وزارة الصحة
Ministry of Health

SAUDI GUIDELINE OF CARDIAC REHABILITATION AND SECONDARY PREVENTION PROGRAMS

2025

1. Introduction

Cardiovascular disease (CVD) is a growing public health concern in Saudi Arabia, largely due to changing lifestyles, urbanization, and rising rates of risk factors like obesity, diabetes, smoking and hypertension. CVD National prevalence in Saudi Arabia is approximately 1.6% of the adult Saudi population who diagnosed with cardiovascular diseases. Cardiac rehabilitation (CR) and secondary prevention programs provide comprehensive medical support for individuals with cardiovascular disease. Numerous studies using a variety of research methods have consistently demonstrated that CR programs offer significant benefits, including reduced comorbidities and mortality rates, enhanced quality of life, improved ability to perform daily activities, and decreases in hospital visits, length of hospital stays, readmissions, and overall healthcare costs.

In Saudi Arabia, the development of cardiac rehabilitation programs supports the goals of Vision 2030's health transformation agenda, which focuses on improving outcomes and quality of life for individuals with cardiovascular disease. Increasing the availability of CR services throughout the country is crucial to managing the rising impact of cardiovascular condition.

1.1 Purpose:

General Administration for Medical Rehabilitation and Extended Care in the Ministry of Health (MOH) in the Kingdom of Saudi Arabia (KSA) had issued the following guideline to clarify the role of rehabilitation in Patients with heart diseases and surgeries in heart centers, MOH, KSA.

1.2 Aim and Scope:

This document serves as a framework and reference guide outlining the essential competencies required for professionals working in cardiac rehabilitation. It also presents the fundamental principles guiding the program. The cardiac rehabilitation team should work as an interdisciplinary unit—collaborating, communicating, sharing knowledge, integrating care, and addressing past errors or safety concerns—to ensure the delivery of a safe, effective, and reliable service.

1.3 Definition of Cardiac Rehabilitation

Cardiac rehabilitation refers to a structured and coordinated set of interventions aimed at positively addressing the root causes of cardiovascular disease (CVD). Its goal is to support individuals in achieving optimal physical, psychological, and social well-being. Through active participation and lifestyle changes, patients are empowered to maintain or regain the highest possible level of functioning, while also slowing down or potentially reversing the progression of their condition.

2. Model of care:

Definition of the Phases of Cardiac Rehabilitation:

Phases	Phase 1	Phase 2	Phase 3
Onset	Acute stage	Early recovery phase	Maintenance phase
Location	Hospitalization	Outpatient	Community
Purpose	Return to daily life	Establish new lifestyle	Comfortable life
Contents	Functional assessment Care planning Bedside physical therapy Instruction on ADLs, diet and drug treatment Education on the importance of rehabilitation counseling	Pathophysiological/ functional assessment - psychological assessment - Exercise stress test - Exercise prescription - Exercise training - Instruction on ADLs, diet and drug treatment - Counseling - Modification of risk factors	Maintain a better lifestyle - Modification of risk factors - Exercise prescription - Exercise training

2.1Phase I Cardiac Rehabilitation

2.1.1 Setting and practical duration

Cardiac rehabilitation typically begins during hospitalization, starting around 48 hours after an acute cardiac event, and continues until the patient is discharged. Phase I of cardiac rehab should commence once the physician confirms the patient's medical stability. In the current healthcare setting, particularly under managed care systems, patients are often discharged within 7 to 10 days following their hospital admission

2.1.1.1 **Objectives**

- Prevent loss of physical capacity.
- Avoid effects of prolonged bed rest.

- Avoid depression.
- Avoid respiratory and thromboembolic complications.
- Facilitate early discharge.
- Provide suitable information to the patient and family.

2.1.1.2 **Inclusion Criteria**

Medically stable post-myocardial infarction (MI)
Post-coronary artery bypass graft (CABG) surgery and others cardiac surgeries
Post-angioplasty
Post-cardiac transplant surgery
Medically stable with other cardiac conditions
Patients undergoing cardiac surgery

2.1.1.3 **Exclusion criteria**

Unstable angina
Acute Congestive Heart Failure
Dysrhythmias
Resting BP's >200/100 mm Hg
Moderate to Severe Aortic Stenosis
Third Degree AV Block
Acute Pericarditis
Recent Embolic Events
Resting ST Segment Depression greater Than 3-4 mm
Uncontrolled Diabetes Mellitus
Moderate to Severe Cardiomyopathies
Orthopedic Problems
Left ventricular failure, cardiogenic shock, persistent hypotension (SBP< 90mmHg)
Persistent supraventricular tachycardia (SVT).

2.1.1.4 **Medical Chart Review**

A thorough review of the patient's medical records is essential for planning appropriate cardiac rehabilitation interventions. The following key questions should guide the chart review process:

- **Primary Diagnosis**
  Identify the patient’s main cardiac condition (e.g., myocardial infarction, aortic stenosis, coronary artery bypass grafting [CABG], etc.).

- **Defibrillation History**
  Determine whether the patient has undergone defibrillation.
- **Surgical History**
  Confirm if the patient has had a CABG procedure.
- **Electrocardiogram (ECG) Findings**
  Analyse the latest ECG report for any abnormalities.
- **Thrombolytic Therapy**
  Check if the patient received thrombolytic agents such as Tissue Plasminogen Activator (tPA) or Streptokinase during the acute phase of myocardial infarction.
- **Lipid Profile**
  Review laboratory results to assess cholesterol and lipid levels.
- **Echocardiogram Results**
  Evaluate for structural or functional abnormalities, including hypokinesis of the septum or ventricular wall, wall thickness, and left ventricular ejection fraction (LVEF). An LVEF >60% is normal; values <35% may limit participation in intensive physical activity.
- **Coronary Angiography**
  If performed, review the catheterization report to identify which coronary vessels are affected and the degree of stenosis.
- **Pulmonary Function Test (PFT)**
  Determine whether a PFT was conducted and whether it indicates obstructive or restrictive lung disease.
- **Medication Review**
  Document all current medications the patient is taking, including dosages and indications.
- **Nursing Notes**
  Examine nursing documentation for additional observations regarding the patient's physical and emotional status, mobility, and response to care.

2.1.1.5 **Patient and Family Interview**

Direct communication with the patient and their family is essential to develop an individualized and effective rehabilitation plan. The interview should address the following components:

- **Mental Status:** Ask the patient to describe why they believe they were admitted. This helps assess their orientation, cognitive function, and understanding of their health condition.
- **Symptom History:** Explore the symptoms experienced prior to hospitalization. Focus on typical cardiac symptoms such as: Chest pain or pressure, pain radiating to the left

arm, and/or shortness of breath. This helps establish a timeline and severity of the cardiac event.

- **Cardiovascular Risk Factors:** Identify known risk factors, including Diabetes mellitus, Hypertension, Hyperlipidaemia, Peripheral vascular disease, Positive family history of heart disease.
- **Smoking Status:** Discuss whether the patient has a history of smoking.
- **Family Support and Involvement:** Family participation is a key determinant of successful rehabilitation. Engage family members in patient education and discharge planning. Evaluate their readiness and ability to support the patient at home. Strong family support is linked to improved outcomes and faster recovery.

2.1.1.6 **Initial Physical Assessment:**

This evaluation provides a baseline for physical function and helps identify any musculoskeletal or cardiopulmonary concerns that may affect rehabilitation planning. Key components include:

- **Range of Motion (ROM)**
  Assess for full, pain-free range of motion in all major joints.
- **Muscle Atrophy**
  Observe for any visible signs of muscle wasting or asymmetry in the limbs.
- **Muscle Strength**
  Evaluate upper and lower limb strength using standardized grading scales to identify any deficits or imbalances.
- **Skin Color**
  Inspect for normal skin coloration and note any signs of cyanosis, pallor, or other abnormalities.
- **Peripheral Pulses**
  Check peripheral pulses for strength and symmetry. Pulses should be palpable, strong, and equal bilaterally.
- **Surgical Sites**
  Identify any surgical incisions, particularly on the thorax or extremities. Assess for signs of infection, healing status, and associated discomfort.
- **Chest Wall Assessment**
  Palpate the chest wall for tenderness. Evaluate for normal anterior-posterior chest expansion during inhalation and observe for appropriate lower rib movement (lateral flaring) during deep inspiration.

- **Blood Pressure Measurement**
  Measure blood pressure in both arms and compare values. Differences between sides may indicate vascular irregularities requiring further investigation.

