The 3rd Indonesian Symposium on Heart Failure and Cardiometabolic Disease 2023

# PHYSICAL EXERCISE IN HEART FAILURE

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# Introduction

- Historically, patients with heart failure (HF) were assumed to be at risk to exercise and were commonly discouraged from participating in physical activity, resulting in a markedly decreased quality of life. .
- Contrary to these concerns, multiple studies have demonstrated the safety and benefits of exercise and physical activity in patients with HF and deleterious effects of prolonged bed rest and immobilization and exercise training is one of the most efficacious ways to improve physical performance and quality of life, and to reduce morbidity and mortality.



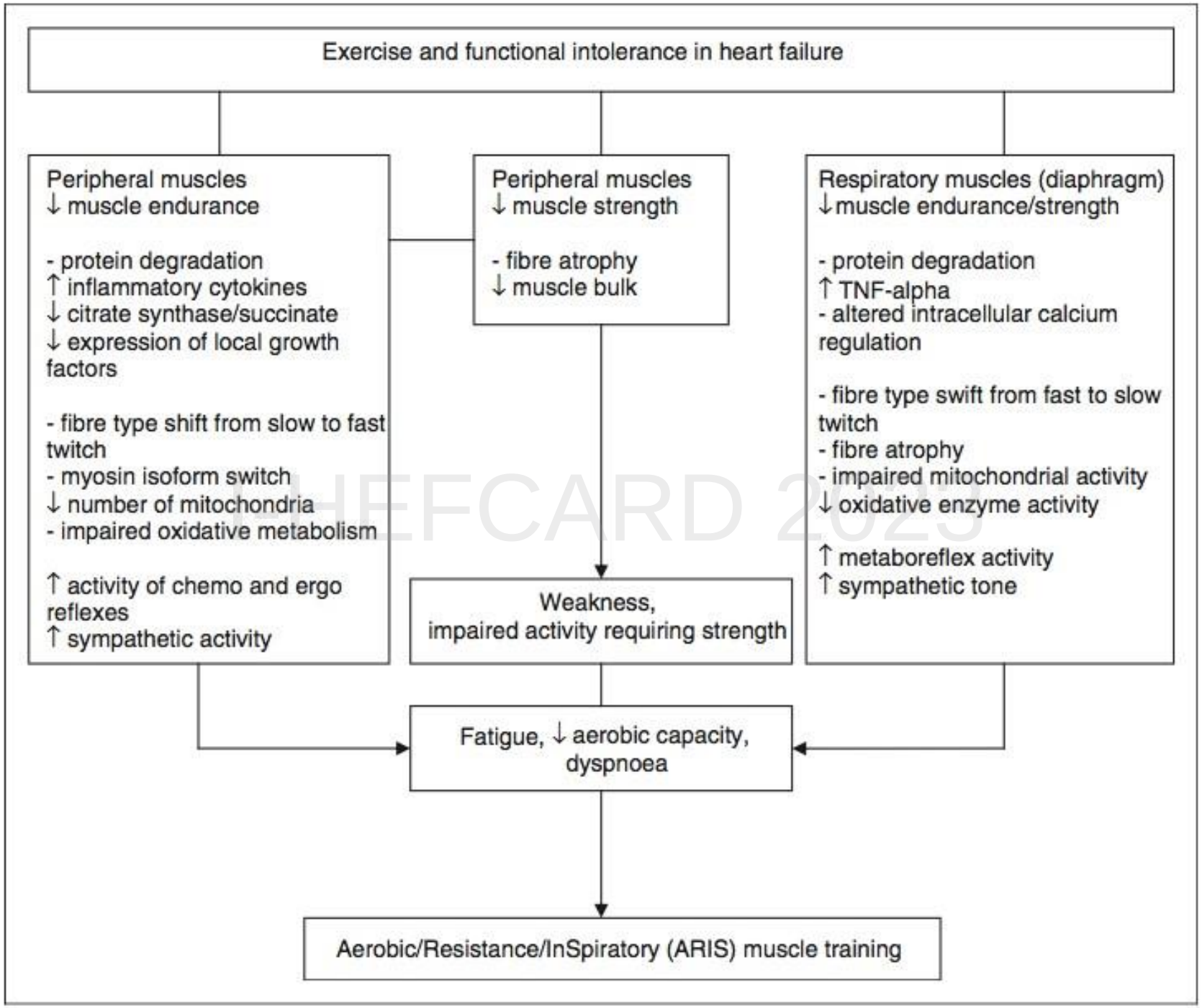
Van Craenenbroeck EM. Exercise training as therapy for chronic heart failure. E-Journal of Cardiology Practice. 2017;14:1-11
*Cardiac Failure Review* 2017;**3**(1):7–11. DOI: 10.15420/cfr.2016:25:2

# Introduction

- Exercise intolerance, with pronounced fatigue and dyspnoea are key characteristics of the HF syndrome, even at low workloads, resulting in a markedly decreased quality of life.
- The severity of exercise limitation in HF is not correlated to the extent of cardiac dysfunction alone.
- Peripheral disturbances such as impaired vasoreactivity, impaired skeletal muscle energy metabolism and functional iron deficiency are as important as cardiac function to determine exercise capacity



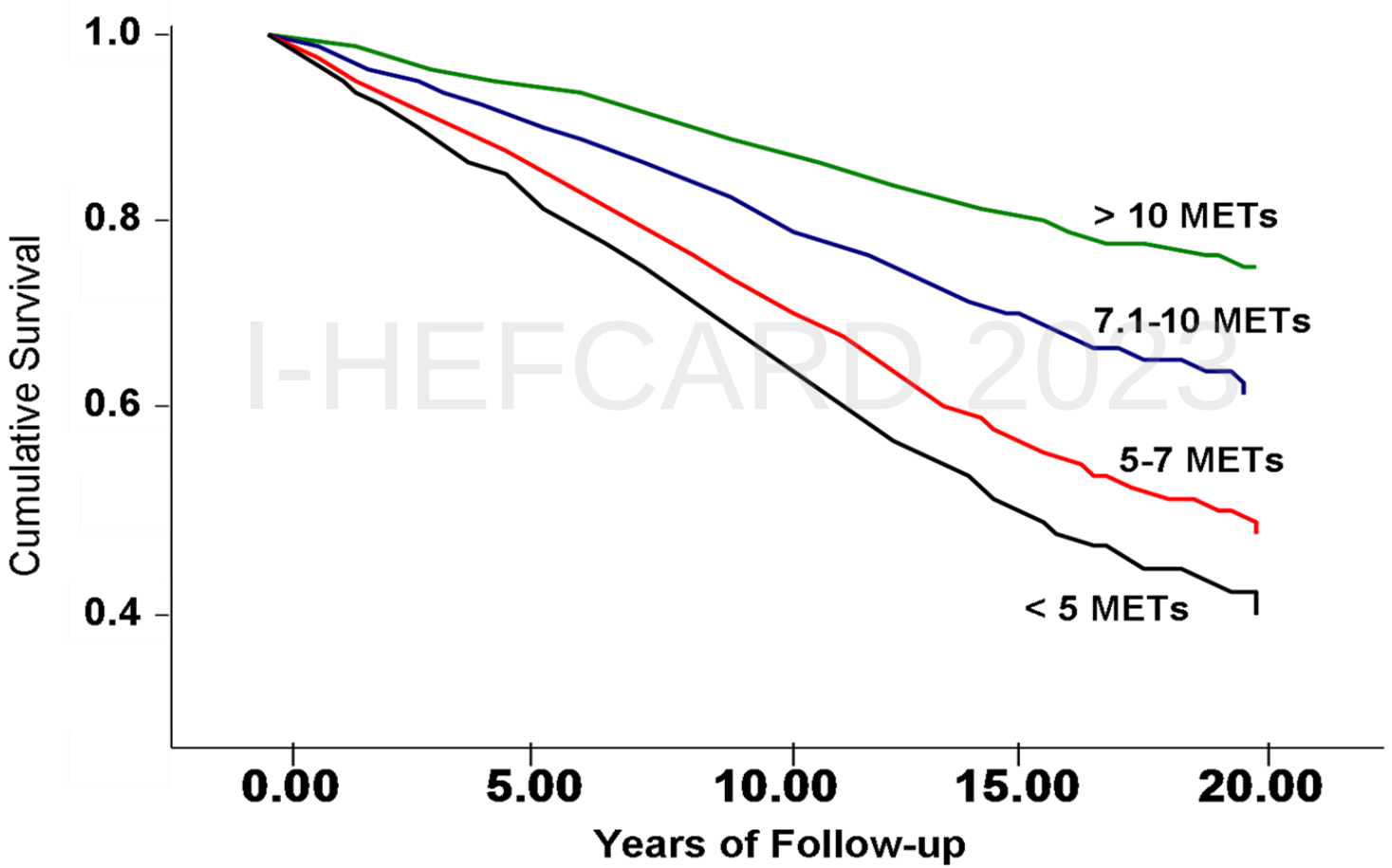
Van Craenenbroeck EM. Exercise training as therapy for chronic heart failure. E-Journal of Cardiology Practice. 2017;14:1-11
*Cardiac Failure Review* 2017;**3**(1):7–11. DOI: 10.15420/cfr.2016:25:2






Bozkurt et al. CR in Patients With HF. JACC Vol. 77, No.11, 2021. https://doi.org/10.1016/j.jacc.2021.01.030

