THE ROLE OF DIGITAL HEALTH ENGAGEMENT IN IMPROVING SELF-CARE BEHAVIOR AMONG PATIENTS WITH HEART FAILURE

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ABSTRACT

Heart failure is a chronic disease with high rates of morbidity and rehospitalization, requiring effective management strategies. Digital health engagement has emerged as an innovative approach to improving self-care behaviour through the utilization of digital technologies such as mHealth, telehealth, and telemonitoring. This study aimed to analyze the role of digital health engagement on self-care behaviour among patients with heart failure using a systematic literature review method based on the PRISMA guidelines. The literature search was conducted using the PubMed, ScienceDirect, Scopus, and Google Scholar databases with a publication range from 2022 to 2026. Article selection was performed using inclusion and exclusion criteria, and quality assessment was conducted using the Joanna Briggs Institute (JBI) appraisal tool. A total of eight articles with Randomized Controlled Trial (RCT) designs were analyzed in this study. The synthesis results showed that digital interventions, including mobile applications, telemonitoring, wearable devices, virtual health coaching, and telerehabilitation, were effective in improving self-care behaviour, adherence to health monitoring, symptom management, physical activity, and patients' quality of life. Interventions based on personalized feedback and real-time monitoring demonstrated more optimal outcomes. In addition, digital health also improved self-efficacy and reduced caregiver stress. However, its effectiveness on long-term clinical outcomes still demonstrated variable results. Digital health engagement has the potential to support patient-centered care management for heart failure.

Keywords: digital health engagement, self-care behaviour, heart failure, mHealth, telehealth.

INTRODUCTION

Heart failure is a chronic health problem that continues to increase globally and has become a major cause of morbidity and mortality (Guleria et al., 2025). Currently, the number of individuals living with heart failure worldwide is estimated to reach nearly 64 million people. Recent epidemiological data from the Heart Failure Society of America indicate that an individual's lifetime risk of developing heart failure has increased to approximately 24% (AstraZeneca, 2025). In addition, the mortality rate among patients after hospitalization has been reported to reach 23.3% within the first year following hospitalization (Savarese et al., 2023; Wojtaszek et al., 2025).

Based on data from the Indonesian Health Survey 2023 published by the Ministry of Health of the Republic of Indonesia, the national prevalence of heart disease reached 0.85%, with the highest prevalence found in the Special Region of Yogyakarta Province at 1.67%, while West Java ranked fourth with a prevalence of 1.18% (Kemenkes, 2023). An increasingly concerning phenomenon indicates that cardiovascular disease is no longer predominantly experienced by older adults, but has shifted toward the productive-age population (Muharram et al., 2024). This condition demonstrates that heart disease has developed into an increasingly complex public health threat and requires serious attention from various healthcare sectors.

In addition to the high prevalence of cases, the major problem in heart failure management in Indonesia remains the high rate of patient rehospitalization (Savarese et al., 2023; Wojtaszek et al., 2025). The frequency of recurrent hospital admissions negatively affects patients' prognosis and quality of life and has become one of the primary factors increasing the burden of catastrophic disease financing within the national health insurance system (Darbà et al., 2025; Darvish et al., 2025; Hessel, 2021; Lee et al., 2026; Suksatan et al., 2022; Wei et al., 2024). This condition demands management approaches that focus not only on pharmacological therapy but also on strategies to empower patients in managing their illnesses (Barbaric et al., 2022; Liu et al., 2022). Therefore, active patient involvement in self-care has become an important component in reducing complication rates and improving clinical outcomes.

Self-care behaviour is a key component in the management of patients with heart failure because it directly contributes to maintaining patient stability (Adipati et al., 2025; Jaarsma et al., 2021). This behaviour includes adherence to medication, monitoring of signs and symptoms, adherence to a low-salt diet, and controlled physical activity. Optimal self-care has been shown to significantly reduce rehospitalization rates and improve patients' quality of life (Jaarsma et al., 2021; Longhini et al., 2025). However, various studies have shown that most patients still experience barriers, with low and inconsistent levels of self-care (Stefanie & Faizal, 2026). Common barriers include a lack of disease-related knowledge, low motivation, and limited access to continuous health education. In addition, psychological and social factors such as family support and self-confidence also influence patients' ability to perform self-care (Negarandeh et al., 2021; Stefanie & Faizal, 2026). These conditions indicate a gap between patient needs and healthcare systems in supporting sustainable behavioural change.

The advancement of digital technology has encouraged the emergence of digital health engagement as an innovative strategy to improve patient involvement (Liu et al., 2022; Maddula et al., 2022). Digital health engagement includes the use of health applications, telemonitoring, wearable devices, and digital communication platforms that enable continuous interaction between patients and healthcare professionals (Jena et al., 2025; Klein et al., 2026; Yuliet et al., 2025). The use of these technologies has increased rapidly, particularly after the COVID-19 pandemic accelerated the transformation of digital-based healthcare services. Studies have shown that digital interventions can improve medication adherence, condition monitoring, and patients' ability to recognize early symptoms (Gray et al., 2022; Sundoro et al., 2025). In addition, digital technology also enables the personalization of interventions according to patients' needs and characteristics. However, the effectiveness of digital health engagement in promoting self-care behavioural changes still shows inconsistent results across studies (Foster et al., 2022; Liu et al., 2022; Nourse et al., 2022). These variations are influenced by factors such as age, digital literacy, access to technology, and the design of the interventions used (Albulushi et al., 2024; Victoria-Castro et al., 2024).