2.1.1.7 **Key Points for physical activity Tolerance assessment**

The occupational therapist should assess the patient's ability to perform basic self-care tasks—such as grooming and dressing—while in supine, sitting, and standing positions. The patient passes this evaluation if they complete these activities without experiencing dizziness, excessive fatigue, syncope, chest pain, abnormal heart rate, blood pressure changes, or ECG abnormalities.

2.1.1.8 **Key Points of Early Mobilization**

Early mobilization plays a critical role in cardiac rehabilitation and should be conducted with close physiological monitoring. Key elements include:

- **Initiation of a Supervised Walking Program**
  Begin with short-distance walking (approximately 25–50 feet) under therapist supervision. The patient should be connected to telemetry for continuous heart rate and rhythm monitoring.
- **Blood Pressure Monitoring**
  Measure blood pressure every 3–4 minutes during mobilization to monitor hemodynamic stability.
- **Gradual Progression**
  Following a rest period, walking may be repeated and progressively increased in duration based on the patient's tolerance, subjective symptoms, and stable vital signs (heart rate, blood pressure, and ECG findings).
- **Exercise Tolerance**
  Activity should be advanced only if the patient exhibits no adverse signs such as arrhythmia, hypotension, abnormal heart rate response, or excessive fatigue.

2.1.1.9 **Phase-1 protocol**

Level	Period	Activities
1	**Day of admission**	○ Complete Bed Rest ○ Relaxation ○ Breathing exercises ○ Active range of motion (AROM) for ankles, feet, fingers, and wrists (5 reps, 3 times/day)

2	**Days 1 ,2**	○ Partial Bed Rest ○ Continuing relaxation and breathing exercises ○ Sit up for 1–2 hours/day and begin self-feeding Sitting (1 – 2 hours / day) and self-feeding ○ Active range of motion exercises to hip and knee 5 reps, 3 times/day ○ Sitting — arm bending / stretching up / bending (5 reps, 3 times/day ○ progress sitting time 3 – 4 hours / day ○ Independent in toileting ○ Alternate heel drags ○ Static quadriceps and glutei 5 reps, 3 times/day ○ Static spinal extension 5 reps, 3 times/day
3	**Days 3,5**	○ Progress previous exercises to 10 repetitions ○ Walk within room thrice a day ○ Standing — Upper limb flexion five repetitions thrice a day ○ Walk-standing — lower limb flexion five repetitions thrice a day ○ Stride-standing — hip and knee flexion (five repetitions thrice a day ○ Walking outside the room thrice a day ○ Bend standing — elbow circling ○ Walking outside the room with arm swings ○ Climbing one flight of steps

2.1.1.10 **Traditional Mobilization Protocol for Post-Surgical Patients**

Mobilization following cardiac surgery should follow a progressive, structured approach to promote recovery and prevent complications. The stages outlined below provide a guideline for advancing patient activity levels:

Stage	**Mobilization Goal**
Stage 1	Patient sits up in bed and performs lower limb exercises.
Stage 2	Patient sits out of bed once or twice daily for approximately 30 minutes to 1 hour.
Stage 3	Patient sits out of bed for extended periods, including during all meals.
Stage 4	Patient walks independently within the room, including to the toilet and shower.
Stage 5	Patient sits out of bed for meals and as desired and walks freely without assistance.

2.1.1.11 **General Exercise Guidelines for Cardiac Rehabilitation (In-Unit and Home Settings)**

Condition	**Recommendation**
Exercise When Feeling Well	Exercise should only be done when the patient feels healthy. Activity should be postponed for at least 48 hours after symptoms of fever, cold, or influenza resolve.
Post-Meal Exercise	Avoid intensive exercise immediately after eating. Wait at least 2 hours after a large meal before exercising.
Hydration	Ensure adequate hydration by drinking water before, during, and after exercise.
Weather Considerations	Adapt exercise based on weather conditions. Extra care should be taken in extreme heat or cold temperatures.
Monitoring Symptoms	Immediately stop exercise if the patient experiences angina, headache, dizziness, breathlessness, muscle cramps, or palpitations.
Appropriate Clothing and Footwear	Wear comfortable, weather-appropriate clothing and supportive footwear. Protect the head from cold and wind.

2.1.1.12 **Patients are instructed to be very attentive to any signs of excessive intensity:**

Clinical signs of excessive exercise intensity
○ Inability to Maintain Intensity: If patients struggle to sustain exercise intensity toward the end of the session, they should slow down to finish feeling energized. ○ Difficulty Speaking: If talking becomes challenging during exercise, the pace should be reduced. ○ Dizziness or Dyspnea: These symptoms may indicate insufficient cool down or excessive effort. ○ Chronic Fatigue: Patients experiencing persistent tiredness should take more breaks and shorten exercise duration. ○ Joint Pain: If joint pain occurs, it may indicate overexertion. Patients should stop the activity or decrease intensity.

2.1.1.13 **Discharge planning:**

Effective discharge planning is essential to ensure continuity of care and optimal recovery. Key components include:

- **Evaluation for Discharge Readiness**: Assess the patient's medical stability and functional capacity to determine suitability for discharge.
- **Comprehensive Discharge Instructions**: Provide clear information on medications, activity guidelines, symptom monitoring, and follow-up care.

- **Referral to Outpatient Cardiac Rehabilitation**: Ensure all eligible patients are referred to a structured outpatient cardiac rehabilitation program for continued support and risk factor management.

At the end of Phase I cardiac rehabilitation, most patients recovering from an uncomplicated myocardial infarction (MI) should be able to ambulate multiple times daily with gradually increasing distances. If the patient displays unusual symptoms during the walking times - dysrhythmias, shortness of breath, the development of crackles in the lungs where none existed prior to exercise, sharp increases in HR and BP with light activity, onset of syncope, vertigo, and other stress symptoms - they must be referred to them in-charge physician before additional exercise times are undertaken.

Most patients with an uncomplicated, moderate-sized MI will successfully complete Phase I. Typically, a short home recovery period (approximately two weeks) is advised before initiating Phase II rehabilitation. At that point, patients may undergo a graded exercise test (e.g., Bruce protocol) to assess their exercise capacity and guide the next phase of structured outpatient rehabilitation.

2.2Phase II- Out Patient Cardiac Rehabilitation

2.2.1 Objectives

The goals of Phase II cardiac rehabilitation focus on improving physical, mental, and cardiovascular health outcomes. Key objectives include:

1. Enhance exercise tolerance and functional capacity.
2. Improve lipid profile and blood pressure control.
3. Support optimal blood glucose management.
4. Reduce anxiety, depression, and emotional distress.
5. Promote independence in activities of daily living (ADLs).
6. Restore confidence and overall well-being.
7. Facilitate return to work and recreational activities.
8. Decrease hospital readmissions and medical visits.
9. Minimize reliance on medications through lifestyle change.
10.

2.2.2 Referral system

Patients are referred to cardiac rehabilitation by a cardiologist or cardiac surgeon. Upon referral, the cardiac rehabilitation physician will assess the patient's eligibility. Participation should be offered to all eligible cardiac patients, with inclusion and exclusion criteria applied to ensure safety.

2.2.3 Inclusion Criteria

- Post-myocardial infarction (MI).
- Stable angina.

- Coronary artery disease (CAD).
- Heart failure (stable).
- Congenital heart disease.
- Coronary artery bypass grafting (CABG).
- Percutaneous coronary intervention (PCI).
- Valve repair or replacement.
- Cardiomyopathy.
- Cardiac pacemaker or implantable cardioverter defibrillator (ICD).
- Cardiac transplantation.
- Peripheral arterial disease (PAD).
- Atrial fibrillation (controlled).
- Individuals at high risk of CAD (e.g., with diabetes, dyslipidaemia, or hypertension).
- Other cardiac surgical procedures, as clinically indicated.

2.2.4 Exclusion Criteria

- Unstable angina.
- Ischemic changes observed on resting ECG.
- Resting systolic blood pressure ≥200 mmHg or diastolic BP ≥110 mmHg.
- Symptomatic orthostatic hypotension (drop in BP >10 mmHg with symptoms).
- Critical aortic stenosis.
- Active or uncontrolled inflammatory or infectious cardiac conditions.
- Severe obstructive cardiomyopathy.
- Acute systemic illness or active fever.
- Pulmonary arterial hypertension >60 mmHg.
- Uncontrolled atrial or ventricular arrhythmias.
- Uncontrolled sinus tachycardia (>120 bpm).
- Decompensated (uncompensated) congestive heart failure (CHF).
- Third-degree atrioventricular (AV) block without pacemaker.
- Active pericarditis or myocarditis.
- Thrombophlebitis.
- Uncontrolled diabetes (resting blood glucose >400 mg/dL).
- Severe orthopaedic limitations preventing safe participation in exercise.
- Significant metabolic disorders (e.g., acute thyroid dysfunction, severe electrolyte imbalances such as hypo/hyperkalaemia).
- History of cardiac arrest without subsequent revascularization.
- Resting ST-segment displacement >3 mm.
- Significant cognitive impairment or mental health issues impacting participation.
- Educational or communication barriers that prevent engagement with the rehabilitation process.

