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CARE-PULSE Intervention for Post-Cardiac Surgery Patients: A Holistic Approach to Improve Patient Outcomes

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ABSTRACT

Post-cardiac surgery rehabilitation is a complex and multidimensional process that necessitates a patient-centered, holistic approach to optimize recovery and long-term outcomes. The CARE-PULSE model is a novel, integrative intervention developed to address the broad spectrum of physiological, psychological, and functional challenges experienced by patients following cardiac surgery. This model incorporates nine foundational components: Cardiac Monitoring, Active Breathing Control, Range of Motion (ROM) Exercises, Early Ambulation, Pain Management, Renal Care, Lifestyle Vital Signs, Strength Restoration, and Enhanced Recovery. Each element is designed to support a specific domain of recovery.

The CARE-PULSE model is grounded in evidence-based practice and supported by theoretical frameworks that emphasize the importance of interdisciplinary care, patient empowerment, and functional restoration. This review critically examines the individual and synergistic effects of the nine CARE-PULSE components in the context of contemporary cardiac rehabilitation practices. The integration of physical activity, respiratory support, symptom management, and lifestyle monitoring forms a cohesive pathway that promotes faster recovery, reduces postoperative complications, and enhances quality of life.

Furthermore, this model emphasizes continuity of care, adaptability to individual patient needs, and alignment with secondary prevention goals. Gaps in the current literature are identified, particularly in areas such as long-term adherence, patient-reported outcomes, and cost-effectiveness. Recommendations are provided for future research to validate and expand the CARE-PULSE framework, with the aim of establishing it as a comprehensive standard for post-cardiac surgery rehabilitation.

KEYWORDS: CARE-PULSE, Cardiac Monitoring, Breathing Control, Range of Motion (ROM) Exercises, Early Ambulation, Nursing Intervention, Post-cardiac surgery, Holistic Approach..

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INTRODUCTION

The increasing prevalence of cardiovascular diseases and the rising number of coronary artery bypass graft (CABG) surgeries necessitate a shift toward more comprehensive post-surgical rehabilitation models. Traditional rehabilitation protocols have predominantly emphasized physical recovery through structured exercise programs. However, evidence from the fields of psychosocial health and holistic care suggests that optimal recovery in post-cardiac surgery patients requires a broader approach—one that incorporates psychological, emotional, and spiritual dimensions of healing alongside physical rehabilitation[5].The CARE-PULSE intervention is an emerging model that seeks to address these multifaceted needs, offering a comprehensive strategy for improving recovery outcomes.

Cardiovascular diseases (CVDs) remain the leading cause of mortality and morbidity worldwide, accounting for nearly 17.9 million deaths annually, which represents 32% of all global deaths[19]. Coronary artery disease (CAD), in particular, constitutes a significant burden on healthcare systems and societies. As the incidence of CAD continues to rise due to factors such as sedentary lifestyles, unhealthy diets, and aging populations, the number of patients undergoing surgical interventions such as coronary artery bypass grafting (CABG) is also increasing proportionately. While CABG surgery is a well-established and effective treatment for restoring myocardial perfusion and improving survival, the journey of recovery following surgery is often complex, prolonged, and multifaceted.

Traditional cardiac rehabilitation protocols have predominantly emphasized physical recovery through structured exercise programs, nutritional counseling, and pharmacological optimization. However, a growing body of research underscores the importance of a more comprehensive, holistic approach to post-operative care. This approach acknowledges the fact that physical

healing alone does not suffice for optimal recovery and long-term health outcomes. Psychological distress, emotional disorientation, and spiritual crises are commonly observed in post-CABG patients and can adversely affect the recovery [21]. Studies have revealed that up to 40% of post-cardiac surgery patients experience clinically significant anxiety or depressive symptoms, and these psychosocial issues are frequently under-recognized and under-treated[6].

In this context, there is a pressing need for integrative models of care that transcend the traditional biomedical paradigm and embrace the biopsychosocial-spiritual dimensions of health. The CARE-PULSE intervention is conceptualized as a novel, multidimensional framework designed to holistically support post-cardiac surgery recovery. The acronym CARE-PULSE stands for Cardiac Monitoring (C), Active Breathing Control (A), Range of Motion Exercises (R), Early Ambulation (E), Pain Management (P), Urine Output and Renal Care (U), Lifestyle Vital Signs (L), Strength Restoration (S), and Enhanced Recovery (E). Each component addresses a specific domain of recovery and collectively forms an interconnected matrix aimed at restoring and enhancing patient well-being across physical, psychological, and emotional domains.

