Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Nursing-Relevant Quality and Safety Indicators in Home-Based Virtual Wards: A Scoping Review

Peng Peng

2508965124@qq.com

The Central Hospital of Xiangtan

An Luo

The Sixth Affiliated Hospital of Sun Yat-sen University

Siyu Chen

The Central Hospital of Xiangtan

Jing Xue

University of South China

Cong He

The Central Hospital of Xiangtan

Qiang Xu

University of South China

Yangyang Fang

University of South China

Peiyu Cheng

The Central Hospital of Xiangtan

Research Article

Keywords: Virtual wards, Hospital at Home, Nursing care, Quality indicators, Patient safety, Scoping review

Posted Date: November 20th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11419445/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Nursing-Relevant Quality and Safety Indicators in Home-Based Virtual Wards: A Scoping Review

Peng **Peng**[1¶], An **Luo**[2¶], Siyu **Chen**[1], Jing **Xue**[3], Cong **He**[1], Qiang **Xu**[3], Yangyang **Fang**[3], Peiyu **Cheng**[1*].

[1]The Central Hospital of Xiangtan, Xiangtan, Hunan Province, China

[2]The Sixth Affiliated Hospital of Sun Yat-sen University, Guangdong Province, China

[3]School of Nursing, University of South China, Hengyang, Hunan Province, China

E-mail:

Peng Peng: 2508965124@qq.com

An Luo: 1028361158@qq.com

* Corresponding author: chengpeiyu@hnu.edu.cn

¶ These authors contributed equally to this work.

Abstract

Background: Home-based virtual wards increasingly substitute for inpatient care, but the evaluative literature underpinning their quality and safety measurement remains sparse relative to this expansion, and nursing contributions are not consistently distinguished.

Aim: To map nursing-relevant quality and safety indicators for home-based virtual wards and to examine how completely they are specified and how far they have been applied.

Methods: We searched PubMed, CINAHL, Embase and Web of Science from inception to 21 July 2026 using Population–Concept–Context criteria, following JBI guidance and PRISMA-ScR. Quantitative measures were harmonised into indicator concepts and classified against five review-specific frameworks; non-quantitative practice standards were synthesised separately.

Results: Eleven sources were included: ten yielded 41 indicator concepts spanning 11 of 12 domains, and one contributed only practice standards. Medication management and vascular access was the largest domain (12 concepts, 29.3%); workforce planning

and competency contained one concept and patient selection and home suitability none. Five concepts (12.2%) were directly nursing-relevant, 25 (61.0%) nursing-contributory and 11 (26.8%) system-level. Eighteen were outcome, 17 process and six structure indicators. Twenty-three concepts (56.1%) had been applied empirically and the same 23 achieved high specification completeness; all 18 unapplied concepts were moderately (n = 6) or poorly (n = 12) specified.

Conclusions: The available evidence yields an uneven portfolio that largely measures multidisciplinary service performance, with little direct representation of nursing and persistent gaps in home-specific domains. Well-specified concepts should be standardised and tested for feasibility and measurement properties; new concepts should be developed only for the gaps identified, before any core set is assembled.

Registration: OSF, DOI: 10.17605/osf.io/puha4, deposited September 10, 2026; retrospectively registered, not prospectively registered.

Keywords: Virtual wards; Hospital at Home; Nursing care; Quality indicators; Patient safety; Scoping review

What is already known

· Nursing activity is integral to home-based virtual ward care, but this contribution is embedded within multidisciplinary pathways and is not consistently distinguished in service-level outcome measures such as readmission or hospital transfer.

· Evaluations of virtual ward and Hospital at Home services have concentrated on clinical outcomes and safety events, while care processes, workforce capability, patient selection and home suitability have been assessed less consistently.

· Practice standards, proposed indicators and empirically applied measures for these services are not always clearly distinguished from one another.

What this paper adds

· This review identified 41 nursing-relevant indicator concepts across 11 of 12 domains from only 11 eligible sources spanning 27 years, showing that indicator development

has not kept pace with the expansion of home-based virtual wards.

· A three-level nursing-relevance classification showed that most indicators reflect multidisciplinary contribution or system-level conditions rather than direct nursing attribution, with only five of the 41 concepts directly nursing-relevant.

· Empirically applied indicators were consistently well specified while unapplied indicators were not, identifying patient selection, home suitability, workforce competency and equity as priority targets for future indicator development.

1.Introduction

Home-based virtual wards provide time-limited, hospital-level care in a patient's usual residence, either as an alternative to inpatient admission or to support earlier discharge (Shi et al., 2024). The term overlaps with, but is not synonymous with, Hospital at Home (HaH) and Hospital in the Home (HITH), which predate contemporary virtual ward models (Norman et al., 2023; Shi et al., 2024). In this review, home-based virtual ward is used as an umbrella term for eligible HaH and HITH services that substitute for all or part of an acute inpatient episode under retained hospital-level clinical governance, whether or not digitally enabled. Their expansion has been associated with population ageing, increasing multimorbidity, and pressure on hospital capacity (Norman et al., 2023).

Quality and safety measurement in home-based virtual wards must account for acute care delivered outside a continuously staffed inpatient environment, where clinical observation is distributed across home visits, remote contact, and information reported by patients or caregivers (Powis et al., 2025; Shi et al., 2024; Wong et al., 2025). Safe care therefore depends on reliable surveillance and escalation pathways, caregiver preparedness, timely professional support, and home suitability (Chauhan and McAlister, 2022; Cheng et al., 2025; Mah et al., 2021; Vindrola-Padros et al., 2021). Mortality, readmission, transfer, emergency department use, and length of stay remain important performance measures, but alone provide an incomplete account of how safe, effective, and equitable care is delivered in the home (Norman et al., 2023; Shi et al., 2024).

Nursing is integral to home-based virtual ward care, encompassing clinical assessment, medication management, deterioration recognition and escalation, care coordination, education, and caregiver support (De Baetselier et al., 2022; Karam et al., 2021; Lewis et al., 2026; Liu et al., 2024). These activities are embedded within multidisciplinary pathways, making nursing's contribution difficult to isolate using conventional service outcomes (Kerr et al., 2021): counting only nurse-exclusive activities understates nursing, whereas reading multidisciplinary outcomes as nursing performance overstates it (Collet et al., 2025; Westby et al., 2024). The relevant question is therefore whether an indicator has a substantive relationship with nursing care, not whether its outcome is attributable to nursing alone — encompassing directly nursing-relevant, multidisciplinary nursing-contributory, and system-level indicators (Hung, 2023; Lewis et al., 2026; Tuinman et al., 2021).

Despite this expansion, published evidence on quality and safety measurement remains fragmented (Norman et al., 2023). The central problem is not an absence of reported outcomes but uneven domain coverage: care processes, caregiver experience, continuity, equity, workforce capability, patient selection, and home suitability have been examined less consistently than clinical outcomes and service utilisation (Larsen et al., 2025; Vindrola-Padros et al., 2021), and comparison between services is further limited by heterogeneity in care models, populations, and indicator definitions (Shi et al., 2024). Practice standards, proposed indicators, and empirically applied measures are also not always clearly distinguished (Larsen et al., 2025): practice standards can specify expected service capabilities without providing the construct definitions, calculation rules, or data sources needed for reproducible quantitative measurement (Greene et al., 2024; Westby et al., 2024). Given the pace of virtual ward expansion, whether the evidence has kept pace is itself an empirical question this review addresses. This scoping review therefore aimed to identify and harmonise quality and safety indicators relevant to nursing in home-based virtual wards, including eligible HaH and HITH services, in order to: (1) map identified concepts across a review-specific 12-domain taxonomy; (2) classify them by nursing relevance, Donabedian component, and quality dimension; and (3) describe their empirical application status and operational

specification completeness — thereby characterising the visibility of nursing within the existing indicator portfolio without implying exclusive professional attribution.

2.Methods

2.1 Design

This scoping review was conducted in accordance with the Joanna Briggs Institute (JBI) methodological guidance for scoping reviews (Peters et al., 2020) and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) checklist (Tricco et al., 2018). A scoping review design was selected because the evidence was expected to encompass heterogeneous service models, study designs, terminology, and measurement approaches, and because the purpose was to map, harmonise, and characterise the available indicator evidence rather than evaluate a specific intervention or estimate a pooled effect (Munn et al., 2018).

The review methods and analytical framework were deposited on the Open Science Framework on 10 September 2026 (DOI: 10.17605/osf.io/puha4); this constitutes retrospective registration and does not meet the criteria for prospective registration.

2.2 Review question and eligibility criteria

The primary review question was: What quality and safety indicators relevant to nursing have been used or proposed in home-based virtual wards, and how have these indicators been defined and operationalised? Secondary questions examined the distribution of the identified concepts across indicator domains, nursing-relevance categories, Donabedian components, and quality dimensions, as well as their empirical application status and operational specification completeness.

