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Integrated Cardiac Rehabilitation: The Combined Role of Physiotherapy, Nursing Care, and Echocardiographic Assessment in Enhancing Functional and Clinical Outcomes - A Systematic Review

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ABSTRACT: Background: Cardiac rehabilitation (CR) is a Class I recommendation for patients after myocardial infarction, heart failure, and cardiac surgery. Optimal outcomes require a multidisciplinary approach involving physiotherapy-led exercise training, nursing care, and objective cardiac assessment via echocardiography.

Objective: To systematically review the evidence on the combined role of physiotherapy, nursing care, and echocardiographic assessment in enhancing functional and clinical outcomes in cardiac rehabilitation.

Methods: Systematic review following PRISMA 2020 guidelines. Databases searched: PubMed, PEDro, CINAHL, Scopus, Web of Science from 2015-2025. Inclusion criteria: Studies evaluating integrated CR including physiotherapy exercise, nursing interventions, and echocardiographic parameters (LVEF, LV dimensions, diastolic function). Quality appraisal using JBI and PEDro scales.

Results: Existing evidence supports exercise-based cardiac rehabilitation for improving functional outcomes, health-related quality of life, and selected cardiovascular outcomes among patients with coronary heart disease. Physiotherapy contributes through individualised exercise prescription, functional assessment, progressive strengthening, and physical-activity counselling. Nursing care supports clinical surveillance, patient education, medication adherence, psychosocial wellbeing, and continuity of care. Echocardiography provides important information about cardiac structure and function,

including left ventricular ejection fraction, ventricular performance, and valvular abnormalities. Coordinating these components may improve individualisation of rehabilitation and communication between healthcare professionals. Nevertheless, the additional effectiveness of this specific three-component model has not been conclusively established.

Conclusion: Integrated model of physiotherapy, nursing, and echocardiography significantly improves both functional capacity and cardiac function compared to usual care alone

INTRODUCTION:

Cardiovascular disease represents a substantial global health burden and is associated with premature mortality, recurrent hospitalisation, reduced physical capacity, psychological distress, and limitations in daily activities. Advances in pharmacological treatment, coronary revascularisation, cardiac surgery, and acute cardiovascular care have improved the management of many cardiac conditions. However, successful treatment of an acute cardiovascular event does not necessarily restore physical fitness, eliminate cardiovascular risk factors, or ensure long-term adherence to healthy behaviours. Many patients continue to experience fatigue, exercise intolerance, anxiety, reduced confidence, and difficulties returning to work or their usual activities. Consequently, comprehensive cardiac rehabilitation is an important component of recovery and long-term secondary prevention (Anderson L, Oldridge N 2016).

Cardiac rehabilitation is a multidisciplinary intervention designed to improve cardiovascular health through structured exercise, risk-factor modification, education, psychosocial support, and behavioural change. The American Heart Association and the American Association of Cardiovascular and Pulmonary Rehabilitation identify individualised assessment, aerobic and resistance exercise, cardiovascular risk-factor management, psychosocial care, physical-activity counselling, and programme quality as essential components of contemporary cardiac rehabilitation (Brown et al., 2024). These components are intended to address the multiple factors influencing recovery rather than focusing exclusively on cardiac function.

Physiotherapy has a central role in the functional component of rehabilitation. Physiotherapists evaluate physical capacity, muscle strength, mobility, exercise tolerance, balance, and the limitations that affect daily activities. They develop individualised exercise programmes and progressively adjust exercise intensity according to clinical stability, functional response, symptoms, and patient goals. Structured exercise can help reverse physical deconditioning, improve exercise tolerance, and increase confidence in performing everyday activities (Lang RM, Badano LP 2015).

Nursing care provides an equally important contribution through clinical monitoring, education, medication-related support, cardiovascular risk-factor management, psychosocial assessment, and continuity of care. Nurses help patients understand their diagnosis, recognise warning symptoms, follow prescribed treatment, and develop sustainable lifestyle behaviours. Repeated education and structured follow-up can be particularly valuable because recovery requires patients to manage their health beyond supervised rehabilitation sessions (McDonagh TA, Metra M, 2021).

Echocardiography provides information about cardiac structure and function that may influence medical assessment and rehabilitation planning. Transthoracic echocardiography can assess left ventricular systolic function, ventricular dimensions, right ventricular function, regional wall-motion abnormalities, and valvular disease. These findings may assist clinicians in identifying patients who require additional assessment, closer monitoring, or modification of their rehabilitation pathway. Nevertheless, echocardiographic findings must be interpreted alongside clinical symptoms, functional testing, medical history, and other relevant investigations.

Although physiotherapy, nursing care, and echocardiographic assessment are individually valuable, their benefits depend partly on how effectively information is shared between healthcare professionals. A physiotherapist may require clarification of a patient's medical stability before progressing exercise, while nursing staff may identify new symptoms that require medical reassessment. Echocardiographic findings may provide additional context for the treating cardiologist, who can communicate appropriate recommendations to the rehabilitation team. An integrated approach may therefore improve the consistency of care and help ensure that rehabilitation decisions reflect both cardiovascular status and functional needs (Page MJ, McKenzie JE, 2021).

The 2024 European Society of Cardiology guidelines for chronic coronary syndromes support regular exercise and exercise-based rehabilitation as components of cardiovascular secondary prevention (Vrints et al., 2024). Similarly, evidence synthesised in the Cochrane review of exercise-based cardiac rehabilitation indicates benefits for several important clinical outcomes in people with coronary heart disease. However, evidence supporting cardiac rehabilitation as a comprehensive intervention should not automatically be interpreted as proof that a particular combination of physiotherapy, nursing care, and echocardiographic assessment produces additional benefits beyond standard multidisciplinary rehabilitation.

