IRISH ASSOCIATION OF CARDIAC REHABILITATION

Cardiac Rehabilitation Guidelines 2013

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Foreword by the Guidelines Committee

These guidelines were developed by the Irish Association of Cardiac Rehabilitation (IACR) based on clinical experience, reviews of the relevant literature and consultation with guidelines developed by other cardiac rehabilitation professional bodies. It is hoped that these guidelines will reflect current best practice in cardiac rehabilitation. It is not the intent of these guidelines to promote a single approach to rehabilitation, but rather to provide an outline of the core components for successful cardiac rehabilitation programme delivery.

Recent years have witnessed an increased recognition that cardiovascular disease (CVD) should be considered as a spectrum of disorders including coronary artery disease, cerebrovascular disease and peripheral arterial disease, particularly as cardiovascular disease does not just manifest itself within the coronary arteries and in light of the fact that individuals are surviving their initial event and are living longer. This current guideline, however, primarily applies to coronary artery disease management as it is the typical manifestation of cardiovascular disease amongst cardiac rehabilitation patients, including patients who have developed heart failure and those that require device therapy. Simultaneously there is a growing need for prevention strategies as there are increasing numbers of younger individuals identified as high risk of developing CVD.

Charlie McCreery (Chair)
Karen Cradock
Noeleen Fallon
Roisin Duffy
Veronica O Doherty
Claire Kingston

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Jonathon Egan (Mater Misericordiae University Hospital)
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Anne Madden (St. Vincent's University Hospital Dublin)
Niamh Lucey (St. Vincent's University Hospital Dublin)
Barbra Dalton (National Coordinator)

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1.0 DEFINITION OF CARDIAC REHABILITATION

Cardiac rehabilitation programmes are integral to the comprehensive care of patients with cardiovascular disease (CVD). Various definitions of cardiac rehabilitation (CR) have been offered in the literature; the World Health Organisation (WHO, 1993) defined cardiac rehabilitation as ***"the sum of activities required to influence favourably the underlying cause of the disease, as well as to ensure patients the best possible physical, mental and social conditions, so that they may by their own efforts, preserve or resume when lost, as normal a place as possible in the life of the community."***

More recently, the Scottish Intercollegiate Guideline Network (SIGN) definition highlighted the role of health professionals and the patient's social network in facilitating recovery: ***"Cardiac Rehabilitation is the process by which patients with cardiac disease, in partnership with a multidisciplinary team of health professionals, are encouraged and supported to achieve and maintain optimal physical and psychosocial health. The involvement of partners, other family members and carers is also important." (SIGN, 2002).*** Both definitions emphasise that CR programmes should consist of a multifaceted and multidisciplinary approach to overall cardiovascular risk reduction; such definitions inform the goals of cardiac rehabilitation.

1.1 GOALS OF CARDIAC REHABILITATION

The goals of cardiac rehabilitation are to promote secondary prevention and to enhance quality of life among cardiac patients (WHO, 1993). The following specific medical, psychological, behavioural, social and health service goals have been identified:

a) Medical Goals

- To improve cardiac function
- To reduce the risk of sudden death and re-infarction
- To relieve symptoms such as breathlessness and angina
- To increase work capacity
- To prevent progression of the underlying atherosclerotic process

b) Psychological Goals

- To restore of self confidence
- To relieve anxiety and depression in participants and their carers
- To relieve or manage stress
- To restore good sexual health

c) Behavioural Goals

- To quit all forms of smoking
- To make heart-healthy dietary choices
- To be physically active
- To adhere to medication regimes

d) Social Goals

- To return to work if appropriate and /or previous level of functional capacity
- To promote independence in activities of daily living for those who are compromised

e) Health Service Goals

- To directly reduce medical cost
- To promote early mobilisation and early discharge from hospital
- To reduce cardiac-related hospital re-admissions

1.2 MULTIDISCIPLINARY CARDIAC REHABILITATION

To achieve the goals of cardiac rehabilitation a multidisciplinary team approach is required. The multidisciplinary team members include:

- Cardiologist/Physician and co-coordinator to lead cardiac rehabilitation (as per Department of Health, 1999)
- Clinical Nurse Specialist
- Clinical nutritionist/Dietitian
- Occupational Therapist
- Pharmacist
- Physiotherapist
- Psychologist
- Smoking cessation counsellor/nurse
- Social worker
- Vocational counsellor
- Clerical Administrator

It is essential that all cardiac rehabilitation staff have appropriate training, qualifications, skills and competencies to practice within their scope of practice and recognise and respect the professional skills of all other disciplines involved in providing comprehensive cardiac rehabilitation.

The cardiac rehabilitation team should actively engage and effectively link with the general practitioner and practice nurses, sports and leisure industry where phase IV is conducted, community pharmacists and other relevant bodies to create a long term approach to CVD management.

2.0 INDIVIDUAL RISK ASSESSMENT

Using a menu-based approach, cardiac rehabilitation can be tailored to meet the needs of the individual. This is based on thorough assessment and evaluation of the patient's cardiovascular risk factor profile on commencement of the program and continued with ongoing assessment and reassessment upon completion of the program. CVD is generally due to a combination of several risk factors and the multifactorial nature of such risk requires comprehensive risk assessment using validated measures which are culturally sensitive and that take into account other co-morbidities.

Risk factors for assessment include:

- Age
- Gender
- Personal Cardiac History
- Family History of CVD
- Diabetes
- Excessive alcohol intake
- Dyslipidaemia
- Hypertension
- Obesity
- Smoking
- Physical Inactivity
- Stress
- Anxiety
- Depression
- Hostility

Other factors to consider

- Social History
- Family Support
- Occupation

A number of the risk factors are non-modifiable (e.g., age, gender, family history) whereas others are potentially modifiable (e.g., cigarette smoking, cholesterol levels). A brief description of the main risk factors is provided below.

2.1 AGE

The lifetime risk of CVD increases with advancing age (Wilson, 2005; Perk *et al*, 2012). The approximate overall lifetime risk of coronary heart disease was 40% in men and 30% in women (Lloyd-Jones *et al*, 1999). With the projected aging of the Irish population the prevalence of CVD is likely to increase.

2.2 GENDER

The natural course of CVD is different for males and females. Men are much more likely to develop coronary heart disease at a younger age than women (Wilson, 2005); however the gender difference decreases with advancing age. Once menopause occurs, women lose the high levels of circulating oestrogen that confers protection from CVD (Wilson, 2005; Perk *et al*, 2012). In post-menopausal women, coronary heart disease (CHD) has been found to be the leading cause of death and disability (Perk *et al*, 2012) and is significantly higher than for other diseases of aging, including fractures, uterine and breast cancer (Wilson, 2005).

2.3 FAMILY HISTORY

Genetic predisposition plays a role in the development of CVD and a detailed family history should be part of the assessment. If one parent has a diagnosis of CVD, the risk of offspring developing CVD is 15% higher than for offspring without parental CVD. This risk rises to 30% if the CVD occurs prematurely i.e. <55 years of age in a male first degree relative and <65years in a female. If both parents develop premature CVD, then the risk rises to 50% (Miller & Vogel, 1996; BACR, 2006).

2.4 DIABETES

Both Type 1 and Type 2 Diabetes are independent risk factors for CVD, and diabetic patients with CVD have a worse prognosis compared to those without diabetes. Data from Finland has led to the concept of type 2 diabetes mellitus as a CVD risk equivalent to that of a person who has already had a myocardial infarction, thus emphasizing the need for aggressive control of risk factors in order to prevent a further cardiac event (Haffner *et al,* 1998; Wilson, 2005). Appropriate glucose control helps prevent microvascular complications and cardiovascular events. Impaired fasting glucose is also a risk for both CVD and Type 2 Diabetes. The glycaemic control treatment target for managing patients with DM or IGT and coronary artery disease as recommended by the European Society of Cardiology in association with the European Association for the Study of Diabetes (2013) is HbA1c (%) generally < 7%, on an individual basis <6.5-6.9%. This recommendation is based on randomized controlled trials demonstrating that lowering HbA1c reduces microvascular and neuropathic complications of diabetes . (American Diabetes Association, 2013).

Initial testing for diagnosis of Diabetes Mellitus should include a fasting venous glucose and concurrent HbA1c measurement. When classic symptoms of hyperglycaemia are present only ***ONE*** of the laboratory measurements below is sufficient to establish diagnosis. In the absence of classic symptoms, any ***TWO*** of the laboratory measurement below may be used to establish a diagnosis of diabetes.

