Cardiac Rehabilitation

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What is Cardiac Rehabilitation?

- Cardiac rehabilitation is a comprehensive exercise, education, and behavior modification program designed to improve the physical and emotional condition of patients with heart disease.

- Prescribed to control symptoms, improve exercise tolerance, and improve overall quality of life.

- The primary goal of cardiac rehabilitation is to enable the participant to achieve his/her optimal physical, psychological, social and vocational functioning through exercise training and lifestyle change.

Core Components of Cardiac Rehabilitation

- Prescribed exercise to improve cardiovascular fitness without exceeding safe limits
- Education about heart disease along with counseling on ways to stabilize or reverse heart disease by improving risk factors
  - Reduction/Cessation of Smoking
  - Lipid Management
  - Controlling High Blood Pressure
  - Weight Loss/Control
  - Improve/Manage Diabetes
  - Increasing Physical Activity
- Encourage Healthy Eating Habits
- Improve Psychological Well Being

Risk factors of CAD

Uncorrectable	Correctable	Controllable
▷ Age ▷ Male ▷ Genetic	▷ Smoking ▷ Physical inactivity ▷ Obesity ▷ Emotion	▷ Diabetes ▷ Hypertension ▷ Dyslipidemia

- Class I indication in clinical guidelines for
    - Myocardial Infarction
    - Percutaneous Coronary Intervention
    - Coronary Bypass Grafting
    - Chronic stable angina
    - Heart failure
    - Peripheral arterial disease
    - Cardiovascular prevention in women

Evidence Supporting the Guidelines

- Decreases Mortality at up to 5 years Post Participation
- Decreases Cardiovascular Events
- Improves Modifiable Risk Factors
- Improves Adherence with Preventive Medications
- Improves Function and Exercise Capacity
- Improves Quality of Life
- Fosters Lifelong Healthy Behaviors

Cardiac Rehabilitation and Survival in Older Coronary Patients

CPR
Cardiovascular
Rehabilitation
Fighting Disease

Mortality Benefit of Cardiac Rehabilitation

Methods

- Examined 1-5 year morta[lity] hospitalized with diagnos[is] rehabilitation in 1997

- Used propensity based a[nalysis] compare up to 5 year mo[rtality] cardiac rehabilitation com[pared]

- Additionally, analysis was (n=17,298) of high-dose (low dose users (1-24 ses[sions])

Suaya JA, Stason WB, Ades PA
J. Am. Coll. Cardiol. 2009;54;25

Results

- Overall Group (n=601,099)
  - Crude Mortality Rate at 5 years: **Relative risk reduction 59%**
- Propensity Based Matched Pairs (70,040 pairs).
  - Mortality at 1 year: users 2.2%; non-users 5.3% **(relative risk reduction 58%)**
  - Mortality at 5 years: users 16.3%; non-users 24.6% **(relative risk reduction 34%)**
- Regression Modeling Mortality Rate at 5 years (adjusting for patient and hospital characteristics)
  - **26% relative risk reduction**
- Instrumental Variable Modeling
  - Mortality Rate at 5 years: Users 29.8%; Non-users 37.8% **(21% relative risk reduction)**
- High Dose versus Low Dose (n=17,298)
  - Mortality at 1 year: high dose 1.1%; low dose 2.6% **(relative risk reduction 58%)**
  - Mortality at 5 years: high dose 14.0%; low dose 17.2% **(relative risk reduction 19%)**

Impact of Cardiac Rehabilitation on Mortality Following PCI

PR
diovascular
itation
ing Disease

A retrospective analysis from a prospectively collected registry of 2,395 consecutive patients who underwent PCI in Olmsted County, Minnesota, from 1994 to 2008

The association of card
cardiac mortality, myoc
assessed

Follow-up of 6.3 years
- 503 total deaths (1
- 394 total myocardi
- 755 total revascula

Participation in CR (40% (964 of 2395) of the cohort) was associated with

- a significant decrease in all-cause mortality (hazard ratio, 0.53 to 0.55; P<0.001).

- A trend toward decreased cardiac mortality was also observed in CR participants;

No effect was observed for subsequent myocardial infarction or revascularization.

Geol K, Lennon RJ, Tilbury RT et al, Impact of Cardiac Rehabilitation on Mortality Following P
Circulation. 2011;123:2344-2352.

Relationship between cardiac rehab & long-term risks of dea... Medicare benefi...

PR
diovascular
tation
ng Disease

Dose dependent reduction in r...
cardiac rehabilitation

Methods

- 30,161 elderly Medicare pa...
  cardiac rehabilitation sessi...
  December 31, 2005.
- Used a Cox proportional h...
  relationship between the n...
  death and myocardial infar...
- The cumulative number of
  covariate.

Hammill BG, Curtis LH, Schulman KA, Whellan DJ.
of Death and Myocardial Infarction Among Elderly M

Results

- After adjustment for demographic characteristics, comorbid conditions, and subsequent hospitalization, **patients who attended 36 sessions** had a
  - **14% lower risk of death** (hazard ratio [HR], 0.86; 95% confidence interval [CI], 0.77 to 0.97) and a **12% lower risk of MI** (HR, 0.88; 95% CI, 0.83 to 0.93) **than those who attended 24 sessions**
  - **22% lower risk of death** (HR, 0.78; 95% CI, 0.71 to 0.87) and a **23% lower risk of MI** (HR, 0.77; 95% CI, 0.69 to 0.87) **than those who attended 12 sessions**
  - **47% lower risk of death** (HR, 0.53; 95% CI, 0.48 to 0.59) and a **31% lower risk of MI** (HR, 0.69; 95% CI, 0.58 to 0.81) **than those who attended 1 session**

Among Medicare beneficiaries, a strong dose-response relationship existed between the number of cardiac rehabilitation sessions and long-term outcomes.