The theoretical underpinnings of CARE-PULSE are drawn from[3]., which posits that health and illness is the product of a dynamic interplay between biological, psychological, and social factors. This model challenges the reductionist view of the biomedical model and promotes a more comprehensive, patient-centered approach to healthcare. In addition, CARE-PULSE is influenced by self-management theory, which emphasizes the patient's active engagement and autonomy in managing their recovery, as well as holistic nursing frameworks that view patients as whole beings with complex, interrelated needs [2].

The need for such an intervention is supported by empirical findings. For instance, respiratory therapy significantly reduced post-operative pulmonary complications [4], the integrated pain management and lifestyle counseling improved patient adherence and rehabilitation outcomes. Despite these isolated successes, few models have attempted to synthesize these elements into a single, unified framework that addresses the full spectrum of recovery needs[2].

By weaving together evidence-based practices into a cohesive and theoretically robust model, CARE-PULSE represents a paradigm shift in post-cardiac surgery care. It operationalizes the principle that recovery is not merely the absence of disease but the restoration of physical functionality, psychological resilience, emotional balance, and spiritual well-being. This paper presents a comprehensive analysis of the CARE-PULSE intervention, detailing each component, its theoretical rationale, and supporting empirical evidence. Moreover, it explores the practical implications of implementing such a model in diverse clinical settings and highlights areas requiring further research to enhance its effectiveness and scalability.

In sum, the CARE-PULSE model addresses a critical gap in cardiac rehabilitation by integrating multidisciplinary elements into a holistic, patient-centered approach. It aligns with current healthcare priorities that emphasize value-based care, patient engagement, and long-term outcome optimization. Through a detailed exploration of its structure and impact, this study aims to advance the discourse on holistic post-operative care and contribute to the development of more effective, compassionate, and sustainable rehabilitation strategies for cardiac surgery patients.

This article critically examines the CARE-PULSE intervention and its constituent components, drawing on existing theoretical frameworks and empirical research to assess its potential efficacy. Through a thorough review of the literature, we aim to provide a conceptual and practical understanding of how the CARE-PULSE model can enhance post-cardiac surgery recovery, improve patient quality of life, and mitigate common post-operative complications.

THE NEED FOR HOLISTIC APPROACHES IN POST-CARDIAC SURGERY REHABILITATION:

The complexity of post-cardiac surgery recovery extends far beyond physical rehabilitation. Cardiovascular surgery often leaves patients with not only physical debility but also psychological and emotional challenges, including anxiety, depression, and post-traumatic stress [17]. Furthermore, patients frequently experience disruptions in their spiritual or existential well-being, a factor often overlooked in traditional rehabilitation programs[14].Therefore, a holistic approach that integrates multiple care domains has been proposed as essential for improving long-term outcomes and patient satisfaction.

Holistic care models aim to address the interconnectedness of body, mind, and spirit, thereby facilitating a more robust and comprehensive healing process[16]. Although early cardiac rehabilitation programs have demonstrated improvements in physical recovery, integrating psychological and spiritual elements into care protocols remains relatively underexplored. This gap is especially pronounced in the context of post-cardiac surgery recovery, where psychological well-being is strongly correlated with physical rehabilitation outcomes [18].
In this context, the CARE-PULSE intervention represents an innovative approach that goes beyond physical rehabilitation by incorporating components designed to address the full spectrum of patient recovery. The intervention offers an integrated model that promotes both physical healing and psychological well-being, thereby enhancing patient outcomes in a manner that aligns with contemporary understandings of patient-centered care

THEORETICAL UNDERPINNINGS AND COMPONENTS OF THE CARE-PULSE INTERVENTION

The **CARE-PULSE** intervention is grounded in several theoretical frameworks, including bio psychosocial models of health and recovery, models of self-management, and holistic care paradigms. These frameworks emphasize the interconnected nature of physical, psychological, and social factors in determining health outcomes[3]. The following sections provide a detailed

examination of each component of the **CARE-PULSE** model, along with an analysis of its theoretical and empirical foundations:

CARDIAC MONITORING (C)

Cardiac monitoring is essential for detecting early signs of complications such as arrhythmias, heart failure, or myocardial ischemia, all of which are common post-surgery. The **CARE-PULSE** intervention utilizes continuous monitoring technologies that enable timely medical interventions. The theoretical underpinnings of this component align with the critical care paradigm, emphasizing early detection and prevention as key strategies in improving patient outcomes [17].