2.2.5 Patient Assessment

Patients should undergo early assessment and individualized screening before initiating physical activity or exercise. Referral documentation must include baseline demographic data, clinical diagnosis, relevant investigations, and treatment history to guide safe and effective rehabilitation planning.

2.2.5.1 **Medical history**

A comprehensive assessment must be completed prior to initiating cardiac rehabilitation to ensure safety, tailor the care plan, and optimize outcomes. The evaluation should include the following components:

- **Cardiac History and Diagnostic Information**
    - Review of prior cardiovascular procedures (e.g., angioplasty, stent placement, CABG, valve surgery, pacemaker, defibrillator) with confirmed diagnosis.
    - Echocardiogram findings: cardiac structure, size, pumping function, and left ventricular ejection fraction (LVEF).
    - Additional cardiac imaging and diagnostic test results as applicable.
    - Documentation of comorbidities: diabetes, hypertension, dyslipidemia, chronic kidney disease, obesity, COPD, and other pulmonary conditions.
    - Date of most recent influenza vaccination.
    - Identification of any educational or cognitive barriers that may affect participation.
- **Symptom Assessment**

    Presence or history of cardiovascular symptoms including:
    - Chest pain, tightness, or angina.
    - Dyspnea or shortness of breath.
    - Cough or respiratory distress.
    - Musculoskeletal pain.
    - Pain in the neck, jaw, or throat.
    - Ascites or fluid retention.
    - Orthopnea.
    - Tachycardia.
    - Dizziness, syncope, or vertigo
    - Cyanosis.
    - Fatigue or fever.
    - Skin rashes.

- **Medication Review**
    - Current medication list.
    - Assessment of adherence and patient compliance.
    - Notation of any adverse effects experienced.
- **Hospitalization History**
    - Date(s) of most recent hospital admission(s).
    - Length of hospital stay.
    - Reason for readmission.
- **Functional and Physical Assessment**
    - Identification of physical or orthopedic limitations that may impact mobility or exercise participation.
- **Cardiovascular Risk Factor Screening**

  Family history of cardiovascular conditions (e.g., myocardial infarction, stroke, hypertension, sudden cardiac death).

  Assessment of:
    - Blood cholesterol and triglyceride levels.
    - Blood pressure control.
    - Diabetes status.
    - Smoking status (current, former, never smoked.
    - Body mass index (BMI) for obesity screening.
    - Physical inactivity using validated tools (e.g., GPPAQ).
    - Presence of excessive psychological stress.
- **Previous Cardiac Rehabilitation Participation**
    - History of prior CR program involvement (attendance, number of sessions completed, patient goal achievement).
    - Documentation of any adverse cardiovascular events during previous CR.
    - Reasons for non-completion, if applicable.
- **Additional Medical History**
    - Review of other significant past or chronic medical conditions not previously listed.

2.2.5.2 **Physical measures:**

- **Vital Signs**: Blood pressure, heart rate, and rhythm.
- **Cardiovascular and Pulmonary Examination**: Includes observation, palpation, percussion, and auscultation.
- **Oxygen Saturation (SpO_2)**: Particularly in patients with pulmonary hypertension, adult congenital heart disease (ACHD), or known lung pathology.
- **Body Weight and Height.**
- **Body Mass Index (BMI).**
- **Waist Circumference.**
- **Cognitive Function**: Assessed using the Cognitive Failures Questionnaire (CFQ).
- **Quality of Life Assessment**: Utilize validated tools such as the SF-36 Health Survey.

2.2.5.3 **Medical investigations**

- **Electrocardiogram (ECG).**
- **Exercise Testing**: ECG-based Exercise Tolerance Test (ETT) or Cardiopulmonary Exercise Testing (CPET).
- **Echocardiography**: Resting or stress echocardiogram, including Dobutamine Stress Echo (DSE) as indicated.
- **Cardiac Imaging**: Diagnostic coronary angiography, Cardiac MRI, or Cardiac CT as clinically appropriate.
- **Cardiac Biomarkers**: Troponin T/I, Creatine Kinase (CK), B-type Natriuretic Peptide (BNP).
- **Laboratory Tests**:
  - Complete Blood Count (CBC).
  - Serum electrolytes.
  - Renal and liver function tests.
  - Fasting blood glucose and glucose monitoring.
  - Lipid profile including LDL-C, HDL-C, and triglycerides.

2.2.5.4 **Plan and intervention:**

Important objectives

The following objectives should guide the development and implementation of individualized care plans during Phase II cardiac rehabilitation:

- Maintain **comprehensive written documentation** of the patient's care plan for use by the cardiac rehabilitation team.
- Develop a **personalized intervention plan** aimed at reducing cardiovascular risk factors and managing persistent symptoms.
- Promote **patient education** to enhance long-term health outcomes and overall quality of life.
- Support **medication adherence** and initiate or adjust pharmacologic therapy as appropriate.
- Ensure patients are prescribed and maintained on **evidence-based medications**, as indicated, including:
    - Aspirin and/or clopidogrel.
    - Dual antiplatelet therapy.
    - Lipid-lowering agents.
    - Beta-blockers (especially post-myocardial infarction).
    - ACE inhibitors, ARBs, aldosterone antagonists.
    - Calcium channel blockers, anticoagulants, and diuretics.
- Perform **routine assessment of post-procedural wound sites** to monitor for infection or complications.
- Maintain **ongoing communication with the referring physician** or specialist when clinical updates, clarification, or changes in care are required.

2.2.6 Nutritional intervention

Assessment

- Assess dietary habits, including meal/snack frequency and dining out, using validated tools.
- Evaluate disordered eating behaviors using the Adult Eating Behavior Questionnaire.
- Review lab results and anthropometric measurements.
- Estimate total daily calorie needs using standard REE formulas (1,34):
    - *Males*: 66.47 + 13.75(weight, kg) + 5(height, cm) – 6.76(age, yrs.)
    - *Females*: 655.1 + 9.65(weight, kg) + 1.84(height, cm) – 4.68(age, yrs.)
- Evaluate nutrient intake risks related to weight, hypertension, diabetes, heart failure, kidney disease, and comorbidities.
- Determine appropriate intake of fat, carbohydrate, protein, cholesterol, sodium, and other nutrients per individual needs.

Intervention & Plan

- Provide individualized nutrition therapy for cardiovascular disease prevention based on clinical status.
- Recommend a heart-healthy diet as a foundation for cardiac rehabilitation, with adjustments for specific populations as needed.

Healthy diet characteristics (98)
Saturated fatty acids account for <10% of total energy intake, through replacement by polyunsaturated fatty acids.
<5 g of salt per day
30–45 g of fiber per day, preferably from wholegrain products.
≥200 g of fruit per day
≥200 g of vegetables per day
Fish 1–2 times per week, one of which to be oily fish
30 grams unsalted nuts per day.

- Prescribe individualized caloric intake, accounting for energy needs and cardiac rehabilitation activity (<300 kcal/session).
- Educate patients and families on dietary goals and strategies to achieve them.
- Develop dietary plans tailored to specific risk factors (e.g., obesity, hypertension, diabetes).
- Ensure adherence to prescribed dietary recommendations.
- Provide culturally appropriate, personalized dietary advice based on patient needs and abilities.
- Address eating behavior and habit issues through targeted planning.
- Recommend a 10% weight reduction for patients with BMI >30 kg/m².

2.2.7 Risk factor control

2.2.7.1 Lipid Management

Assessment

- Measure fasting HDL, LDL, and triglycerides.
- Review history for modifiable factors affecting lipids (e.g., diet, medications, substance use).
- Evaluate current lipid-lowering therapy and adherence.
- Monitor liver function and creatine kinase in patients on lipid-lowering drugs.
- Assess dietary fat intake.