Limitations of previous studies indicate that inconsistencies still exist regarding the role of digital health engagement in self-care behaviour among patients with heart failure. Several studies employed heterogeneous research designs, making it difficult to directly compare findings. Relatively small sample sizes and short intervention durations also present challenges in assessing long-term effectiveness. In addition, most studies focused more on clinical outcomes, such as reduced hospitalization, rather than on in-depth changes in self-care behaviour. Existing research also remains limited in exploring patients' experiences and perceptions regarding the use of digital technology. The lack of integration of psychosocial and cultural aspects in digital interventions further affects the success of implementation across different contexts. Consequently, there is still no comprehensive understanding of the mechanisms underlying patient engagement in the use of digital technology to support self-care (Nourse et al., 2025; Olofsson et al., 2025).

Based on the above explanation, this literature review study is important to systematically examine the role of digital health engagement in self-care behaviour among patients with heart failure. This study aims to identify patterns of effective digital interventions in improving patient engagement. In addition, this study also seeks to analyze the factors influencing the successful implementation of digital health engagement. The identification of gaps in previous studies serves as the basis for formulating more comprehensive recommendations. This study is expected to provide a stronger and more integrated synthesis of scientific evidence. The urgency of this study lies in the need for innovative technology-based strategies to improve patient independence in managing chronic diseases. The findings of this study are expected to contribute to the advancement of nursing science and to improve the quality of care and outcomes for patients with heart failure.

METHOD

Research Design

This study employed a literature review design with a systematic approach to identify, evaluate, and synthesize research findings related to the role of digital health engagement in self-care behaviour among patients with heart failure. This approach was selected to obtain a comprehensive understanding of the effectiveness of digital-based interventions in improving self-care behaviour. The review process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure transparency, systematic reporting, and reproducibility.

Data Sources and Search Strategy

The literature search was conducted using several reputable electronic databases, including PubMed, ScienceDirect, and Scopus. The search keywords were developed using combinations of Medical Subject Headings (MeSH) terms and Boolean operators (AND, OR), namely: "digital health engagement" OR "eHealth" OR "mHealth" OR "telehealth" AND "self-care behavior" OR "self-management" AND "heart failure".

The search was limited to articles published between 2022 and 2026, written in English or Indonesian, and available in full-text format.

Inclusion and Exclusion Criteria

a. Inclusion Criteria

The inclusion criteria for the reviewed articles were as follows: (1) original research articles or systematic reviews; (2) studies focusing on patients with heart disorders; (3) studies discussing digital health interventions or patient digital engagement; (4) articles published between 2022 and 2026; and (5) articles available in full-text format.

b. Exclusion Criteria

The exclusion criteria for the reviewed articles were as follows: (1) literature reviews, systematic reviews, meta-analyses, and case studies; and (2) articles not published in English.

Study Selection Process

The study selection process was conducted using the PRISMA flow diagram, which consisted of four stages: identification, screening, eligibility, and inclusion. During the identification stage, all articles retrieved from the databases were collected, and duplicate articles were removed. The screening stage was conducted by reviewing the titles and abstracts to assess their relevance to the research topic. Articles that passed the screening stage were then analyzed in full text during the eligibility stage. Finally, articles that met all inclusion criteria were included in the final analysis.

Data Extraction and Analysis

Data from the selected articles were extracted using a matrix table that included the authors' names, year of publication, research design, sample size, type of digital intervention, and outcomes. The analysis was conducted descriptively by grouping the findings based on the type of intervention and its effects on self-care. Data synthesis was performed to identify patterns, similarities, and differences among the study findings. This approach enabled the researchers to draw more comprehensive conclusions regarding the effectiveness of digital health engagement.

Quality Assessment of Studies

The quality assessment of the reviewed articles was conducted using the Joanna Briggs Institute (JBI) appraisal instrument (Joana Briggs Institute, 2020). The assessment results were used to ensure that only high-quality studies were included in the further analysis of this research.

Ethical Considerations

This study did not directly involve human subjects; therefore, ethical approval was not required. However, the entire process was conducted by upholding the principles of scientific integrity, transparency, and plagiarism avoidance through proper citation of all reference sources.

