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2023 TAMIS/TSOC/TACVPR Consensus Statement for Patients with Acute Myocardial Infarction Rehabilitation

Kuan-Cheng Chen,[1,2,3#] Chih-Neng Hsu,[4#] Cheng-Hsueh Wu,[5] Ko-Lung Lin,[6] Shyh-Ming Chen,[7] Yuchun Lee,[8] Chien-Yi Hsu,[9,10] Che-Wei Hsu,[1] Chi-Yao Huang,[11] Shou-Hsien Huang,[2] Chia-Te Liao,[12] Christina Soong,[13] Po-Wei Chen,[14] Shu-Ming Yeh,[15] Chang-Cheng Wu,[16] Cho-I Lin,[17] Nai-Wen Guo,[18] Yi-Heng Li,[14] Tsung-Hsien Lin,[19,20] Chia-Hsin Chen,[21,22] Chun-Yao Huang,[9] Ssu-Yuan Chen,[3,13,23] Yu-Chen Wang,[24] Wei-Chun Huang,[25,26,27] Willy Chou[28]* and Wen-Jone Chen[29]**

Cardiac rehabilitation is a comprehensive intervention recommended in international and Taiwanese guidelines for patients with acute myocardial infarction. Evidence supports that cardiac rehabilitation improves the health-related quality of life, enhances exercise capacity, reduces readmission rates, and promotes survival in patients with cardiovascular disease. The cardiac rehabilitation team is comprehensive and multidisciplinary. The inpatient, outpatient, and maintenance phases are included in cardiac rehabilitation. All patients admitted with acute myocardial infarction should be referred to the rehabilitation department as soon as clinically feasible. Pre-exercise evaluation, including exercise testing, helps physicians identify the risks of cardiac rehabilitation and organize appropriate exercise prescriptions. Therefore, the Taiwan Myocardial Infarction Society (TAMIS), Taiwan Society of Cardiology (TSOC), and Taiwan Academy of Cardiovascular and Pulmonary Rehabilitation (TACVPR) address this consensus statement to assist healthcare practitioners in performing cardiac rehabilitation in patients with acute myocardial infarction.

Key Words: Acute myocardial infarction • Cardiac rehabilitation • Exercise • Rehabilitation

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[1]Kangze Rehabilitation Clinic, Taoyuan; [2]Department of Rehabilitation, Far Eastern Memorial Hospital; [3]Division of Physical Medicine and Rehabilitation, Fu Jen Catholic University Hospital, New Taipei City; [4]Division of Cardiology, Department of Internal Medicine, National Taiwan University Hospital Yunlin Branch, Yunlin; [5]Department of Critical Care Medicine, Taipei Veterans General Hospital, Taipei; [6]Department of Physical Medicine and Rehabilitation, Kaohsiung Veterans General Hospital; [7]Department of Cardiology, Kaohsiung Chang-Gung Memorial Hospital, Kaohsiung; [8]Department of Physical Medicine and Rehabilitation, Taichung Veterans General Hospital, Taichung; [9]Division of Cardiology and Cardiovascular Research Center, Department of Internal Medicine, Taipei Medical University Hospital; [10]Division of Cardiology, Department of Internal Medicine, School of Medicine, College of Medicine, Taipei Medical University, Taipei; [11]Department of Cardiology, Taichung Veterans General Hospital, Taichung; [12]Division of Cardiovascular Medicine, Chi Mei Medical Center, Tainan; School of Medicine, College of Medicine, National Sun Yat-sen University, Kaohsiung; [13]Department of Physical Medicine and Rehabilitation, National Taiwan University Hospital, Taipei; [14]Division of Cardiology, Department of Internal Medicine, National Cheng Kung University Hospital, College of Medicine, National Cheng Kung University, Tainan; [15]Department of Physical Medicine and Rehabilitation, Lo-Hsu Medical Foundation, Inc., Lotung Poh-Ai Hospital, Yilan; [16]Department of Physical Medicine and Rehabilitation, Taoyuan General Hospital, Ministry of Health and Welfare, Taoyuan; [17]Department of Physical Medicine and Rehabilitation, National Taiwan University Hospital Yunlin Branch, Yunlin; [18]Institue of Behavioral Medicine, College of Medicine, National Cheng Kung University, Tainan; [19]Division of Cardiology, Department of Internal Medicine, Kaohsiung Medical University Hospital; [20]Faculty of Medicine and Graduate Institute of Medicine, College of Medicine, Kaohsiung Medical University; [21]Department of Physical Medicine and Rehabilitation, Kaoshiung Medical University Hospital; [22]School of Medicine, College of Medicine, Kaoshiung Medical University, Kaoshiung; [23]Fu Jen Catholic University College of Medicine, New Taipei City; [24]Department of Cardiology, Asia University Hospital, Taichung; [25]Department of Critical Care Medicine, Kaohsiung Veterans General Hospital, Kaohsiung; [26]Department of Medicine, School of Medicine, National Yang Ming Chiao Tung University, Taipei; [27]Department of Physical Therapy, Fooyin University, Kaohsiung; [28]Department of Rehabilitation, Chi Mei Medical Center, Tainan; [29]Department of Cardiology, Min-Sheng General Hospital, Taoyuan, Taiwan.
Corresponding author: Dr. Wei-Chun Huang, Department of Critical Care Medicine, Kaohsiung Veterans General Hospital, No. 386, Dazhong 1st Road, Zuoying District, Kaohsiung, Taiwan. Tel: 886-7-346-8278; E-mail: wchuanglulu@gmail.com
* Willy Chou and Wen-Jone Chen jointly supervised this work and serve as co-corresponding authors.
# Both authors contributed equally to this work.

Abbreviations

6MWT	Six-minute walk test
ACS	Acute coronary syndrome
AMI	Acute myocardial infarction
ASCVD	Atherosclerotic cardiovascular disease
CABG	Coronary artery bypass graft
CHD	Coronary heart disease
CIND	Cognitive impairment without dementia
CPET	Cardiopulmonary exercise testing
CR	Cardiac rehabilitation
CVD	Cardiovascular disease
DM	Diabetes mellitus
HIIT	High-intensity interval training
HR	Heart rate
HRQoL	Health-related quality of life
ICU	Intensive care unit
LDL-C	Low-density lipoprotein cholesterol
MET	Metabolic equivalent
MI	Myocardial infarction
OA	Osteoarthritis
PAD	Peripheral vascular disease
ROM	Range of motion
RPE	Rating of perceived exertion
TACVPR	Taiwan Academy of Cardiovascular and Pulmonary Rehabilitation
TAMIS	Taiwan Myocardial Infarction Society
TSOC	Taiwan Society of Cardiology
VO_2	Oxygen uptake

1. INTRODUCTION

Cardiac rehabilitation (CR) is a secondary prevention program that improves the health-related quality of life (HRQoL), survival rates, and exercise capacity, and reduces the readmission rates of patients with cardiovascular disease (CVD).[1-4] Several controlled cohort studies and meta-analyses have demonstrated survival benefits for patients receiving CR after acute coronary syndrome (ACS) compared with no CR (26% reduction of cardiac mortality and 18% reduction of recurrent hospitalization[4]), even in the modern era of early revascularization and statin therapy.[5-7] In a large and representative community cohort of Dutch patients with ACS or an intervention, CR was associated with a substantial survival benefit of up to 4 years. This survival benefit as present regardless of age, or type of diagnosis or intervention.[8] The reduction in mortality rate with CR is dose-dependent,[9] with proven cost-effectiveness.[10] In addition, exercise-based CR reduces anxiety[11] and has been recommended strongly in several ACS guidelines. For example, according to the 2020 European Society of Cardiology guidelines for managing patients with ACS,[12] multidisciplinary exercise-based CR is a class I level of evidence. Therefore, it is recommended that individuals diagnosed with acute myocardial infarction (AMI) should participate in an exercise-oriented CR program.[4] This recommendation is an effective means for patients with coronary artery disease to achieve a healthy lifestyle and manage risk factors to reduce all-cause and cardiovascular mortality and morbidity and improve their HRQoL.[4,6,8,12]

Early CR is safe and effective with a few major complications such as death, cardiac arrest, and myocardial infarction.[13-15] According to the 2020 update of the Taiwan Society of Cardiology's 2012 guidelines,[16] inpatient referral for CR is an ST-segment elevation myocardial infarction (MI) quality indicator. In addition, the 2014 American College of Cardiology/American Heart Association Task Force guideline suggests that all eligible patients with non-ST-elevation-ACS are referred to a comprehensive CR program before hospital discharge or during the first outpatient visit.[17]

Traditionally, CR consists of three phases: inpatient, outpatient, and maintenance. Phase 1 is typically an inpatient service, and early mobilization to prepare for discharge and resuming simple daily living activities is emphasized. It includes brief counseling about the nature of the illness, the treatment, risk factors management, and follow-up planning. Phase 2 is primarily a supervised ambulatory outpatient program; ideally, referral for outpatient CR should occur at hospital discharge. Phase 3 is a lifetime maintenance to continue the risk factor, lifestyle, and exercise training modifications.[18,19] The American Association of Cardiovascular and Pulmonary Rehabilitation endorses a "cardiovascular continuum of care" model that emphasizes a smooth transition from inpatient to outpatient programs.[18]

The consensus statement meeting comprised an expert panel of members of the Taiwan Myocardial Infarction Society (TAMIS), Taiwan Society of Cardiology (TSOC), and Taiwan Academy of Cardiovascular and Pulmonary Rehabilitation (TACVPR). The recommendations for CR protocols focused on a multidisciplinary approach, including diet, risk factor modification, psychosocial management, drug use, and exercise. The experts at the meeting agreed the recommendations in the consensus

statement. The disagreements raised were discussed, and the recommendations were adjusted accordingly. Apart from life support care, a proper CR protocol for patients with AMI needs to be established and emphasized in clinical practice in Taiwan.