Attending all 36 sessions reimbursed by Medicare was associated with lower risks of death and MI at 4 years compared with attending fewer sessions.

- Of eligible patients, only 14-35% of heart attack survivors and approximately 31% of patients after CABG participate in cardiac rehabilitation

- Participation is lowest in women, minorities, socio-economically disadvantaged patients, and the elderly

JA Suaya, DS Shepard, ST Normand, PA. Ades, J Prottas, WB Stason. Use of Cardiac Rehabilitation by Medicare Beneficiaries After Myocardial Infarction or Coronary Bypass Surgery. *Circulation* 2007;116;1653-1662

Weeks

0	1	2	3	4	5	6	7	8	9	10	11	12	Beyond

Inpatient—hospital
clinical pathway

Transitional care—subacute facility, home
care, pretraining at home

Outpatient programming—cardiac rehabilitation center

Maintenance—lifelong—community facility or at home

Recommended Continuum of Care for CR Services

Phase 1: Inpatient rehabilitation

Goal: independent daily activity, avoid deconditing
Rx: early mobilization and brief counselling

Goals for Inpatient CR

- Identify patients with significant cardiovascular, physical, or cognitive impairments that may influence the performance of physical activity.
- Offset the deleterious physiologic and psychological effects of bed rest.
- Provide additional medical surveillance of patients and their responses to physical activity.
- Evaluate and begin to enable patients to safely return to activities of daily living (ADL) within the limits imposed by their CVD.
- Prepare the patient and support system at home or in a transitional setting to optimize recovery following acute care hospital discharge.
- Facilitate physician referral and patient entry into an outpatient cardiac rehabilitation program.

Basic of Inpatient Cardiac Rehabilitation Program

Assessment Parameters for Inpatient/ Transitional CR Activity Program

To begin rehabilitation

Patient is considered "stable" under the following conditions:

- No new/recurrent chest pain in past 8 hr
- CK and/or troponin levels are not rising
- No new signs of uncompensated failure (dyspnea at rest with bibasilar rales)
- No new significant, abnormal rhythm or ECG changes in past 8 hr

Progression of rehabilitation

Patient may be considered for activity progression when activity responses include the following:

- Adequate HR increase
- Adequate systolic BP rise to within 10-40 mmHg from rest
- No new rhythm or ST changes are identified on telemetry rhythm strip
- No cardiac symptoms such as palpitations, dyspnea, excessive fatigue, or chest pain are observed

Contraindication for Cardiac Rehabilitation

- Unstable angina
- Uncontrolled hypertension — that is, resting systolic blood pressure (SBP) >180 mm Hg and/or resting diastolic BP (DBP) >110 mm Hg
- Orthostatic BP drop of >20 mm Hg with symptoms
- Significant aortic stenosis (aortic valve area <1.0 cm^2)
- Uncontrolled atrial or ventricular arrhythmias
- Uncontrolled sinus tachycardia (>120 beats · min^{-1})
- Uncompensated heart failure
- Third-degree atrioventricular (AV) block without pacemaker
- Active pericarditis or myocarditis
- Recent embolism
- Acute thrombophlebitis
- Acute systemic illness or fever
- Uncontrolled diabetes mellitus (see *Chapter 10*)
- Severe orthopedic conditions that would prohibit exercise
- Other metabolic conditions, such as acute thyroiditis, hypokalemia, hyperkalemia, or hypovolemia (until adequately treated)

FITT RECOMMENDATIONS FOR INPATIENT PROGRAMS

Frequency: Mobilization: two to four times per day for the first 3 d of the hospital stay.

Intensity: Seated or standing resting heart rate (HR_{rest}) +20 beats $\cdot$ min^{-1} for patients with an MI and +30 beats $\cdot$ min^{-1} for patients recovering from heart surgery; with an upper limit ≤120 beats $\cdot$ min^{-1} that corresponds to an RPE ≤13 on a scale of 6–20 (6).

Time: Begin with intermittent walking bouts lasting 3–5 min as tolerated with exercise bouts of progressively increasing duration. The rest period may be a slower walk (or complete rest at the patient's discretion) that is shorter than the duration of the exercise bout. Attempt to achieve a 2:1 exercise/rest ratio.

Type: Walking.

Progression: When continuous exercise duration reaches 10–15 min, increase intensity as tolerated within the recommended RPE and HR limits.

Sample Progressive Activity Plan for 4-day Length of Stay

	MET Level	Activity
Day 1: Critical care unit (CCU)	1-2	• Bed rest until stable • Then OOB in chair • Bedside commode
Day 2: Transfer to step-down unit	2-3	• Routine CCU activities, with emphasis on self-care • Sitting warm-ups • Walking in room
Day 3	2-3	• OOB as tolerated • Standing warm-ups • Walking 5-10 min in hall 2-3 times (first time with supervision)
Day 4	3-4	• Shower with seat • Standing warm-ups • Walking 5-10 min in hall 3-4 times; walking up one flight of stairs or treadmill walking

Table 4.1 Types of Activities Commonly Used in Early Cardiac Rehabilitation

Activity	Method	METs	Average HR response
Toileting	Bedpan	1-2	5-15 beats ≠ from RHR
	Commode	1-2	
	Urinal (in bed)	1-2	
	Urinal (standing	1-2	
Bathing	Bed bath	2-3	10-20 beats ≠ from RHR
	Tub bath	2-3	
	Shower	2-3	
Walking	Flat surface		5-15 beats ≠ from RHR
	2 mph	2-2.5	
	2.5 mph	2.5-2.9	
	3 mph	3-3.3	
Upper body exercise	While standing		10-20 beats ≠ from RHR
	Arms	2.6-3.1	
	Trunk	2-2.2	
Leg calisthenics		2.5-4.5	15-25 beats ≠ from RHR
Stair climbing	1 flight = 12 steps		
	Down 1 flight	2.5	10 beats ≠ from RHR
	Up 1-2 flights	4.0	10-25 beats ≠ from RHR