Eligibility criteria were structured using the Population–Concept–Context framework (Peters et al., 2020). The population comprised patients receiving eligible home-based virtual ward care. Caregivers and healthcare professionals were also within scope when their experiences, activities, or characteristics contributed directly to the development, measurement, or evaluation of an eligible indicator. The concept

comprised explicitly identified quality or safety indicators, key performance indicators, metrics, performance measures, indicator sets, or other evaluative measures with an identifiable relationship to nursing care. Quantitative measures were eligible when they assessed a defined aspect of care quality, patient safety, clinical or service performance, or care delivery. Peer-reviewed practice standards and evaluation frameworks were eligible when they articulated explicit quality or safety expectations relevant to nursing, even if they did not provide an operationalisable quantitative measure; these sources were analysed separately from the quantitative indicator concepts. Nursing relevance encompassed directly nursing-relevant measures, multidisciplinary measures to which nursing made a substantive contribution, and system-level conditions with clear implications for nursing care. The context was defined as time-limited, hospital-level acute care delivered predominantly in the patient's usual residence under retained hospital governance or clinical responsibility, either as an alternative to inpatient admission or to facilitate earlier discharge. Hospital at Home and Hospital in the Home services were eligible when they met this service-level definition. Digital enablement, remote monitoring, or virtual consultation was not required for inclusion.

Peer-reviewed, English-language, full-text sources were eligible without restrictions on publication year, patient age, clinical condition, or study design. Eligible sources included empirical studies, service evaluations, quality-improvement studies, indicator-development or validation studies, and peer-reviewed practice-standard or evaluation-framework publications. Sources covering more than one care setting were included only when findings relating to an eligible home-based virtual ward model could be identified separately.

Sources were excluded when they addressed conventional inpatient care, in-hospital virtual nursing, routine home or community care, primary care, outpatient care, long-term care, or stand-alone telehealth or remote-monitoring programmes without retained hospital-level clinical responsibility. Sources were also excluded if they did not report an eligible quality or safety indicator, presented only descriptive variables or clinical outcomes without an explicit evaluative function, or contained no identifiable relevance to nursing practice, nursing contribution, or the conditions under which

nursing care was delivered. Conference abstracts or papers, protocols, editorials, commentaries, dissertations, and other grey literature were excluded. This threshold was applied deliberately: sources reporting clinical or service variables without an explicit evaluative function, or without identifiable nursing relevance, were excluded even when such variables were common in the broader virtual ward literature.

2.3 Search strategy

PubMed, CINAHL, Embase, and Web of Science Core Collection were searched from database inception to 21 July 2026. The searches combined controlled vocabulary, where available, with free-text terms covering three principal concepts: (1) home-based virtual wards, Hospital at Home, and Hospital in the Home; (2) healthcare quality and patient safety; and (3) indicators, performance measures, standards, quality assessment, audit, benchmarking, and service evaluation.

The search was intentionally broad because potentially eligible measures were not consistently described as indicators in the published literature. Indicator-specific terminology was therefore combined with broader quality-assessment and service-evaluation terms to identify sources in which relevant measures were reported as outcomes, metrics, standards, audit criteria, or performance measures. Search terms, subject headings, field codes, truncation, phrase searching, and Boolean operators were adapted to the indexing structure and syntax of each database.

No publication-date restrictions were applied. Retrieved records from the four databases were combined before duplicate removal, after which the eligibility criteria were applied during title and abstract screening and full-text assessment. The complete database-specific search strategies, including the exact search syntax used for each database, are provided in Supplementary Appendix S1.

2.4 Source selection

After duplicate records were removed, two reviewers (P.P. and A.L.) independently screened titles and abstracts against the eligibility criteria described above. Reports considered potentially eligible by either reviewer were sought in full text. Reports that could not be obtained were recorded separately as not retrieved and

were not included among the full-text eligibility exclusions. Retrieved full-text reports were assessed independently by the same reviewers, and one primary reason for exclusion was recorded for each ineligible report. Disagreements at either stage were resolved through discussion and consensus, with consultation of a third reviewer when required. The source-selection process is presented in the PRISMA-ScR flow diagram (Figure 1).

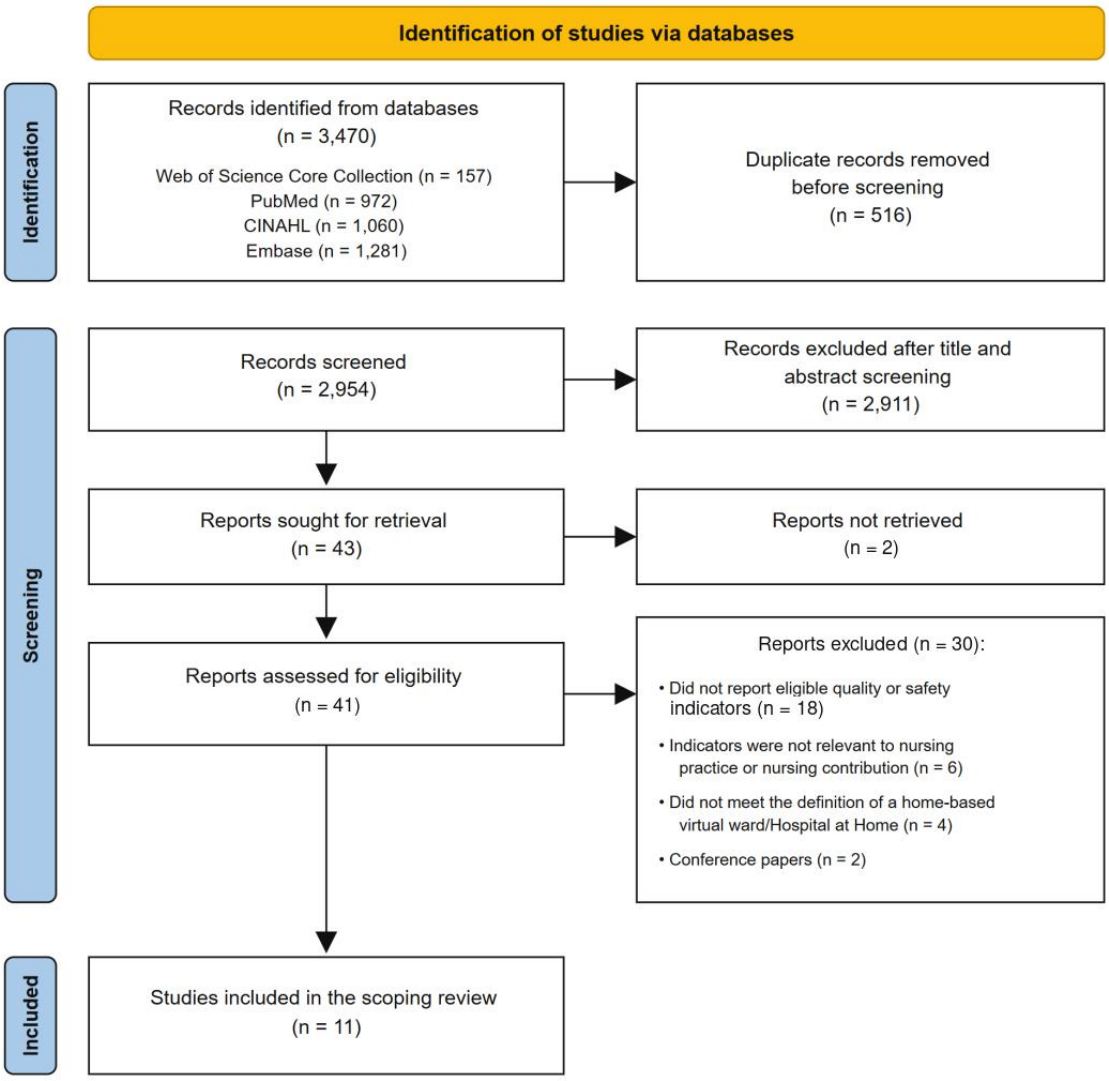

Figure 1. PRISMA-ScR flow diagram of source selection.

2.5 Data charting and harmonisation

Data were charted independently by two reviewers (P.P. and A.L.) using a standardised form developed for this review. Source-level data comprised author, publication year, country and region, study aim and design, sample or data source, study

period, care setting and model, and primary evidence contribution. Measure-level data comprised the original measure label, measured construct, operational definition, numerator and denominator or scoring rule, target population, analytic unit, measurement timing or observation window, data source or instrument, reported target or benchmark, and evidence of empirical application. Discrepancies were resolved through discussion and consensus.

Measures were retained when they were reported as an indicator, key performance indicator, metric, or other explicitly evaluative measure of service quality or safety. Variables reported solely to describe study populations, adjust statistical models, or provide contextual information were not treated as indicators. The original wording and operational details of every retained measure were preserved in Supplementary Table S1.