# Fitness Improves Longevity

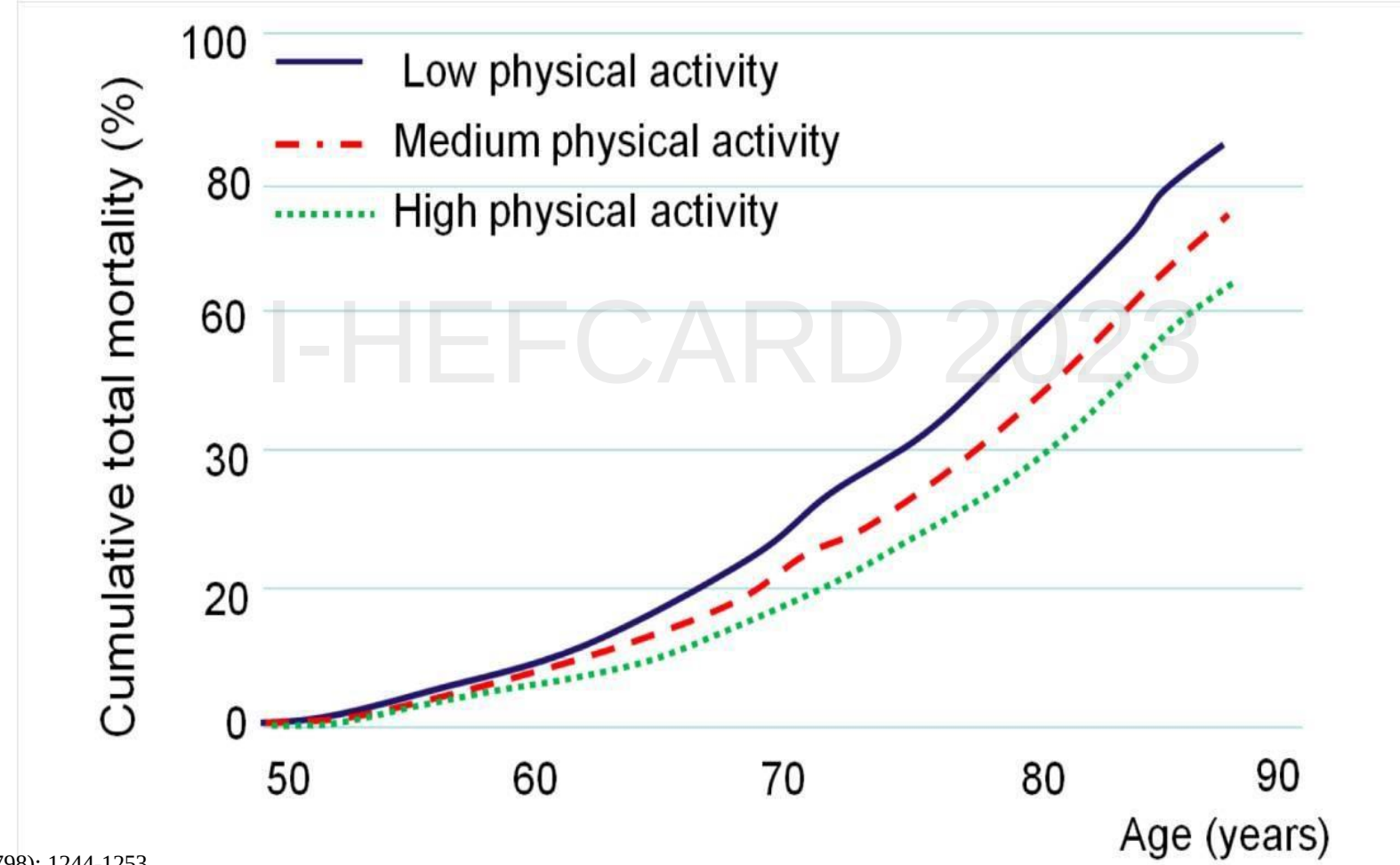





Kokkinos P, et al, Circulation 2008; 117:614-22

# Physical Activity and Survival*

*Studies also show strong link between lifetime Physical Activity & Dementia Risk



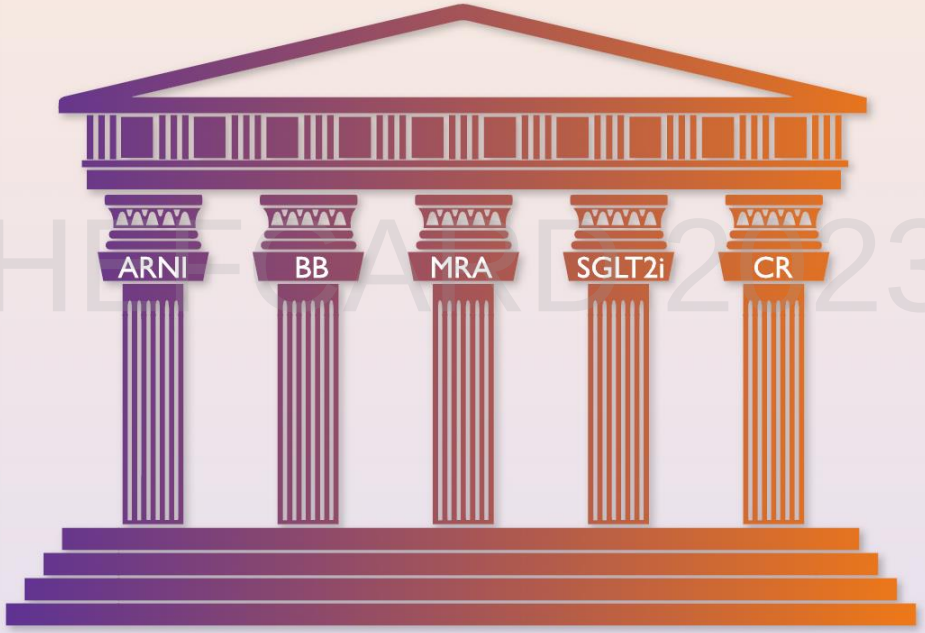



Wen CP et al. Lancet 2011;378(9798): 1244-1253
Van Craenenbroeck EM. Exercise training as therapy for chronic heart failure. E-Journal of Cardiology Practice. 2017;14:1-11.

Cardiac rehabilitation for heart failure (HF) improves health-related quality of life and contributes to reduced hospitalization and is Class I / level A evidence by international (US & EU) Guidelines

Despite this, referral to cardiac rehabilitation for HF is suboptimal and currently ranges from **5% to 50%** across countries

Cardiac rehabilitation should be the 5th pillar in HF management alongside drug and medical device provision




Choice of cardiac rehabilitation delivery models (centre-based/home-based ± digitally supported) should be developed and be available to patients in the future

European Heart Journal (2023) 00, 1–8. https://doi.org/10.1093/eurheartj/ehad118

# Recommendations for exercise rehabilitation in patients with chronic heart failure

| Recommendations | Class | Level |
|---|---|---|
| Exercise is recommended for all patients who are able in order to improve exercise capacity, QOL, and reduce HF hospitalization.[a] | I | A |
| A supervised, exercise-based, cardiac rehabilitation programme should be considered in patients with more severe disease, frailty, or with comorbidities. | IIa | C |

HF = heart failure; QOL= quality of life.
[a]In those who are able to adhere to the exercise programme.







2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure
(European Heart Journal 2021 – doi:10.1093/eurheartj/ehab368)

# Case Illustration 1

## PATIENT's Anamnesis

| Patients characteristic | Present and past medical history | Routine Medications |
|---|---|---|
| • Male<br>• 67 years old | • **Complaints**: easily fatigue DOE, sometimes angina<br>• **History:** Post NSTEMI, 2x PCI<br>• **Risk factors:** Hypertension (+), dyslipidemia (+), hyperuricemia (+), smoking(+) | • Asetosal 80 mg OD, Clopidogrel 75 OD, Ramipril 10 mg OD, Amlodipin 10 mg OD, Bisoprolol 2.5 mg OD, Spironolactone 25 mg OD, HCT 25 mg OD, Atorvastatin 40 mg OD, Lansoprazol 30 OD, Furosemid 40 prn, ISDN 5 mg prn |

# PATIENT's examination

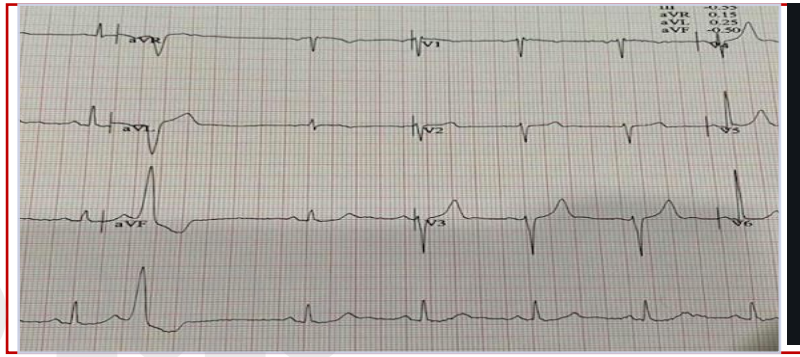
## Vital signs

BP: 110/70 mmHg
HR: 67x/min
RR 19x/min
SpO2 98%

## Physical examination

JVP: PR+0 mmHg, anemic(-)
Heart sounds: S1-S2 normal, regular heart sound, murmur (-)
Extremities: warm, not edematous

## ECG



Sinus rhythm 67 bpm, ICRBBB, PVC occasional

## Laboratory results

| Complete Blood Count (30/12/2022) | | | |
|---|---|---|---|
| WBC | 7.79 | 4.1-11.0 | $10^3$/µL |
| HGB | 12.2 | 12.0-16.0 | g/dL |
| HCT | 36.2 | 41.0-53.0 | % |
| PLT | 260 | 150-440 | 10 µ/µL |
| Neu# | 3.58 | 2.50-7.50 | $10^3$/µL |
| Lymph# | 2.44 | 1.00-4.00 | $10^3$/µL |
| NLR | 1.47 | <=3.13 | |

| Blood Chemistry (30/12/2022) | | | |
|---|---|---|---|
| BUN | 14.1 | 8 – 23 | mg/dL |
| SC | 1.34 | 0.7-1.2 | mg/dL |
| eLFG | 54.43 | >=90 | |
| SGOT | 22.7 | 5-34 | U/L |
| SGPT | 9.8 | 11.0-50.0 | U/L |
| RBS | 91 | 70-140 | mg/dL |

| Blood Chemistry (11/1/2023) | | | |
|---|---|---|---|
| BUN | 11.7 | 8 – 23 | mg/dL |
| SC | 1.15 | 0.7-1.2 | mg/dL |
| eLFG | 65.48 | >=90 | |

| Lipid Profile (11/1/2023) | | | |
|---|---|---|---|
| Total Chol | 164 | 140 – 199 | mg/dL |
| HDL | 40 | 40 – 65 | mg/dL |
| LDL | 113 | <130 | mg/dL |
| TG | 76.8 | <150 | mg/dL |
| Uric acid | 7.50 | 2 – 5.7 | mg/dL |

# PATIENT's work-up diagnostics

| Echocardiography (12/5/2022) | Echocardiography (3/3/2023) | CAG (13/06/2022) | CAG (10/01/2023) |
|---|---|---|---|
| LA dilatation<br>LV Concentric Hypertrophy<br>Decreased left ventricle systolic function (EFBP 33%)<br>LV diastolic dysfunction grade I<br>Normal right ventricular systolic function (TAPSE 2.0 cm)<br>RWMA (+)<br>Valves : Mild AR, mild TR with low probability of PH<br>eRAP 8 mmHg | Normal cardiac chamber dimension<br>LVH (-)<br>Decreased left ventricle systolic function (EFBP 46.9%)<br>LV diastolic dysfunction grade I<br>Normal right ventricular systolic function (TAPSE 2.0 cm)<br>Moderate hypokinesis: basal inferior septal, basal inferior, mid inferior septal, mid inferior, apical septal, apical inferior. Normal wall motion: all remaining segments<br>Valves : Mild AR, moderate TR with intermediate probability of PH<br>eRAP 8 mmHg | L-RCA-graphy<br>LM : Normal<br>LAD : Stenosis 70-80% at proximal until mid<br>LCx : Stenosis 60-70% at distal<br>RCA : Stenosis 50% at proximal.<br>Aneurysma at proximal<br><br>Conclusion : CAD 3 VD<br>Suggestion : Elective PCI at LAD and LCx | L-RCA-graphy<br>LM : Normal<br>LAD : patent stent at proximal until mid<br>LCx : stenosis 80-90% at distal<br>RCA : not evaluated<br><br>Conclusion : CAD 3 VD, successfull elective PCI with 1 DES at proximal to distal LCx<br>Suggestion : DAPT 1 year |

