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Original Article

Effect of Telenursing-Based Interventions on Health Outcomes After Cardiac Surgery: A Systematic Review

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Abstract

Background: Patients undergoing cardiac surgery are at risk of adverse outcomes, including hospital readmission, postoperative complications, psychological distress, and reduced quality of life. Telenursing-based interventions, including patient education, remote monitoring, and post-discharge follow-up, may improve recovery; however, their effectiveness has not been comprehensively synthesized.
Objectives: This systematic review aimed to evaluate the effectiveness of telenursing-based interventions on health outcomes following cardiac surgery in adult patients.
Methods: A comprehensive literature search was conducted in PubMed, Scopus, Web of Science, SID, MagIran, and Google Scholar from inception to June 28, 2026. We included interventional studies that investigated telenursing-based interventions in patients after cardiac surgery and assessed at least one health-related outcome. Risk of bias was evaluated using the Cochrane RoB 2 tool. A narrative synthesis was undertaken due to substantial heterogeneity.
Results: Of 535 records identified, 11 studies involving 3,262 participants met the inclusion criteria. Outcomes included quality of life, psychological outcomes, self-care behaviors, physical functioning, pain, hospital readmission, and healthcare utilization. Most studies reported beneficial effects of telenursing interventions, particularly on quality of life, psychological outcomes, self-care, physical functioning, and reduced readmissions. Two studies had a high risk of bias; nine raised some methodological concerns.
Conclusion: Telenursing-based interventions may complement post-cardiac surgery care by improving patient-centered outcomes and reducing healthcare utilization. However, methodological limitations and heterogeneity warrant further high-quality studies to confirm these findings and identify optimal implementation strategies.

Implications for Nursing and Midwifery Preventive Care

- Telenursing can support secondary preventive care through post-discharge monitoring, early complication detection, and self-care promotion.
- Structured remote follow-up can strengthen care continuity and reduce hospital readmissions after cardiac surgery.

Introduction

Cardiovascular diseases (CVDs) remain the leading cause of mortality worldwide, accounting for approximately 19.8 million deaths annually, representing nearly 32% of all global deaths [1]. Despite substantial advances in diagnostic and therapeutic approaches and improvements in patient survival, the number of individuals requiring advanced interventions, including cardiac surgery, continues to increase [2]. Cardiac surgical procedures, including coronary artery bypass grafting (CABG), percutaneous coronary intervention (PCI), and valvular heart surgeries, are among the most common therapeutic approaches for managing a wide range of cardiovascular conditions [3]. Despite advancements in surgical techniques and postoperative care, many patients continue to experience challenges after hospital discharge that may adversely affect their recovery process [4]. These challenges have been evaluated in various studies using indicators such as pain, wound complications and infections, respiratory problems, arrhythmias, hospital readmissions or rehospitalization, quality of life, physical functioning, treatment adherence, self-care behaviors, and patient satisfaction [4-7]. Beyond increasing healthcare costs, these complications may prolong recovery periods, increase healthcare utilization, and negatively affect patients' quality of life [8]. The first weeks and months following discharge represent one of the most vulnerable phases of recovery for cardiac patients due to postoperative physiological changes and the challenges associated with transitioning from hospital-based care to home management. Evidence suggests that inadequate education, limited follow-up, poor adherence to treatment regimens, and delayed recognition of warning signs may increase the risk of complications and hospital readmissions [9, 10]. In response to these existing gaps in post-discharge care, telehealth-based approaches have gained increasing attention as strategies to improve continuity of care, among which telenursing represents one of the most important approaches [11]. Telenursing refers to the use of communication technologies to deliver nursing care, education, consultation, patient monitoring, and treatment follow-up remotely. It is recognized as an important component of transitional care and post-discharge management [11, 12]. By fostering continuous communication with patients, providing personalized education, early identification of health problems, and preventing avoidable complications, telenursing may play a key role in enhancing preventive care and improving health outcomes [13]. Previous studies have demonstrated that telenursing-based interventions may improve quality of life, reduce pain and certain postoperative complications, enhance treatment adherence and physical functioning, and, in some cases, decrease hospital readmissions [4, 7]. However, the available evidence remains inconsistent, as the characteristics of interventions, technological platforms, follow-up durations, types of cardiac surgeries, and assessed outcomes have varied considerably across studies [14-17].

Furthermore, most previous reviews have focused broadly on telemedicine or digital health interventions and have not independently evaluated the specific contribution of nursing-based telenursing interventions [18].

Given the expanding application of digital health technologies and the increasing emphasis of healthcare systems on remote care delivery, synthesizing reliable evidence is essential to support evidence-based decision-making regarding telenursing implementation [19]. Despite the growing number of studies in this field, a comprehensive synthesis specifically examining the effectiveness of telenursing-based nursing interventions among patients undergoing cardiac surgery remains lacking. Moreover, the heterogeneity of existing evidence has made the interpretation and comparison of findings across studies challenging [4, 14, 18].

Objectives

This systematic review synthesized evidence on telenursing interventions to improve health outcomes in cardiac surgery patients, integrating clinical trial findings to provide a comprehensive overview of effectiveness.

Methods

Search Strategy

This systematic review followed PRISMA 2020 guidelines, with study selection per the PRISMA flow diagram [20]. The protocol for this systematic review was registered in PROSPERO (CRD420261435745) on June 28 2026. The registration was performed retrospectively at the journal's request to ensure adherence to publication requirements. All methodological procedures were predefined and conducted systematically in accordance with PRISMA 2020 guidelines. Persian (SID, MagIran) and international (PubMed, Scopus, WOS) databases were searched on June 28, 2026, The search strategy was developed using the keywords "Telenursing", "Cardiac Surgery", and "Clinical Outcomes", which were validated using Medical Subject Headings (MeSH) terms in PubMed and combined using Boolean operators (AND/OR) across the different databases. No time restrictions were applied to maximize the retrieval of all potentially relevant studies. Google Scholar was also searched to enhance the comprehensiveness of the search, and the reference lists of all eligible studies were manually screened to identify additional relevant publications. Appendix 1 provides complete search strategies for all databases.

Inclusion and Exclusion Criteria

Studies were eligible for inclusion if they met the following criteria based on the PICOS framework:

Population (P): Adult patients (≥18 years) undergoing any type of cardiac surgery, including but not limited to coronary artery bypass grafting (CABG), percutaneous coronary intervention (PCI), heart valve replacement or repair, and abdominal aortic aneurysm (AAA) repair.