Laboratory Diagnostic Cut-points for diabetes (WHO 2011, ESC/EASD 2013)

IFCC / HbA1c ≥48mmol/L (6.5%)
Fasting Venous Plasma glucose ≥7.0mmol/L
Random Venous Plasma Glucose ≥11.1mmol/L

Impaired glucose tolerance is defined as two-hour glucose levels of 7.8 to 11.0mmol/L on the oral glucose tolerance test, and impaired fasting glucose is defined as glucose levels of 5.6 to 6.9mmol/L in fasting patients (American Diabetes Association, 2013).

2.5 EXCESSIVE ALCOHOL INTAKE

Excessive alcohol intake is a risk factor for CVD. The Department of Health and Children have issued new weekly low risk alcohol limits, with a downward revision from 21 to 17 standard drinks for a man, and from 14 to 11 standard drinks for a woman – with **3 free alcohol days** per week. One standard drink equates to 10 grams of pure alcohol.

One standard drink in Ireland is defined as:

- a glass of stout/lager/cider (284mls), long neck bottle (275mls),
- a small glass of wine (100mls),
- a pub measure of spirits (35mls),

The exact amount of alcohol in each drink depends on the alcohol percentage of that particular drink. This is called the alcohol by volume (ABV). For example, a bottle of wine (750ml) with an ABV of 12% contains 7 standard drinks, while a bottle of wine (750ml) with an ABV of 13.5% contains 8 standard drinks (Hope 2009). Accurate assessment of alcohol consumption is necessary to detect problem drinking; it has been proposed that the CAGE questionnaire is a useful tool for use in clinical practice to assess alcohol dependence (Ewing, 1984; Beresford *et al*, 1990). Documentation of excess alcohol intake and subsequent referral for management should occur during the Cardiac Rehabilitation programme.

2.6 DYSLIPIDEMIA

Strong evidence supports the benefits of lowering serum cholesterol in patients with CVD and a reduction in mortality, cardiac events, hospital admissions and progression of atherosclerosis have been demonstrated (Simvastatin Survival study Group, 1994; Wenger *et al,* 1995; AAVCPR, 2004). Cholesterol evaluation following an overnight fast and early management are the recommendations (NCEP, 2001; AAVCPR, 2004). In the general population, total plasma cholesterol should be below 5mmol/L and Low Density Lipoprotein (LDL) cholesterol should be below 3mmol/L. However in patients with documented CVD the treatment goals are much lower. It is recommended that LDL cholesterol in these very high risk individuals should be <1.8mmol/L or ≥ 50% reduction from baseline LDL cholesterol (Perk *et al*, 2012). This level is associated with the lowest risk of recurrent CVD events in patients with established disease (Baigent *et al,* 2010). These treatment goals are also applicable for individuals with Type 1 or Type 2 Diabetes Mellitus with one or more CV risk factors and/or target organ damage (Perk *et al*, 2012). Treatment goals are not defined for High Density Lipoprotein (HDL) and Triglycerides, but HDL of greater than 1mmol/L (men) and greater than 1.2mmol/L (women), and fasting Triglycerides of greater than 1.7mmol/L are markers of increased cardiovascular risk. It is also useful to consider a patient's total cardiovascular risk when deciding on drug therapy including dosage.

2.7 HYPERTENSION

Hypertension is a major risk factor and is highly prevalent in patients with CVD (AAVCPR, 2004). The terms mild, moderate and severe hypertension are no longer recommended (Perk *et al,* 2012). According to the 2012 Joint European Society of Cardiology (ESC) Guidelines on CVD prevention in clinical practice, normal systolic BP is 120-129mmHg, diastolic 80-84mmHg with high normal defined as systolic 130-139mmHg, diastolic 85-89mmHg. Measurements greater than the latter are graded accordingly to Grade 1, 2 and 3 hypertension (Perk *et al*, 2012). Diagnosis of hypertension should be established by ambulatory blood pressure monitoring. The choice of antihypertensive agents depends on the underlying cardiovascular disease, concomitant disease, the presence or absence of target organ damage and other cardiovascular risk factors. Lifestyle changes (reduction in dietary sodium, excessive alcohol consumption and calorie intake and increase levels of physical activity) are also recommended in the management of hypertension (AAVCPR, 2004; Perk et al,).

2.8 OBESITY

Overweight and obesity is significantly associated with CV morbidity and mortality (Poirier *et al*, 2006, Whitlock *et al*, 2009, Berrington *et al*, 2010, Zheng *et al*., 2010, Perk *et al*, 2012). BMI and waist circumference are the most widely used measurements to identify overweight and obesity. Overweight is defined as a BMI of 25 to 29.9kg/m^2. Obesity is defined as BMI >30kg/m^2. Increasing BMI is associated with increased risk for CVD (Katzmarzyk *et al,* 2012; Perk *et al*, 2012). Central obesity, as measured by waist circumference, may be a better predictor of CVD risk than BMI (SIGN, 2007, Perk *et al*, 2012). Central obesity is present if the waist circumference is ≥102cm in men (≥90cm in Asian men) and ≥88cm in women (≥80cm in Asian women) (Appendix 1). There is currently insufficient evidence however to suggest that waist circumference or direct measurement of fat mass should replace BMI measurement in clinical practice (Perk *et al*, 2012).

2.9 SMOKING

Tobacco smoking has a strong dose-dependent association with both CVD and non-CVD mortality and morbidity (Ambrose, 2004). While cigarette smoking is the most common, all forms of tobacco including pipe smoking, cigars, marijuana and "light" cigarettes have deleterious effects. (Center for Disease Control and Prevention, 2010). The benefits of smoking cessation are reported extensively in the literature (SIGN 2007, Graham *et al*, 2007, IARC 2007). There is a substantial decrease in CVD mortality for former smokers compared with continuing smokers. This diminution in risk occurs relatively soon after smoking cessation in people of all ages, and increasing intervals since the last cigarette smoked are associated with progressively lower mortality rates from CVD (AAVCPR, 2004). Benefits from quitting are apparent even after many years of heavy smoking. Smoking cessation after a myocardial infarction can confer a mortality benefit of 0.64 (95% CI 0.58-0.71) compared with those individuals that continue to smoke (Chow *et al*, 2010).

Current smoking status should be established and history of tobacco use with past attempts to quit discussed. Smoking cessation must be encouraged in all smokers. The five A's (Appendix 2) are a recommended appropriate strategy to assess a person's readiness to quit with follow up monitoring (Perk *et al*, 2012). Exposure to environmental tobacco smoke increases the risk of CHD (Law *et al*, 1997, He *et al*, 1999, Raupach *et al*, 2006), and patients must be advised of same and recommended to avoid unnecessary exposure.

2.10 PHYSICAL INACTIVITY

The National Guidelines for Physical Activity in Ireland (2009) recommended at least 150 minutes a week of moderate physical activity to achieve health benefit. This is an average of 30 minutes of activity five days per week. Individuals who are active are twice less likely to die prematurely of a myocardial infarction than their inactive contemporaries (Leon *et al*, 1997). People who are physically active reduce their risk of developing coronary heart disease, stroke and Type 2 diabetes by 50% and risk of premature death by 20-30% (Wannamethee *et al*, 2001).

2.11 PSYCHOSOCIAL FACTORS:

Psychosocial factors can directly affect Cardiac Rehabilitation and may impact on coronary heart disease (CHD). Psychosocial factors are numerous and include anxiety and depression, personality issues, social isolation, lack of social support, chronic or sub-acute life stress and anger/hostility (Graham *et al*, 2011).

2.11.1 Anxiety and Depression

Anxiety and Depression can be commonly experienced by patients diagnosed with CHD. Both anxiety and depression are associated with increased morbidity and mortality. Although they may be normal responses after a cardiac event and a natural part of recovery after any life-threatening or stressful event, in excess, they may seriously impede rehabilitation. Anxiety may trigger a number of physiological reactions in patients: an increase in circulating lipids, platelet and macrophage cell activation, increased heart rate, high blood pressure and increased myocardial oxygen demand, all of which can potentially contribute to atherosclerosis and acute coronary syndromes, and hence impede rehabilitation (Graham *et al*, 2011). A recent meta-analysis of initially healthy participants found that anxious people had approximately a 25% greater risk of CHD and an almost 50% higher risk of cardiac death than non-anxious individuals over a mean follow-up period of 11.2 years (Roest *et al*, 2010).

