

Review Article

Effect of clinical telemonitoring on treatment adherence in patients with heart failure: protocol for a systematic review of clinical trials

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Abstract: Objectives: To evaluate the effectiveness of telemonitoring on clinical outcomes in adult patients with heart failure, with an emphasis on treatment adherence, mortality, and hospital readmission, through a systematic review and meta-analysis of randomized clinical trials. Methods: This is a systematic review protocol developed in accordance with the recommendations of the Cochrane Handbook for Systematic Reviews of Interventions and reported following the PRISMA-P guidelines. The protocol was registered on the PROSPERO platform (CRD420251181047). Randomized clinical trials evaluating telemonitoring interventions in adults with heart failure and reduced (HFrEF) or preserved (HFpEF) left ventricular ejection fraction will be included. Searches will be conducted in the MEDLINE (PubMed), Cochrane CENTRAL, Embase, Scopus, Web of Science, LILACS, CINAHL, and PsycINFO databases, without language or publication date restrictions. Two independent reviewers will perform study selection, data extraction, and risk of bias assessment using the RoB 2.0 tool. The certainty of evidence will be assessed using the GRADE approach. When appropriate, data will be synthesized through meta-analysis using a random-effects model. Results: This systematic review is expected to compile and synthesize the best available evidence regarding the effectiveness of telemonitoring in patients with heart failure, identifying its impact on treatment adherence, mortality, and hospital readmission. It is also expected to identify which telemonitoring modalities and intervention components are associated with better clinical outcomes, as well as to highlight existing gaps in the scientific literature. Conclusions: The findings of this review may provide robust evidence to support evidence-based clinical practice, inform decision-making in digital health, and guide the development and implementation of technologies aimed at cardiovascular care. Furthermore, this study is expected to contribute to the optimization of heart failure management and to the strengthening of more efficient and patient-centered models of care.

Keywords: Heart failure, remote patient monitoring, treatment adherence, mortality, patient readmission

Introduction

Heart failure (HF) is one of the leading causes of morbidity and mortality worldwide. HF affects more than 64 million people globally, highlighting its growing epidemiological relevance [1]. In Brazil, prevalence remains around 2% of the adult population, with an estimated 240,000 new cases annually, an increase driven by population aging [2]. The disease negatively impacts important clinical outcomes, such as self-care, quality of life, mortality, and rehospitalizations, mainly due to low treatment adherence, which involves complex therapeutic

regimens and continuous health self-management [3, 4].

Despite therapeutic advances, the management of these patients still presents challenges related to pharmacological treatment, adherence to self-care measures, and continuous follow-up.

The main challenges in the treatment of heart failure (HF) include the high frequency of clinical decompensation and hospital readmissions, particularly among patients with multiple comorbidities and clinical frailty. Furthermore,

the prescription of complex therapeutic regimens, often involving multiple medications, hinders treatment adherence. Another relevant issue is the difficulty in the early identification of signs of clinical deterioration. In addition, limited access to continuous specialized follow-up and frequent monitoring of symptoms, body weight, blood pressure, and medication adherence remains a significant barrier. Studies have shown that maintaining optimized therapy and adequate self-care continues to be one of the major challenges in contemporary clinical practice [5].

Poor treatment adherence is multifactorial and associated with clinical, social, economic, and behavioral factors. Among the main contributing factors, it is important to highlight the complexity of therapeutic regimens, polypharmacy, adverse drug effects, cognitive impairment, and limited understanding of medical recommendations. Other psychosocial factors, such as depression, social isolation, low income, and insufficient family support, also negatively influence adherence. Evidence further indicates that many patients have limited knowledge about their condition and difficulty recognizing early signs of clinical decompensation, thereby reducing the effectiveness of self-care [6, 7, 30].

HF decompensation is frequently associated with inadequate adherence to both pharmacological and non-pharmacological treatment. In this context, telemonitoring emerges as a healthcare intervention with an educational component, enabling remote interventions through phone calls, text messages, automated devices, or video monitoring, without requiring in-person visits. This approach allows continuous follow-up, early detection of signs of decompensation, and timely interventions, contributing to reduced hospitalizations and improved quality of life [8, 9, 12].

Despite its potential benefits, previous systematic reviews present methodological limitations, such as restricted database searches, biases in risk of bias assessment, and inconsistencies in the presentation of results, in addition to inconclusive evidence regarding the effectiveness of telemonitoring, particularly in relation to treatment adherence [10, 11, 13]. These gaps highlight the need for more rigorous systematic reviews to comprehensively evaluate the impact of telemonitoring in patients with HF.