Intervention (I): Telenursing-based interventions delivered during the post-discharge period. Telenursing was defined as the delivery of remote nursing care via information and communication technologies (ICTs), including telephone follow-up, mobile health applications, web-based platforms, text messaging, video consultations, or other ICT-based approaches. Interventions had to include at least one structured nurse-patient interaction.

Comparison (C): Usual care or standard post-discharge follow-up without telenursing components.

Outcomes (O): At least one postoperative health outcome, including but not limited to quality of life, psychological outcomes (anxiety, depression, stress), self-care behaviors, pain, functional status, hospital readmission, and healthcare utilization.

Study design (S): Randomized controlled trials (RCTs), pilot RCTs, and quasi-experimental studies with a comparison group.

Exclusion criteria: Observational studies, qualitative studies, case reports, case series, systematic reviews, meta-analyses, protocols, feasibility studies without a comparison group, letters, editorials, conference abstracts, and dissertations were excluded. Only original full-text research articles published in peer-reviewed journals were included.

Data Extraction

Records were imported into EndNote 21; duplicates were removed. Two reviewers independently screened titles/abstracts and full texts; disagreements were resolved by consensus or a third reviewer. Database searches yielded 535 records (PubMed: 137, Scopus: 321, WOS: 77). After removing 101 duplicates, 434 records were screened; 353 were excluded, and 81 were assessed. Eleven were selected for full-text; one was excluded for duplication, leaving 10 from electronic sources. Google Scholar and reference lists added three records, yielding one more eligible study. Finally, 11 studies were included. Selection process in PRISMA 2020 flow diagram [Figure 1].

Two reviewers independently extracted data using a standardized form based on the Cochrane Handbook, covering author, year, country, participant characteristics, surgery type, intervention/comparator, follow-up, outcomes, tools, and findings. Disagreements were resolved by consensus.

Quality and Risk of Bias Assessment

Two reviewers independently evaluated methodological quality and risk of bias using the

Cochrane Risk of Bias 2 (RoB 2) tool. The tool assesses five domains: randomization process, deviations from intended interventions, missing outcome data, outcome measurement, and selection of the reported result. Overall judgments were categorized as low risk of bias, some concerns, or high risk of bias according to RoB 2 algorithms [21]. Disagreements were resolved through discussion, and a third reviewer was consulted when required.

Synthesis Methods

Clinical, methodological, and statistical heterogeneity were assessed before synthesis. Meta-analysis was considered inappropriate due to substantial heterogeneity in intervention characteristics, populations, outcomes, follow-up durations, and measurement instruments. Moreover, the number of sufficiently comparable studies was insufficient to estimate pooled effects. Therefore, statistical pooling was not performed, and heterogeneity statistics, including Cochran's Q and I^2, were not calculated.

Findings were synthesized narratively by exploring patterns of consistency and variation among included studies.

Result

Characteristics of Included Studies

Following the PRISMA 2020-based selection process, 11 studies were included. These comprised 10 RCTs and 1 pilot RCT conducted between 2009 and 2026 across 9 countries, with China contributing the most studies (n = 3). Most participants were adults undergoing cardiac surgery, particularly coronary artery bypass grafting (CABG); other procedures included valve replacement, PCI, and AAA repair.

Telenursing interventions were delivered through various technologies, including web-based programs, mobile applications, telephone or video consultations, text messaging, telehealth systems, and social networking platforms.

Follow-up periods ranged from 7 days to 12 months. Reported outcomes included pain, anxiety, depression, stress, sleep quality, quality of life, self-care behaviors, treatment adherence, patient satisfaction, functional status, blood pressure control, healthcare utilization, and postoperative clinical outcomes. Detailed demographic and intervention characteristics of each included study are presented in Table 1A, and measurement instruments with corresponding outcomes are presented in Table 1B.

Risk of Bias Assessment

The RoB 2 assessment results are presented in Table 3. Among the 11 studies, two (18.2%) were judged to have a high risk of bias and nine (81.8%) to have some concerns. No study was classified as having low overall risk of bias. The greatest concerns were observed in Domain 2 (deviations from intended interventions) and Domain 5 (selection of the reported result), with eight studies (72.7%) rated as having some concerns in each domain. The randomization process was assessed as low risk in six studies (54.5%).

Synthesis of Findings

Due to substantial heterogeneity in intervention characteristics, populations, measurement instruments, outcomes, and follow-up durations [Table 1 A], meta-analysis was not considered appropriate.

Therefore, findings were synthesized narratively, categorized, and reported according to clinically comparable outcomes.

To provide an overview of the direction and consistency of the evidence, the results are summarized by outcome domain in Table 2.

Anxiety, Depression, Stress, and Sleep Quality

As presented in Table 1 B, six studies assessed psychological outcomes, including anxiety, depression, stress, or psychological distress.

The study by Jin et al. demonstrated reductions in HAMA, HAMD, and PSQI scores in both groups after three months. Although numerical mean and SD values were not reported, the authors reported greater improvements in the network-based family care group than in the control group ($p < 0.05$), indicating improvements in anxiety, depressive symptoms, and sleep disturbances [22]. In addition, patients in the intervention group showed greater improvements in pulmonary function, and better sleep quality was positively correlated with pulmonary indicators [22]. In the study by Bikmoradi et al., depression, anxiety, and stress were assessed using the Depression Anxiety Stress Scale-21 (DASS-21). After six weeks of telenursing intervention, the mean scores of depression, anxiety, and stress in the intervention group decreased from 11.95 to 7.85, from 18.17 to 10.45, and from 18.75 to 10.50, respectively. These reductions were statistically significant compared with the control group ($p < 0.001$) [23].

In the study by Mala et al., implementation of a telehealth-based transitional care model was associated with significant reductions in anxiety and depression scores. HADS-A scores decreased from a baseline of 7.94 (SD = 2.10) in the intervention group and 7.97 (SD = 2.35) in the control group to 3.58 (SD = 1.64) versus 6.65 (SD = 2.87) at 30 days, and to 1.48 (SD = 0.86) versus 5.74 (SD = 3.33) at 90 days ($p < .001$). HADS-D scores likewise decreased from a baseline of 4.28 (SD = 1.79) versus 4.17 (SD = 1.77) to 2.78 (SD = 1.46) versus 4.38 (SD = 2.70) at 30 days, and to 0.85 (SD = 0.94) versus 3.63 (SD = 2.62) at 90 days ($p < 0.001$). Functional status scores (Thai-ESDS) also improved, decreasing from a baseline of 23.02 (SD = 4.19) in the intervention group and 21.17 (SD = 5.05) in the control group to 17.82 (SD = 3.82) versus 24.11 (SD = 6.58) at 30 days, and to 13.78 (SD = 3.12) versus 20.46 (SD = 7.84) at 90 days ($p < 0.001$), with lower scores indicating greater functional independence [24]. In contrast, Nilsson et al. evaluated anxiety and depression using HADS-A and HADS-D. In the intention-to-treat analysis, the eHealth intervention did not significantly reduce anxiety scores compared with the control group (−1.21 vs. −0.54; $p = .330$).