Depression as a secondary risk factor is at least as potent as traditional risk factors for patients with CHD, with an estimated prevalence rate of 15% or up to 20% if subclinical or minor depression is included (Lichtman *et al*, 2008). Depression during hospital admission for myocardial infarction is a significant predictor of long-term mortality and morbidity (Graham *et al*, 2011). Psychological treatments have been shown to improve both depression and anxiety, with a small effect for cardiac mortality (Whalley *et al*, 2012).

2.11.2 Personality Issues

Type A and type D personality have been implicated in the pathogenesis of cardiovascular disease. The type A person may respond to stress with hostility or aggression, feel a sense of time pressure, and be competitive and ambitious (Kent & Shapiro, 2009). Recent evidence suggests that the risk of coronary heart problems is linked to the Type A characteristics of hostility and anger (Chida & Steptoe, 2009).

Type D, (the distressed personality), describes patients who experience increased negative emotions and tend to inhibit the expression of these emotions in social interactions. Type D has been associated with increased depression and fatigue (Kent & Shapiro, 2009).

2.11.3 Stress

Stress is defined by psychologists as a perceived discrepancy between the demands placed on the individual and the coping resources available to the individual. Coping resources include the person's personality and the perceived quality of social support available. Activation of the hypothalamic-pituitary-adrenal (HPA) axis and autonomic nervous system (ANS), serotonergic dysfunction, secretion of proinflammatory cytokines, altered autonomic control, and platelet activation are potential mechanisms by which psychosocial stress may contribute to CVD risk.

3.0 CARDIAC REHABILITATION PARTICIPATION

Participation in cardiac rehabilitation programs should be available to all cardiac patients who require it. Age is not and should not be a barrier to cardiac rehabilitation participation. However, consideration of patient safety results in the following specific inclusion/exclusion criteria applying to participation in the Phase III exercise component (AACPVR, 2004).

Inclusion Criteria

- Medically stable post MI
- Coronary artery by-pass surgery (CABG)
- Percutaneous Coronary Intervention (PCI)
- Stable angina
- Stable Heart Failure (NYHA class I - III)
- Cardiomyopathy
- Cardiac Transplantation
- Implantable Cardioverter Defibrillator (ICD)
- Valve Repair/Replacement
- Insertion of Cardiac Pacemakers (with one or more other inclusion criteria)
- Peripheral Arterial Disease
- Post Cerebral Vascular Disease
- At risk of coronary artery disease with diagnosis of diabetes, dyslipidaemia, hypertension etc.

Exclusion Criteria

- Unstable angina
- Ischaemic changes on resting ECG
- Resting systolic blood pressure ≥200mmHg or resting diastolic≥110mmHg should be evaluated on a case by case basis
- Orthostatic blood pressure drop >10mmHg with symptoms
- Critical aortic stenosis (peak pressure gradient >50mmHg with aortic valve orifice <0.75cm^2 in average-size adult)
- Acute systemic illness or fever
- Uncontrolled atrial or ventricular arrhythmias
- Uncontrolled sinus tachycardia (>120bpm)
- Uncompensated CHF
- Acute systemic illness
- 3rd- degree atrioventricular (A-V) block (without pacemaker)
- Active pericarditis or myocarditis
- Recent embolism
- Thromophlebitis
- Uncontrolled diabetes (resting blood glucose >400mg/dL)
- Severe orthopaedic problems that would prohibit exercise
- Other metabolic problems, such as acute thyroiditis, hypo-hyperkalaemia, hypovolaemia etc.

3.1 REFERRAL TO CARDIAC REHABILITATION

An agreed and coordinated referral pathway should be established in order to identify eligible patients and ensure invitation to the program. Each center should agree local policy for referral to their cardiac rehabilitation program. The referral letter should include the patient's name, age, address, contact telephone number, type of cardiac event, date of event, cardiac history, complications, medication, reason for referral, referring person's name and contact number, date of request, and any clinically relevant additional information e.g. results of Exercise Stress Test (EST), Echo, fasting lipid profile and fasting glucose profile.

Patients can be referred to cardiac rehabilitation by:

- Cardiologist/Physician
- Cardiothoracic Surgeon
- Cardiac team (Registrar, SHO, Intern)
- Cardiac Rehabilitation Coordinator
- G.P.
- Coronary Care Unit (CCU) nurses
- Members of Multidisciplinary Team

4.0 CARDIAC REHABILITATION & SECONDARY PREVENTION

Cardiac rehabilitation typically comprises four phases. The term phase is used to describe the varying time frames following a cardiac event. The secondary prevention component of CR requires delivery of exercise training, education and counseling, risk factor intervention and follow up (AAVCPR, 2004).

4.1 PHASE I (IN PATIENT HOSPITAL PERIOD)

The average length of stay is 2-5 days and a member of the cardiac rehabilitation team usually visits the patient in the Coronary Care Unit or ward. The purpose of these visits is to:

- Give support and information to the patient and their families about heart disease
- Assist the patient to identify personal cardiovascular risk factors (See Section 2.0)
- Discuss lifestyle modifications of personal risk factors and help provide an individual plan to support these lifestyle changes
- Gain support from family members to assist the patient in maintaining the necessary progress
- Plan a personal discharge activity program and encourage the patient to adhere to this and commence daily walks
- Inform patients regarding Phase II and Phase III programs, if available, and encourage their attendance

The patient's activity/functional levels are progressed using a staged approach based on the patient's medical condition/diagnosis. The emphasis at this stage is to counteract the negative effects of deconditioning after a cardiac event rather than to promote training adaptations (Woods, 2010). The patient is observed closely for any signs and symptoms of cardiac de-compensation during ambulation.

Educational sessions are initiated in Phase I and may comprise verbal information and the use of both written and audiovisual materials regarding the cardiac event, psychological reactions to the event, cardiac pain/symptom management and correction of cardiac misconceptions. Education materials can be sourced from the Health Promotion Unit and Irish Heart Foundation.

At this stage the patient is provided with an individual plan for self-care and lifestyle change. A discharge plan with instruction in exercise can be formulated at this time. The psychosocial status of the patient can be assessed using a validated structured interview or by self-report questionnaire (Appendix 3). On the basis of the information received during Phase I appropriate referrals are made to members of the multidisciplinary cardiac rehabilitation team such as the social worker or the smoking cessation officer. Driving guidelines from the Road Safety Authority (RSA) can be utilized to clarify any queries in relation to driving a vehicle. Post hospital follow-up arrangements are part of the discharge planning process.

4.2 PHASE II

During the post discharge period prior to commencing the Phase III exercise and education programme, the objectives of Phase II cardiac rehabilitation are to reinforce risk factor modification, provide education and support to the patient and his/her family, and promote continuing adherence with lifestyle recommendations.

Options available include the following:

- Telephone follow-up
- Provision of educational sessions (Individual or group basis) with emphasis on risk factor reduction by means of focused information and education and counseling
- Review by a member of the cardiac rehabilitation team in an out patients clinic

- Home visit by member of cardiac rehabilitation team or allied health professional
- Use of the Heart Manual program

In addition, at this stage it may be possible to establish links with:

- Health Professionals at Hospital Outpatient Clinic
- Clinical Nurse Specialists in Heart Failure
- Chest Pain Services
- G.P.
- Practice Nurses and primary health care team

Patients begin gradual activity and a low level exercise regime once stable. The intensity of exercise is increased over a varying period of time depending on diagnosis and procedure:

- Less than 2 weeks after an uncomplicated PCI (Parker et al, 2011)
- Two weeks after Myocardial Infarction (Parker et al, 2011)
- 2-3 weeks after cardiac surgery (Williams, 2006)

This may vary with individuals and is done under the guidance of the local cardiologist.

There is a general consensus that patients should complete a period of perhaps four to six weeks aerobic exercise prior to initiating resistance training. This period allows examination of the patients' haemodynamic response to exercise. The American College of Sports Medicine suggest waiting 4-6 weeks post myocardial infarction and post sternotomy or as directed by the cardiothoracic surgeon. (Pollock, 2000; Williams, 2007). Post PCI the time frame can be less. Prior to upper limb resistance training, patients with a sternotomy wound should ensure there is adequate healing and stability of their wound. There is some evidence that exercise that places strain on the sternal area should not be commenced for 3 months post operatively but this will vary between individuals (Pollack, 2000).

