CARDIAC REHABILITATION (CR): 2026 CLINICAL STATUS AND GUIDELINES

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I CORE PRINCIPLE AND THE THREE PHASES OF CARDIAC REHABILITATION

- **Core Definition:** Cardiac Rehabilitation (CR) is a comprehensive, multidisciplinary **Class I (Level A)** secondary-prevention intervention combining **prescribed exercise training, cardiovascular risk factor optimization, nutritional counseling, medication adherence, and psychosocial support**.

Phase of Rehabilitation	Clinical Setting & Timing	Primary Objectives & Structure
Phase I (Inpatient)	Hospital ward / CCU (Days 1 to discharge)	Early progressive ambulation (preventing deconditioning & VTE), self-care education, medication reconciliation, and **automatic referral to Phase II**
Phase II (Early Outpatient)	Supervised clinical center, **Home-Based, or Hybrid Virtual CR** (Starts 1–3 wk post-discharge for **8–12 weeks / 36 sessions**)	Individualized ECG/wearable-monitored aerobic & resistance exercise, titration of GDMT, smoking cessation, nutrition, and depression screening
Phase III (Lifelong Maintenance)	Community or independent home setting (Beyond 3–6 months)	Unsupervised lifelong maintenance of exercise habits and risk factor targets to prevent recurrent MACE

II CORE COMPONENTS OF MODERN CARDIAC REHABILITATION (BACPR / AHA-ACC / ESC STANDARDS)

- **Prescribed Exercise Training (FITT-VP Principle — Frequency, Intensity, Time, Type, Volume, Progression):**
  - **Continuous Moderate-Intensity Aerobic Exercise (MICT): 30 to 60 minutes per session, 3 to 5 days per week** at **40 to 80 percent of Peak VO2 or Heart Rate Reserve** (Karvonen formula) or a **Borg Rating of Perceived Exertion (RPE) of 12 to 14**.
  - **High-Intensity Interval Training (HIIT):** Alternating 1-to-4-minute bouts at **85 to 95 percent of Peak HR / Peak VO2** with active recovery periods; HIIT is safe; in stable CAD it gives modestly larger short-term Peak VO2 gains (about 1 mL/kg/min over MICT), but in HFrEF the **SMARTEX-HF** trial found HIIT **not superior** to MICT.
  - **Progressive Resistance (Strength) Training: 2 to 3 non-consecutive days per week** (1 to 3 sets of 10 to 15 repetitions at 40 to 60 percent of 1-Repetition Maximum, avoiding prolonged Valsalva strain) to reverse **sarcopenia and frailty** and improve insulin sensitivity.
  - **Comprehensive Risk Factor and Cardiometabolic Optimization:**
  - **Lipid, Glycemic, and Weight Management:** Active titration of high-intensity statins/ezetimibe/PCSK9i (to LDL-C <55 mg/dL), antihypertensives (<130/80 mmHg), **SGLT2 inhibitors**, and **GLP-1 receptor agonists (Semaglutide/Tirzepatide)**.
  - **Nutritional Counseling:** Adoption of a **Mediterranean or DASH dietary pattern** (high in extra-virgin olive oil/nuts, vegetables, whole grains, and fish; sodium restriction).
  - **Psychosocial and Behavioral Intervention:** Routine screening (e.g., PHQ-9 / GAD-7) and cognitive-behavioral management for **post-MI depression, anxiety, and cardiac distress** (which roughly double non-adherence and post-ACS mortality), alongside **smoking cessation pharmacotherapy** (**Varenicline**, bupropion, or dual nicotine replacement therapy).