Harmonisation was undertaken at the construct level. Measures were grouped within the same indicator concept only when they represented an equivalent underlying construct and had a consistent intended interpretation. Where measures addressed the same construct but differed in target population, numerator or denominator, analytic unit, direction of interpretation, measurement window, data source, or threshold, these differences were retained as source-specific operational variants. Measures were maintained as separate concepts when such differences materially changed what was being measured or how the result should be interpreted. We did not infer missing definitions; partial specification was credited only where the source provided identifiable detail.

The 12-domain taxonomy was developed specifically for this review and iteratively refined during data charting to organise the breadth of retained concepts according to their principal care or service function. To reduce the risk that domain boundaries reflected reviewer-specific judgement rather than field-recognised categories, the taxonomy was cross-checked against related domain structures in this evidence base and the broader nursing-sensitive-indicator literature, including the seven-domain structure of the included HaH Practice Standards (Levine et al., 2025) and domains commonly used in frameworks such as the National Database of Nursing

Quality Indicators (NDNQI). Domain labels and boundaries were reviewed against the complete concept set and then applied consistently across all concepts. Each harmonised concept was assigned to one mutually exclusive primary domain to prevent duplicate counting. Where a concept could plausibly relate to more than one domain, assignment was based on its principal measured construct; cross-cutting attributes were captured separately through the non-mutually exclusive quality-dimension classification described in Section 2.6. The taxonomy was used as an analytical organising framework and was not treated as a validated measurement instrument.

Practice standards, organisational expectations, and recommendations that did not provide an operationalisable quantitative measure were retained in a separate practice-standards layer. They were not incorporated into the 41-concept pool and did not contribute to concept-level frequencies, percentages, application-status classifications, or operational-specification completeness scores.

2.6 Classification framework and synthesis

Each concept was characterised against five frameworks — nursing relevance, Donabedian component, quality dimension, application status and specification completeness — and each source by its primary evidence contribution (Table 1).

Table 1. Review-specific classification frameworks applied to harmonised indicator concepts and included sources

Framework	Category / Element	Definition
Nursing relevance (mutually exclusive)[a]	Directly nursing-relevant	Explicitly measures a nursing structure, a nursing-delivered process, or an outcome immediately linked to an identifiable nursing activity
	Nursing-contributory	A multidisciplinary process or outcome to which nursing makes a substantive, identifiable contribution but which cannot reasonably be attributed to nursing alone
	System-level nursing-relevant	An organisational, technological, governance, capacity, or service-level condition that materially shapes the context of nursing care without directly measuring a nursing activity
Donabedian component (mutually exclusive)[b]	Structure / Process / Outcome	Structure: resources, workforce, infrastructure, or service capabilities required to deliver care. Process: actions undertaken in providing, coordinating, monitoring, or escalating care. Outcome: patient health outcomes, safety events, experiences, or service consequences observed following care(Donabedian, 1988)
Quality dimension (non-mutually exclusive)[c]	Safety; Effectiveness; Patient-centredness; Timeliness; Efficiency; Equity	Assigned using Berwick's(Berwick, 2002) quality dimensions; a dimension was assigned only when directly supported by the construct definition or operational rule. Full category-level definitions in Supplementary Table S2
Empirical application status (mutually exclusive)[a]	Applied-direct	A construct-aligned operational variant was calculated, audited, monitored, or applied using data from an eligible service
	Applied-restricted	Application identified, but the variant measured only a component of the construct or did not fully retain its essential features
	Not applied	Proposed, recommended, or described, but not operationally applied within the included sources
Operational specification completeness (5 elements; 0–5 total)[a]	High 4.0–5.0; Moderate 2.5–3.5; Low 0–2.0	Scored across five elements — construct definition; calculation/scoring rule; target population/denominator/analytic unit; measurement timing/observation window; data source/instrument — each rated 0/0.5/1. Full scoring protocol in Supplementary Table S2
Source-level evidence contribution (mutually exclusive; source level)[a]	Empirical measurement/service evaluation	Primary contribution is empirical indicator measurement or service-performance evaluation
	Indicator/practice-standard development	Primary contribution is developing or proposing indicators or practice standards
	Quality-improvement intervention	Primary contribution is a quality-improvement intervention study

Notes. [a]When more than one category was plausible, classification followed the most direct relationship between the measured construct and nursing care. [b]When a concept had features of more than one component, classification was based on what was quantified rather than its presumed determinants or downstream effects. [c]A dimension was assigned only when directly supported by the construct definition, operational rule, or intended direction of interpretation, not inferred solely from a plausible indirect benefit; totals may exceed the number of concepts. Full decision rules, boundary-case examples, and category definitions for nursing relevance, Donabedian component and quality dimension are provided in Supplementary Table S2. [d]Where multiple operational variants existed, the most completely specified variant was scored; for Applied-restricted concepts, the selected variant was scored and its limited construct alignment documented separately in Supplementary Table S1. [e]Where a source could plausibly contribute to more than one category, classification followed its primary objective and the form of evidence used in

the synthesis. None of these frameworks was treated as a validated measurement scale or as an assessment of indicator validity or overall quality.

Two reviewers (P.P. and A.L.) independently applied the classification and scoring criteria to each concept and source, with disagreements resolved as in Section 2.4; the frameworks were iteratively refined during data charting and then applied consistently across the full concept set. Because the nursing-relevance framework required the most interpretive judgement of the five frameworks in Table 1, its reproducibility was additionally examined through a post-hoc inter-rater reliability check after data charting was complete. A third author (Y.F.), who had not participated in the original classification, independently classified all 41 harmonised concepts while blinded to the consensus assignments, using only each concept's name and domain together with the category definitions and decision rule in Table 1; the fuller construct-level detail available to the original coders (Supplementary Table S1) was withheld, making this a restricted-information post-hoc agreement check. Agreement with the consensus classification was quantified as raw percentage agreement, Cohen's kappa, and Gwet's AC1, the latter included because the marginal distribution of the three categories was unbalanced, a condition under which kappa can understate agreement (Gwet, 2008). Results were summarised narratively using frequencies and percentages; because the review mapped heterogeneous evidence rather than estimated pooled effects, no meta-analysis or inferential comparison was undertaken. Concept-level assignments, completeness scores, and classification rationales are reported in Supplementary Table S2. Non-quantitative practice standards were synthesised separately and excluded from concept-level classifications and scores unless they also provided an eligible quantitative measure. Each concept was scored on its most completely specified variant.

3.Results

3.1 Source selection

The database searches identified 3,470 records: 1,281 from Embase, 1,060 from CINAHL, 972 from PubMed, and 157 from Web of Science Core Collection. After 516 duplicate records were removed, 2,954 records underwent title and abstract screening,

of which 2,911 were excluded.

Forty-three reports were sought for retrieval. Two reports could not be obtained, leaving 41 full-text reports for eligibility assessment. Of these, 30 were excluded: 18 did not report an eligible quality or safety indicator; six reported indicators without an identifiable relationship to nursing practice or nursing contribution; four did not meet the review definition of a home-based virtual ward or Hospital at Home service; and two were conference papers. Eleven sources met all eligibility criteria and were included in the scoping review (Figure 1). Exclusions were concentrated in the absence of an explicit evaluative indicator or identifiable nursing relevance, rather than in the service-level definition of a home-based virtual ward.

3.2 Characteristics of included sources

The 11 included sources were published between 1999 and 2026 and represented five countries: Australia (n = 4), the United States (n = 3), Spain (n = 2), France (n = 1), and Chile (n = 1). At the regional level, four sources originated from Oceania, three from North America, three from Europe, and one from South America (Table 2; Figure 2A).

The evidence base encompassed prospective and retrospective observational studies, clinical audits, service evaluations, registry-based analyses, survey research, indicator-development studies, practice-standard development, and one quality-improvement intervention. Units of analysis included patients, admissions or care episodes, vascular-access devices, and healthcare services. Sample sizes ranged from small single-site cohorts and implementation evaluations to a population-based analysis of 31,901 Hospital at Home episodes (Table 2).

The included sources examined conventional Hospital in the Home services, admission-avoidance and early-discharge Hospital at Home programmes, acute hospital care-at-home models, and condition-specific virtual multidisciplinary pathways. The extent of digital enablement varied between services and was not used to determine eligibility when the model otherwise met the review definition of hospital-level acute care delivered in the home.

Based on their primary contribution to the review, seven sources were classified as empirical indicator measurement or service evaluation, three as indicator or practice-standard development, and one as a quality-improvement intervention (Figure 2B). Each source was assigned to one mutually exclusive primary evidence-contribution category. Ten sources contributed at least one quantitative measure to the 41 harmonised indicator concepts, whereas one source contributed exclusively to the separate practice-standards layer and was not included in the concept-level analyses.