In light of these gaps, the main objective of this review is to systematically synthesize the available evidence in the literature regarding the effects of telemonitoring on clinical outcomes, treatment adherence, readmission, and mortality in patients with HF.

Method

Study design and research question

This is a protocol for a systematic review with meta-analysis, developed in accordance with the guidelines of the *Cochrane Handbook for Systematic Reviews of Interventions* (Cochrane) [14]. The report was structured following the *Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols* (PRISMA-P) guidelines [29]. The protocol was prospectively registered in the *International Prospective Register of Systematic Reviews* (PROSPERO) under the number (CRD420251181047).

Eligibility criteria

Eligibility criteria were defined according to the PICOT strategy (**Table 1**): Population (P): adults (≥ 18 years) diagnosed with heart failure, with reduced (HFrEF) or preserved (HFpEF) left ventricular ejection fraction, undergoing telemonitoring; Intervention (I): telemonitoring conducted via voice, messages, automated devices, and/or video; Comparator (C): usual care/no telemonitoring; Outcomes (O): treatment adherence, mortality, and readmission; Type of study (T): randomized clinical trials (RCTs) that evaluated the use of telemonitoring (via voice, messages, automated devices, or video) focusing on the outcomes of treatment adherence, mortality, or rehospitalization.

Based on this strategy, the review addresses the following research question: What is the effect of telemonitoring on the clinical outcomes of treatment adherence, readmission, and mortality in patients with HF?

Exclusion criteria

Studies will be excluded if they: (1) are not randomized clinical trials, including observational studies, case reports, narrative or systematic reviews, editorials, and quasi-experimental studies without randomization; (2) use telemonitoring exclusively for diagnostic purposes, cardiac rehabilitation, or health education,

Table 1. Description of the PICOT strategy

Element (PICOT)	Description
Population	Adults (≥ 18 years) diagnosed with heart failure, with reduced (HFrEF) or preserved (HFpEF) left ventricular ejection fraction, undergoing telemonitoring.
Intervention	Telemonitoring delivered via voice calls, text messages, automated devices, and/or video.
Comparator	Usual care.
Outcomes	Treatment adherence, mortality, and readmission.
Study design	Randomized controlled trials.

Note: PICOT: Population, Intervention, Comparator, Outcomes, Study design.

without structured clinical follow-up by a healthcare professional; (3) employ invasive or implantable cardiac monitoring devices as the main intervention; (4) do not include a control group for comparison; (5) do not report at least one of the outcomes of interest (treatment adherence, mortality, or hospital readmission).

When multiple publications refer to the same trial or dataset, the publication with the largest sample size or the longest follow-up period will be included, and the others will be recorded as linked references. Authors of studies with insufficient data for meta-analysis will be contacted by email. In the absence of a response within four weeks, such studies will be retained in the qualitative synthesis and excluded from the meta-analysis.

Information sources and search strategy

The search will be conducted in the following databases: MEDLINE (PubMed), Cochrane Central Register of Controlled Trials, Embase, Scopus, Web of Science, LILACS (BVS), Psychological Information Database (PsycINFO), and CINAHL. Controlled descriptors (MeSH and DeCS) and free-text terms related to heart failure, telemonitoring, treatment adherence, mortality, and hospital readmission will be used, combined with Boolean operators (AND/OR). The reference lists of included studies will also be manually screened to identify additional studies. No restrictions will be applied regarding language or publication period. The complete search strategies for each database will be provided in tabular form (**Table 2**).

Study selection

The retrieved records will be exported to EndNote software for duplicate removal and subsequently imported into the Rayyan plat-

form for screening [15, 28]. Two independent reviewers will assess titles and abstracts according to the eligibility criteria. Potentially relevant studies will undergo full-text review. Discrepancies will be resolved by consensus or by consultation with a third reviewer. The selection process will be presented using a flow diagram in accordance with the PRISMA 2020 guidelines [29].

Data extraction

Data extraction will be performed independently by two reviewers using a standardized instrument based on the recommendations of the Cochrane Handbook [11].

