2 The report should be completed in a timely manner, filed in the patient's medical record, with a copy sent to their GP and/or the referring medical consultant.[7,8,19,21,24,28,29,31]

IACR Recommendation 12.3: CR Discharge/ Progress Report

Following CR completion, a comprehensive summary of the patient's progress should be prepared and forwarded to the patient's GP and referring Consultant to ensure continuity of care and support ongoing secondary prevention. This should include pre- and post-CR assessment findings; documented outcome measures (*e.g.* CRF, medical and lifestyle risk factors, psychosocial health); and corresponding CR interventions delivered.

12.4 Phase 4 - Maintenance of Ongoing CR Activities

A key goal of CR is to maintain health gains achieved (*e.g.* CRF) and prevent further cardiovascular events through long-term health behaviour change and the integration of regular exercise to everyday life.[206,207] Unfortunately, long-term adherence to exercise is often poor in people with CVD, and thus interventions that support long-term behaviour change with sustained levels of physical activity are imperative for patients completing supervised, centre-based CR.[184,208] Interventions offered shortly after CR completion may help patients with CVD maintain physical activity and quality of life, and reduce their cardiovascular risk profile.[209–213]

12.4.1 Phase 4 maintenance CR[8,12,22,24,29] typically refers to a less supervised period of maintaining ongoing exercise and health behaviour change by people with cardiac conditions. A variety of interventions may be employed during this phase including supervised hospital-based maintenance cardiac rehabilitation (MCR) programmes, community exercise programmes, utilisation of wearable technologies and local long-term patient support networks.[8,24,29] Collaboration between hospital and community CR providers is important to support patients to achieve their long-term goals through integrated care systems.[24]

12.4.2 Phase 4 community programmes aim to facilitate long-term maintenance of lifestyle changes, including ET. Such programmes are established across the UK, with a network of gym instructors who have undergone training with the British Association of Cardiovascular Prevention and Rehabilitation.[24] The BACPR provide similar training courses in Ireland.

12.4.3 Patients may choose among various pathways to maintain their ET routine, including self-directed home-based practice, general gym membership, or attending a formal supervised phase 4 programme. Sports Partnerships across Ireland also run a variety of exercise classes that admit graduates of phase 3 CR. Patients (and their families, when appropriate) are supported in accessing relevant resources and support systems to enable informed, individualised decision-making. No recommendation is made by CR teams as to the merits of any particular routine, gym or phase 4 MCR programme.

IACR Recommendation 12.4: Phase 4 CR - Maintenance of Ongoing CR Activities

Strategies for long-term maintenance of lifestyle changes such as exercise include signposting patients (and families where appropriate) to community exercise programmes and activity groups; cardiac patient support groups; and community tobacco cessation, dietetic/weight management and counselling services.

13.0 Alternative Models of CR Delivery

A rationale for alternative CR modalities is to improve access for patients impacted by barriers to participation in centre-based CR (CBCR) (*e.g.* travel time, caregiving responsibilities, low patient interest).[89] Irish CR centres have long embraced alternative models of CR delivery,[44,214] and established outreach CR programmes provide CR to remote geographical regions by replicating the hospital-based CR model to ensure consistency.[44,215]

Non-traditional models have been increasingly investigated as viable ways of expanding the reach of CR programmes,[39,89,90] and home-based CR (HBCR) is recommended as a reasonable alternative to CBCR to improve functional capacity and quality of life in patients with ACS.[216] Similarly, telehealth interventions are considered more effective than no intervention for patients with CCS,[217] although more data on safety is needed.[218]

Ideally, CR centres should be able to offer additional care modalities (supervised and/or self-delivered) such as cardiac tele-rehabilitation, facilitated HBCR, online training / education sessions and community-based training.[7,90] Patients may also receive a hybrid of these delivery models, with varying combinations of in-person, virtual (synchronous), or remote (asynchronous) sessions while undergoing CR.[39,89,90,219]

Importantly, patient preference may impact both CR participation and outcomes.[220–222] Although most patients prefer hospital-based CR,[103,222] it is important to offer flexible delivery as one approach will not suit all patients.[8,39,89,90] For example, both peer interaction in CR and in-person ET appears to be particularly important in supporting mental health,[223,224] whereas hybrid cardiac telerehabilitation has been shown to attract younger patients with better baseline health.[225] CR-HCPs should also be mindful of the increasing digital divide in patients with CVD, especially in older individuals attending CR.[89,90,226]

13.1.1 All CR guidelines emphasise that contemporary CR is an evidence-based, multidisciplinary programme, entailing risk factor management, education, ET and psychological support.[6,7,19–25,27–32,38] Standards for alternative CR models should comply with those for hospital-based centres.[8,19,20,24,38,89,90] All core components should be delivered to ensure patients are offered the most clinically effective CR service.[8,19,20,24,28,89,90] In particular, CR-specific protocols are required to maintain patient safety and manage emergencies.[8,89,90]

13.1.2 No consensus exists within current international CR guidelines regarding the optimal alternative method of CR delivery or CR population that would benefit.[8,89,90] Moreover, it is accepted that comprehensive, high-quality research is required to establish optimal methods of delivering clinically effective CR using alternative modalities which examine longer-term outcomes (*e.g.* mortality) and in specific populations such as women, older persons, minority groups and high-risk populations.[89,90,126,227]

13.1.3 Patients who are deemed at a lower risk or who have completed a period of supervised CR may be considered for a home-based or community setting.[7,20,27,31,89,90]

13.1.4 Where virtual HBCR is offered, the guidelines reviewed recommend that some face-to-face elements of CR delivery should remain, particularly the functional capacity assessment (*e.g.* exercise test for risk stratification and exercise prescription) [24,89,90] and initial ET sessions.[19,28] Some CR guidelines recommend that the main exercise component of CR should be conducted in person.[38]

13.1.5 With respect to current practice, a hybrid CR model focusing on aspects of CR amenable to virtual delivery (*e.g.* education sessions), whilst continuing in-person ET (at least in the initial stages) is likely to be the most effective approach.[219,228,229]

IACR Recommendation 13: Alternative Models of CR Delivery

Alternative CR models, such as home-based CR, should be considered as an alternative for those who cannot participate in centre-based CR. All CR programmes, regardless of delivery method or setting, should align with the CR standards described in this guideline, and include all CR core components.

14.0 Programme Quality Assessment and Audit

CR is a high-value yet underutilised intervention in patients with CVD. All CR centres should comprehensively assess programme quality at least annually. This entails measuring CR quality at the system level (hospital referrals), programme level (enrolment, adherence, completion), and patient level (*e.g.* improvements in exercise capacity, BP control, lipid profile).[6–8,20–22,24,25,29,31,32] Patient reported outcomes (PROs) are particularly important in CR as they are associated with positive outcomes.[230] CR centres that carefully assess programme quality will likely reveal various performance gaps in CR delivery which are amenable to quality improvement (QI) efforts, such as referral, wait time and CR participation.[229,231] As there is urgent need for programme evaluation and QI in CR, programme quality may be considered a core component of CR in its own right.[20]

14.1.1 Data relating to patient participation, outcome measures and the post-CR functional capacity test should be formally recorded for evaluation and clinical audit purposes.[7,8,24]

14.1.2 Programme-level measures to evaluate include rates of CR enrolment, adherence (*e.g*. percentage of patients attending ≥12 supervised sessions), and CR completion. Important patient-level measures include changes in functional capacity, improvements

on self-reported measures (*e.g.* Mediterranean diet score[232], PHQ-9)[59], and risk factor measures such as smoking status, BP, lipids (particularly LDL-cholesterol), HbA1c, weight, abdominal circumference and prescribed cardioprotective medications.[6–8,12,20–22,24,25,29,31,32] Other items which may be considered include PROs such as patient satisfaction or health-related quality of life.[6–8,21,24,25,29,31,32,233]

14.1.3 The resulting data can be used to monitor CR programme effectiveness, inform future QI initiatives, promote effective treatments and deliver optimal outcomes.[8,22,24,28,29]

14.1.4 Importantly, a suitable balance should be achieved between the resources required of CR staff to measure and record outcomes and the burden placed on patients.[8]

IACR Recommendation 14: Programme Quality Assessment and Audit

Data obtained from CR outcome measures should be systematically recorded for each patient to inform future QI initiatives to address gaps in care.

15.0 Cardiac Populations/Specific Demographic Populations

This section examines specific clinical and sociodemographic populations that according to the literature, exhibit known variability and warrant focused attention.