Intervention and plan

- Initiate nutrition counselling and weight management for patients with LDL >130 mg/dL; consider medication for LDL 100–130 mg/dL.
- Implement lifestyle or medical interventions to raise HDL >35 mg/dL.
- Aim for long-term lipid targets: LDL <100 mg/dL; HDL >35 mg/dL; triglycerides <200 mg/dL.

2.2.7.2 **Hypertension Management**

Assessment

- Measure resting blood pressure.
- Review current antihypertensive therapy and adherence.
- Evaluate sodium and other nutrient intake affecting BP.

Intervention and plan

- For BP 130–139/85–90 mm Hg: implement lifestyle changes (exercise, sodium reduction, weight control, smoking cessation); consider medication.
- For BP >140/90 mm Hg: initiate both lifestyle changes and pharmacologic treatment:
  - Monitor medication use and effectiveness regularly.
  - Educate on home BP monitoring.
- Adjust interventions until BP <130/85 mm Hg is achieved.

2.2.7.3 **Smoking Cessation**

Assessment

- Determine smoking status (current, former, never); record daily use and duration, including cigars, pipes, chewing tobacco, and second-hand exposure.
- Review tobacco use history, past quit attempts.
- Assess aggression and hostility (Buss–Perry Aggression Questionnaire).
- Evaluate nicotine dependence (e.g., Cigarette Dependence Scale).
- Assess readiness to quit; motivate those not ready.
- Reassess smoking status at every visit.
- Identify psychosocial barriers to cessation.

Intervention and plan

- When the patient confirms smoking, the practitioner selects following suitable strategies:
  -Minimum intervention.
  -Provide relapse prevention problem solving, anticipated threats, practice scenarios.
  -Provide education session.

Optimum intervention

If ready to quit, tailor strategy:

- **Minimum intervention**: (brief advice, relapse prevention, and education).
- **Optimal intervention:** structured cessation programs (individual/group counselling), pharmacotherapy (e.g., bupropion, NRT, varenicline, e-cigarettes if appropriate).
- Provide follow-up via visits or phone for at least 6–12 months.
- Advise avoiding exposure to smoke at home and work.

2.2.7.4 **Weight Management**

Assessment

- Measure BMI, height, weight, and waist circumference.
- Review patient's weight history.
- Assess physical activity using the General Practice Physical Activity Questionnaire (GPPAQ).

Inactive	Sedentary job, no exercise or cycling.
Moderately inactive	Sedentary job with <1 hour/week of exercise or cycling.
Moderately active	• Sedentary job with 1–3 hours/week of exercise or cycling, OR. • Standing job with <1 hour/week of exercise or cycling, OR. • Physical job without additional exercise.
Active	• Sedentary job with ≥3 hours/week of exercise or cycling, OR. • Standing job with 1–2.9 hours/week of exercise or cycling, OR. • Physical job with some additional exercise, OR. • Heavy manual job.

Intervention and plan

For patients with BMI >25 kg/m² and/or waist circumference >102 cm (men) or >88 cm (women):

- Set realistic short- and long-term weight goals, aiming for a 10% reduction over 3–6 months, considering individual risk factors.
- Develop a comprehensive plan including diet, physical activity, and behavioural strategies to achieve a daily energy deficit of 500–1000 kcal, while ensuring adequate nutrient and fibre intake.
- Monitor progress toward weight goals through regular follow-up with a nutrition counsellor.
- Encourage daily physical activity, including extended walking (e.g., 90 minutes), tailored to fitness level.
- Target body weight goals: BMI 18.5–24.9 kg/m² and waist circumference <85 cm (men), <90 cm (women).
- Refer to an obesity clinic if weight goals are not met within the planned timeframe.

2.2.7.5 **Diabetes Management**

Assessment

- Review patient history, current diabetes medications (type and dose).
- Perform fasting plasma glucose test and assess frequency/type of glucose monitoring.
- Screen for hypoglycemia symptoms (e.g., confusion, sweating, tachycardia, nausea) and hyperglycemia signs (e.g., fatigue, neuropathy, thirst).
- Monitor HbA1c and fasting glucose to guide treatment.
- Evaluate dietary intake and nutrition.

Intervention and plan

- Develop a comprehensive plan including diet, weight control, oral hypoglycemics, insulin, and risk factor management.
- Prescribe and monitor medication at the primary care level.
- Educate on prevention and management of post-exercise hypoglycemia:
    1. Check glucose before and after exercise.
    2. Avoid exercise during peak insulin activity.
    3. No hot showers post-training; avoid late evening workouts.
    4. Consume pre-exercise snacks.

Insulin	Start	Peak	End
Hum/Nov/Apidra	10–20 m	1.5–2.5 h	4.5–6 h
Regular	30–45 m	2–3.5 h	2–3.5 h
NPH	1–3 h	4–9 h	14–20 h
Lantus	1–2 h	6 hr	18–26 h
Levemir	1–3 h	8–10	18–26 h

If there is hypoglycaemia during exercise:

1. Stop activity.
2. Rest, eat a snack, hydrate.
3. Resume when glucose >100 mg/dL.
4. Warn of possible delayed hypoglycaemia (24–48 hrs post-exercise).

- Avoid exercise if blood glucose >300 mg/dL.
- Target fasting glucose: 80–110 mg/dL.
- Prescribe diabetic medications as indicated.
- Train patients on proper glucometer use and self-monitoring, especially during unsupervised physical activity.
- Advise insulin-dependent patients to avoid exercise during peak insulin times and inject insulin into the abdomen.

2.2.8 Psychosocial Management

Evaluation

-Assess substance abuse.
-Assess alcohol consumption.
-Evaluate depression by Hospital Anxiety and Depression Scale (HADS) or PATIENT HEALTH QUESTIONNAIRE (PHQ-9).
-Assess quality of life by SF-36 QUESTIONNAIRE.
-Assess Anxiety by Anxiety Screen Questionnaire GAD-7.
-Assess anger and Assess Emotion/mood.
-Identify using of psychotropic medications.

Plan and action

- Psychotherapy counseling in term of adjustment to stress management and health-related lifestyle change (profession, car driving and sex activities resumption)
- Modify patients' environment and identify community resources (special equipment – facilities – social support- specific food, specialist …etc.) to support patient's and.
- Teach self-help strategies for depression and anxiety.
- Develop a plan for continuous management if psychosocial issues are present .

2.2.9 Physical Activity Counseling

Assessment

- Evaluate physical activity using the General Practice Physical Activity Questionnaire (GPPAQ), considering domestic, occupational, and recreational activities.
- Assess activities of daily living.
- Identify barriers to physical activity and the most challenging activities.
- Evaluate readiness to change behavior, self-efficacy, and barriers (e.g., time, motivation, medical issues, energy, social support).

Intervention and plan

- Provide tailored physical activity counselling, including educational materials, and accommodate those with physically demanding jobs.
- Set activity goals: 30 minutes of activity, at least 5 days per week (e.g., parking farther from destinations).
- Recommend low-impact aerobic exercises to reduce injury risk.
- Encourage participation in domestic, occupational, and recreational activities.
- Promote self-care and stress management to enhance well-being.
- Advise avoiding unaccustomed vigorous physical activity and suggest enjoyable activities.
- Advise meeting metabolic requirements for recreational, occupational, and sexual activities (28), and aim for a minimum of 1000 kcal/week from physical activity.
- Provide recommendations to prevent musculoskeletal injuries related to physical activity.

2.2.10 Exercise Training; Baseline Assessment

- Perform exercise stress or tolerance tests as appropriate, with repeats based on clinical changes. The test should assess:
    - Heart rate and rhythm.

- Blood pressure response.
- Symptoms (e.g., shortness of breath, chest pain, dizziness, leg fatigue).
- ST-segment changes.
- Exercise capacity (via 6MWT, METs, peak VO2 in ml/kg/min; 1 MET = 3.5 ml/kg/min).

2.2.10.1 **Maximum Exercise testing by Cardiopulmonary Exercise Testing (CPET):**

CPET is the current gold standard for objectively defining exercise capacity (EC), by measuring the maximum oxygen uptake (VO_2 max). CPET plays an essential role in cardiac rehabilitation by accurately assessing a patient's functional capacity and identifying the limitations of the cardiovascular, pulmonary, and muscular systems during exercise.

Purpose in Cardiac Rehabilitation

- Maximal CPET is essential for:
- Baseline assessment of exercise capacity.
- Risk stratification.
- Detection of ischemia, arrhythmias, or abnormal BP response.
- Tailoring an individualized exercise prescription.
- Monitoring progress and outcomes in cardiac rehabilitation.