The following information will be collected: publication data (authors, year, country, journal); methodological characteristics (sample size, randomization method, allocation concealment, blinding, duration of follow-up, losses); participant characteristics (age, sex, clinical condition, comorbidities, ejection fraction); intervention characteristics (type of telemonitoring, frequency of follow-up, professional involved); and outcomes (instrument used to measure adherence, mortality rates, and readmission rates). When necessary, study authors will be contacted to obtain additional data.

To characterize the interventions in greater detail, information regarding the telemonitoring modalities employed in the included studies will be extracted and classified into four categories: (1) active or passive voice calls, (2) automated or interactive text messaging, (3) automated data collection devices, such as connected weighing scales, pulse oximeters, and digital sphygmomanometers, and (4) video monitoring or teleconsultations. Data regarding the indicators monitored by the interventions will also be collected, including daily body

Table 2. Description of the search strategies

Database	Search strategy
Pubmed	"Heart Failure" [Mesh] OR (Cardiac Failure) OR (Heart Decompensation) OR (Decompensation, Heart) OR (Congestive Heart Failure) OR (Heart Failure, Congestive) OR (Heart Failure, Right-Sided) OR (Heart Failure, Right Sided) or (Right-Sided Heart Failure) OR (Right Sided Heart Failure) OR (Heart Failure, Left-Sided) OR (Heart Failure, Left Sided) OR (Left-Sided Heart Failure) OR (Left Sided Heart Failure) OR (Myocardial Failure) OR "Heart Failure, Systolic" [Mesh] OR (Heart Failures, Systolic) OR (Systolic Heart Failures) OR (Heart Failure, Reduced Ejection Fraction) OR (Systolic Heart Failure) AND "Remote Patient Monitoring" [Mesh] OR (Monitoring, Remote Patient) OR (Patient Monitoring, Remote) OR "Telemedicine" [Mesh] OR (Virtual Medicine) OR (Medicine, Virtual) OR (Tele-Referral) OR (Tele Referral) OR (Tele-Referrals) OR (Mobile Health) OR (Health, Mobile) OR (mHealth) OR (Telehealth) OR (eHealth) OR (Telecare) OR (Tele-Care) OR (Tele Care) OR "Telenursing" [Mesh] AND "Treatment Adherence and Compliance" [Mesh] OR (Therapeutic Adherence and Compliance) OR (Treatment Adherence) OR (Adherence, Treatment) OR (Therapeutic Adherence) OR (Adherence, Therapeutic) OR "Patient Readmission" [Mesh] OR (Readmission, Patient) OR (Unplanned Readmission) OR (Readmission, Unplanned) OR (Unplanned Readmissions) OR (Rehospitalization) OR (Rehospitalizations) OR (Hospital Readmissions) OR (Readmission, Hospital) OR (Readmissions, Hospital) OR (Hospital Readmission) OR (Unplanned Hospital Readmissions) OR (Hospital Readmissions, Unplanned) OR (Hospital Readmission, Unplanned) OR (Unplanned Hospital Readmission) OR (Thirty Day Readmission) OR (Readmission, Thirty Day) OR (Thirty Day Readmissions) OR (30 Day Readmission) OR (30 Day Readmissions) OR "Hospitalization" [Mesh] OR (Hospitalizations) OR "Mortality" [Mesh] OR (Mortalities) OR (Mortality Rate) OR (Mortality Rates) OR (Rate, Mortality) OR (Death Rate) OR (Death Rates) OR (Rate, Death) AND randomized controlled trial[Publication Type] OR (randomized[Title/Abstract] AND controlled[Title/Abstract] AND trial[Title/Abstract])