15.1 Chronic Coronary Syndrome (CCS)

CCS has been defined as a range of clinical presentations or syndromes that arise due to structural and/or functional alterations related to chronic diseases of the coronary arteries and/or microcirculation.[217] An important aspect of this syndrome is that 'although stable for long periods, chronic coronary diseases are frequently progressive and may destabilise at any moment with the development of an ACS'.[217] The concept of CCS has evolved beyond the idea of a fixed, focal, flow-limiting atherosclerotic stenosis of a coronary artery that directly causes myocardial ischaemia and angina symptoms. Rather, CCS is viewed as more complex structural and functional abnormalities in both the macro- and microvascular compartments of the coronary tree that may lead to transient myocardial ischaemia.[217] CR has been shown to improve exercise capacity and decrease angina frequency in patients with stable angina[234,235] and is associated with fewer MACE and reduced healthcare costs compared to PCI.[236,237]

15.1.1 ESC reiterates that a multidisciplinary, exercise-based programme to improve cardiovascular risk profile and reduce cardiovascular mortality in these patients is a Class 1A recommendation.[217] ET is therefore a treatment that should be offered to every patient with CCS in the setting of secondary disease prevention.[7,8,12,19,21,23–25,27,29,30,30–32,38] Signs and symptoms of residual myocardial ischaemia during exercise are not a contraindication to ET and, in fact, ET should be considered a viable therapy for angina.[8]

15.1.2 As the definition of CCS is quite broad, and potentially applicable to many patients, guidance on CR eligibility may be helpful in the context of limited resourcing. Patients

with CCS (with or without PCI) are recommended for CR participation provided that one or more of the following preconditions are fulfilled:[30]

- Clinical prognosis is limited due to insufficiently treated cardiovascular risk factors and risk diseases (*e.g.* ESC-SCORE >5%).
- Ongoing typical cardiac symptomatology (*e.g.* angina pectoris, dyspnoea) without the option for (additional) coronary revascularisations.
- Comorbidities (*e.g.* PAD, COPD, diabetes, chronic renal disease) which increase the risk of adverse outcomes.
- Increased risk of CCS to compromise the individual's social and vocational reintegration during follow-up.

15.1.3 Symptom limited 12-lead ECG exercise testing is recommended before initiating CR to establish a baseline fitness level, determine the HR response, assess for symptoms, arrhythmias and ischaemic ECG changes, and to potentially identify an ischaemic threshold.[8] Hence it is important that patients are tested whilst taking their usual cardiac medications, particularly rate-limiting medications such as beta blockers.

15.1.4 CR programmes for patients with CCS should be centre-based and under the supervision of a cardiologist, and the exercise component needs to be structured, supervised and individually adapted to sustainably increase the individual's physical performance.[30]

15.1.5 Exercise should be individually prescribed and ideally based on exercise testing, using the FITT-VP principle. Where the patient has an identified ischaemic threshold (*i.e.* angina and/or ≥1mm ST segment depression on exercise test) exercise should be prescribed at a HR 10 beats per minute (BPM) below the ischaemic threshold, and work rate below this point.[8,11] For patients with stable exertional angina, an extended warm-up period or more graduated increase in exercise intensity may help to reduce symptom onset and/or severity. Moderate-intensity continuous ET is the most feasible and cost-effective aerobic training modality for patients with CCS,[217] and RT should take place at least twice weekly.[30]

15.1.6 The importance of exercise adherence is highlighted by evidence demonstrating that the largest reductions in total and cardiovascular mortality have been observed in CR patients who maintain the highest rate of adherence.[7,238] A minimum volume of CR-based exercise has been recommended for patients with CCS: total exercise volume to be ≥1000 min as calculated by the "number of weeks" times "exercise sessions per week" times "exercise duration per session in minutes", with the total number of CR sessions being ≥36.[30] Given the chronic nature of CCS, comprehensive CR programmes should provide individually tailored self-management interventions (*e.g.* education, psychological support, support for social/vocational reintegration) in addition to targeted reduction of cardiovascular risk factors.[30]

15.2 Cardiac Surgery (Coronary Artery Bypass Graft, Cardiac Valve Surgery/ TAVI).

15.2.1 In general, patients following structural heart surgery should be referred early to CR, within two weeks of discharge.[8] Initial assessment should include the sternal wound and harvest site(s), associated pain/discomfort, sternal movement/instability or sternal clicking, with early referral for physician/surgeon review if indicated.[8,30]

15.2.2 Restrictions in range of movement (ROM) and weight load are commonly advised in upper limb movement for 8–12 weeks.[8] This requires ongoing assessment during the CR ET sessions so that the goals of patient progress are advanced whilst limiting sternal complications.

15.2.3 As persistent chest wall pain is common post-CABG, some patients may need to commence exercise at a lower intensity or modified exercise prescription, but the aim should be to progress and increase workload as tolerated. The CR programme should always be tailored to individual patients' needs and goals .[30]

15.2.4 Early enrolment in exercise-based CR post cardiac surgery/sternotomy is shown to be safe and effective,[239] however it is important to follow the treatment instructions and care plan of the patient's surgical team. In practice, surgeons may advise delay of comprehensive CR up to 12 weeks post-surgery.

15.2.5 CR is also recommended for patients post heart valve surgery. While evidence is lacking for the impact of ET in this population,[30,240] there appeared to be beneficial effects on physical capacity recovery and on hospital readmissions post-surgery.[8,241] Special consideration should be given to this cohort as they tend to be older, frailer, have increased co-morbidities, with often a substantial difference in disability profile at admission.[7,242] As well as having the potential to improve physical functioning and reduce frailty,[243] CR programmes should also give focus to nutrition and cognition in this population. Individually adapted exercises to improve coordination (especially sensorimotor training and balance training), flexibility and gait training should be included in the exercise programme.[30] Otherwise, exercise prescriptions for patients post valvular surgery will be similar to those for patients post-CABG.[8]

15.2.6 For patients post transcatheter aortic valve implantation (TAVI), the same recommendations as 15.2.5 above apply. Although the average age of this patient group is higher (~81 years in a recent Irish study of TAVI outcomes)[244], evidence suggests that these patients are likely to benefit similarly from exercise-based CR.[245,246]

15.2.7 It is important to note that for younger patients post mechanical valve surgery, and on oral anticoagulation therapy (currently warfarin), all contact sports or other injury-prone exercise should be avoided.[30]

15.3 Surgical Repair of the Aorta

15.3.1 Patients who are post-surgical repair of the aorta should be referred for CR and ET.[12,30,247] Given both the rigours of the surgery (which is more often emergency surgery) and the life-threatening nature of this condition, there are clear potential physical and psychological benefits to CR participation.[38,248–253]

15.3.2 Particular attention should be paid to BP control in this cohort.[30] During CR, BP needs to be monitored closely including ambulatory blood pressure monitoring (ABPM), and systolic BP must not exceed 160 mmHg during exercise testing.[30] During ET, cycle ergometer training can be useful as this allows repetitive accurate BP measurements.[30]

15.3.3 Signs and symptoms suspicious for malperfusion are claudication, intestinal angina, repetitive back pain, hoarseness or increasing dysphagia.[30] Competitive sports, contact sport, sprinting, isometric strength sports, and any physical effort associated with excessive exhalation on exertion are to be strictly avoided.[30]

15.4 Heart Failure

15.4.1 CR is strongly recommended for patients with a diagnosis of heart failure (HF) with broad international consensus endorsing CR tailored to this cohort.[7,8,12,19,24,30,38] While ET for patients with HF has yet to clearly demonstrate mortality benefits,[254] there is some evidence for improved LV function[255] and reduced rates of hospitalisation,[256] and clear evidence for improved exercise capacity and quality of life.[256–258] The benefits of supervised exercise training in patients with heart failure and preserved ejection fraction (HFpEF), in terms of improved exercise capacity and quality of life, have also been clearly demonstrated.[259,260]

15.4.2 As with other cardiac populations, it is likely that the dose of exercise or volume is a significant factor in outcomes for patients with HF.[261,262] RT also appears to be safe and beneficial for this cohort.[263]

15.4.3 Before commencing the ET programme, it is essential that the patient is clinically stable and on optimised drug therapy.[19,30] The CR team should continuously liaise with the primary HF service for symptom management and medication optimisation.