Pre-Test Protocol

Patient Screening:

- Detailed history, physical exam, and resting ECG.
- Assess medications (esp. beta-blockers, antiarrhythmics).
- Ensure cardiac stability (no angina, recent MI, uncontrolled arrhythmia, or decompensated HF). (105)

Pre-Test Instructions:

- Light meal 2–3 hours prior.
- Avoid caffeine and smoking.
- Withhold specific meds if instructed (usually continue beta-blockers unless otherwise advised).
- Wear appropriate clothing and shoes.

Equipment

- Cycle ergometer (preferred) or treadmill.

- Metabolic cart for real-time VO_2, VCO_2, VE, RER.
- Continuous 12-lead ECG monitoring.
- Automated BP cuff.
- Pulse oximeter.
- Emergency equipment and trained resuscitation staff available.

CPET Protocol for Cardiac Rehab

Exercise Modality:

- Cycle ergometer is preferred for safety, control, and ease of ECG monitoring.

Protocol Type:

- Ramp or Incremental Protocol
    - Begin with 2–3 min of unloaded cycling.
    - Increase workload 10–20 watts/minute, depending on patient condition.
    - Aim for total test duration of 8–12 minutes.

Termination Criteria

Per AHA guidelines:

Absolute:

- Onset of angina or significant Anginal symptoms.
- Drop in systolic BP >10 mmHg with increased workload.
- Severe desaturation (SpO_2 <80%).
- Signs of poor perfusion (cyanosis, confusion).
- Sustained ventricular tachycardia.
- ST elevation ≥1 mm without Q waves.

Relative:

- Fatigue, shortness of breath, wheezing, leg cramps.
- Hypertensive response: SBP >250 mmHg or DBP >115 mmHg.
- Increasing arrhythmias.
- Exercise-induced bundle branch block.
- Development of BBB making ST interpretation difficult.

Intervention and plan:

Key Parameters Measured in Cardiac Rehab

Functional Capacity:

- Peak VO_2 (mL/kg/min): gold standard for aerobic capacity
    - VO_2 <14 mL/kg/min = poor prognosis in HF.
    - VO_2 >20 mL/kg/min = low risk.

Ventilatory Efficiency:

- VE/VCO_2 slope
  - 34 indicates worse prognosis in cardiac patients.
  - ≤30 is favourable.

Chronotropic Response:

- Ability to reach age-predicted max HR.
- Chronotropic incompetence = HR peak <85% of predicted (or <62% if on beta-blockers).

Anaerobic Threshold (AT):

- Indicates submaximal exercise capacity.
- Important for tailoring initial exercise intensity.
- **Each patient specific aerobic exercise prescription will be designed individually according to the peak VO2 max:**
  - Low risk: Normal ECG, VO_2 >20, no symptoms.
  - Moderate risk: Mild VO_2 reduction, isolated ECG changes.
  - High risk: VO_2 <14mL/kg/min significant arrhythmias, poor BP or HR response.

2.2.10.2 **Submaximal exercises testing ;6MWT**

- The 6 Minute Walk Test is an exercise test used to evaluate aerobic capacity and endurance.

6MWT Equipment:

- Single chair or more, positioned at one end of the walking course.
- A validated scale to catch out dyspnea level (Modified breathlessness scale) and subjective fatigue.
- Sphygmomanometer for blood pressure measurement.
- Pulse oximeter.
- Stopwatch.
- Corridor with flat area 25m.
- oxygen and telephone must be accessible in case of an emergency.
- Portable supplemental oxygen if needed by patient to accomplish exercise test.
- Data sheet and pen.

Before the 6MWT

Ensure that already a medical history is reported for the patient and precautions or contraindications to exercise testing must be considered prior testing process.

Exercise Test Contraindications and Precautions

- Unstable angina* or myocardial infarction among the last month.
- Resting heart rate > 120 beats / min.
- Systolic blood pressure > 200 mmHg ± diastolic blood pressure > 100 mmHg.
- Resting pulse oximetry (SpO2) % < 85%.

Exercise Test Termination Criteria

- Onset of angina or angina-like symptoms.
- Lightheadedness, confusion, pallor, central cyanosis, nausea, cold clammy skin, sweating.
- Patient requests to terminate test.
- Physical or verbal disturbance due to severe fatigue.
- abnormal gait pattern.
- Tachycardia.
- SpO2 < 85%*.
- Failure of heart rate to increase with exercise.

Safety considerations Associated with Exercise Testing

- The health practitioners that supervising the exercise program must be trained efficiently in cardiopulmonary resuscitation.
- crash trolleys" and oxygen must be accessible.
- Ensure adequate well prepared emergency procedures are in place.

Safety Monitoring During Walking Tests

- Using Pulse oximetry to show heart rate and oxygen saturation
- The dyspnea (Borg) score is used to measure the patient's perception of short of breath during physical effort.
- Patient should be instructed to dress comfortably, wear suitable footwear and to avoid having meals for at least one-hour prior testing.
- Any prescribed inhaled bronchodilator medication should be given within one hour of test duration or when the patient arrives for testing.
- The patient should get some rest for at least 15 minutes before starting the test.
- Record: Blood pressure., Heart rate. Oxygen saturation. Dyspnea score.

During the test

- Patient should be monitored for unwanted signs and symptoms.

At the End of the 6MWT

- The distance walked should be marked and determined.
- Seat the patient or keep him stand if he preferably wants.
- Immediately record oxygen saturation (SpO2) %, heart rate and dyspnea scoring on the 6MWT recording sheet.
- Measure the total distance.

If the Patient Stops During the Test

- Allow the patient to sit in a chair if they wish.
- Measure the SpO2% and heart rate.
- Ask patient about the reason for stopping during test.
- stopped time must be recorded (but keep the stopwatch running).
- Once SpO2%>/= 85% the following encouragement should be given (repeat this encouragement every 15 seconds if necessary).
  "Begin walking as soon as you feel ready.
- Monitor the patient for untoward signs and symptoms.

Terminate the Test in the Event of Any of the Following

- Chest pain.
- Evolving mental confusion or lack of coordination.
- Evolving light-headedness.
- Intolerable dyspnea.
- Leg cramps or leg muscle fatigue.
- Persistent SpO2 < 80%. (In a community setting the test may be stopped if SpO2 < 85%)

6mwt calculation

- If walked distance is 220 m in six minutes:
  One-minute distance = 220 ÷ 6 = 36.7 m.
  30-minute distance = 36.7 x 30 = 1100 m.
  80% of 1100 = 880 m in 30 minutes.

Repetition max

- Perform 1Rm test by 1RM = W x (36 / (37 – R)) (76)
- Or 1RM = Weight ÷ (1.0278 – (0.0278 × number of repetitions))
  And then, set the number of repeating as following chart:

Estimated Reps at Percent of 1 Repetition Maximum														
Reps:		1	2	3	4	5	6	7	8	9	10	11	12	15
%1RM	Brzycki	100	95	90	88	86	83	80	78	76	75	72	70	
	Baechle	100	95	93	90	87	85	83	80	77	75		67	65
	dos Remedios	100	92	90	87	85	82		75		70		65	60

- Before participating in the exercise training component of cardiac rehabilitation, all patients should undergo comprehensive assessment, including baseline assessment of fitness/functional capacity and risk stratification This will explore the appropriate (92):
  1- Exercise prescription and intensity.
  2- level of resuscitation training and safety.
  3- Choice of venue (home/community/hospital).

Intervention and plan

- Design tailored exercise prescription of each patient for aerobic and resistance program training depending on findings, risk stratification, comorbidities, program goals and consider the appropriate protocol (1).
- Endurance training must be designed according to 50% to 80% of exercise capacity for exercise stress test (METS and vo2) and 6MWT, i.e., beginning at 50% of maximal workload or VO2 max if available and gradually ramping up to 70%.
- Exercise prescription must specifically determine frequency (F), intensity, duration (D), and modalities including treadmill, walking, cycling, cuff/hand weights, dumbbells, free weights, wall pulleys, and weight machines.
- Educate patient safety issues during exercise.
- Flexibility exercise should be performed throughout the session.
- The exercise prescription should be routinely updated.
- The program is reviewed by a program medical officer before starting.
- Telemetry monitoring is essential during training.
- Home-based programs must be appropriate and suitable.