2. PATHOPHYSIOLOGY

Exercise-based CR provides cardiac protection by decreasing the incidence of MI and increasing the chance of survival after coronary events.[1-3] A recent Cochrane review that included 85 trials and 23,430 people with coronary heart disease (CHD) showed that exercise-based CR is beneficial, including promoting a slight reduction in all-cause mortality, an appreciable decrease in all-cause hospitalization, and improved HRQoL up to 12 months of follow-up.[4] The effect of CR on cardiac physiology was mediated by increasing the left ventricular ejection fraction and peak oxygen uptake (VO_2) and lowering the resting heart rate (HR), left ventricular end-diastolic volume, and wall motion score index.[20] Two mechanisms, physio-pathological and psychosocial, are suggested to explain the effect of CR (Figure 1).

2.1. Physio-pathological mechanism

2.2.1. Exercise reduces cardiovascular risk factors

Exercise-based CR benefits many cardiovascular risk factors, such as arterial hypertension, insulin resistance, hyperlipidemia, and obesity.[21-23] A recent review showed that aerobic exercise, dynamic resistance, and concurrent training effectively lowered blood pressure.[24] Isometric exercise's ability to reduce high blood pressure must be confirmed in future randomized trials. Exercise training can increase insulin sensitivity through multiple glucose transport and metabolism adaptations.[25] Increased cardiovascular mortality is associated with being overweight and abnormal body fat distribution, which is improved by exercise.[26] Aerobic exercise can lower serum cholesterol levels and improve lipid profiles via a mechanism involving increased lipoprotein lipase activity.[27]

2.1.2. Exercise induces ischemic preconditioning

Exercise can produce short periods of ischemia and render the myocardium more resistant to subsequent ischemic insults. This phenomenon, called "ischemic preconditioning," can limit infarct size progression, protect against arrhythmia, and improve myocardial stunning due to ischemia-reperfusion.[28] Ischemic preconditioning induces the production of specific metabolites, activating protein kinase C, which activates several cell kinases, such as tyrosine kinase. Furthermore, multiple downstream kinase cascades are activated by exercise and are responsible for cardiac protection.[29]

2.1.3. Exercise improves cardiac electrical stability

Animal studies have shown that intensive exercise

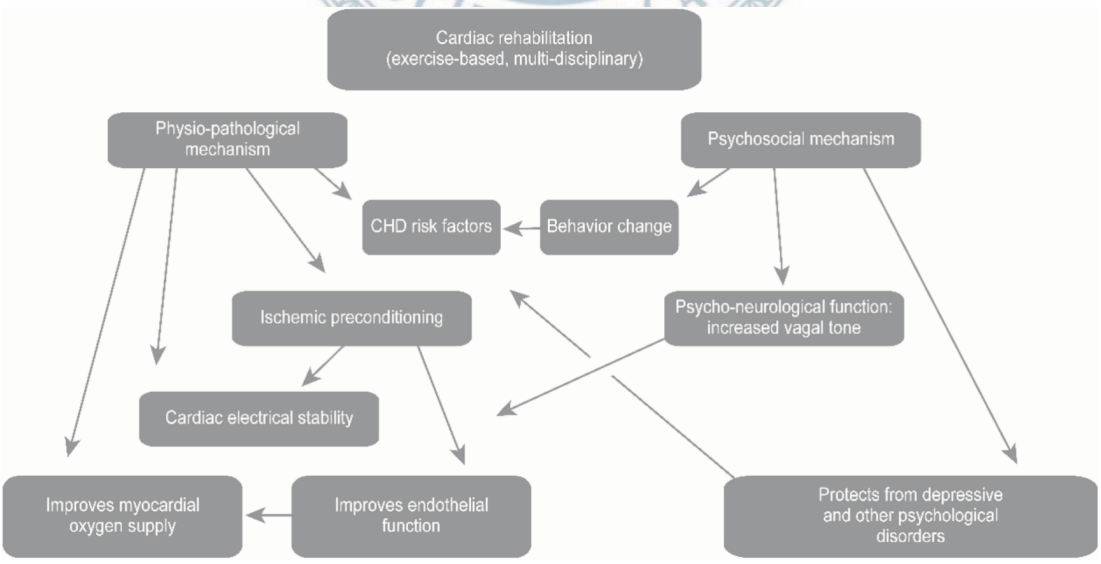

Figure 1. *Proposed pathophysiology of cardiac rehabilitation. Arrows indicate connections. CHD, coronary heart disease.*

reduces susceptibility to malignant arrhythmia in infarcted hearts. This phenomenon is linked to intrinsic exercise-induced normalization of refractoriness in infarcted hearts.[30] Exercise training also induces a shift in autonomic balance toward increased cardiac vagal activity, which has been shown to have an anti-fibrillatory effect.[1]

2.1.4. Exercise improves myocardial oxygen supply

In a study involving 39 postinfarction subjects using cardiac magnetic resonance imaging, an exercise training program was found to increase myocardial perfusion reserve in remote (30%, $p < 0.01$) and infarcted myocardium (25%, $p < 0.05$).[31] In addition, coronary collateral circulation to diseased vessels was found to be significantly increased in response to exercise.[32] In patients with CHD, an exercise training program induced a favorable alteration in the myocardial oxygen consumption indexes at which myocardial ischemia develops.[33] Furthermore, exercise-based CR significantly decreased the plaque burden in mildly stenotic lesions of the culprit coronary artery in patients with ASC.[34] Exercise-based CR was also shown to decrease ST-segment depression during exercise[35] and improve myocardial perfusion measured by thallium-201 scintigraphy.[36]

2.1.5. Exercise improves endothelial function

Coronary artery disease is associated with impaired endothelial function, especially in young patients with MI.[37] In patients with CHD, an exercise training program can improve the endothelial function of large coronary conduits and resistance arteries.[38] Several mechanisms have been proposed to explain this phenomenon. For example, exercise-induced shear stress has been demonstrated to augment the expression of nitric oxide synthase in the endothelium,[39] upregulate levels of cytosolic copper- and zinc-containing superoxide dismutase,[40] and suppress the activity of angiotensin-converting enzymes, which are able to break down bradykinin (a functional vasodilator).[41]

2.2. Psychosocial mechanism

2.2.1. Exercise improves psycho-neurological function

Psychological risk factors increase the risk of CHD and influence long-term outcomes. Recent evidence has shown that exercise-based CR programs can improve psycho-neurological function, reducing all-cause mortality.[42] Some evidence demonstrates that exercise has favorable effects on cognitive function, inflammation, platelet activation, and brain plasticity.[43-45] Patients with coronary artery disease were found to have a higher concentration of catecholamines as a result of sympathetic system activation.[46] Aerobic exercise training can enhance vagal tone, resulting in resting bradycardia, which has a protective effect in patients with CHD.[46]

2.2.2. Exercise protects against depressive and other psychological disorders

A meta-analysis comprising 11 randomized trials and 771 subjects showed that exercise training may be effective in alleviating anxiety and depression symptoms in patients with CHD.[47] A review of Ochsner studies by Lavie et al.[48] supported the benefit of exercise training in reducing psychological stress, improving CHD risk factors, and reducing all-cause mortality. Furthermore, Lavie et al.[49] showed that exercise training reduced the prevalence of anxiety (Kellner's anxiety symptoms score > 7) and high anxiety (Kellner's anxiety symptoms score > 10) by 56% and 69%, respectively. In a study of 522 patients with CHD, exercise training reduced the prevalence of depression from 17% to 6% (-63%, $p < 0.001$).[50] In a trial by Blumenthal et al.,[51] patients assigned to the exercise training groups had lower clinical event rates compared with those assigned to the non-exercise group (hazard ratio: 0.44; confidence interval: 0.27-0.71; $p < 0.001$). Patients who underwent additional stress management treatment demonstrated fewer clinical events compared with the group who underwent exercise training alone (18% vs. 33%; hazard ratio: 0.49; confidence interval: 0.25-0.95; $p = 0.04$). Therefore, exercise training and stress management treatment produced better psychological functioning than the usual care.