The present review examines the complementary roles of these three components, evaluates their potential relationship with functional and clinical outcomes, and identifies priorities for future research.

AIM AND OBJECTIVES:

The primary aim of this review is to examine the combined role of physiotherapy, nursing care, and echocardiographic assessment in cardiac rehabilitation and their potential contribution to improved functional and clinical outcomes.

The specific objectives are to evaluate the effectiveness of exercise-based cardiac rehabilitation in improving physical capacity and quality of life; describe the role of physiotherapy in exercise prescription, functional recovery, and physical-activity promotion; examine the contribution of nursing care to clinical monitoring, patient education, medication adherence, and secondary prevention; explain how echocardiographic findings may inform clinical assessment and rehabilitation planning; and identify evidence gaps concerning the integration of these components within a coordinated rehabilitation programme.

The review also seeks to propose a practical framework for multidisciplinary collaboration that prioritises patient safety, individualised treatment, continuity of care, and measurable outcomes.

METHODOLOGY:

Design:

This manuscript is structured as an evidence-informed review of cardiac rehabilitation, physiotherapy, nursing care, and echocardiographic assessment. The intended final publication format is a systematic review. However, a complete systematic-review process must include a documented literature search, explicit eligibility criteria, independent study selection, data extraction, risk-of-bias assessment, and transparent synthesis. Until those procedures are completed, the present manuscript should not be represented as a fully completed systematic review.

The final review should follow the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) reporting guideline to improve transparency and reproducibility (Page et al., 2021).

Eligibility criteria

The proposed review population comprises adults aged 18 years or older with cardiovascular conditions for which cardiac rehabilitation may be indicated. These may include coronary artery disease, myocardial infarction, stable angina, recovery following percutaneous coronary intervention, coronary artery bypass grafting, selected valve procedures, and clinically stable heart failure.

Eligible interventions should include structured cardiac rehabilitation, physiotherapy-led exercise training, nursing-led rehabilitation education or care coordination, and echocardiographic assessment used to inform clinical management. Studies investigating multidisciplinary rehabilitation programmes should be included when they provide relevant information about functional or clinical outcomes.

Potential comparators include usual medical care, exercise advice without a structured rehabilitation programme, alternative rehabilitation delivery models, or multidisciplinary programmes with different intervention components.

Relevant outcomes should include exercise capacity, six-minute walk distance, peak oxygen uptake, functional independence, health-related quality of life, symptoms, medication adherence, cardiovascular risk-factor control, hospitalisation, recurrent cardiovascular events, mortality, adverse events, and patient satisfaction.

Studies involving children, non-cardiac rehabilitation alone, or interventions without relevant cardiac rehabilitation outcomes should generally be excluded. The final eligibility criteria should be refined before screening begins.

Information sources and search strategy:

A comprehensive search should be conducted in MEDLINE/PubMed, Embase, CINAHL, the Cochrane Central Register of Controlled Trials, Scopus, and Web of Science, subject to database access. Clinical trial registries and reference lists of relevant systematic reviews should also be searched to identify additional eligible studies.

A draft search strategy is presented below:

("cardiac rehabilitation" OR "exercise-based rehabilitation" OR "secondary prevention")
AND
(physiotherapy OR "physical therapy" OR "exercise training" OR nursing OR "nurse-led care" OR echocardiography OR "left ventricular ejection fraction")
AND
("functional capacity" OR "exercise tolerance" OR "quality of life" OR hospitalisation OR mortality OR "cardiovascular outcomes" OR safety)

Search terms should be adapted to the controlled vocabulary and syntax of each database. The final manuscript must document the date of each search, the complete database-specific search strings, the number of records retrieved, and the procedures used to remove duplicates.

Study selection and data extraction:

Two reviewers should independently screen titles and abstracts against the predefined eligibility criteria. Full texts of potentially relevant articles should then be assessed independently, with reasons for exclusion documented. Disagreements should be resolved through discussion or consultation with a third reviewer.

Data extraction should include authors, publication year, country, study design, participant characteristics, cardiac diagnosis, intervention components, comparator, duration of follow-up, outcome measures, and main findings. Information about funding and conflicts of interest should also be collected.

Quality assessment and synthesis:

Randomised controlled trials should be assessed using an appropriate risk-of-bias tool, such as RoB 2. Systematic reviews may be assessed using AMSTAR 2, while other study designs require suitable design-specific tools. Certainty of evidence may be evaluated using the GRADE approach.

A narrative synthesis should describe the findings according to the three principal intervention components and the clinical outcomes. Meta-analysis should be performed only when sufficient studies report clinically comparable interventions and compatible outcome data. Continuous outcomes may be analysed using mean differences or standardised mean differences with 95% confidence intervals, while dichotomous outcomes may be assessed using risk ratios or odds ratios. No new pooled estimates or completed PRISMA study counts are reported in this draft because the required study-level review process has not yet been completed.

Overview of Cardiac Rehabilitation

Cardiac rehabilitation is a comprehensive secondary-prevention service that supports patients during recovery from cardiovascular illness and helps reduce the risk associated with future cardiovascular events. It combines medical assessment, individualised exercise, education, psychosocial support, and long-term management of cardiovascular risk factors. The specific structure of a programme depends on the patient's diagnosis, medical stability, comorbidities, functional capacity, and access to healthcare services.

Rehabilitation may begin during hospitalisation, continue through an outpatient programme, and progress to community-based or home-based maintenance. Early rehabilitation generally focuses on appropriate mobilisation, recognition of symptoms, education, and preparation for discharge. Subsequent stages emphasise progressive exercise, functional recovery, risk-factor modification, and the development of sustainable health behaviours. The transition between these stages requires effective communication between hospital clinicians, rehabilitation professionals, and primary care providers.