# PATIENT's Diagnosis and Cardiac rehabilitation program

## Diagnosis

CHF FC II ec CAD 3 VD
- Successfull elective PCI with 1 DES at proximal to distal LCx (10/1/23)
  - Post successful elective PCI 2 DES at proximal until distal LAD (5/8/22)
  - EF BP 33% → 46.9%, RWMA (+)
  - Mild AR
  - Moderate TR with intermediate prob of PH
  - Post NSTEMI April 2022
- on HHD
  - Hipertensi terkontrol
- ACKD ec susp prerenal on CKD ec susp NS
- Dyslipidemia
- Hyperuricemia

**17/3/23**
- 384 m
- 4.25 METs

**20/3/23**
- Ergo arm cycle 25 watt 10 menit
- Jalan : 2x700 m

**24/3/23**
- Ergo arm cycle 25 watt 10 menit
- Jalan : 2x800 m

**27/3/23**
- Ergo arm cycle 25 watt 10 menit
- Jalan : 2x900 m

**28/3/23**
- Ergo arm cycle 25 watt 10 menit
- Jalan : 1x1800 m

**29/3/23**
- Ergo arm cycle 25 watt 10 menit
- Treadmill I : 2.8 (500 meter) dalam 15 menit
- Treadmill II : 4.4 (900 meter) dalam 15 menit

**30/3/23**
- Ergo arm cycle 25 watt 10 menit
- Treadmill I : 4.7 (1000 meter) dalam 15 menit
- Treadmill II : 4.7 (1000 meter) dalam 15 menit

**31/3/23**
- Ergo arm cycle 25 watt 10 menit
- Treadmill I : 5.0 (1100 meter) dalam 15 menit
- Treadmill II : 5.0 (1100 meter) dalam 15 menit

# PATIENT's Cardiac rehabilitation program and outcomes

**03/04/23**
- Ergo arm cycle 25 watt 10 menit
- Treadmill I : 4.7 (1079 meter) dalam 15 menit
- Treadmill II : 4.7 (1079 meter) dalam 15 menit

**11/4/23**
- Ergo arm cycle 25 watt 10 menit
- Treadmill I : 4.4 (1079 meter) dalam 15 menit
- Treadmill II : 4.2 (1130 meter) dalam 15 menit

**12/4/23**
- Ergo arm cycle 25 watt 10 menit
- Treadmill I : 4.3 (1142 meter) dalam 15 menit
- Treadmill II : 4.3 (1141 meter) dalam 15 menit

**14/4/23**
- Ergo arm cycle 25 watt 10 menit
- Treadmill I : 4.4 (1212 meter) dalam 15 menit
- Treadmill II : 4.5 (1228 meter) dalam 15 menit
- 6MWT : 422 m → 4.6 METs, HRWSi 1.2



**Pre rehabilitation 17/3/23 : 384 m → 4.25 METs**

**Post rehabilitation 14/4/23 : 422 m → 4.6 METs, HRWSi 1.2**

# TST evaluation post rehabilitation (20/4/2023)

Resting ECG: premature ventricular contraction occasional. Right bundle branch block
Functional capacity: moderately decreased (20% to 30%)
HR response to exercise: appropriate, chronotropic incompetent
BP response to exercise: normal resting BP - appropriate response
Chest pain: none
Arrhythmia: none
ST-T changes: none

Conclusion:
Suggestive positive ischemic response with 5.97 METs
Fair fitness classification
Functional Class II
Appropriate HR response, with chronotropic incompetent
Hypertensive response (-)
HRR 1 = 4 beats
HRR 2 = 18 beats
Other finding: polymorphic ventricular premature beats with episode of bigeminy, trigeminy, and quadrigeminy during exercise and recovery phase without symptoms

Suggestion:
Optimal medical therapy

Consider holter monitoring

Regular exercise
Life style modification
Risk factor management



Recomendation :
Target HR 74-78 x/menit Kapasitas aerobik 3.5-4.1 METs

Rekomendasi latihan :
Pemanasan 10 menit
Sepeda statis 35 watt, 50 rpm selama 15 menit
Sepeda non statis 4.8 km dalam 30 menit
Jalan/Treadmill : 2.4 Km dalam 30 menit

# Case Illustration 2

## PATIENT's Anamnesis

### Patients characteristic

- Female
- 83 years old

### Present and past medical history

- **Complaints**: easily fatigue DOE,sometimes angina
- **History:** Post UAP, 3x PCI,PPM
- **Risk factors:** Hypertension (+), dyslipidemia (+), hyperuricemia (+), DM(+), menopause
- Comorbid: HNP, DM, HT

### Routine Medications

- : Clopidogrel 1x75 mg, Candotens 1x8 mg, Concor 1x2.5 mg, Spironolactone 1x25 mg, Farsix 40 mg 1/2-0-0 AC K/P, Lipitor 1x40 mg, Vastarel 2x35 mg, Ranexa 2x375 mg, Ryzodec 2 x 10 u, Pantopump 1x40 mg K/P,Mucosta 3x100 mg, Cedocard 5 mg S.L K/P, Fluimucyl eff 2x600 mg K/P, Tonicard 1x1 tab

# PATIENT's examination

## Vital signs

BP: 128/62 mmHg
HR: 68x/min
RR 19x/min
SpO2 98%

## Physical examination

JVP: PR+0 mmHg, anemic(-)
Heart souds: S1S2 normal, regular heart sound, murmur (-)
Extremities: warm, not edematous



## Laboratory results

| Complete Blood Count (10/03/2023) | | | |
|---|---|---|---|
| WBC | 7.51 | 4.1-11.0 | $10^3$/µL |
| HGB | 11.7 | 12.0-16.0 | g/dL |
| HCT | 35.00 | 41.0-53.0 | % |
| PLT | 155 | 150-440 | 10 µ/µL |
| Neu# | 5.29 | 2.50-7.50 | $10^3$/µL |
| Lymph# | 1.35 | 1.00-4.00 | $10^3$/µL |
| NLR | 3.91 | <=3.13 | |

| Blood Chemistry (10/03/2023) | | | |
|---|---|---|---|
| BUN | 19.7 | 8 – 23 | mg/dL |
| SC | 0.94 | 0.7-1.2 | mg/dL |
| eLFG | 56.1 | >=90 | |
| SGOT | 20.1 | 5-34 | U/L |
| SGPT | 14.7 | 11.0-50.0 | U/L |
| RBS | 161 | 70-140 | mg/dL |

| Lipid Profile (21/2/2023) | | | |
|---|---|---|---|
| Total Chol | 164 | 140 – 199 | mg/dL |
| HDL | 40 | 40 – 65 | mg/dL |
| LDL | 113 | <130 | mg/dL |
| TG | 76.8 | <150 | mg/dL |
| Uric acid | 7.50 | 2 – 5.7 | mg/dL |

# PATIENT's work-up diagnostics

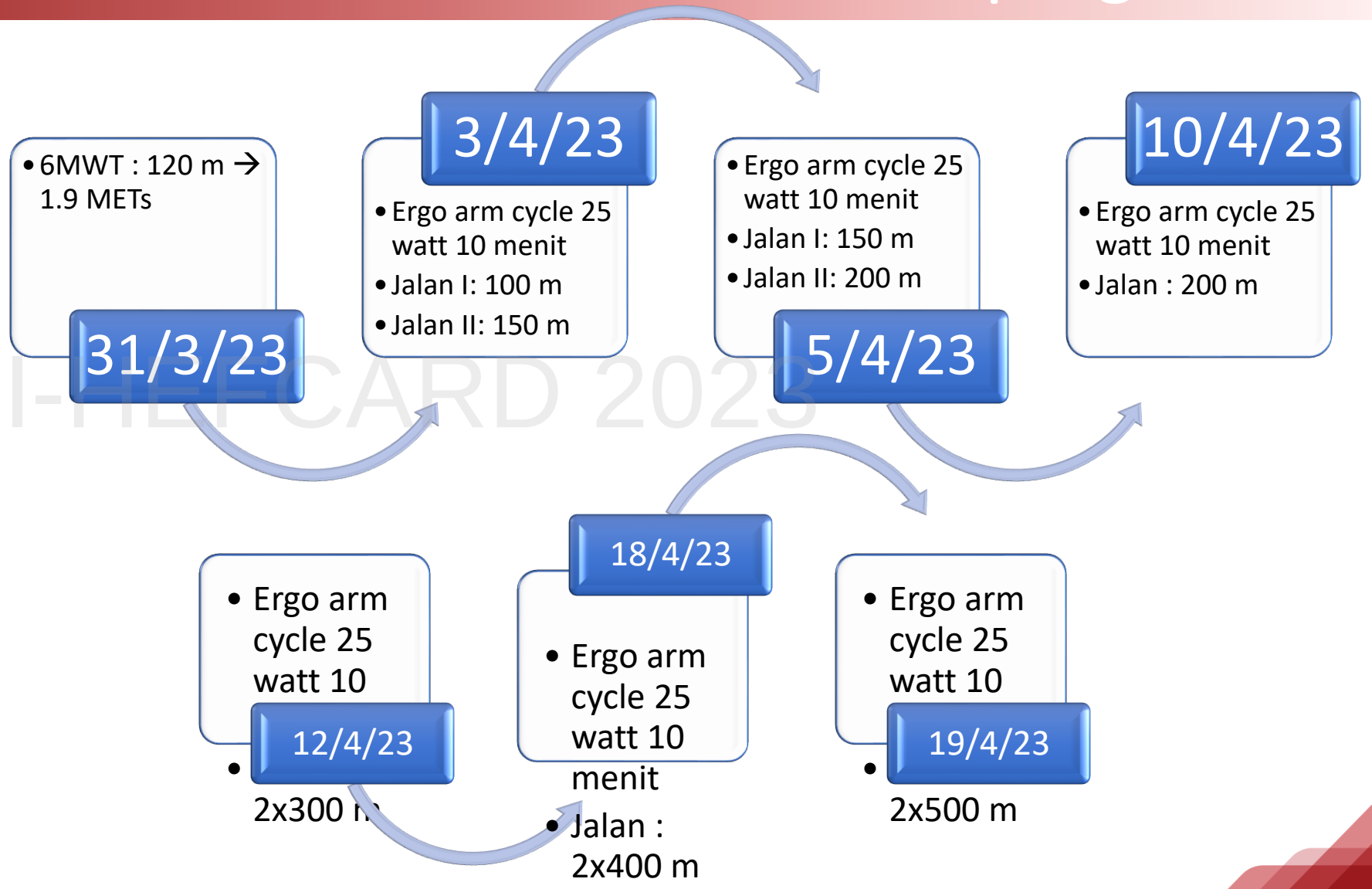
| Echocardiography (20/2/2022) | Echocardiography (9/3/2023) | CAG (19/04/2022) | CAG (13/07/2022) |
|---|---|---|---|
| Normal cardiac chamber dimension<br>LVH (-)<br>Normal LV systolic function (EF SP 62 %)<br>Grade I LV diastolic dysfunction<br>Normal RV systolic function (TAPSE 2.0 cm)<br>Kinetic: global normokinetic<br>Valves: seems normal, Aortic sclerosis<br>eRAP 3 mmHg | Normal cardiac chamber dimension<br>LV concentric hypertrophy<br>Normal left ventricle systolic function (EFBP 60.8%)<br>LV diastolic dysfunction grade I<br>Normal right ventricular systolic function (TAPSE 2.3 cm)<br>Global normokinetic<br>Valves : MR Mild, TR Mild with Low Probability of PH, PR Mild, Aortic sclerosis (kalsifikasi semua kuspis), AR moderate.<br>eRAP 8 mmHg | L-RCA-graphy<br><br>LM : Normal<br>LAD : Stenosis 80-85% proximal setelah D1, Kalsifikasi (+), Stenosis 25% sebelum D1<br>LCx : Stenosis 95% proximal, kalsifikasi (+)<br>RCA : Stenosis 30% proximal, Kalsifikasi (+)<br><br>Kesan<br>CAD 2 VD , early PCI 1 DCS LAD, 1 DCS LCx, Calcification (+) | L-RCA-graphy<br><br>LM : Normal<br>LAD : Tampak ISR Mehran type 1 di proksimal dan distal stent di proksimal LAD<br>D1 : Normal<br>D2 : Normal<br>LCx : Osteal stenosis 90%, TIMI thrombus grade 3, TIMI 3 flow, stent patent di proksimal<br>OM1 : Normal<br>OM 2 : Normal<br>RCA : Stenosis 50% at proximal<br><br>Kesan<br>CAD 2 VD , ISR proximal LAD Mehran type 1, osteal stenosis dan patent stent at LCx dengan Left Main PCI dengan Reverse TAP<br><br>Tahun 2020 post PPM DDDR a.i Bradikardia simptomatis (SND dengan escape junctional rhythm) |