2.2.11 Stratification for risk of cardiac events

After gathering relevant outcome measures, we can stratify the level of risk for the patients and choose an appropriate protocol accordingly:

Level of risk	Description
Low risk	-No complex ventricular dysrhythmias, no headedness or dizziness during exercise testing. -No angina. -VO_2 >14mL/kg/min -Functional capacity ≥ 7 METS. -Normal hemodynamics during exercise testing. -Gradual raises and drop HR and Systolic Blood Pressure with increasing workloads. - No signs or symptoms of post-event/post-procedure ischemia - No CHF. - No complicated ventricular dysrhythmias at rest. -Uncomplicated MI or revascularization procedure. -Resting Ejection fraction ≥50%.
Moderate Risk	-Angina or other significant symptoms such as unusual Short of Breathing, lightheadedness or dizziness, occurring only at high levels of exertion ≥ 7 METS). -Mild to moderate level of silent ischemia during exercise testing or recovery (ST-segment depression <2 mm from baseline). -Resting Ejection fraction 40 – 49%. -Functional capacity <5 METS.
High risk	- Clinical depression. - Symptoms of post-event/post-procedure ischemia. - Presence of CHF. -VO_2 <14mL/kg/min. - Revascularization procedure or Complicated MI. - Complex dysrhythmias at rest. - History of cardiac arrest. - Resting EF <40%. - Abnormal hemodynamics with exercise testing (i.e. chronotropic incompetence or flat or decreasing SBP with increasing workloads) or recovery (severe post exercise hypotension). - High level of ischemia (ST-segment depression > 2mm from baseline) during exercise testing. - Complex ventricular dysrhythmias during exercise testing. - Angina or other significant symptoms (for example unusual Short of Breath, lightheadedness or dizziness at low levels of exertion (<5METS).

Physical therapist can select the following program

Program	Type of training	Intensity	Duration and frequency of sessions	Program length
American	Aerobic training (treadmill, cycling)	40–80% VO2peak or HRmax based on maximal exercise Test, RPE 11–16	20–60 minutes per session 3–5 sessions per week	12 weeks
	Resistance training (e.g. calisthenics, hand weights, pulleys, dumbbells, free weights, machine weights).	To moderate fatigue (RPE 11–13) 50% 1RM progressing to 60–70% 1RM	1–3 sets of 10–15 reps for 8–10 different exercises 2–3 sessions per week (non-consecutive days)	
	Flexibility training (Static stretching with emphasis on lower back and thigh)	To point of mild discomfort	3–5 reps per exercise, 30–90 seconds for each stretch as tolerable 2–3 sessions per week (non-consecutive days)	
British	Aerobic endurance training	Moderate intensity 40–70% HRR RPE 11–14	20–60 minutes per Session	4–24 weeks (Depending on the status of the patient)
	Resistance training	30–40% 1RM for upper body 50–60% 1RM for lower body Progress to 50–80% 1RM for both	2–4 sets of 8–12 reps for 8–10 muscle groups 2–4 sessions per week	
	Flexibility training (Static, ballistic or PNF stretches)	To point of tightness	2–4 reps, accumulating 60 seconds per stretch 2–3 sessions per week	

European	Aerobic endurance training Walking, jogging, cycling	50–80% VO2 or 40–60% of heart rate reserve; 10/20–14/20 of the Borg Rating of Perceived Exertion	45–60 min at least 3 days/week	3 months
	Resistance training	30–40% of the 1-repetition maximum for the upper body and 40–50% of the 1-repetition maximum for lower body exercises,	12 to 15 repetitions in 1 set repeated two to three times weekly	2 months

2.2.12 Specific protocols

2.2.12.1 **Chronic heart failure**			
Type of training	Intensity	Duration	Frequency and length
Aerobics (stationary cycling-walk-treadmill-	30%-80% hear rate reserved-50-80%MHR-12-14 Borg perceived exertion.	30min.	4 sessions a week for 12 weeks
Resistance training	40–60% 1RM	2–3 set (8–15rep)	2–3 days week

2.2.12.2 **Coronary heart disease**			
Type of training	Intensity	Duration	Frequency and length
Aerobic exercise: walking, jogging, cycling, swimming, rowing, stair climbing, elliptical trainers, aerobic dance	Aerobic exercise: 50%-75% of peak VO_2 or close to anaerobic threshold, or 65%-85% of maximal heart rate; 10-15 beats/min below the level of exercise-induced ischemia	at least 20-30 min (preferably 45-60 min)	least 5/wk.
Resistance training: hand weights, elastic bands,	10-15 repetitions; 1-3 sets of 8-10 different exercises for both		2-3 sessions/wk.

weight machines, calisthenics	upper and lower extremities		
2.2.12.3 **Patients treated with an implantable cardioverter defibrillator (ICD)**			
Type of training	Intensity	Duration	Frequency and length
Aerobic exercise	50– 80% of their estimated maximum heart rate, calculated by Karvonen's formula	30-40min	began after three months and lasted for 12 weeks with sessions twice a week
Resistance training	60–80% of one-repetition maximum		began after three months and lasted for 12 weeks with sessions twice a week
2.2.12.4 **Patients surgical prosthetic valve implantation for aortic stenosis**			
Type of training	Intensity	Duration	Frequency and length
Aerobic exercise arm ergometer or cycle	70% of the maximum predicted peak heart rate (HR	30min	6-day week
2.2.12.5 **Patients with controlled arrhythmias affected by coronary artery disease and type 2 diabetes.**			
Type of training	Intensity	Duration	Frequency and length
Aerobic exercise arm ergometer or cycle	Reach 80% of the maximum heart rate	30min	5 weeks 4 sessions per week
2.2.12.6 **Patients After Coronary Artery Bypass Grafting Surgery**			
Type of training	Intensity	Duration	Frequency and length
Aerobic exercise arm ergometer or cycle	70-80% HRmax	30min	6 wk. 3 times/wk.
2.2.12.7 **Patients with Myocardial Infarction**			
Type of training	Intensity	Duration	Frequency and length
Aerobic exercise arm ergometer or cycle	70% to 85% of heart rate attained during baseline symptom-limited exercise test	35min	24 sessions 3 times/wk.
2.2.12.8 **Patients with Angioplasty**			
Type of training	Intensity	Duration	Frequency and length
Aerobic exercise arm ergometer or cycle	60% of peak oxygen uptake (VO2)	30 min	**2** times/wk six month

2.2.13 Calculating heart reserve rate:

If Training intensity was 40 – 70% HRR

Patient at rest with HR of 60 bpm and achieves a HRmax of 155 during a maximal ECG exercise test.

Calculation of HRR = 155 – 60 = 95 bpm.

Selection of % of HRR 40% of HRR = 0.40 x 95 = 38

38 + 60 = 98 bpm

70% of HRR = 0.70 x 95 = 66.5

66.5 + 60 = 126.5

THR Result: 40 – 70% HRR = 98 to 126.5 bpm

2.2.14 Safety principles in cardiac rehabilitation

Venue and environment

- The recommended size of the gym should be sufficient for patients and equipment.
- Environmental Risk assessment should be regularly done.
- Safe Zoon of Temperature between 18-23oC.
- Well ventilation gym.
- Equipment should be maintained in accordance with local protocols and staff must be aware of operation and safety according to the company booklist.
- Infection control procedures should be followed by health practitioners (hand washing-cleaning of equipment- disposal of sharps -Personal protective).
- At all times, drinking water must be available.
- Crush Car should be accessible and intervened in critical time.
- Crush Car must be daily checked.
- Oxygen delivery devices.
- Fire and telephone system must be available and accessible.

2.2.15 Criteria and condition for cardiac rehabilitation session

Specific Preparations for training session

1-Patient must wear comfortable shoes do not slip and well-suited clothes and suitable for weather.

2- Light eating meal 2 hours prior session.

3-Sufficient Drinking Pre- and post-training.

3- Heavy meal 3 hours before is prohibited.
4- No smoking for ≥ 1 hour.
5-Patient bring his GTN, medications, blood glucose monitor, bottle of water, bronchodilator, towel.
6-Patient must be free of chest pain, breathless, stomach pain, fever, cold, virus, cough, muscle pain, dizziness.
7- Patient capability depending on assessment pre –session must be known.
8- Compliance with the prescribed home exercise.
9- Double check with Risk stratification.