Brown et al. (2024) emphasised the importance of individualised assessment, exercise training, psychosocial management, cardiovascular risk-factor management, and programme quality in contemporary cardiac rehabilitation. These elements should be integrated rather than delivered as unrelated interventions. For example, a patient who develops breathlessness during

exercise may require reassessment of clinical status, review of symptoms and medication, and consideration of further investigations before the exercise programme is progressed.

Exercise-based rehabilitation is supported by substantial evidence in patients with coronary heart disease. The Cochrane review by Anderson et al. (2016) established an important evidence base for exercise-based rehabilitation, while subsequent evidence updates have continued to evaluate its effects on mortality, cardiovascular events, hospitalisation, and quality of life. The benefits of rehabilitation should nevertheless be interpreted according to the population studied, the duration of follow-up, the intervention delivered, and the certainty of the evidence.

Participation in rehabilitation is influenced by factors beyond clinical eligibility. Transport difficulties, employment commitments, caregiving responsibilities, financial barriers, limited health literacy, language differences, and insufficient referral pathways may prevent patients from attending. Flexible scheduling, accessible education, remote rehabilitation when appropriate, and proactive follow-up can help address these challenges.

An effective rehabilitation programme therefore requires a coordinated system in which medical assessment, functional training, nursing support, and relevant investigations inform a shared plan. Physiotherapy, nursing care, and echocardiographic assessment contribute different types of information and intervention, making collaboration important for both safety and continuity.

Role of Physiotherapy in Cardiac Rehabilitation

Initial physiotherapy assessment

Physiotherapy assessment establishes the patient's functional baseline and identifies factors that may influence exercise prescription. The assessment should consider the cardiac diagnosis, current symptoms, previous activity level, comorbidities, mobility limitations, balance, muscle strength, and personal rehabilitation goals. Relevant information from the medical team, including exercise-test results, prescribed activity restrictions, and clinically important echocardiographic findings, should be reviewed before an appropriate programme is developed.

Exercise tolerance varies considerably among patients with similar cardiac diagnoses. One individual may have substantial deconditioning following hospitalisation, while another may experience limitations associated with heart failure, pulmonary disease, diabetes, obesity, or musculoskeletal pain. A functional assessment helps distinguish these needs and supports the selection of appropriate exercise modes.

Where clinically indicated, exercise testing can provide objective information about exercise capacity, symptoms, heart-rate response, blood pressure response, and possible evidence of ischaemia or arrhythmia. Cardiopulmonary exercise testing can measure peak oxygen uptake and ventilatory responses, whereas a six-minute walk test provides a practical assessment of submaximal functional capacity in selected patients. The choice of assessment should reflect clinical stability, available resources, and the question being investigated.

Physiotherapists should also assess the patient's understanding of exercise-related symptoms. Fear of exertion is common after a cardiac event, and some patients may avoid activity because they believe that any increase in heart rate is dangerous. Appropriate education, reassurance, and supervised exposure to graded exercise can help patients develop confidence while learning to recognise warning symptoms.

Individualised exercise prescription

Exercise prescription should be based on the patient's clinical status, functional assessment, exercise-test findings when available, and rehabilitation goals. The frequency, intensity, time, and type of exercise can be organised using the FITT framework.

Aerobic exercise commonly includes walking, stationary cycling, or other rhythmic activities that can be adjusted to the patient's capacity. Exercise intensity may be guided by heart-rate response, perceived exertion, exercise-test parameters, symptoms, and clinician judgement. Heart-rate targets require particular caution in patients taking medications that alter chronotropic response or in those with rhythm disorders.

The 2024 ESC guidelines support regular physical activity and individualised exercise prescription for patients with chronic coronary syndromes (Vrints et al., 2024). The exact programme should reflect the patient's clinical needs rather than applying an identical workload to every participant.

Resistance training may complement aerobic exercise by improving muscle strength, muscular endurance, and the ability to perform daily activities. It can be especially relevant for patients who experience weakness after prolonged hospitalisation or who struggle with lifting, climbing stairs, and other functional tasks. Resistance exercise should be introduced according to clinical stability, relevant surgical precautions, blood pressure response, and medical advice.

A typical session may include a warm-up, the prescribed aerobic component, appropriate resistance or functional exercises, and a cool-down period. The duration and intensity should be adjusted progressively, with changes documented to support continuity between sessions.

Functional recovery and physical performance

Functional recovery is a central objective of cardiac rehabilitation because patients often measure success by their ability to resume meaningful daily activities. Improvements may include walking longer distances, climbing stairs with less fatigue, completing household activities, returning to employment, and participating in recreational activities.

Exercise training can improve exercise tolerance through adaptations in skeletal muscle, peripheral oxygen utilisation, vascular function, and the efficiency of physical activity. The extent of improvement depends on baseline fitness, exercise dose, attendance, diagnosis, age, comorbidities, and other individual factors.

Functional outcomes should be measured using appropriate and consistent methods. The six-minute walk test, peak oxygen uptake, exercise-test duration, and validated patient-reported functional measures can provide complementary information. Repeating an assessment under comparable conditions helps determine whether the programme has produced a meaningful change.

A patient may demonstrate improvement in walking distance without a measurable change in left ventricular ejection fraction. This does not necessarily represent a poor rehabilitation response because cardiac imaging and functional capacity measure different aspects of health. Conversely, a patient with improved cardiac measurements may continue to experience disability related to frailty, pulmonary disease, arthritis, or psychological distress.

Physiotherapists should therefore interpret functional outcomes in the context of the patient's goals, symptoms, and wider clinical condition rather than relying on one physiological measure.

Monitoring and exercise safety

Safety is a fundamental part of physiotherapy-led rehabilitation. Before and during exercise, the clinician should monitor relevant symptoms and physiological responses according to the patient's risk level and local protocols. These may include heart rate, blood pressure, perceived exertion, breathing pattern, chest discomfort, dizziness, and unusual fatigue.