PRISMA

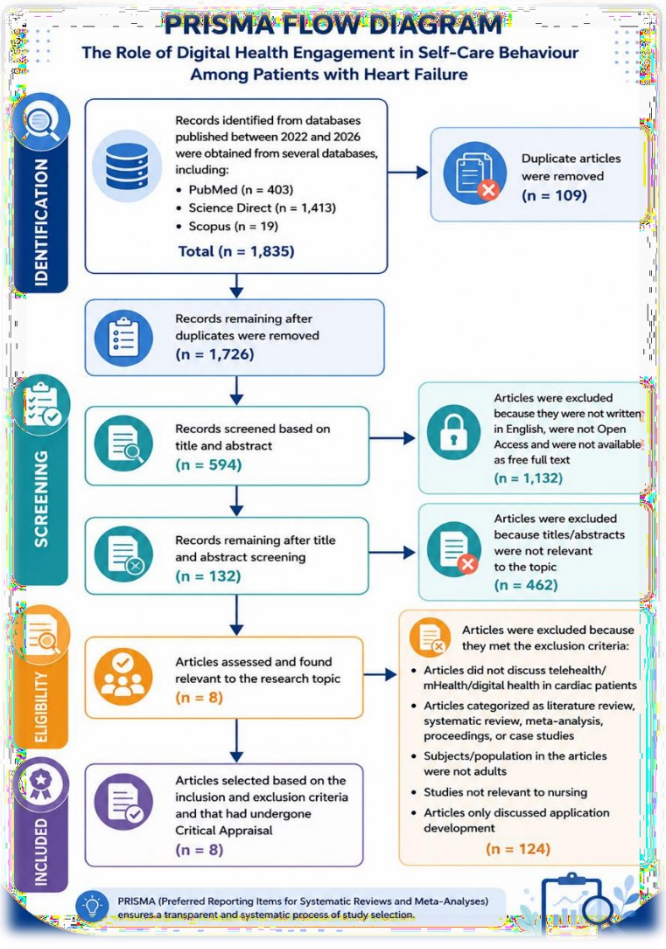

Figure 1.
PRISMA Flow Diagram

Data Extraction

Table 1.
Data Extraction

Title and Authors	Methods	Results
Patient-Centered mHealth Intervention to Improve Self-Care in Patients With Chronic Heart Failure: Phase 1 Randomized Controlled Trial. (Kitsiou et al., 2025)	**Objective**: To assess the feasibility, acceptability, safety, and preliminary effectiveness of a patient-centered mHealth intervention (iCardia4HF) in improving self-care among patients with heart failure. **Design**: Randomized Controlled Trial with an 8-week intervention period. **Sample**: A total of 27 patients (aged ≥40 years, NYHA class I–III) were divided into an intervention group (n=13) and a control group (n=14). Intervention: The intervention included: (1) the use of mHealth applications and devices (Heart Failure Health Storylines, Fitbit, and Withings); (2) monitoring of vital signs, including body weight and blood pressure; (3) tracking of symptoms and physical activity; and (4) tailored educational text messages to enhance self-care. Instruments: - Self-Care of Heart Failure Index (SCHFI) version 7.2 (primary outcome) - Self-Care Self-Efficacy Scale - Beliefs about Adherence Scales (medication, diet, and monitoring) - Dutch Heart Failure Knowledge Scale - Kansas City Cardiomyopathy Questionnaire (KCCQ-12) - Device-generated data (Fitbit and Withings) for daily monitoring	The mHealth-based intervention was effective in improving self-care behaviour, although the effects were still preliminary due to the pilot study design. Psychological factors such as self-efficacy and health beliefs served as important mediators of behavioural change. Wearable technology and personalized text messages were shown to improve adherence to monitoring activities. However, this study was not sufficiently robust to draw definitive conclusions regarding clinical effectiveness due to the small sample size
Effectiveness of a Smartphone App–Based Intervention With Bluetooth-Connected Monitoring Devices and a Feedback System in Heart Failure (SMART-HF Trial): Randomized Controlled Trial (Yoon et al., 2024)	**Objective**: To determine the effectiveness of a smartphone application-based intervention connected to Bluetooth monitoring devices and a feedback system in improving heart failure symptoms among patients with heart failure. **Design**: Randomized Controlled Trial. **Sample**: The sample consisted of patients with acute heart failure aged ≥20 years who were able to use an Android smartphone. A total of 84 patients were randomly assigned to the intervention and control groups. Subsequently, 77 patients were included in the final analysis, consisting of the intervention group (n=39) and the control group (n=38). **Intervention**: The intervention group used an mHealth application connected to Bluetooth devices to monitor blood pressure, heart rate, body weight, body water, heart failure symptoms, diet, medication adherence, and physical activity. The system also provided automated feedback and alerts based on a Clinical Decision Support System (CDSS).	The study results showed that the intervention group experienced a greater reduction in dyspnea scores compared to the control group from baseline to week 4 (mean −1.3 vs −0.3; P=.048). In addition, the intervention group demonstrated improved adherence to application use, reduced body water composition, and a tendency toward higher application satisfaction levels. The study concluded that the mHealth platform integrated with Bluetooth monitoring and feedback was effective in improving self-care and reducing symptoms among patients with heart failure.