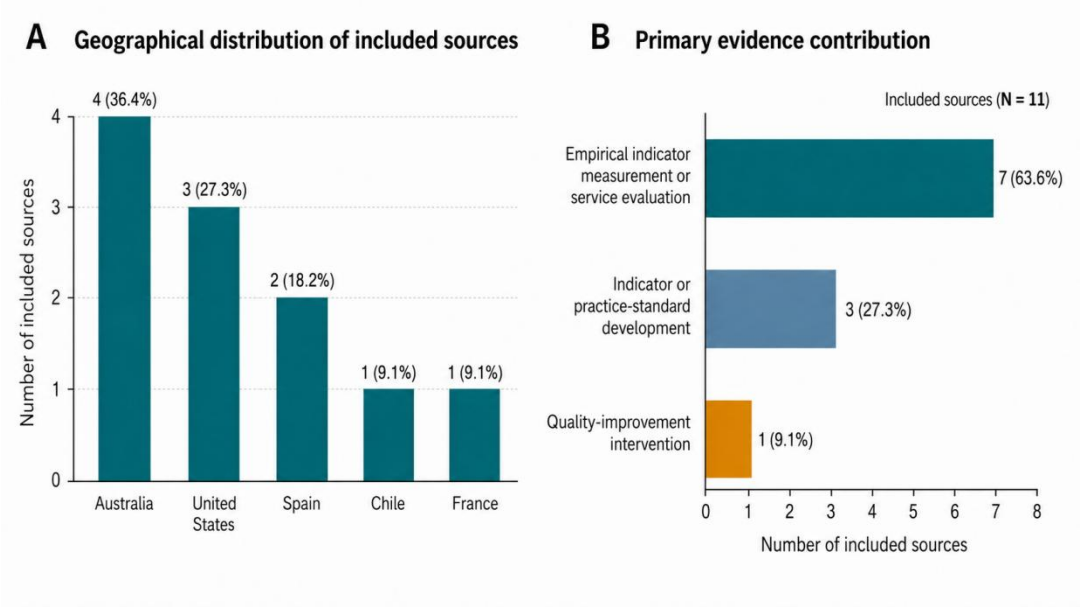

Figure 2. Geographical distribution and primary evidence contribution of the included sources (source-level analysis, N = 11).

(A) Number and proportion of included sources by country. (B) Distribution of sources according to their mutually exclusive primary evidence contribution: empirical indicator measurement or service evaluation, indicator or practice-standard development, or quality-improvement intervention. Each source was counted once according to its primary contribution. Ten sources contributed quantitative measures to the harmonised indicator-concept pool; one contributed exclusively to the separate practice-standards layer.

Table 2. Characteristics and primary evidence contributions of the included sources (N = 11)

Author(s), year	Country/region	Aim	Study design	Sample or data source and study period	Care setting and model	Primary evidence contribution and measurement focus
Montalto et al. (1999)	Australia Oceania	To develop, operationalise, and field-test	Prospective descriptive	759 admissions;	HITH; nine Victorian units delivering	**Indicator or practice-standard**

Author(s), year	Country/region	Aim	Study design	Sample or data source and study period	Care setting and model	Primary evidence contribution and measurement focus
		clinical indicators for HITH.	multicentre field test	March–May 1998	hospital-substitution care at home	**development.** Developed five clinical indicators, operationalised them as 10 measures, and field-tested their implementation across nine HITH units.
Mann et al. (2018)	United States North America	To describe adverse drug events (ADEs) and potential ADEs in HaH.	Retrospective case series with structured chart review	First 50 consecutive adults; November 2014–October 2015; follow-up through 30 days after discharge	HaH accepting patients from the emergency department, outpatient clinics, or home; Mount Sinai Mobile Acute Care Team	**Empirical indicator measurement or service evaluation.** Reported medication-harm incidence and event-category measures, including administration and adherence problems.
Page et al. (2018)	Australia Oceania	To assess equity of participation in HITH.	Retrospective administrative-record analysis with multivariable logistic regression	3,552 potentially eligible adults; 931 received HITH; December 2013–March 2015	HITH services across four hospitals/outreach services in the Sydney Local Health District, delivered under nursing and medical oversight	**Empirical indicator measurement or service evaluation.** Reported overall and stratified access measures by age, sex, home language, socioeconomic disadvantage, and diagnosis.
Dickson et al. (2019)	Australia Oceania	To compare midline-catheter and PICC performance and investigate failures.	Retrospective cohort audit triggered by a cluster of device failures	59 patients; 71 device-associated admissions (38 midline-catheter and 33 PICC admissions); December	HITH; Liverpool Hospital outpatient antimicrobial programme	**Empirical indicator measurement or service evaluation.** Reported vascular-access dwell time, failure

Author(s), year	Country/region	Aim	Study design	Sample or data source and study period	Care setting and model	Primary evidence contribution and measurement focus
				2016–March 2017		incidence and reasons, and factors associated with failure.
González-Colom et al. (2024)	Spain (Catalonia) Europe	To assess regional HaH outcomes and propose transferable key performance indicators.	Mixed methods: population-based retrospective registry analysis plus expert focus groups	31,901 HaH episodes (2015–2019); matched analysis, 24,802 HaH versus 24,802 conventional admissions; seven experts	Admission-avoidance HaH across 27 Catalan hospitals	**Empirical indicator measurement or service evaluation.** Evaluated population-level HaH outcomes and service heterogeneity; through expert consultation, selected 16 generalisable structure, process, and outcome KPIs.
Puchi et al. (2025)	Chile South America	To develop a multidimensional HaH quality indicator set.	Three-round e-Delphi indicator-development study	20 experts consented; 17 completed round 1; 13 completed rounds 2 and 3	HaH programmes represented by 14 units in Chile	**Indicator or practice-standard development.** Generated 22 proposed indicators across effectiveness, efficiency, timeliness, patient-centredness, equity, and safety (nine new, 13 adapted).
Levine et al. (2025)	United States North America	To develop national HaH practice standards and assess self-reported practice performance against them.	National practice-standard development with cross-sectional programme self-assessment	20-member Practice Standards Council; 31 standards; 49/213 eligible HaH practices responded (23.0%)	US HaH practices participating in the Hospital at Home Users Group practice-standards survey	**Indicator or practice-standard development.** Produced 31 assessable standards across seven domains, retained as a separate practice-standards layer rather than as

Author(s), year	Country/region	Aim	Study design	Sample or data source and study period	Care setting and model	Primary evidence contribution and measurement focus
						quantitative indicator concepts.
Webster et al. (2025)	United States North America	To assess whether a low-technology medication-storage system reduced medication errors.	Pre–post quality-improvement project, reported in accordance with SQUIRE 2.0	552 admissions (292 pre, 260 post); January–December 2022; surveys of 10 patients and 12 healthcare workers	Academic medical-centre HaH programme; video-call nurse verification and a medication-storage intervention	**Quality-improvement intervention.** Compared medication-error rates and profiles before and after implementation; reported patient and staff satisfaction survey findings.
Billotte et al. (2026)	France Europe	To describe the implementation and clinical impact of admission medication reconciliation.	Retrospective observational implementation study	29 patients receiving medication reconciliation; January 2022–June 2023	HaH facility; pharmacy-led admission medication reconciliation, including in-home medication review	**Empirical indicator measurement or service evaluation.** Reported timeliness, discrepancy, intervention, acceptance, and CLEO impact measures.
Granel et al. (2026)	Spain Europe	To evaluate patient-safety culture among HaH professionals.	National descriptive cross-sectional survey	199 professionals (72.0% nurses); December 2024–February 2025	Public HaH services in 11 of 13 Spanish autonomous communities with HaH	**Empirical indicator measurement or service evaluation.** Reported 10 HSOPSC 2.0 composite dimensions, positive-response rates, and overall/global safety assessments.
Nguyen et al. (2026)	Australia Oceania	To design, implement, and evaluate a virtual clinical pharmacy service.	Retrospective audit and service evaluation	140 patients; 15 March–30 September 2022	Cardiology and post-cardiac-surgery HITH-VC programme delivered through remote monitoring and a hospital-	**Empirical indicator measurement or service evaluation.** Reported medication-reconciliation

Author(s), year	Country/region	Aim	Study design	Sample or data source and study period	Care setting and model	Primary evidence contribution and measurement focus
					based virtual multidisciplinary team, including nursing case managers, cardiologists, and a clinical pharmacist, with pathways for in-person escalation when required	, counselling, intervention, supply, discharge-documentation, and 30-day outcome measures.

Note. Country indicates the location of the evaluated service or indicator-development work rather than author affiliation. Regions were grouped as Europe, North America, Oceania, and South America. The bold opening phrase in the final column identifies the mutually exclusive primary evidence-contribution category used in Figure 2B. Publication year was based on final issue assignment; Billotte et al. and Nguyen et al. were available online before assignment to 2026 issues. Levine et al. (2025) contributed exclusively to the practice-standards layer and was excluded from the 41-concept analysis.

Abbreviations. ADE, adverse drug event; CLEO, Clinical, Economic and Organisational; HaH, hospital at home; HITH, hospital in the home; HITH-VC, Hospital in the Home Virtual Care; HSOPSC, Hospital Survey on Patient Safety Culture; KPI, key performance indicator; PICC, peripherally inserted central catheter; SQUIRE, Standards for Quality Improvement Reporting Excellence.