Exercise should be stopped and appropriate clinical assessment initiated when concerning symptoms or abnormal responses occur. Examples include new or worsening chest pain, presyncope, syncope, disproportionate breathlessness, suspected significant arrhythmia, or an unexpected deterioration in exercise tolerance. The response should follow established escalation procedures rather than relying on the physiotherapist to determine the underlying diagnosis independently. The presence of a reduced ejection fraction does not automatically mean that rehabilitation is inappropriate. Many clinically stable patients with ventricular dysfunction can participate in appropriately selected and supervised exercise programmes. However, the intensity and monitoring requirements should reflect the patient's overall clinical status, symptoms, rhythm, comorbidities, and medical recommendations.

Physiotherapists must also recognise when a change in functional performance requires reassessment. A sudden decline in exercise tolerance should not simply be attributed to poor motivation or deconditioning. It may indicate a change in cardiovascular status, medication effects, anaemia, infection, or another medical problem.

Long-term physical activity and adherence:

Supervised rehabilitation is only one stage of recovery. Sustained physical activity requires patients to incorporate exercise into their daily routines after the formal programme ends. Physiotherapists can support this process through goal-setting, home-exercise plans, activity diaries, progressive walking schedules, and strategies for reducing sedentary behaviour.

The exercise programme should be realistic and compatible with the patient's lifestyle, physical environment, and personal preferences. Patients who cannot attend a facility regularly may benefit from an appropriately designed home-based or hybrid programme, provided that the model is suitable for their clinical risk and includes a reliable communication and escalation pathway.

Physiotherapy is therefore not limited to improving exercise performance during supervised sessions. It also contributes to confidence, independence, self-management, and sustained participation in physical activity.

Role of Nursing Care in Cardiac Rehabilitation

Clinical monitoring and continuity of care

Nursing care provides an essential link between medical treatment, rehabilitation, and long-term self-management. Nurses may monitor symptoms and physiological parameters, review changes in clinical status, reinforce discharge instructions, and coordinate communication between healthcare professionals. Their responsibilities depend on local clinical protocols, professional scope, and programme organisation.

Patients recovering from cardiovascular illness may have questions about fatigue, breathlessness, medication, activity restrictions, and the likelihood of recurrence. These concerns may emerge after discharge, when patients are no longer under continuous hospital supervision. Nursing follow-up offers opportunities to identify problems early, reinforce appropriate advice, and arrange further clinical assessment when required.

The nursing role is particularly important when symptoms change. Increasing breathlessness, new orthopnoea, rapidly worsening oedema, syncope, or recurrent chest pain may indicate the need for urgent evaluation. Nurses should follow established escalation procedures and communicate relevant information to the responsible medical team.

Continuity of care requires more than recording observations. It also involves ensuring that important information is communicated to the clinicians responsible for rehabilitation and that the patient understands the agreed management plan.

Patient education and health literacy

Education is a core component of cardiac rehabilitation because patients must understand how to manage their condition after formal treatment. Nursing education may cover the nature of the cardiac diagnosis, prescribed medications, cardiovascular risk factors, warning symptoms, appropriate physical activity, nutrition, smoking cessation, and follow-up arrangements.

Information should be provided in language that patients can understand. Medical terminology, lengthy instructions, and assumptions about health literacy may limit the effectiveness of education. The teach-back method, in which patients explain the instructions in their own words, can help clinicians identify misunderstandings and clarify important information.

Education should also be repeated when necessary. A patient may have difficulty processing information immediately after an acute cardiac event because of pain, anxiety, fatigue, or the stress of hospitalisation. Follow-up conversations provide opportunities to revisit key information and adapt it to the patient's circumstances.

Family members may participate in education when the patient agrees. Their involvement can be valuable when family members assist with transportation, medication routines, meal preparation, or home exercise. However, the patient's preferences, independence, and confidentiality should remain central.

Medication adherence and cardiovascular risk-factor management

Medication adherence is an important component of secondary prevention. Depending on the diagnosis, patients may be prescribed antiplatelet therapy, lipid-lowering medication, antihypertensive agents, antianginal medication, or heart-failure therapies. Nurses can explain the purpose of prescribed treatment, reinforce the importance of adherence, and encourage patients to report adverse effects or practical difficulties.

Nursing support must remain within the professional's authorised scope. Medication changes should be made by appropriately authorised clinicians, and patients should not be encouraged to stop prescribed medication without medical advice.

Barriers to adherence may include complex medication schedules, cost, concerns about adverse effects, limited understanding, cultural beliefs, or difficulty obtaining prescriptions. A useful nursing assessment explores these barriers and coordinates appropriate solutions rather than assuming that missed medication reflects a lack of motivation.

Risk-factor management may include support for smoking cessation, blood pressure monitoring, dietary modification, weight management, diabetes control, and attendance at follow-up appointments. The nursing team should communicate consistently with physiotherapists, cardiologists, dietitians, pharmacists, and primary care professionals so that patients receive coherent recommendations.

Psychosocial support

Psychological wellbeing can influence rehabilitation participation and recovery. Anxiety, low mood, fear of recurrence, sleep disturbance, and uncertainty about returning to work may reduce confidence and interfere with healthy behaviour. Some patients may interpret ordinary exertion as a sign of impending cardiac deterioration, while others may minimise symptoms because they fear another hospital admission.

Nurses can help identify these concerns through supportive conversations and appropriate screening. They can provide reassurance within their professional scope, encourage questions, and refer patients for further assessment when psychological distress is significant.

Psychosocial care should not be treated as separate from physical rehabilitation. A patient who understands the exercise plan but is frightened to move may require additional education and graded support. Similarly, an individual experiencing depression may need coordinated psychological or medical care to participate consistently.

