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Understanding nursing handoff errors in clinical practice: trends and contributing factors based on a systematic review and meta-analysis

Seonmi Yeom[1], Myung-Gwan Kim[2] and Joon Ho Park[2*]

Abstract

Background Nursing handoff is a critical process in which essential patient and treatment-related information, as well as responsibilities, are exchanged to ensure quality of care and continuity of treatment. Errors during this process may lead to adverse clinical outcomes and compromise patient safety. This study aimed to systematically review the overall trends of and factors contributing to nursing handoff errors in clinical settings to enhance nurses' awareness and understanding.

Methods Following a study protocol pre-registered with the International Prospective Register of Systematic Reviews (PROSPERO; CRD42024610621), a systematic review was conducted, including a comprehensive search of Public MEDLINE (PubMed), Excerpta Medica Database (EMBASE), Cumulative Index of Nursing and Allied Health Literature (CINAHL), Web of Science, and Scopus. A systematic review and meta-analysis were performed based on selected studies, adhering to the Joanna Briggs Institute (JBI) Manual for Evidence Synthesis and reported in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

Results Twelve studies were included in the systematic review, six of which were eligible for meta-analysis. The most commonly identified type of nursing handoff error was information omission. Contributing factors fell into four categories: handoff process complexity, environmental, organizational, and individual factors. The pooled proportion of nursing handoff errors derived from the meta-analysis of six studies was approximately 88% (pooled proportion = 0.88, 95% CI = 0.72 ~ 0.99; I^2 = 98%), indicating substantial variability across studies. This estimate represents the overall occurrence of reported handoff error types across the included studies.

Conclusions Reducing nursing handoff errors requires a multidimensional approach encompassing the handoff communication process, physical environment, organizational systems, and individual nurse competencies. This study underscores the importance of targeting key error types and contributing factors to develop integrated strategies such as structured communication tools, standardized protocols, and competency-based training that collectively enhance handoff quality and patient safety.

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Keywords Nurses, Patient handoff, Medical errors, Risk factors

Background

Nursing handoff is generally defined as a process occurring within the flow of nursing care, through which nurses exchange patient-related information and responsibility during transitions of care [1]. This process includes, but is not limited to, shift-to-shift handoffs, intra-shift transfers, inter-unit patient movements, and bedside or verbal handoffs. During this process, nurses communicate critical information related to the patient and their treatment, which is essential for ensuring continuity of care, maintaining the quality of nursing care, and promoting patient safety [2, 3].

However, the information exchanged during handoffs can be inconsistent and variable owing to factors such as individual nurse differences and social or environmental contexts, thereby posing risks of inaccuracy or omission [4]. Such variability-induced handoff errors are a common cause of medical errors in clinical settings [5], as they not only cause adverse patient outcomes [6, 7] but also pose a fundamental threat to patient safety [7–9]. In addition, nursing handoff errors may lead to delayed shift changes, reduced direct patient care time, and unexpected additional tasks, thereby undermining nursing efficiency, increasing workload, and straining professional relationships among nurses or between nurses and patients [1]. This may reduce the quality of nursing care and ultimately negatively impact patients [1]. Therefore, reducing nursing handoff errors in clinical settings to improve handoff quality is considered a key strategy for enhancing patient safety and a means of improving the overall quality of nursing and healthcare.

A fundamental examination of nursing handoff errors is required before implementing any efforts to reduce them in clinical settings [8]. Such analysis provides a foundation for the future development of evidence-based and practical solutions. However, existing reviews on nursing handoff errors have addressed various aspects, including external interruptions that cause handoff errors [10], factors negatively affecting communication during handoffs [11, 12], interventions such as structured handoff methods [13], and educational programs [14] to improve handoff quality, as well as the use of standardized handoff tools aimed at reducing complications, medication errors [15], and improving patient outcomes [7]. In other words, previous studies have focused on different dimensions of the issue, each addressing only specific aspects of nursing handoff errors. Accordingly, comprehensive identification of the major types of nursing handoff errors occurring in clinical settings and the areas requiring improvement to reduce such errors remains challenging.