15.4.4 As quality of life is a particularly important outcome for this population, assessment of health status and quality of life before and after CR can be made using disease specific questionnaires, *e.g.*, Minnesota Living with Heart Failure Questionnaire,[264] or Kansas City Cardiomyopathy Questionnaire.[265]

15.4.5 A functional assessment should be performed, preferably with a symptom limited CPET or treadmill exercise test (TMET), and the use of less aggressive testing protocols such as the Naughton or Modified Bruce are suggested.[7] The exercise test protocol should be individually selected based on the assessment and self-reported activity levels. Where the aforementioned functional tests are unavailable, the 6-minute walk test (6MWT) can serve as a parameter for monitoring functional gains.[19,38] With consideration to frailty in this population, other functional tests include gait speed test, timed up-and-go (TUG) test, PRISMA-7 questionnaire, Frail Score, or the short physical performance battery.[7] Centre-based, supervised ET programmes are specified for this cohort.[7,8,12,19,30]

15.4.6 Although the same general principles of ET in CR apply to patients with HF, individuals with more severe disease and greater functional limitations should start at the lower end of the exercise prescription, with progression of intensity to the upper tolerated limit as training advances.[19,38] In de-conditioned patients with poor exercise tolerance, it may be necessary to commence with intermittent aerobic training, with active recovery periods suitably inserted into the session.[38] As the CR programme advances, the rest periods should be gradually decreased until the patient achieves the minimum target of 30 minutes of continuous exercise. Importantly, the increased volume of exercise should be achieved before the exercise intensity is progressed.[8,38]

15.4.7 For patients with HF, common co-morbidities include iron deficiency, diabetes, kidney disease, issues with sodium restriction, hyper/hypokalaemia and potentially malnutrition, cachexia, and sarcopenia, due to a restricted dietary intake. Therefore, in addition to education regarding a cardioprotective diet, patients with HF may require specialist and individualised dietetic input.[24]

15.5 Dysrhythmias and Cardiac Implantable Electrical Devices (CIEDs): Implantable cardioverter defibrillator (ICD) and cardiac resynchronisation therapy (CRT).

15.5.1 Cardiac rhythm disturbances are common in patients with heart disease and range from the generally benign (*e.g.* premature atrial and ventricular complexes, mild bradycardia, first degree atrioventricular block) to the potentially/likely harmful (atrial fibrillation/flutter with a rapid rate, symptomatic bradycardia, advanced atrioventricular block, ventricular tachycardia, ventricular fibrillation). The CR team are often the first to identify rest or exercise-related dysrhythmia and must understand their significance, the corresponding haemodynamic consequences and resulting impact on exercise physiology.[8]

15.5.2 Atrial fibrillation (AF) is a common cardiac arrhythmia which occurs frequently in patients with CVD and risk factors such as hypertension and overweight/obesity. AF can be managed effectively during CR,[266,267] and pathways should be in place to identify AF in patients with symptoms (usually palpitations) and/or with irregular pulse on palpation.[24] Erratic BP readings on automated devices may also be suggestive of AF. The gold-standard for the diagnosis of persistent AF is via a 12-lead ECG. Paroxysmal (intermittent) AF may be diagnosed using ECG telemetry, home ECG recording via commercially available devices or the use of smartphone enabled applications.[24] As patients with AF are often asymptomatic, the added value of continuous ECG monitoring in CR setting is clear, with ECG telemetry often the first indication of a potentially new diagnosis of AF.[20,268]

15.5.3 Exercise-based CR is safe, reduces AF recurrence, symptom burden and improves quality of life and CRF in participants with AF.[257,269,270] However, the impact of CR on all-cause mortality or serious adverse events for people with AF is less clear.[270]

15.5.4 Exercise-based CR also appears to be safe and effective in patients with cardiac implantable electrical devices (CIEDs), with increases in exercise capacity observed without increases in device activation.[271,272]

15.5.5 CR- HCPs supervising ET for this cohort must know and document the therapy threshold settings for CR participants. Assessment of the patient's knowledge of device-related information should also be conducted, with education provided on same.[30]

15.5.6 Baseline exercise testing should ideally be done by EST.[38] Testing can help to ensure that the patient's peak HR is safely below the activation threshold and to determine whether exercise induces arrhythmias. These results can be used to establish a safe and appropriate exercise target HR zone.[8,38] Monitoring (HR, BP, ECG telemetry, symptoms) of this cohort during supervised ET provides a unique vantage point to observe 'real-

time' responses to movement, activity and exercise.[38] Early recognition of a change of rhythm is a key goal.[33]

15.5.7 Communication between CR, the patient's primary medical team and the cardiac physiology team can help optimise device therapy where indicated. Keen observation on telemetry of the device response to ET (including all pacemakers) in liaison with the Cardiac Physiologist who can expertly adjust device programming, can result in improved exercise responses, improved exercise capacity and reduced symptom profile.[8] Optimisation of medicines (particularly HR-limiting medications such as beta blockers) may further be required to optimise device functioning, which can be particularly important in achieving optimal outcomes from cardiac resynchronisation therapy (CRT).

15.5.8 A large-scale retrospective study reported the rate of device lead dislodgement events as 1.69% (n=350).[273] Although most events occurred within one month of implantation, they nonetheless constitute a major complication risk with significant clinical implications. Appropriate precautions should therefore be taken with this cohort in both the timing of CR (to allow site healing) and the type of exercise undertaken, particularly in the initial period post-insertion.[30]

15.5.9 Information on causes of lead dislodgement/fracture is scarce but documented cases have included patient manipulation of the pulse generator (either inadvertent or deliberate) or direct trauma to the chest.[274] Cases of actual lead fracture have been associated with lifting weights, but more so with crush injury,[275] suggesting that inadequate control during bench-pressing could be sufficient to cause blunt trauma to the chest and lead fracture. Standard advice to patients after device insertion is to avoid lateral pull-downs. While this exercise primarily recruits back, shoulder and arm muscles, the degree of stretch exerted on the chest wall and pectoralis major muscle, could potentially cause enough movement of the pulse generator and leads to cause dislodgement. Thus, alternative resistance exercises that avoid the overhead and keep the arm position below shoulder height should be suggested.[30]

15.6 Left Ventricular Assist Devices (LVADs)

15.6.1 LVADs are a therapeutic option for patients with end stage HF as a bridge to cardiac transplantation or as continuous therapy for those who do not qualify for transplant (destination therapy).[7]

15.6.2 LVADs can help to significantly increase cardiac output during exercise through mechanisms such as increased preload and decreased afterload. However, the fixed speed of the current generation of LVADs ultimately limits this increase in cardiac output. Despite this, large gains in functional capacity are possible.[8]

15.6.3 Patients with LVAD are likely to be extremely deconditioned with skeletal muscle atrophy secondary to prolonged poor perfusion and resultant sedentary behaviour.[7,8] Nonetheless, exercise-based CR for patients with LVADs is associated with significant improvements in exercise capacity and quality of life,[276–278] with greater benefits shown for patients on destination therapy compared to those on bridge-to-transplant therapy.[277]

15.6.4 CR delivered in specialised centres is recommended, and supervision by CR- HCPs with in-depth knowledge of LVAD functioning is necessary.[12,30] As with other populations, careful monitoring and supervision of this cohort by CR- HCPs can lead to early detection of paroxysmal dysrhythmias, infection, device malfunction, bleeding and stroke.[7,8] Further guidance in the supervision and ET of these patients is also available.[7,8,30]

15.6.5 Exercise is contraindicated if pre-exercise mean arterial BP is <66mmHg, if the low flow device alarm activates, or if the patient exhibits intolerance to the workload regardless of BP findings.[8] Other contraindications include supine resting HR >100 bpm or oxygen saturation <90% with the caveat that oximetry readings might be difficult to obtain due to low pulsatility.[7]

15.6.6 Depending on baseline level of function, functional capacity testing may involve a modified protocol treadmill test (*e.g.*, modified Bruce), or the 6MWT.[12] Patients on LVAD support have been shown to have a linear relationship between HR and VO_2.[279] Accordingly, a standard aerobic ET prescription of 40–80% HRR can be employed but in practice the ET intensity will generally be low to moderate (40–60%) with a prolonged warm-up and cool-down.[7,30] As with all deconditioned patients, the initial focus should be on progressing ET time.