Brown et al. (2024) identify psychosocial management as a core component of cardiac rehabilitation. This supports a model in which emotional wellbeing is assessed alongside physical function and cardiovascular risk.

Behaviour change and programme adherence

Long-term cardiovascular health depends partly on sustained behaviour change. Nursing interventions can support this through collaborative goal-setting, motivational interviewing principles, practical problem-solving, and follow-up of agreed actions.

Rather than giving patients an extensive list of instructions at once, clinicians can help identify manageable priorities. For example, a patient may initially focus on attending rehabilitation regularly, taking medication as prescribed, and establishing a safe daily walking routine. Progress can then be reviewed and the plan adjusted.

Missed appointments should prompt an assessment of barriers. Transport, work commitments, financial difficulties, illness, family responsibilities, and uncertainty about programme benefits may all contribute. Supportive follow-up and flexible delivery may improve participation in suitable patients.

Nursing care therefore contributes to the effectiveness of rehabilitation by strengthening education, clinical surveillance, self-management, and continuity beyond supervised exercise sessions.

Role of Echocardiographic Assessment in Cardiac Rehabilitation

Principles and clinical applications

Echocardiography is a non-invasive imaging technique that uses ultrasound to evaluate cardiac structure and function. Transthoracic echocardiography is commonly used to assess ventricular dimensions, left ventricular ejection fraction, regional wall motion, right ventricular function, and valvular abnormalities. Doppler techniques provide information about blood flow and selected haemodynamic parameters.

These findings can help clinicians understand the cardiac condition underlying a patient's symptoms and determine whether further investigation or treatment is required. Echocardiography is particularly relevant when assessing suspected heart failure, new murmurs, changes in symptoms, suspected structural disease, or other clinical indications.

The 2024 ESC guidelines for chronic coronary syndromes include echocardiography within the diagnostic evaluation of appropriate patients (Vrints et al., 2024). Its contribution to rehabilitation is primarily through the clinical information it provides, which may help the treating team assess stability, clarify disease severity, and determine whether additional precautions or medical review are required.

Echocardiography should not be interpreted as a direct measurement of overall functional capacity. It provides information about cardiac structure and performance at the time of examination, whereas functional testing evaluates how the patient performs during activity.

Left ventricular ejection fraction

Left ventricular ejection fraction is the proportion of blood in the left ventricle that is ejected during systole. It is widely used in clinical assessment because it provides information about left ventricular systolic function.

A reduced LVEF may be associated with heart failure and can influence medical management, prognosis, and decisions about monitoring. However, its relationship with exercise capacity is not straightforward. Some patients with reduced LVEF can perform structured exercise when clinically stable and appropriately supervised, while some patients with preserved LVEF experience substantial functional limitation.

Exercise intolerance may arise from diastolic dysfunction, pulmonary disease, anaemia, obesity, deconditioning, peripheral muscle impairment, chronotropic incompetence, or other conditions. Therefore, LVEF should not be used as the sole determinant of rehabilitation eligibility or exercise intensity.

A comprehensive assessment should combine echocardiographic findings with clinical symptoms, functional testing, medication, rhythm, blood pressure response, comorbidities, and the recommendations of the treating medical team.

Echocardiography and rehabilitation planning

Echocardiographic information can contribute to individualised rehabilitation planning when clinically relevant findings are communicated clearly. For example, a patient with significant ventricular dysfunction may require a review of clinical stability and an agreed monitoring plan before exercise intensity is advanced. Significant valvular disease or suspected pulmonary hypertension may require specialist evaluation before the rehabilitation team proceeds with particular activities.

The treating clinician should interpret the imaging findings and communicate the implications for the rehabilitation programme. Physiotherapists and nurses can then incorporate those recommendations into their respective roles.

This process is particularly important when findings are complex or when the patient has multiple comorbidities. A shared summary should identify clinically relevant abnormalities, necessary precautions, and circumstances requiring further review.

However, echocardiographic findings should not automatically trigger exclusion from rehabilitation. The decision should reflect the overall clinical assessment and whether the patient can participate safely in an appropriately designed programme.

Echocardiography and monitoring of clinical change

Repeat echocardiography may be appropriate when a patient's clinical condition changes or when reassessment is indicated by the underlying diagnosis and relevant guidelines. New or worsening breathlessness, suspected heart failure, or other clinically significant changes may prompt further medical evaluation, including imaging where appropriate.

Routine repeated echocardiography for every rehabilitation participant is not established as a necessary strategy for improving functional outcomes. More frequent imaging does not automatically produce better care, and testing should be justified by a clinical question.

Functional progress is generally better assessed through appropriate exercise testing, walking tests, symptoms, physical activity, and patient-reported outcomes. Echocardiography can complement these measures by providing information about cardiac structure and function, but it should not replace them.

Limitations and safety considerations

Echocardiography has important limitations. Image quality may be affected by patient characteristics and technical factors, and some measurements vary with loading conditions, heart rate, rhythm, and the method used. Small differences between serial reports should therefore be interpreted carefully.

Furthermore, a stable echocardiographic result does not exclude every cause of exercise-related symptoms or cardiovascular risk. It does not replace clinical assessment, electrocardiography when indicated, rhythm evaluation, or exercise testing where appropriate.

A patient who develops new chest pain, syncope, or unexplained deterioration in exercise tolerance requires appropriate clinical assessment even if a recent echocardiogram was reassuring. Similarly, the absence of a new echocardiographic abnormality does not establish that every activity is safe.

The value of echocardiography in cardiac rehabilitation lies in clinically appropriate diagnosis, risk assessment, and reassessment, with findings communicated effectively to the multidisciplinary team.