3.3 Harmonised indicator concepts and domain distribution

Measures reported across the included sources were harmonised into 41 conceptually distinct quality and safety indicator concepts relevant to nursing in home-based virtual wards. Ten sources contributed at least one retained quantitative concept. Levine et al. contributed exclusively to the separate practice-standards layer; consequently, its standards-based self-assessment content was not included in the 41-concept pool or in the concept-level counts (Levine et al., 2025). Source-level measure-to-concept mappings and retained operational variants are provided in Supplementary Table S1, while concept-level classifications are reported in Supplementary Table S2.

The 41 concepts were distributed across 11 of the 12 review-specific indicator

domains (Supplementary Table S2; Figure 3A). Medication management and vascular access was the largest domain, comprising 12 concepts (29.3%). These concepts addressed medication errors, medication reconciliation, adverse and potential adverse drug events, medication education, and vascular-access management and complications (Billotte et al., 2026; Dickson et al., 2019; Mann et al., 2018; Montalto et al., 1999; Nguyen et al., 2026; Puchi et al., 2025; Webster et al., 2025).

The remaining domains contained between one and five concepts each (Supplementary Table S2; Figure 3A). Coverage was thinnest for workforce planning and competency (one concept) and absent for patient selection and home suitability.

No retained quantitative indicator concept was assigned to patient selection and home suitability. Standards-based expectations concerning patient eligibility, caregiver availability and preparedness, suitability of the home environment, and escalation planning were identified in the separate practice-standards layer (Levine et al., 2025). Because these expectations described required service capabilities without specifying operationalisable quantitative measures, they were not incorporated into the 41-concept pool or included in the concept-level classifications and counts.

3.4 Nursing relevance, Donabedian classification and quality dimensions

Of the 41 harmonised indicator concepts, 25 (61.0%) were classified as nursing-contributory, 11 (26.8%) as system-level nursing-relevant, and five (12.2%) as directly nursing-relevant (Figure 3A; Supplementary Table S2). Agreement between this classification and the independent, blinded post-hoc reclassification described in Section 2.6 was 87.8% (36/41 concepts), with Cohen's $\kappa = 0.79$, indicating substantial agreement, and Gwet's AC1 = 0.83, indicating almost-perfect agreement (Landis and Koch, 1977). The five disagreements occurred only between conceptually adjacent categories: three at the directly nursing-relevant/nursing-contributory boundary, involving nurse-delivered activities embedded in multidisciplinary processes (medication-administration errors, medication education or counselling, and admission-information provision), and two at the nursing-contributory/system-level

boundary (laboratory-result turnaround time and discharge destination); no concept was reclassified between directly nursing-relevant and system-level nursing-relevant, the two most conceptually distant categories. The five directly nursing-relevant concepts comprised pressure-injury risk identification or assessment, peripheral or midline catheter functional survival, peripheral-catheter phlebitis, vascular-access device dwell time, and pressure injury occurring during Hospital at Home care (Dickson et al., 2019; Puchi et al., 2025). Nursing-contributory concepts encompassed multidisciplinary care processes and outcomes, including service contacts, medication-management processes, adverse drug events, hospital use, mortality, length of stay, and patient or caregiver experience (González-Colom et al., 2024; Mann et al., 2018; Montalto et al., 1999; Nguyen et al., 2026; Puchi et al., 2025; Webster et al., 2025). System-level nursing-relevant concepts addressed organisational safety culture, workforce and service capacity, clinical and digital infrastructure, service participation, and equity of access (González-Colom et al., 2024; Granel et al., 2026; Page et al., 2018; Puchi et al., 2025).

According to the Donabedian framework, 18 concepts (43.9%) were classified as outcomes, 17 (41.5%) as processes, and six (14.6%) as structures (Supplementary Table S2). Structure concepts assessed organisational safety culture, workforce capacity, clinical equipment, digital infrastructure, remote-contact capability, and service capacity. Process concepts included clinical assessment, service contacts, medication-management activities, patient or caregiver communication, and annual service activity. Outcome concepts comprised clinical harm, vascular-access outcomes, hospital use, mortality, discharge disposition, patient and caregiver experience, service participation, and length of stay.

Quality-dimension assignments were non-mutually exclusive. Safety was the most frequently represented dimension, assigned to 23 concepts (56.1%). Effectiveness, patient-centredness, and timeliness were each assigned to six concepts (14.6%), efficiency to five (12.2%), and equity to one (2.4%) (Supplementary Table S2).

3.5 Empirical application status, source convergence and operationalisation completeness

Two concepts were Applied-restricted. For unplanned emergency department utilisation, the empirical variants did not consistently preserve the unplanned, case-related or same-reason qualifiers of the proposed measures. For patient experience, measurement was confined to satisfaction with a medication-storage system and did not capture the service-level construct (González-Colom et al., 2024; Webster et al., 2025). Overall, 23 concepts (56.1%) had some form of empirical application in an eligible home-based virtual ward service, whereas 18 (43.9%) were classified as Not applied within the included literature (Figure 3B; Supplementary Table S2).

Source convergence was limited. Twenty-nine concepts (70.7%) were supported by a single source, eight (19.5%) by two sources, and four (9.8%) by three sources; no concept was reported by more than three included sources. Supporting-source frequency was assessed independently of empirical application status, and concepts reported by multiple sources were not necessarily operationalised in the same manner. Source-specific operational variants and their mappings to the harmonised concepts are presented in Supplementary Table S1.

Operational specification completeness was high for 23 concepts (56.1%), moderate for six (14.6%), and low for 12 (29.3%) (Figure 3C; Supplementary Table S2). Cross-classification showed that all 21 Applied-direct concepts and both Applied-restricted concepts had high operational specification completeness. The 18 Not applied concepts comprised all six moderately specified concepts and all 12 concepts with low completeness; none had high completeness. Across the moderate- and low-completeness concepts, incompletely reported elements included the construct definition, calculation or scoring rule, target population, denominator or analytic unit, measurement timing or observation window, and data source or instrument.

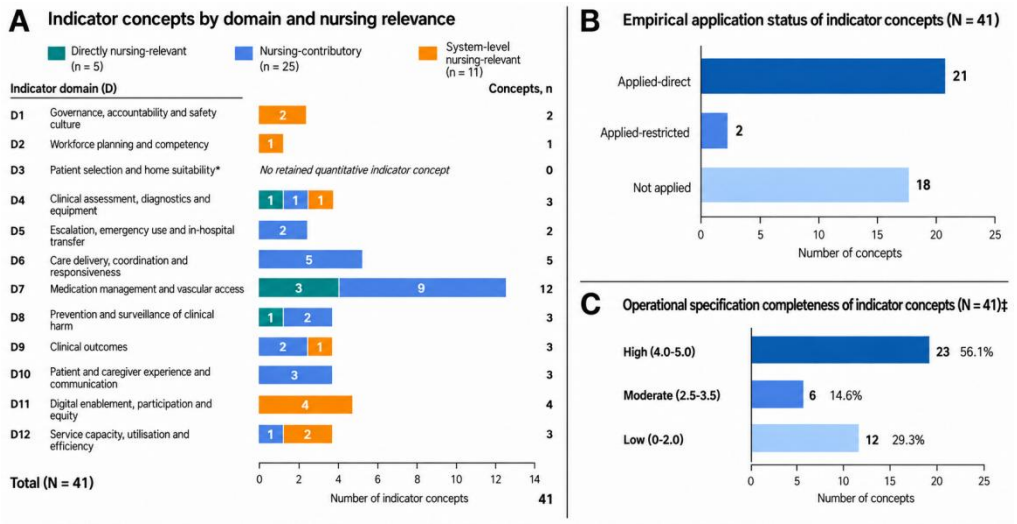

Figure 3. Distribution, empirical application status and operational specification completeness of the 41 harmonised nursing-relevant quality and safety indicator concepts in home-based virtual ward services.

(A) Distribution across the 12 review-specific domains and three nursing-relevance categories: directly nursing-relevant (n = 5), nursing-contributory (n = 25), system-level nursing-relevant (n = 11). (B) Empirical application status (category definitions in Table 1): Applied-direct (n = 21), Applied-restricted (n = 2), Not applied (n = 18). (C) Operational specification completeness (scoring criteria in Table 1): high (n = 23), moderate (n = 6), low (n = 12); assessed independently of empirical application status.

* No quantitative indicator concept was retained for patient selection and home suitability; relevant content appeared only in the separate practice-standards layer. Source-level mappings and operational variants are provided in Supplementary Table S1; concept-level classifications, scores, and coding rationales in Supplementary Table S2.