2.2.3. Exercise promotes behavior changes

Patients who have depressive symptoms may not engage in health improvement behaviors, including consuming a balanced diet, smoking cessation, and good drug adherence.[52] Multidisciplinary CR programs, including exercise planning, can reduce depressive symptoms, encourage behavior changes, and improve clinical outcomes.[53,54]

3. TIMING OF CARDIAC REHABILITATION

Early CR is usually safe and effective, although patients with complex hospital cases may have to wait longer before starting a CR program. There is no evidence of increased risk from moderate exercise during the early period after stent implantation.[55] Earlier studies recommended daily walking soon after discharge for most patients.[17] However, randomized control trials regarding the optimal timing of CR following an AMI were lacking. In addition, there is little evidence to indicate specifically when patients should commence CR to derive the most benefits.[55] In a retrospective study,[56] investigators collected mortality and hospital readmission data to examine a cohort of patients following MI, MI/percutaneous coronary intervention, and coronary artery bypass graft (CABG). The proportion of participants with MI was 58.5% in the CR group and 83.2% in the non-CR group. The CR group demonstrated lower all-cause mortality and decreased hospital readmissions. In addition, early separation of the survival curves of the CR and the non-CR groups revealed long-term benefits of CR.

Furthermore, Dunlay et al.[13] showed that in a population-based surveillance study of 2,991 patients with MI, those starting a CR program following hospital discharge had lower all-cause, cardiovascular, and non-cardiovascular readmissions and mortality risk. Similar early separation of curves of the estimated mean number of readmissions over time and the Kaplan-Meier curves of time to death were observed,[13] supporting that early CR program entry is safe and results in positive outcomes.[13,14] Nakamura et al.[57] identified 31,603 adult patients with AMI who underwent percutaneous coronary intervention on the day of admission and who were admitted to the intensive care unit (ICU) for more than three consecutive days between July 2010 and March 2018. Patients who started a rehabilitation program within 3 days of ICU admission were included in the early CR group, while others were included in the usual care group. Although no correlations were observed between early CR and the Barthel activities of daily living index scores, at discharge, early CR was established to be safe and associated with lower hospital costs and shorter hospital stays. Kim et al.[58] examined the safety and effectiveness of CR in patients resuscitated from cardiac arrest due to AMI; improvement was observed in the patients' exercise capacity after aerobic exercise throughout the CR program. This study provided evidence that CR is safe for high-risk patients with a history of cardiac arrest. However, in-patient CR may be preferred for some cases of severe left ventricular dysfunction or comorbidities needing 24-hour attention, and early enrollment may have better results on left ventricular remodeling[59] and functional outcomes.[60]

Early CR enrollment improves subsequent attendance and outcomes,[61,62] although varying degrees of monitoring or supervision during exercise is needed.[63] Lay et al.[64] provided objective data on physical activity levels of patients with AMI. Patients, of which 81% could walk independently, spent about half the day being physically inactive, implying that CR in the first week after MI's optimal timing and dose remained unclear. Exercise for conditioning purposes might not be recommended in high-risk patients with unstable disease; nevertheless, daily activities can be prescribed on the basis of individual assessment.[63] The American College of Sports Medicine's clinical exercise guidelines[18] state that submaximal exercise testing may be performed as early as 4-6 days after an AMI and symptom-limited tests at more than 14 days. Inpatient referral is considered a strong predictor of CR enrollment, and a lack of referral in Phase 1 negatively affects enrollment rates.[65]

Delayed CR significantly impacts fitness outcomes. A study by Fell et al.[60] used the United Kingdom National Audit of CR's data to explore the relationship between the timing of CR and fitness-related outcomes. For every day increase in wait time, patients were 1% less likely to improve across all fitness-related measures. Haykowsky et al.[59] conducted a meta-analysis of the effects of exercise training on left ventricular remodeling following MI, and found that every week exercise is delayed requires an additional month of exercise to accomplish the same level of benefit. Therefore, efforts should be made to identify and overcome barriers to timely CR provision.

A systematic review of survivors of AMI reported major depression in 19.8%, and the proportion with significant symptoms varied between 15% and 31% depending on the type of screening instrument used.[66] In addition, the CR wait time has been shown to detrimentally affect the outcome of patients' anxiety and depression status commensurate with the delay. Therefore, CR programs falling outside the 4-week window for com-

mencement following referral must strive to reduce the wait time to avoid negative impacts on patients' psychological outcomes.[67]

Borrayo-Sánchez et al.[68] reported that early CR following MI, from the first 24-48 hours in the ICU and hospitalization, allowed early discharge, better HRQoL, and fewer disability leave days. Early discharge (within 48-72 hours) is considered appropriate in select low-risk patients only if early CR and adequate follow-up can be arranged,[69] and individuals who have experienced an ACS should be referred to an early exercise-based CR program[70,71] to initiate Phase 2 CR soon after discharge.[71-73]

Recommendation 1: All patients admitted with MI should be referred to the rehabilitation department as early as clinically feasible during the ICU stay.

Early entry into a CR program reduces the long-term risk for all-cause mortality, cardiovascular readmission, and an increase in survival rate following MI. Even if the patient is medically unstable, early referral means that the rehabilitation team is aware of the patient and can start Phase 1 rehabilitation as soon as possible. The timing, phases, and intensity of CR in patients with AMI are summarized in Figure 2.

4. ORGANIZATION OF CARDIAC REHABILITATION

The structured exercise-based approach to CR was developed by Hellersten in the 1950s for patients with acute cardiac conditions.[74] However, the number of personnel, types of equipment, and facilities vary according to institution's size, funding, number of CR medical professionals and eligible patients. Therefore, CR programs should be structured according to the organizational environment. The structure of a multidisciplinary CR team, particularly the number of people on the team and the type of healthcare professionals, is directly dependent on the number of patients and the content of the program, the complexity of the cases of the patients being treated, the organization's human resources policies, and the program's availability to deliver community resources.

Participation in a medically supervised, structured, comprehensive, multidisciplinary exercise-based CR and prevention program for patients after an AMI is recommended to improve patient outcomes. The CR program should be comprehensive and multidisciplinary,[75] including exercise training, diet therapy, and lifestyle intervention, and must consider the facilities' site-specific equipment and the associated safety requirements and considerations.

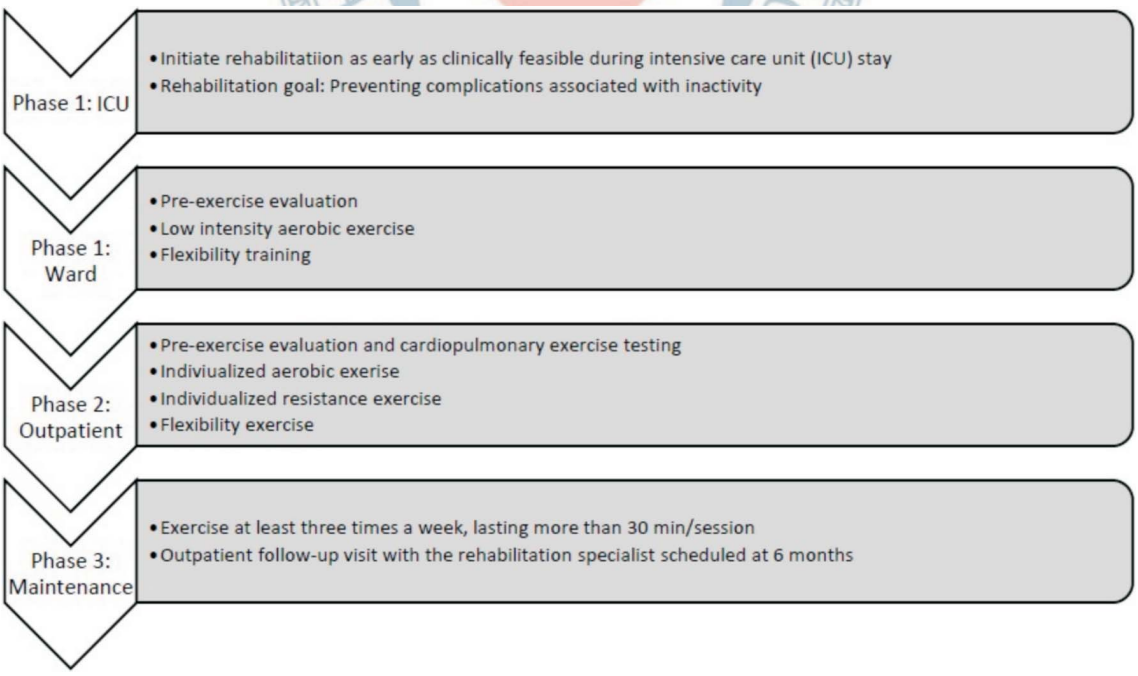

Figure 2. *Timing, phases, and intensity of cardiac rehabilitation in patients with acute myocardial infarction.*

Recommendation 2: The multidisciplinary team should consist of cardiologists, physiatrists, physical and occupational therapists, rehabilitation nurses, dieticians, clinical psychologists, medical technologists, case managers, and pharmacists (Figure 3). Certified CR specialists should lead CR programs.[76]

Team members should undergo professional training in CR and the secondary prevention of CVD, and have good communication and coordination skills. This team should conduct a comprehensive assessment for each individual requiring CR. The CR team should formulate personalized rehabilitation prescriptions and comprehensive intervention measures based on their expertise using a multidisciplinary approach. In addition, the team should implement strict quality control of the CR program and an evaluation system to improve it continuously.