III CONTEMPORARY EXPANDED INDICATIONS AND DELIVERY MODELS

- **Home-Based and Hybrid / Virtual Cardiac Rehabilitation (HBCR / V-CR — AHA/AACVPR/ACC Scientific Statement):**
  - **Overcoming the Referral-to-Attendance Gap:** Because global participation in facility-based CR remains **below 25 to 35 percent** (lowest among women, older adults, rural patients, and lower socioeconomic groups due to travel distance and work hours), **Home-Based and Hybrid Virtual CR** programs utilizing smartphone apps, tele-coaching, and wearable heart-rate/ECG sensors are validated as **safe and equally effective alternatives (Class IIa)** for low-to-moderate risk patients.
  - **Cardiac Rehabilitation Across Heart Failure Phenotypes (Class I, Level A):**
  - **HFrEF (HF-ACTION Trial, *JAMA* 2009):** In 2,331 patients with LVEF <=35%, supervised exercise training significantly improved quality of life and **reduced the prespecified covariate-adjusted composite of all-cause mortality or hospitalization by 11 percent** and **CV mortality or HF hospitalization by 15 percent** (confirming complete safety in stable NYHA II–III HFrEF).
  - **HFpEF (Ex-DHF Pilot / Mueller et al. OptimEx-Clin):** Supervised aerobic and resistance exercise training is one of the most potent interventions in **HFpEF**, improving **Peak VO2 (about 1.5 to 2.5 mL/kg/min in meta-analyses), 6-Minute Walk Distance, and KCCQ quality of life** (although **OptimEx-Clin**, *JAMA* 2021, showed no significant Peak VO2 gain vs. guideline control at 3 months) (primarily by improving **peripheral skeletal muscle oxygen extraction [arteriovenous O2 difference] and endothelial function**).
  - **Acute Decompensated Heart Failure in Older Adults (REHAB-HF Trial, *NEJM* 2021):** Early, tailored, multi-domain physical rehabilitation targeting **balance, mobility, strength, and endurance** initiated during or immediately after hospitalization for acute HF in frail older adults produced a large, clinically meaningful improvement in the **Short Physical Performance Battery (SPPB) score** and 6-minute walk distance.
  - **Post-TAVR, Surgical Valve, LVAD, and PAD Populations:** Early physical rehabilitation is recommended after **SAVR/TAVR**, **LVAD implantation (Rehab-VAD)**, and as **Supervised Exercise Therapy (Class I, Level A — CLEVER Trial)** for **Peripheral Arterial Disease** with intermittent claudication.

IV CLINICAL EVIDENCE AND MORTALITY OUTCOMES

- **Coronary Heart Disease (Cochrane Meta-Analysis — Dibben et al., *Eur Heart J* 2023):** Exercise-based CR in patients post-MI, post-PCI, or post-CABG significantly reduces **Cardiovascular Mortality by 26 percent (RR 0.74)**, **recurrent Myocardial Infarction by 18 percent (RR 0.82)**, and **Hospital Readmissions by 23 percent (RR 0.77)**, with a clear **dose-response relationship** (Hammill et al., *Circulation* 2010: attending all **36 sessions** lowers 4-year mortality by **47 percent** and MI by **31 percent** compared with attending only 1 session).

Clinical Condition	Guideline Class & Level of Evidence	Primary Proven Clinical Benefits
Post-ACS (STEMI / NSTE-ACS) & Post-PCI	**Class I, Level A** (ESC 2023 ACS / AHA-ACC)	**26% reduction in CV mortality, 18% reduction in recurrent MI, 23% reduction in readmissions**
Post-CABG & Valvular Surgery / TAVR	**Class I, Level A**	Accelerates sternal/functional recovery, reverses frailty, reduces readmission
Chronic Stable HFrEF & HFpEF (NYHA I–III)	**Class I, Level A** (ESC 2021 / AHA-ACC 2022)	Improves **Peak VO2, 6MWD, KCCQ**, and reduces **HF hospitalizations** (**HF-ACTION, REHAB-HF**)
Chronic Coronary Syndrome (Stable Angina)	**Class I, Level A** (ESC 2024 CCS)	Raises ischemic threshold, reduces angina frequency, improves endothelial function

KEY REFERENCES

- **Dibben GO, Faulkner J, Oldridge N, et al.:** Exercise-based cardiac rehabilitation for coronary heart disease: a meta-analysis, *European Heart Journal / Cochrane Database of Systematic Reviews*, 2023.
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- **Thomas RJ, Beatty AL, Beckie TM, et al.:** Home-Based Cardiac Rehabilitation: A Scientific Statement From the American Association of Cardiovascular and Pulmonary Rehabilitation, the American Heart Association, and the American College of Cardiology, *Circulation*, 2019.