15.6.7 Light RT should be delayed at least 8–12 weeks post-implantation, primarily due to wound healing, with particular caution around activities that might increase intra-abdominal pressure.[8,38] Special care is recommended in the selection of exercises and training equipment for RT,[30,38] and breath-holding and the Valsalva manoeuvre should be avoided.[7] In addition, abrupt changes in position (*e.g.* movement from sitting to standing with a rapid shift in blood volume) generally are not recommended when performing any form of exercise.[38]

15.7 Cardiac Transplant

15.7.1 Cardiac transplant is the treatment of choice for eligible patients with advanced HF, and is associated with improved survival, greater functional status, and enhanced quality of life, despite a generally complicated clinical course both before and after transplant.[8]

15.7.2 CR should be initiated early after transplantation, be multidisciplinary in nature and specifically tailored to this patient population.[7,12,19,30,38,280] Exercise-based CR has been shown to be a safe and beneficial component of postoperative care and increases both functional capacity and quality of life.[281] Furthermore, CR attendance of ≥23 ET sessions has been associated with lower risk of major adverse cardiac events (MACE) following heart transplant.[282]

15.7.3 CR staff must receive extensive education on the particular care required for this patient cohort prior to CR enrolment.[12,30] In addition to the usual concerns for patients with prolonged HF and who have undergone cardiothoracic surgery, there are the unique challenges of transplant itself. Lifelong special care is required to reduce the risk of infection, and special precautions to prevent infection during CR should be employed as far as is practicable.[7]

15.7.4 Long-term immunosuppressant treatment is required to prevent acute rejection of the donor heart. Apart from the immediate medication side-effects and ongoing risk of infection, there are longer-term consequences with increased prevalence of comorbidities such as: hypertension, renal dysfunction, diabetes mellitus, obesity, dyslipidaemia, osteoporosis and depression.[8] CR staff should communicate promptly to the transplant medical team any changes in the patient's clinical condition or parameters, as interventions to prevent rejection will be time critical.[30]

15.7.5 There are several unique factors involved in the patient's response to exercise post-transplant. The primary consideration is the surgical denervation of the donor organ, as it receives no direct efferent input from the autonomic nervous system and likewise provides no afferent signals to the central nervous system. Due to the loss of parasympathetic innervations, the HR at rest of the donor heart is elevated to a range of 95–115 bpm.[8] During exercise there is a delayed increase in HR with a peak HR that may typically be lower than normal. Additionally, there is a delayed decrease in HR after exercise due to circulating epinephrine. The HRR will therefore be lower than normal but significant improvement in the HR response during exercise and recovery has been shown over the first year post-transplant.[283] Evidence of cardiac reinnervation can occur early in post-transplant but is more commonly found in the second year and is associated with improved exercise capacity.[284]

15.7.6 The 12-lead ECG monitored treadmill test may be used as a functional capacity test.[7,8,12,19,38] However, given the blunted HR response to exercise, this test should commence at a low MET value, with initial increments of 1 to 2 METs per stage.[8] Thus, the Modified Bruce Protocol represents an ideal formula.[7] Where the patient has a low predicted exercise capacity, the 6MWT can instead be used to assess submaximal aerobic capacity/endurance and repeated to evaluate progress during CR.[12]

15.7.7 Pre-transplant, patients with chronic HF will have reduced exercise capacity due to central and peripheral circulatory abnormalities, and skeletal muscle dysfunction.[7] In addition, the recovery/healing process post-surgery, along with the use of corticosteroids, will result in further deconditioning and skeletal muscle atrophy.[8]

15.7.8 Although exercise prescription is similar to that used post cardiac surgery, RPE should be used instead of target HR due to the effects of denervation.[8,12,19,38] Depending on the individual response to exercise, more gradual warm-up and cool-down phases may be employed. Aerobic conditioning can commence with modes of exercise that employ the lower limb muscles (*e.g.* treadmill, cycle ergometer, step training) then progressing to more upper body work as sternal union is completing (*e.g.* rower, hand crank, air bike).

15.7.9 RT has the potential to improve both muscle strength and bone density and should be incorporated into the exercise programme as soon as sternal precautions are decreased.[7,38]

15.8 Spontaneous Coronary Artery Dissection (SCAD)

15.8.1 Spontaneous coronary artery dissection (SCAD) is an increasingly recognized cause of myocardial infarction (MI) that most frequently affects younger women, representing an

important cause of morbidity and mortality in this population.[285] Up to 90% of SCAD survivors are women, with females also more likely to have a prior MI compared to men (7% v 0.8%).[286]

15.8.2 Risk factors associated with SCAD include fibromuscular dysplasia, oestrogen-containing oral contraceptives, emotional or physical stress, pregnancy and postpartum, connective tissue disorders, and systemic lupus erythematous.[287,288] SCAD is preceded by physical stress in most cases, with emotional stress implicated in females more than males.[289] Although current evidence does not point to traditional cardiovascular risk factors as major causal factors for SCAD,[290]70% of SCAD survivors have at least one cardiovascular risk factor.[291]

15.8.3 The gold-standard for SCAD diagnosis is coronary angiography, and management is frequently conservative given the risk of further iatrogenic injury (or dissection extension) during PCI, and the tendency for SCAD lesions to exhibit angiographic healing over time.[292] However, in high-risk patients (*e.g.* ongoing ischaemia, left main artery dissection, or haemodynamic instability) urgent intervention by PCI or CABG will be considered.[293]

15.8.4 All patients who have an MI caused by SCAD should be referred for CR. Despite a lack of randomised trial evidence on SCAD-specific interventions, CR is considered essential to recovery and secondary prevention post-SCAD, offering notable physical and mental health benefits,[24,294,295] and a return to full activity following SCAD, including non-extreme sport, is considered a reasonable goal.[290,294]

Multidisciplinary exercise-based CR is safe and beneficial for improving symptoms, exercise capacity, and psychosocial well-being in patients with SCAD, and dedicated CR programmes are associated with reduced cardiovascular events.[296,297] Psychological support provided during CR is particularly important given the unique demographic, cardiovascular and psychological profile of this population.[298,299]

15.8.5 After the acute event, common considerations in CR include ongoing chest pain, BP management and secondary prevention.[295] Chest pain post-SCAD is a frequent reason for hospital readmission and such pain may persist for several months.[292] Medical management has the most effect in reducing recurrent events and includes nitrates, calcium channel blockers and ranolazine.[295] Hypertension is associated with increased risk of recurrent SCAD, while beta blocker use appears to be protective.[300,301] Interventions that reduce hypertension (*e.g.* pharmacotherapy and aerobic exercise) are likely to be beneficial, whereas excessive physical (*e.g.* isometric exercise) and emotional stressors may be detrimental.[285]

15.8.6 Given the association with more extreme physical activity as a trigger for SCAD, a prudent approach to prescribing physical activity should be taken, balancing the known benefits of exercise with the potential risks associated with high levels of exertion and strain.[293,302] Supervised ET during CR, combined with close monitoring of HR, BP and heart rhythm, provides an ideal setting to assess any exercise-related symptoms and ensure an individualised exercise prescription.[290]

15.8.7 The exercise prescription and components of ET should be adjusted in accordance with the medical goal of reducing arterial shear stress. A baseline functional capacity test (ideally a 12-lead ECG monitored treadmill test) is particularly useful for assessing the exercise response, due to the level of monitoring employed. Regular BP measurement before, during and after ET, especially in the initial exercise sessions, is very important. Given the potential risk of recurrent SCAD with hypertension, a conservative approach should be adopted.[301,302]

Vancouver General Hospital's SCAD-specific CR programme[296] recommended a BP limit of 130/80 mmHg, however the limit employed should be clinician guided and individualised. Ultimately, ET for this cohort is likely to be beneficial for blood pressure control.[290] Pragmatic ET prescription (40-80% HRR) would suggest starting at a low intensity with gradual increments to achieve positive and safe progression. A collaborative plan with regular feedback and review is important. Patients should be counselled against isometric or extreme exercise and RT should focus on increasing muscle strength using more repetitions with lighter weights rather than significantly increasing the weight lifted.[290,294,302] Various weight limits have been suggested in the literature, but as no large-scale prospective study data currently exists to guide practice, an individualised approach is advised.[290]

15.8.8 Patients living with SCAD are more adversely impacted psychologically than their non-SCAD counterparts,[303] and have unique educational, psychological and exercise-specific needs during CR.[293,303] SCAD survivors are generally a younger, low-risk, population who have experienced a completely unexpected life-threatening medical emergency, and postpartum patients have the added challenge of a new baby.[294,304] A diagnosis of SCAD comes with considerable uncertainty in terms of management and prognosis, and most patients with SCAD are fearful of resuming exercise and triggering another dissection.[305] SCAD survivors also view their condition as less controllable than other patients with heart disease.[306] The high psychosocial burden experienced by patients with SCAD includes depression, anxiety, post-traumatic stress disorder, with many patients affected by migraine headaches and 'brain fog'.[307–309]

15.8.9 Although sex differences exist conventional CR programming can be deemed inadequate by SCAD survivors and low completion rates are common.[299,305,310] Patients perceive HCPs' knowledge of SCAD and its management as poor,[305,311–314] CR educational content as irrelevant, and isolation experienced due to lack of SCAD peers is associated with CR non-attendance.[304,305,313]

15.8.10 Addressing mental health is a critical part of providing tailored secondary preventive care for patients living with SCAD.[298,315] Despite the lack of an established evidence base, patients with SCAD are likely to benefit from some combination of SCAD-specific CR, psychological interventions (*e.g*. CBT, trauma-focused care) and peer support (*e.g.* SCAD Ireland) in addition to the provision of coherent SCAD-specific information.[285,296,308,312,313,316,317]

IACR Recommendation 15.0: Cardiac Disease Populations

Certain disease-specific populations (*e.g.* CCS, cardiac surgery, aortic surgery, heart failure, LVAD, cardiac transplant, ICD and SCAD) may be appropriate candidates for CR enrolment. However, specialised input and careful consideration are necessary to ensure the CR programme is appropriately tailored to meet their unique needs.