# PATIENT's Diagnosis and Cardiac rehabilitation program

## Diagnosis

CHF FC II ec CAD 3VD
- Riwayat PCI Maret, April dan Juli 2022
- AR Moderate, MR Mild, TR Mild with Low Probability of PH, PR Mild
- Post PPM 2020 medtronic a.i Bradikardia simptomatis (SND dengan escape junctional rhythm)
- post UAP Februari 2023
- EF BP 60.8%, global normokinetic

DM Tipe 2
Dispepsia Syndrome
Dyslipidemia
Hyperuricemia (improved)



# PATIENT's Cardiac rehabilitation program

**26/4/23**
- Ergo arm cycle 25 watt 10 menit
- Jalan : 2x300 m

**28/4/23**
- Ergo arm cycle 25 watt 10 menit
- Jalan : 2x300 m

**3/5/23**
- Ergo arm cycle 25 watt 10 menit
- Jalan : 2x400 m

**5/5/23**
- Ergo arm cycle 25 watt 10 menit
- Jalan : 2x300 m

**15/5/23**
- Pasien mengeluh badannya lemas, Rehab Fase 2 ditunda

**22/5/23**
- Ergo arm cycle 25 watt 10 menit
- Jalan ditunda karena pasien mengeluh cape dan EKG telemetri menunjukkan PVC Bigemini → dilakukan Evaluasi EKG 12 lead setelah istirahat 10- 15 menit, tidak didapatkan PVC

# PATIENT's Cardiac rehabilitation program and evaluation

- Evaluasi Rehab Fase 2: Dilakukan 6 MWT, hasil 200 M setara dengan 2,6 METs, HRWSi 2,8

29/5/23



**Pre rehabilitation 31/3/23 : 120 m → 1.9 METs**

**Post rehabilitation 29/5/23 : 200m → 2.6 METs, HRWSi 2.8**

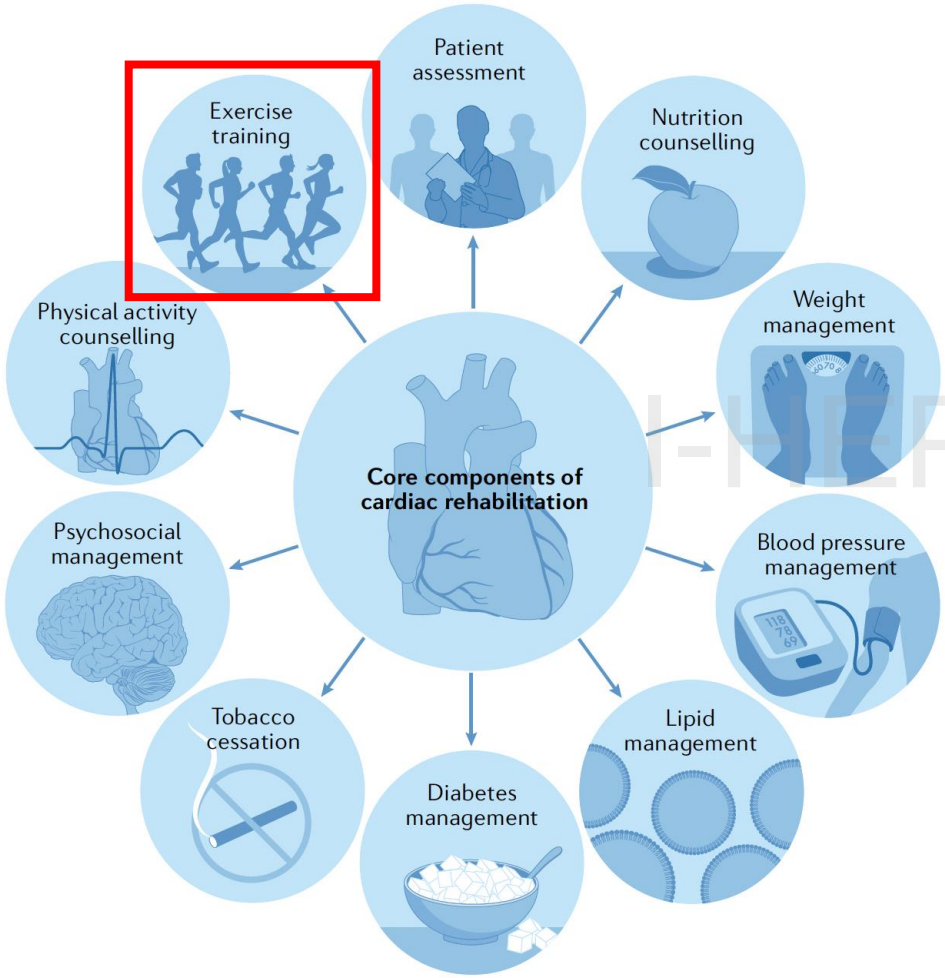
# Definisi

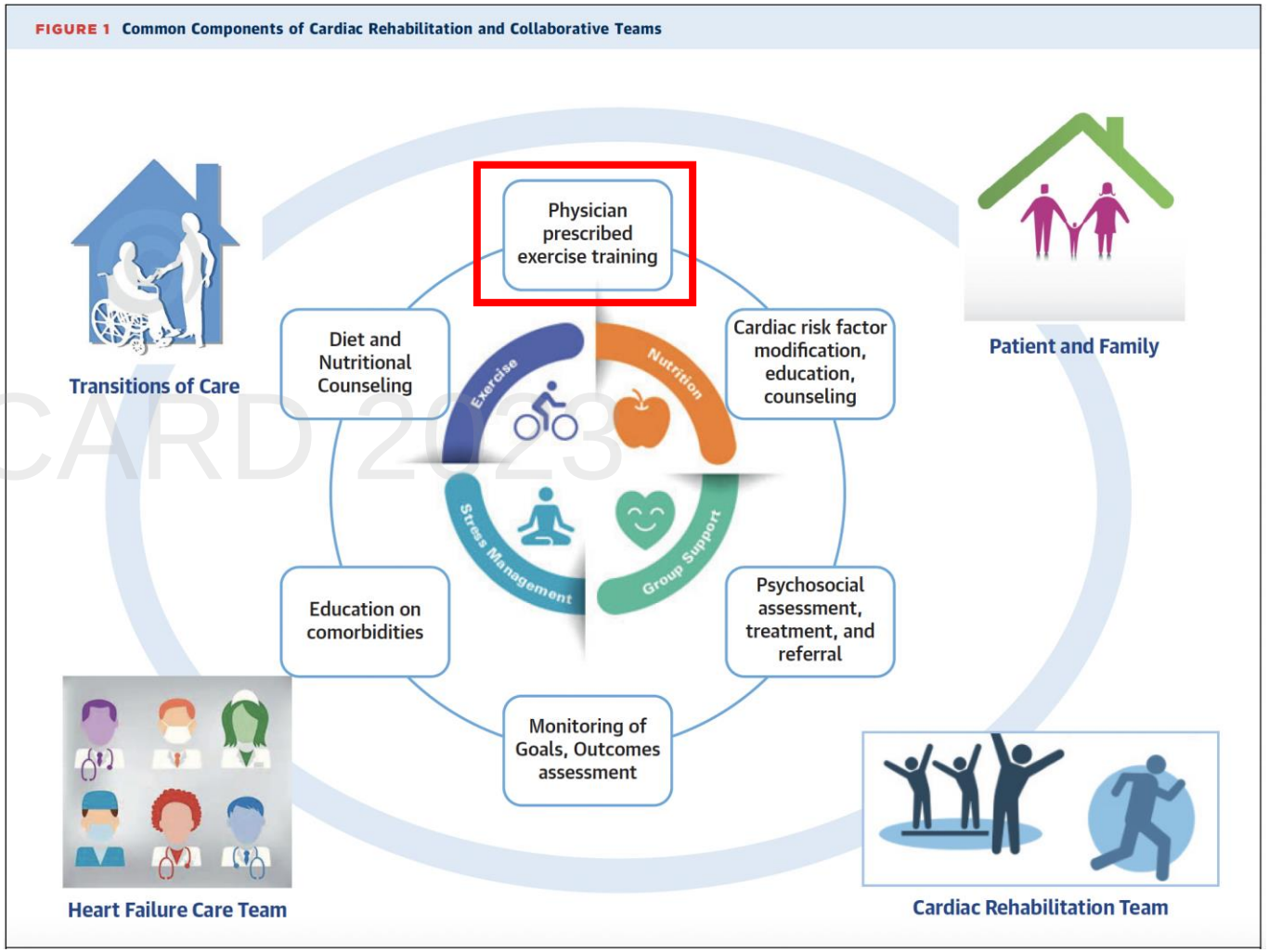
Rehabilitasi Kardiovaskular adalah sekumpulan upaya atau program yang terintegrasi yang dilakukan untuk mengontrol penyebab dasar penyakit kardiovaskular, memperbaiki kondisi fisik, mental dan sosial pasien penyakit kardiovaskular atau individu yang mempunyai risiko penyakit kardiovaskular sehingga dapat mempertahankan atau mengembalikan kondisi terbaiknya dan dapat melakukan upaya pencegahan sekunder secara mandiri, dan dapat kembali ke dalam kehidupan yang produktif.



