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Systematic Review

Tele health Nursing Models in Virtual Hospitals: Effects on Patient Outcomes, Safety, and Service Efficiency in Outpatient, Critical Care, Medical Consultation, and Mental Health Services; A Systematic Review

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Abstract

Background: Telehealth enabled virtual hospitals are increasingly used to extend nursing care in outpatient follow-up, critical care, medical consultation, and mental health services. Studies found benefits for outcomes, safety, and efficiency, but effects differ by model and setting. **Objective:** To systematically review telehealth nursing models in virtual hospitals and evaluate the effects on patient outcomes, safety indicators, and service efficiency in major service lines. **Methods:** We conducted a systematic review of original studies according to PRISMA guidelines to evaluate nurse-involved telehealth models. Eligible designs included randomized trials and observational studies reporting at least one domain outcome (clinical outcomes, safety, or efficiency). Two reviewers independently screened records, extracted data, and assessed risk of bias using RoB 2 or ROBINS-I. Results were synthesized by service line and outcome domain. **Results:** Included studies covered nurse-led outpatient telemonitoring, transitional care, tele-ICU support, and telemental health care management. Telehealth nursing models were associated with reductions in readmissions and emergency visits in transitional care, improvements in symptom control and quality of life in chronic disease programs, and lower mortality or shorter ICU length of stay in tele-ICU contexts. Patient satisfaction and acceptability were positive. **Conclusion:** Telehealth nursing models in virtual hospitals improve outcomes and efficiency while supporting safe, continuous care. We need standardized reporting of safety indicators and implementation fidelity.

Keywords: Telehealth; Virtual hospital; Telenursing; Remote patient monitoring; Tele-ICU; Transitional care; Nurse-led

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Introduction

Virtual hospitals and telehealth nursing models expanded rapidly to address workforce constraints, rising acuity, and the need for continuous access to specialist support in outpatient follow-up, critical care, medical consultation, and mental health services. In telehealth programs, patient satisfaction is linked to perceived effectiveness, improved outcomes, convenience, and reduced travel (1). These drivers are highly relevant to nursing-led virtual care pathways, where symptom surveillance, education, and coordination can be delivered beyond traditional clinical settings.

In critical care, tele–ICU models is one of the most established forms of virtual hospital practice. A systematic review and meta-analysis of telemedicine in the ICU found reductions in ICU and hospital mortality and shorter ICU and hospital length of stay, and remote monitoring and specialist support improve outcomes in selected settings (2). Virtual hospital nursing also extends into transitional care and readmission prevention. In a meta-analysis of randomized trials, interventions aiming to prevent early readmission reduced 30 day readmissions overall (3).

In acute care, telehealth nursing models increasingly target chronic disease management and symptom control. A systematic review and meta-analysis of telecoaching interventions reported improvements in glycemic control and reductions in systolic blood pressure, this indicate the value of structured, remotely delivered coaching (4). In oncology, nurse-led telehealth has been evaluated for symptom outcomes and quality of life (5). In stroke survivorship, nurse-led telecare has been studied on follow-up outcomes and blood pressure control (6). Telepsychiatry study suggests comparable symptom outcomes to face to face care overall, with condition-specific differences (7). We aimed to conduct a systematic review focusing on how telehealth nursing models in virtual hospitals affect patient outcomes, safety, and service efficiency in service lines.

Methods

This systematic review was conducted and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement. The review aimed to analyze studies on telehealth nursing models delivered through virtual hospitals and their effects on patient outcomes, safety, and service efficiency in outpatient, critical care, medical consultation, and mental health services.

Eligibility criteria

We included original peer-reviewed studies that evaluated a telehealth care model with a defined nursing role (nurse-led follow-up, nursereviewed remote monitoring, nurse care management, or tele-ICU nursing teams with documented nursing processes). Eligible designs were randomized controlled trials, quasiexperimental studies, prospective or retrospective cohort studies, and controlled before after studies. Studies were required to report at least one outcome within: patient outcomes (mortality, rehospitalization, symptom control, quality of life), safety indicators (adverse events, emergency visits, protocol adherence), or service efficiency (length of stay, utilization, workflow indicators). We included adult populations in any clinical condition relevant to the target service lines (outpatient, ICU, consultation services, mental health). We excluded editorials, commentaries, protocols, conference abstracts without full text, nonoriginal studies, and studies

where the nursing component could not be distinguished.