Therefore, this study aimed to systematically review the existing literature to identify the types and frequency of major nursing handoff errors, as well as the factors contributing to their occurrence. The findings are expected to enhance nurses' awareness and understanding of handoff errors, thereby laying the groundwork for error reduction. Furthermore, by providing foundational data for the development of intervention programs, this study seeks to contribute to the improvement of patient safety in clinical nursing practice.

Methods

Protocol registration

The protocol for this study was registered with the International Prospective Register of Systematic Reviews (PROSPERO; CRD42024610621) before initiation. The study followed the Joanna Briggs Institute (JBI) Manual for Evidence Synthesis [16], and the results were reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist [17].

Search strategy

This study explored the following clinical question: "What types of errors occur during nurse handoffs in clinical settings, how frequently do they occur, and what factors influence them?" To investigate this question, we conducted a comprehensive literature search in the following electronic bibliographic databases: Public MEDLINE (PubMed), Excerpta Medica Database (EMBASE), Cumulative Index of Nursing and Allied Health Literature (CINAHL), Web of Science, and Scopus. The search strategy combined database-specific controlled vocabulary terms (e.g., Medical Subject Headings [MeSH] and CINAHL Subject Headings) and free-text keywords derived from prior literature, encompassing the primary concepts: nurses, handoff errors, and contributing factors. Boolean operators (AND, OR) were used to appropriately combine the search terms. The final search was completed on October 30, 2025. No restrictions on publication year were applied. Full search strategies for each database are detailed in Supplementary Table 1. In addition, we manually screened the reference lists of the included studies to identify gray literature. A professional librarian with expertise in systematic reviews assisted in developing and refining the search strategy.

Eligibility criteria and study selection

Based on the key questions of the systematic review [16, 17], the inclusion criteria were as follows: (1) population:

hospital-based nurses; (2) exposure: factors contributing to nursing handoff errors; (3) outcome: the frequency and types of nursing handoff errors; (4) setting: hospital (general ward, intensive care unit, emergency department, etc.); and (5) study design: observational studies with empirical data on nursing handoff errors, regardless of whether data were collected through direct observation, surveys, record review, or mixed-method approaches. Only studies conducted and reported in English were included, with no restrictions on the publication year. Studies were excluded if they were not directly related to nurse handoff errors, involved a study design mismatch (e.g., systematic reviews, meta-analyses, purely qualitative studies, or experimental studies), did not involve hospital-based nurses in hospital settings, did not focus on nurse handoff errors as a primary outcome, or had inaccessible full texts. The selection process included de-duplication, title and abstract screening, and full-text review to identify studies that met the inclusion criteria. Two researchers independently performed this process. Disagreements were documented and resolved through discussion and consensus, and a third reviewer was consulted when consensus could not be reached. All retrieved records were imported into EndNote (Clarivate Analytics, Philadelphia, PA, USA) for reference management and duplicate removal prior to screening.

Data extraction

Data extraction followed the JBI Manual [16] using a standardized form to collect information about the author, publication year, study design, setting, population, handoff type, data collection period, exposure, and outcomes. Unclear information in the included studies was clarified by contacting the corresponding authors via email. Two researchers independently conducted the extraction, resolving discrepancies through discussion and consensus.