The rehabilitation management of CVD emphasizes the entire process and continuity. For patients in the acute stage, CR should be implemented early and promptly by referral to a CR center or clinic for systematic and comprehensive rehabilitation training.[77]

5. DIET PROGRAM FOR PATIENTS WITH CARDIOVASCULAR DISEASE

Certain dietary patterns may be related to a decreased risk of CVD, especially after MI. Besides medication treatment, life-style and diet modifications are required to improve the secondary prevention of MI or

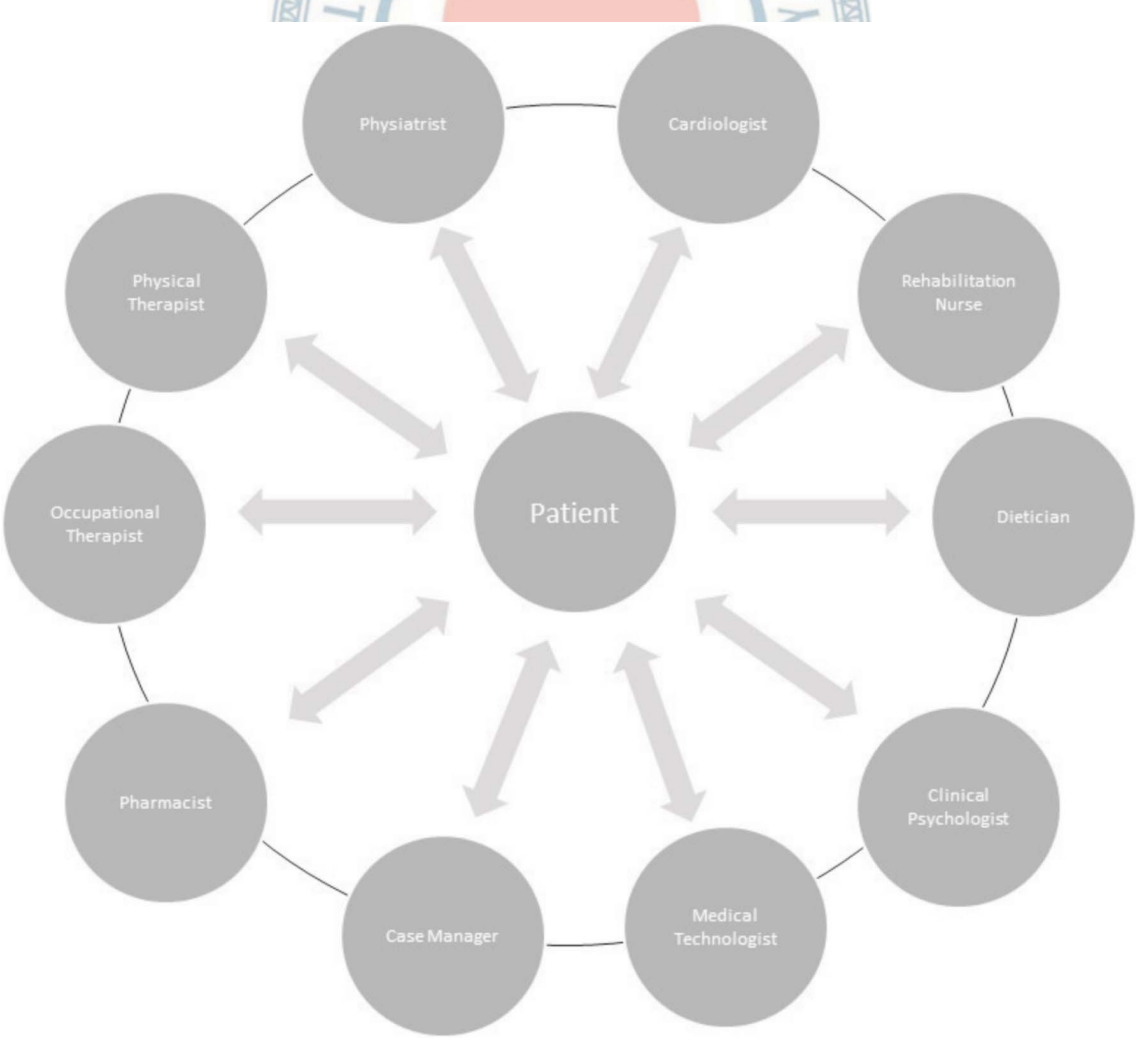

Figure 3. *The multidisciplinary cardiac rehabilitation team.*

other related complications. Therefore, choosing "heart-friendly" foods is essential. The dietary principles for coronary artery disease according to recent research are as follows:

5.1. Low-fat diet

The low fat diet, defined as saturated fat ≤ 7% of total daily calories,[78] or food fat weight < 50 g/day,[79] is known to improved CVD outcomes. Recommendations to reduce saturated fat are largely based on the notion that high levels of intake increases the risk of CVD. However, several studies have suggested that fat reduction could increase the risk of CHD, unless saturated fat is replaced with other fats.[80]

5.2. Mediterranean diet

The Mediterranean and low-fat diets decrease the risk of CVD.[78,81,82] Primary-outcome-free survival (a composite of all-cause and cardiac deaths, MI, hospital admissions for heart failure, unstable angina pectoris, or stroke) did not differ between the low-fat and Mediterranean-style diets.[77] However, the Mediterranean diet was found to be superior to the low-fat diet in the secondary prevention of major cardiovascular events. These effects were more evident in men.[82] Based on the published results from the Lyon Diet Heart Study and conservative assumptions, the Mediterranean diet is highly cost-effective for persons after a first AMI and represents an exceptional return on investment.[81]

5.3. Dietary approach to stop hypertension diet

Adherence to the dietary approach to stop hypertension (DASH) dietary pattern has been associated with a substantially lower risk of CAD and stroke mortality in an Asian population.[79] In addition, an inverse association between the DASH score and incidence of CAD has been demonstrated among US veterans.[83] Furthermore, the DASH dietary pattern is a well-accepted blood pressure-lowering diet associated CVD benefits, supported by reductions in blood pressure, hemoglobin A1c, low-density lipoprotein cholesterol (LDL-C) and other established CVD risk factors in people with and without diabetes.[84]

5.4. Plant-based food diets

Diets higher in plant and lower in animal foods have been associated with a lower risk of cardiovascular morbidity and mortality in the general population.[85] However, a systemic review revealed the favorable role of healthy plant-based foods in reducing cardiovascular mortality and CVD, but not total mortality.[85,86]

Recommendation 3: The diet program recommendations for patients with CVD are as follows: 1. Follow a low-fat, Mediterranean, DASH, or plant-based diet, which includes foods indicated in Table 1 as frequently as possible; 2. Limit sugar, salt, and unhealthy fats and avoid the foods shown in Table 2; this is especially recommended after experiencing an MI.

However, diet habits may have other considerations, such as personal preferences (e.g., tradition, culture, religion, or economics), and metabolic goals.[87] Different types of heart-friendly foods may be relevant to different evidence-based medicine diet choices. Besides, there is an overlap between food groups in evidence-based medical diet choices: the vegetables, fruits, and fish and seafood have three choice groups involved (Table 1).

Table 1. "Heart-friendly" foods

Food type	Type 2 DM may be adequate intake	Group of EBM diet choice +
Vegetables	-	
Fruits	Adequate intake	
Nuts and seeds	Adequate intake	
Beans and legumes	Adequate intake	
Whole grains	Adequate intake	
Plan-based oil (olive oil)	-	
Fish and seafood	-	
Lean meats	Adequate intake	
Skinless poultry	-	

+ (I) Low-fat die (II)Mediterranean diet (III)DASH diet (IV)Plant-based diet

DASH, dietary approach to stop hypertension; DM, diabetes mellitus; EBM, evidence-based medicine.

Table 2. Foods to limit or avoid

Fried food	Cookies and cakes	Fast food
Candy	Chips	Processed frozen meals
Biscuits	Ice cream	Canned food*
Red meat	Hydrogenated vegetable oils	Pizza, burgers, and hot dogs

* Veggies and beans are the exceptions, as long as there's no added salt.

In addition, the prevalence of CVD is much higher in patients with type 2 diabetes mellitus (DM), who may benefit from lifestyle changes, which include adapted diets. Research has investigated the DM diet selection for decreasing the CVD risk. In addition, some heart-friendly foods types may be limited in patients with diabetes mellitus. The food choice must be considered sugar content for patients with type 2 DM (Figure 4).[88]

In conclusion, benefits from lifestyle changes, which include dietary adaptations, play an essential role in CR. Patients with CVD should be educated about different dietary approaches and the nutrients associated with better and worse outcomes.