Web of Science	TS = ("Heart Failure" OR "Cardiac Failure" OR "Heart Decompensation" OR "Congestive Heart Failure" OR "Right Sided Heart Failure" OR "Left Sided Heart Failure" OR "Myocardial Failure" OR "Heart Failure, Systolic" OR "Systolic Heart Failure") AND TS = ("Remote Patient Monitoring" OR "Telemedicine" OR "Virtual Medicine" OR "Tele Referral" OR "Mobile Health" OR mHealth OR Telehealth OR eHealth OR Telecare OR "Tele Care" OR "Telenursing") AND TS = ("Treatment Adherence and Compliance" OR "Therapeutic Adherence and Compliance" OR "Treatment Adherence" OR "Therapeutic Adherence" OR "Mortality" OR "Mortalit*" OR "Mortality Rate" OR "Death Rate" OR "Patient Readmission" OR "Readmission, Patient" OR "Unplanned Readmission" OR "Rehospitalization" OR "Rehospitalizations" OR "Hospital Readmissions" OR "Hospital Readmission" OR "Unplanned Hospital Readmissions" OR "Thirty Day Readmission" OR "30 Day Readmission" OR "30 Day Readmissions" OR "Hospitalization" OR "Hospitalizations") AND TS = ("randomized controlled trial" OR "randomised controlled trial" OR "randomized clinical trial" OR "randomised clinical trial" OR "randomized trial" OR "randomised trial" OR RCT)
COCHRANE	(Heart Failure) OR (Heart Failure, Congestive) OR (Congestive Heart Failure) OR (Cardiac Failure) OR (Right-Sided Heart Failure) OR (Heart Failure, Right Sided) OR (Right Sided Heart Failure) OR (Heart Failure, Left Sided) OR (Heart Failure, Left-Sided) OR (Left-Sided Heart Failure) OR (Left Sided Heart Failure) OR (Myocardial Failure) OR (Heart Decompensation) OR (Decompensation, Heart) AND (Remote Patient Monitoring) OR (Monitoring, Remote Patient) OR (Patient Monitoring, Remote) OR (Telemedicine) OR (Telecare) OR (Tele Care) OR (Tele-Care) OR (Virtual Medicine) OR (Medicine, Virtual) OR (Tele-Referrals) OR (Tele Referral) OR (mHealth) OR (Health, Mobile) OR (Mobile Health) OR (eHealth) OR (Telehealth) OR (Telenursing) AND (Treatment Adherence and Compliance) OR (Therapeutic Adherence and Compliance) OR (Adherence, Therapeutic) OR (Therapeutic Adherence) OR (Adherence, Treatment) OR (Treatment Adherence) OR (Mortality) OR (Death Rate) OR (Mortality Rate) OR (Rate, Mortality) OR (Death Rates) OR (Mortality Rates) OR (Rate, Death) OR (Mortalities) OR (Patient Readmission) OR (Thirty Day Readmission) OR (30 Day Readmission) OR (30 Day Readmissions) OR (Thirty Day Readmissions) OR (Hospital Readmission, Unplanned) OR (Hospital Readmissions, Unplanned) OR (Hospital Readmissions) OR (Unplanned Hospital Readmissions) OR (Readmissions, Hospital) OR (Hospital Readmission) OR (Readmission, Hospital) OR (Unplanned Readmission) OR (Rehospitalization) OR (Rehospitalizations) OR (Unplanned Readmissions) OR (Readmission, Patient) OR (Readmission, Unplanned)