4.3. PHASE III

The Phase III programme typically lasts for at least 6 weeks, with patients exercising at least twice a week. However shorter programmes (e.g. 4 weeks) with more frequent classes may be provided to selected low-risk groups. Programs of longer duration may be more suitable for heart failure patients. An exercise class comprises a warm-up, aerobic exercise and a cool-down phase. In addition, resistance training with active recovery stations may be included where appropriate. The expertise of the multidisciplinary team and the commitment of the patient to attend the programme is essential.

Phase III comprises all of the following:

- Exercise prescription based on clinical status, risk stratification, previous activity and future needs
- Education for patient and family regarding:
  - Cardiac anatomy and physiology related to the cardiac event
  - Recognition of cardiac pain and symptom management
  - Risk factor identification and management
  - Benefits of physical activity
  - Energy conservation/graded return to activities of daily living
  - Cardio protective healthy eating
  - Prescribed cardiac medication and importance of compliance with same
  - Resumption of sexual activity
  - Benefits and entitlements
- Stress management and relaxation techniques
- Counselling and behaviour modification
- Smoking cessation
- Vocational counseling

The importance of providing cardiopulmonary resuscitation (CPR) training is acknowledged and the Irish Heart Foundation recommends training for everyone in the community. However, providing CPR training to cardiac rehabilitation attendees is not a direct responsibility of cardiac rehabilitation programmes; cardiac rehabilitation may facilitate such training by providing appropriate links with the relevant organisations.

4.3.1. Exercise component of phase III

Heran *et al* (2011) found that exercise-based cardiac rehabilitation is effective in reducing total and cardiovascular mortality (in medium to longer term studies) and hospital admissions (in shorter term studies) but not total MI or revascularisation (CABG or PCI**).**

The benefits of exercise training in this patient group have been well documented. Benefits include increase in exercise tolerance (Hamm *et al*, 2013), reduction in blood pressure (Brook *et al*, 2013), reduction in LDL and total cholesterol with an increase in HDL cholesterol (Ernest, 2012) and an increase in insulin sensitivity (Grice, 2013).

4.3.1.1 Risk stratification for cardiac arrhythmia or event during exercise

European Association for Cardiovascular Prevention and Rehabilitation (EACPR), American Association for Cardiovascular and Pulmonary Rehabilitation (ACCPVR), Canadian Association of Cardiac Rehabilitation (CACR) European Society Cardiology (ESC) and American Heart Association (AHA) guidelines recommend exercise testing as part of the patient's initial assessment for cardiac rehabilitation. This enables exercise training evaluation, risk stratification and individualised exercise prescription.

Functional capacity exercise testing is recommended to ensure that exercise prescription is accurate and individualised. There are a number of exercise tests that can be used in the cardiac population. While the BRUCE protocol (Appendix 4) is used in diagnostics it can be used for exercise prescription if resources allow. If there are considerations around orthopaedic and neurological limitations an alternative such as the Naughton or Modified Bruce (Appendix 4) may be a better substitute. Other tests that can be considered are the six minute walk test (Lucas *et al*, 1999; Faggiano *et al*, 2004), Chester Step Test (Buckley *et al*, 2011), modified shuttle walk test (Pulz *et al*, 2008).

Patients are risk stratified according to their performance, Metabolic Equivalents (METS) achieved and levels of ischaemia, if any during exercise. Their ejection fraction measured by cardiac echocardiogram is another factor used in risk stratification. (AACPVR, 2006) (Appendix 5).

The risk categorisation of each patient will have a bearing on staffing and group mixing. See section 4.3.7. It is also a consideration for the level of cardiac monitoring that a patient requires (telemetry, polar watches or manual heart rate monitoring). It is important to note that the overall risk of a cardiac event during exercise is low if patients follow the correct prescription and warm up and cool down period.

In prescribing exercise intensity heart rate and rate of perceived exertion scales are widely used in the cardiac population.

4.3.1.2. Heart Rate

A liner relationship is found between heart rate and peak VO_2 and work rate. Current guidelines suggest that training intensities equal 40-80% peak VO_2 which equates to 50-85% peak heart rate.

Heart rate reserve (HRR) and VO_2 reserve are defined as the difference between resting and peak heart rate. They are currently being used for exercise prescription purposes.
Percentage heart rate reserve has been adopted by the American College of Sports Medicine as the gold standard for exercise intensity and 40-70% HRR for cardiac patients has been proposed.

In using either method of prescription care should be taken in patients who demonstrate chronotropic incompetence (Collcucci, 1989; Witte, 2006.)

4.3.1.3. Rate of perceived exertion (RPE)

The RPE is commonly used as an adjunct to heart rate monitoring in many cardiac rehabilitation settings (Appendix 6 & 7). The average RPE associated with exercise adapation is 13-16. (Mezzani *et al*, 2012). This loosely corresponds with RPE 2.5-6 on the CR 10 Borg Scale. Good correlation of a value of 13 and the first ventilatory threshold in exercise testing has been found (Dunbar, 1992; Eston, 1996; Roberston, 1997).

4.3.1.4. TIME and TYPE of Exercise

Guidelines vary from 2-7 days per week at high (>75% Maximum Heart Rate) to low intensities (ACSM, 2010; SIGN, 2002). Warm-up periods vary from 10 to 15 minutes with a cool down period of 10 minutes. SIGN guidelines further recommend a 5 – 10 minute relaxation period in order to further observe patients after exercise. ESC guidelines (Perk et al, 2012) recommend that patients with previous acute myocardial infarction, CABG, PCI, stable angina pectoris or stable chronic heart failure should undergo moderate to vigorous intensity aerobic training ≥3 times a week and 30 minutes per session. Sedentary patients should be strongly encouraged to start light-intensity exercise programmes after adequate exercise related risk stratification.

4.3.2 RESISTANCE TRAINING

Resistance training can safely and effectively increase weight-carrying tolerance and skeletal muscle strength. This will lead to improvement in cardiovascular function, have a favourable effect on modifiable risk factors and enhance psychosocial well-being in stable coronary patients (Pollock, 2000; AAVCPR, 2004). Heart rate and systolic BP responses to a given submaximal load are attenuated with regular weight training leading to reduced myocardial demand during activities of daily living e.g. carrying the groceries or lifting moderate to heavy objects. Resistance training can be both safe and effective in the heart failure population when properly prescribed (AAVCPR, 2004).

4.3.3 SPECIAL PATIENT GROUPS

4.3.3.1. Implantable defibrillators

Cardiac Rehabilitation programmes are recommended in patients with implantable cardiovertor defibrillators (Vanhees, 2004). Benefits include reduced catecholamine response. However in this patient group it is important that care is taken to avoid inappropriate shocks (Jayanthi, 2011). This can occur when exercise heart rates increase and move into the programmed ventricular tachycardia zone or if exercise induced supraventricular tachycardia develops. Exercise heart rate target levels should be set 15-20 beats below the threshold levels (Kelly *et al,* 1996; Pashkow *et al*, 1997; Lampman *et al* , 2000)

4.3.3.2 Heart Transplantation

There are a number of contributors to reduced exercise capacity in patients post transplantation (Marconi *et al*, 2003; Giovartz *et al*, 1997).

- Use of corticosteroids (Renlund *et al*, 1996)
- Marked deconditioning pre transplant due to heart failure
- Peripheral vasoconstriction
- Dennervation of the heart causing delayed cardiovascular response to exercise (Lord *et al*, 1996)

Exercise intensities should begin at RPE 11-12 following a minimum warm-up of 20 minutes. Cool downs should be no shorter than 20 minutes (Vile *et al*, 2002; Scott *et al*, 2009).

4.3.3.3. Heart Failure patients

Davis *et al* (2010) found that exercise does not increase the risk of all-cause mortality and may reduce heart failure-related hospital admissions. Exercise training may offer important improvements in patients' health-related quality of life.