Depression scores also did not differ significantly between the groups at follow-up. However, in the per-protocol analysis, participants who used the eHealth tool showed a greater reduction in anxiety scores than the control group (−2.00 vs. −0.54; $p = 0.028$) [25].

Also, in the study by Martorella et al., the effect of the web-based telenursing intervention SOULAGE-TAVIE on psychological outcomes was assessed using the Hospital Anxiety and Depression Scale (HADS).

Also, in the study by Martorella et al., the effect of the web-based telenursing intervention SOULAGE-TAVIE on psychological outcomes was assessed using the Hospital Anxiety and Depression Scale (HADS). Anxiety scores decreased from 6.77 (SD = 4.44) at baseline to 5.37 (SD = 4.15) on postoperative day 7 in the intervention group, compared with a decrease from 8.32 (SD = 5.17) to 5.84 (SD = 3.25) in the control group; however, no statistically significant between-group difference was reported. Depression scores increased from 3.67 (SD = 3.40) to 4.30 (SD = 3.32) in the intervention group and from 2.86 (SD = 2.29) to 4.21 (SD = 4.01) in the control group, with no statistically significant between-group difference reported [26].

Overall, these findings indicate that SOULAGE-TAVIE did not produce a significant short-term effect on postoperative anxiety or depression. Although anxiety decreased in both groups, the reduction cannot be attributed specifically to the telenursing intervention because a comparable decrease was also observed in the control group [26].

In the study by van Steenbergen et al., anxiety was assessed as a secondary outcome using HADS. No significant between-group difference in anxiety was observed at six weeks ($p = 0.69$) [27].

Overall, the available evidence suggests that some telenursing interventions, particularly multidimensional programs that incorporate education, regular follow-up, nursing counseling, and remote monitoring, may reduce anxiety, depression, stress, and sleep disturbances following cardiac surgery.

However, the magnitude of these effects varied across studies.

Table 1A. Demographic and Intervention Characteristics of Included Studies

Study (Country, Design)	Population	Age, *M* (*SD*), years	Sample size, *n*	Follow-up	Tele-nursing intervention
Martorella et al., 2012 [26] (Canada, Pilot RCT)	Adults ≥18 years undergoing CABG and/or valve replacement	Int: 64.6 (8.2); Ctrl: 63.2 (9.9)	Int: 30; Ctrl: 30	Days 1, 2, 3, and 7 post-surgeries	SOULAGE-TAVIE web-based; tailored 30-min session
Ding et al., 2024 [28] (China, RCT)	Adults aged 18–65 years after first MHVR for VHD	Int: 51.32 (0.77); Ctrl: 52.00 (1.08)	Int: 45; Ctrl: 45	Day before; 1, 3, 6m	6-month Banhu app
Jin et al., 2020 [22] (China, RCT)	CHD patients undergoing CABG, NYHA II–III	Int: 43.76 (6.57); Ctrl: 45.30 (7.31)	Int: 56; Ctrl: 56	10 days and 3 months	Family Network-Assisted Nursing (FNAN)
Yu et al., 2025 [31] (China, RCT)	Adults 18–79 with CHD after PCI	Int: 62.24 (11.09); Ctrl: 62.00 (10.99)	Int: 1,046; Ctrl: 1,021	12 months	WeChat-based platform
Mala et al., 2026 [24] (Thailand, RCT)	Adults ≥60 undergoing CABG, NYHA I–III	Int: 67.07 (6.56); Ctrl: 68.86 (6.83)	Int: 42; Ctrl: 42	Baseline, 30, 90d	Telehealth based on TCM
van Steenbergen et al., 2022 [27] (Netherlands, RCT)	Adults >18 scheduled for elective/urgent isolated CABG	Int: 67.9; Ctrl: 69.6	Int: 136; Ctrl: 135	Discharge; 1,2,3,6w	eHealth, videos, 2 video consultations
İlgin et al., 2024 [30] (Turkey, RCT)	Adults ≥18 after CABG discharge	Int: 58.60 (8.75); Ctrl: 58.66 (10.41)	Int: 30; Ctrl: 30	4 weeks post-discharge	Weekly telephone/video calls & counseling
Yadav et al., 2021 [17] (India, RCT)	Patients with ACS after successful PCI	Int: 54.3 (11.3); Ctrl: 54.2 (10.2)	Int: 109; Ctrl: 119	30 days	Health RADAR app
Nilsson et al., 2021 [25] (Sweden, RCT)	Patients ≥50 undergoing elective AAA repair (EVAR/open)	Int: 72.6 (7.2); Ctrl: 73.3 (5.8)	Int: 60; Ctrl: 60	4–6 weeks	6-week early-recovery telehealth
Bikmoradi et al., 2023 [23] (Iran, RCT)	Patients 40–60 discharged after CABG	Int: 52.78 (6.20); Ctrl: 55.75 (8.34)	Int: 45; Ctrl: 43	3 times/week for 6 weeks	SMS-based follow-up
Barnason et al., 2009 [29] (USA, RCT)	Adults 65–85 with high preoperative burden after CABG	71.6 (5.1)	Int: 23; Ctrl: 31	3 and 6 weeks; 3 and 6 months	6-week early recovery telehealth (symptom management)