Specific Demographic Populations

15.9 Women and Men

15.9.1 Although CVD is a leading cause of death in both women and men, there are important differences in presentation.[8] Men have a higher risk of obstructive coronary disease whereas women more often develop non-anatomically obstructive CVD such as spontaneous coronary artery dissection (SCAD) or Takotsubo cardiomyopathy.[8]

15.9.2 Most traditional cardiovascular risk factors have similar effects in men and women, however some such as T2DM appear to confer a greater risk for CVD in women.[8] In addition, many non-traditional risk factors disproportionately affect women, including pre-term delivery, hypertensive pregnancy, gestational diabetes, autoimmune disorders, and depression.[8] Moreover, women with CVD are shown to be undertreated, with poorer control of risk-factors and lower adherence to secondary prevention measures compared to men.[7,318–320]

15.9.3 CR barriers are multifactorial with many common to both males and females, such as transport/distance to CR centre, family responsibilities, leave from paid work, lack of awareness about CR, and unfounded fears associated with exercise. Men most frequently report work responsibilities as a barrier, whereas experiencing exercise as painful/tiring is more commonly a barrier for women.[8,321,322]

15.9.4 Research suggests that women (particularly younger women) are significantly underrepresented in CR programmes,[323–325] and significant sex disparities also exist in CR programming and outcomes.[325,326] For example, women may benefit less than men on some physiological variables in response to exercise interventions.[327–329]

15.9.5 Growing evidence has emphasised the importance of strategies to increase CR participation in women and ensure that CR is specifically tailored to their needs.[7,8,24,38,325] This issue was the subject of the first clinical practice guideline by the International Council of Cardiovascular Prevention and Rehabilitation (ICCPR) on how to address low referral, enrolment and completion in CR: Women-Focused Cardiovascular Rehabilitation [330]

15.9.6 Upon entry to CR, a gender-sensitive risk-evaluation should be performed, considering multi-morbidity, obesity, depression, and psychosocial functioning.[38]

IACR Recommendation 15.9: Women and Men

To promote enrolment and sustained participation in CR, and to optimise secondary prevention outcomes, it is essential to consider sex and gender specificities. Where feasible, CR programmes should be adapted to provide individualised interventions and ensure access to appropriate resources that address sex and gender differences.

15.10 Older Persons

With improved treatments, the number of adults with CVD surviving to an older age has increased, thereby increasing the likelihood of both further cardiac events and the number of potential co-morbidities. Unfortunately, despite older adults representing an increasing proportion of patients with CVD, they are often excluded from CR.[7]

CR is particularly beneficial for older adults as it provides an opportunity to personalise cardiovascular care in the context of their aggregate health issues.[331] For example, comprehensive CR provides an opportunity for strength training, nutritional support and other strategies to mitigate the effects of frailty and improve patient-centred outcomes.[242,332–334] Although elderly patients achieve smaller gains in functional capacity during CR[335], these improvements are strongly associated with improvements in health-related quality of life and mental health.[336] Despite improvements however, many elderly patients still have multiple risk factors not at target within 1 year of completing CR.[337]

15.10.1 Several international CR guidelines highlight the specific needs of this population and the requirement to tailor CR programme content to meet their needs[7,8,12,22,30,38] Challenges to providing care for this population include multimorbidity, polypharmacy, frailty, cognitive decline and functional decline/post hospitalisation syndrome.[8] Additional issues include mobility limitations, vision/hearing impairments, incontinence and poor sleep. Elderly patients with CVD may also experience more depression (but less anxiety) than their younger or middle-aged peers.[338,339]

15.10.2 For older persons attending CR, conducting an individualised initial assessment may require more time and space, with more specific tools than are used generally in CR. [7,8,12,22] In addition to routine screening, a frailty assessment for patients over 75 years should be included using validated tools, along with a detailed musculoskeletal history of any orthopaedic issues, back pain or other physical limitations.[7] Assessment of activities of daily living (ADL) and falls history should also be taken, with further balance assessment as required. Other specific areas requiring evaluation in this population include psycho-cognitive deterioration, nutritional status, sarcopenia, disability, isolation and social deprivation.[340,341]

15.10.3 Evaluation of functional capacity should be by standard exercise tolerance testing where possible. Modified treadmill test protocols (*e.g.* Modified Bruce) may be more suitable but should be evaluated on an individualised basis. In more deconditioned older persons, a submaximal test such as the 6MWT may be utilised instead, with walking regarded as relatively familiar and comfortable to anticipate.[8]

15.10.4 In frail patients or those unable to walk, the Short Physical Performance Battery (SPPB) or other chair-based tests should be considered.[7,12] Other tools for frailty assessment may include walking speed (gait speed test), timed up-and-go (TUG) test, PRISMA-7 questionnaire and Frail Score.[7] Balance function may be assessed using the single-leg standing time and functional reach test[12], and handgrip strength test using a dynamometer may be used as a proxy for overall muscle strength.[8,242]

15.10.5 Assessment of frailty (*e.g.* severity) enables CR to be individually tailored to achieve the best results safely. Higher levels of frailty are associated with CR dropout,[333] whereas frailty improvements during CR are associated with CR goal achievement.[243]

15.10.6 Older patients' goals and motivation may be less about overcoming CVD and more about enhancing quality of life, physical functioning and independence,[8] therefore it is important that a personalised CR programme is collaboratively designed and based on their individual goals.[7] For older patients with CVD, aerobic exercise and RT are recommended to be performed concomitantly to improve exercise capacity, muscle strength, and quality of life.[8,12,30]

15.10.7 Graduated warm-up activities are particularly important in older adults to optimise HR responses, increase perfusion to muscles/joints, and improve flexibility. A graduated cool-down can attenuate vascular pooling in older patients prone to hypotension, and can lessen arrhythmias and ischaemia.[8]

15.10.8 Aerobic training is the mainstay of the conditioning phase and should ideally replicate the activities of the older person's daily life. Walking, particularly treadmill walking, as a weight bearing exercise should be combined with intermittent weight-supported exercise (*e.g.* cycle ergometer). Patients with low exercise capacity may often need rest periods interspersed through the initial exercise sessions. Adjustment to modes of training and equipment should also be made to reduce the risk of falls (*e.g.* bars to aid balance). Given the high prevalence of chronotropic incompetence in older patients, it is important to use RPE to guide exercise intensity in this cohort.[8]

15.10.9 Older adults are generally vulnerable to deconditioning and weakening but more particularly after a cardiac event requiring hospital admission. RT can increase muscle strength and mass, facilitate improvements in gait, balance, functional capacity and reduced falls occurrence.[38] For further guidance, see also: ACSM position statement on exercise and physical activity in older adults[342]; and ESC consensus statement for cardiovascular risk factor management in older adults.[171]

IACR Recommendation 15.10: Older Persons

Older adults warrant particular attention in personalised care planning to address cardiac and psychosocial health, comorbidities, and functional ability. For patients over 75 years of age, a more in-depth, multidimensional geriatric assessment may be necessary. CR should be individually tailored, with a focus on maintaining mobility, independence, cognitive and psychosocial function, and preventing both sarcopenia and frailty.

15.11 Race, Language and Culture

Racial and ethnic differences in CR participation and completion have been identified[8,28,29,32,38], which may be attenuated by household income.[343,344] While various barriers and facilitators to CR utilisation are linked to cultural and societal norms[345], CR participants from ethnic minorities achieve similar benefits to majority peers for multiple risk factors and potentially, mortality and morbidity.[346] Thus, CR should be strongly promoted to this underserved population.

15.11.1 To ensure equitable healthcare provision and support, CR programmes should be tailored to account for equality and diversity issues.[8,24,28,29,32,38] There is consensus across all international guidelines that CR must be individualised to take consideration of these factors.

15.11.2 CR centres should also provide access to language interpreters either in person, telephonically or digitally (*e.g.* video interpreters) and written information should be available for patients in commonly spoken foreign languages.[38]

IACR Recommendation 15.11: Race, Language and Culture

To ensure optimal CR participation and enhance secondary prevention outcomes, it is essential to consider socio-cultural and language-specific factors. Patients should be offered an individualised, culturally appropriate CR programme with access to the appropriate tools and resources required for a multilingual, multicultural population.

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Appendices

Appendix A Guideline Process and Methodology

17.0 National CR Guidelines were last published by the IACR in 2013.[5] Since then, most major international CR guidelines[7,8,23,24,28,30,31,38] have been revised and updated, other than Canada's, which are currently being updated. In order to revise and update IACR guidelines, a GDG was formed comprised of IACR council members.