1st Step

2nd Step

3rd Step

6ᵗʰ Step

BOX 9.3 — Adverse Responses to Inpatient Exercise Leading to Exercise Discontinuation

- Diastolic blood pressure (DBP) $\geq$110 mm Hg
- Decrease in systolic blood pressure (SBP) >10 mm Hg during exercise with increasing workload
- Significant ventricular or atrial arrhythmias with or without associated signs/symptoms
- Second- or third-degree heart block
- Signs/symptoms of exercise intolerance including angina, marked dyspnea, and electrocardiogram (ECG) changes suggestive of ischemia

Discharge Planning Design

⤳ **Discharge-readiness assessment**

⤳ **Physiological stability & functional ability**

⤳ **Competency (cognitive & psychomotor) to carry out self-care**

⤳ **Perceived self-efficacy**

⤳ **Availability of social support**

⤳ **Access to health care resources**

⤳ **Predischarge exercise testing or 6MWT**

Concern of cardiac pt during the 1st mo after D/C

- Return to work

- Driving

- Household activity

- Stair climbing

- Lifting

- Sexual activity

- Walking

- Socializing

Clinical Pathways

Table 4.2 Sample Clinical Pathway for Rehabilitation Services: Uncomplicated				
	Day 1	**Day 2**	**Day 3**	**Day 4**
Consults		CR to assess: • Readiness for activity • Readiness to learn		
Activity	Bed rest until stable, then OOB in chair; bedside commode	Routine CCU activities; sitting warm-ups, walk in room	Up in room; standing warm-ups; walk 5-10 min in hall 2-3 times/d (first time with supervision)	Up in room; standing warm-ups; walk 5-10 min in hall 3-4 times/d; walk down & up 1 flight of stairs with supervision
Education	Orient to CCU; basic explanation of event and treatment plan	Assess readiness to learn; when ready, teach survival lesson—signs/symptoms recognition, nitroglycerine use, emergency plan	Assess readiness to learn; when ready, teach survival lesson—safety factors, precautions for home	Review survival lessons; discuss postdischarge plans: 1. Phone number to call with questions 2. CR f/u: where, when 3. MD office visit
Discharge planning				CR predischarge visit and

Preexisting conditions
- General frailty
- Chronic renal insufficiency
- Cerebrovascular accident
- Orthopedic problems
- Cognitive impairment

CV complications
- Postoperative bleeding
- Arrhythmia
- Pulmonary infections
- Perioperative MI
- Reduced left ventricular function
- Cerebrovascular accident
- Postoperative wound infections

Phase 2: Ambulatory outpatient rehabilitation

Goal: ↑ functional capacity & risk factor modification

Rx: ambulatory exercise program & group education

BOX 9.4 Goals for Outpatient Cardiac Rehabilitation

- Develop and assist the patient to implement a safe and effective formal exercise and lifestyle physical activity program.
- Provide appropriate supervision and monitoring to detect change in clinical status.
- Provide ongoing surveillance data to the patient's health care providers in order to enhance medical management.
- Return the patient to vocational and recreational activities or modify these activities based on the patient's clinical status.
- Provide patient and spouse/partner/family education to optimize secondary prevention (e.g., risk factor modification) through aggressive lifestyle management and judicious use of cardioprotective medications.

Risk of Cardiac Events During Cardiac Rehabilitation

The mortality rate is 6 times higher when patients exercised in facilities w/o the ability to successful CPR.

TABLE 1.6. Summary of Contemporary Exercise-Based Cardiac Rehabilitation Program Complication Rates

Investigator	Year	Patient Exercise Hours	Cardiac Arrest	Myocardial Infarction	Fatal Events	Major Complications[a]
Van Camp (58)	1980–1984	2,351,916	1/111,996[b]	1/293,990	1/783,972	1/81,101
Digenio (13)	1982–1988	480,000	1/120,000[c]		1/160,000	1/120,000
Vongvanich (59)	1986–1995	268,503	1/89,501[d]	1/268,503[d]	0/268,503	1/67,126
Franklin (17)	1982–1998	292,254	1/146,127[d]	1/97,418[d]	0/292,254	1/58,451
Average			1/116,906	1/219,970	1/752,365	1/81,670

[a] Myocardial infarction and cardiac arrest.
[b] Fatal 14%.
[c] Fatal 75%.
[d] Fatal 0%.

Home-based VS Center-based exercise programs: No increase in cardiovascular complications:

Factors needed to be concerned

♥ **Medical history**
   eq. Risk factors, Systemic disease, Pain
♥ **Current status**
♥ **Medical regimen**
♥ **Trainer's understanding of exercise physiology**
   "Normal hemodynamic response"
♥ **Insight of patient's interest & expectation**

Assessment

Objective:
1. Screening contraindication for exercise
2. To rule out / aware some conditions that must be careful during exercise eq. low fever, inadequate sleep, dizziness
3. Risk stratification (low, moderate, high)
4. Assess individual factors effect on exercise

BOX 2.4	American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR) Risk Stratification Criteria for Patients with Cardiovascular Disease

LOWEST RISK

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

- Absence of complex ventricular dysrhythmias during exercise testing and recovery
- Absence of angina or other significant symptoms (*e.g.*, unusual shortness of breath, light-headedness, or dizziness, during exercise testing and recovery)
- Presence of normal hemodynamics during exercise testing and recovery (*i.e.*, appropriate increases and decreases in heart rate and systolic blood pressure with increasing workloads and recovery)
- Functional capacity ≥7 metabolic equivalents (METs)