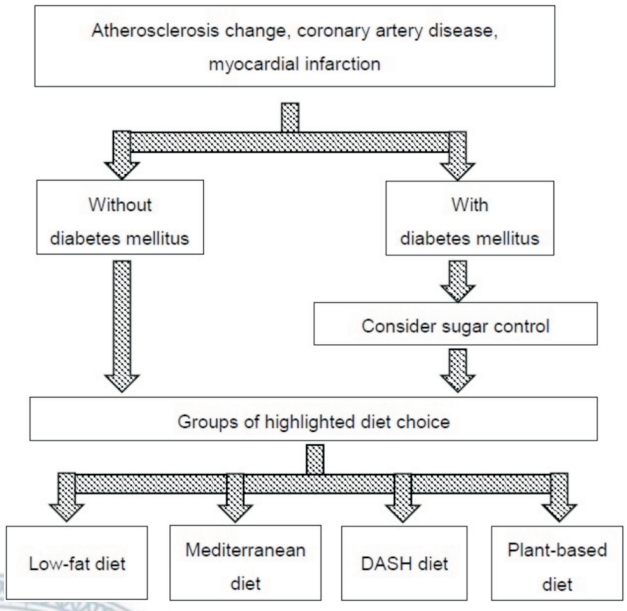

Figure 4. *Food choices for patients with diabetes mellitus. DASH, dietary approach to stop hypertension.*

6. CARDIOVASCULAR DISEASE RISK MODIFICATION

Major atherosclerotic CVD (ASCVD) risk factors can be divided into non-modifiable (age, sex, family history of CVD, and ethnicity) and modifiable factors (cigarette smoking, DM, high blood pressure, high cholesterol, and adiposity).[89] Due to the diversity of patient risk factors, individualized intervention and treatment goals are critical for risk modification. Patient- and family-centered shared decision-making, multidisciplinary teamwork, and an integrated approach are recommended to benefit the process and achieve favorable risk modifications.[90] Patients experiencing AMI are usually those with established ASCVD and belong to the very high CVD recurrence risk group, especially if the risk factors are not treated.[90]

Recommendation 4: A stepwise approach (Figure 5) is recommended to make ultimate patient treatment goals for CVD risk factor modification.[90]

In the first CR step, smoking cessation, risk factor modification, required individualized treatment (i.e., blood pressure and diabetes control, LDL-C reduction, and antithrombotic therapy), and establishing a healthy lifestyle (e.g., avoiding adiposity and adequate physical activity), are highly recommended for all patients. After the initial management and achievement of treatment goals, individualized treatments based on residual 10-year and lifetime CVD risks, treatment benefits, and patient comorbidities, frailty, and preferences are mandatory to achieve intensified goals in the second step for very high-risk patients.[89] Presently, there are no Taiwanese recurrent CVD risk stratification tools for secondary prevention. The Secondary Manifestations of Arterial Disease (SMART) and the European Action of Secondary and Primary Prevention by Intervention to Reduce Evens (EUROASPEIRE) risk models estimate the 10-year residual CVD risk and 2-year risk of recurrence of CVD in patients with established ASCVD.[91,92] The lifetime CVD risk reduction and long-term treatment benefits can also be derived from previous randomized controlled studies or meta-analyses of these studies.[93-95] Some online calculators, such as the European Society of Cardiology's CVD risk app, are available to estimate the lifetime benefit of smoking cessation, lipid reduction, and blood pressure control.[96] The estimate and interpretation of CCVD risk can be helpful in communication with patients when proceeding with individualized treatments.

6.1. Smoking cessation

Smoking cessation is the most effective CVD risk modification, significantly reducing the risk of MI and mortality.[11,12] Cessation should be encouraged in all smokers, and passive smoking, i.e., second-hand smoking, should be avoided through educating patients. The time of diagnosis or treatment of CVD is a good impetus

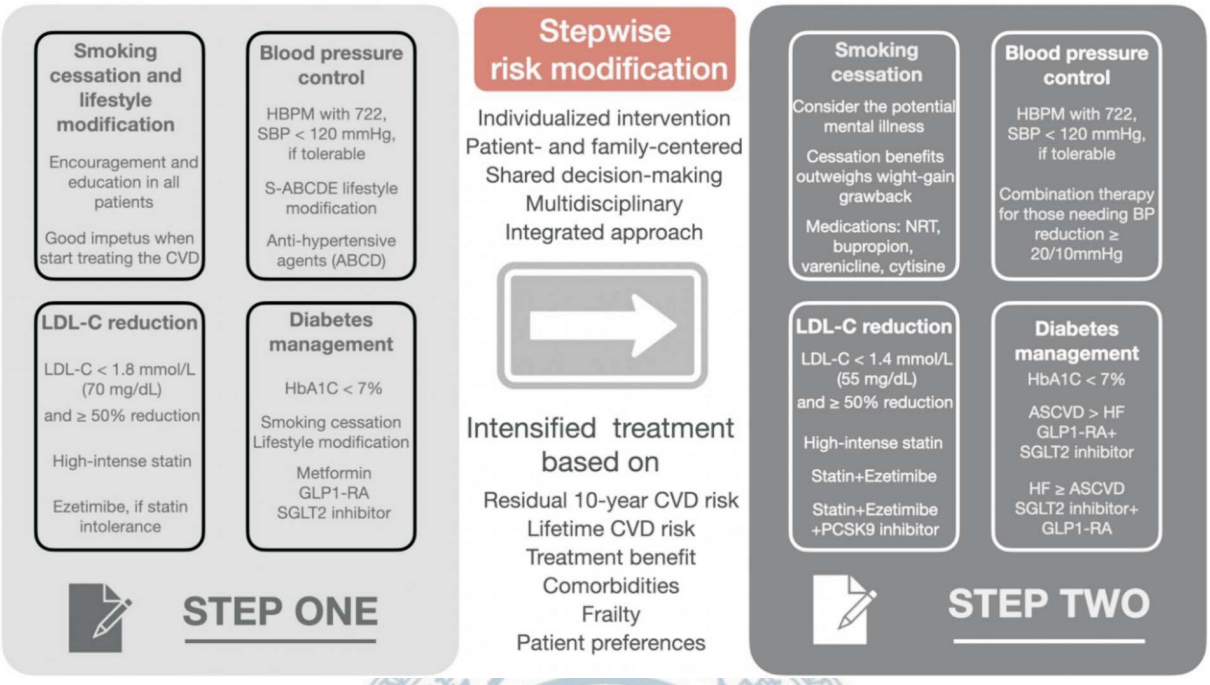

Figure 5. *Stepwise cardiovascular risk modification. ABCD, angiotensin-converting enzyme inhibitors or angiotensin receptor blockers, beta-blockers, calcium-channel blockers, and thiazide diuretics; ASCVD, atherosclerotic CVD; BP, blood pressure; CVD, cardiovascular disease; GLP1-RA, glucagon-like peptide-1 receptor agonists; HbA1C, glycated hemoglobin; HBPM, home blood pressure monitoring; HF, heart failure; LDL-C, low-density lipoprotein cholesterol; NRT, nicotine-replacement therapy; S-ABCDE, sodium restriction, alcohol limitation, body weight reduction, cigarette smoking cession, diet adaption and exercise adoption; SBP, systolic blood pressure; SGLT2, sodium-glucose transport protein 2.*

to start the cessation program. The failure of smoke cessation is common in patients with ASCVD; however, the cessation program still needs to be continuously implemented. Some patients who repeatedly fail to stop smoking may have a mental illness of severe depression or environmental exposure; therefore, mood-management therapies may benefit the success of cessation.[97,98] Smokers who quit smoking may gain 5 kg on average, but the health benefits outweigh the drawbacks of weight gain.[99] Evidence-based medication, such as nicotine-replacement therapy, bupropion, varenicline, and cytisine, can be considered for smokers ready to quit smoking.[100-102]

6.2. Blood pressure

All patients with CVD need to be screened for hypertension. The 2022 clinical practice guidelines of hypertension recommend using home blood pressure monitoring and the 722 protocol to obtain a more accurate assessment of the blood-pressure profiles.[103] Based on home blood pressure monitoring, the overall blood-pressure target is < 130/80 mm of mercury (mmHg). Patients with established ASCVD or high CV risks are recommended a more intensive systolic blood-pressure target of < 120 mmHg, if tolerable.[103,104] Lifestyle modification with sodium restriction, alcohol limitation, body weight reduction, cigarette smoking cession, diet adaption, and exercise adoption (S-ABCDE) and primary antihypertensive agents, including angiotensin-converting enzyme inhibitors or angiotensin receptor blockers, beta-blockers, calcium-channel blockers, and thiazide diuretics (ABCD) are recommended as first-line treatments.[103] It is advised to begin with combined therapy, ideally in the form of a single-pill, for individuals with blood pressure levels exceeding the target by 20/10 mmHg. Implementing a prioritized approach can enhance hypertension control by first achieving the home blood pressure monitoring goal, then maintaining or reducing the homeostatic model assessment levels, and, if necessary, utilizing ambulatory blood pressure monitoring for treatment adjustments. In cases where blood pressure levels have not reached their targets after 4 weeks of therapy, a modification strategy should be promptly employed before adjusting medications. The recommended adjustment approach, referred to as ATGOALs, encompasses the following as-

pects: adherence, timing of administration, increased dosages, additional drug classes, alternative combinations or single-pill combinations, and lifestyle modifications (along with relevant laboratory tests). In addition, renal denervation could be explored as an alternative method for lowering blood pressure after thorough clinical and imaging assessments.[103]