Effect of clinical telemonitoring on treatment adherence in patients with heart failure

EMBASE	'heart failure'/exp OR 'heart failure' OR 'cardiac failure'/exp OR 'cardiac failure' OR 'heart decompensation'/exp OR 'heart decompensation' OR 'congestive heart failure'/exp OR 'congestive heart failure' OR 'right-sided heart failure' OR 'right sided heart failure'/exp OR 'left-sided heart failure' OR 'left sided heart failure' OR 'myocardial failure'/exp OR 'myocardial failure' OR 'systolic heart failure'/exp OR 'systolic heart failure' AND 'telemonitoring'/exp OR 'telemonitoring' OR 'remote patient monitoring'/exp OR 'remote patient monitoring' OR 'telemedicine'/exp OR 'telemedicine' OR 'virtual medicine'/exp OR 'virtual medicine' OR 'tele referral' OR 'mobile health'/exp OR 'mobile health' OR 'mhealth'/exp OR 'mhealth' OR 'telehealth'/exp OR 'telehealth' OR 'ehealth'/exp OR 'ehealth' OR 'telecare'/exp OR 'telecare' OR 'telenursing'/exp OR 'e-nursing' OR 'electronic nursing' OR 'eNursing' OR 'tele-nursing' OR 'virtual nursing' OR 'telenursing' AND 'patient compliance'/exp OR 'patient compliance' OR 'treatment adherence and compliance'/exp OR 'treatment adherence and compliance' OR 'therapeutic adherence and compliance' OR 'treatment adherence'/exp OR 'treatment adherence' OR 'therapeutic adherence' OR 'mortality'/exp OR 'mortality' OR 'mortality rate'/exp OR 'mortality rate' OR 'death rate'/exp OR 'death rate' OR 'hospital readmission'/exp OR 'patient readmission' OR 'readmission' OR 'readmission rate' OR 'readmissions' OR 'rehospitalization' OR 'hospital readmission' AND 'randomized controlled trial'/de
CINAHL	(MH "Heart Failure") OR (Chronic Heart Failure) OR (Congestive Heart Failure) OR (Heart Failure, Chronic) OR (Heart Failure, Congestive) AND (MH "Remote Patient Monitoring") OR (MH "Telemedicine") OR (MH "Telenursing") OR (Telenursing Care) AND (MH "Patient Compliance") OR (Compliance, Patient) OR (Patient Cooperation) OR (Patient Non-Compliance) OR (Patients: Compliance) OR (Regimen Adherence) OR (MH "Mortality") OR (Death Rate) OR (Death Rates) OR (Mortalities) OR (MH "Readmission") OR (Patient Readmission) OR (Patient Readmissions) OR (Readmissions) OR (Rehospitalization) OR (Rehospitalizations) AND (MH "Randomized Controlled Trials") OR (Clinical Trial, Randomized) OR (Clinical Trials, Controlled, Randomized) OR (Clinical Trials, Randomized) OR (Controlled Clinical Trials, Randomized) OR (Controlled Trials, Randomized) OR (Randomised Controlled Trial) OR (Randomised Controlled Trials) OR (Randomized Clinical Trial) OR (Randomized Clinical Trials) OR (Randomized Controlled Clinical Trials) OR (Randomized Controlled Trial)
SCOPUS	TITLE-ABS-KEY ("heart failure" OR "Heart Failure, Congestive" OR "Congestive Heart Failure" OR "Cardiac Failure" OR "Right-Sided Heart Failure" OR "Heart Failure, Right Sided" OR "Heart Failure, Right-Sided" OR "Right Sided Heart Failure" OR "Heart Failure, Left Sided" OR "Heart Failure, Left-Sided" OR "Left-Sided Heart Failure" OR "Left Sided Heart Failure" OR "Myocardial Failure" OR "Heart Decompensation" OR "Decompensation, Heart") AND TITLE-ABS-KEY ("Remote Patient Monitoring" OR "Monitoring, Remote Patient" OR "Patient Monitoring, Remote" OR "Telemedicine" OR "Telecare" OR "Tele Care" OR "Tele-Care" OR "Virtual Medicine" OR "Medicine, Virtual" OR "Tele-Referrals" OR "Tele Referral" OR "Tele-Referral" OR "mHealth" OR "Mobile Health" OR "eHealth" OR "Telehealth" OR "Telenursing") AND TITLE-ABS-KEY ("Treatment Adherence and Compliance" OR "Therapeutic Adherence and Compliance" OR "Adherence, Therapeutic" OR "Therapeutic Adherence" OR "Adherence, Treatment" OR "Treatment Adherence" OR "Death Rate" OR Mortality OR "Mortality Rate" OR "Rate, Mortality" OR "Death Rates" OR "Mortality Rates" OR "Rate, Death" OR "Mortalities" OR "Patient Readmission" OR "Thirty Day Readmission" OR "30 Day Readmission" OR "30 Day Readmissions" OR "Thirty Day Readmissions" OR "Readmission, Thirty Day" OR "Hospital Readmission, Unplanned" OR "Hospital Readmissions, Unplanned" OR "Hospital Readmissions" OR "Unplanned Hospital Readmissions" OR "Unplanned Hospital Readmission" OR "Readmissions, Hospital" OR "Hospital Readmission" OR "Readmission, Hospital" OR "Unplanned Readmission" OR "Rehospitalization" OR "Rehospitalizations" OR "Unplanned Readmissions" OR "Readmission, Patient" OR "Readmission, Unplanned") AND TITLE-ABS-KEY ("Randomized Controlled Trials" OR "Clinical Trial, Randomized" OR "Clinical Trials, Controlled, Randomized" OR "Clinical Trials, Randomized" OR "Controlled Clinical Trials, Randomized" OR "Controlled Trials, Randomized" OR "Randomised Controlled Trial" OR "Randomised Controlled Trials" OR "Randomized Clinical Trial" OR "Randomized Clinical Trials" OR "Randomized Controlled Clinical Trials" OR "Randomized Controlled Trial")