Nonexercise Testing Findings

- Resting ejection fraction ≥50%
- Uncomplicated myocardial infarction or revascularization procedure
- Absence of complicated ventricular dysrhythmias at rest
- Absence of congestive heart failure
- Absence of signs or symptoms of postevent/postprocedure ischemia
- Absence of clinical depression

MODERATE RISK

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 shortness of breath, light-headedness, or dizziness occurring only at high levels of exertion [≥7 METs])
- Mild to moderate level of silent ischemia during exercise testing or recovery (ST-segment depression <2 mm from baseline)
- Functional capacity <5 METs

Nonexercise Testing Findings
- Rest ejection fraction 40% to 49%

HIGHEST RISK

Characteristics of patients at high risk for exercise participation (any one or combination of these findings places a patient at high risk)

- Presence of complex ventricular dysrhythmias during exercise testing or recovery
- Presence of angina or other significant symptoms (*e.g.,* unusual shortness of breath, light-headedness, or dizziness at low levels of exertion [<5 METs] or during recovery)
- High level of silent ischemia (ST-segment depression ≥2 mm from baseline) during exercise testing or recovery
- Presence of abnormal hemodynamics with exercise testing (*i.e.,* chronotropic incompetence or flat or decreasing systolic BP with increasing workloads) or recovery (*i.e.,* severe postexercise hypotension)

Nonexercise Testing Findings

- Rest ejection fraction <40%
- History of cardiac arrest or sudden death
- Complex dysrhythmias at rest
- Complicated myocardial infarction or revascularization procedure
- Presence of congestive heart failure
- Presence of signs or symptoms of postevent/postprocedure ischemia
- Presence of clinical depression

Functional class

Class 1 : $\geq$ 7 METS
Class 2 : 5-6 METS
Class 3 : 3-4 METS
Class 4 : 1-2 METS

CLASS I	CLASS II	CLASS III	CLASS IV
No symptoms with ordinary physical activity	Some symptoms with ordinary activity and slight limitation of physical activity	Symptoms with less than ordinary activity and increased limitation of physical activity	Symptoms with any activity, possibly even while at rest

Recommendations for Intensity of Supervision & Monitoring

	Low Risk	Moderate Risk	High Risk
Direct staff supervision	6-18 exe sessions 30 d postevent/ postprocedure	12-24 exe sessions 60 d postevent/ postprocedure	24-36exe sessions 90 d postevent/ postprocedure
Beginning w/ continuous ECG monitoring and decreasing to intermittent	6-12 session	12-18session	18,24,36 session

Exercise Testing

- ACC/AHA 2002 Guideline Update for exercise testing

    - Class I recommendation:

        - MI w/ revascularization

    - Class II recommendation:

        - MI w/o revascularization

        - Coronary revascularization alone

BOX 9.5   **Reasons for No Available Preparticipation Exercise Test**

- Extreme deconditioning
- Orthopedic limitations
- Recent successful percutaneous intervention or revascularization surgery without residual obstructive coronary artery disease

BOX 3.5 Contraindications to Exercise Testing

ABSOLUTE

- A recent significant change in the resting electrocardiogram (ECG) suggesting significant ischemia, recent myocardial infarction (within 2 d), or other acute cardiac event
- Unstable angina
- Uncontrolled cardiac dysrhythmias causing symptoms or hemodynamic compromise
- Symptomatic severe aortic stenosis
- Uncontrolled symptomatic heart failure
- Acute pulmonary embolus or pulmonary infarction
- Acute myocarditis or pericarditis
- Suspected or known dissecting aneurysm
- Acute systemic infection, accompanied by fever, body aches, or swollen lymph glands

RELATIVE[a]

- Left main coronary stenosis
- Moderate stenotic valvular heart disease
- Electrolyte abnormalities (*e.g.*, hypokalemia or hypomagnesemia)
- Severe arterial hypertension (*i.e.*, systolic blood pressure [SBP] of >200 mm Hg and/or a diastolic BP [DBP] of >110 mm Hg) at rest
- Tachydysrhythmia or bradydysrhythmia
- Hypertrophic cardiomyopathy and other forms of outflow tract obstruction
- Neuromotor, musculoskeletal, or rheumatoid disorders that are exacerbated by exercise
- High-degree atrioventricular block
- Ventricular aneurysm
- Uncontrolled metabolic disease (*e.g.*, diabetes, thyrotoxicosis, or myxedema)
- Chronic infectious disease (*e.g.*, HIV)
- Mental or physical impairment leading to inability to exercise adequately

Mode of Testing

- ❧ **Field tests**

- ❧ **Motor-driven treadmills**

- ❧ **Mechanical braked cycle ergometers**

- ❧ Step testing

TABLE 5.2. Recommended Monitoring Intervals Associated with Exercise Testing

Variable	Before Exercise Test	During Exercise Test	After Exercise Test
ECG	Monitored continuously; recorded supine position and posture of exercise	Monitored continuously; recorded during the last 15 s of each stage (interval protocol) or the last 15 s of each 2 min period (ramp protocols)	Monitored continuously; recorded immediately postexercise, during the last 15 s of first minute of recovery, and then every 2 min thereafter
HR[a]	Monitored continuously; recorded supine position and posture of exercise	Monitored continuously; recorded during the last 5 s of each minute	Monitored continuously; recorded during the last 5 s of each minute
BP[a,b]	Measured and recorded in supine position and posture of exercise	Measured and recorded during the last 45 s of each stage (interval protocol) or the last 45 s of each 2 min period (ramp protocols)	Measured and recorded immediately postexercise and then every 2 min thereafter
Signs and symptoms	Monitored continuously; recorded as observed	Monitored continuously; recorded as observed	Monitored continuously; recorded as observed
RPE	Explain scale	Recorded during the last 15 s of each exercise stage or every 2 min with ramping protocol	Obtain peak exercise value then not measured in recovery
Gas exchange	Baseline reading to ensure proper operational status	Measured continuously	Generally not needed in recovery