ACTIVE BREATHING CONTROL TECHNIQUES (A)

Active Breathing Control Techniques (ACBT) are employed to improve pulmonary function and prevent respiratory complications, such as pneumonia and atelectasis, which are common following cardiac surgery. This component is grounded in respiratory therapy models and has been shown to improve oxygenation, reduce the risk of pulmonary infections, and enhance overall recovery[4].

Active Cycle of Breathing Technique (ACBT) is a valuable respiratory physiotherapy method used to improve lung function and airway clearance in patients who have undergone Coronary Artery Bypass Graft (CABG) surgery. Postoperative CABG patients are at risk of developing pulmonary complications such as atelectasis and retained secretions due to anesthesia, pain, and reduced mobility, which can impair effective coughing and deep breathing. ACBT helps by promoting airway clearance, enhancing lung expansion, and improving oxygenation. The technique consists of three phases: breathing control, thoracic expansion exercises, and the forced expiration technique (huffing). Breathing control involves gentle, relaxed diaphragmatic breathing to reduce airway irritation. Thoracic expansion exercises include deep breaths with or without a breath hold to mobilize secretions and improve lung volumes. The forced expiration technique aids in moving secretions proximally by using controlled huffs rather than coughing, which is less tiring and reduces the risk of sternal wound stress. Collectively, these phases facilitate effective secretion clearance, prevent pulmonary complications, and promote faster respiratory recovery after CABG surgery[1,11].

The **Active Cycle of Breathing Technique (ACBT)** consists of **three distinct phases**, each serving a specific function to aid in secretion clearance and improve pulmonary function, particularly useful for **post-CABG (Coronary Artery Bypass Graft)** patients:

1. **Breathing Control**:
   This is the first and foundational phase. It involves relaxed, gentle diaphragmatic breathing, usually through the nose with relaxed exhalation through the mouth. It helps reduce bronchospasm and relax the airways after physical exertion or coughing. This phase is crucial post-CABG to minimize stress on the sternum and stabilize breathing patterns.
2. **Thoracic Expansion Exercises**:
   In this phase, the patient takes deep breaths, sometimes with a 2–3 second hold at the end of inspiration. This encourages full lung expansion, helps open up collapsed alveoli (atelectasis prevention), and mobilizes secretions from peripheral to central airways. It is often repeated 3–4 times, with breathing control in between.
3. **Forced Expiration Technique (FET) / Huffing**:
   This final phase involves one or two huffing maneuvers—a forced exhalation through an open mouth and glottis from mid to low lung volume. It is designed to move mucus toward the mouth without excessive coughing, which is important after CABG to avoid straining the surgical site.

These phases can be repeated in cycles as needed. ACBT is safe, can be taught easily, and is highly effective for reducing postoperative pulmonary complications and enhancing respiratory recovery in CABG patients[9, 10].

RANGE OF MOTION (ROM) EXERCISES (R)

Early mobilization and range of motion exercises prevent musculoskeletal complications, such as joint stiffness and muscle atrophy, which can impair functional recovery. The inclusion of ROM exercises in the **CARE-PULSE** intervention draws from principles of early rehabilitation, where maintaining joint flexibility and muscle strength is integral to reducing the burden of post-surgical sequelae[6].

Range of Motion (ROM) exercises play a crucial role in the early rehabilitation of patients following Coronary Artery Bypass Graft (CABG) surgery. Postoperative immobility, pain, and use of sternal precautions can lead to muscle stiffness, joint limitations, and functional decline. ROM exercises help in maintaining joint flexibility, preventing contractures, and promoting circulation, which collectively enhance overall recovery. These exercises also reduce the risk of deep vein thrombosis and pulmonary complications by improving venous return and respiratory mechanics.

ROM exercises are typically introduced in phases:

1. **Passive ROM**: Performed with the help of a therapist or caregiver in the immediate postoperative period when the patient has limited ability to move independently. It helps maintain joint mobility and prevent stiffness.
2. **Active-Assisted ROM**: As the patient regains some strength and mobility, they begin to perform movements with partial assistance. This phase supports gradual muscle activation while observing sternal precautions.
3. **Active ROM**: The patient independently performs movements of the upper and lower limbs within pain-free range, promoting muscle strengthening and functional independence.
4. **Resisted ROM**: Introduced later in the rehabilitation phase (usually after 6–8 weeks), incorporating light resistance to improve endurance and strength, always under supervision to avoid stress on the sternum.

These exercises, particularly for the shoulders, wrists, elbows, and ankles, are tailored to avoid strain on the sternotomy site while promoting early functional mobility. Regular ROM exercise sessions have been shown to improve physical performance, reduce

hospital stay, and support better quality of life outcomes in post-CABG patients[12, 13].