6.3. Diabetes mellitus

Screening for DM with the hemoglobin A1c or fasting blood sugar assessment is warranted for patients with ASCVD.[105] Lifestyle modifications are suggested, including smoking cessation, a low-saturated fat, high-fiber diet, aerobic physical activity, and weight training.[106] A target hemoglobin A1c of < 7.0% is recommended to reduce the recurrent CVD risk and microvascular complications for patients with either type 1 or 2 DM.[107,108] Metformin treatment can be initiated for patients with ASCVD and type 2 DM if there are no contraindications.[109-111] Despite the clinical benefits of dipeptidyl peptidase-4 inhibitors,[112-115] the use of glucagon-like peptide-1 receptor agonists and sodium-glucose transport protein 2 inhibitors are preferentially recommended for patients with concurrent ASCVD and DM.[116] Glucagon-like peptide-1 receptor agonists are preferable for patients with ASCVD and DM; however, if these patients develop heart failure, sodium-glucose transport protein 2 inhibitors should be prioritized.[116]

6.4. Lipids

Dyslipidemia can be screened with fasting or non-fasting sampling of lipid parameters, as the samples have the same prognostic values.[117,118] Nevertheless, if the patient has metabolic syndrome, DM, and hypertriglyceridemia, the calculated LDL-C from a non-fasting sampling should be interpreted cautiously. The corresponding non-high-density lipoprotein cholesterol value (total cholesterol minus high-density lipoprotein) or apolipoprotein B can be alternative treatment goals, particularly in patients with DM or hypertriglyceridemia because the values do not need to consider the triglyceride concentration.[119-121] An ultimate LDL-C goal of < 70 mg/dL and an LDL-C reduction of ≥ 50% from baseline is suggested for patients with established ASCVD without DM.[90,122] In patients with ASCVD and DM, an LDL-C goal of < 55 mg/dL and LDL-C reduction of ≥ 50% from baseline is recommended.[90,122]

If tolerable, a maximal dose of high-intensity statin is suggested to achieve the treatment goal for patients with a very high CVD risk, e.g., experiencing ACS.[91,122] A statin regimen is also recommended as the first-line treatment for CVD risk reduction for patients with hypertriglyceridemia (200 mg/dL). Combined statin and ezetimibe treatment is suggested if the LDL-C goals are not achieved with statin alone.[91,122] For secondary prevention among patients with ASCVD, a combined treatment with PCSK9 inhibitors is recommended if the treatment goal is not achieved with statin alone.[91,122]

Inclisiran is the first small interfering ribonucleic acid therapy to lower LDL-C with two doses a year. Despite promising trial results, real-world practice and use approval may need more evidence.[123,124] The same strategy of lowering lipids is suggested with a statin for young and older patients with ASCVD. Nevertheless, a low dose can be initiated if there is significant renal impairment or the potential for drug interactions.

7. DRUG THERAPY FOR ACUTE MYOCARDIAL INFARCTION

Drug therapy for MI involves antithrombotic agents, renin-angiotensin-aldosterone system blockers, beta-blockers, and nitrates. In addition, mineralocorticoid receptor antagonists and lipid- and glucose-lowering agents are essential drugs for special populations.[5,125]

Recommendation 5: Patient issues that are associated with taking guideline-directed medical therapy should be considered in CR.

Patients taking dual antiplatelet agents should avoid exercise with body collisions, especially when combined with oral anticoagulants, due to the risk of hemorrhaging.[126] However, exercise capacity, HR, and blood pressure are not influenced by anti-thrombotic agents.

Patients taking beta-blockers may be unable to exercise up to the anticipated performance and HR. In addition, they may have an attenuated HR response to exercise and an increased or decreased maximal exercise capacity. For patients whose beta-blocker dose was altered after an exercise test or during CR, a new graded

exercise test may be helpful.[127] Monitoring patients' signs and symptoms and the Borg rating of perceived exertion (RPE) scale are currently the most used in CR. The HR and Borg RPE scale should be defined as patients' target for exercise intensity.[128,129]

The evaluation of maximal voluntary effort during exercise testing is often questioned because current equations to predict maximum HR (220 - age) are based on subjects without CHD or beta-blocker therapy. Therefore, maximal HR measurement may be overestimated in patients taking beta-blockers. Data from symptom-limited exercise tests completed on patients with systolic heart failure taking beta-blockers in a controlled trial were used to develop a simplified equation as follows: 119 + 0.5(resting HR) – 0.5(age) – (0, if the test was completed using a treadmill or 5, if a stationary bike was used).[128]

Based on the Henry Ford Preventive Cardiology Outcomes database for patients with a history of MI or revascularization procedures, a prediction equation was developed as follows: HR maximum = 164 – 0.7 × age, with a standard error of the estimate of 18/min.[127] This equation provides a better estimate of the maximum HR for patients with coronary artery disease receiving beta-blockers than previously reported equations.

In addition, patients on diuretic therapy are at a potentially elevated risk for orthostatic hypotension and volume depletion, particularly after rounds of exercise. For these patients, the hemodynamic responses to exercise, including the symptoms of light-headedness, dizziness, and arrhythmias, should be monitored during rehabilitation. Similar conditions should be considered for patients on vasodilator therapy, such as nitrates.[19]

8. PSYCHOSOCIAL ASSESSMENT AND INTERVENTION

Older patients surviving AMI have measurable cognitive impairment without dementia (CIND). It has been reported that about 25% and 30% of older patients surviving AMI display moderate to severe and mild CIND, respectively, making CIND an important condition to consider when optimizing AMI care.[130] In addition, it was found that CIND was clinically insignificant but associated with less invasive care, less referral and participation in CR, and worse risk-adjusted first-year survival rates in patients with moderate to severe CIND.[130] Even if not immediately evident to the physician, CIND may impact AMI care, medication adherence, clinical follow-up, and HRQoL.[131] Therefore, appropriate mental function assessment and cognitive rehabilitation programs[131,132] are necessary to assist patients in preserving their daily life activities.

Stressors and episodes of anger, depression, anxiety, and frustration can trigger the onset of AMI.[133,134] The risk of having an AMI is more than 2-fold higher following outbursts of anger compared with other episodes, such as depression and anxiety, and is associated with higher relative risk.[135] The psychosocial index incorporating many of these adverse behavioral factors has demonstrated them to be high AMI risk factors.[136,137] In addition, adverse psychological risk factors have been associated with several standard CHD risk factors and peripheral vascular disease (PAD).[49]

Recommendation 6: Clinical psychologists' evaluation and intervention at the psychological and social level should incorporate individual or group treatments, such as mindfulness promoting, emotional monitoring, executive function, and stress adjustment, such as mindfulness therapy, cognitive behavioral therapy, emotion-focused therapy, neuropsychotherapy, etc., to reduce patients' risk of morbidity.

9. PHASE 1: INPATIENT REHABILITATION

Traditionally known as Phase I CR, inpatient CR is offered during hospitalization and reduces the rate of physical deconditioning following an AMI event.[70,138,139] The content of inpatient CR includes adjusting the CVD risk factors, assessing physical activity ability, early mobilization, and education for home-based exercise.

For patients staying in the ICU, rehabilitation aims to prevent the complications of inactivity through conditioning exercises. The rehabilitation program includes self-care activities and breathing, range of motion (ROM), and bed mobility exercises.[19] In addition, out-of-bed standing and stepping are recommended for eligible patients to restore ambulation function and prevent falling. Short-distance walking and low-intensity cycling

(3-4 metabolic equivalents [METs]) for 5-10 min, 3-4 times/day in the ICU unit are also encouraged.[140]

Once there is no deterioration of the patient's cardiac state, they can be transferred to a general ward where CR can be conducted at the bedside or in the rehabilitation unit.

Recommendation 7: The rehabilitation program in the general ward should focus on low-intensity aerobic exercise. The recommended inpatient aerobic exercise prescription is shown in Table 3.[19]

Flexibility training should be incorporated before and after each session. Stretching helps to lessen the musculoskeletal discomfort brought about by exercise, particularly for patients who previously did not have regular exercise habits. Implementing resistance training during the inpatient phase is discouraged.[18,19]

The mean hospital stay length of patients with AMI in Taiwan is 9.1 days.[141] However, studies have shown that patients with uncomplicated AMI can be safely discharged within 48-72 hours post-primary percutaneous coronary intervention.[142,143] The global trend of shortening the length of hospital stay allows minimal time for inpatient CR. Consequently, patient and family education and referral to outpatient CR during Phase 1 is essential. Patients are encouraged to continue exercise after discharge following the inpatient exercise prescription until they receive exercise testing at the outpatient department.[19] It is recommended to provide a manual with documented, individualized exercise instructions as a reference on discharge.