4.Discussion

4.1 Principal findings

This scoping review synthesised 11 peer-reviewed sources from five countries, spanning service evaluations, indicator-development studies, practice standards, and one quality-improvement intervention (Billotte et al., 2026; Dickson et al., 2019; González-Colom et al., 2024; Granel et al., 2026; Levine et al., 2025; Mann et al., 2018; Montalto et al., 1999; Nguyen et al., 2026; Page et al., 2018; Puchi et al., 2025; Webster et al., 2025). Ten sources yielded quantitative measures harmonised into 41 nursing-

relevant indicator concepts across 11 of 12 review domains; one practice-standard source was retained separately. That only 11 peer-reviewed sources met an explicitly evaluative, nursing-linked indicator definition, across more than two decades (1999–2026) and five countries, is itself a principal finding: measurement development has not kept pace with service expansion. This scarcity was not an artefact of an overly narrow service definition — most exclusions reflected the absence of an explicit evaluative indicator or identifiable nursing relevance (Section 3.1) — but a genuine feature of the available literature. Three findings stand out.

First, the indicator portfolio was safety-dominated, concentrated in medication and vascular-access management, adverse events, and service utilisation; no concept addressed patient selection or home suitability, workforce planning and competency contained only one concept, and equity — the least-represented quality dimension — was assigned to only one concept. The Donabedian distribution was comparatively balanced (outcome n = 18, process n = 17, structural n = 6), indicating that the imbalance lay in domain coverage rather than in an excess of outcome indicators.

Second, nursing relevance was expressed mainly through multidisciplinary contribution rather than direct attribution: five concepts were directly nursing-relevant, versus 25 nursing-contributory and 11 system-level. This reflects how nursing assessment, monitoring, medication management, education, coordination, and escalation are embedded within multidisciplinary virtual-ward pathways, without implying that these are direct or sensitivity-established measures of nursing performance.

Third, empirical application, specification completeness, and measurement validity were distinct properties. Twenty-one concepts were Applied-direct, two Applied-restricted, and 18 Not applied; all 23 applied concepts showed high specification completeness, versus moderate (n = 6) or low (n = 12) completeness among those not applied — a pattern that describes, but does not establish, a developmental pathway. Cross-source convergence was limited (29 concepts supported by a single source, none by more than three), and measurement properties and cross-context comparability remain unassessed.

4.2 An uneven, safety-dominated indicator landscape

This safety-dominated, unevenly distributed indicator profile (Section 4.1) persisted across the 27 years and five countries spanned by the included sources, despite considerable heterogeneity in care models — from conventional Hospital in the Home services to admission-avoidance, early-discharge, and condition-specific multidisciplinary pathways (Section 3.2). Workforce planning and competency and patient selection and home suitability remained the least-represented domains, containing one concept and none respectively (Section 3.3; Supplementary Table S2), and equity was the least-represented quality dimension, assigned to only one concept (Section 3.4; Supplementary Table S2). The concentration in medication and vascular-access management is clinically plausible: home-based care lacks the continuous on-site infrastructure of an inpatient unit, making medication administration, vascular access, deterioration, and unplanned transfer immediate safety concerns, and these events are also comparatively accessible through clinical records, incident-reporting systems, and administrative datasets (Billotte et al., 2026; Dickson et al., 2019; Mann et al., 2018; Montalto et al., 1999; Nguyen et al., 2026; Puchi et al., 2025; Webster et al., 2025).

The near-equal process–outcome split (Section 4.1) should not be read as comprehensive process coverage. Existing process indicators clustered around medication reconciliation and administration, service contacts, home visiting, and admission or discharge documentation, whereas continuity, caregiver preparation, relational support, and education quality—aspects typically requiring prospective assessment rather than routine-dataset extraction—were less consistently operationalised (Azzellino et al., 2026; Loftus Moran and Casey, 2026). A safety-dominated portfolio therefore gives only a partial account of quality: the absence of documented harm does not confirm appropriate patient selection, home suitability, adequate staffing and competency, caregiver preparation, or continuous responsive support (Levine et al., 2025).

This gap is most evident for patient selection and home suitability: the independently developed HaH Practice Standards (Levine et al., 2025) likewise treat patient eligibility, caregiver readiness, and home-environment suitability as expected service capabilities, yet had not translated them into a reproducible quantitative indicator meeting this review's eligibility criteria. This convergence between an independently derived practice-standard framework and the present taxonomy strengthens confidence that the absence reflects a genuine measurement gap rather than a boundary artefact of the review's own domain definitions, and signals a broader translation gap between professional expectations and reproducible measurement (González-Colom et al., 2024; Levine et al., 2025; Puchi et al., 2025).

This pattern contrasts with nursing-metric frameworks for ambulatory and general-practice care, which emphasise prevention, education, coordination, accessibility, and participation more heavily (Loftus Moran and Casey, 2026): the eligible virtual ward literature instead retains a predominantly acute-care-oriented measurement logic despite its distributed, home-based delivery. A more balanced portfolio is needed across these domains, without diluting existing safety surveillance (Section 4.5).

4.3 Making nursing contributions visible in multidisciplinary virtual wards

All five directly nursing-relevant concepts concerned pressure-injury prevention or vascular-access management (Section 3.4) — activities that are nurse-executed, bounded in time, and documented at the point of care. Their scarcity reflects both the multidisciplinary organisation of virtual ward care and a deliberately restrictive threshold for direct relevance. In one virtual cardiac model, for example, nursing case managers delivered onboarding, remote-monitoring education, telephone follow-up and urgent-review coordination alongside pharmacist and cardiologist input, so the

resulting outcomes could not be attributed confidently to any single professional group (Nguyen et al., 2026).

The 25 nursing-contributory concepts were classified on this basis. Nurses may perform or coordinate medication education and reconciliation, admission and discharge information provision, and responses to unscheduled contacts, but source reports located these activities within multidisciplinary processes; outcome measures such as hospital transfer, readmission, emergency department use, adverse drug events, length of stay and mortality further depend on patient acuity, medical decision-making, pharmacy input and service configuration (Billotte et al., 2026; Nguyen et al., 2026). Unscheduled contacts illustrate the interpretive ambiguity this creates: they may signal inadequate preparation or unmet need, or an accessible service encouraging early reporting, and earlier Hospital in the Home work linked them to education, communication and visit planning rather than treating them as nurse-exclusive measures (Montalto et al., 1999).

The practical implication is that such indicators should be read alongside the nursing processes contributing to them — hospital transfer and readmission paired with surveillance, continuity and escalation measures, and medication outcomes with reconciliation, education and documentation measures — making nursing's contribution visible without implying that complex service outcomes are produced by nursing alone.

4.4 From indicator proposal to reproducible measurement

Empirical application and operational specification completeness were assessed independently, yet all 23 empirically applied concepts (21 Applied-direct, two Applied-restricted) had high completeness, while all 18 Not applied concepts had moderate or low completeness. This reflects the reporting characteristics of the evidence base—empirical analyses typically specified the calculation rules, units, periods, and data

sources needed for measurement, whereas proposal-based sources did so less completely. Neither property implies the other, and neither implies validity.

This divergence reflects two evidentiary pathways, not differences in quality. Empirical studies specified calculation rules, populations, and observation periods while measuring bounded events in defined cohorts (Billotte et al., 2026; Dickson et al., 2019; Mann et al., 2018; Nguyen et al., 2026; Webster et al., 2025), interpretable only within that context. Proposal-based sources followed a different logic: e-Delphi and key-performance-indicator exercises captured expert agreement on relevance without specifying calculation rules or thresholds (González-Colom et al., 2024; Puchi et al., 2025), while practice standards described expected capabilities rather than reproducible measures (Levine et al., 2025).

Empirical application should not be equated with measurement validity: an indicator may be used within a single programme without formal assessment of reliability, construct validity, responsiveness, feasibility, or cross-organisational comparability, while a concept supported through expert consensus may remain unsuitable for routine measurement until its operational requirements are specified and tested. Indicator values are further shaped by admission criteria, patient acuity, service configuration, care pathways, follow-up practices, and the balance between admission avoidance and early discharge, so measures such as hospital transfer, readmission, emergency department utilisation, and length of stay cannot support fair cross-service comparison without consistent episode definitions, observation periods, and adjustment for patient and service characteristics.

4.5 Implications for practice, policy and research

For practice, the findings do not support indiscriminate adoption of all 41 concepts or an immediate core indicator set. Services could instead select a small subset of operationally specified, clinically actionable concepts matched to their care pathway, for example medication reconciliation and education, medication errors and adverse

drug events, vascular-access performance, unscheduled contacts, unplanned hospital return, and patient safety culture, while treating emergency department utilisation, patient experience, and caregiver experience as needing further operational refinement before implementation. Each selected indicator should first have its construct definition, eligible population, calculation rule, observation period and data source agreed; electronic extraction and responsibility for reviewing and acting on results, should follow rather than precede this specification, embedding indicators within continuous quality improvement rather than as isolated performance targets.