LILACS	mh:"Heart Failure" OR mh:c14.280.434* OR (heart failure) OR (cardiac failure) OR (congestive heart failure) OR (decompensation, heart) OR (heart decompensation) OR (heart failure, congestive) OR (heart failure, left sided) OR (heart failure, left-sided) OR (heart failure, right sided) OR (heart failure, right-sided) OR (left sided heart failure) OR (left-sided heart failure) OR (myocardial failure) OR (right sided heart failure) OR (right-sided heart failure) OR (insuficiência cardíaca) OR (descompensação cardíaca) OR (falência cardíaca) OR (falência cardíaca congestiva) OR (insuficiência cardíaca congestiva) OR (fallo cardíaco congestivo) OR mh:"Heart Failure, Systolic" OR mh:c14.280.434.676* OR (heart failure, systolic) OR (heart failure, reduced ejection fraction) OR (systolic heart failure) AND mh:"Remote Patient Monitoring" OR (remote patient monitoring) OR (telemonitoring) OR (telemonitoramento) OR (telemonitorização) OR (telessaúde) OR mh:"Telemedicine" OR (telemedicine) OR (mobile health) OR (mhealth) OR (telehealth) OR (ehealth) OR (telecare) AND mh:"Treatment Adherence and Compliance" OR (treatment adherence) OR (therapeutic adherence) OR (adesão ao tratamento) OR (aderência terapêutica) OR (adherencia al tratamiento) OR mh:"Patient Readmission" OR (Patient Readmission) OR (Hospital Readmission) OR (30-Day Readmission) OR (Rehospitalization) OR mh:"Mortality" OR mortality OR (taxa de mortalidade) OR (mortalidade) AND (mh:("Randomized Controlled Trials as Topic" OR "Controlled Clinical Trials as Topic" OR "Random Allocation" OR "Double-Blind Method" OR "Single-Blind Method") OR pt:("Randomized Controlled Trial" OR "Controlled Clinical Trial") OR ti:(random* OR aleatori* OR placebo*) OR ab:(randomi* OR aleatori* OR placebo*)) AND NOT ((mh:"animals" AND NOT mh:"humans") OR mh:"Retrospective Studies")
PsycINFO	(DE "Heart Failure") OR TI(heart failure OR cardiac failure OR heart decompensation OR congestive heart failure OR right-sided heart failure OR left-sided heart failure OR myocardial failure) OR AB(heart failure OR cardiac failure OR heart decompensation OR congestive heart failure OR right-sided heart failure OR left-sided heart failure OR myocardial failure) AND (DE "Telemedicine" OR DE "Electronic Communication" OR DE "Mobile Devices" OR DE "Home Nursing" OR DE "Remote Monitoring") OR TI(telehealth OR telemedicine OR telecare OR telenursing OR mobile health OR mhealth OR ehealth OR remote patient monitoring) OR AB(telehealth OR telemedicine OR telecare OR telenursing OR mobile health OR mhealth OR ehealth OR remote patient monitoring) AND (DE "Patient Compliance" OR DE "Treatment Adherence" OR DE "Hospitalization" OR DE "Mortality" OR DE "Readmission") OR TI(adherence OR nonadherence OR treatment adherence OR readmission OR rehospitalization OR hospitalization OR mortality OR death rate) OR AB(adherence OR nonadherence OR treatment adherence OR readmission OR rehospitalization OR hospitalization OR mortality OR death rate)

Note: mHealth: Mobile Health; eHealth: Electronic Health; RCT: Randomized Controlled Trial; MH: Medical Heading; DE: Descriptor; TS: Topic Search; TITLE-ABS-KEY: Title, Abstract and Keywords.

weight, blood pressure, heart rate, clinical symptoms related to heart failure (dyspnea, edema, and fatigue), medication adherence, and quality of life. These data will enable a more comprehensive characterization of the evaluated interventions and are consistent with the eligibility criteria established in the PICOT framework (**Table 1**).

Risk of bias assessment

The risk of bias will be assessed independently by two reviewers using the Cochrane Risk of Bias 2.0 (RoB 2.0) tool. Any disagreements will be resolved by consensus.

Data synthesis and analysis

A meta-analysis will be conducted when at least three clinically homogeneous studies are

available, defined as those with comparable populations, interventions, and outcomes. A random-effects model will be applied due to the expected variability among telemonitoring interventions. Analyses will be performed using R version 4.5.2 (R Core Team, 2025).

For dichotomous outcomes (mortality and readmission), effect estimates will be expressed as Risk Ratios (RR) with 95% confidence intervals. For continuous outcomes (treatment adherence), Mean Difference (MD) will be used when studies employ the same measurement scale, or Standardized Mean Difference (SMD) when different instruments are used.