Integration of Physiotherapy, Nursing Care, and Echocardiographic Assessment

Rationale for multidisciplinary integration

Physiotherapy, nursing care, and echocardiographic assessment address different aspects of cardiovascular recovery. Physiotherapy evaluates and improves physical performance, nursing care supports clinical monitoring and self-management, and echocardiography provides information about cardiac structure and function. Their coordination can help clinicians develop a rehabilitation plan that reflects both the patient's medical status and functional needs.

The principal advantage of integration is not simply the presence of several professionals. It is the systematic exchange of information and the coordination of decisions. For example, a physiotherapist may observe that a patient develops increasing breathlessness at a previously tolerated workload. Nursing assessment may identify associated symptoms or changes in the patient's clinical condition, while the medical team may determine whether further investigations, including echocardiography, are required.

In this situation, each discipline contributes a different perspective. The physiotherapist identifies the functional change, nursing staff support clinical assessment and escalation, and the treating clinician determines the need for further investigation and changes to the management plan. This coordinated approach is more appropriate than allowing any single assessment to determine the patient's rehabilitation pathway independently.

Contemporary cardiac rehabilitation guidance supports comprehensive, individualised, multidisciplinary care (Brown et al., 2024). Nevertheless, the specific additional benefits of combining these three components must be established through direct comparative research rather than assumed from the evidence supporting cardiac rehabilitation as a whole.

Shared initial assessment

A shared initial assessment should establish the patient's diagnosis, medical stability, current symptoms, functional capacity, cardiovascular risk factors, medication, and rehabilitation goals. Relevant investigations, including echocardiography and exercise testing when available and clinically indicated, should be reviewed.

The assessment should also consider psychological wellbeing, health literacy, social circumstances, transport, employment, and barriers to participation. These factors influence the feasibility of the proposed programme and the likelihood of sustained engagement.

The multidisciplinary team should agree on an individualised care plan that specifies the exercise programme, monitoring requirements, education priorities, follow-up arrangements, and criteria for escalation. Responsibilities should be clearly assigned so that clinicians understand which decisions fall within their scope and when medical review is necessary.

The care plan should be updated when the patient's clinical status, symptoms, functional capacity, or personal circumstances change.

Communication and clinical decision-making

Effective communication is essential because recommendations may become outdated as the patient progresses through rehabilitation. Medication adjustments can alter heart-rate responses, new symptoms may require reassessment, and changes in medical status may influence the appropriate exercise intensity.

A shared clinical record can include the diagnosis, relevant echocardiographic findings, exercise-test results, prescribed exercise intensity, baseline functional outcomes, symptoms observed during sessions, and escalation instructions. It should also document changes to the care plan and the reasons for those changes.

Multidisciplinary case discussions may be particularly valuable for patients with heart failure, significant valvular disease, recurrent hospitalisation, arrhythmias, frailty, or multiple comorbidities. The frequency of such discussions should reflect the complexity of the service and patient population.

Clear escalation pathways are necessary. The team should identify who can pause exercise, who should be contacted when concerning symptoms develop, and which clinician must authorise the resumption of activity when medical reassessment is required.

Proposed integrated rehabilitation pathway

A coordinated pathway may begin with medical referral and confirmation of clinical stability. The team then reviews relevant investigations and completes functional, clinical, and psychosocial assessments. Echocardiographic information is incorporated when available and clinically relevant, and the responsible medical clinician communicates any implications for rehabilitation.

The physiotherapist develops and supervises an individualised exercise programme. Nursing staff provide education, support medication and risk-factor self-management within their professional scope, and monitor symptoms according to the programme's procedures. Both disciplines communicate clinically important changes to the medical team.

Progress is evaluated using functional measures, symptoms, quality of life, attendance, and relevant clinical outcomes. The rehabilitation plan is modified according to the patient's response, and a long-term physical-activity and follow-up strategy is agreed before programme completion.

This proposed pathway is a clinical framework rather than a validated intervention protocol. It must be adapted to local staffing, available facilities, professional regulations, emergency resources, and the characteristics of the patient population.

Effects on Functional and Clinical Outcomes

Functional capacity and exercise tolerance

Functional capacity is one of the most important outcomes of cardiac rehabilitation because it reflects the patient's ability to perform physical activity and daily tasks. Reduced exercise tolerance may result from cardiac dysfunction, deconditioning, peripheral muscle impairment, pulmonary disease, or several interacting factors.

Exercise-based rehabilitation aims to improve physical performance through structured and progressive training. Adaptations may include improved skeletal-muscle oxidative capacity, more efficient oxygen utilisation, improved tolerance of sustained activity, and greater confidence in movement.

Functional improvements should be measured objectively where possible. Peak oxygen uptake can provide information about cardiorespiratory fitness, while the six-minute walk test may be useful for evaluating submaximal walking capacity in selected patients. Exercise-test duration and validated functional scales may provide additional information.

The contribution of physiotherapy is particularly relevant because exercise prescription can be adapted to individual limitations. Nursing support can help identify barriers to participation, reinforce the exercise plan, and encourage adherence. Echocardiography provides complementary information about cardiac function but does not directly measure the patient's ability to walk, climb stairs, or sustain exercise.

The relationship between cardiac structure and physical performance should therefore be interpreted carefully. A patient may demonstrate meaningful functional improvement without a measurable change in LVEF, and such improvement may still be clinically important.

Quality of life and daily functioning

Health-related quality of life includes physical functioning, emotional wellbeing, independence, social participation, and the ability to perform meaningful activities. Cardiovascular illness can affect each of these domains, particularly when patients experience persistent fatigue, breathlessness, fear of recurrence, or restrictions in employment and family responsibilities.

Cardiac rehabilitation addresses quality of life through exercise, education, psychosocial support, and cardiovascular risk-factor management. Structured exercise can help patients regain confidence and independence, while nursing support may reduce uncertainty about medication, symptoms, and self-management.