10. PHASE 2: OUTPATIENT REHABILITATION

After discharge from the hospital, patients with AMI are encouraged to participate in an outpatient CR program. An exercise training session comprises warm-up, conditioning, and cool-down periods.[19] The warm-up period usually consists of 5-10 min, including low-intensity aerobic exercises to speed up circulation, increase muscular blood perfusion and temperature, increase ROM, and prepare patients psychologically for following the conditioning phase training.[144]

The conditioning period can be divided into aerobic and resistance training. Aerobic training involves rhythmic, alternating activation of large muscle groups.

Recommendation 8: The recommended Phase 2 CR training frequency, intensity, duration, and types of aerobic exercises are outlined in Table 4.[19,144]

Table 3. Phase 1 inpatient aerobic exercise recommendation

Phase 1 aerobic exercise prescription following acute myocardial infarction	
Frequency	2-4 times/day
Intensity	Target heart rate = resting heart rate + 20 beats/min, with an upper limit of 120 beats/min or Borg rating of perceived exertion scale = 13
Time	Beginning with intermittent bouts that last 3-5 min; progress to 10-15 min continuous bouts
Type	Walking, ergometer, or treadmill

Table 4. Phase 2 outpatient aerobic exercise recommendation

Phase 2 aerobic exercise prescription following acute myocardial infarction	
Frequency	3-5 days/week
Intensity	Commencing with 40% exercise capacity and progressing to 80% exercise capacity using HR or VO_2 reserve, or VO_2max. A Borg rating of perceived exertion scale value of 12-16 is suggested as the training intensity in patients with atrial fibrillation, advanced disease, or who are using beta-blockers. The (HRrest) + 20-30 beats/min or the "talk test" should be used in the absence of exercise testing
Duration	Progress from 20-60 min/day. Multiple bouts of 10-min low-intensity activities are recommended for frail or deconditioned patients
Type	Treadmill walking, stationary cycling, upper or lower limbs ergometers, as tolerated

HR, heart rate; HRrest, resting heart rate; max, maximal; VO_2, oxygen uptake.

High-intensity interval training (HIIT), comprising 3-4 min of very high-intensity exercise interposed with 3 min at a moderate intensity, has been established as an alternative in outpatient CR. Previous studies have revealed that HIIT is not inferior to moderate-intensity continuous training. Concerning the risk of exercise, there is still no consensus for HIIT training in patients with AMI. However, HIIT may be adopted in the maintenance phase of CR, as there are several methods to define the intensity using VO_2, HR, and METs.[19]

Resistance training can increase muscle mass, muscle quality, lean body mass, and improved HRQoL. In addition, it may also improve bone mass and endothelium function.[145] Therefore, outpatient resistance exercise should be started at least 6-10 weeks after the date of the MI.

Recommendation 9: The recommended prescription for Phase 2 resistance exercise is shown in Table 5.[19,70,145,146]

After the condition period, a 5-10 min cool-down period, similar to the warm-up period, should be performed. Cool-down helps the HR and blood pressure to recover to the resting state gradually and decreases the incidence of hypotension, arrhythmia, and possible syncope due to the sudden cessation of exercise.[19,144]

Flexibility exercises can improve the ROM in major joints and muscle/tendon groups, balance, and postural stability.[147] Flexibility exercises can be performed after the cool-down period to the point of mild tightness but not elicit pain, with each static stretching position being held for 10-30 seconds for 2-4 repetitions. All stretching techniques can be performed, including static, dynamic, and proprioceptive neuromuscular facilitation stretching.[19]

All patients should be monitored continuously. If any adverse signs and symptoms occur, such as cold sweating, headache, dizziness, chest discomfort, excessive dyspnea, or near fainting, the exercise should be stopped, and a medical consultation should be advised.[19,70]

11. PHASE 3: MAINTENANCE

Increasing evidence supports the detrimental effects of physical inactivity and sedentary lifestyles on cardiovascular outcomes, emphasizing the importance of continuing the conditioning program initiated in Phase 2 to gain long-term cardiac benefits.[148-151] Phase 3 is the long-term maintenance of physical activity and continued integration of secondary prevention strategies into a patient's daily lifestyle. This phase involves transitioning from an outpatient to a home exercise program, from a medically supervised to an independent self-monitored program,[152] and may occur in patients' homes, outdoors, gyms, or specialized rehabilitation facilities.[153] The time of transition is highly variable and depends on the patient's clinical condition, risks of exercise, and the National Health Insurance Policy. Before transferring to an unsupervised program, patients should have stable cardiac symptoms and appropriate hemodynamic responses to exercise. The patient should have knowledge of proper exercise principles, be capable of recognizing abnormal symptoms, and be motivated to exercise without supervision.[152] Exercise intensity is individualized,[153] and the patient can regulate their exercise prescription using their submaximal HR and the Borg RPE scale as instructed by the rehabilitation team.

Recommendation 10: Phase 3 maintenance exercise

Table 5. Phase 2 outpatient resistance training recommendation

Phase 2 resistance exercise prescription following acute myocardial infarction	
Frequency	From two nonconsecutive days/week, progressing to three nonconsecutive days/week
Intensity	Starting from 30%-40% one-repetition maximum (1-RM) for upper body and 50%-60% 1-RM for lower body; increase by approximately 5%; 2-5 lb for upper body and 5-10 lb for lower body exercises if patients can comfortably achieve the upper limit of the desired repetition range or 11-13 on the Borg rating of perceived exertion scale
Duration	Starting from one and progressing to three sets; 10-15 repetitions of eight to 10 exercises
Mode	Body weight, dumbbells, wrist weights, elastic bands, calisthenics, pulley weights, free weights, or weight machines, focusing on major muscle groups

training should be performed at least three times/week, lasting more than 30 min/session.[154] An outpatient follow-up visit with the rehabilitation specialist should be scheduled 6 months after starting the Phase 3 program. In addition, cardiopulmonary exercise testing (CPET) should be redone at the follow-up visit to monitor the patient's progression, make appropriate adjustments to the exercise prescription, and detect possible physiological changes that may have taken place.

12. PRE-EXERCISE EVALUATION AND CARDIOPULMONARY EXERCISE TESTING

Before initiating CR, every patient should receive a comprehensive medical evaluation, physical examination, and exercise testing. The medical evaluation should include assessing the patient's diagnoses, symptoms, risk factors, surgical history, medication records, physical activity, recreational habits, work type, and psychosocial status. The physical examination should include evaluating the patient's cognitive function, body composition, balance, lower limb strength, peripheral circulation, comorbid conditions, such as musculoskeletal and neurologic disorders and pulmonary disease, and a standard resting 12-lead electrocardiogram.[19] Pre-exercise evaluation, including exercise testing, helps physicians identify the CR risks and organize the patient's individualized exercise prescription.[18,155,156]

Recommendation 11: CPET, also known as the VO_2 test, and the 6-min walk test (6MWT) should be used in pre-exercise evaluation (Table 6) before commencing CR.

12.1. Cardiopulmonary exercise testing in patients with acute myocardial infarction

Cardiopulmonary exercise testing is the gold standard for assessing functional and exercise capacity before initiating an exercise training program, as it collects gas analysis data and presents the changes during exercise testing. Symptom-limited CPET is conducted before Phase 2 CR.[18,156,157] In addition, several exercise testing protocols exist for treadmill and stationary cycle ergometers. Physicians should select an exercise protocol according to the patient's fitness and underlying disease. For example, if a patient is high risk or has a weight problem, stationary cycle ergometers with a less aggressive protocol are a better choice.[158] The symptom-limited exercise testing duration should last 8-12 min.[159] Staged protocols with one MET increment of metabolic demand per stage or cycle ergometer ramp protocol with 10 watts/min intensity increments are appropriate for high-risk patients with a functional capacity of < 7 METs. Protocols with a metabolic demand > 2 METs/stage or an intensity increment of 20 watts/min are appropriate for low- to intermediate-risk patients with a functional capacity > 7 METs.[18] The risk can be stratified according to the medical history, symptoms, electrocardiography, and the presence of heart failure.[160] The physicians can use the result of CPET to organize the exercise prescription.