During session

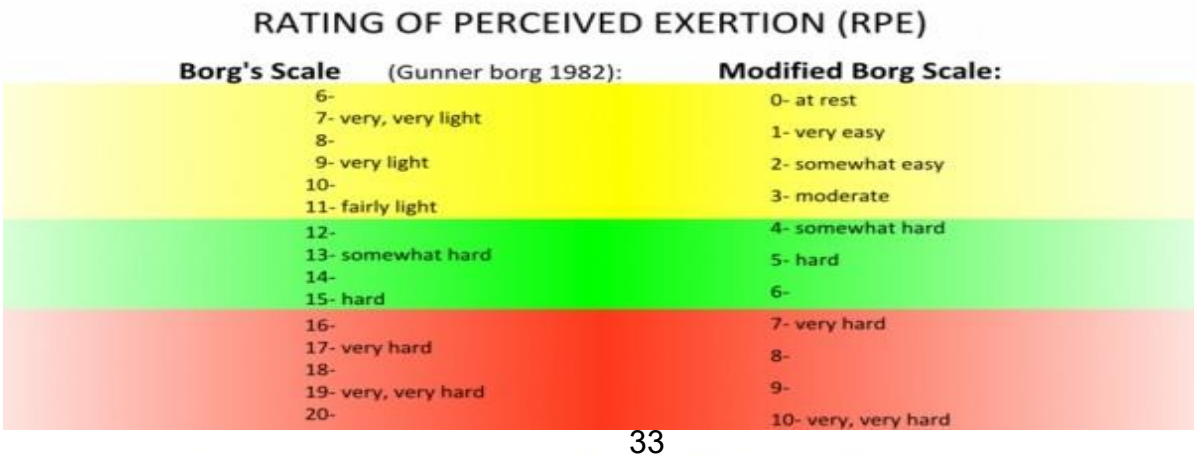
Endurance exercise

- Cardiac training session must include

Warm up	**Main exercise**	**Cool down**
Gradually increased HR 5-10min	Target heart rate 20-30min	Gradually decrease heart rate 5-10min

Warm up phase:

- Begin with static stretching.
- Begin gradually increase workload of heart and slowly raise to target exercise.
- Mobilize joints and warm up all large muscles that will be recruited in the exercise training session.
- By the end of the warmup the following should have been achieved:
- A maximum of 40-50% of peak capacity (MET and vo2).
- A maximum of 40% heart rate reserve (HRR).
- A RPE - BORG <11 (RPE scale) or <3 (CR10).



Conditioning phase

- Frequency: at least 2-3 times weekly basis.
- Intensity: Moderate intensity and patient must be trained at:
- 40%-70% HRR (VO2 max).
- 2 – 4 (CR10 scale).
- 11 – 14 (BORG RPE scale).
- Duration; 20-40 MIN.

Cool down phase

- Gradually, training intensity for 10min with slower speed including stretch exercise.
- Cool down should gradually conversely decline warm up in most respects.
- Patient need 5-10mins of relaxation prior to leaving home.

Resistance training

- Resistance training held after aerobic training.
- 1RM testing is a safe tool for practice and preventing fatigue.
- Focus on action of muscle group during training, rhythmical manner, full range of motion
- Allow muscles to relax between exercises.
- Consider good posture, and balance of antagonist muscle groups, avoid Valsalva maneuver hold, no excessive gripping of weights and no isometric exercises.
- 48 hours should be counted between resistance training sessions.
- Resistance training for patients post heart open surgery is not permitted until the surgical wound completely healed and takes clearance from in charged physician and recommended to begin after 6week post sternotomy (96).
- Cardiac surgery patients will take up to 12 weeks post-surgery to return to ordinary upper body resistance training (96).
- 40%-70% 1RM and probable Upper body 30 - 40% 1RM and Lower body 50 - 60% 1RM.
- < Borg RPE 14 - 16 or 4 - 6 (CR10).
- At least twice per week.
- Training may reach 80% RM if patients are asymptomatic.
- A set 2 – 4.
- Perform 8 - 12 repetitions to boost strength and power.
- Perform 15 - 20 repetitions to boost muscular endurance.

- Recommended frame (shoulder press-triceps extension-biceps curl-quadriceps extension- -leg (hamstring) curl-calf raise).
- Feet should have kept moving during upper body exercise.
- No sudden change in the position of patients, this lead to hypotension. Example from lying to standing.
- Therapist must closely supervise patients who have comorbidities.

Absolute and relative contraindications to resistance training

- Within one week of acute myocardial infarction.
- Decompensated Heart Failure.
- Severe and symptomatic aortic stenosis.
- Acute myocarditis, endocarditis, or pericarditis.
- Uncontrolled hypertension (>180/110 mmHg).
- Postural hypotension.
- blood pressure with symptoms of dizziness or light-headedness).
- Aortic dissection.
- Marfan syndrome.
- Recent embolism.
- Thrombophlebitis.

Relative (should consult a physician before participation)

- Major risk factors for coronary heart disease.
- Diabetes at any age.
- Uncontrolled hypertension (>160/>100 mmHg).
- Low functional capacity (<4 METs).
- Musculoskeletal deficits.
- Individuals who have implanted pacemakers or defibrillators.

Flexibility recommendations

- Prior aerobic and resistance exercise.
- Calf Stretch-Achilles Stretch-Lower Back and Hamstring Stretch-Thigh Stretch.
- Holding time of stretch for 30 seconds.

Monitoring during session:

Patient must be monitored during the session, and the following must be considered:

HR response:

- measured by pulse oximetry or ECG connected by treadmill during training.
- Patient should work within recommended HR training zones following target protocol.
- After the session HR must return to pre-exercise status.
- In certain situations, medication effect on HR should be considered such as beta blocker.

BP response

- BP measured by validated equipment in sitting position.
- BP should be in borderline and consider if the patient is taking anti-hypertensive medication.
- Allow patient to rest for 5 mins and then check.

RPE

- This is assessed by BORG RPE (6 - 20 scale) or CR10 scale

METS and Vo2

- Patient should work within recommended METS zone and vo2 following target protocol

Observation

- Ensure that patient must be free of Dizziness/Lightheadedness, Poor or discoloration, Nausea, disturbance of movement, Excessive sweating, Chest pain, fatigue, breathlessness.
- Compliance with exercise prescription.
- Monitor breathing, position and movement of patient and sure they in the correct manner.
- Use talk test during session.
- Management of severe dyspnea if needed also, you can use O2 supplementation in this situation.
- Pulse oximetry for O2 saturation levels (Normal SpO2 values vary between 94 and 100%). Diminish exercise if:
  - Chest pain or tightness.
  - Fatigue.
  - Palpitation and arrhythmias; compromised of heart rate or sudden raise HR
  - Excessive dyspnea.
  - Suddenly increase of BP.
  - Feeling dizzy, Sickness, nausea.

- Ischemia.
- Joint pain and swelling, muscle spasm.
- Cyanosis, facial pallor, or cold sweat.
- Decrease in SpO2 ≤92%.
- A relaxation/rest duration after the training is incorporated into the program that participants must complete as part of the session before leaving home.

If patient experience angina follows:

Rest and use sublingual 1-2 GTN tablet and wait 5min if pain not relived – again use same mentioned dose and wait 5min if pain not relived – call emergency.

2.2.16 Emergency procedures:

- All cardiac rehabilitation emergency plans should be documented and practiced regularly.
- Establishing such a plan should include consultation with a cardiologist or qualified physician with well cardiac experience.
- Suitable equipment and well training to manage an emergency situation should always be ready or easily accessible during exercise visits.

The following circumstances need to be considered:

- The location where the resuscitation device is kept should be clearly identified and known to staff.
- Resuscitation device must comply with relevant facility standards and be regularly checked following the recommendations of the manufacturer.
- The location where an emergency medications kit is kept should be clearly identified and known to staff.
- Delegated staff assigned to ensure the contents of the emergency medication kit that still intact and no expired. This should be done and documented daily.
- The local ambulance service or in-hospital 'code blue team' should be clearly updated with the place and access points for the cardiac rehabilitation outpatient service.
- All engaged health professional should be qualified in Basic Life Support.
- Engaged Health team should be familiar with the emergency protocols adopted by the program.
- The emergency protocol must be reviewed, signed and approved by the program's medical adviser every 6 months.
- Staff-to-client ratios should allow well-framed supervision of patients, depending on

their functional capacity, symptoms, risk stratification and exercise intensity.

For high-risk patients exercising at moderate-to-high intensity or patients undergoing symptom-limited ETT, the following is recommended:

- A service able defibrillator should be available and accessible in the exercise gym.
- A fully equipped resuscitation box or trolley should be available and accessible in the exercise gym.
- At least one member of the team (preferably two) should be well qualified in Advanced Life Support or ACLS

In emergency event such vital sign collapse, collapsing pulse, weak pulse, activate code blue.