Table 1B. Measurement Instruments and Clinical Outcomes of Included Studies

Study	Measurement instruments	Intervention group (Before → After)	Control group (Before → After)
Martorella et al., 2012 [26]	BPI; HADS; BQ-II; PCS	BPI (breathing/coughing): 4.7 (2.5) → 3.4 (2.6); HADS-A: 6.77 (4.44) → 5.37 (4.15); HADS-D: 3.67 (3.40) → 4.30	BPI (breathing/coughing): 6.2 (2.8) → 5.0 (3.8); HADS-A: 8.32 (5.17) → 5.84 (3.25); HADS-D: 2.86 (2.29) → 4.21 (4.01)
Ding et al., 2024 [28]	SF-36; Self-Care Competency Scale; Morisky; PF	PF: 45.98 (0.42) → 50.12 (0.32) / 52.85 (0.52) / 57.07 (0.41) at 1/3/6m; Morisky: 5.12 (0.23) → 5.69 (0.19) / 6.43 (0.18) / 9.29 (0.23)	PF: 44.51 (0.82) → 48.19 (0.50) / 46.67 (0.89) / 45.88 (0.76); Morisky: 5.13 (0.22) → 4.89 (0.19) / 4.49 (0.17) / 4.14 (0.23)
Jin et al., 2020 [22]	HAMA; HAMD; PSQI; CAT; lung function	NR (baseline) → Respiratory infection: 2 (4.0%); Pulmonary infection: 2 (4.0%); Airway obstruction: 1 (2.0%)	NR (baseline) → Respiratory infection: 6 (13.0%); Pulmonary infection: 4 (8.7%); Airway obstruction: 5 (10.9%)
Yu et al., 2025 [31]	Office BP	SBP: 129.90 (19.59) → 117.74 (13.80); DBP: 79.88 (12.31) → 73.60 (10.18)	SBP: 129.11 (20.85) → 121.46 (16.85); DBP: 79.79 (12.89) → 75.72 (10.45)
Mala et al., 2026 [24]	Thai-ESDS; HADS-A; HADS-D; Rehospitalization	Thai-ESDS: 23.02 (4.19) → 17.82 (3.82) / 13.78 (3.12) at 30/90d; HADS-A: 7.94 (2.10) → 3.58 (1.64) / 1.48 (0.86); HADS-D: 4.28 (1.79) → 2.78 (1.46) / 0.85 (0.94); Rehospitalization: → 5 (11.9%)	Thai-ESDS: 21.17 (5.05) → 24.11 (6.58) / 20.46 (7.84); HADS-A: 7.97 (2.35) → 6.65 (2.87) / 5.74 (3.33); HADS-D: 4.17 (1.77) → 4.38 (2.70) / 3.63 (2.62); Rehospitalization: → 16 (38.1%)
van Steenbergen et al., 2022 [27]	SF-36; iMCQ; HADS-A	HADS-A: baseline *p* = .29 → Healthcare utilization: 31.6%; Costs: 183 (515); HADS-A at 6w: *p* = .69	NR → Healthcare utilization: 45.2%; Costs: 285 (777); HADS-A: NR
İlgin et al., 2024 [30]	Self-Care Strength Scale	91.60 (20.13) → 105.83 (9.99)	88.47 (24.08) → 85.77 (27.62)
Yadav et al., 2021 [17]	Patient Satisfaction; Composite outcome; Controlled BP	NR → Satisfaction: 20.7 (1.29); Composite outcome: 18 (15.0%); Controlled BP: 32/42 (76.2%)	NR → Satisfaction: 16.5 (2.68); Composite outcome: 14 (12.8%); Controlled BP: 18/40 (45.0%)
Nilsson et al., 2021 [25]	HADS-A; HADS-D; SF-12 (PCS/MCS)	HADS-A: 4.68 (3.80) → mean change −2.00 (app users); HADS-D: NR; SF-12: NR	HADS-A: 3.83 (3.87) → mean change −0.54; HADS-D: NR; SF-12: NR
Bikmoradi et al., 2023 [23]	DASS-21	Depression: 11.95 (4.08) → 7.85 (2.33); Anxiety: 18.17 (3.87) → 10.45 (3.46); Stress: 18.75 (4.80) → 10.50 (2.10)	Depression: 11.55 (2.54) → 10.56 (2.58); Anxiety: 17.40 (2.03) → 16.50 (3.64); Stress: 18.37 (2.62) → 17.90 (2.77)
Barnason et al., 2009 [29]	RT3 accelerometer; Activity Diary; MOS SF-36; RISKO	RT3: NR → Energy expenditure: 27.9 kcal/kg/day	RT3: NR → Energy expenditure: 26.6 kcal/kg/day

Note. Arrows (→) indicate changes from baseline to follow-up; multiple timepoints are separated by slashes (/); values are presented as *M* (*SD*). NR = not reported.

Table 2. Methodological Quality Assessment of Included Studies Using the Cochrane RoB 2 Tool

Study	D1: Randomization process	D2: Deviations from intended interventions	D3: Missing outcome data	D4: Measurement of the outcome	D5: Selection of the reported result	Overall risk of bias
Martorella et al., 2012	Low	Some concerns	Some concerns	High	Some concerns	High risk
Ding et al., 2024	Low	Some concerns	Low	Low	Some concerns	Some concerns
Jin et al., 2020	Low	Some concerns	Some concerns	Low	Some concerns	Some concerns
Yu et al., 2025	Low	Low	Low	Low	Some concerns	Some concerns
Mala et al., 2026	Low	Low	Low	Some concerns	Low	Some concerns
van Steenbergen et al., 2022	Some concerns	Low	Low	Some concerns	Low	Some concerns
İlgin et al., 2024	Some concerns	Some concerns	Low	Some concerns	Some concerns	Some concerns
Yadav et al., 2021	Low	Some concerns	Low	Some concerns	Some concerns	Some concerns
Nilsson et al., 2021	Low	Some concerns	Some concerns	Low	Some concerns	Some concerns
Bikmoradi et al., 2023	Some concerns	Some concerns	Some concerns	High	Some concerns	High risk
Barnason et al., 2009	Some concerns	Some concerns	Some concerns	Some concerns	Some concerns	Some concerns

Note. D1–D5 = domains of the Cochrane RoB 2 tool. Risk levels: Low, Some concerns, High risk.

Table 3. Summary of Evidence by Outcome Domain

Outcome Domain	Number of Studies (n)	Studies Reporting Beneficial Effect	Studies Reporting No Significant Effect	Studies Reporting Mixed/Inconclusive	Consistency of Evidence*
Anxiety/Depression/Stress	6	4	2	0	Moderate
Sleep Quality	2	2	0	0	Low
Quality of Life	4	2	1	1	Low-Moderate
Pain	1	0	1	0	Insufficient
Self-Care/Adherence	3	3	0	0	Moderate
Functional Status	3	3	0	0	Low-Moderate
Healthcare Utilization/Readmission	2	2	0	0	Low
Clinical Outcomes (BP, complications)	3	2	1	0	Low

*Consistency of Evidence: High = ≥75% of studies report consistent direction of effect with similar magnitude; Moderate = 60–74% consistent; Low = <60% consistent; Insufficient = fewer than 2 studies.