	The control group used the application without Bluetooth devices and without automated feedback. **Instruments**: - Dyspnea score questionnaire as the primary outcome - Monitoring of blood pressure, heart rate, body weight, and body water - Symptom diary integrated into the application - Application usage adherence data - Body composition measurement using bio-impedance analysis - Application satisfaction score	
Health Coaching Improves Outcomes of Informal Caregivers of Adults With Chronic Heart Failure: A Randomized Controlled Trial. (Riegel et al., 2024)	**Objective**: The study aimed to examine the effectiveness of a virtual health coaching intervention compared to the provision of health information alone on self-care, stress, coping, and health status among informal caregivers of patients with chronic heart failure. **Design**: Randomized Controlled Trial with a longitudinal approach conducted over 6 months. Sample: The sample consisted of 250 informal caregivers of patients with chronic heart failure who provided care for at least 8 hours per week, had poor self-care, and were able to use technology. The majority of respondents were female (85.2%), spouses of the patients (59.8%), with a mean age of 55±13.6 years. **Intervention**: All respondents received a tablet containing an educational website related to heart failure and caregiving. In addition, the intervention group received 10 sessions of virtual synchronous support with a health coach over 6 months, whereas the control group received only health information without coaching. **Instruments**: - Self-care maintenance - Self-care neglect - Caregiver stress level - Coping mechanisms - Mental and physical health status Data were collected at baseline, month 3, and month 6.	The intervention group showed a significant improvement in self-care maintenance compared to the control group (5.05±1.99; P=0.01) and a significant reduction in stress levels (−4.50±1.00; P<0.0001). Self-care neglect decreased significantly, although the result did not remain significant after adjustment for multiple comparisons. Mental health status improved statistically but was not clinically significant. No significant changes were found in physical health status. The virtual health coaching intervention was considered effective in improving self-care and reducing stress among caregivers of patients with heart failure.
Effectiveness of a Digital Technology-Assisted Personalized Exercise Prescription in the Telerehabilitation of Postoperative Coronary Heart Disease Patients: A Randomized Controlled Trial. (Wu et al., 2026)	**Objective**: The study aimed to evaluate whether technology-based digital cardiac rehabilitation with personalized exercise prescriptions was more effective than traditional remote home-based rehabilitation in improving cardiorespiratory endurance and quality of life among patients after coronary artery disease surgery. **Design**: Randomized Controlled Trial using a telerehabilitation approach with follow-up conducted up to 24 weeks. **Sample**: The sample consisted of 62 patients who underwent percutaneous coronary	The study results showed that the intervention group experienced significant improvements in: - VO_2AT at week 12 (Z=2.247; P=0.025) and week 24 (Z=2.017; P=0.044) - General health (P=0.033) - Social functioning (P=0.001) - Exercise duration at weeks 4, 12, and 24 The study concluded that digital-based telerehabilitation with personalized exercise prescriptions was effective in

	intervention (PCI) due to coronary artery disease and were recruited from a tertiary hospital in Beijing between October 2022 and April 2024. A total of 58 patients completed the study, consisting of the intervention group (n=30) and the control group (n=28). **Intervention**: The intervention group received a digitalized personalized exercise prescription through a mobile application combined with remote monitoring rehabilitation. The intervention included: - Individualized exercise prescriptions through the application - Weekly monitoring by an exercise therapist - Feedback based on real-time electrocardiography data - Personalized exercise adjustments - The control group only received an exercise movement library within the application and a wearable ECG device for self-monitoring exercise intensity. The intervention was conducted for 12 weeks. **Instruments**: - Measurement of maximal oxygen uptake (VO_2AT) - Exercise duration test - Quality of life assessment using SF-36 domains, including general health and social functioning - Real-time electrocardiography data from the wearable ECG device - Assessments were conducted at baseline, week 4, week 12, and week 24.	improving cardiorespiratory capacity and quality of life among patients after coronary artery disease. In addition, nurses played an important role as rehabilitation supervisors and multidisciplinary team coordinators within the digital rehabilitation model.
Effectiveness of the Individualized Self-Care Program Based on Orem's Self-Care Theory: Impact on Learning Needs and Self-Care Behaviors Following Coronary Artery Bypass Surgery: A Randomized Controlled Trial. (Alkuwaisi et al., 2024)	**Objective**: To identify patients' learning needs after receiving an Orem's self-care theory-based Individualized Self-Care Program (ISCP) at two measurement points and to evaluate the effectiveness of the program in improving self-care behaviour among patients after Coronary Artery Bypass Graft (CABG) surgery compared to standard health education. **Design**: The study used a Randomized Controlled Trial (RCT) design with a pretest-posttest and repeated measurement approach. **Sample**: The sample consisted of 128 patients undergoing first-time CABG surgery. Respondents were randomly assigned into two groups, namely the intervention group (n=64) and the control group (n=64). **Intervention**: The intervention group received an Orem's self-care theory-based Individualized Self-Care Program (ISCP) during the first week and third week after hospital discharge. The program included individualized education, self-care guidance, identification of patients' learning needs, and assistance during home recovery. The control	The study results showed a significant reduction in patients' learning needs after the implementation of the ISCP. During the first week, patients still demonstrated high learning needs (4.3 ± 1.5), which subsequently decreased by the third week (2.6 ±1.1). In addition, the intervention group experienced a significantly greater improvement in self-care behaviour compared to the control group, which received only standard education. The study concluded that the ISCP was effective in improving self-care abilities and in addressing patients' learning needs during the post-CABG recovery period.