Statistical heterogeneity will be assessed using the chi-square test ($P < 0.10$) and the I^2 statistic, interpreted alongside confidence intervals, in accordance with the Cochrane Handbook. I^2

values between 50% and 75% will be considered indicative of substantial heterogeneity, and values above 75% as considerable heterogeneity [11].

Pre-specified subgroup analyses will be conducted to explore potential sources of heterogeneity, where sufficient data are available, according to: (1) type of intervention (telephone/voice, text messaging, automated devices, or videomonitoring); and (2) duration of follow-up (< 6 months vs. $\geq$ 6 months).

Certainty of evidence assessment

The certainty of evidence will be evaluated using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) system [16].

Results

This systematic review is expected to rigorously and comprehensively synthesize the best available evidence regarding the effectiveness of telemonitoring on treatment adherence among patients with heart failure. As a result, it will be possible to identify which telemonitoring modalities are most effective, which intervention components contribute to better outcomes, and which gaps still persist in the literature. The findings may support evidence-based clinical decision-making, guide the development of public policies in digital health, and inform future research and interventions aimed at improving self-care and quality of life in this patient population.

Discussion

Heart failure (HF) represents one of the greatest challenges in contemporary public health, characterized by a high burden of morbidity and mortality, elevated hospitalization rates, and significant socioeconomic impact on health-care systems worldwide [6, 17]. It is associated with frequent readmissions and progressive deterioration in quality of life, particularly among aging populations [14].

In this context, treatment adherence emerges as a critical factor in the clinical course of the disease. Poor adherence to therapeutic regimens (including both appropriate medication use and non-pharmacological measures such

as fluid control, sodium restriction, weight monitoring, and physical activity) is one of the main determinants of clinical decompensation, preventable hospitalizations, and increased mortality [7, 17]. It is estimated that non-adherence rates among patients with HF range from 40% to 60%, depending on the assessment method and the therapeutic component evaluated [7, 18].

Adherence in HF is a multifactorial phenomenon influenced by patient-related, disease-related, and healthcare system factors, including educational level, social support, complexity of the therapeutic regimen, and access to healthcare services [17, 19, 30]. Evidence suggests that interventions aimed at strengthening self-care and promoting active patient engagement can significantly improve clinical outcomes, reducing hospitalizations and enhancing symptom control [6, 17].

Corroborating this evidence, studies show that patients undergoing telemonitoring demonstrate better adherence to essential behaviors, such as correct use of prescribed medications ($P = 0.014$), daily weight monitoring ($P = 0.001$), and attendance at scheduled appointments ($P = 0.008$), indicating a direct positive effect of this strategy on self-care in HF [20]. Systematic reviews further report significant improvements in disease-related knowledge ($P < 0.00001$; $I^2 = 0\%$) and quality of life ($P = 0.03$; $I^2 = 20\%$) following telemonitoring interventions, particularly in medium-term follow-up periods [21].

Therefore, the development and implementation of innovative strategies that promote sustained patient engagement in self-care are essential, with telemonitoring emerging as a promising approach in this context.

Telemonitoring has gained prominence as a relevant alternative to enhance clinical follow-up, enable early detection of decompensation signs, and promote self-management. Evidence from previous systematic reviews and meta-analyses suggests favorable, albeit inconsistent, results. One systematic review including 21 studies (3,082 patients) identified a significant reduction in mortality with home telemonitoring compared to usual care (RR = 0.64; 95% CI: 0.48-0.85), along with additional ben-

efits in hospitalization rates and quality of life [6].

Additionally, a meta-analysis including 37 randomized clinical trials (13,366 participants) demonstrated that eHealth-based interventions significantly reduced HF-related hospital admissions (OR: 0.73; 95% CI: 0.62-0.86; $P = 0.0002$), although no significant effect was observed on all-cause mortality (OR: 0.93; 95% CI: 0.85-1.03; $P = 0.16$) or cardiovascular mortality (OR: 0.85; 95% CI: 0.71-1.01; $P = 0.07$) [22]. These findings suggest that the modality and structure of the intervention are critical determinants of the observed outcomes.