Information sources and search strategy

An electronic search was performed in major bibliographic databases (PubMed, MEDLINE, CINAHL, and Scopus) from 2007 to 2025. We also screened reference lists of included studies and relevant reviews to identify additional eligible articles. Search terms combined controlled vocabulary and keywords related to telehealth and virtual hospitals (telemedicine, telehealth, remote monitoring, virtual care, tele-ICU, telenursing), nursing models (nurse-led, nurse care management, nursing intervention), and outcomes (mortality, readmission, safety, quality of life, length of stay, utilization). The full strategy was adapted for each database.

Study selection

All retrieved citations were exported to a reference manager, and duplicates were removed. Two reviewers independently screened titles and abstracts, followed by full-text assessment of eligible records. Disagreements were resolved through discussion and, when needed, consultation with a third reviewer. Reasons for exclusion at the full-text stage were documented.

Data extraction and quality appraisal

Two reviewers independently extracted data using a standardized form: study characteristics, setting, sample size, patient population, details of the telehealth nursing model, comparator, follow up duration, and outcomes. Risk of bias was assessed independently using RoB 2 for randomized trials and ROBINS-I for nonrandomized studies. Any disagreements were resolved by consensus.

Synthesis

Findings were summarized and organized by service line and outcome domain. Where studies were sufficiently comparable in design, intervention, and outcome metrics, quantitative pooling was planned; otherwise, results were presented descriptively with emphasis on direction and consistency of effects.

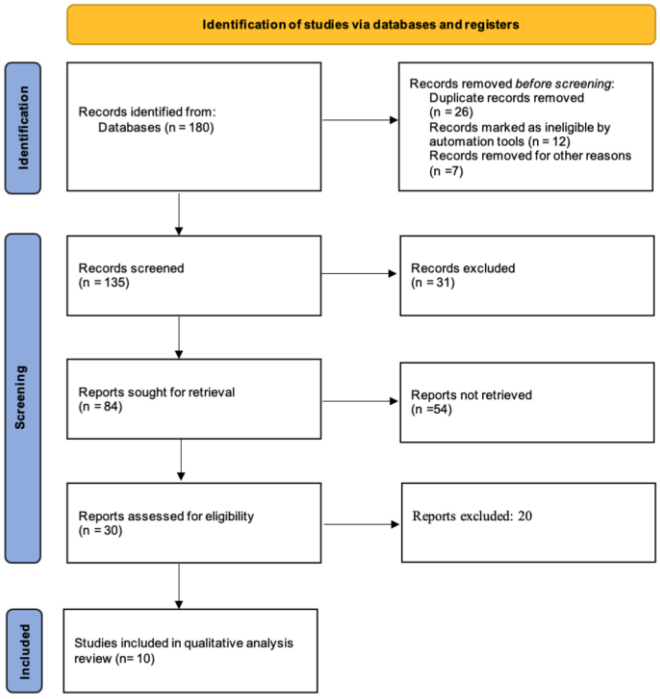

Fig 1: PRISMA flow chart

Results

We include ten studies evaluating telehealth models in outpatient chronic disease management, post-discharge monitoring, telemental health, caregiver support, and teleICU programs. Four were randomized trials, one secondary analysis of RCT data, and the others were observational or program evaluations.

Two studies targeted heart failure, two evaluated mental health services, one assessed caregiver outcomes, two examined home monitoring after discharge, and three investigated tele-ICU implementation. Outcomes included mortality,

readmissions, LOS, symptom scales, biomarkers, and satisfaction.

In outpatient heart failure, the nurse-led AMULET telecare program decreases the composite of first unplanned heart failure hospitalization or cardiovascular death over 12 months (17.1% vs 23.9%; HR 0.69) and lowered heart failure hospitalizations, with no difference in cardiovascular mortality. In a separate cohort study, a nurse-led follow-up program was associated with clinical improvement and fewer re hospitalizations at 12 months; NT-proBNP decreased more in the intervention group and heart failure re hospitalization was lower (19.6% vs 24.1%).