	group received only standard hospital health education. **Instruments**: The instruments used included: - A questionnaire assessing post-CABG patients' learning needs - A self-care behaviour assessment instrument - Measurements conducted at Time 2 (first week) and Time 3 (third week) after discharge	
Mobile App–Based Self-Monitoring of Health Behaviors in Middle-Aged Men after Myocardial Infarction: A One-Year Randomized Controlled Trial. (Kim et al., 2026).	**Objective**: The study aimed to evaluate the effectiveness of a one-year mobile app-based self-monitoring program on changes in health behaviour and psychological outcomes among middle-aged men after myocardial infarction (MI) who were at risk of developing heart failure. **Design**: A single-blind randomized controlled trial (RCT) with longitudinal measurements conducted at baseline, month 3, month 6, and month 12. **Sample**: The sample consisted of 68 men after myocardial infarction who underwent percutaneous coronary intervention (PCI) with a left ventricular ejection fraction (LVEF) <50%. Respondents were divided into the intervention group (n=35) and the control group (n=33). **Intervention**: The intervention group used the mobile application "With Your Heart," which was specifically developed for this study. The application included a weekly self-monitoring checklist with algorithm-based feedback related to health behaviours. In addition, patients received nurse counseling every three months during outpatient visits. The control group received only standard lifestyle education in the form of a leaflet at the beginning of the study. **Instruments**: - Health Behavior Scale (25 items), including health responsibility, exercise, eating habits, stress management, and smoking behaviour - Resilience Scale for cardiovascular patients - Illness Perception Questionnaire - Depression assessment scale - Follow-up data on health behaviours over 12 months	The study results demonstrated a significant interaction between group and time on health behaviours ($F=10.24$; $p<0.001$) and illness perception ($F=3.15$; $p=0.026$). The intervention group showed consistent improvements in health behaviours across all follow-up periods compared to the control group. Negative illness perceptions decreased at months 3 and 6. Resilience levels were higher in the intervention group, although no significant interaction effect over time was observed. Depression levels decreased in both groups; however, no significant differences were found between the groups. The study concluded that mobile app-based self-monitoring was effective in improving health behaviours and psychological outcomes among post-myocardial infarction patients at risk of heart failure.
Heart Failure-Smart Life: a randomized controlled trial of a mobile app for self-management in patients with heart failure. (Choi et al., 2023)	**Objective**: To develop the mobile self-management application "Heart Failure-Smart Life" for patients with heart failure and to evaluate the effects of the program on the physical, psychosocial, and behavioural aspects of patients with heart failure. **Design**: Randomized Controlled Trial (RCT), non-blinded experimental study. Data were collected from July 2018 to June 2019.	After the 3-month intervention, significant differences were found in NYHA Functional Class ($p=0.003$) and cardiac diastolic function/E/Ea ratio ($p=0.024$) between the intervention and control groups. The intervention group demonstrated greater improvements in physical condition and cardiac function compared to the control group.

	Sample: A total of 74 patients with heart failure participated in the study. The intervention group consisted of 36 respondents, while the control group consisted of 38 respondents. Respondents were recruited from two tertiary hospitals in Korea. **Intervention**: The intervention group used the "Heart Failure-Smart Life" mobile application for 3 months. The application provided education, a daily health check diary, blood pressure and body weight monitoring, a Q&A feature, and a one-on-one chat feature with cardiac nurses. Nurses provided daily monitoring, feedback, reminders, and self-management education. The control group received only usual care at the cardiac outpatient clinic. **Instruments**: - Physiological measurements: BMI, waist circumference, SBP, DBP, NYHA Functional Class, LVEF, and E/Ea ratio - Geriatric Depression Scale for depression assessment - MacNew Heart Disease Health-Related Quality of Life questionnaire for quality of life assessment - Hill Bone Medication Adherence Scale for medication adherence - European Heart Failure Self-Care Behavior Scale for self-management behaviour assessment	However, no significant changes were observed in depression, quality of life, medication adherence, or self-management behaviour between the two groups. The mobile application program was considered beneficial in supporting practical and sustainable self-management among patients with heart failure.
Impact of Digital Health Technology on Quality of Life in Patients With Heart Failure. (Victoria-Castro et al., 2024)	**Objective**: To evaluate the effects of three digital health technologies on the quality of life of patients with heart failure (HF), particularly in improving self-care, knowledge, and patient engagement in disease management. **Design**: The study used a Randomized Controlled Trial (RCT) design with four groups, consisting of usual care and three digital technology intervention groups. Outcomes were evaluated over 90 days using a comparative effectiveness study approach. **Sample**: The sample consisted of 182 patients with heart failure, of whom 151 participants (83%) completed the 90-day follow-up. The median age of respondents was 61 years, and 37.9% were female. **Intervention**: There were three digital health technology **interventions**: 1. Bodyport: a smart scale used to monitor fluid status and cardiovascular conditions. 2. Conversa: an automated conversational platform for patient education and self-management. 3. Noom: a smartphone application based on behaviour change coaching with support from coaches and peer groups. The control group received usual care.	The study results showed no significant changes in the Kansas City Cardiomyopathy Questionnaire (KCCQ) Overall Summary Score (OSS) across all intervention groups compared to usual care. However, the Noom group demonstrated significant improvements in: - Total Symptom Score (TSS): median increase of +4.2 compared to usual care (P=0.006) - Clinical Summary Score (CSS): median increase of +2.8 compared to usual care (P=0.002) The study concluded that digital health technologies, in general, did not demonstrate independent effects on overall quality of life. However, behaviour change-based applications such as Noom showed potential in improving symptoms and physical functioning among patients with heart failure. The study also emphasized the need for larger-scale studies to evaluate the effectiveness of digital technology

	Instruments: - Kansas City Cardiomyopathy Questionnaire (KCCQ) Overall Summary Score (OSS) as the primary outcome for quality of life - Total Symptom Score (TSS) - Clinical Summary Score (CSS) - Ninety-day follow-up data related to symptoms and physical functioning among patients with heart failure	implementation in heart failure management.