Within the scope of randomized clinical trials, the potential of telemonitoring has also been highlighted. One RCT conducted within a multidisciplinary telemedicine program for HF patients demonstrated a 65% reduction in the risk of the primary composite outcome in favor of the intervention (RR 0.35; 95% CI: 0.20-0.59; $P < 0.001$), along with reductions in HF-related readmissions (RR 0.39; $P = 0.007$), cardiovascular readmissions (RR 0.43; $P = 0.008$), and direct hospital costs [23].

In another study involving 151 patients hospitalized for HF and enrolled in a nurse-coordinated telephone-based program, a longer time to first readmission was observed (HR = 0.67; 95% CI: 0.47-0.96; $P = 0.029$), along with reductions in the number of hospitalizations and healthcare costs during the first six months [24]. However, these benefits were not sustained after twelve months of follow-up, suggesting that short-term interventions may underestimate the long-term benefits of telemonitoring.

Another meta-analysis including 29 randomized clinical trials (13,837 patients) demonstrated that telecardiology interventions are associated with a statistically significant reduction in rehospitalization rates compared to usual care (RR: 0.94; 95% CI: 0.90-0.98; $P = 0.004$), indicating that remote monitoring combined with continuous clinical support contributes to early detection of decompensation and optimization of treatment [25].

Supporting these findings, a randomized clinical trial conducted in Brazil showed that a structured telemedicine intervention signifi-

cantly reduced HF-related rehospitalization rates over a 180-day follow-up. Patients in the intervention group had a readmission rate of 26%, compared to 46% in the control group, corresponding to a 44% relative risk reduction (RR = 0.56; 95% CI: 0.34-0.91; $P < 0.01$) [26]. These results reinforce the role of remote monitoring associated with continuous clinical support in the early identification of decompensation signs and timely therapeutic interventions.

Regarding mortality, a significant reduction was observed in the composite outcome of all-cause mortality and rehospitalization. Patients in the telemedicine group showed a lower incidence of this outcome compared to the control group (30% vs. 47%), corresponding to a 37% relative risk reduction (RR = 0.63; 95% CI: 0.40-0.99; $P = 0.04$) [27].

Complementarily, evidence from meta-analysis indicates that telecardiology reduces the risk of all-cause mortality (RR: 0.90; 95% CI: 0.83-0.99; $P = 0.02$) [26]. This effect may be related to closer follow-up, improved treatment adherence, earlier therapeutic adjustments, and enhanced health education enabled by remote monitoring technologies.

Taken together, these findings support the hypothesis that telemonitoring not only improves intermediate outcomes but also directly impacts the clinical course of patients with HF, emerging as a promising strategy for the longitudinal management of this population. These results are particularly relevant in middle-income countries, highlighting the feasibility and effectiveness of such interventions in settings marked by greater social vulnerability and limited access to healthcare services [31].

It is important to acknowledge that this systematic review may be subject to limitations inherent to the included studies. The heterogeneity of telemonitoring interventions regarding the type of technology used, duration of follow-up, patient characteristics, and modalities of clinical support may pose challenges for data synthesis and comparability. Additionally, the risk of publication bias, variability in diagnostic criteria for HF with reduced ejection fraction, and differences in healthcare systems across countries represent potential sources of imprecision in the estimates. These limitations will be sys-

tematically assessed using standardized tools, such as the Cochrane Risk of Bias 2 (RoB 2) tool and Egger's test for funnel plot asymmetry.

This systematic review is expected to compile and synthesize the best available evidence regarding the effectiveness of telemonitoring in patients with heart failure, identifying its impact on treatment adherence, mortality, and hospital readmission. In addition, it aims to determine which telemonitoring modalities and intervention components are associated with better clinical outcomes, as well as to identify existing gaps in the scientific literature. The findings may contribute to strengthening the evidence on the use of telemonitoring in heart failure management, supporting evidence-based clinical practice, the development of digital health technologies, and the implementation of more patient-centered models of care. Furthermore, the review may inform future research aimed at optimizing remote monitoring strategies and expanding their application across different healthcare settings.

Conclusion

This systematic review has the potential to consolidate the evidence regarding the effectiveness of different telemonitoring models in the care of patients with heart failure, particularly concerning treatment adherence, mortality, and hospital readmission. Its findings may support evidence-based clinical practice, the development of public policies in digital health, and the advancement of technologies aimed at cardiovascular care. Furthermore, the review may facilitate the implementation of innovative strategies capable of optimizing disease management, strengthening self-care, and promoting more integrated, efficient, and patient-centered models of care.

Disclosure of conflict of interest

None.

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