For policy and governance, standards and indicators should remain complementary but distinct: standards specify the capabilities expected of a service, whereas indicators assess whether these are achieved in practice (Levine et al., 2025), and should not be converted directly into performance targets without field testing. A minimum standardised dataset, with context-specific modules and case-mix adjustment rather than uniform thresholds, could support comparison across admission-avoidance, early-discharge and condition-specific pathways, provided policy frameworks extend beyond mortality, readmission and utilisation to nursing-relevant processes, patient and caregiver experience, digital equity, and workforce planning.

For research, two priorities follow. The first is to standardise and evaluate concepts already applied empirically, assessing feasibility, reliability, validity, responsiveness and cross-context comparability, with case-mix adjustment where benchmarking is intended, rather than developing duplicative measures for proposed but incompletely specified concepts such as patient and caregiver experience. The second is to develop new indicators, involving patients, caregivers and clinicians, for constructs that remain absent or under-represented, particularly patient selection, home suitability, staffing adequacy, workforce competency, caregiver preparedness, continuity and equity. Longitudinal, multilevel studies should further test whether nursing surveillance, education and escalation are associated with adverse events, hospital transfer and

patient experience after adjustment for patient and service characteristics, providing an evidential basis for a future parsimonious core indicator set.

4.6 Strengths and limitations

This review's principal strength lies in applying an explicit, service-level definition of home-based virtual wards and Hospital at Home care, and in harmonising heterogeneous source-reported measures into 41 auditable indicator concepts, each characterised for nursing relevance, Donabedian component, empirical application, and specification completeness with full audit trails in Supplementary Tables S1–S2.

Four limitations should be considered when interpreting these findings. First, the search was restricted to peer-reviewed, English-language publications, excluding grey literature such as governmental frameworks and organisational dashboards; the results therefore reflect the eligible peer-reviewed evidence rather than a comprehensive inventory of indicators used in practice. Second, the scarcity of eligible sources identified in Section 4.1 necessarily limits the present synthesis: findings draw on a geographically concentrated evidence base (Australia, the United States, and Western Europe) with heterogeneous service models and follow-up periods, and should be revisited as the evaluative literature expands rather than treated as a stable indicator inventory. Third, harmonisation and classification against the review-specific 12-domain taxonomy and quality-dimension assignments involved interpretive judgement that was not independently validated; despite explicit decision rules and concept-level rationales, alternative classifications for these frameworks remain possible, and quality-dimension assignments should be read as analytical mappings rather than author-specified categories. For the nursing-relevance framework specifically — arguably the most interpretively demanding classification in this review — a post-hoc inter-rater reliability check by a third, previously uninvolved author indicated substantial-to-almost-perfect agreement in the post-hoc check (87.8% agreement; $\kappa = 0.79$; Gwet's AC1 = 0.83), with disagreement confined to conceptually adjacent category boundaries (Section 3.4). This check was nonetheless conducted after consensus classification by a single additional rater working from concept names and domains rather than the full

operational detail available to the original coders, and should be read as supportive evidence of reproducibility rather than a substitute for concurrent, fully blinded double- or triple-coding of every framework in Table 1. Finally, consistent with the mapping purpose of a scoping review, no critical appraisal or risk-of-bias assessment was undertaken and measurement properties were not evaluated; empirical application should not be interpreted as validation, nor should nursing-contributory classification be read as evidence of a causal or exclusive nursing contribution.

5.Conclusion

Set against more than two decades of service expansion, the eligible evidence remains sparse and unevenly distributed. This scoping review indicates that this body of evidence on home-based virtual wards and Hospital at Home services yields an indicator portfolio weighted toward multidisciplinary, service-level performance, with few measures directly attributable to nursing structures, processes, or outcomes. Coverage was concentrated in medication management, vascular access, and service utilisation, while workforce planning and competency remained thinly represented, and patient selection and home suitability were addressed only at the level of practice standards rather than through retained quantitative measures.

Empirical application and operational specification were closely coupled rather than independent: concepts already applied in practice were consistently well specified, whereas proposed but unapplied concepts were not. This pattern reflects the reporting characteristics of the included literature and should not be read as evidence of validity, responsiveness, or readiness for cross-service benchmarking.

Future work should prioritise standardising and field-testing the well-specified concepts already in use, evaluating their measurement properties before assuming applicability beyond the reporting context. New indicators should be developed selectively, targeting constructs this review found absent or under-represented — patient selection, home suitability, workforce competency, caregiver preparedness, continuity, and equity — rather than duplicating existing but incompletely specified measures. A parsimonious core indicator set should follow, not precede, this evidence

base, and should be validated for cross-service comparability before being used to benchmark nursing's contribution to multidisciplinary outcomes.

Ethics approval

This scoping review synthesised previously published, publicly available data and did not involve human participants, individual patient data, or primary data collection. Ethical approval was therefore not required.

CRediT authorship contribution statement

Peng Peng: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Writing – original draft. **An Luo**: Methodology, Investigation, Data curation, Formal analysis, Writing – review & editing. **Siyu Chen**: Methodology, Writing – review & editing. **Jing Xue**: Methodology. **Cong He**: Methodology. **Qiang Xu**: Methodology, Writing – review & editing. **Yangyang Fang**: Methodology, Validation, Writing – review & editing. **Peiyu Cheng**: Methodology, Supervision, Writing – review & editing.

Peng Peng and An Luo contributed equally to this work and share first authorship. Peiyu Cheng serves as the guarantor of the work. All authors reviewed and approved the final version of the manuscript for submission.

Competing interests

None declared.

Data availability statement

No primary data were collected for this review. The harmonised indicator-concept data extracted and synthesised from the included sources are provided in Supplementary Tables S1 and S2.

Funding

This work was supported by the National Key Clinical Specialty Major Scientific Research Project (Grant Number: Z20230146).

Patient and public involvement

Patients and members of the public were not involved in the design, conduct, or

reporting of this review, which was based exclusively on the synthesis of previously published, publicly available literature.

References

Azzellino, G., Vagnarelli, P., Mengoli, L., Aitella, E., Passamonti, M., Ginaldi, L., De Martinis, M., 2026. Missed nursing care in community-based health care: A scoping review. International Journal of Nursing Studies 180, 105548. https://doi.org/10.1016/j.ijnurstu.2026.105548

Berwick, D.M., 2002. A user's manual for the IOM's 'quality chasm' report. Health Affairs 21, 80–90. https://doi.org/10.1377/hlthaff.21.3.80

Billotte, J., Ramambason, C., Marquet, D., Foucault-Fruchard, L., 2026. Improve quality of care in hospital-at-home by implementing medication reconciliation on admission: A retrospective observational study. Eur J Hosp Pharm 33, 7–12. https://doi.org/10.1136/ejhpharm-2024-004326

Chauhan, U., McAlister, F.A., 2022. Comparison of mortality and hospital readmissions among patients receiving virtual ward transitional care vs usual postdischarge care: A systematic review

and meta-analysis. JAMA Netw Open 5, e2219113. https://doi.org/10.1001/jamanetworkopen.2022.19113

Cheng, S.-A., Tan, S.I., Goh, S.L.E., Ko, S.Q., 2025. The value of remote vital signs monitoring in detecting clinical deterioration in patients in hospital at home programs or postacute medical patients in the community: Systematic review. J Med Internet Res 27, e64753. https://doi.org/10.2196/64753

Collet, R., van Grootel, J., van Dongen, J., Wiertsema, S., Ostelo, R., van der Schaaf, M., Lazzari, E., Geleijn, E., Major, M., van der Leeden, M., 2025. The impact of multidisciplinary transitional care interventions for complex care needs: A systematic review and meta-analysis. Gerontologist 65, gnaf088. https://doi.org/10.1093/geront/gnaf088

De Baetselier, E., Dilles, T., Feyen, H., Haegdorens, F., Mortelmans, L., Van Rompaey, B., 2022. Nurses' responsibilities and tasks in pharmaceutical care: A scoping review. Nurs Open 9, 2562–2571. https://doi.org/10.1002/nop2.984

Dickson, H.G., Flynn, O., West, D., Alexandrou, E., Mifflin, N., Malone, M., 2019. A cluster of failures of midline catheters in a hospital in the home program: A retrospective analysis. Journal of Infusion Nursing 42, 203–208. https://doi.org/10.1097/NAN.0000000000000330

Donabedian, A., 1988. The quality of care. How can it be assessed? JAMA 260, 1743–1748. https://doi.org/10.1001/jama.260.12.1743

González-Colom, R., Carot-Sans, G., Vela, E., Espallargues, M., Hernández, C., Jiménez, F.X., Nicolás, D., Suárez, M., Torné, E., Villegas-Bruguera, E., Ozores, F., Cano, I., Piera-Jiménez, J., Roca, J., 2024. Five years of hospital at home adoption in catalonia: Impact, challenges, and proposals for quality assurance. BMC Health Serv Res 24, 154. https://doi.org/10.1186/s12913-024-10603-1