After careful consideration and discussion, it was decided by the GDG to undertake this objective exercise by systematically reviewing all the major CR international guidelines published since 2013. The group sought to critically appraise these, then subsequently develop a set of guidelines that best reflect international best practice, tailored to the Irish healthcare context. In contrast to a more subjective approach, some benefits of this process lay in the fact that whereas some CR guidelines may be particularly strong in areas such as health behaviour change, other guidelines, for example, may have been stronger on the detail of the exercise component, and the adopted process enabled the IACR guidelines to benefit from the strengths of each. The adopted approach also served to improve transparency. The specific intention was to provide an operational framework document that can assist healthcare staff in the day-to-day management of a CR service. The structure of document was also designed with the specific objective of reflecting the chronological journey of the person through a CR programme.

17.2 A comprehensive systematic literature search was conducted with the assistance of a librarian.

The search strategy used by Mehra *et al.,* (2019) (Systematic Review of Cardiac Rehabilitation Guidelines: Quality and Scope)[347] was updated to include CR guidelines published in the English language since 2019 and inclusive of the period January 2014 to May 2023. The following search terms were used: ''ischemic heart disease'' OR ''ischaemic heart disease'' OR ''myocardial ischemia'' OR ''coronary artery disease'' AND ''rehabilitation'' AND ''guideline.'' The search was performed on May 16th 2023. Multiple sources were searched including academic databases, professional CR society websites and guideline repositories (Figure 3).[348] When combined there was a total of 284 titles/abstracts to be screened. Thereafter, all titles and abstracts of identified citations and identified CR guidelines were screened and CR guidelines meeting the inclusion criteria were included. This process is outlined in Figure 3. Of the 14 CR guidelines initially considered eligible, one was excluded. It was an expert opinion paper rather than a guideline (Jegier *et al*., 2021),[349] and the full exercise-prescription component was reported in a companion paper that was not available in English. The process was updated on October 15th, 2025, to incorporate CR guidelines published after May 16th, 2023. This update led to the identification of one additional eligible publication, which was subsequently included.[22]

The final selected CR guidelines which were appraised are listed in Table 3. Recommendations (including categorisation of strength) and level of evidence rating for each CR element were extracted from each of the identified CR guidelines. A decision matrix table composed of the extracted recommendations was compiled using an excel spreadsheet. This can be accessed here: CR Guideline Matrix

17.3 The GDG considered each recommendation in turn and developed a summary of the most important and contextually appropriate major recommendations. These adopted recommendations form the basis of the updated IACR (2025) guidelines. In the few instances where the CR guidelines reviewed did not provide sufficient detail or clarity for elements of the patient journey, other sources of evidence have been included. The composition of the guideline writing committee was multi-disciplinary ensuring that multiple health professions/disciplines were represented in addition to academic expertise. Further reviews were conducted by CR MDT members specific to their area of expertise (*e.g.* registered dietitians in CR). The final document was also subject to external international peer review. All members of the GDG provided written declarations of interest. The GDG, contributors and reviewers are acknowledged in Table 2.

GDG Member	Employer	Position	
Professor David Hevey	Trinity College Dublin	Professor in Clinical Health Psychology, Trinity College Dublin	Chair
Sophie Charles	HSE	CR Coordinator, St Columcilles Hospital, Loughlinstown, Dublin	IACR Council Member
Professor Frank Doyle	Royal College of Surgeons in Ireland	Associate Professor, Royal College of Surgeons in Ireland	IACR Council Member
Jonathan Gallagher	HSE	Senior Psychologist, Department of Cardiology (Cardiac Rehabilitation) Beaumont Hospital, Dublin	IACR Council Member
Stephen Giffney	HSE	CR Coordinator, University Hospital, Waterford	IACR Council Member
Deirdre O'Reilly	HSE	CR Coordinator, Roscommon University Hospital, Roscommon	IACR President
Contributors			
Dr Cathy Breen	HSE	Interim Dietetic Lead – National Clinical Programme for Diabetes & Clinical Specialist Dietitian in Diabetes & Obesity, St Columcille's Hospital, Loughlinstown, Dublin	
Emma Kennedy	HSE	Clinical Specialist Dietitian, Beaumont Hospital, Dublin	
Sadhbh Ní Cheallaigh	HSE	Senior Pharmacist (Cardiology), Pharmacy Department, Beaumont Hospital, Dublin	IACR Council Member
John Hayden	HSE	Senior Physiotherapist, University Hospital Waterford	
Andrew Simpson	Royal College of Surgeons in Ireland	Associate Librarian, Education, Research and Clinical Support	
Reviewers			
Prof Randal Thomas MD, MS		Professor of Medicine, Department of Cardiovascular Medicine,Division of Preventive Cardiology,Mayo Clinic, Rochester, Minnesota USA	
Prof. Borut Jug, MD, PhD, FESC		Professor of Medicine, Head of the Department of Vascular Medicine University Medical Centre Ljubljana, Slovenia Chair, Working Group for Preventive Cardiology Slovenian Society of Cardiology National coordinator Slovenian Cardiac Rehabilitation Network	
David J. Sheahan		Patient Representative	
Dan Smyth		Patient Representative	

Table 2 Guideline Development Group, Contributors and Reviewers. GDG, Guideline development group; HSE, Health Service Executive; IACR, Irish Association of Cardiac Rehabilitation

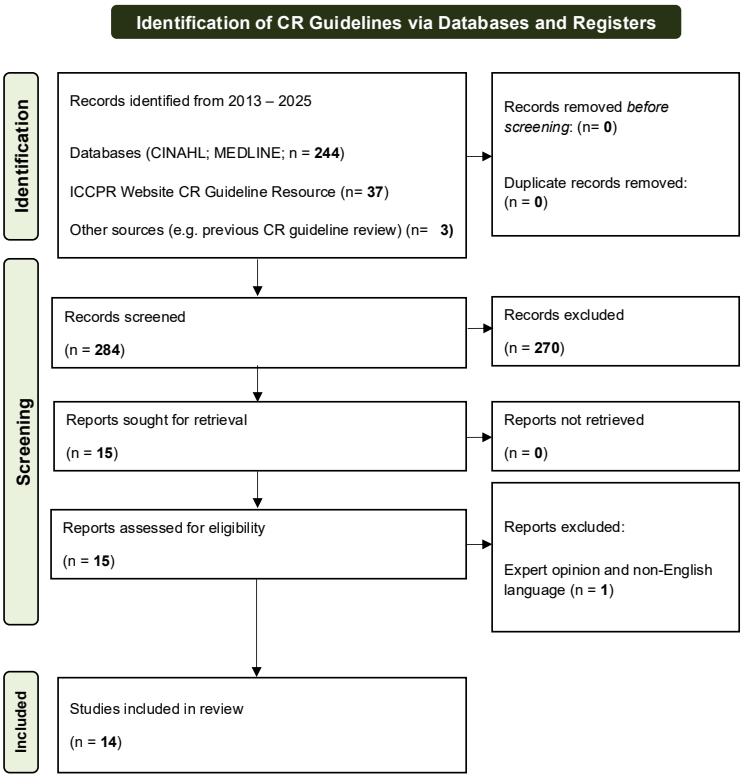


Figure 2 Outline of CR Guideline Identification and Selection Process

PRISMA 2020 flow diagram which includes searches of databases, registers and other sources. [349]

CR Guidelines Included in Process		Year Published
American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR) [8]	Guidelines for Cardiac Rehabilitation Programs	2021
National Heart Foundation of Australia and Australian Cardiovascular Health and Rehabilitation Association [30]	A Pathway to Cardiac Recovery Standardised Program content for Phase II Cardiac Rehabilitation	2019
Brazilian Society of Cardiology (SBC) [21]	Brazilian Cardiovascular Rehabilitation Guideline	2020
British Association for Cardiovascular Prevention and Rehabilitation (BACPR)[26]	The BACPR Standards and Core Components for Cardiovascular Disease Prevention and Rehabilitation	2023
Cardiac Society of Australia and New Zealand (CSANZ) [31]	New Zealand Cardiac Support and Secondary Prevention (Cardiac Rehabilitation) Core Components	2021
European Association of Preventive Cardiology (EAPC) [7]	Secondary prevention through comprehensive cardiovascular rehabilitation: From knowledge to implementation. 2020 update	2021
International Council of Cardiovascular Prevention and Rehabilitation (ICCPR) [33]	Cardiac Rehabilitation Delivery Model for Low-Resource Settings	2016
Japanese Circulation Society/the Japanese Association of Cardiac Rehabilitation Joint Working Group. (JCS/JACR) [12]	Guideline on Rehabilitation in Patients With Cardiovascular Disease	2022
Korean Society of Cardiology (KSC) [29]	Clinical Practice Guideline for Cardiac Rehabilitation in Korea: Recommendations for Cardiac Rehabilitation and Secondary Prevention after Acute Coronary Syndrome	2019
LKardReha-D-A-CH [32,40]	Cardiac Rehabilitation in German Speaking Countries of Europe-Evidence-Based Guidelines from Germany, Austria and Switzerland Part I & 2	2021
Portuguese Society of Cardiology (PSC) [23]	Mandatory Criteria for Cardiac Rehabilitation Programs	2018
Scottish Intercollegiate Guidelines Network (SIGN) [34]	Cardiac rehabilitation - A national clinical guideline	2017
Taiwan Myocardial Infarction Society/ Taiwan Society of Cardiology/ Taiwan Academy of Cardiovascular and Pulmonary Rehabilitation (TAMIS/TSOC/TACVPR) [24]	Consensus Statement for Patients with Acute Myocardial Infarction Rehabilitation	2023
World Health Organisation (WHO) [25]	Package of interventions for rehabilitation: module 4: cardiopulmonary conditions	2023