RESULTS AND DISCUSSION

Based on the literature review findings, all analyzed articles employed a Randomized Controlled Trial (RCT) design to evaluate the effectiveness of interventions based on digital health, telehealth, mobile health (mHealth), and self-care programs among patients with cardiovascular diseases. The main focus of the studies included patients with heart failure, post-myocardial infarction (MI) patients, post-coronary artery bypass graft (CABG) patients, and patients after percutaneous coronary intervention (PCI). Most studies were conducted in the context of developing self-management, improving self-care behaviour, cardiac rehabilitation, and technology-based health monitoring (Choi et al., 2023; Kitsiou et al., 2025; Wu et al., 2026; Yoon et al., 2024). In addition, several studies also evaluated the effectiveness of interventions for caregivers of patients with heart failure through a virtual health coaching approach (Riegel et al., 2024).

The sample characteristics demonstrated considerable variation in the number of respondents, ranging from 27 to 250 participants. Most respondents were adults and older adults diagnosed with chronic heart failure or coronary heart disease. The study by Kitsiou et al. involved 27 patients with heart failure classified as NYHA I–III, whereas the study by Wu et al. involved 62 post-PCI patients with coronary artery disease (Kitsiou et al., 2025; Wu et al., 2026). Other studies involved 68 male patients after myocardial infarction who were at risk of heart failure and 74 patients with heart failure recruited from two tertiary hospitals in Korea (Choi et al., 2023; Kim et al., 2026). Meanwhile, the study by Riegel et al. (2024) involved 250 informal caregivers of patients with chronic heart failure to evaluate the impact of interventions on self-care and caregiver stress.

The forms of intervention used in the studies were relatively diverse; however, all were oriented toward improving self-care and patient self-monitoring. mHealth-based interventions were implemented through smartphone applications connected to Bluetooth devices to monitor blood pressure, body weight, physical activity, heart failure symptoms, and automated feedback based on a clinical decision support system(Yoon et al., 2024). Another study used a self-monitoring mobile application with algorithm-based feedback to improve health behaviours among post-MI patients (Kim et al., 2026). In addition, telerehabilitation based on personalized exercise prescriptions was used to improve cardiorespiratory capacity and quality of life among patients after coronary artery disease(Wu et al., 2026). Other interventions included virtual health coaching, telehealth self-monitoring, and an Orem's theory-based individualized self-care program for post-CABG patients (Alkuwaisi et al., 2024; Riegel et al., 2024).

The research instruments used across the studies demonstrated similarities in measuring health behaviour outcomes, self-care, quality of life, and patients' clinical symptoms. Several studies used the Kansas City Cardiomyopathy Questionnaire (KCCQ) as a tool to assess quality of life among patients with heart failure (Victoria-Castro et al., 2024). In addition, the Self-Care of Heart Failure Index (SCHFI), Health Behavior Scale, Illness Perception Questionnaire, as well as stress and depression assessment instruments, were used to evaluate behavioural

changes and respondents' psychological conditions (Kim et al., 2026; Kitsiou et al., 2025). Objective measurements using digital devices, such as blood pressure monitoring, body weight assessment, wearable ECG devices, physical activity monitoring, and body water composition measurement, were also identified in several studies as part of the evaluation of digital health interventions (Wu et al., 2026; Yoon et al., 2024).

In general, the findings of this study indicate that digital technology-based interventions have a positive impact on improving self-care, adherence to health monitoring, health behaviors, and patients' quality of life. The study by Kitsiou et al. demonstrated improvements in self-care maintenance, symptom perception, and self-care management following the use of a patient-centered mHealth application. Similarly, the study conducted by Kim et al. reported significant improvements in health behaviors and illness perception among post-myocardial infarction patients who used a self-monitoring application for one year. In addition, Wu et al. found significant improvements in cardiorespiratory capacity, exercise duration, and quality-of-life domains among patients undergoing digital-based telerehabilitation compared with standard rehabilitation. Among caregivers of heart failure patients, virtual health coaching was proven effective in improving self-care and significantly reducing stress levels (Riegel et al., 2024).

Nevertheless, several studies have shown that digital interventions do not always produce significant effects on major clinical outcomes, such as hospitalization rates and overall quality of life. The study by Victoria-Castro et al. (2024) found that most digital health technologies had not demonstrated significant changes in the overall quality-of-life scores of heart failure patients, although behavior change-based applications such as Noom showed improvements in patients' symptoms and clinical functioning (Victoria-Castro et al., 2024). These findings suggest that the effectiveness of digital health interventions is more consistent in promoting health behavior changes and self-management than in improving long-term clinical outcomes.

Overall, the synthesis results indicate an increasing trend in the use of digital technology for cardiovascular disease management, particularly in the areas of self-care, cardiac rehabilitation, and independent health monitoring. Digital interventions tend to be effective in enhancing patient engagement, self-management adherence, and health behaviors. However, their effectiveness in improving major clinical outcomes remains inconsistent across studies. Therefore, further research with larger sample sizes, longer follow-up durations, and more standardized interventions is needed to strengthen the evidence regarding the effectiveness of digital technology in cardiovascular disease management.