Pain

In the study by Martorella et al., a web-based pain self-management education program (SOULAGE-TAVIE) was evaluated for its effect on postoperative pain-related outcomes. Pain interference with breathing and coughing decreased from 4.7 (SD = 2.5) on postoperative day 1 to 3.4 (SD = 2.6) on day 7 in the intervention group, compared with a decrease from 6.2 (SD = 2.8) to 5.0 (SD = 3.8) in the control group ($F(1,31) = 4.09$, $p = 0.05$).

Furthermore, patients' pain interference with daily activities, barriers to pain management, and pain catastrophizing were assessed using the Brief Pain Inventory (BPI), Barriers Questionnaire-II (BQ-II), and Pain Catastrophizing Scale (PCS), respectively. Overall, these findings suggest that SOULAGE-TAVIE may have reduced pain interference with breathing and coughing during the early postoperative period. However, evidence for broader effects on pain-related outcomes remains limited [26]. Given that only one study investigated this outcome, the current evidence remains insufficient to draw definitive conclusions regarding the effectiveness of telenursing interventions for postoperative pain management after cardiac surgery. Further high-quality studies are warranted to clarify the potential benefits of these interventions in pain control.

Quality of Life

Four studies evaluated quality of life or health-related quality of life (HRQoL) outcomes. In the study by Ding et al., patients' quality of life after their first mechanical heart valve replacement was assessed using the Short Form-36 Health Survey (SF-36). After 6 months of follow-up, patients in the mobile application-based continuity care program had significantly higher SF-36 scores across all subscales than the control group ($p < 0.05$). Furthermore, the intervention was associated with improved treatment adherence and self-care capacity. Specifically, the Physical Functioning (PF) score in the intervention group increased from 45.98 (SD = 0.42) at baseline to 50.12 (SD = 0.32), 52.85 (SD = 0.52), and 57.07 (SD = 0.41) at 1, 3, and 6 months after discharge, respectively [28]. In the study by Jin et al., quality of life was assessed using the Chronic Obstructive Pulmonary Disease Assessment Test (CAT) in patients with coronary artery disease undergoing CABG who were classified as NYHA functional class II–III. Although numerical CAT scores were not reported, the authors reported significantly lower CAT scores in the network-based family nursing group than in the control group after the intervention, indicating improved quality of life [22].

Barnason et al. evaluated physical and mental health-related quality of life using the Medical Outcomes Study 36-Item Short Form Health Survey (MOS SF-36). Although physical functioning and role limitations due to physical health improved in both groups during the follow-up period ($p < 0.05$), no significant differences were observed between the intervention and control groups in physical or mental health dimensions. These improvements were observed over time in both groups; however, no significant differences were found, indicating no clear additional benefit of the intervention on health-related quality of life [29]. In the study by van Steenbergen et al., baseline health-related quality of life was assessed using the SF-36. However, SF-36 was assessed only at baseline, and follow-up quality-of-life outcomes using this instrument were not reported; therefore, the longitudinal effect of the eHealth intervention on SF-36-based quality of life could not be assessed Overall, the included studies provide mixed evidence regarding the effects of telenursing interventions on quality of life. Although some studies reported improvements in quality-of-life outcomes, others found no significant between-group differences or did not report follow-up quality-of-life data. Heterogeneity in intervention characteristics, assessment instruments, and methodological quality further limits the ability to draw definitive conclusions about the effects of telenursing on quality of life.