Quality assessment of the included studies

The methodological quality and risk of bias of the included studies were assessed using the appropriate JBI critical appraisal checklists according to the methodological structure of each study [16]. We used the JBI checklist for analytical cross-sectional studies for studies employing cross-sectional observation and the JBI cohort checklist for studies with prospective observation. When studies incorporated qualitative data, the JBI checklist for qualitative research was additionally applied. Each item in the checklists was rated as "Yes," "No," "Unclear," or "Not applicable." Rather than deriving an overall numerical score, particular attention was paid to items related to selection bias, measurement validity, and confounding when interpreting study quality. A priori, studies were not excluded solely based on insufficient reporting of strategies to manage confounding factors, provided that the occurrence and context of handoff errors were clearly observed or described. Potential limitations related to confounding were considered when interpreting findings concerning factors linked to handoff errors. Two independent reviewers conducted the appraisal, and discrepancies were resolved through discussion until consensus was reached. Inter-rater agreement was assessed using Cohen's kappa, which was 0.80, indicating substantial agreement between reviewers.

Data syntheses

Because one of the aims of this study was to identify the frequency of major nursing handoff errors across clinical studies, pooling the reported error proportions was considered an appropriate quantitative approach to illustrate the overall tendency of error occurrence in practice. Although the included studies used different terminologies and measurement approaches, the outcomes were interpreted in light of both information transfer-level (process) and clinical consequence-level (outcome) errors. All fundamentally assessed failures in patient-related information transfer during nurse-to-nurse handoffs in hospital-based clinical settings. Based on this shared underlying mechanism and clinical context, the studies were considered sufficiently comparable to support quantitative synthesis, as recommended in JBI guidance for proportion meta-analysis.

A meta-analysis was conducted using six studies that reported nursing handoff errors. The analysis was performed using R version 4.3.2 [18], with the metaprop function from the meta package, and the pooled effect size was calculated as the proportion of handoff errors. To improve statistical stability, the Freeman–Tukey double-arcsine transformation was applied, as several included studies reported extremely high event rates approaching 100%, a condition in which alternative transformations (e.g., logit) may produce unstable estimates in the presence of small event numbers or extreme proportions [19]. The pooled results were back-transformed to proportions to allow clinically meaningful interpretation of handoff error rates [19]. A random-effects model was used to account for heterogeneity that may arise due to methodological differences among the included studies. The statistical significance of the effect size was determined based on the 95% confidence interval (CI), which was estimated using the Wilson score method. For studies in which handoff errors were assessed using multiple items, the probability of no error was first calculated by assuming the potential for multiple simultaneous errors. The overall handoff error proportion was then derived by subtracting this value from one.

In accordance with JBI methodological guidance [16], heterogeneity across studies was assessed using

Cochrane's Q-statistic ($p < .10$), Higgins' I^2 statistic (≥ 50%), and τ^2 (larger values) [16, 20]. When these statistics collectively indicated substantial between-study variability, subgroup analyses were conducted based on study-level characteristics, including type of handoff error, measurement method, and patient severity. In subgroups containing only a single study, that study was excluded from comparison and subsequently included in a sensitivity analysis to assess the robustness of the findings. The pooled estimate was interpreted as an overall statistical average across heterogeneous study contexts rather than as a single generalizable value, given the anticipated variability among studies. In addition, 95% prediction intervals were calculated to estimate the expected range of true effect sizes across comparable clinical settings in the presence of substantial between-study heterogeneity. The potential risk of publication bias was visually evaluated using a funnel plot and statistically tested using Egger's regression test. In interpreting these results, particular attention was paid to the characteristics of these methods and the small number of included studies ($n = 6$) [16, 21].

Results

Study selection

A total of 521 records were identified through database searches. After removing 244 duplicates, 223 records were excluded based on title and abstract screening, and seven records were excluded due to the unavailability of full texts. After reviewing the full texts of the remaining 47 records, 41 were excluded for not meeting the eligibility criteria, resulting in the inclusion of six records. A reference list search of the included studies identified six additional records that met the eligibility criteria, bringing the total to 12. Details of the study selection process are presented in Fig. 1.