TABLE 4.7. The Borg Rating of Perceived Exertion Scale

6	No exertion at all
7	Extremely light
8	
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

7 ไม่เหนื่อย
8 เบามาก
9 เบา
10 ค่อนข้างเบา
11 ปานกลางค่อนข้างเบา
12 ปานกลาง
13 ปานกลางค่อนข้างมาก
14 ค่อนข้างหนัก
15 หนัก

BOX 5.2 Indications for Terminating Exercise Testing

ABSOLUTE INDICATIONS

- Drop in systolic BP of ≥10 mm Hg with an increase in work rate, or if systolic BP decreases below the value obtained in the same position prior to testing when accompanied by other evidence of ischemia
- Moderately severe angina (defined as 3 on standard scale)
- Increasing nervous system symptoms (*e.g.*, ataxia, dizziness, or near syncope)
- Signs of poor perfusion (cyanosis or pallor)
- Technical difficulties monitoring the ECG or SBP
- Subject's desire to stop
- Sustained ventricular tachycardia
- ST elevation (+1.0 mm) in leads without diagnostic Q waves (other than V_1 or aVR)

RELATIVE INDICATIONS

- Drop in systolic BP of ≥10 mm Hg with an increase in work rate, or if systolic BP below the value obtained in the same position prior to testing
- ST or QRS changes such as excessive ST depression (>2 mm horizontal or downsloping ST-segment depression) or marked axis shift
- Arrhythmias other than sustained ventricular tachycardia, including multifocal PVCs, triplets of PVCs, supraventricular tachycardia, heart block, or bradyarrhythmias
- Fatigue, shortness of breath, wheezing, leg cramps, or claudication
- Development of bundle-branch block or intraventricular conduction delay that cannot be distinguished from ventricular tachycardia
- Increasing chest pain
- Hypertensive response (SBP of >250 mm Hg and/or a DBP of >115 mm Hg).

Design of exercise prescription

Warm-up: at least 5–10 min of light-to-moderate intensity cardiorespiratory and muscular endurance activities

Conditioning: at least 20–60 min of aerobic, resistance, neuromotor, and/or sports activities (exercise bouts of 10 min are acceptable if the individual accumulates at least 20–60 min $\cdot$ d^{-1} of daily aerobic exercise)
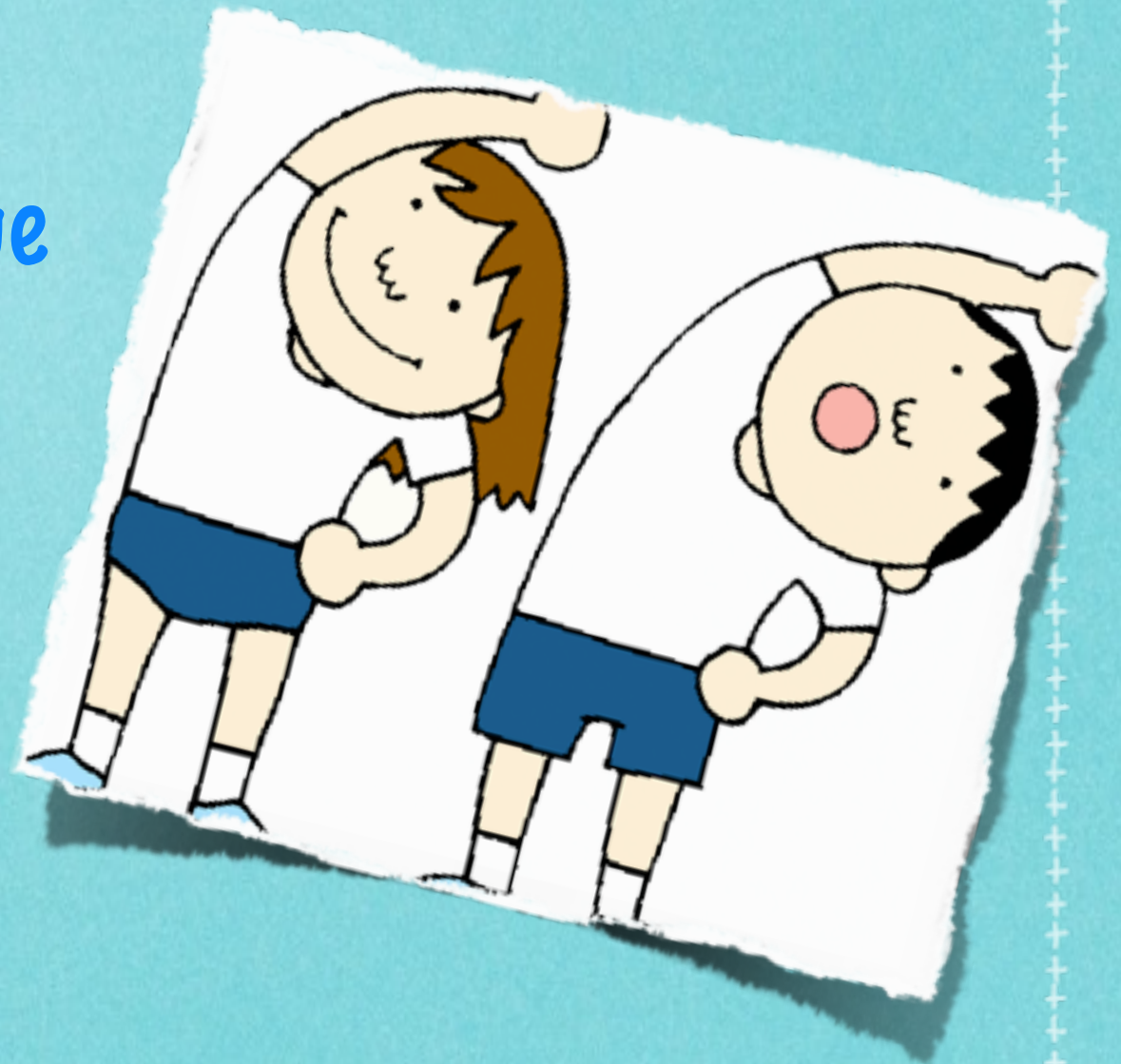
Cool-down: at least 5–10 min of light-to-moderate intensity cardiorespiratory and muscular endurance activities