Granel, N., Sanchez Martos, E.A., Subirana-Casacuberta, M., Watson, C.E., Gomez-Ibáñez, R., Risco, E., 2026. Assessing patient safety culture in hospital at home services across spain through a national survey. Nursing & Health Sciences 28, e70337. https://doi.org/10.1111/nhs.70337

Greene, L., Rahja, M., Laver, K., Wong, V.V., Leung, C., Crotty, M., 2024. Hospital staff perspectives on the drivers and challenges in implementing a virtual rehabilitation ward: Qualitative study. JMIR Aging 7, e54774. https://doi.org/10.2196/54774

Gwet, K.L., 2008. Computing inter-rater reliability and its variance in the presence of high

agreement. Br J Math Stat Psychol 61, 29–48. https://doi.org/10.1348/000711006X126600

Hung, C.-H., 2023. Nursing's unique contribution to quality of care. J Nurs Res 31, e280. https://doi.org/10.1097/jnr.0000000000000570

Karam, M., Chouinard, M.-C., Poitras, M.-E., Couturier, Y., Vedel, I., Grgurevic, N., Hudon, C., 2021. Nursing care coordination for patients with complex needs in primary healthcare: A scoping review. Int J Integr Care 21, 16. https://doi.org/10.5334/ijic.5518

Kerr, H., Donovan, M., McSorley, O., 2021. Evaluation of the role of the clinical nurse specialist in cancer care: An integrative literature review. Eur J Cancer Care (Engl) 30, e13415. https://doi.org/10.1111/ecc.13415

Landis, J.R., Koch, G.G., 1977. The measurement of observer agreement for categorical data. Biometrics 33, 159–174.

Larsen, M.N., Dreisig, T.S., Rasmussen, M.K., Schultz, A.N.Ø., Nielsen, T.L., Fischer, T.K., 2025. Virtual health care in hospital-at-home models for patients with acute infections: A scoping review. Mayo Clin Proc Digit Health 3, 100250. https://doi.org/10.1016/j.mcpdig.2025.100250

Levine, D.M., DeCherrie, L.V., Siu, A., Schiller, G., Timpe, C., Murphy, S., Paulson, M., Lung, C.L., Nottidge, M., Titchener, K., Leff, B., Hospital at Home Users Group Practice Standards Council, 2025. Practice standards for acute hospital care at home. J American Geriatrics Society 73, 2037–2045. https://doi.org/10.1111/jgs.19427

Lewis, C., Kearns, T., Shannon, M., 2026. Beyond the bedside: The pivotal role of nursing clinical leadership in developing virtual ward care through telemedicine-a review of the evidence. J Clin Nurs. https://doi.org/10.1111/jocn.70413

Liu, Q., Xie, C., Tan, J., Xu, L., Zhou, F., Peng, L., 2024. Exploring the nurses' experiences in recognising and managing clinical deterioration in emergency patients: A qualitative study. Aust Crit Care 37, 309–317. https://doi.org/10.1016/j.aucc.2023.06.004

Loftus Moran, O., Casey, M., 2026. Assessing the landscape of quality care nursing metrics in general practice settings: A scoping review. Journal of Advanced Nursing 82, 1039–1054. https://doi.org/10.1111/jan.17008

Mah, J.C., Stevens, S.J., Keefe, J.M., Rockwood, K., Andrew, M.K., 2021. Social factors influencing utilization of home care in community-dwelling older adults: a scoping review. BMC Geriatr 21, 145. https://doi.org/10.1186/s12877-021-02069-1

Mann, E., Zepeda, O., Soones, T., Federman, A., Leff, B., Siu, A., Boockvar, K., 2018. Adverse drug events and medication problems in “hospital at home” patients. Home Health Care Services Quarterly 37, 177–186. https://doi.org/10.1080/01621424.2018.1454372

Montalto, M., Portelli, R., Collopy, B., 1999. Measuring the quality of hospital in the home care: A clinical indicator approach. International Journal for Quality in Health Care 11, 413–418. https://doi.org/10.1093/intqhc/11.5.413

Munn, Z., Peters, M.D.J., Stern, C., Tufanaru, C., McArthur, A., Aromataris, E., 2018. Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. BMC Med Res Methodol 18, 143. https://doi.org/10.1186/s12874-018-0611-x

Nguyen, S., Lau, J., Tran, T., Yeoh, J., Martin, L., Horrigan, M., 2026. Designing and implementing a virtual cardiac hospital in the home pharmacy service: A retrospective analysis. Pharmacy Practice and Res 56, 89–95. https://doi.org/10.1002/jppr.70047

Norman, G., Bennett, P., Vardy, E.R.L.C., 2023. Virtual wards: A rapid evidence synthesis and implications for the care of older people. Age Ageing 52, afac319. https://doi.org/10.1093/ageing/afac319

Page, J., Comino, E., Burgess, M., Cullen, J., Harris, E., 2018. Participation in hospital in the home for patients in inner metropolitan sydney: Implications for access and equity. Australian Health Review 42, 557–562. https://doi.org/10.1071/AH18117

Peters, M.D.J., Marnie, C., Tricco, A.C., Pollock, D., Munn, Z., Alexander, L., McInerney, P., Godfrey, C.M., Khalil, H., 2020. Updated methodological guidance for the conduct of scoping reviews. JBI Evid Synth 18, 2119–2126. https://doi.org/10.11124/JBIES-20-00167

Powis, M., Ali, A., Salmini, J., Hack, S., Fazelzad, R., Barbara, L., Berlin, A., Cheung, M., DeVera, M., Edwards, A., McTaggart-Cowan, H., Olson, R., Peacock, S., Sayani, A., Singh, S., Krzyzanowska, M.K., 2025. Virtual care, what are we measuring and what should we measure? Scoping review of reviews. J Med Internet Res 27, e65312. https://doi.org/10.2196/65312

Puchi, C., Paravic-Klijn, T., Salazar, A., 2025. Generation of indicators to assess quality of health care in hospital at home through e-delphi. Quality Management in Health Care 34, 63–71. https://doi.org/10.1097/QMH.0000000000000451

Shi, C., Dumville, J., Rubinstein, F., Norman, G., Ullah, A., Bashir, S., Bower, P., Vardy, E.R.L.C., 2024. Inpatient-level care at home delivered by virtual wards and hospital at home: A systematic

review and meta-analysis of complex interventions and their components. BMC Med 22, 145. https://doi.org/10.1186/s12916-024-03312-3

Tricco, A.C., Lillie, E., Zarin, W., O'Brien, K.K., Colquhoun, H., Levac, D., Moher, D., Peters, M.D.J., Horsley, T., Weeks, L., Hempel, S., Akl, E.A., Chang, C., McGowan, J., Stewart, L., Hartling, L., Aldcroft, A., Wilson, M.G., Garritty, C., Lewin, S., Godfrey, C.M., Macdonald, M.T., Langlois, E.V., Soares-Weiser, K., Moriarty, J., Clifford, T., Tunçalp, Ö., Straus, S.E., 2018. PRISMA extension for scoping reviews (PRISMA-ScR): Checklist and explanation. Ann Intern Med 169, 467–473. https://doi.org/10.7326/M18-0850

Tuinman, A., De Greef, M.H.G., Finnema, E.J., Roodbol, P.F., 2021. A systematic review of the association between nursing staff and nursing-sensitive outcomes in long-term institutional care. J Adv Nurs 77, 3303–3316. https://doi.org/10.1111/jan.14840

Vindrola-Padros, C., Singh, K.E., Sidhu, M.S., Georghiou, T., Sherlaw-Johnson, C., Tomini, S.M., Inada-Kim, M., Kirkham, K., Streetly, A., Cohen, N., Fulop, N.J., 2021. Remote home monitoring (virtual wards) for confirmed or suspected COVID-19 patients: A rapid systematic review. EClinicalMedicine 37, 100965. https://doi.org/10.1016/j.eclinm.2021.100965

Webster, L.W., Martinez, H.R., Cowdell, J.C., 2025. The impact of a low-technology medication organization system on hospital-at-home medication errors. AJN, American Journal of Nursing 125, 52–58. https://doi.org/10.1097/AJN.0000000000000092

Westby, M., Ijaz, S., Savović, J., McLeod, H., Dawson, S., Welsh, T., Le Roux, H., Walsh, N., Bradley, N., 2024. Virtual wards for people with frailty: What works, for whom, how and why-a rapid realist review. Age Ageing 53, afae039. https://doi.org/10.1093/ageing/afae039

Wong, A., Cooper, C., Evans, C.J., Rawle, M.J., Walters, K., Conroy, S.P., Davies, N., 2025. Supporting older people through hospital at home care: A systematic review of patient, carer and healthcare professionals' perspectives. Age Ageing 54, afaf033. https://doi.org/10.1093/ageing/afaf033

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryAppendixS1.Fullsearchstrategiesforalldatabases.docx
- SupplementaryTableS1.docx
- SupplementaryTableS2.docx