Heart failure patients present with impaired exercise tolerance which has been found to be related to altered endothelial function, exaggerated ergoreflex (Ponikowski, 2001) and reduced oxygen diffusing capacity (Mettauer, 1999) compounded by impaired mitochondrial activity (Menshikova, 1997) capillary density (Puri, 1995) and altered fibre typing in the skeletal musculature (Harrington, 1997 Gielen, 2003). All intensities of exercise have been tested in patients with heart failure and all contribute to improved exercise capacity. The European Society of Cardiology recommend exercise 3 times per week at moderate intensity. Piepoli *et al,* (2011) recommend varying degrees of interval and continuous training with some inspiratory muscle training following an assessment using peak VO_2 or the six minute walk test (Appendix 8). Resistance training in this patient group has also been explored (Bjarnason-Wehrens *et al*, 2004; Piepoli *et al*, 2011) (Appendix 8).

4.3.4. PSYCHOLOGICAL / PSYCHOSOCIAL INTERVENTIONS

Psychological assessment of the patient's well-being should be conducted at least once over the course of the programme. Assessment may be used to identify patients in need of specific psychological support and/or for service evaluation purposes. Following psychological assessment, patients can avail of low level psychological intervention in the form of psycho-educational talks/sessions which address the adjustment difficulties and lifestyle changes which occur following a cardiac event. This form of intervention can provide patients with a sense of clarity and also foster a sense of shared responsibility by the patient for their own personal healthcare and psychological well-being.

If a patient requires further support, he/she is then referred for individual therapy. The patients individual needs and preferences are the basis for choosing a form of intervention to adopt in individual therapy. This is assessed using psychometric tools and clinical interview. These psychological interventions vary in form, for example stress and mood management, relaxation training (breathing re-training, guided visualizations, meditation), mindfulness based cognitive therapy, cogntive behavioural therapy (cogitive restructuring, problem solving, homework assignments), individually tailored psychological interventions; motivational interviewing and so on (Randal *et al*, 2007; Graham *et al*., 2011). Psychological interventions may also address organisational issues with a view to improving patient communication and support (Jolly, 1998; Whalley, 2011).

4.3.5 OTHER CONSIDERATIONS

Adherence to secondary prevention recommendations should be assessed at least once during the course of the programme.

4.3.6. STAFFING CARDIAC REHABILITATION

The cardiac rehabilitation team should agree a local policy to ensure a staff-patient ratio for safe practice depending upon the risk level of the group, the presence of telemetry/polar watches and access to medical support. The British Association of Cardiac Rehabilitation (1995) recommended a staff: patient ratio of 1:6 for the exercise component of cardiac rehabilitation.

The Association of Chartered Physiotherapists in Cardiac Rehabilitation (ACPICR) Standards for Physical Activity & Exercise in the Cardiac Population (2009) Standard 12 states that the minimum staff to patient ratio is 1:5 but that it **varies with** the risk stratification of patients i.e. **increased staff** ratio for higher risk patients.
SIGN (2002) guidelines recommend that:

- Staff with basic life support training and ability to use a defibrillator are required for group exercise of low to moderate risk patients.
- Basic life support training should be regularly updated based on local protocols.
- Immediate access to on site staff (hospital emergency team) with advanced cardiac life support (ACLS) training is required for high risk patients and classes offering high intensity exercise.

ACLS training should be completed in line with local policy. Decisions to complete training will depend on location and access to medical support.

4.3.7. CARDIAC MONITORING

The AACPVR (2004) guidelines indicate levels of cardiac monitoring for patients depending on diagnosis (Appendix 9). Monitoring options include telemetry, heart rate monitors Borg Scale (Appendix 6 & 7).

5.0 PHASE IV

The aims of this phase are to facilitate long term maintenance of lifestyle changes, monitoring risk factor changes and secondary prevention. As per Phase II, options available include the following:

- Educational sessions
- Support groups
- Telephone follow-up
- Review in a hospital clinic
- Outreach programmes
- Phase IV exercise programs organized by qualified phase IV gym instructors in community gyms

In addition, at this stage it is possible to establish links with the GP and Primary health care team. Vocational support may be provided where required. In addition, ongoing involvement of spouse/partner or family member is very important in this stage.

6.0 REQUIREMENTS FOR CARDIAC REHABILITATION

6.1 FACILITIES AND EQUIPMENT REQUIRED FOR CARDIAC REHABILITATION

The **minimum** facilities necessary to provide a cardiac rehabilitation service are:

- Separate office space and facilities for cardiac rehabilitation staff
- An Education Room furnished with seats, TV and DVD player and with a selection of information booklets and DVD's provided. The size of the education room will depend upon the number of participants (patients, spouses, and staff) in the education sessions and given resources.
- It is recommended that the exercise warm-up area and the exercise room combined should be approximately 300m^2
- The exercise room should be air-conditioned
- In addition, patients should have access to
  - Toilet
  - Shower and changing room
  - Available drinking water

- Equipment in the exercise room **may** include
  - Central monitor and telemetry
  - Equipped emergency trolley, portable suction, defibrillator and oxygen
  - Treadmill
  - Rowing machine
  - Dual cycle ergometer
  - Bicycle ergometer
  - Versa climber
  - Hand crank
  - Stepper
  - Multigym weights system and/or dumb bells
  - Couch
  - Desk
  - Chairs
  - Automated Blood Pressure Recording Machine e.g. Dinamap
  - Aneroid BP recorder
  - Stethoscope
  - Minute timer
  - Music system
  - Glucometer
  - Scales and stadiometer
  - Measuring tape

7.0 SAFETY ISSUES IN CARDIAC REHABILITATION

The relative safety of medically supervised, physician directed, cardiac rehabilitation exercise programs that follow standard guidelines is well established (Leon *et al*, 2005). Risk stratification procedures for the management of coronary heart disease help to identify patients who are at increased risk for exercise-related cardiovascular events and who may require more intensive cardiac monitoring in addition to the medical supervision provided for all cardiac rehabilitation program participants (Wenger *et al,* 1995). Special consideration is given to safety issues when running a group exercise programme. Aspects to be noted include:

- The environment
- Appropriate footwear and clothing
- Adequate space
- Equipment maintenance

8.0 AUDIT

Audit is a critical element of cardiac rehabilitation service assessment and it is recommended that all cardiac rehabilitation centers engage in audit. A number of audit systems are available and used in Ireland depending on available resources. It is recommended that data pertaining to patient and programme measures are collected. Patient measures may include access to cardiac rehabilitation services, the profile of those attending cardiac rehabilitation, attendance, drop-out rates and time to treatment, as well as measuring clinical, behavioural and psychological outcomes. Programme measures may include phases of cardiac rehabilitation provided and staffing levels, education provided by the cardiac rehabilitation programme, programme format, patient throughput and programme resources.

8.1. PROVISION OF CARDIAC REHABILITATION AND COMPLIANCE.

The National Survey of Cardiac Rehabilitation Service provision in Ireland (Delaney *et al,* 1999) found that 12 sites throughout the country offered a cardiac rehabilitation service. The implementation of the cardiovascular strategy led to the number of these centres increasing to thirty five by 2006. The different phases of cardiac rehabilitation established by that time are shown in Table 1. The Irish Heart Foundation and the IACR conducted a survey of resources and current service provision in CR in 2013 and details are shown in Table 2.

Phases of Cardiac Rehabilitation	**Number of hospital**
Phase I	37 hospitals
Phase II	36 hospitals
Phase III	35 hospitals
Phase IV	16 hospitals

Table 1 *Source: The Third National Survey of Cardiac Rehabilitation Service Provision Ireland*

Phases of Cardiac Rehabilitation	**Number of hospital**
Phase I	35 hospitals
Phase II	35 hospitals
Phase III	35 hospitals
Phase IV	19 hospitals

Table 2 *Source: IHF / IACR Survey of CR Services in Ireland 2013*

The IHF/IACR Survey of Cardiac Rehabilitation services (2013) found that compliance of 80% or greater was achieved only in 7 centres (Table 3). Once enrolled, compliance with the phase III cardiac rehabilitation programme was over 60% in all centres with 29 centres achieving 80 to 100% (Table 4).