Stretching: at least 10 min of stretching exercises performed after the warm-up or cool-down phase

Warm Up

▷ for... 1. stretching soft tissue
   2. initiate full joint ROM
   3. ↓ oxygen debt

   4. early elicit abnormal hemodynamic response

Warm Up

- 5-15 minutes
  - large muscle
  - slow continuous movement
  - 25-40 % Of functional capacity
  - calisthenic exercise, casual walking
  - avoid isometric exercise

Conditioning Period

for... 1. ↑ functional capacity

2. ↑ ischemic threshold

3. ↑ energy consumption

4. ↑ muscle strength

5. apply it to daily activity

Exercise Prescription

♥ Intensity

♥ Mode

♥ Duration

♥ Frequency

♥ Rate of progression

Knowledge

ART

Skill of clinical observation

Experience of trainer
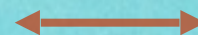
Intensity

♥ Indicators of ischemic threshold
 ♥ Heart rate
 ♥ Functional capacity as VO2
1 MET = oxygen consumption 3.5 ml/kg/min
 ♥ Rate Pressure Product
 ♥ Rate Perceived Exertion (RPE)

Mode of Estimate Intensity

- HRR method: Target HR (THR) = [($HR_{max/peak}{}^{a}$ − HR_{rest}) × % intensity desired] + HR_{rest}
- $\dot{V}O_2R$ method: Target $\dot{V}O_2R^{c}$ = [($\dot{V}O_{2max/peak}{}^{b}$ − $\dot{V}O_{2rest}$) × % intensity desired] + $\dot{V}O_{2rest}$
- HR method: Target HR = $HR_{max/peak}{}^{a}$ × % intensity desired
- $\dot{V}O_2$ method: Target $\dot{V}O_2{}^{c}$ = $\dot{V}O_{2max/peak}{}^{b}$ × % intensity desired
- MET method: Target MET^{c} = [($\dot{V}O_{2max/peak}{}^{b}$)/3.5 mL · kg^{-1} · min^{-1}] × % intensity desired

TABLE 7.2. Commonly Used Equations for Estimating Maximal Heart Rate

Author	Equation	Population
Fox (19)	$HR_{max} = 220 - age.$	Small group of men and women
Astrand (9)	$HR_{max} = 216.6 - (0.84 \times age)$	Men and women ages 4–34 yr
Tanaka (48)	$HR_{max} = 208 - (0.7 \times age)$	Healthy men and women
Gellish (21)	$HR_{max} = 207 - (0.7 \times age)$	Men and women participants in an adult fitness program with broad range of age and fitness levels
Gulati (23)	$HR_{max} = 206 - (0.88 \times age)$	Asymptomatic middle-aged women referred for stress testing

✓ Exercise stress test

Intensity	HR max(%)	VO2 max(%)	RPE
Light	35-59	30-49	10-11
Moderate	60-79	50-74	12-13
Heavy	80-89	75-84	14-16

1. % of peak functional capacity (VO2 max)
   if VO2 max =10 METs
   70 % → = 6.3-7.7 METs

2. % of peak heart rate
   2.1
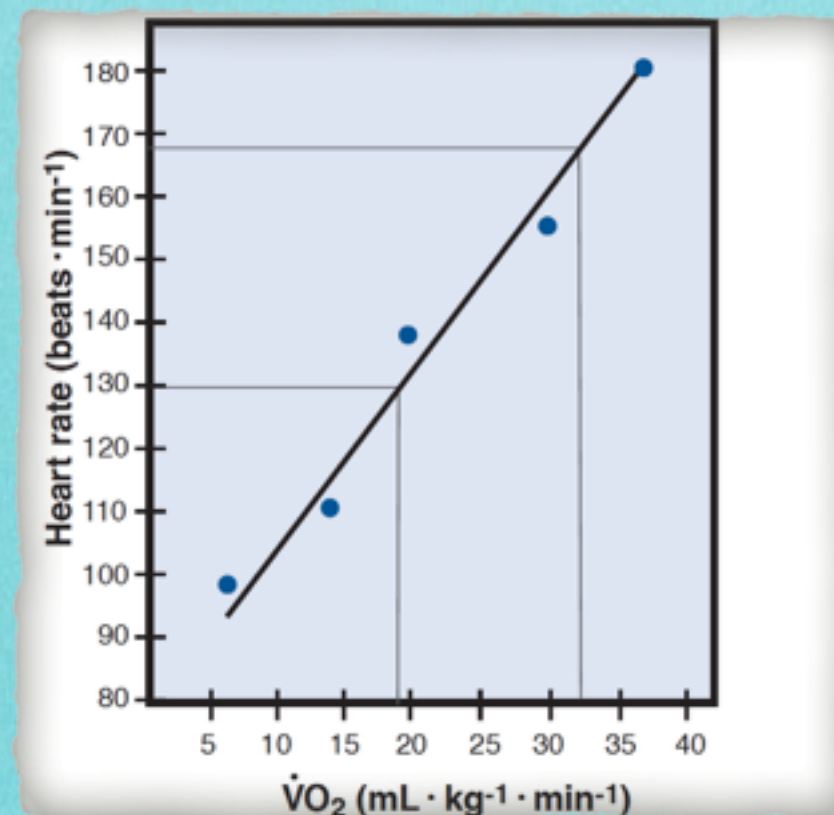
2.2 Straight heart rate percentage method
   50-90 % of HR max = 40-85 % of VO2 max