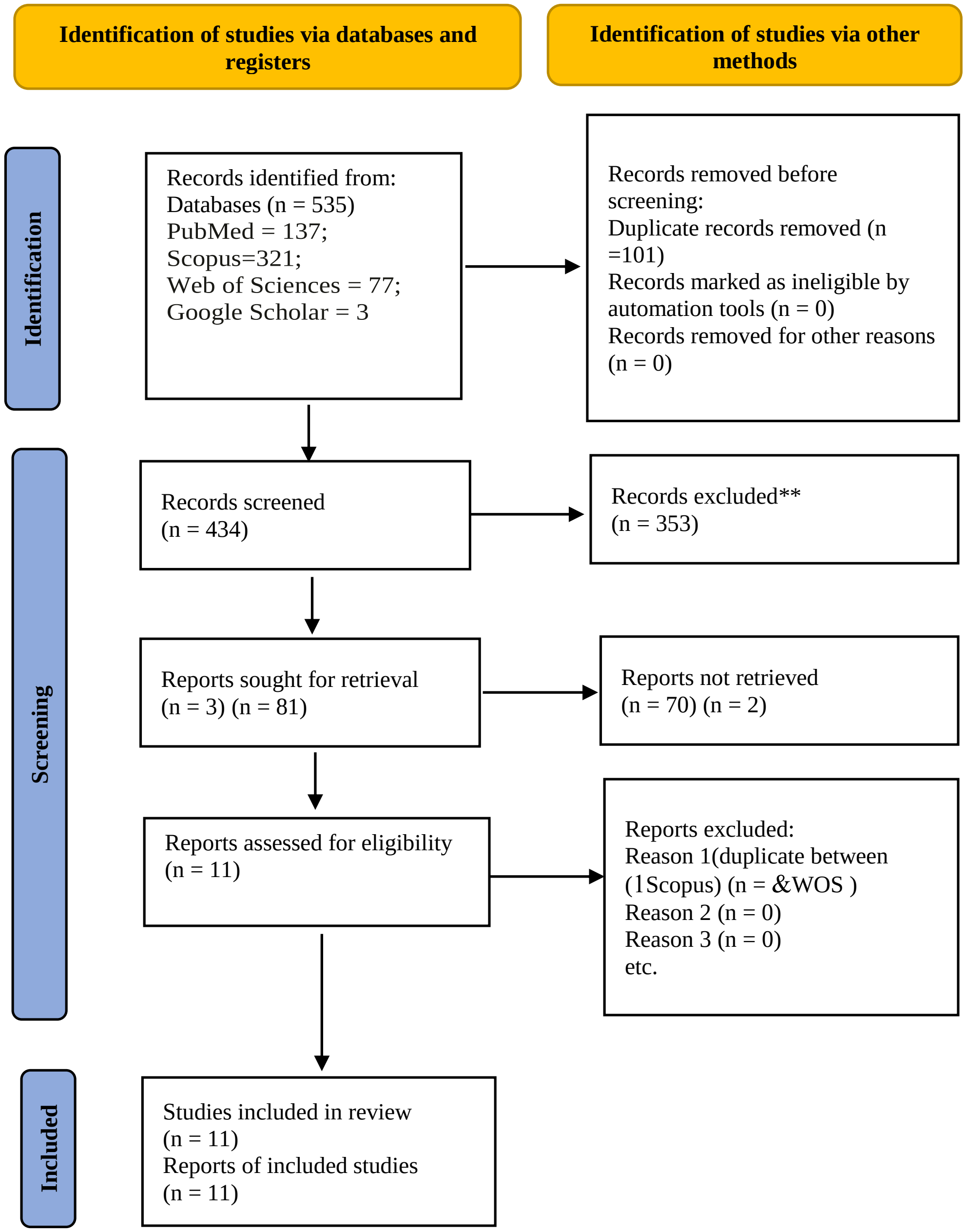

Figure 1. PRISMA 2020 Flow Diagram of the Literature Search and Study Selection Process

Self-Care, Treatment Adherence, and Patient Satisfaction

Three studies evaluated outcomes related to self-care, treatment adherence, and patient satisfaction [17, 28, 30]. The study by İlgin et al. demonstrated that nursing education and counseling delivered via weekly telephone calls over 4 weeks after discharge improved self-care strength among patients following CABG. The mean self-care score in the intervention group increased from 91.60 (SD = 20.13) before the intervention to 105.83 (SD = 9.99) after the intervention.

In contrast, only limited changes were observed in the control group (88.47 (SD = 24.08) before the intervention and 85.77 (SD = 27.62) after the intervention) [30]. In the study by Ding et al., a mobile application-based continuity care program implemented for six months after mechanical heart valve replacement significantly improved warfarin medication adherence and self-care ability compared with the control group at 1, 3, and 6 months after discharge ($p < 0.05$). Medication adherence was assessed using the Morisky Medication Adherence Scale, while self-care ability was evaluated using the Self-Care Competency Rating Scale. Specifically, mean Morisky adherence scores were comparable between groups before discharge (intervention: 5.12 (SD = 0.23) vs control: 5.13 (SD = 0.22); $p = 0.991$), but diverged significantly thereafter, with the intervention group showing progressively higher scores at 1 month (5.69 (SD = 0.19) vs 4.89 (SD = 0.19); $p = 0.004$), 3 months (6.43 (SD = 0.18) vs 4.49 (SD = 0.17); $p < 0.001$), and 6 months (9.29 (SD = 0.23) vs 4.14 (SD = 0.23); $p < 0.001$) after discharge. In contrast, adherence scores in the control group declined steadily over the follow-up period, whereas those in the intervention group continued to rise [28].

Yadav et al. (2021) investigated the effects of the health RADAR application among patients with acute coronary syndrome following percutaneous coronary intervention (PCI).

The results showed that use of the application significantly increased patient satisfaction in the intervention group compared with usual care (20.7 (SD = 1.29) vs. 16.5 (SD = 2.68); $p = 0.0001$) [17]. Overall, the available evidence indicates potential benefits of telenursing interventions for improving self-care behaviors, treatment adherence, and patient satisfaction.

However, variations in measurement instruments and study populations limit direct comparisons among findings.

Functional Status and Physical Activity

Three studies evaluated functional status, physical activity, or related functional indicators among patients undergoing cardiac surgery [22, 24, 29]. In the study by Mala et al., the effect of a telehealth-based transitional care model was investigated among older adults undergoing CABG surgery. The results indicated that the intervention was associated with improvements in patients' functional status at 30- and 90-day follow-ups after discharge. In the intervention group, the mean functional status score decreased significantly, from 23.02 (SD = 4.19) at baseline to 13.78 (SD = 3.12) post-intervention. In contrast, the control group showed minimal change, moving from 21.17 (SD = 5.05) to 20.46 (SD = 7.84). Given the instrument's scoring direction, lower scores reflect greater functional independence [24].

In the study by Barnason et al., postoperative physical activity following CABG was assessed using an RT3 accelerometer and an Activity Diary. The intervention group had higher estimated energy expenditure than the control group (27.9 vs. 26.6 kcal/kg/day; $p = 0.03$). The intervention group also spent more time in moderate or higher levels of physical activity (190.6 vs. 148.2 min/day; $p < 0.05$) [29]. Furthermore, Jin et al. (2020) evaluated pulmonary function and physical health-related outcomes in patients following CABG. Pulmonary function was assessed using maximum voluntary ventilation (MVV), arterial oxygen pressure (PaO_2), arterial carbon dioxide pressure ($PaCO_2$), peripheral oxygen saturation (SpO_2), forced expiratory volume in one second (FEV1), and forced vital capacity (FVC). The results showed that network-based family care significantly increased MVV, PaO_2, SpO_2, FEV1, and FVC, and reduced $PaCO_2$ compared with usual care ($p < 0.05$) [22].

Overall, these studies' findings suggest that telenursing interventions may be associated with improvements in physical functioning, increased physical activity, and enhanced functional indicators following cardiac surgery.

However, differences in assessment instruments and outcome definitions limit direct comparisons across studies.

Healthcare Utilization, Readmissions, and Healthcare Visits

Two studies evaluated healthcare utilization outcomes after hospital discharge [24, 27]. In the study by van Steenbergen et al., the effects of an eHealth program consisting of educational videos and two video-based counseling sessions following CABG were evaluated. Healthcare utilization was assessed using the iMTA Medical Consumption Questionnaire (iMCQ). At 6 weeks, unplanned healthcare utilization occurred in 31.6% of patients in the intervention group compared with 45.2% in the control group (HR = 0.56, 95% CI [0.34, 0.92]; $p = 0.02$). Mean healthcare costs were also lower in the intervention group than in the control group (€183 (SD = 515) vs. €285 (SD = 777); $p < 0.001$). The intervention group also had fewer telephone consultations than the control group (21.3% vs. 34.8%; HR = 0.51, 95% CI [0.29, 0.87]; $p = 0.01$), whereas the difference in unplanned general practitioner visits was not statistically significant ($p = 0.07$) [27]. In the study by Mala et al., rehospitalization was assessed as a secondary outcome. The number of rehospitalizations was assessed using a questionnaire designed to record rehospitalization events. The results indicated that the telehealth-based transitional care model was associated with a lower rehospitalization rate following CABG. Specifically, 30-day rehospitalization occurred in 5 patients (11.9%) in the intervention group compared with 16 patients (38.1%) in the control group [24].