DISCUSSION

The synthesis results from all reviewed articles indicate that the development of digital technology in healthcare services has brought significant changes to the management approach for cardiovascular diseases, particularly heart failure and coronary heart disease. Interventions based on digital health, telehealth, mobile health (mHealth), telerehabilitation, and application-based self-management generally demonstrate a tendency to improve self-care abilities, patient engagement, treatment adherence, quality of life, and patients' functional capacity (Choi et al., 2023; Kitsiou et al., 2025; Lee et al., 2026; Wu et al., 2026). This transformation reflects a paradigm shift in healthcare services from a hospital-centered approach to patient-centered and home-based care, which positions patients as the primary actors in managing their chronic diseases (Kerkar et al., 2025). The digitalization of healthcare services also enables real-time and continuous patient monitoring, allowing clinical interventions to be implemented more rapidly when changes in patients' health conditions occur (Choi et al., 2023; Victoria-Castro et al., 2024).

Most studies indicate that digital interventions have a positive influence on patients' health behaviors, particularly in the areas of self-care maintenance, symptom monitoring, medication adherence, physical activity, and decision-making related to disease symptoms. These findings suggest that digital technology can enhance patients' awareness of their health conditions through continuous monitoring processes and the provision of direct (Choi et al., 2023; Kim et al., 2026; Yoon et al., 2024). In patients with heart failure, the ability to recognize symptom changes at an early stage is an important factor in preventing acute decompensation and rehospitalization (Liori et al., 2026; Wleklik et al., 2025). Therefore, the use of mobile applications and wearable devices integrated with blood pressure, body weight, and physical activity monitoring has the potential to improve patients' abilities to independently perform symptom recognition and symptom response (Kitsiou et al., 2025). Furthermore, feedback systems based on clinical decision support systems enable patients to continuously receive education and reinforcement of health behaviors without having to rely solely on visits to healthcare facilities (Yoon et al., 2024).

The research findings also indicate that digital interventions not only affect physical aspects but also influence the psychological conditions of patients and caregivers. The study by Riegel et al. (2024) demonstrated that virtual health coaching was able to significantly reduce caregiver stress levels while simultaneously improving caregivers' self-care in caring for patients with heart failure. This condition indicates that the successful management of chronic diseases is influenced not only by the patient's condition but also by family support and caregivers as part of the care system. In addition, the study by Kim et al. (2026) found that a smartphone-based self-monitoring application could improve illness perception and enhance resilience among post-myocardial infarction patients. Changes in illness perception play an important role in shaping patients' motivation to maintain long-term health behaviors (Kim et al., 2026; Lang et al., 2025; Zhang et al., 2026). Thus, digital technology functions not only as a clinical monitoring tool but also as a medium for patients' psychosocial empowerment (Choi et al., 2023; Kim et al., 2026).

Although most studies demonstrated positive results, the effectiveness of digital interventions on major clinical outcomes remains inconsistent. The study by Victoria-Castro et al. (2024) showed that most digital technologies have not been able to improve overall quality of life despite improvements in certain symptom domains. These differences in findings indicate that improvements in self-care and health behaviors do not necessarily directly result in changes in clinical outcomes within a short period. Outcomes such as rehospitalization and mortality are influenced by many complex factors, including disease severity, comorbidities, long-term adherence, and access to healthcare services (Abubakar et al., 2025; Alexescu et al., 2026; Victoria-Castro et al., 2024).

Variations in the effectiveness of digital interventions are likely influenced by differences in characteristics, study designs, and the types of interventions used. Studies demonstrating better outcomes generally applied personalized intervention approaches with active feedback features, coaching, automated reminders, and real-time monitoring (Choi et al., 2023; Kim et al., 2026; Wu et al., 2026). In contrast, studies using digital technologies such as Bodyport (smart scale), Conversa (automated conversational platform), and Noom (smartphone application based on behavior change coaching) for home care management in patients with heart failure were not able to improve overall quality of life despite improvements in certain symptom domains (Victoria-Castro et al., 2024). This finding indicates that the success of digital health is determined not only by the presence of technology but also by the quality of interaction, continuity of communication, and the involvement of healthcare professionals in assisting patients (Hu et al., 2026; Victoria-Castro et al., 2024; Yuliastuti et al., 2026). In the context of nursing, the therapeutic relationship between nurses and patients remains a primary

component even when healthcare services are delivered digitally (Dijkman et al., 2026; Duffy et al., 2023; Tolosa-Merlos et al., 2023).

Differences in respondent characteristics may also be important factors influencing the effectiveness of digital interventions. Most studies involved adult and older adult patients with varying levels of education, health literacy, and technological proficiency. In older adult populations, limitations in the ability to use digital devices may become barriers to optimizing telehealth and mHealth interventions (Choi et al., 2023; Riegel et al., 2024; Victoria-Castro et al., 2024; Yoon et al., 2024). In addition, socioeconomic factors also affect access to smartphones, internet connectivity, and wearable devices. Studies conducted among underserved Black and Hispanic populations demonstrated that socioeconomic limitations may potentially influence the effectiveness of telemonitoring utilization (Choi et al., 2023; Lee et al., 2026; Victoria-Castro et al., 2024). Therefore, the implementation of digital health should consider aspects of equity and accessibility to ensure that healthcare technology does not widen disparities in healthcare services.