For high-risk patients after discharge, daily remote physiologic monitoring reviewed by nurses reduced 30-day readmission or death (23.7% vs 18.2%; RR 0.77) and reduced 30 day ED visits (14.2% vs 8.6%; RR 0.61). In primary care patients with type 2 diabetes and hypertension, home monitoring increased documented nursing activities, but the parent trial reported no significant differences in A1C or systolic blood pressure versus usual care. Telemedicine-enabled collaborative care improved depression outcomes in rural clinics: response and remission were higher at 6 and 12 months and patient satisfaction was greater than usual care. Within a VA program, care manager telephone contact was associated with improvement in PTSD symptoms, while an association with depression improvement was not significant in a small subgroup with elevated baseline PHQ-9. A caregiver telenursing program reduced anxiety, while depression did not differ significantly. In ICU settings, tele-ICU implementation was associated with lower mortality and shorter ICU stay or improved LOS metrics; one study reported a small increase in hospital LOS.

Table 1. Characteristics of the included studies

Study	Country and setting	Design	Population	Telehealth and virtualcare model	Comparator	Followup
Krzesinski et al., 2022 (4)	Poland; outpatient HF after recent acute HF	Prospecti ve RCT	HF with LVEF ≤49% after acute HF within 6 months (n=605; telecare 300, standard 305)	Nurse-led non-invasive assessments + telemedicine support enabling remote cardiologist decisions	Standard care	12 months
Mo et al., 2021 (8)	China; outpatient CHF management	Prospecti ve cohort (nonrandomized)	CHF patients (n=300; intervention 138, control 162)	Nurse-led program with follow-up targeting mental health and QoL; HF rehospitalization monitoring	Usual care	12 months
Dawson et al., 2021 (9)	USA; 2 tertiary hospitals	Prospecti ve RCT	High readmission-risk patients postdischarge (n=1380)	Home-installed monitoring (BP, HR, SpO2; weight if HF; glucose if diabetes) with daily transmission reviewed by a nurse	Standard care	30 days
Howland et al., 2020 (10)	USA; primary care clinic	Secondary analysis of RCT EMR data	Type 2 diabetes + hypertension (trial participants)	Home monitoring system transmitting self-measured glucose, BP; evaluated nursing activities (education, follow-up, medication adjustment)	Usual care	Trial period (per parent RCT)

Study	Country and setting	Design	Population	Telehealth and virtualcare model	Comparator	Followup
Goudarzian et al., 2018 (11)	Iran; caregivers of elderly stroke patients	RCT	Caregivers (n=154; telenursing 77, control 77)	Telephone follow-up: 12 weeks; 3 calls, week for 3 weeks then weekly (9 sessions; 20–30 min)	Routine care	12 weeks
Fortney et al., 2007 (12)	USA; 7 rural VA community clinics	Randomized trial	Depressed patients (n=395)	Telemedicine-based collaborative care	Usual care	6 and 12 months
Hoerster et al., 2015 (13)	USA; VA telemental health program	Program evaluation Mixed methods	Veterans enrolled in program	Care-manager telephone contact; examined association between contact intensity and PTSD, depression symptom change	No control group	Withinprogram followup
Becker et al., 2020 (14)	USA; 7 ICUs across 2 hospitals	Observational pre–post	ICU encounters (pre n=1403; post n=14874)	Tele-ICU implementation across ICUs (centralized remote support)	Preimplementation	Pre vs post periods
Sadaka et al., 2013 (15)	USA; community hospital ICU	Retrospective pre– post	Adult ICU admissions (pre vs post tele-ICU periods)	Tele-ICU program	Preintervention	Pre vs post periods
Watanabe et al., 2023 (16)	Japan; singlecenter ICU	Retrospective historical comparison	ICU admissions (pre n=893; post n=5438)	Tele-ICU intervention; included assessment of physician workload via EMR access metrics	Preintervention	Pre vs post periods