Panduan rehabilitasi Kardiovaskular. Kelompok kerja prevensi dan rehabilitasi kardiovaskular. Pengurus pusat PERKI 2019

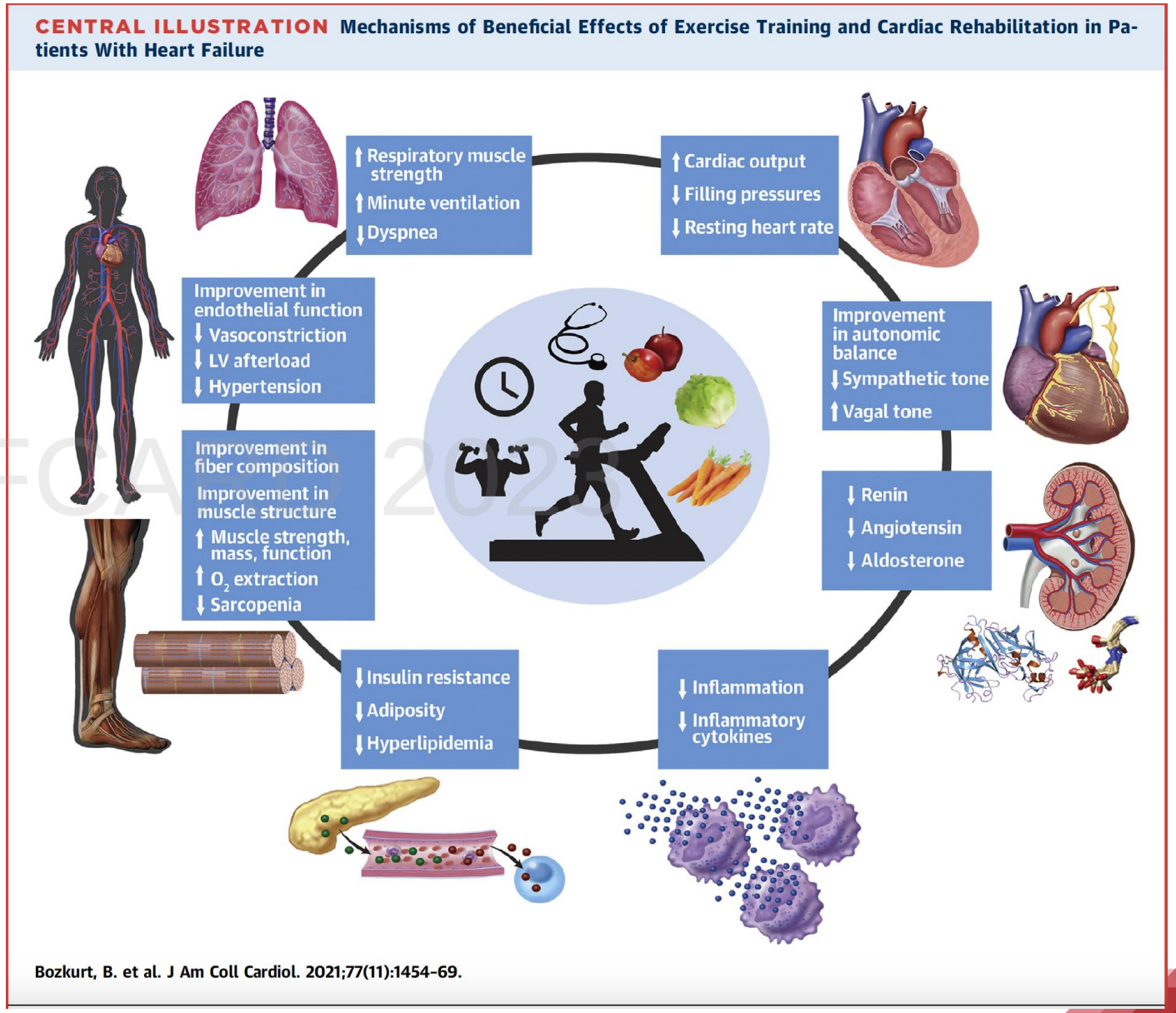
# Components of Comprehensive Cardiac Rehabilitation




The role of cardiac rehabilitation in improving cardiovascular outcomes. https://doi.org/10.1038/s41569-021-00611-7
Bozkurt et al. CR in Patients With HF. JACC Vol. 77, No.11, 2021. https://doi.org/10.1016/j.jacc.2021.01.030

# Mechanisms by Which Cardiac Rehabilitation and Exercise Training Improve Overall Status in Patients with Heart Failure




Bozkurt et al. CR in Patients With HF. JACC Vol. 77, No.11, 2021. https://doi.org/10.1016/j.jacc.2021.01.030

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Canadian Journal of Cardiology 32 (2016) S365–S373

Review

# Impact of Cardiac Rehabilitation and Exercise Training on Psychological Risk Factors and Subsequent Prognosis in Patients With Cardiovascular Disease

Carl J. Lavie, MD,[a] Arthur R. Menezes, MD,[a] Alban De Schutter, MD,[a] Richard V. Milani, MD,[a] and James A. Blumenthal, PhD[b]

[a] *Department of Cardiovascular Diseases, John Ochsner Heart & Vascular Institute, Ochsner Clinical School, The University of Queensland School of Medicine, New Orleans, Louisiana, USA*

[b] *Department of Psychiatry and Behavioral Science, Duke University Medical Center, Durham, North Carolina, USA*



**Table 1.** Effects of cardiac rehabilitation and exercise training programs on symptoms of anxiety, hostility, and depression in young and older patients with coronary artery disease

| | Young patients (n = 104) | | | Older patients (n = 260) | | |
|---|---|---|---|---|---|---|
| Symptom | Before rehabilitation (%) | After rehabilitation (%) | *P* value | Before rehabilitation (%) | After rehabilitation (%) | *P* value |
| Anxiety | 27.9 | 8.7 | < 0.001 | 13.5 | 9.2 | < 0.01 |
| Hostility | 12.5 | 5.8 | < 0.01 | 4.6 | 2.3 | < 0.05 |
| Depression | 23.1 | 3.8 | < 0.001 | 18.8 | 6.2 | < 0.001 |

Modified from Lavie et al.[18] with permission from Elsevier.

Lavie CJ et al. CJC 2016; 32: S 365- S 373. https://doi.org/10.1016/j.cjca.2016.07.508

# Peak VO2 Improvements with Cardiac Rehab and Survival

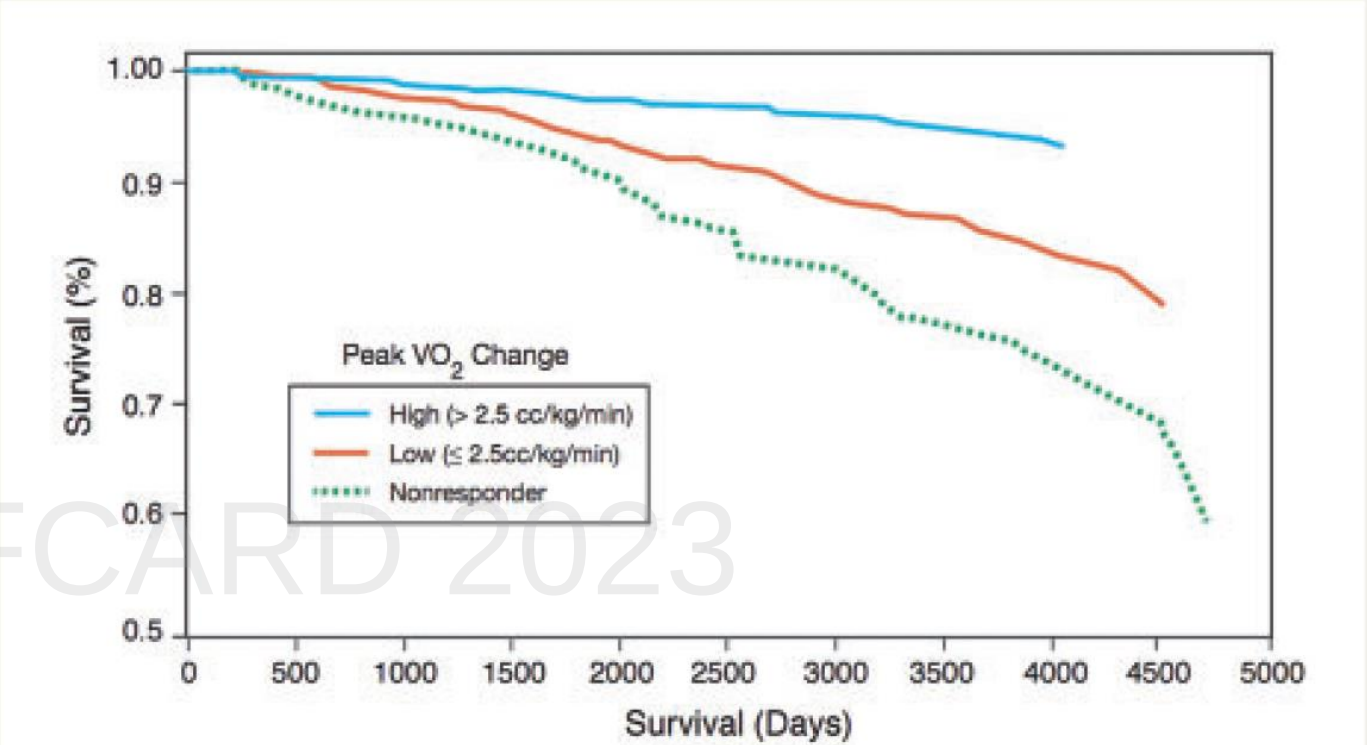



**Figure 2** Cardiac rehabilitation patients were stratified by absolute improvement in $VO_2$ (none, low, and high) and adjusted for predictors of mortality show a direct correlation between improvement in oxygen consumption and mortality.

De Schutter A , Kachur S, Lavie CJ et al. EHJ-QCCO 2018;4: 173-179

# Benefit

# Exercise-Based Rehabilitation for Heart Failure

## Cochrane Systematic Review, Meta-Analysis, and Trial Sequential Analysis

Rod S. Taylor, PhD,[a] Linda Long, PhD,[b] Ify R. Mordi, MD,[c] Michael Tvilling Madsen, PhD,[d] Edward J. Davies, MD,[e] Hasnain Dalal, MD,[f,g] Karen Rees, PhD,[h] Sally J. Singh, PhD,[i] Christian Gluud, DrMedSci,[j] Ann-Dorthe Zwisler, PhD[k]

**ABSTRACT**

**OBJECTIVES** This study performed a contemporary systematic review and meta-analysis of exercise-based cardiac rehabilitation (ExCR) for heart failure (HF).