2.3 Heart rate reserve(Karvonen method)
   Training HR= % of (HR. max – resting HR) + resting HR

3. Rating of Perceived Exertion
   RPE 12-16 = 60-85% Of HR. max

Resistance Training

- Improve muscular strength and endurance
- Decrease cardiac demands of muscular work (*i.e.*, reduced rate pressure product) during daily activities
- Prevent and treat other diseases and conditions, such as osteoporosis, Type 2 diabetes mellitus, and obesity
- Increase ability to perform activities of daily living
- Improve self-confidence
- Maintain independence
- Slow age and disease-related declines in muscle strength and mass

BOX 4.7 Absolute and Relative Contraindications to Resistance Training and Testing

ABSOLUTE

Unstable CHD

Decompensated HF

Uncontrolled arrhythmias

Severe pulmonary hypertension (mean pulmonary arterial pressure >55 mm Hg)

Severe and symptomatic aortic stenosis

Acute myocarditis, endocarditis, or pericarditis

Uncontrolled hypertension (>180/110 mm Hg)

Aortic dissection

Marfan syndrome

High intensity RT (80% to 100% of 1-RM) in patients with active proliferative retinopathy or moderate or worse nonproliferative diabetic retinopathy

RELATIVE (SHOULD CONSULT A PHYSICIAN BEFORE PARTICIPATION)

Major risk factors for CHD

Diabetes at any age

Uncontrolled hypertension (>160/100 mm Hg)

Low functional capacity (<4 METs)

Musculoskeletal limitations

Individuals who have implanted pacemakers or defibrillators

Patient criteria for a resistance exercise program

- Minimum of 5 wks after date of MI or cardiac Sx, <u>including</u> 4 wks of consistent participation in a supervised endurance training CR program

- Minimum of 3 wks after catheter procedure <u>including</u> 2 wks of consistent participation in a supervised endurance training CR program

- No evidence of the following conditions:

    - CHF

    - uncontrolled arrhythmia

    - severe valvular disease

    - uncontrolled HT. Pt w/ moderate HT (SBP >160 mmHg or DBP >100) should be referred for appropriate management, although these values are not absolute contraindication for participation in a resistance training program

    - unstable symptoms

Resistance training guideline

- To prevent soreness and minimize the risk of injury, the initial load should allow 12-15 rep. comfortably.

- If a 1RM pretest is used

  - 30-40% 1RM for the upper body

  - 50-60% for hips & legs.

- Low-risk-stratified, well-trained Pt. may progress to relative loads depending on program goals.

- Perform 1 set of 6-8 exe (major muscle group) 2-3d/wk. An additional set may be added, but additional gains are not proportionate.

Some specific considerations are as follows:

- Exercise large muscle groups before small muscle groups.

- Increase loads by 5% when the Pt can comfortably lift 12-15 rep.

- Raise wt w/ slow, controlled movements; emphasize complete extension of the limbs when lifting.

- Avoid straining.

- Exhaled (blow out) during the exertion phase of the lift (e.g., exhale when pushing a weight stack overhead & inhale when lowering it).

- Avoid sustained, tight gripping, which may evoke an excessive BP response to lifting.

- Minimize rest periods b/w exercises as tolerable to maximize muscular endurance.

- An RPE of 11-13 may be used as a subjective guide to effort.

- Stop exe if warning S/S occur, especially dizziness, arrhythmias, unusual SOB, or anginal discomfort.

Phase 2

Phase 3: Maintenance

Goal: independently maintain physical fitness & risk factors control

Rx: varied contents

จัดประชุมวิชาการ   แลกเปลี่ยนเรียนรู้

การทำกลุ่มสนับสนุนโดยสหสาขาวิชาชีพ

"Trainer"