2.2.17 Specific Emergency Protocols

In despite the same principles for exercise training suitable for all individuals, special considerations and adaptations for specific population can be found in the following:

Hypertension

- Isometric exercises are not allowed.
- Reduced intensity of 40% up to 60% HRR (VO2 max).
- No training allowed if resting SBP ≥180mmHg and/or DBP ≥110mg Hg.
- Must be prescribed appropriate antihypertensive drugs before they handle exercise training.
- Check for hypotension or orthostatic hypotension due to anti-hypertensive agents.

Angina

- Carrying GTN tablets or sprays always is crucial.
- No supine position.
- Sudden posture changes are not allowed that can raise intrathoracic pressure.

Ischemia

- Anginal symptoms (chest pain, Nausea, sweeting…etc.) should be monitored in term of identifying frequency, severity or triggers.
- It is essential that program involves relaxation and stress management components.

Open heart surgery

The following common post-operative manifestations impact on physical recovery and should therefore be considered before prescribing exercise:

- Fatigue, persistent sternal pain, Sleep disturbance, dyspnea, pleural effusion, Neck, shoulder, thoracic spine, and lumbar spine discomfort.
- Anemia; significantly more common in geriatric individuals.
- High resting HR
- Postural exercises should be encouraged 24 hours after surgery
- Should perform lower limbs exercises only for 8 weeks' post-surgery.
- Avoid traditional resistive training.

Atrial fibrillation

Exercise intensity should ideally be prescribed according to METs and perceived exertion levels. The use of HR may be inappropriate.

Heart failure

- training HRs zoon for HF population will be approximately 10 – 20 beats lower than in individuals without heart failure.
- Intensity of exercise should be low-moderate levels (35-60% VO2), RPE 10-14 (6-20 scale), 40% or less of HRR.

The progressive of resistive training should be:
- 5-10 reps at < 30% 1RM (RPE <12) x 2-3 week - to learn technique.
- 12-25 reps at 30-40% 1RM (RPE 12-13) x 2-3 week - to improve endurance and coordination.
- 8-15 reps at 40-60% 1RM (RPE <15) x 2-3 week- to enlarge muscular mass.

- Excessive accessory muscle use and muscle fatigue with arm and upper body exercise in very de-conditioned individuals should be avoided.
- Avoid breath holding and Valsalva maneuver.
- Avoid sudden postural changes and stopped activities.
- Avoid keeping legs stationary.
- Encourage leg and calf muscle movements to increase venous return.

Implantable cardiac device

- Activities which may lead to damage to the device itself, or lead displacement must be restricted.
- Start exercise training a minimum of 6 weeks post device implantation to ensure Integrity and safety.
- Keep the exercise HR 10 bpm below shock level.
- Avoid extra end ranges of shoulder movement and/or repetitive vigorous
- shoulder movements.
- Horizontal and seated arm exercises should be kept to a minimum.
- Avoid Valsalva maneuver and sustained isometric work.
- Particularly of the abdominal region, should be avoided especially during arm exercise.
- If patient experiences a shock during an exercise session:
- Sit or lie the individual down
- If the individual recovers quickly and feels well after a shock, referring to physician to device settings may be altered.
- If the individual is still unwell after a shock, local emergency procedures (if in hospital) should be activated, or an ambulance should be called.

Congenital heart disease

- Most patients with ACHD can safely engaged in most forms of activity of low to moderate intensity (4 – 6 METS, 35-55% VO2).
- dynamic exercise is more suitable than static exercise.
- Avoid sudden acceleration or deceleration over short distance.
- Avoid Activity in extreme environmental conditions due to alterations in blood volume, and hydration.

Peripheral arterial disease

Non-weight-bearing exercise (cycle ergometry, arm ergometry, rowing ergometry) may be preferable due to leg pain.

Patients with COPD

Patients with measurable obstruction should be advised to use a bronchodilator agent before starting the exercise.

Chronic renal failure

1-To avoid injury of the arteriovenous fistula and pain in the shunt-arm: the puncture area should be protected with dressing while training.
2-training should be accomplished on the day between hemodialysis treatments
3-No stretching exercises for the upper part of the body.

2.2.18 Specific Medication with exercise considerations

- Some beta-blockers may limit sub-maximal and maximal exercise capacity primarily in patients without myocardial ischemia. Using RPE to monitor training intensity is especially essential for those patients.
- Antihypertensive medications may lead to sudden excessive decline in post exercise BP. Extend and carefully monitor the cool down period carefully under these circumstances. In order to enhance exercise compliance in those individuals, education about the acute or immediate BP-lowering effects of training (known as post-exercise hypotension) is essential.
- Beta-blockers and diuretics may affect thermoregulatory function. Beta-blockers may also cause hypoglycemia. In these circumstances, patients should learn about fluid replacement and precautions when exercising in the heat and the precautions that should be taken to avoid these situations.

2.3Phase III cardiac rehabilitation; Long term management

2.3.1 **By the end of the cardiac rehabilitation program** the patient should be aligned with the following criteria:

- determine the long-term management goals.
- 6-12 months one-year follow-up.
- Home exercise must be designed according to functional capacity test and clinical assessment.

- Combine the home activities with Recreational activities for patients and clarify intensity, frequency, duration, and model.
- Involve families (a partner, relative, close friend) to encourage long-term maintenance.
- Doctor will assess fitness to coach a care.
- Doctor will discuss sexual activity (, level of activity, sexual response cycle, Impact of sexual activity on heart, psychological factors effect on sexual activity, side effect of medication) and prescribe suitable medication.
- Doctor will assess return to work and vocational advice as following (return to work, Retired, planning to change job task, and Changed job).
- Doctor will assess Normal activities of daily living.

2.3.2 Inclusion criteria

- Medically stable
- Successfully completed outpatient CR phase 2.
- Able to exercise independently, effectively and safely.
- Able to achieve an exercise capacity of 5 Mets.
- With low risk of cardiac event.
- Able to achieve 20-30 minutes of continuous physical activity without symptoms.
- Confidence to undertake independent activity

2.3.3 Exclusion criteria.

Patients should not be referred to the training component or should stop attending if any of the following occur:

- Unstable Angina (defined as any or all the following:
- Angina occurring at rest.
- A new event of angina within the past four weeks.
- Angina occurring more easily on less effort.
- Angina does not respond so easily to GTN or fails to respond at all.
- Uncontrolled blood pressure where resting systolic is > 180 mmHg and/or Diastolic 100mmHg>.
- BP drop > 20 mm/Hg demonstrated during Exercise Tolerance Testing.

- Resting pulse rate of greater than 100 beats per minute.
- Uncontrolled arterial or ventricular arrhythmia.
- Unstable or acute heart failure..
- Unstable diabetes
- Patient with severe co-morbidity which prevents safe or effective exercise.
- Patients with severe psychiatric illness who may endanger themselves or others.
- Acute fever or systemic illness.
- musculoskeletal deficits which would prohibit exercise.

2.3.4 Exercise prescription

Mode	Intensity	Duration	Frequency
Flexibility	Stretch until mild discomfort.	Hold 10 to 30 seconds 3 to 5 reps	Before aerobic and strength exercise
Aerobic walking, biking, jogging	Same previous level of heart rate in phase2. until RPE of 12 to 14 Until tolerance - no symptoms.	45 to 60 minutes.	3 - 4 times a week
Strength	Same previous level of 1RM in phase2	Same previous repletion in phase2	Same previous Frequency in phase2

2.3.5 Follow up visiting

Patient must regularly follow up each member of the rehabilitation team during long-term maintenance phase (6-12months) for continuous progress assessment. Long term maintenance phase may be performed via Tele rehabilitation depending on recommendation of rehab team.

Patient responsibilities

- Achieve long-term management goals.
- Know biopsychosocial self-management and monitoring skills.
- Know principle of safety.

- Adhere to instruction perfectly including physical activity, weight control, smoking cessation…. etc.
- Compliance to primary health care visiting.
- Periodic visits to the CR clinic and contacts with the team.
- Ensure compliance with prescribed medications.
- Control risk factors of cardiovascular (diabetic, hypertension, limiting alcohol intake, healthy weight and food, Cholesterol management, control psychological status …etc.)

3. Conclusion

This guideline provides evidence-based documents to help and guide clinical decision-making during CR in all phases of CR. Furthermore, this guideline is sufficient to activate CR program including 3 phases in health facilities. The cardiac center can use this guideline as reference statement for CR team in practicing their tasks in CR.

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