Table 2. Main findings and outcomes

Study	Key outcomes	Main findings
Goudarzian et al., 2018 (11)	Caregiver anxiety (STAI) and depression (BDI)	Anxiety improved with telenursing. Depression difference not statistically significant.
Fortney et al., 2007 (12)	Depression response, remission; patient satisfaction	Higher response and remission at both 6 and 12 months with telemedicine-based collaborative care; higher satisfaction versus usual care.
Hoerster et al., 2015 (13)	PTSD symptoms (PCL-M); depression (PHQ-9); feasibility	PTSD symptoms decreased (PCL-M 53.65 to 46.76) with care-manager contact. No statistically significant association with depression reduction in those with baseline PHQ-9 ≥10.
Becker et al., 2020 (14)	ICU and hospital mortality; ICU, hospital LOS; performance metrics	Tele-ICU associated with lower adjusted ICU mortality (OR 0.58) and hospital mortality (OR 0.66). Lower ICU and hospital LOS O, E ratios.
Sadaka et al., 2013 (15)	ICU mortality; ICU LOS; hospital outcomes	ICU mortality decreased (7.9% to 3.8%; OR 0.46). ICU LOS reduced (2.7 to 2.2 days).
Watanabe et al., 2023 (16)	ICU, hospital mortality; ICU, hospital LOS; ventilation duration; workload proxies	Lower unadjusted ICU and hospital mortality post-intervention. ICU LOS decreased; hospital LOS slightly increased.
Krzesinski et al., 2022 (4)	Unplanned HF hospitalization or CV death; HF hospitalizations; CV mortality	Primary composite: 17.1% vs 23.9% (HR 0.69). Reduced first and total HF hospitalizations; no difference in CV mortality.
Mo et al., 2021 (8)	NT-proBNP; NYHA class; HF re-hospitalization; mental health (MHI-5) and QoL (KCCQ)	Lower NT-pro BNP at 12 months and greater improvement. Fewer NYHA III–IV. HF re-hospitalization 19.6% vs 24.1%; nurse-led program independently associated with lower re-hospitalization.
Dawson et al., 2021 (9)	30-day readmission or death; 30day ED visit	Readmission and death reduced (23.7% vs 18.2%; RR 0.77). ED visits reduced (14.2% vs 8.6%; RR 0.61).
Howland et al., 2020 (10)	Nursing activities; A1C and systolic BP (parent RCT outcomes)	Home monitoring increased documented nursing activities. Parent RCT reported no significant differences in A1C or systolic BP versus usual care.

Discussion

This review analyzes articles on telehealth nursing models operating within virtual hospital ecosystems in outpatient follow-up, critical care support, medical consultation pathways, and mental health services. The studies aligns with broader telehealth literature which indicate that virtual care can be acceptable to patients and improve outcomes when integrated with clear workflows and responsive clinical escalation. In telehealth programs, satisfaction has been associated with perceived effectiveness, improved outcomes, and convenience-related benefits (1). This underscores the importance of usability, communication quality, and timely problem-solving, mainly when care is delivered in diverse populations and conditions.

A systematic review and meta-analysis found that telemedicine in ICUs reduced ICU and hospital mortality and shortened ICU and hospital length of stay. These benefits are mediated by enhanced surveillance, earlier intervention, and stronger adherence to best practices, mechanisms also discussed within tele–ICU evaluations (2). For virtual hospitals, this supports models where experienced remote nurses and intensivist teams partner with bedside staff to standardize care and provide coverage during low-intensity staffing periods.

In medical consultation and post-discharge care, readmission prevention is an important efficiency outcome. A meta-analysis of randomized trials show a reduction in 30-day readmissions, which support interventions that bridge inpatient to outpatient transitions and strengthen patient capacity for self care (3).

In outpatient chronic disease services, telecoaching meta-analysis indicates clinically good improvements in HbA1c and systolic blood pressure (4). Structured nurse-led coaching, goal setting, and iterative feedback contribute to physiologic benefit, when engagement is sustained. For mental health services, telepsychiatry trials show that symptom improvement is similar to face-to-face treatment, with some diagnosis specific differences (4,7,8). This supports virtual-hospital psychiatric nursing pathways indicating continuity, adherence support, and access, while recognizing that service design needs to be tailored by condition and risk profile.

A consistent implication is that outcomes depend less on telehealth vs. in-person and more on intervention intensity, clinical integration, and the reliability of escalation protocols. Future studies should report standardized safety indicators, service utilization metrics, and implementation fidelity to clarify which nursing components drive benefit in virtual hospitals.

Conclusion

Telehealth nursing models in virtual hospitals can extend access, strengthen monitoring, and support timely escalation across outpatient, critical care, consultation, and mental health services. Evidence from telehealth satisfaction syntheses indicates that convenience and perceived effectiveness shape acceptance. TeleICU meta-analysis findings suggest potential reductions in mortality and length of stay when remote services are integrated with bedside workflows.

List of abbreviation

BP=blood pressure; CHF=chronic heart failure; CV=cardiovascular; ED=emergency department; HF=heart failure; ICU=intensive care unit; LOS=length of stay; OR=odds ratio; RR=relative risk; RCT=randomized controlled trial; teleICU=tele–intensive care unit.

Data Availability Statement

The datasets generated or analyzed during the current study are available from the corresponding author on reasonable request.

Conflict of Interest

The authors declare no conflicts of interest.

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