Methodological quality of included studies

The detailed appraisal results are presented in Supplementary Table 2. Overall, most studies satisfied the majority of the JBI appraisal items across study designs. In the cross-sectional studies, items related to the reporting of strategies to manage confounding factors (Q6) were less frequently satisfied. The cohort study met nearly all appraisal criteria. In the qualitative studies,

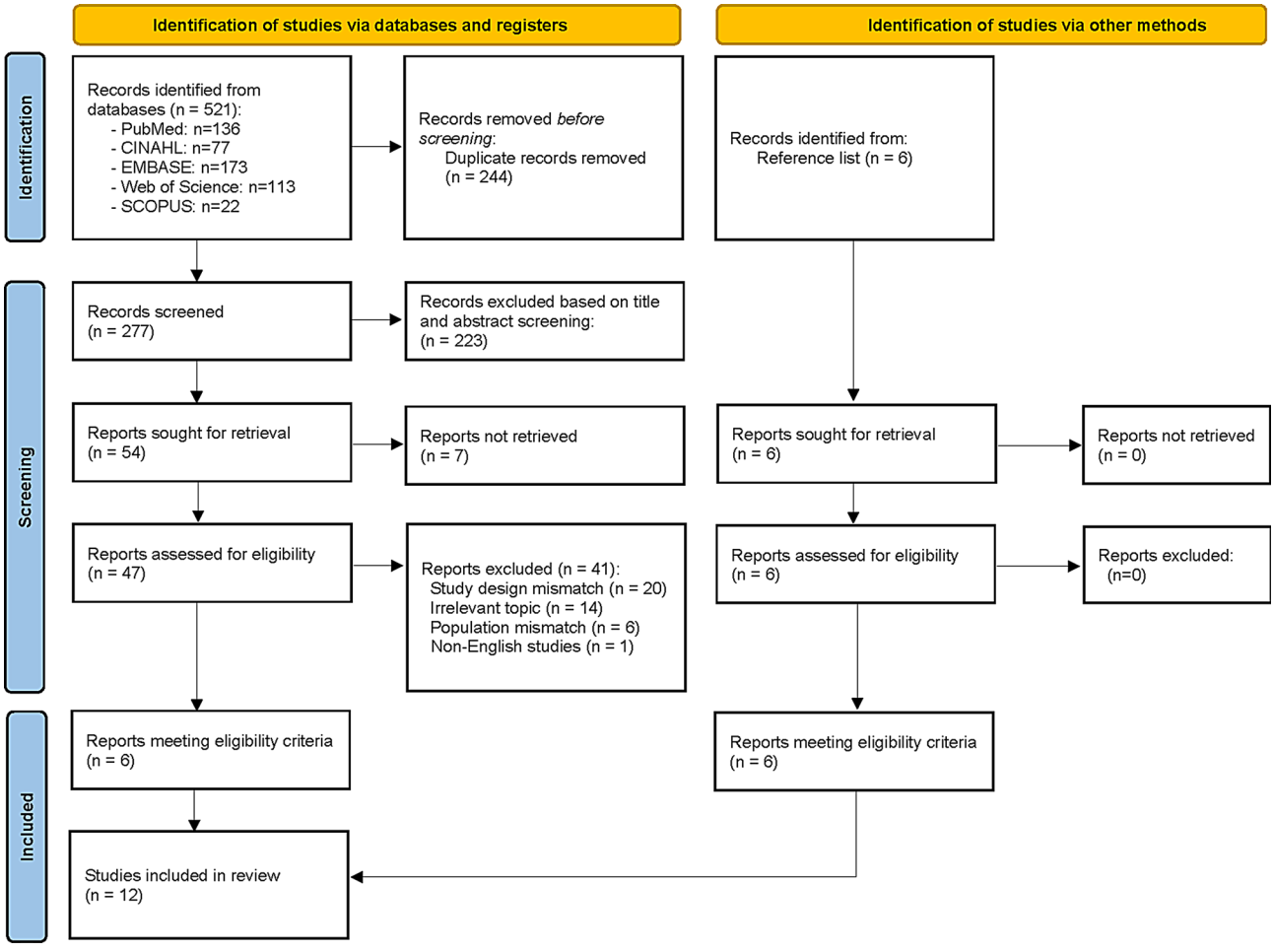

Fig. 1 Flow diagram of study selection. This figure illustrates the process of study selection based on PRISMA 2020 guidelines

most appraisal items were satisfied, although some studies provided limited discussion regarding the influence of the researcher on the research process. No studies were excluded based on the appraisal results.