\Overall, the available evidence suggests that telenursing interventions may help reduce potentially avoidable healthcare utilization, lower rehospitalization rates, and optimize post-discharge care.

However, differences in intervention characteristics and follow-up durations limit direct comparisons across studies.

Other Reported Clinical Outcomes

Three studies evaluated specific clinical outcomes, including postoperative complications and blood pressure control. In the study by Jin et al. (2020), the incidence of postoperative complications following CABG was lower among patients receiving network-based family care than among those receiving usual care. Respiratory tract infection occurred in 2 patients (4.0%) in the intervention group compared with 6 patients (13.0%) in the control group, pulmonary infection occurred in 2 (4.0%) versus 4 (8.7%), and airway obstruction occurred in 1 (2.0%) versus 5 (10.9%), respectively. The overall incidence of postoperative complications was also lower in the intervention group, which also had a higher overall treatment effectiveness rate [22]. In the study by Yu et al., the effects of a multicomponent WeChat-based platform incorporating health education, medication reminders, patient monitoring, and artificial intelligence (AI)-based counseling on blood pressure control were evaluated among patients with coronary artery disease following PCI. After 12 months, mean systolic blood pressure decreased from 129.90 (SD = 19.59) to 117.74 (SD = 13.80) mmHg, while mean diastolic blood pressure decreased from 79.88 (12.31) to 73.60 (10.18) mmHg in the intervention group [31].

Yadav et al. evaluated a composite clinical outcome comprising death, myocardial infarction, stroke, target-vessel revascularization, hospitalization for heart failure, and emergency department visits. No significant between-group difference was observed in the composite outcome (15.0% vs. 12.8%; $p = .620$). In contrast, blood pressure control among patients with hypertension was significantly better in the intervention group than in the control group (76.2% vs. 45.0%; $p = .0062$) [17]. Overall, although only a limited number of studies evaluated specific clinical outcomes, the findings suggest potential beneficial effects of telenursing interventions on selected clinical outcomes following cardiac surgery or other cardiac interventions.

However, given the methodological concerns identified among the included studies, these findings should be interpreted cautiously.

Discussion

The present systematic review evaluated the effectiveness of telenursing interventions on patient outcomes following cardiac surgery. Despite variations in technologies, intervention components, and follow-up durations, telenursing interventions were associated with improvements in psychological outcomes, quality of life, self-care, functional status, and healthcare utilization after discharge across most included studies. However, heterogeneity in patient characteristics, types of cardiac surgery, intervention components, measurement instruments, and methodological quality limited direct comparisons and precise determination of intervention effects. Moreover, the absence of studies with low risk of bias requires cautious interpretation of the findings. These results are consistent with evidence on telehealth and remote cardiac rehabilitation. Alqahtani et al. demonstrated that telehealth-based cardiac rehabilitation may improve functional capacity and quality of life, although evidence regarding mortality remains insufficient [32]. Similarly, Zhong et al. reported improvements in functional capacity following remote cardiac rehabilitation after PCI [33].

In contrast, Ariyanto et al. reported improved quality of life among patients with heart failure receiving telenursing [34]. Overall, telenursing may support post-discharge cardiac management through continuity of care, communication, and self-management support; however, its effectiveness depends on the intervention design, intensity, and delivery quality. In the present review, psychological outcomes represented the largest body of evidence.

Multidimensional programs incorporating education, remote monitoring, follow-up, nursing counseling, and psychological support generally reduced anxiety, depression, and stress, and improved sleep quality. However, outcomes varied depending on intervention objectives, duration, assessment tools, and the populations involved. This heterogeneity may be explained by differences in intervention objectives, follow-up duration, assessment tools, and study population characteristics. Ma et al. demonstrated that a WeChat-based rehabilitation program after CABG, including education, rehabilitation guidance, activity monitoring, and psychological support, reduced anxiety and depression [35]. These effects may be related to improved access, continuous communication, timely feedback, and social support. However, long-term psychological benefits remain uncertain, as Zhong et al. found improvements in quality of life and functional capacity but no significant long-term changes in anxiety or depression [36]. Therefore, psychological effects may depend on the intervention's content, intensity, timing, follow-up duration, and patient engagement, rather than solely on technology. Telenursing may also improve quality of life, self-care, and treatment adherence after cardiac surgery by enhancing health literacy, self-management, behavioral changes, and follow-up support. Hou et al. showed that mHealth-based interventions improved quality of life and reduced anxiety and depression [37]. However, these improvements should be interpreted in light of natural postoperative recovery, as Creber et al. demonstrated that quality of life after CABG generally improves over time [38]. Programs involving education, continuous monitoring, nurse–patient communication, and individualized support appeared more effective, consistent with findings of Leutualy et al. regarding improved self-care abilities through telenursing-based education [39]. One notable pattern identified among the included studies was the importance of continuous nurse–patient interaction. Although technology enables remote care, clinical benefits appear to arise primarily from therapeutic communication, monitoring, and structured nursing support. Continuous interaction may facilitate early problem identification, behavioral modification, and individualized recommendations, consistent with Li et al., who emphasized that the effectiveness of telehealth cardiac rehabilitation depends on intervention components and implementation [40].

Functional status improvements were also observed, suggesting that telenursing may support rehabilitation by monitoring, educating, and encouraging participation. Similar findings were reported by Zhong et al. after PCI [33] and Kalpesh et al. among CABG patients [41]. Telenursing may reduce healthcare utilization after discharge by improving symptom management, communication, and self-care. Alshahrani et al. reported reductions in unplanned healthcare visits and rehospitalizations through remote monitoring and mHealth disease-management programs [42].

Similarly, Braver et al. reported that mHealth-based disease management programs may be associated with reductions in rehospitalizations and emergency department visits among patients with coronary artery disease [43].