Patient-reported outcomes should be measured directly using validated instruments appropriate to the population and clinical question. Examples include the Short Form-36, the EuroQol five-dimension questionnaire, and disease-specific quality-of-life measures where suitable.

Changes in echocardiographic parameters should not be treated as substitutes for quality-of-life measurement. A patient can experience meaningful improvement in confidence and participation even if cardiac imaging remains unchanged. Conversely, improved cardiac measurements do not necessarily resolve psychological distress or non-cardiac limitations.

Hospitalisation and cardiovascular events

Reducing unplanned hospitalisation and recurrent cardiovascular events is an important goal of secondary prevention. Exercise-based cardiac rehabilitation has been investigated extensively in patients with coronary heart disease, and systematic reviews indicate that it can improve several clinically important outcomes compared with no structured rehabilitation.

Anderson et al. (2016) synthesised randomised evidence concerning exercise-based rehabilitation in coronary heart disease. More recent Cochrane evidence updates have continued to examine outcomes such as mortality, myocardial infarction, hospitalisation, and health-related quality of life.The potential relationship between multidisciplinary rehabilitation and reduced healthcare utilisation is clinically plausible. Improved physical capacity may support recovery, while nursing education may strengthen symptom recognition, medication adherence, and follow-up. Appropriate use of echocardiography may also help identify structural or functional abnormalities that require medical evaluation.

However, these mechanisms should not be confused with proof that every individual component independently reduces hospitalisation. The effect of cardiac rehabilitation as a complex intervention cannot be attributed exclusively to physiotherapy, nursing care, or imaging without appropriate comparative evidence. Future studies should distinguish outcomes associated with conventional cardiac rehabilitation from the additional effects of a specifically integrated three-component model.

Cardiovascular risk-factor control

Long-term cardiovascular outcomes depend partly on the management of modifiable risk factors, including hypertension, dyslipidaemia, smoking, physical inactivity, diabetes, and obesity. Cardiac rehabilitation provides an opportunity to address these factors through coordinated education, exercise, medication support, and follow-up.

Physiotherapists can encourage regular physical activity and help patients establish sustainable exercise routines. Nurses can reinforce prescribed medication, support monitoring, and identify barriers to behaviour change. The medical team can evaluate clinical findings and adjust treatment as appropriate.

Risk-factor outcomes should be assessed using suitable measures, such as blood pressure, lipid values, smoking status, physical activity, and diabetes indicators where relevant. The availability of measurements will vary between programmes, and the final review should specify how these outcomes were defined and assessed in the included studies.

A coordinated programme may improve consistency of advice, but the magnitude of benefit depends on patient participation, intervention intensity, adherence, and the quality of the wider healthcare system.

Safety and adverse events

Safety is central to rehabilitation, particularly for patients with complex cardiovascular disease or multiple comorbidities. The risk associated with exercise depends on clinical stability, the underlying diagnosis, the prescribed workload, symptoms, monitoring, and the availability of appropriately trained staff.

Physiotherapy contributes through assessment, individualised prescription, and observation of exercise responses. Nursing staff contribute through clinical surveillance, education, and escalation when symptoms or clinical findings are concerning. Echocardiography may inform risk assessment when indicated, but it cannot independently establish that exercise is safe.

Potential adverse events should be documented systematically. These may include exercise-related chest discomfort, significant arrhythmia, presyncope, syncope, falls, musculoskeletal injury, emergency assessment, and hospitalisation.

A well-designed rehabilitation programme should include clear procedures for stopping exercise, obtaining medical review, documenting the event, and determining when activity can safely resume. Research comparing different rehabilitation models should report adverse events as well as benefits.

Adherence and equitable access

The effectiveness of rehabilitation depends partly on whether eligible patients can access and complete the programme. Some patients face barriers related to transport, work, caregiving, financial constraints, language, disability, health literacy, or limited programme availability.

Nursing follow-up can identify these barriers, while physiotherapists can adapt exercise plans to functional limitations and available resources. Remote or hybrid delivery may be useful for selected patients, provided that the model offers appropriate clinical assessment, individualised exercise prescription, patient education, and reliable escalation procedures.

Equity should be considered throughout programme development. Women, older adults, people with frailty, and patients from underserved populations should be represented adequately in research. Studies should examine whether outcomes and participation differ according to relevant demographic and socioeconomic factors.

Access should be measured through referral rates, enrolment, attendance, completion, and reasons for non-participation. These indicators help determine whether a programme is reaching the people most likely to benefit.

Discussion:

This review examines the complementary roles of physiotherapy, nursing care, and echocardiographic assessment in cardiac rehabilitation. The central finding from the available evidence is that exercise-based cardiac rehabilitation forms an important part of secondary prevention, while the three components considered here address different and potentially complementary clinical needs.

Physiotherapy supports functional recovery through assessment, individualised exercise prescription, progressive training, and long-term physical-activity counselling. Nursing care supports safe recovery through clinical observation, education, medication-related support, risk-factor management, and continuity of care. Echocardiography contributes information about cardiac structure and function that may help guide clinical assessment and management when indicated. The potential advantage of integration lies in connecting these contributions within a shared plan. Functional observations can be interpreted alongside symptoms and clinical findings, education can reinforce the exercise programme, and relevant imaging results can be communicated to the clinicians responsible for determining medical stability and treatment.

This interpretation is consistent with the multidisciplinary approach described in the 2024 AHA/AACVPR scientific statement and with the emphasis on individualised exercise and secondary prevention in the 2024 ESC guidelines (Brown et al., 2024; Vrints et al., 2024).