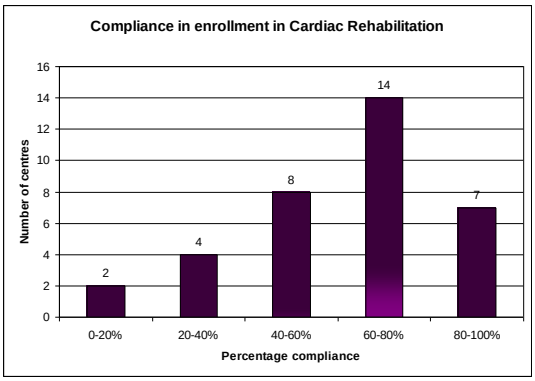


Table 3: Compliance in enrollment with cardiac rehabilitation

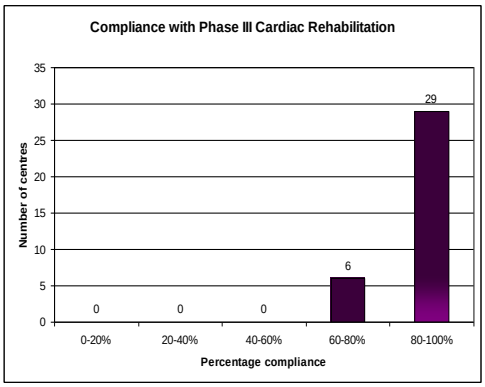


Table 4: Enrolled compliance with phase III programmes

Barriers identified in cardiac rehabilitation enrollment, within the Irish context, include poor understanding of the cardiac rehabilitation programmes, long waiting times, poor advocacy by the medical profession and lack of flexibility around evening sessions (Spelman, 2011). Non–attendees and non completers were significantly likely to be unskilled workers and/or smokers with reasons identified as illness, employment, disinterest, exercise not meeting their specific needs, depression or organizational issues (Kerins 2011).

Compliance can be defined as the extent to which a person's behaviour such as adherence to medication, diet and executing life style changes coincides with medical or health advice (Haynes, 1979). Previous studies identify compliance at a cardiac rehabilitation programme as attendance varying from 34% - 85% of the program (Europe) with Ireland measuring 68% (EuroASPIRE III) and more recently 79% (EuroASPIRE IV). This latter percentage is in comparison to all patient compliance of 81.3% (results from EuroASPIRE IV). SIGN guidelines (2002) identify compliance as attendance as 75% of the programme.

SUMMARY

With cardiovascular disease accounting for 33% of all deaths in Ireland, both primary and secondary prevention remain the main focus for healthcare in Ireland. The implementation of the Acute Coronary Syndrome and National Heart Failure Clinical Programmes is beginning to take effect. Cardiac rehabilitation is well recognized as an important part of both programmes targeting both primary and secondary prevention.

Targets for therapy include smoking avoidance, management of diabetes, alcohol intake reduction, total cholesterol target of less than 4.5mmol/L and LDL <1.8mmol/L, blood pressure targets <140/90mmHg, normal BMI 25kg/m^2, regular physical activity progressing to three times per week aerobic training with established disease and management of anxiety and depression. This is best achieved under the care of a multidisciplinary team with focused goal setting.

APPENDIX 1

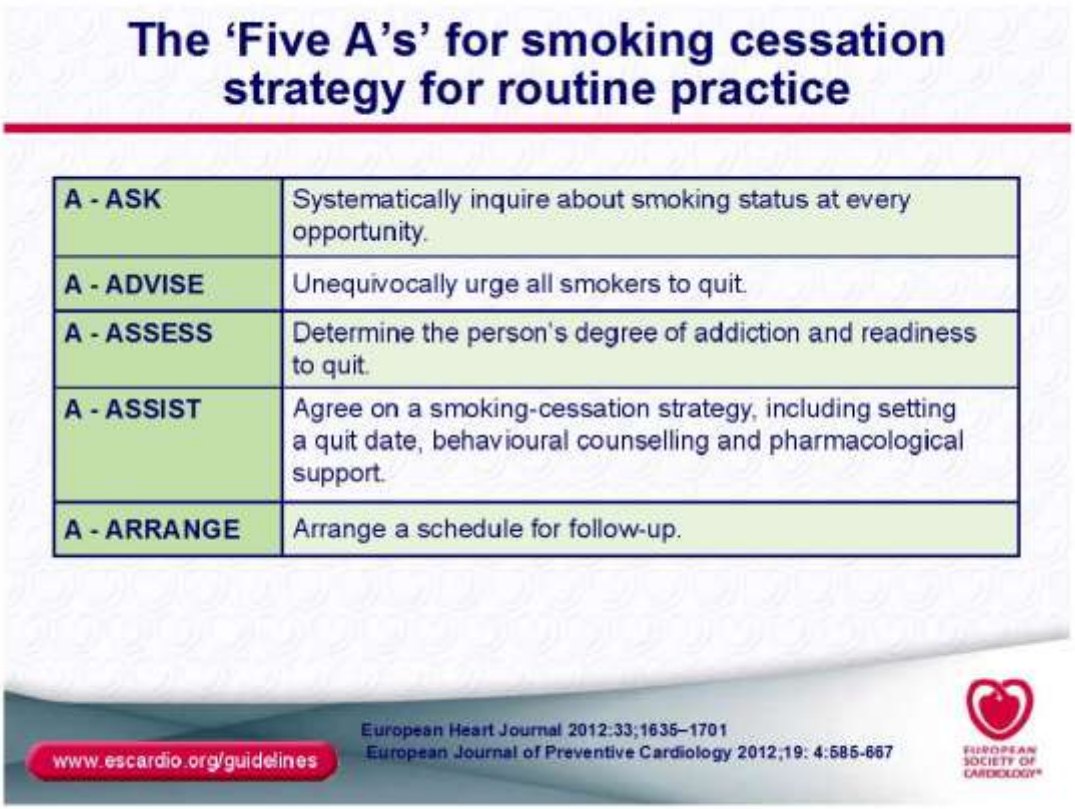
Anthropometric procedures are available online at

http://www.cdc.gov/nchs/nhanes/nhanes3/anthropometric_videoss.htm

Cut offs of waist circumference associated with risk of metabolic complication			
	Europids		**Asian Adults**
	Increased risk	Substantial risk	Increased
Men	≥94cm (37 inches)	≥102 cm 94 inches)	≥94cm (37 inches)
Women	≥80 cm (32 inches)	≥ 88cm (35 inches)	≥80 cm (32 inches)
From: WHO Report: Obesity: Preventing and Managing the Global Epidemic and WHO/IASO/IOTF Report: The Asia- Pacific Perspective: Redefining Obesity and its Treatment			

Source: Optimal Approaches to Adult Weight Management by Dietitians in Ireland, Irish Nutrition and Dietetic Institute (2013)

APPENDIX 2: The Five A's



APPENDIX 3: Psychological Assessment & Interventions

Psychological assessment in cardiac psychology is conducted using objective and verifiable measurement tools (Graham et al, 2011). This may involve the use of a validated structured interview, behavioral observation or the use of self-report questionnaires. Self-report questionnaires, more formally known as psychometric tools, are used by clinicians to assess the psychological well-being of a patient. These tools and the clinical interview provide the clinician with the necessary information to make a formulation and subsequently choose the most appropriate intervention for each individual patient.

In choosing a psychometric tool, clinicians must ensure that the tool is robust, in terms of its level of validity and reliability. Before administering any type of psychological instrument it is necessary for potential users to have completed appropriate training in testing, measurements, statistics, and psychometrics. Clinicians should also be thoroughly trained in the application, interpretation and reporting of the specific instrument being used. Communicating the results of a psychological assessment to a patient is a serious matter, and results or interpretations should be reported to a high standard and with a great degree of sensitivity.

The use of psychological instruments in research is bound by the ethics that apply to research with human participants. Issues such as the necessity of informed consent, the nature and extent of debriefing, including feedback of results, and the disguised use of test materials, must be addressed on a case-by-case basis with due attention to the protection of the participants and the integrity of the instrument.

Unauthorized modification of a published or unpublished test is a violation of the publisher's or author's copyright, and is thus both unethical and illegal. Security of test materials, confidentiality of records, standardized administration, and appropriate methods of score reporting must be maintained as in any other testing situation.