Who?.....
1. Physician
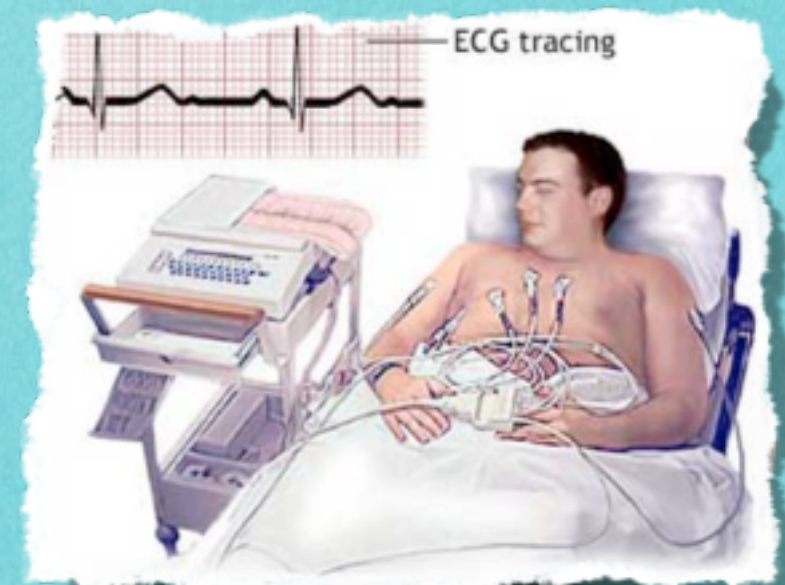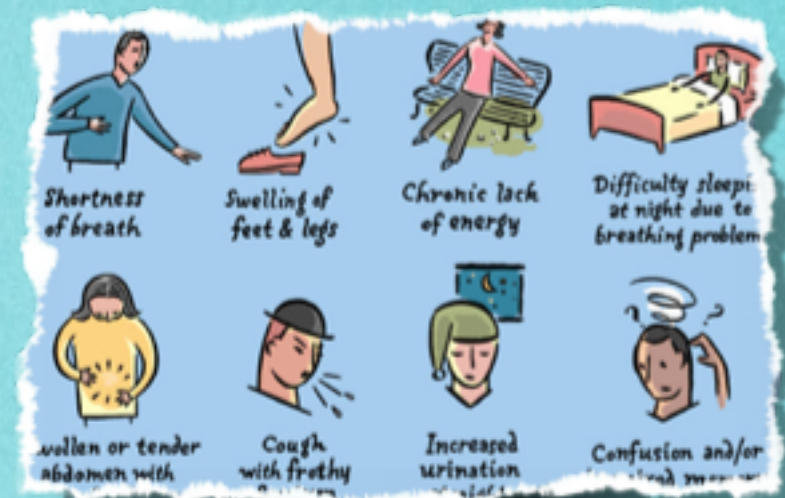2. Nurse
3. Physical therapist
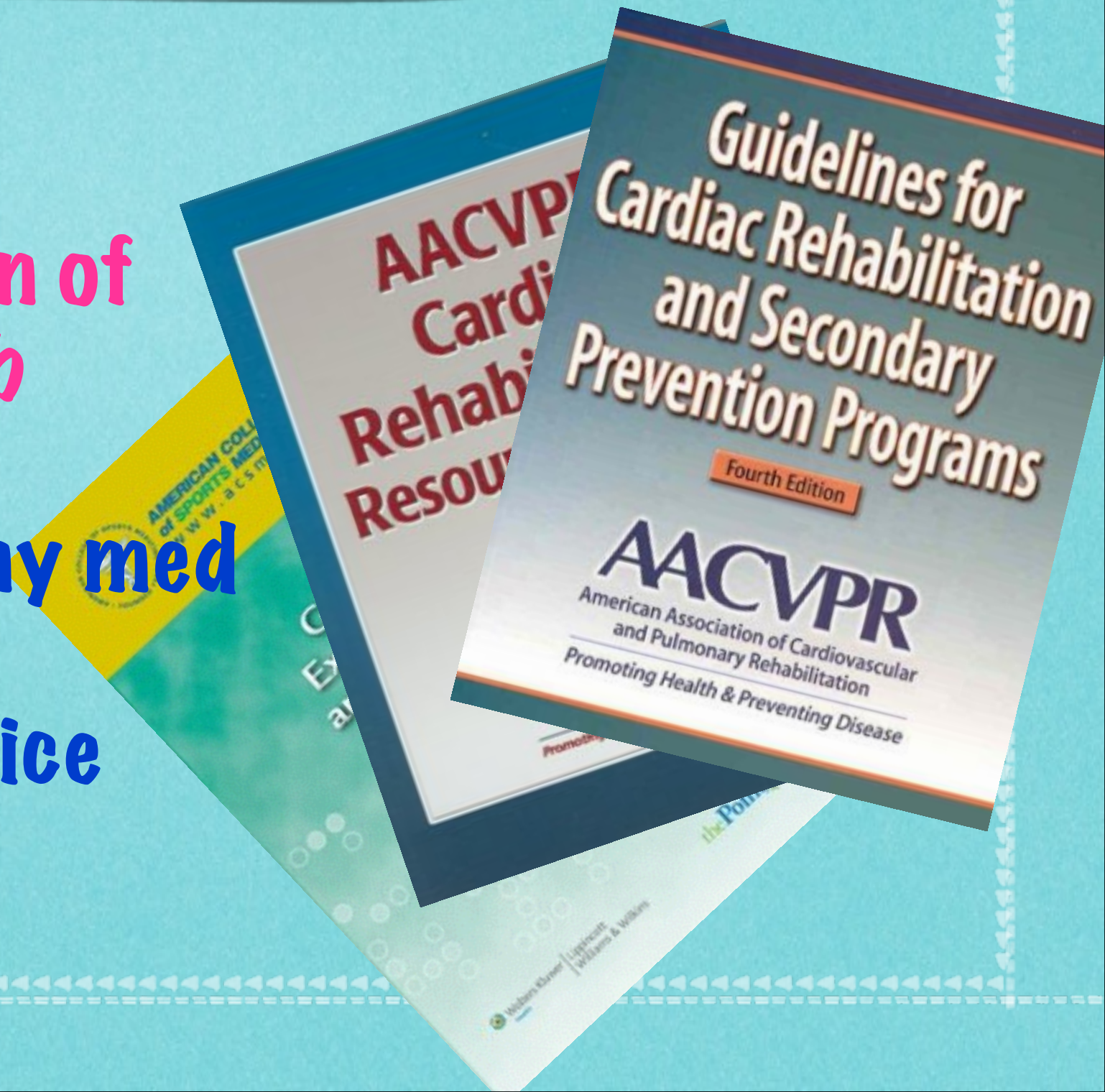4. Exercise physiologist

Minimal requirement...

1. Good understanding & skill for inpatient program.
2. Early detection of sign/ symptom of exertional intolerance.
3. CPR: basic life support
4. EKG interpretation especially arrhythmia.

How...

- **Guided instruction of CCIT cardiac-rehab guideline**
- **easily done for any med persons**
- **need skill & practice**

Summary

*Good program
- Effectiveness
- Simple
- Flexibility
- Valid
- Efficacy of trainer