Table 3 CR Guidelines Reviewed as Part of the IACR (2025) Guideline Development Process

Appendix B: Facilities and Equipment Required for CR Programmes

- Dedicated consultation area for medical evaluation and prescription, psychological evaluation and intervention.[6,7]
- Access to exercise facility with equipment for assessment of functional capacity.[7]
- Dedicated facilities for exercise training with a floor space of approximately $4m^2$ per person.
- Dedicated office space and facilities for CR staff.[8]
- Equipment for assessment of clinical status: sphygmomanometer, access to 12 lead ECG, ECG Telemetry Monitoring.[6,7]
- Access to LV Function Assessment – ECHO; Holter monitoring; Ambulatory BP monitoring.[6,7]
- Equipment to conduct an exercise training programme – aerobic and resistance training.[6,7]
- All areas should provide temperature and humidity control that allow for a comfortable environment. Humidity should be at or below 60%, and temperature should be 20-22 0° Celsius.[8]
- Ceiling height in exercise areas must allow for full, unrestricted activity with a minimum height of 3 metres.[8]
- Sound levels should be kept at a comfortable level that is conducive for conversations between patients and healthcare professionals.[8]
- A water source should be immediately available to all exercise areas.[8]
- A clearly visible RPE scale should be available to all exercise areas.[8]
- To minimise the risk of accidental falls, slip-resistant flooring is mandatory.[19]
- IT infrastructure including relevant software licenses as required.[8]
- The means onsite to summon assistance in the case of emergency and commence life support: Defibrillator, equipment for airway management and ventilation, equipment for intravenous drug administration.[6,7]
- Emergency services available or <10 minutes away.[6,7]

Optimal

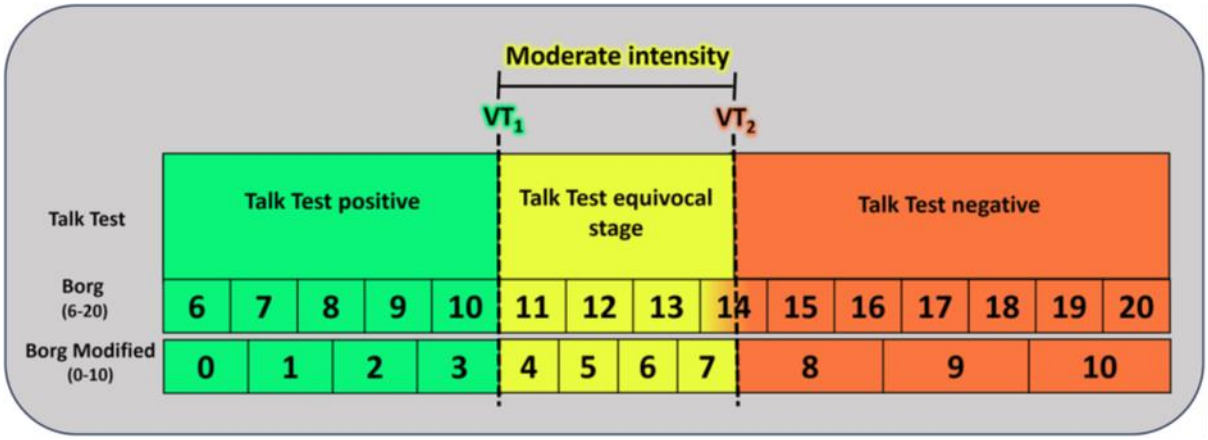
- Specific education area for counselling and group education sessions.[6,7]
- Separate changing area with toilet and shower facilities.[6,7]
- Lockers to safely store patients' belongings while training.[6,7]
- Equipment for assessment of psychosocial status: licensed tests and screening instruments (ideally computerised)[6,7]

General Equipment Considerations

- All equipment should be commercial grade with stringent maintenance guidelines to ensure patient safety.[8,33]
- Equipment should be of sufficient quantity and quality to adequately meet the purpose and intended function for the participating patient population.[8]
- Scheduled maintenance and cleaning programmes for all exercise equipment must be documented.[8]
- Equipment that is not functioning properly or that is damaged (and may cause a hazard) should be designated as out-of-service until repairs are completed.[8]
- Equipment such as treadmills or cycle ergometers should be regularly calibrated and maintained as recommended by the manufacturer.[8]
- CR staff should be thoroughly trained in the proper use of all equipment and manufacturer information for correct use and calibration, and troubleshooting should be readily available.[8]
- The CR facility should provide equipment that can be accessed by people with physical limitations, including the use of a wheelchair, with at least one modality for cardiorespiratory fitness (CRF) and resistance training.[8]
- Food and drink should not be allowed on or near exercise or monitoring equipment.[8]

Appendix C: Borg Rate of Perceived Exertion Scales

Borg Scale [10,11]



(Table from Milani *et al.* 2024 [336])

Modified Borg CR10 Scale

1-10 Borg Rating of Perceived Exertion Scale	
0	Rest
1	Really Easy
2	Easy
3	Moderate
4	Sort of Hard
5	Hard
6	
7	Really Hard
8	
9	Really, Really Hard
10	Maximal, just like my hardest race

Appendix D: Anthropometric Measurement - Waist Circumference

Overweight and Obesity Management: Identifying and assessing overweight, obesity and central adiposity[350]

Method for people to measure their own waist and calculate their waist-to-height ratio [350]
Measure
Find the bottom of the ribs and the top of the hips. Wrap a tape measure around the waist midway between these points (this will be just above the belly button) and breathe out naturally before taking the measurement.
Calculate
Measure waist circumference and height in the same units (either both in centimetres, or both in inches). If you know your height in feet and inches, convert it to inches (for example, 5 feet 7 inches is 67 inches). Divide waist measurement by height measurement. For example: 38 inches divided by 67 inches = waist-to-height ratio of 0.57 or 96.5 cm divided by 170 cm = waist-to-height ratio of 0.57

For more detail refer to https://www.nhs.uk/conditions/obesity/

Appendix E: Stratification of Risk for Cardiac Events during Exercise Participation (AACVPR, 2021)[8]

Characteristics of patients at highest risk for exercise participation (any one or combination of these findings places a patient at HIGH RISK):

- Presence of complex ventricular arrhythmias during exercise testing or recovery
- Presence of angina or other significant symptoms [shortness of breath, light-headedness, or dizziness at low levels of exertion (< 5.0 METs) or during recovery]
- High level of silent ischaemia (ST depression ≥ 2mm from baseline) during exercise testing or recovery
- Presence of abnormal haemodynamics with exercise testing (*i.e.*, chronotropic incompetence or flat/decreasing systolic blood pressure with increasing workloads) or recovery (*i.e.*, severe postexercise hypotension)
- Functional capacity ≤3.0 METs

Non-exercise testing findings
- Left ventricular dysfunction with resting ejection fraction < 35%
- History of cardiac arrest
- Complex dysrhythmia at rest
- Complicated myocardial infarction or incomplete revascularisation procedure
- Presence of heart failure
- Presence of signs or symptoms of post event or post procedure ischaemia
- Presence of clinical depression
- Implanted cardiac defibrillator

Characteristics of patients at moderate risk for exercise participation (any one or combination of these findings places a patient at MODERATE RISK):

- Presence of stable angina or other significant symptoms [*e.g.*, unusual shortness of breath, light-headedness, or dizziness occurring only at high levels of exertion (≥ 7 METs)]
- Mild to moderate level of silent ischaemia during exercise testing or recovery (ST segment depression < 2mm from baseline)
- Functional capacity < 5 METs

Non-exercise testing findings
- Resting left ventricular ejection fraction = 35% to 49%

Characteristics of patients at lowest risk for exercise participation (all characteristics listed must be present for patient to remain at LOW RISK):

- Absence of complex ventricular dysrhythmia during exercise testing or recovery
- Absence of angina or other significant symptoms (*e.g.*, unusual shortness of breath, light-headedness, or dizziness during exercise testing or recovery)
- Presence of normal haemodynamics during exercise testing and recovery (*i.e.*, appropriate increases and decreases in heart rate and systolic blood pressure with increasing workloads and recovery)
- Functional capacity ≥ 7.0 METs

Non-exercise testing findings
- Resting left ventricular ejection fraction ≥ 50%
- Uncomplicated myocardial infarction and/or complete revascularisation procedure
- Absence of complicated ventricular arrhythmias at rest
- Absence of heart failure
- Absence of signs or symptoms of post event of post procedure ischaemia
- Absence of clinical depression

Appendix F: Recommendations for Intensity of Supervision and Monitoring Related to Risk of Exercise Participation (AACVPR, 2021) [8]

Patients at LOWEST RISK for Exercise Related Event

- Direct medical supervision of exercise should optimally occur until a safe and appropriate exercise response during exercise sessions has been demonstrated. This often begins with continuous electrocardiogram (ECG) and decreasing as appropriate (*e.g.*, after 3–6 sessions).