**BACKGROUND** There is an increasing call for trials of models of ExCR for patients with HF that provide alternatives to conventional center-based provision and recruitment of patients that reflect a broader HF population.

**METHODS** The Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE, EMBASE, CINAHL, and PsycINFO databases were searched between January 2013 and January 2018. Randomized trials comparing patients undergoing ExCR to control patients not undergoing exercise were included. Study outcomes were pooled using meta-analysis. Metaregression examined potential effect modification according to ExCR program characteristics, and risk of bias, trial sequential analysis (TSA), and Grading of Recommendations Assessment Development and Evaluation (GRADE) were applied.

**RESULTS** Across 44 trials (n = 5,783; median follow-up of 6 months), compared with control subjects, ExCR did not reduce the risk of all-cause mortality (relative risk [RR]: 0.89; 95% confidence interval [CI]: 0.66 to 1.21; TSA-adjusted CI: 0.26 to 3.10) but did reduce all-cause hospitalization (RR: 0.70; 95% CI: 0.60 to 0.83; TSA-adjusted CI: 0.54 to 0.92) and HF-specific hospitalization (RR: 0.59; 95% CI: 0.42 to 0.84; TSA-adjusted CI: 0.14 for 2.46), and patients reported improved Minnesota Living with Heart Failure questionnaire overall scores (mean difference: −7.1; 95% CI: −10.5 to −3.7; TSA-adjusted CI: −13.2 to −1.0). No evidence of differential effects across different models of delivery, including center- versus home-based programs, were found.

**CONCLUSIONS** This review supports the beneficial effects of ExCR on patient outcomes. These benefits appear to be consistent across ExCR program characteristics. GRADE and TSA assessments indicated that further high-quality randomized trials are needed. (J Am Coll Cardiol HF 2019;7:691–705) 

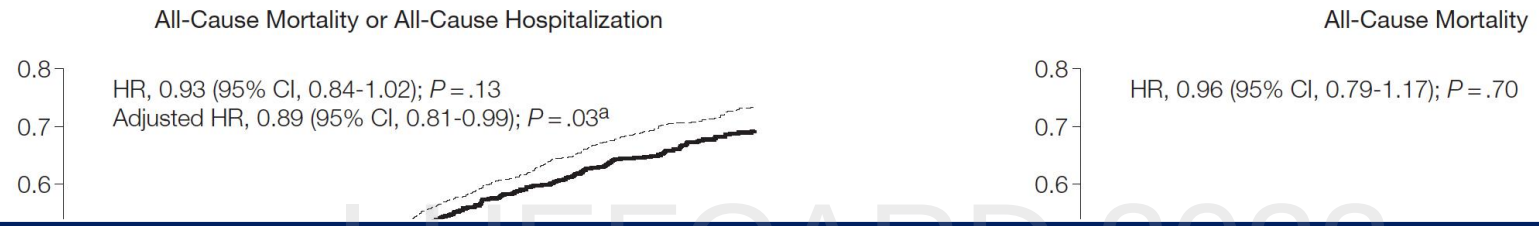
JAMA®

Online article and related content current as of May 28, 2010.

# Efficacy and Safety of Exercise Training in Patients With Chronic Heart Failure: HF-ACTION Randomized Controlled Trial

Christopher M. O'Connor; David J. Whellan; Kerry L. Lee; et al.

**Figure 2.** Time to All-Cause Mortality or All-Cause Hospitalization and to All-Cause Mortality






Conclusions:

In the protocol-specified primary analysis, exercise training resulted in nonsignificant reductions in the primary end point of all-cause mortality or hospitalization and in key secondary clinical end points.

After adjustment for highly prognostic predictors of the primary end point, exercise training was associated with modest significant reductions for both all-cause mortality or hospitalization and cardiovascular mortality or heart failure hospitalization.

Van Craenenbroeck EM. Exercise training as therapy for chronic heart failure. E-Journal of Cardiology Practice. 2017;14:1-11.

# Contraindications for Exercise Training in HF

| Cardiac | Non-cardiac |
|---|---|
| Early after acute coronary syndrome (2 days) | Acute systemic illness, fever |
| Untreated life-threatening cardiac arrhythmias | Uncontrolled diabetes mellitus or thyroid dysfunction |
| Acute heart failure | Severe COPD |
| High degree atrioventricular block | Cerebrovascular or musculoskeletal disease preventing exercise testing or training |
| Acute myocarditis and pericarditis | |
| Symptomatic aortic stenosis | |
| Severe hypertrophic obstructive cardiomyopathy | |
| Intracardiac thrombus | |
| Progressive worsening of heart failure symptoms in previous 3-5 days, NYHA Class IV | |
| Significant myocardial ischaemia or arrhythmia during low-intensity exercise | |



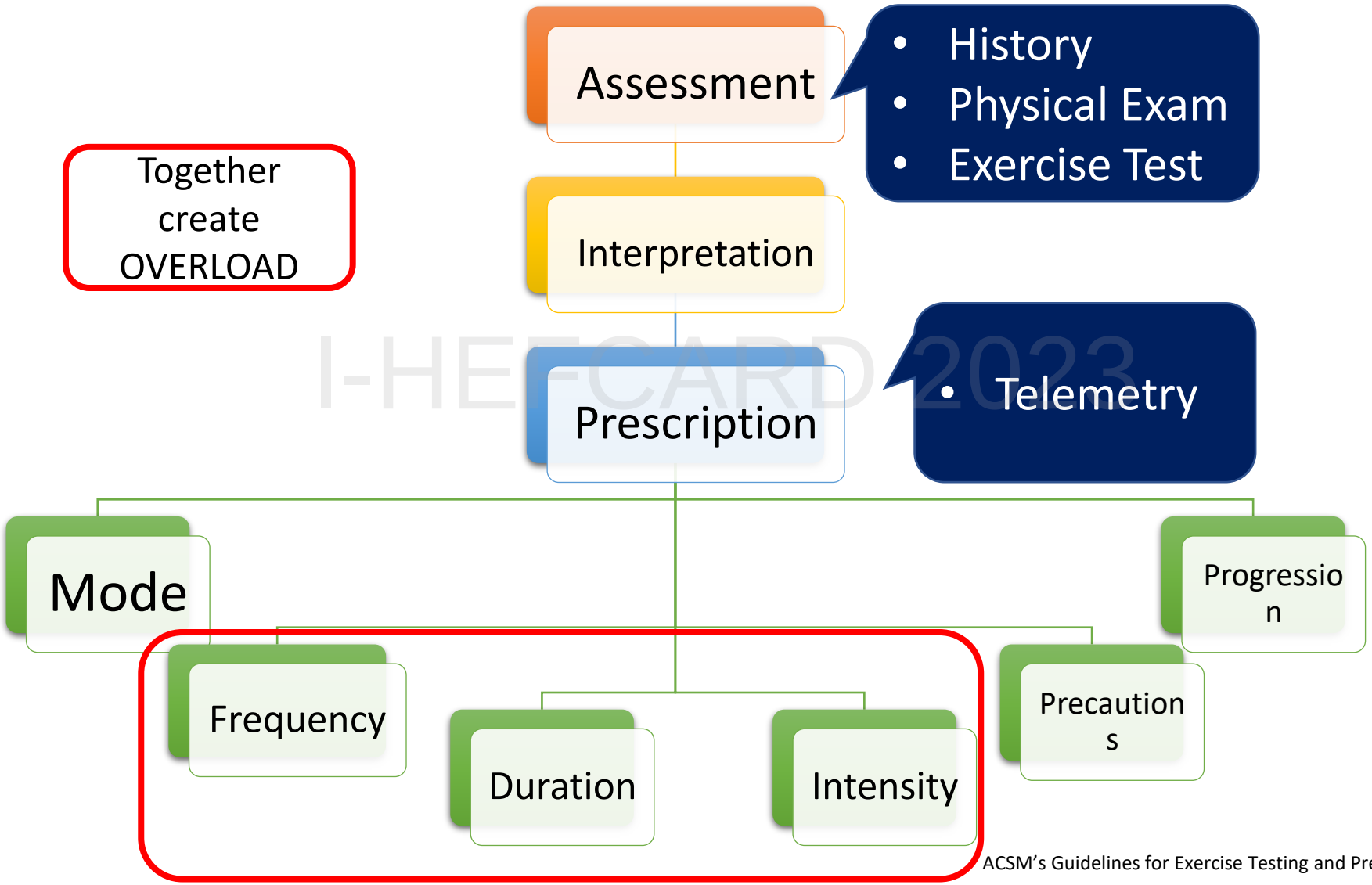
Van Craenenbroeck EM. Exercise training as therapy for chronic heart failure. E-Journal of Cardiology Practice. 2017;14:1-11.

# Klasifikasi Gangguan Jantung Berdasarkan Tingkat Risiko

| *Jenis* | *Karakteristik* |
|---|---|
| Resiko Rendah | Paska bedah by pass atau infark myocardial tanpa komplikasi<br>Kapasitas fungsional ≥ 8 METs pada exercise test selama 3 minggu<br>Tidak adanya gejala klinis selama exercise testing setara pada aktivitas vocational sehari-hari<br>Tidak adanya iskemia, disfungsi ventrikular kiri dan disaritmia kompleks |
| Resiko Sedang | Kapasitas fungsional <8METs pada exercise tset selama 3 minggu.<br>Shock atau PJK selama infark myocardial (<6 bulan)<br>Ketidakmampuan untuk memonitor denyut jantung<br>Ketidakmampuan untuk melaksanakan program latihan<br>Terjadinya iskemia yang dipicu oleh latihan (ST<2mm) |
| Resiko Tinggi | Fungsi ventrikel kiri yang sangat rendah (fraksi ejeksi <30%)<br>Disritmia ventrikel pada saat istirahat<br>Hipotensi pada saat latihan (≥15 mm Hg)<br>Infark myokardial baru (<6 bulan) dengan komplikasi disritmia ventrikel<br>Terjadinya iskemia yang dipicu oleh latihan (ST>2mm)<br>Pernah mengalami serangan jantung. |

(Williams, 2001:415)