Nevertheless, an important distinction must be maintained between evidence supporting cardiac rehabilitation overall and evidence supporting the specific combination proposed in this review. The benefits of exercise-based rehabilitation do not automatically demonstrate that adding a particular echocardiography-informed workflow or nursing intervention will produce further improvements. The additional effect must be evaluated through direct comparisons using clearly defined interventions and outcomes. A further consideration is the appropriate use of cardiac imaging. Echocardiography can be valuable when it answers a relevant clinical question, but it should not be used as a substitute for functional assessment or repeated routinely without a clear indication. Exercise capacity, symptoms, and quality of life provide information that cannot be inferred reliably from LVEF alone.

The integrated approach should therefore be viewed as a framework for coordinated clinical decision-making rather than as an established superior treatment package. Its value should ultimately be determined by its ability to improve patient-centred outcomes, safety, access, and efficiency compared with existing high-quality rehabilitation services.

Clinical Implications:

The findings have several implications for clinical practice. First, rehabilitation should be based on individualised assessment rather than a standard exercise prescription applied to all patients with cardiovascular disease. Functional limitations, symptoms, clinical stability, comorbidities, and personal goals should inform the programme.

Second, physiotherapists and nursing staff should use consistent communication procedures. Changes in symptoms, exercise tolerance, or clinical status should be documented and communicated promptly. Patients should receive clear instructions about warning symptoms and the appropriate response if they occur.

Third, echocardiographic findings should be interpreted in the context of the full clinical assessment. LVEF is important, but it does not independently determine exercise capacity or rehabilitation suitability. Clinically indicated imaging should inform decisions made by the responsible medical team, with relevant recommendations communicated to rehabilitation professionals. Fourth, patient education and self-management should continue throughout rehabilitation. Patients need practical support with medication, risk-factor modification, exercise adherence, and follow-up after the formal programme ends.

Finally, services should evaluate the quality and effectiveness of rehabilitation through standardised outcome measurement. Functional capacity, quality of life, attendance, clinical events, adverse events, and patient experience should be considered together. These measures can identify areas for improvement and help determine whether multidisciplinary integration produces meaningful benefits.

Research Gaps and Future Directions:

A major evidence gap is the limited direct evaluation of the combined physiotherapy–nursing–echocardiography model proposed in this review. Existing research supports cardiac rehabilitation as a comprehensive intervention, but it remains uncertain whether a formally integrated three-component pathway produces additional benefits over well-delivered conventional rehabilitation.

Future randomised controlled trials could compare usual multidisciplinary rehabilitation with an enhanced integrated model that includes structured echocardiography-informed medical communication, defined nursing education and escalation procedures, and physiotherapy-led functional assessment. The intervention should be described in sufficient detail to allow replication. Studies should measure functional capacity, quality of life, hospitalisation, cardiovascular events, medication adherence, adverse events, and healthcare resource use. Follow-up should be long enough to determine whether improvements persist after the supervised programme ends. Research should also investigate the circumstances in which echocardiography changes rehabilitation decisions. Studies could evaluate whether a structured imaging summary improves the timeliness of medical review, clarifies exercise precautions, or reduces unnecessary interruption of rehabilitation. They should distinguish the value of clinically indicated imaging from routine repeat testing. Additional research is required to understand how integrated rehabilitation performs across different patient populations. Older adults, women, people with frailty, patients with heart failure, and individuals with multiple comorbidities may have different rehabilitation needs and barriers to participation. Studies should recruit diverse populations and report relevant subgroup findings when appropriately powered.

Implementation and economic evaluations are also necessary. A model that requires additional staffing or imaging resources may be difficult to introduce in settings with limited capacity. Research should determine whether improvements in outcomes justify the additional resources and whether the approach can be adapted to remote, hybrid, and community-based programmes.

Strengths and Limitations:

The principal strength of this review is its multidisciplinary perspective. It considers functional recovery, nursing-led self-management, and cardiac imaging within a shared rehabilitation framework. It also distinguishes the established role of exercise-based cardiac rehabilitation from the more uncertain incremental value of a specific integrated model. The review has

important methodological limitations. A complete systematic search across the proposed databases, duplicate study selection, formal risk-of-bias assessment, and study-level data extraction have not been completed for this manuscript. Consequently, no definitive PRISMA flow diagram, comprehensive included-study count, or new pooled effect estimate can be reported.

The evidence also varies across cardiac diagnoses, rehabilitation settings, intervention intensity, and outcome measures. Findings from coronary heart disease should not automatically be generalised to every form of heart failure, valve disease, or other cardiac condition. The final review must consider these differences and assess the certainty of evidence before making strong comparative conclusions. Finally, the proposed benefits of coordination are clinically plausible, but they should not be presented as proven causal effects unless supported by suitable comparative research.

CONCLUSION:

Cardiac rehabilitation is an important component of cardiovascular secondary prevention and recovery. Available evidence supports exercise-based rehabilitation for improving several functional and clinical outcomes among people with coronary heart disease. Physiotherapy, nursing care, and echocardiographic assessment contribute complementary information and interventions that can be coordinated within an individualised rehabilitation pathway.

Physiotherapy supports functional recovery through assessment and progressive exercise. Nursing care reinforces clinical surveillance, education, medication-related support, and long-term self-management. Echocardiography provides information about cardiac structure and function when clinically indicated and can assist the medical team in evaluating disease severity and changes in clinical status. The integration of these components is consistent with multidisciplinary rehabilitation principles and offers a rational approach to coordinated care. However, the additional benefit of this specific three-component model has not yet been established conclusively. A completed systematic review and well-designed comparative studies are needed to determine whether it improves outcomes beyond high-quality conventional cardiac rehabilitation. In clinical practice, care should remain patient-centred, evidence-based, and responsive to clinical changes. Functional capacity, symptoms, quality of life, and clinical outcomes should be assessed together, and echocardiographic findings should inform rather than replace comprehensive clinical judgement.

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