The included interventions varied in technology, contact frequency, monitoring intensity, educational content, and nursing support, making it difficult to identify the most effective components. Clinical implementation should consider digital literacy, access to technology, communication skills, and patient engagement. This review has strengths including adherence to PRISMA 2020, systematic searching, independent screening and extraction, and RoB 2 assessment. Nevertheless, most studies were rated as "Some Concerns" and none as low risk of bias. Blinding is often not feasible in telenursing interventions; therefore, subjective outcomes, such as quality of life and self-care, may be more vulnerable to bias, whereas objective outcomes, such as rehospitalization, are less affected. Considerable heterogeneity prevented meta-analysis and required narrative synthesis. Most studies focused on CABG, limiting generalizability.

Overall, telenursing shows potential to improve outcomes after cardiac surgery; however, findings should be interpreted as evidence of potential effectiveness rather than definitive superiority over standard care.

Conclusion

Due to methodological limitations (lack of blinding, heterogeneity of interventions, and limited numbers of studies for certain outcomes), evidence certainty varied. Evidence was more consistent for psychological outcomes, quality of life, and self-care, but limited for pain management and specific clinical outcomes. Available data suggest that telenursing may improve psychological outcomes, quality of life, and self-care, and reduce healthcare utilization post-surgery. However, evidence on pain, complication prevention, and clinical endpoints remains insufficient owing to few studies and substantial heterogeneity. Thus, telenursing may serve as a complementary approach to usual care in structured post-discharge and secondary prevention programs. Future research should prioritize well-designed RCTs with adequate sample sizes, longer follow-up, standardized reporting (e.g., TIDieR and telehealth frameworks), and direct comparisons of delivery models and emerging technologies (e.g., intelligent decision support) to strengthen the evidence base.

Ethical Consideration

Ethical Considerations – As a systematic review of published studies without primary human data, informed consent and ethical approval were not required. All review stages followed ethical principles for scientific research and international standards, including transparent reporting, academic integrity, and standardized methodologies to minimize bias in selection, extraction, and interpretation.

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Conflict of Interest

No conflict of interest.

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Authors' Contributions

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All authors read and approved the final manuscript.

Artificial Intelligence Utilization

We used AI-assisted tools for editing and translation. Specifically, we used ChatGPT version GPT-4 to enhance the language and readability of the manuscript. All content was thoroughly reviewed and revised by the authors to ensure accuracy and scientific integrity.

Data Availability Statement

Data sharing is not required for this article because no new datasets were generated or analyzed during the current study.

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Appendix 1. Comprehensive search strategy in databases (Scopus) WoS ,(Web of Science، PubMed] and Search engines (Google Scholar]

Database	Search strategy
PubMed	((Telenursing [Mesh] OR Telemedicine [Mesh] OR "Remote Consultation"[Mesh] OR "Remote Patient Monitoring"[Mesh] OR telenursing OR telehealth OR "remote monitoring" OR "remote patient monitoring" OR "virtual nursing" OR "virtual care" OR "digital health" OR eHealth OR mHealth OR Telecommunications OR "Nursing Care" OR "Home Care Services" OR "Patient Care Management" OR "Mobile Applications") AND ("Cardiac Surgical Procedure*"[Mesh] OR "Cardiovascular Surgical Procedure*"[Mesh] OR "Thoracic Surgery"[Mesh] OR "Coronary Artery Bypass"[Mesh] OR "Heart Valve Prosthesis Implantation"[Mesh] OR "Heart Valve Repair"[Mesh] OR "cardiac surgery" OR "heart surgery" OR "cardiovascular surgery" OR "Cardiovascular Surgical Procedure*" OR "cardiac operation*" OR "heart operation*" OR "cardiac surgical patient*" OR "heart surgical patient*" OR "open heart surgery" OR CABG OR "coronary artery bypass graft*" OR "valve surgery" OR "heart valve surgery" OR "valve replacement" OR "valve repair" OR "cardiac valve surgery" OR "postoperative cardiac patient*" OR "cardiac postoperative patient*" OR "cardiothoracic surgery" OR "mitral valve surgery" OR "aortic valve surgery" OR sternotomy)) AND ("clinical outcome*"[Title/Abstract] OR "early outcome*"[Title/Abstract] OR "postoperative outcome*"[Title/Abstract] OR "complication*" OR" Primary 30-day hospital readmission"[Title/Abstract] OR "quality of life"[Title/Abstract] OR "Self-care behaviors"[Title/Abstract] OR "Postoperative wound complications"[Title/Abstract] OR "Emergency department visits"[Title/Abstract] OR "Physical functioning"[Title/Abstract] OR "Pain intensity"[Title/Abstract] OR "Anxiety & depression"[Title/Abstract] OR "Self-efficacy"[Title/Abstract] OR "Patient satisfaction"[Title/Abstract])
Scopus	TITLE-ABS-KEY ((Telenursing OR "Tele-nursing" OR "Remote Consultation" OR "Remote Patient Monitoring" OR telehealth OR "remote monitoring" OR "virtual nursing" OR "virtual care" OR "digital health" OR eHealth OR mHealth" OR "telemonitoring" OR "mobile health" OR "Telecommunications" OR "Nursing Care" OR "Home Care Services" OR "Patient Care Management" OR "Mobile Applications"] AND TITLE-ABS-KEY ("Cardiac Surgery" OR "Cardiovascular Surgical Procedures" OR "post operation"] AND TITLE-ABS-KEY ("clinical outcome*" OR "Patient-Relevant Outcome" OR "early outcome*" OR "postoperative outcome*" OR "complication*" OR readmission OR mortality OR morbidity OR "quality of life" OR "self-care"]]
WOS	] "Telenursing" OR "Telemedicine" OR "Remote Consultation" OR "Remote Patient Monitoring" OR telehealth OR "remote monitoring" OR "remote patient monitoring" OR "virtual nursing" OR "virtual care" OR "digital health" OR eHealth OR mHealth]] (Abstract] AND ("Cardiac Surgical Procedures" OR "Cardiovascular Surgical Procedures" OR "Thoracic Surgery" OR "Coronary Artery Bypass" "Heart Valve Prosthesis Implantation" OR "Heart Valve Repair" OR "cardiac surgery" OR "heart surgery" OR "cardiovascular surgery" OR "cardiac surgical procedure" OR "cardiac operation" OR "open heart surgery" OR "open-heart surgery" OR CABG OR "coronary artery bypass" OR "coronary artery bypass grafting" OR "valve surgery" OR "heart valve surgery" OR "valve replacement" OR "valve repair" OR "cardiac valve surgery"]](Abstract] AND ("Clinical Outcomes"](Abstract]
Google Scholar	Telenursing AND cardiac surgery AND Clinical Outcomes