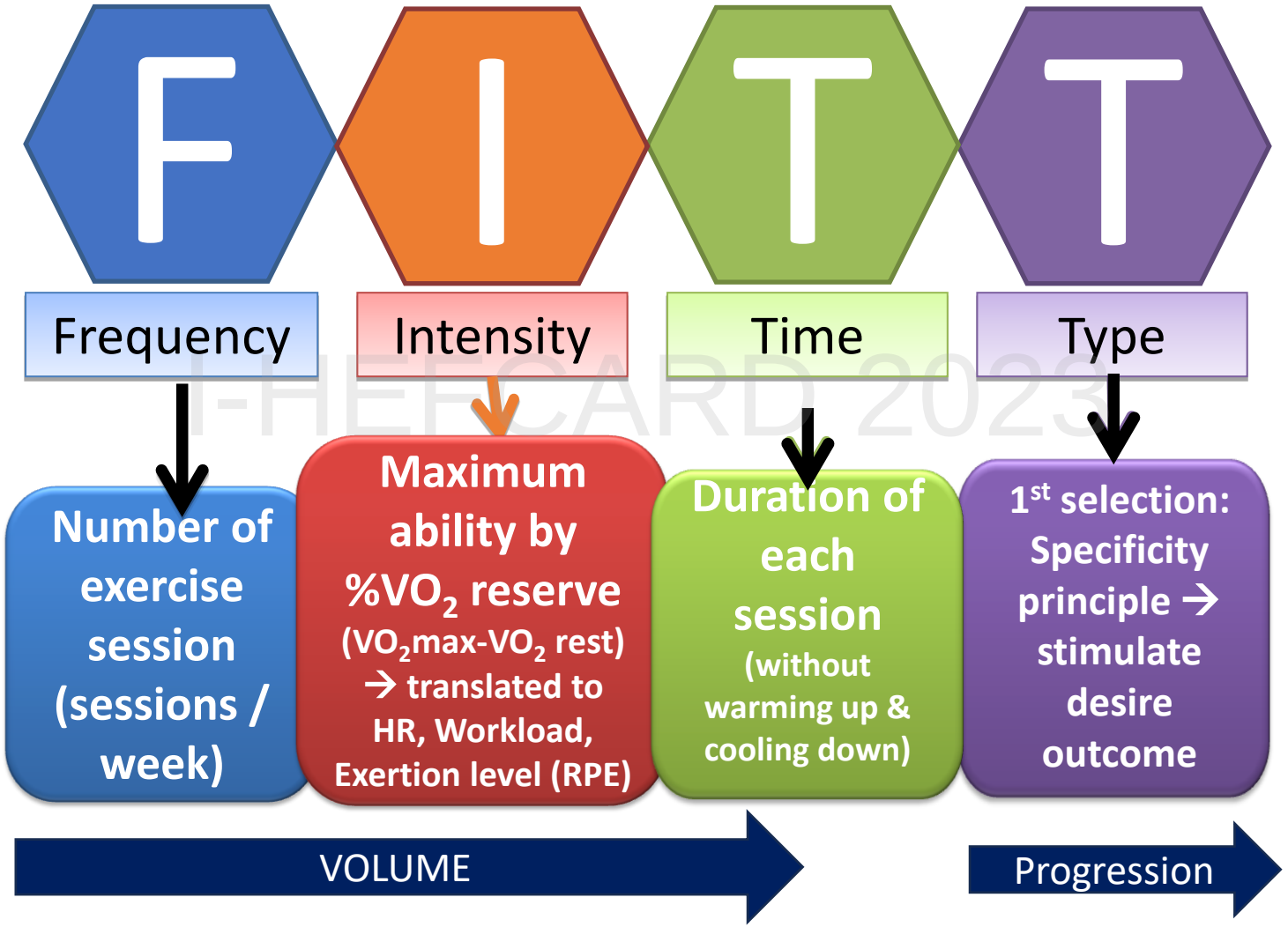
# Exercise Prescription






ACSM's Guidelines for Exercise Testing and Prescription-10th ed-2017

# Exercise Prescription




- Telemetry

ACSM's Guidelines for Exercise Testing and Prescription-10th ed-2017

**TABLE 4** Frequency, Intensity, Time, and Type of Exercise Regimen Commonly Used for Patients With Heart Failure in Cardiac Rehabilitation

| | Aerobic Exercise | Resistance Exercise |
|---|---|---|
| Frequency | 5 days/week, moderate intensity*<br>3 days/week, high intensity† | 2 or 3 nonconsecutive days/week |
| Intensity | Exercise in target heart rate<br>Focus on a variety of intensities | Determined by the amount of weight lifted and the repetitions and sets<br>Goal of 8-10 exercises, about 1-3 sets of 8-16 repetitions of each exercise |
| Time | 30-60 min/session; shorter if exercise is high intensity | Depends on strength and schedule: up to 1 h for total body workout, less for split-routine workout |
| Type | Any activity that increases heart rate, such as running, walking, cycling, or dancing | Activities using resistance: bands, dumbbells, machines, body weight exercise |

Modified with permission from Josephson and Mehanna (93). *Moderate intensity: 50% to 69% of target heart rate. †High intensity: 70% to <90% of target heart rate.

FITT

## FITT RECOMMENDATIONS FOR INDIVIDUALS WITH HEART FAILURE (24,128)

| | Aerobic | Resistance | Flexibility |
|---|---|---|---|
| Frequency | 3–5 d · wk$^{-1}$ | 1–2 nonconsecutive d · wk$^{-1}$ | ≥2–3 d · wk$^{-1}$ with daily being most effective |
| Intensity | If HR data are available from a recent GXT, set intensity between 60% and 80% of HRR. In the absence of data from a GXT or if atrial fibrillation is present, use RPE of 11–14 on a 6–20 scale. | Begin at 40% 1-RM for upper body and 50% 1-RM for lower body exercises. Gradually increase to 70% 1-RM over several weeks to months. | Stretch to the point of feeling tightness or slight discomfort. |
| Time | Progressively increase to 30 min · d$^{-1}$ and then up to 60 min · d$^{-1}$. | 2 sets of 10–15 repetitions focusing on major muscle groups | 10–30 s hold for static stretching; 2–4 repetitions of each exercise |
| Type | Treadmill- or free-walking and stationary cycling | Machines may be best due to loss of strength and balance. | Static, dynamic, and/or PNF stretching |

1-RM, one repetition maximum; GXT, graded exercise test; HR, heart rate; HRR, heart rate reserve; PNF, proprioceptive neuromuscular facilitation; RPE, rating of perceived exertion.

ACSM's Guidelines for Exercise Testing and Prescription-10th ed-2017

Bozkurt et al. CR in Patients With HF. JACC Vol. 77, No.11, 2021. https://doi.org/10.1016/j.jacc.2021.01.030

# Implementasi Latihan Pada Pasien Gagal Jantung

| | |
|---|---|
| Keamanan | • Gagal jantung yang tidak terkompensasi merupakan kontraindikasi latihan: Dekompensasi juga merupakan salah satu indikator penghentian program.<br>Pemeriksaan tanda·tanda vital sebelum latihan harus dilakukan setiap sesi rehabilitasi.<br>Sebagal bagian darl awal evaluasi, pasien sebaiknya ditanya tentang latihan yang sudah dilaksanakan. |
| Latihan | • Uji latih jantung harus dilakukan jika memungkinkan, menggunakan protokol yang bertahap seperti 1 METs/*stage* seperti protocol Naughton<br>Pasien dengan aritmia ventrikular dan dekompensasi termasuk kategori risiko tinggi<br><br>Resep latihan:<br><br>40-60% dari kapasitas fungsional ($VO_2$ max), atau 11-13 RPE, ditingkatkan durasi lebih dahulu dilanjutkan dengan peningkatan intensitas.<br><br>Protokol latihan:<br><br>Pemanasan dan pendinginan yang lebih panjang; dan peningkatan yang bertahap karena latihan yang bertahap dan pasien dengan risiko tinggi maka lama Latihan dan supervisi akan lebih panjang.<br>Latihan dimulai dengan beban yang ringan (low resistance training)<br>Monitoring EKG dilakukan dalam periode yang lebih panjang, periksa tekanan darah lebih sering. Hipotensi secara signifikan menandakan tanda dekompensasi<br>Efek samping yang sering terjadi adalah kelelahan pasca latihan. |
| Edukasi | • Prioritas edukasi adalah pengenalan tanda dan gejala seperti kelelahan, kelemahan, napas pendek, sesak ketika aktivitas, sesak ketika berbaring, sesak malam hari, edema dan peningkatan berat badan<br>Konsultasi nutrisi: diet rendah garam dan diet rendah lemak.<br>Regimen pengobatan: penjelasan obat dan kepatuhan minum obat dari obat-obatan diuretik, digitalis, *ACE Inhibitor*, *beta blocker*.<br>Konsultasi psikososial untuk depresi, menggunakan kelompok pendukung dan konseling lndividu. |



Perhimpunan Dokter Spesialis Kedokteran Fisik dan Rehabilitasi Indonesia (PERDOSRI). Rehabilitasi Kardiovaskular. PERDOSRI; 2016.

# *Evaluasi Awal*

- Anamnesis, pemeriksaan fisik, identifikasi faktor risiko dan status pekerjaan.

- Mendesain rencana
  → ***modifikasi gaya hidup***

# Konsultasi *Aktivitas Fisik & Olahraga*

- **Mengevaluasi aktivitas fisik dan toleransi latihan dengan exercise stress test (CPET)/6MWT**
- *Mengidentifikasi hambatan dalam melakukan aktivitas fisik*
- **Target peningkatan aktivitas fisik**

## Rumus Konversi Jarak Tempuh 6MWT Ke Mets

| | | | | |
|---|---|---|---|---|
| METs | = | VO2 max | = | 0,03 x Jarak (meter) + 3,8 |
| | | 3,5 | | 3,5 |
| | = | 0,06 x Jarak Tempuh (meter) – (0,104 x Usia (tahun) + 0,052 x BB (Kg) | | |
| | | 3,5 | | |

Ross *et al. BMC Pulmonary Medicine* 2010, **10**:31
http://www.biomedcentral.com/1471-2466/10/31

BMC Pulmonary Medicine

RESEARCH ARTICLE Open Access

# The six minute walk test accurately estimates mean peak oxygen uptake

Robert M Ross*[1], Jayasimha N Murthy[2], Istvan D Wollak[3] and Andrew S Jackson[4]

**Abstract**

**Background:** Both Peak Oxygen Uptake (peak VO2), from cardiopulmonary exercise testing (CPET) and the distance walked during a Six-Minute Walk Test (6 MWD) are used for following the natural history of various diseases, timing of procedures such as transplantation and for assessing the response to therapeutic interventions. However, their relationship has not been clearly defined.

**Methods:** We determined the ability of 6 MWD to predict peak VO2 using data points from 1,083 patients with diverse cardiopulmonary disorders. The patient data came from a study we performed and 10 separate studies where we were able to electronically convert published scattergrams to bivariate points. Using Linear Mixed Model analysis (LMM), we determined what effect factors such as disease entity and different inter-site testing protocols contributed to the magnitude of the standard error of estimate (SEE).

**Results:** The LMM analysis found that only 0.16 ml/kg/min or about 4% of the SEE was due to all of the inter-site testing differences. The major source of error is the inherent variability related to the two tests. Therefore, we were able to create a generalized equation that can be used to predict peak VO2 among patients with different diseases, who have undergone various exercise protocols, with minimal loss of accuracy. Although 6 MWD and peak VO2 are significantly correlated, the SEE is unacceptably large for clinical usefulness in an individual patient. For the data as a whole it is 3.82 ml/kg/min or 26.7% of mean peak VO2. Conversely, the SEE for predicting the mean peak VO2 from mean 6 MWD for the 11 study groups is only 1.1 ml/kg/min.