Examples of Screening/Evaluation Measures

Construct(s)	Instrument	Reference
Depression & Anxiety	HADS	Zigmond, AS. & Snaith, R.P. (1983) The hospital anxiety and depression scale. *Acta Psychiatrica Scandinavica, 67(6): 361-370*
	PHQ-9	Spitzer RL, Kroenke K, Williams JB (1999). Validation and utility of a self-report version of the prime-MD: the PHQ primary care study. Primary Care Evaluation of Mental Disorders. Patient Health Questionnaire. JAMA. 1999;282(18):1737–1744.
Health-related Quality of Life	HeartQoL	N. Oldridge, H. Saner, H.M. McGee The Euro Cardio-QoL Project. An international study to develop a core heart disease health-related quality of life questionnaire, the HeartQoL. *European Journal of Cardiovascular Preventative Rehabilitation, 12*, 87–94
Personality	DS-14	Denollet, J. (2005). DS14: Standard assessment of negative affectivity, social inhibition, and Type D personality. *Psychosomatic Medicine*, *67*(1), 89-97.
Insomnia	Insomnia Severity Index (ISI)	Morin, M. (1993). Insomnia: Psychological Assessment and management. New York Guildford Press
Illness Beliefs	Brief Illness Perception Questionnaire (B-IPQ)	Broadbent, E., Petrie, K.J., Main, J., Weinman, J. (2006). The Brief Illness Perception Questionnaire (BIPQ). Journal of Psychosomatic Research, 60, 631-7.
	York Cardiac Beliefs Scale (YCBQ)	Furze G, Lewin RJP, Murberg T, Bull P, Thompson DR. Does it matter what patients think? The relationship between changes in patients' beliefs about angina and their psychological and functional status. Journal of Psychosomatic Research 2005; 59(5): 323-329

Psychological Interventions

Following psychological assessment, a psychological formulation is made and an intervention is subsequently chosen. These interventions are aimed at promoting psychological health. Psychological distress following a cardiac event, evidenced by clinically significant levels of depression, anxiety, social isolation and/or low perceived solcial support, significant ongoing stressors, personality issues,

sexual dysfunction & substance abuse should all be systematically identified using clinical interview and psychometric tools and in turn treated using psychological/psychosocial interventions. Linden, Philips and LeClerc (2007) found that men receiving psychological therapies had a 27 percent reduction in mortality and a 43 percent reduction in number of cardiac events. Psychological interventions for heart disease have been found to help reduce total cholesterol and anxiety. Interventions which addressed specific behavioral change reduced heart attacks and interventions which addressed cognitive aspects helped to reduce depressive cognitions (Welton et al, 2009). Psychotherapeutic inteventions have been found to reduce depression and cardiac events (Rutledge et al, 2013). Below are examples of psychological interventions utilized in cardiac rehabilitation.

Self Management programs are designed to enable patients to take an active part in the management of their own cardiac conditions. These programs promote the patient as an expert decision maker in his/her treatment/recovery process. This is achieved by addressing behavioral and lifestyle changes in a manner which fosters empowerment. Essentially, self-management is what a patient does to ensure their health is monitored, their signs and symptoms of illness are addressed, their emotion and interpersonal relationships are maintained and their treatment program is adhered to.

Cognitive behavioral therapy is an intervention which provides patients with tools to deal with adverse emotional events which arise as a result of or are compounded by, a cardiac event. There are a number of strategies/approaches available when using cognitive behavioral therapy, which aim to promote and enhance active coping strategies. This approach and programs using this approach can be made up of a combination of the following: health education, stress management training, coping skills and problem solving skills, training in anger-management skills, training in assertiveness, group support etc. A number of studies have shown that cognitive behavioral therapy can be used with a number of populations (Graham et al, 2011).

Individual based psychotherapeutic interventions are often used in cardiac rehabilitation as individual interventions. These can include cognitive behavioral therapy, emotion-focused therapy, interpersonal therapy, or psychodynamic therapy. Therapists assess the individuals needs here throughout the application of the intervention and may extend the average duration of the approach (1 hour per week for 8-12 weeks), depending on patient responsiveness and reaction.

Relaxation and Stress Management are a vital component of the cardiac rehabilitation program as they address the symptoms which can potentially cause preventable high levels of physiological arousal, for example raised blood pressure, muscular tension, sleep deprivation, etc. One form of relaxation developed in Tallaght Hospital, Dublin was the provision of a relaxation CD, which uses progressive muscular relaxation. This resource is useful to patients as it is a simple, yet effective way of reducing stress and inducing relaxation, while also it functions as a reminder of the positive and motivational aspects of their cardiac rehabilitation (Graham et al, 2011).

Mindfulness Meditation teaches patients in cardiac rehabilitation to become aware of their thoughts, feelings and sensations, in a mindful, yet non-judgmental manner. The premise of this approach is that patients begin to pay attention in a particular way and notice what they are experiencing, but do not burden themselves by defining any of this as positive or negative.

The use of cognitive behavior therapy techniques may not be utilized or maintained by patients in recovery, because unlike Mindfulness Meditation it may not foster a positive and affirming reaction. Unlike other approaches, mindfulness teaches patients to recognize the times when negative emotions take control as a result of rumination. In recognizing these times patients develop an ability to identify early signs and symptoms of anxiety, depression and so on, thus impacting on the use preventative measures.

Social Support is a valuable resource for a patient following a cardiac event. The patient and also his/her family/close partner can be impacted upon by the major life event. Research suggests that cardiac patients who live alone or lack social support face a higher risk of a recurrent myocardial infarction, sudden death and all-cause mortality, than those who have adequate social support. Social support acts as a buffer against life stress for all individuals (Graham et al, 2011).

References for Appendix 3.

Anxiety

Hospital Anxiety and Depression Scale (HADS)
Zigmond, A. and Snaith, R. (1983). The Hospital Anxiety and Depression Scale. *Acta Psychiatrica Scandinavica* 67: 361-70.

State-Trait Anxiety Inventory Form X-1 (SSAI)
Speilberger, C., Gorsuch, R. and Lushene, R. (1970). *The State-Trait Anxiety Inventory*. Consulting Psychologists Press, Palo Alto, CA.

General Mood

Global Mood Scale (GMS)
Denollet J (1993b). Emotional distress and fatigue in coronary heart disease: the Global Mood Scale (GMS) *Psychological Medicine*, 23, 111-121.

General Health Questionnaire (GHQ)
Goldberg, D. (1978). *Manual of the General Health Questionnaire*. Windsor, NFER-NELSON Publishing Company.

Profile of Mood States (POMS)
McNair DM, Lorr M, Droppleman LF. Manual for the Profile of Mood States. San Diego, CA: Educational Testing Service, 1971.

Cardiac Specific Quality of Life Measures

Quality of Life Index- Cardiac Version III (QLI-CV III)
Ferrans, C.E. & Powers, M.J. (1992) Psychometric assessment of the quality of life index. *Research in Nursing and Health*, 15, 29-38.

MacNew Quality of Life after Acute Myocardial Infarction Questionnaire (MacNew QLMI)
Valenti, L., Lim, L., Heller, R.F. & Knapp, J. (1996). An improved questionnaire for assessing quality of life after myocardial infarction. *Quality of Life Research* 5: 151-161.

Heart Patients Psychological Questionnaire (HPPQ)
Erdman, R., Duivenvoorden, H., Verhage, F., Krazemier, M., & Hugenholtz, P. (1986). Predictability of beneficial effects in cardiac rehabilitation: a randomised clinical trial of psychosocial variables. *Journal of Cardiopulmonary Rehabilitation* 6: 206-213.

Multidimensional Index of Life Quality.
Avis, N.E., Smith, K.W., Hambleton, R.K., Feldman, H.A., Selwyn, A. & Jacobs, A. (1996). Development of the Multidimensional Index of Life Quality. A Quality of Life Measure for Cardiovascular Disease. *Medical Care*, 34, 1102-1120.

APPENDIX 4: Bruce Treadmill protocol

Stage	Time	Speed	Grade	Met
1	3 minutes	1.7 mph	10%	4.7
2	3 minutes	2.5 mph	12%	7.1
3	3 minutes	3.4 mph	14%	10.2
4	3 minutes	4.2 mph	16%	13.5
5	3 minutes	5.0mph	18%	17.3

Modified Bruce protocol

Stage	Time	Speed	Grade	Mets
1	3 minutes	1.7mph	0%	1.7
2	3 minutes	1.7mph	5%	2.9
3	3 minutes	1.7 mph	10%	4.7
4	3 minutes	2.5 mph	12%	7.1
5	3 minutes	3.4 mph	14%	10.2
6	3 minutes	4.2 mph	16%	13.5
7	3 minutes	5.0mph	18%	17.3

Principles in Exercise testing by RA Bruce, 1973, in J.P. Naughton and H.K. Hellerstein (Eds.) Exercise Testing and Exercise training in Coronary Heart Disease (p.45-61), New York: Academic Press.