From the perspective of nursing theory, the findings of this study support Self-Care Deficit Nursing Theory proposed by Dorothea Orem, which emphasizes that individuals possess the capacity to perform self-care in order to maintain health and well-being (Alkuwaisi et al., 2024). Digital interventions in the analyzed studies functioned as supportive-educative systems that assisted patients in improving self-care abilities through education, monitoring, reinforcement, and strengthening health-related decision-making. Furthermore, the study findings are also consistent with Social Cognitive Theory proposed by Albert Bandura, which identifies self-efficacy as a major factor in health behavior change. The use of digital applications with positive feedback, health progress monitoring, and coaching has been shown to enhance patients' confidence in independently managing their illnesses (Bezerra Giordan et al., 2022; Kim et al., 2026; Rahmawati et al., 2022; Rampengan et al., 2025). This finding demonstrates that the integration of digital technology and behavioral science approaches may become an effective strategy in chronic disease management.

The implications of these findings for nursing practice are highly important within the context of modern healthcare transformation. Nurses play a central role in the implementation of digital health, whether as educators, care coordinators, health coaches, or case managers (Lapão, 2020). Nurses are not only responsible for providing health education but also for ensuring that patients are able to use digital technology effectively and consistently (Riegel et al., 2024). The use of telemonitoring enables nurses to continuously monitor patients' conditions so that changes in clinical status can be identified earlier (Yoon et al., 2024). In addition, digital-based telerehabilitation can expand access to cardiac rehabilitation for patients with geographical or mobility limitations (Wu et al., 2026). In community nursing practice, digital technology also has the potential to improve continuity of care and reduce the burden on hospital services (Markovich et al., 2026; Nugraha et al., 2025).

Nevertheless, the synthesis findings indicate that several research gaps still need to be further explored. Most studies involved small sample sizes and relatively short follow-up durations, thereby limiting the evaluation of long-term impacts on mortality, rehospitalization, and the sustainability of patients' behavioral changes (Kitsiou et al., 2025; Yoon et al., 2024). In addition, there is still no standardization regarding the types of digital platforms, monitoring frequency, outcome indicators, or methods for evaluating intervention effectiveness, resulting in heterogeneous study findings (Victoria-Castro et al., 2024). Research related to cost-effectiveness, patient data security, ethical issues in the use of digital technology, and healthcare professionals' readiness for implementing digital health also remains very limited. Furthermore, most studies were conducted in developed countries with well-established

technological infrastructures, so the generalizability of the findings to developing countries still requires further investigation.

Other limitations identified in the analyzed studies include the use of self-report questionnaires that may introduce response bias, limitations in blinding within digital intervention designs, and low long-term adherence to application use (Kim et al., 2026; Kitsiou et al., 2025). Several studies also did not consider the influence of culture, family support, and digital literacy on intervention success. In addition, the heterogeneity of technological platforms and variations in outcomes made direct comparisons between studies difficult. These conditions indicate that the evidence regarding the effectiveness of digital health still requires further strengthening through studies with more robust methodologies.

Based on the findings of this synthesis, future studies are recommended to apply multicenter designs with larger sample sizes and long-term follow-up periods to more comprehensively evaluate the effectiveness of digital health interventions on major clinical outcomes. Intervention development should also become more personalized and adaptive to patient characteristics, including age, culture, health literacy, and patients' digital capabilities. In addition, research regarding the integration of digital health into community nursing practice, primary care, and home care services should be expanded to support sustainable and evidence-based healthcare technology implementation. Evaluations of cost-effectiveness, data security, and healthcare system readiness in supporting digital transformation are also important research areas that need to be further developed in the future.

LIMITATION OF THE STUDY

There are several limitations in this systematic literature review that should be considered when interpreting the findings. The literature search was limited to articles published in English and Indonesian, which may have resulted in relevant studies published in other languages not being identified. In addition, restrictions related to publication year, study design, and full-text availability may have led to the exclusion of several relevant studies from the analysis.

The possibility of publication bias also could not be entirely avoided, as studies with non-significant results tend to be published less frequently. Most of the analyzed studies were conducted in developed countries with well-established digital infrastructures; therefore, the generalizability of the findings to developing countries, including Indonesia, should be interpreted with caution. The heterogeneity of digital intervention types, measurement instruments, and follow-up durations across studies also represents a limitation in drawing fully consistent conclusions regarding the effectiveness of digital health engagement on self-care behavior among patients with heart failure.

CONCLUSIONS AND SUGGESTIONS

The synthesis results from eight articles indicate that digital health-based interventions, including mHealth, telehealth, telerehabilitation, and technology-based self-care programs, are effective in improving self-care behaviors, self-efficacy, adherence to health monitoring, and quality of life among patients with cardiovascular diseases, particularly heart failure and coronary heart disease. These findings suggest that digital interventions are more consistently associated with improvements in health behavior changes than with long-term clinical outcomes such as rehospitalization and mortality, which remain variable across studies.

These findings highlight the need for further research using multicenter designs, larger sample sizes, and longer follow-up periods to evaluate clinical impacts more comprehensively. The development of digital interventions should also emphasize more personalized and adaptive approaches by considering patients' digital literacy, socioeconomic conditions, and family support. In addition, evaluations of cost-effectiveness, data security, and feasibility of implementation in primary healthcare services are important aspects that need to be addressed.

In the context of nursing practice, strengthening the role of nurses as educators, care coordinators, and health coaches is essential for optimizing the implementation of digital health. Furthermore, the standardization of interventions and research instruments is necessary to improve the consistency of findings and strengthen the generalizability of results across various healthcare settings.

ETHICAL CONSIDERATIONS

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Conflict of Interest Statement

The authors declare no conflict of interest related to this study.

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