**Conclusions:** A generalized equation can be used to predict peak VO2 from 6 MWD. Unfortunately, like other prediction equations, it is of limited usefulness for individual patients. However, the generalized equation can be used to accurately estimate mean peak VO2 from mean 6 MWD, among groups of patients with diverse diseases without the need for cardiopulmonary exercise testing. The equation is:

$$\text{Mean Peak VO2 (ml / kg / min)} = 4.948 + 0.023 * \text{Mean 6 MWD (meters)}$$
$$(\text{SEE } 1.1 \text{ ml / kg / min})$$

# Latihan Fisik

- Pemanasan
  - 5-10 menit, intensitas ringan-sedang, aktivitas kardiovaskular dan ketahanan otot
- *Conditioning*
  - 20-60 menit
  - Aerobik, resistensi, neuromuskular, dan/atau aktivitas olahraga lain
- *Cooling down*
  - 5-10 menit
  - Resistensi ringan-sedang
- Peregangan
  - Minimal 10 menit.

# Program Latihan Pada Pasien Gagal Jantung Kronik Terdiri Dari 4 Jenis

1. Latihan aerobik: merupakan latihan yang melibatkan aktivitas kelompok otot besar.

   - Tujuan:
     - Meningkatkan ambang batas $VO_2$ maksimal dan ventilasi
     - Meningkatkan kemampuan aktivitas dan stamina/ketahanan
   - Dosis (FITT):
     - Frekuensi: 3-7 hari/minggu
     - Intensitas: 40-70% $VO_2$ maksimal atau *Heart Rate reserve*
     - Time: 20-40 menit/sesi
     - Type: *walking, jogging, cycling, treadmill*
     - Skala Borg RPE 11-16
     - Waktu: sesuai dengan fase rehabilitasi gagal jantung



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# Program Latihan Pada Pasien Gagal Jantung Kronik Terdiri Dari 4 Jenis

2. Latihan penguatan, dapat dengan latihan yang menggunakan sirkuit.
   - Tujuan: mengurangi atrofi otot rangka.
   - Dosis: repetisi yang banyak, tetapi dengan tahanan yang rendah (*high repetition, low resistance*).
   - Waktu: 3 bulan
3. Latihan fleksibilltas: melatih *range of motion* (ROM) ekstremitas atas dan bawah.
   - Tujuan: mengurangi rislko cedera
   - Dosis: frekuensi 3 - 5 kall/minggu
   - Waktu: 4·6 bulan
4. Latihan fungsional: difokuskan pada aktivitas tertentu.
   - Tujuan:
   - Meningkatkan kemampuan aktivitas sehari-hari
   - Kembali bekerja
   - Meningkatkan kualitas hidup
   - Mempertahankan kemandirian
   - Waktu : 3 bulan



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# 4 Metode Uji Latih Yang Digunakan Pada Pasien Gagal Jantung

1. Kekuatan erobik (*aerobic power*)
   - Ergocycle dengan protokol *ramp* (10· 15 Watt/menit atau 25- 50 Watt/3menit)
   - T*readmill* dengan protokol Bruce/Modified Bruce/Naughton.
2. Ketahanan (*endurance*)
   - Dapat menggunakan 6MWT (menilai jarak yang ditempuh pasien dalam waktu 6 menit)
3. Kekuatan (*strength*)
   - Menggunakan tes isotonic (kekuatan kontraksi otot mengakibatkan gerakan yang akan meningkatkan beban volume ke ventrikel kiri sehingga kekuatan pompa akan meningkat)
4. Kapasitas fungsional (*functional capacity*)
   - Metode uji latih yang menilai gaya hidup pasien dengan cara melihat kemampuan dan cara pasien dalam menjalani aktivitas sehari-hari.



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# Tunda Program Latihan dan Konsultasikan Kepada Dokter

- Merasa lemas atau melayang yang tidak biasa atau lebih dari biasa
- Hipetensi yang tidak terkontrol (>200/100 mmHg)
- Hipotensi yang tidak biasa (<90 mmHg)
- Dehidrasi (diare, muntah yang belum teratasi,, makan minum kurang)
- Demam, sedang sakit infeksi
- Sakit dada atau sesak napas yang dirasa lebih berat dari biasanya
- Gula darah yang tidak terkontrol (>300 mg/dl, < 80 mg/dl)
- Krisis emosional: Marah-marah, sedih, depresi

# Tips and Tricks
# Physical Exercise in HF Patients

1. Avoid exercises that require or encourage holding your breath, such as pushups, situps, and isometric exercises.
2. Wait at least one hour after eating to exercise.
3. Avoid actions that need quick bursts of energy.
4. Exercise when you have the most energy. For most people with heart failure, that is in the morning.
5. Think about exercising with a friend or family member. It's easier to stay with it when you have a partner, and it can be an enjoyable social time.
6. Don't exercise if you are sick or have a fever.
7. Avoid exercising outdoors in extreme weather or high humidity



Ashley Welch. https://www.everydayhealth.com/heart-failure/living-with/safe-exercises-people-with-heart-failure/

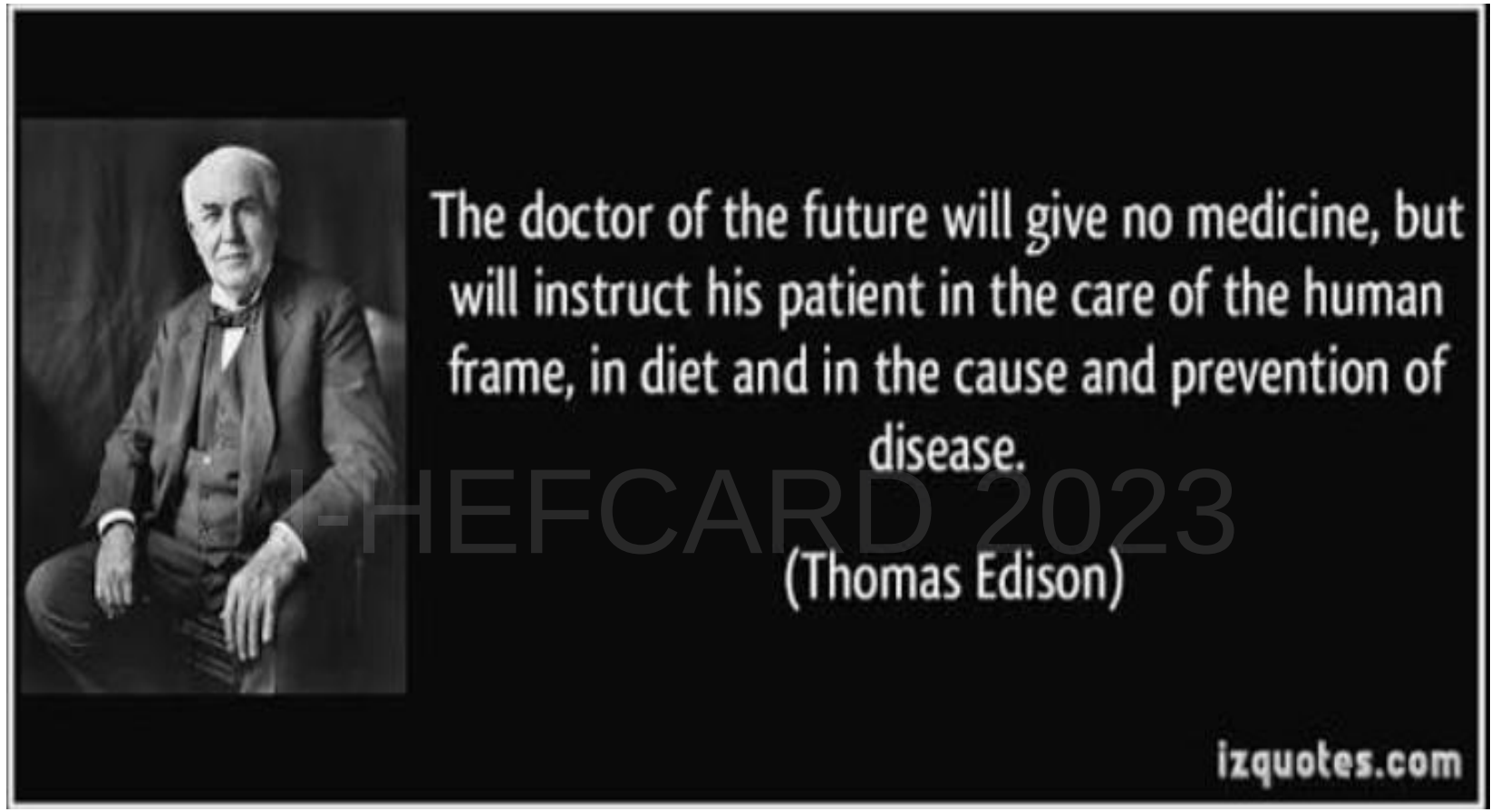
# Hal Yang Perlu Diperhatikan Saat Melakukan Program Latihan

- Kelelahan dan sesak napas (*Borg Scale*) lebih diperhatikan disamping target denyut jantung dan beban latihan.
- Sesi pemanasan dan pendinginan harus lebih panjang.
- Hindari latihan isometrik.
- Monitor EKG diperlukan pada pasien dengan riwayat ventrikel takikardi, henti jantung (*cardiac arrest*), hipotensi yang dicetuskan aktivitas.
- Pertimbangkan pemeriksaan ekokardiogram, studi radionuklir, studi hemodinamik, analisis gas respirasi selama melakukan program latihan.
- Aktivitas latihan dimulai dengan intensitas ringan dilakukan dalam jangka waktu yang panjang.
- Keadaan pasien gagal jantung dapat berubah dengan cepat sehingga pasien perlu dievaluasi berkala untuk melihat tanda dari dekompensasi, perubahan cepat pada berat badan atau tekanan darah, sesak napas dan angina yang dicetuskan latihan, meningkatnya aritmia.
- Secara umum latihan tidak boleh melewati batas latihan yang dapat menyebabkan abnormalitas gerak otot jantung, menurunkan fraksi ejeksi, batas ambang ventilasi.

# Contoh Latihan Isometrik

# Conclusions

- Physical Exercise / ET is an evidence-based adjunct treatment modality for patients with heart failure.
- The benefits of physical exercise entail both central and peripheral adaptations and are clinically translated into anti-remodelling effects, increased exercise capacity and reduced morbidity and mortality.
- Cardiopulmonary exercise testing is mandatory to objectify exercise capacity objectively and to define exercise intensity.
- Ideally, a patient-tailored physical exercise programme is prescribed instead of a “one size fits all” approach.
- Increasing long-term adherence and reaching the frailest patients are challenging goals for future initiatives in the field.






# Thank you