- For a patient to remain at lowest risk, the haemodynamic findings must remain normal; there should be no development or progression of abnormal signs and symptoms or intolerance to exercise within or outside the supervised programme. Progression of the exercise regimen is appropriate.

Patients at MODERATE RISK for Exercise Related Event

- Direct staff supervision of exercise should occur until a safe exercise response has been demonstrated. This begins with continuous ECG monitoring and decreased to intermittent or no ECG monitoring as appropriate (*e.g.*, after 3–6 sessions).

- To move the patient to the lowest-risk category, hemodynamic findings during exercise must be normal; there should be no development or progression of abnormal signs and symptoms or intolerance to exercise within or outside the supervised programme. Progression of the exercise regimen is appropriate.

- Abnormal ECG or haemodynamic findings or the development or progression of abnormal signs and symptoms or intolerance to exercise within or outside of the supervised programme, or the need to dramatically decrease exercise levels, may result in the patient remaining in the moderate-risk category or even moving to the high-risk category.

Patients at HIGHEST RISK for Exercise Related Event

- Direct staff supervision of exercise should occur for a minimum of 18-36 exercise sessions, beginning with continuous ECG monitoring and decreasing to intermittent ECG monitoring as deemed appropriate for the patient by clinical criteria.

- For a patient to move to the moderate-risk category, ECG and haemodynamic findings during exercise should be normal, there should be no development or progression of abnormal signs and symptoms or intolerance to exercise, within or outside the supervised programme. Progression of the exercise regimen is appropriate.

- Findings of the development or progression of ischaemic symptoms such as angina or abnormal ECG or hemodynamic findings during exercise, including intolerance to exercise within or outside the supervised programme, should be evaluated immediately. Significant limitations in the ability to participate may result in discontinuation of the exercise programme until appropriate medical evaluation and intervention, when indicated, can take place.

Appendix G: Sample Orientation Checklist for Exercise Training Sessions

Date	Time	Comments	Initial
		Welcome	
		Orientation to Locations of: **Toilets** **Changing Area** **Shower** **Water Cooler**	
		Explanation of Pre Exercise routines	
		Telemetry	
		Blood Pressure readings	
		Heart rate/pulse recording (before exercise begins)	
		Information Given on Exercising Safely	
		RPE scale demonstrated and explained	
		Exercise intensities, what is moderate intensity	
		Warm-up and cool-down	
		Patients asked to declare any medical or orthopaedic issues that may impair exercise ability	
		Patients instructed to stop and immediately report to staff if they feel unwell during exercise.	
		Patients instructed to report if they are having any difficulty or discomfort/pain with an exercise routine	
		Full demonstration of each Exercise station	
		Information given on infection control precautions and cleaning routines.	
		Explanation of Post Exercise routines	
		Telemetry	
		Blood Pressure readings	
		Finally, reiterate to patients the importance of working at moderate intensity and to stop exercise and report any problems immediately.	

Appendix H: Resistance Training (AACVPR, 2021)[8]; see 9.4

Patient Selection Criteria for Participation in a Resistance Training (RT) Programme
A resistance training (RT) programme is defined here as one in which patients lift weights >50% of their 1 RM. Elastic bands, 1 to 3 lb (0.45-1.3 kg) hand weights and light free weights may be used in a progressive fashion starting at outpatient programme entry provided that no other contraindications exist. When determining whether a patient is eligible to begin RT, CR staff should consider the following:

- Minimum of 6-8 weeks after date of MI or cardiac surgery, including 4 weeks of consistent participation in a supervised CR endurance training programme.
- Minimum of 3 weeks following transcatheter procedures (*e.g.*, PCI), including 2 weeks of consistent participation in a supervised CR endurance training programme.

<u>No evidence of the following conditions:</u>

- Acute congestive heart failure
- Uncontrolled dysrhythmia
- Severe valvular disease
- Uncontrolled hypertension: patients with moderate hypertension (SBP>160 or DBP>100 mmHg) should be referred for appropriate management, although these values are not absolute contraindications for participation in an RT programme.
- Unstable symptoms.

Components of an Exercise Prescription for Muscular Strength and Endurance for Cardiac Patients Cleared for Participation:

Component	Recommendation
Frequency	2 or 3 non-consecutive days of the week
Intensity	Use resistance that allows – 10-15 repetitions without significant fatigue (RPE 11-13 on Borg 6-20 scale) Complete movement through as full a ROM as possible, avoiding breath holding and straining (Valsalva manoeuvre) by exhaling during the exertion phase of the motion and inhaling during the recovery phase. Maintain a secure but not overly-tight grip on the weight handles or bar to prevent an excessive BP response. RPP should not exceed that identified as threshold for CRF exercise Hold to a position of tightness or mild/slight discomfort (not painful)
Type	Variable: Use free weights, weight machines, resistance bands, pulley weights, dumbbells, light wrist- or ankle-weights. Select equipment that is safe, comfortable, effective and accessible
Volume	Perform a minimum of one and maximum 3 sets per exercise, avoiding significant fatigue May increase to two or three sets once accustomed to the regime and, if greater gains are desired , 8-10 different exercises using all major muscle groups of the upper and lower body [*e.g.*, chest press, shoulder press, triceps extension, biceps curl, lateral pull-down, lower back extension, abdominal crunch or curl up, quadriceps extension, leg curl (hamstrings) , and calf raise]
Progression	Training loads may be increased – 5% when the patient can comfortably achieve the upper limit of the prescribed repetition range

Appendix I: Components of an Exercise prescription for Musculoskeletal Flexibility (AACVPR, 2021)[8]

Component	Recommendation
Frequency	≥2-3 days /week; ideally daily
Intensity	Hold to a position of tightness or mild/slight discomfort (not painful)
Time	Gradually increase to 15-30 secs, then as tolerable to 90 secs for each stretch, breathing normally. Do 3-5 repetitions for each exercise
Type	Static, with a major emphasis on the lower back and thigh regions

Appendix J: Nutritional Counselling, Healthy Food Choices

A summary of healthy food choices is provided below. Full details can be found at Secondary prevention through comprehensive cardiovascular rehabilitation: From knowledge to implementation. 2020 update. A position paper from the Secondary Prevention and Rehabilitation Section of the European Association of Preventive Cardiology | European Journal of Preventive Cardiology | Oxford Academic[7]

Nutrient/ Food Group	Dietary Guidelines (EAPC 2021)[7]
Saturated Fats	<10% of total energy intake through replacement by polyunsaturated fatty acids. <7% of total energy intake in the presence of dyslipidaemia.[158]
Trans unsaturated fatty acids	As little as possible, preferably no intake from processed food and <1% of total energy intake from natural origin.
Salt	Less than 5g of salt per day
Protein	High-quality protein sources including lean meat and chicken, fish and plant sources
Fibre	30-45g of fibre per day preferably from wholegrain products Soluble Fibre ≥ 7-13g per day in the presence of dyslipidaemia [158]
Fruit	≥200g of fruit per day (2–3 servings)
Vegetables	≥200g of vegetables per day (2–3 servings)
Fish	1–2 times per week, one of which to be oily
Nuts	30g of unsalted nuts per day
Processed Meats	Processed meat should be minimized
Sugar	Sugar-sweetened soft drinks and alcoholic beverages consumption must be discouraged
Alcohol	Consumption of alcoholic beverages should be limited to two glasses per day (20g/day of alcohol) for men and one glass per day (10g/day of alcohol) for women [6] Consumption of alcoholic beverages should be limited to up to 17 units per week for men and 11 units a week for women. [120] 2-3 alcohol free days per week. Avoid consuming more than 6 standard drinks on any one occasion[120]