EARLY AMBULATION (E)

Early ambulation, or mobilization, is recognized as a key intervention for preventing complications like deep vein thrombosis (DVT), improving circulation, and enhancing cardiovascular recovery. The biopsychosocial model suggests that early mobility not only benefits physical recovery but also fosters psychological well-being by increasing autonomy and reducing anxiety[15].
Novel walking, a structured and progressive form of early ambulation, is an essential strategy in the postoperative recovery of Coronary Artery Bypass Graft (CABG) patients. After CABG surgery, patients are often at risk for complications such as pulmonary infections, deep vein thrombosis, muscle reconditioning, and delayed return to normal activities due to prolonged immobility. Early ambulation, initiated within 24 to 48 hours post-surgery, can significantly reduce these risks by promoting lung expansion, enhancing circulation, stimulating bowel function, improving psychological well-being, and accelerating functional recovery.

A novel walking program typically involves individualized, gradual progression in walking distance and frequency based on the patient's condition, starting with short, assisted walks at the bedside or within the ward and advancing to longer, independent walks. Key strategies to enhance the effectiveness of early ambulation include setting achievable goals, monitoring vital signs, managing postoperative pain, and providing patient education and encouragement. This approach not only improves physical capacity but also enhances confidence, motivation, and quality of life.

Studies have shown that CABG patients who participate in structured walking programs have better outcomes, including reduced length of hospital stay, fewer postoperative complications, and faster return to baseline activity levels [7,8]. Therefore, implementing novel walking as a routine part of early cardiac rehabilitation is a simple yet powerful intervention in improving recovery trajectories for CABG patients.

PAIN CONTROL (P)

Effective pain management, particularly through multimodal approaches, is essential for facilitating patient participation in rehabilitation. This component integrates pharmacological and non-pharmacological interventions, such as cognitive-behavioral therapy (CBT) and guided relaxation techniques, to reduce reliance on opioids and improve patient comfort [2, 12].

URINE OUTPUT AND RENAL CARE (U)

Renal function is often compromised after cardiac surgery due to fluid imbalances and medication side effects. Monitoring urine output and addressing renal health is crucial for preventing kidney complications and ensuring optimal recovery. This component is consistent with integrated care models that focus on monitoring and managing all physiological systems to prevent further complications [4].

LIFESTYLE VITAL SIGNS (L)

Lifestyle vital signs encompass nutrition, physical activity, sleep, and stress management. These factors have a profound impact on long-term cardiovascular health and recovery. This component emphasizes the role of behavioural interventions in fostering sustainable lifestyle changes, which is central to patient empowerment and long-term health[16].

STRENGTH RESTORATION (S)

Strength restoration focuses on rebuilding muscle mass and endurance lost due to prolonged bed rest. Exercise regimens are personalized based on the patient's recovery status and are designed to progressively increase functional capacity, thereby improving overall quality of life and reducing the risk of future cardiovascular events[6] .

ENHANCED RECOVERY (E)

The concept of enhanced recovery is integral to the **CARE-PULSE** model. It involves comprehensive post-surgical care that includes patient education, psychological support, and personalized recovery plans. This component aligns with contemporary models of patient-centered care and self-management, where the patient is empowered to take an active role in their recovery[3].

CRITICAL EVALUATION AND RESEARCH GAPS

While the **CARE-PULSE** intervention integrates a range of evidence-based practices, there is a need for further empirical validation of its effectiveness. Few studies have evaluated holistic interventions that address all aspects of post-cardiac surgery recovery in a comprehensive, integrated manner. More robust, randomized controlled trials (RCTs) are required to assess the impact of **CARE-PULSE** on both short-term and long-term recovery outcomes across diverse patient populations.
Moreover, while the components of **CARE-PULSE** are grounded in established theoretical models, their integration into a single, cohesive intervention requires further exploration. The practical challenges of coordinating multidisciplinary care and ensuring patient adherence to a complex set of interventions also warrant consideration in future research.

CONCLUSION

The **CARE-PULSE** intervention represents a promising holistic model for improving post-cardiac surgery recovery. By addressing the interconnected dimensions of physical, psychological, and emotional health, it offers a comprehensive approach to patient rehabilitation that could lead to improved outcomes. However, further research is needed to assess the long-term efficacy, feasibility, and scalability of this model in diverse clinical settings. The development of more robust, evidence-based

frameworks will ultimately enhance our understanding of how holistic interventions can improve recovery and quality of life for post-cardiac surgery patients.

CONFLICT OF INTERESTS

The author declared that there is no known competing interest.

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