Naughton

Stage	Time	Speed	Grade	Mets
1	2 minutes	1mph	0%	1.8
2	2minutes	2 mph	0%	3.5
3	2 minutes	2mph	3.5%	4.5
4	2 minutes	2mph	7%	5.4
5	2 minutes	2 mph	10.5%	6.4
6	2 minutes	2 mph	14%	7.4
7	2 minutes	2 mph	17.5%	8.3
8	2 minutes	2 mph	22%	

APPENDIX 5 : AACVPR Stratification for risk of Cardiac Events during exercise (Williams, 2001; AACPVR, 2006)

Characteristics of patients at lowest risk for exercise participation (all characteristics listed must be present for patient to remain at lowest risk)
Absence of complex ventricular arrhythmias during exercise testing and recovery
Absence of angina or other significant symptoms(e.g. unusual SOB, Light-headedness or dizziness, During exercise testing and recovery)
Presence of normal haemodynamic responses during exercise testing and recovery(appropriate increases and decreases in heart rate and SBP with increasing workloads and recovery)
Functional capacity ≥ 7 METS
Rest EF > 50%
Uncomplicated MI or revascularisation procedure
Absence of complicated ventricular arrhythmias at rest
Absence of CHF
Absence of signs or symptoms of post event/ post procedure ischaemia
Absence of clinical depression
Characteristics of patients at moderate risk for exercise participation (any one or combination of these findings places a patient at moderate risk)
Presence of angina or other significant symptoms(e.g. unusual SOB< light-headedness or dizziness, occurring only at high levels of exertion (≥ 7 METs)
Mild to moderate level of ischaemia during exercise testing or recovery(ST segment depression < 2 mm from baseline)
Functional capacity < 5 METs
Resting EF 40-49%
Characteristics of patients at high risk for exercise participation(any more 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(e.g. unusual SOB, Light-headedness or dizziness at low levels of exertion (<5METs) 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 BP with increasing workloads) or recovery (severe post exercise hypotension)
History of cardiac arrest , or cardiac arrest
Rest EF < 40%
Complicated MI or revascularisation procedure
Complex dysrhythmias at rest
Presence of CHF
Presence of signs or symptoms of post event/ post procedure ischaemia
Presence of clinical depression

APPENDIX 6: Rate of Perceived Exertion (BORG SCALE)

	Borg Scale
6	No exertion at all
7	
8	Extremely light
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard (heavy)
16	
17	Very Hard
18	
19	Extremely Hard
20	Maximal exertion

0	None
0,5	Very, very light
1	Very light
2	Light
3	Moderate
4	A little intense
5	Intense
6	
7	Very intense
8	
9	Very, very intense
10	Maximum

APPENDIX 7 - Rate of Perceived Exertion (BORG SCALE)

Borg's RPE Scale Instructions

While exercising we want you to rate your perception of exertion, i.e. how heavy and strenuous the exercise feels to you. The perception of exertion depends mainly on the strain and fatigue in your muscles and on your feeling of breathlessness or aches in the chest. Look at this rating scale: we want you to use this scale from 0 to 10 or 6 to 20, where 0 or 6 means 'no exertion at all' and 10 or 20 means 'maximal exertion'.

1 or 9 Corresponds to 'very light' exercise.
For a normal healthy person it is like walking slowly at his or her own pace for some minutes.

4 or 13 On the scale is "a little intense" or "somewhat hard" exercise but it still feels OK to continue.

7 or 17 "Very intense" or "very hard" is very strenuous. A healthy person can still go but he or she has to push him or herself. It feels very heavy and the person is very tired.

9 or 19 On the scale this is an extremely strenuous exercise level. For most people this is the most strenuous exercise they have ever experienced.

Try to appraise your feeling of exertion as honestly as possible, without thinking of what the actual physical load is. Don't underestimate it either. It's your own feeling of effort and exertion that's important, not how it compares to others. What other people think is not important either. Look at the scale and expression and then give a number.

APPENDIX 8 - Step III-Strength training, muscle build up training

Training Programme	Training objectives	Stress form	Intensity	Repetitions	Training volume
Step I pre training	To learn and practice the correct implementation	Dynamic	<30%1RM RPE <12	5-10	2-3 training sessions per week, 1-3 circuits during each session
Step II- Resistance / endurance training	To improve local aerobic endurance and intermuscular coordination	Dynamic	30-40% 1RM RPE 12-13	12-25	2-3 sessions per week, 1 circuit per session
Step III-Strength training, muscle build up training	To increase muscle mass, to improve intramuscular endurance	Dynamic	40-60% 1RM RPE<15	8-15	2-3 sessions per week, 1 circuit per session

	< 65 years		≥ 65 years	
	Active	Sedentary	Active	Sedentary
VO2 peak ≤ 10ml/kg/min or 6MWT < 300metres	CT RT RST LIT	CT RT RST LIT	CT RT RST LIT	CT RT LIT
VO2 peak >10 ≤ 18ml/kg/min or 6MWT 300-450 metres	CT RT RST IT	CT RT RST	CT RT RST	CT RT
VO2 peak > 18ml/kg/min or 6MWT >450 metres	CT RT* RST HIT	CT RT* RST HIT	CT RT* RST HIT	CT RT* RST HIT

CT, Continuous enduance training;LIT/HIT/IT, low/high intensity interval endurance training;
RT,Respiratory training(*, in case of respiratory weakness)

APPENDIX 9: Monitoring Guidelines for Cardiac Rehabilitation (AACVPR, 2004)

Recommendations for ECG Monitoring and intensity of supervision during exercise participation.

Patients at lowest risk for exercise participation

- Direct staff supervision of exercise should occur for a minimum of 6-18 exercise sessions, beginning with continuous ECG monitoring and decreasing to intermittent ECG monitoring as appropriate (e.g. 6-12 sessions).
- For a patient to remain at lowest risk, his or her ECG and hemodynamic findings should remain normal, there should be no development of abnormal signs and symptoms either within or away from the exercise program, and progression of the exercise regimen should be appropriate.

Patients at moderate risk for exercise participation

- Direct staff supervision of exercise should occur for a minimum of 12-24 exercise sessions beginning with continuous ECG monitoring and decreasing to intermittent ECG monitoring as appropriate (e.g.12-18 sessions).
- For a patient to move to the lowest-risk category, ECG and hemodynamic findings during exercise should be normal, there should be no development of abnormal signs and symptoms either within or away from the exercise program, and progression of the exercise regimen should be appropriate.
- Abnormal ECG or hemodynamic findings during exercise, the development of abnormal signs and symptoms either within or away from the exercise program, or the need to severely 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 participation

- 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 appropriate (e.g.18, 24, or 30 sessions).
- For a patient to move to the moderate-risk category, ECG and hemodynamic findings during exercise should be normal, there should be no development of abnormal signs and signs either within or away from the exercise program, and progression of the exercise regimen should be appropriate.
- Abnormal ECG or hemodynamic findings during exercise, the development of abnormal signs and symptoms either within or away from the exercise program, or significant limitations in the patient's ability to participate in the exercise regimen may result in discontinuation of the exercise program until appropriate evaluation and intervention where necessary, can take place.

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Ambrose, J.A. and Barua, R.S. (2004) 'The pathophysiology of cigarette smoking and cardiovascular disease: an update.' *Journal of the American College of Cardiology,* 43 (10):1731-7.

American College of Sports Medicine (2006) *Guidelines for Exercise Testing and Prescription*. 7th Edition. Baltimore, Maryland: Lippincott Williams & Wilkins.

American Association of Cardiovascular and Pulmonary Rehabilitation Williams, M.A. (Ed.) (2004) *Guidelines for Cardiac Rehabilitation and secondary Prevention programs.* Champaign: Human Kinetics.

American Association of Cardiovascular and Pulmonary Rehabilitation Robertson, L (Ed.) (2006) *Cardiac Rehabilitation Resource Manual.* Champaign: Human Kinetics.

American Diabetes Association (2013) 'Standards of Medical Care in Diabetes—2013', *Diabetes Care*, 36: S11-S66.

Association of Chartered Physiotherapists in Cardiac rehabilitation (2009) Standards for Physical Activity & Exercise in the Cardiac Population.

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