12.2. Six-minute walk test in patients with acute myocardial infarction

Even though CPET is considered the gold standard for pre-exercise evaluation, the need for complex equipment and the requirement for expert interpretation make applying it inconvenient, and several studies have revealed low utilization.[161,162] The 6MWT is an alternative tool for pre-exercise evaluation. A good correlation between the VO_2 peak and 6MWT distance has been found,[163] and it is widely accepted as an alternative tool for pre-exercise evaluation. In addition, the 6MWT can be utilized in exercise prescription and follow-up in clinical changes.[164]

Table 6. Recommendation for pre-exercise evaluation

Pre-exercise evaluation	
Medical evaluation	Diagnoses, symptoms, risk factors, surgical history, medication records, physical activity, recreational habits, work type, and psychosocial status
Physical examination	Cognitive function, body composition, balance, lower limb strength, peripheral circulation; comorbid conditions, including musculoskeletal and neurologic disorders and pulmonary disease, and a standard resting 12-lead electrocardiogram
Exercise testing	Cardiopulmonary exercise testing or the 6-min walk test

13. SPECIAL CONSIDERATIONS FOR THE EXERCISE PRESCRIPTION

13.1. Special considerations for patients with a coronary artery bypass graft

Exercise prescription for patients following CABG surgery is similar to those with MI. It is well documented that physical activities and upper limb exercises reduce patients' sternal pain after sternotomy and should be encouraged. Patients who have undergone CABG surgery can start CR from 2 weeks after discharge and are initially prescribed lower extremity exercises, such as walking or stationary cycling. Upper extremity exercises for patients following sternotomy are restricted to general mobility and stretching for 6 weeks after the operation.[165]

The complications after median sternotomy include superficial wound infections, bony nonunion/sternal instability, sternal dehiscence, and mediastinitis. The incidence of postsurgical complications of median sternotomy is reported to be 1%-8%.[166] Complication risk factors after median sternotomy includes female gender, DM, obesity, bilateral internal mammary artery harvesting, reoperation procedures, and increased blood product requirements.[167] Sternal wound and stability evaluation is recommended at hospital discharge and when initiating the outpatient CR program.[166] Ultrasound is a reliable and precise measure of sternal motion after median sternotomy and is useful for patients with known or suspected sternal instability.[168] The sternal instability scale was another method to assess the stability of the sternum in patients following median sternotomy and has been demonstrated to have excellent validity and inter- and intra-rater reliability.[169]

Evidence suggests that less restrictive sternal precautions can facilitate greater movement, activity, and health perception following median sternotomy. Less restrictive sternal precautions focusing on the lever arm portion of the torque equation encourage motion close to the body with short lever arms and within the safe limits of pain and discomfort.[167] In addition, it has been demonstrated that a reduced arm force when tasks were performed at a "slow" compared with a typical "self-selected" speed may be a valuable strategy for patients recovering from median sternotomy.[170]

Pleural and pericardial effusions are common complications after CABG surgery and may occur within the first several weeks after the operation. About one-fifth of cardiac surgery patients have a pericardial effusion on postoperative day 20, with an incidence of cardiac tamponade between 1%-2.6%.[171] These conditions are generally related to postoperative inflammation and can be detected during early outpatient CR by evidence of nonspecific symptoms, such as decreasing exercise capacity, chest discomfort, and increasing dyspnea. The new onset of these symptoms after outpatient CR programs should be further evaluated by a physiatrist.

13.2. Special considerations for patients with peripheral vascular disease

Cardiopulmonary exercise test using a treadmill is more common than cycle ergometry in patients with PAD. In addition to the patient's functional capacity and exercise limitations, the onset of claudication pain and total walking times should be determined.[172] Patients should be asked to report the onset of claudication and rate the severity of discomfort at each stage of the treadmill test using claudication pain scales with five category ratings as shown in Table 7.[19]

A recent study of patients with PAD reported the benefit of high-intensity compared with low-intensity exercise.[173] In addition, treadmill training was preferred for intermittent claudication and exercise intolerance improvement in patients with PAD. A high-intensity exercise workload that induces moderate to moderate/severe claudication within 3-5 min is recommended. Therefore, the walking duration should be 5-10 min to reach moderate to moderate/severe claudication, followed by rest until the pain has dissipated (2-5 min).[173]

14. SPECIAL CONSIDERATIONS FOR PATIENTS WITH OSTEOARTHRITIS

A major problem for patients with AMI and osteo-

Table 7. Claudication pain scale

Pain scale	Verbal descriptor
0	No discomfort
1	Minimal discomfort
2	Moderate pain
3	Intense pain
4	Unbearable pain

arthritis (OA) starting a CR program is the belief that exercise, particularly weight-bearing exercise, will exacerbate joint damage and osteoarthritis progression. Therefore, these patients must be reassured that exercise is safe and consistently reported to improve cardiopulmonary fitness and osteoarthritis symptoms. Generally, CR recommendations are consistent with patients with AMI without osteoarthritis. A shared decision-making process should be applied to patients' exercise prescription, including exercise mode and intensity.[174]

During OA acute flare-ups, patients should avoid a strenuous exercise program. However, gentle ROM and stretch exercises to keep the joints full ROM are recommended. Adequate warm-up and cool-down periods are essential for minimizing pain. If exercise exacerbates an OA acute flare-up, alternative exercises that work the same muscle groups and energy systems should be considered. Flexibility training is vital to enhance ROM and counteract OA's adverse effects on joint mobility. Resistance training for patients with AMI and OA may need increased loads at slower rates and smaller increments to minimize localized joint reactions and pain.[19]

15. SPECIAL CONSIDERATIONS FOR DECONDITIONING

Decondition is due to detraining, bed rest, casting, using crutches, paralysis, aging, or space flight. Deconditioning, such as bed rest, induces muscle atrophy and weakness and causes bone loss, cardiovascular changes (such as decreased blood and stroke volumes), increased resting HR, and orthostatic intolerance.

Training regimens for a patient with deconditioning should start with extended periods of very low-intensity activity, including high proportions of strength and balance training, in those suffering severe functional incapacitation at the onset. Strength training of the back, lower limbs, and postural muscle groups, such as the back extensors, quadriceps, hip extensors, and ankle plantar flexors, should be included. Seated activities (e.g., cycle ergometer, seated stepping ergometer) may be more effective and safer than those that rely on standing or ambulating. The risk of bone fractures, even after muscle strength has returned to normal, should always be considered.[19]

16. STRATEGIES TO IMPROVE CARDIAC REHABILITATION PARTICIPATION

Despite numerous studies indicating the benefits of CR, including reduced hospital readmissions, cardiovascular mortality, and improved exercise capacity and HRQoL in patients post-MI,[5,175,176] the participation rate of outpatient CR remains low, ranging from 7% to 15% in individual hospital analyses in Taiwan.[177,178] Several factors are associated with decreased participation in outpatient CR after AMI.[179,180] These include patients' lack of awareness of the importance of CR, lack of recommendation or endorsement for CR by the primary-care cardiologist or cardiac surgeon, and uncoordinated CR referral processes. Moreover, socioeconomic factors, including financial, transportation, and time issues, may hinder CR participation.

Recommendation 12: Several strategies have been proposed (Figure 6) to overcome the barriers to CR participation.

First, systematic approaches to facilitate inpatient CR referrals are crucial to promote outpatient participation.[181,182] These include implementing an automatic electronic medical records-based referral system and a preset opt-out CR option for all eligible patients. Second, the deployment of a case manager or a liaison officer increases CR participation,[181-183] by educating the patients about the benefits of outpatient CR and coordinating

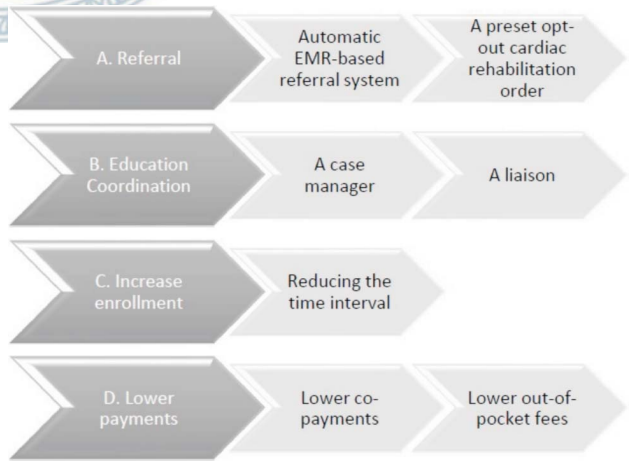

Figure 6. *Strategies to improve patient cardiac rehabilitation participation. EMR, electronic medical records.*

the referral and enrollment processes for qualifying patients. Third, reducing the time interval between hospital discharge and the first CR clinic appointment helps to increase CR enrollment.[181,184] Evidence shows that for every day of delay in the first CR clinic appointment, patients are 1% less likely to participate.[184] Fourth, lowering co-payments or other out-of-pocket fees for patients enrolled in outpatient CR is essential.[179,181,184]

17. CONCLUSION

Cardiac rehabilitation is a multi-disciplinary intervention recommended in international and Taiwanese guidelines for patients with AMI. All patients admitted with AMI should be referred to a rehabilitation center or clinic as early as clinically feasible. The multidisciplinary CR team consists of cardiologists, physiatrists, physical therapists, occupational therapists, rehabilitation nurses, dieticians, clinical psychologists, medical technologists, case managers, and pharmacists. The CR program is divided into the inpatient, outpatient, and maintenance phases. The exercise prescription is organized according to individual clinical conditions. Several strategies may be helpful to overcome the barriers to CR participation.

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DECLARATION OF CONFLICT OF INTEREST

All the authors declare no conflict of interest.

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