Study characteristics

Table 1 presents the characteristics of the studies included in this systematic review. All included studies were published between 2010 and 2024, with most published after 2015 [22–31]. Four studies were conducted in Australia [27, 29, 32, 33], and three in South Korea [25, 26, 31]. The remaining studies were conducted in China [23], Israel [22], Norway [28], Turkey [30], and the United States of America [24]. The included studies comprised cross-sectional studies [24–26, 28, 30, 31], prospective cross-sectional studies [27, 29, 32], prospective cohort study [22], and retrospective cross-sectional studies [23, 33]. Some studies additionally incorporated qualitative components [24, 27, 33]. Two studies were retrospective cross-sectional studies based on the secondary analysis of existing data sources [23, 33]. Five studies were conducted as multi-center investigations [23–26, 31]. Regarding the study settings, three studies were conducted in general hospital wards [22, 25, 30], while others were carried out in specialized clinical environments, including intensive care units (ICUs) [27, 29, 32], a post-anesthesia care unit (PACU) [28], and delivery rooms and neonatal units [31]. Given the variability in clinical settings and patient severity levels across studies, potential differences in the types and frequency of reported handoff errors were anticipated and subsequently examined through subgroup and sensitivity analyses.

Participants

After excluding four studies without participant numbers [22, 23, 28, 33], 2,512 nurses were included in the remaining eight [24–27, 29–32]. Detailed participant characteristics were reported in only a few studies. The reported studies showed a wide range of ages [22, 25, 26, 30, 31], with a predominant proportion of female participants [22, 25–27, 30, 31]. The proportion of staff nurses was over 80% [25, 26, 28, 29, 32] and clinical or unit experience ranged from less than one year to a maximum of 22 years [22, 25–31].

Nursing handoff errors

Nine studies examined nursing handoff errors, reporting various error types [22–24, 27, 28, 31–33]. These errors were organized into several conceptual domains. A predominant domain involved errors related to informational completeness, most commonly the omission of information [24, 26–28, 31, 32] and in some cases the inclusion of excessively unnecessary information [31]. Another domain concerned informational accuracy, including inaccurate information [24, 27, 31, 33] and misunderstanding during information exchange [31]. Some studies also identified failures in the communication process itself, such as breakdowns in nurse-to-nurse communication [33]. Importantly, a subset of errors reflected downstream clinical or workflow consequences, including deviations from prescribed care [22], communication-related medication errors [23], and work delays [31], indicating that certain handoff errors had direct implications for patient care and operational efficiency. Across studies, nursing handoff errors were assessed using both objective and subjective methods. Objective measures included cross-checking against the patient's chart [22] and observations by a research nurse [27, 32], whereas subjective measures relied on self-reports from nurses involved in the handoffs [23, 24, 26, 28, 31, 33].

Factors contributing to nursing handoff errors

Of the studies included in this systematic review, ten examined factors contributing to nursing handoff errors [22, 24–31, 33]. These factors were broadly classified into handoff process complexity, environmental, organizational, and individual factors. The reviewed literature predominantly emphasized handoff process complexity, environmental, and organizational factors, rather than the individual characteristics of nurses. Commonly reported handoff process complexity factors included "excessive inclusion of unnecessary information in handoff contents," [25, 26, 28, 30] "limited nurse-to-nurse interaction," [26, 31] "excessively long handoff duration including preparation time," [25, 26] and "increased information complexity due to patient acuity" [27, 28]. Furthermore, "differences in expectations regarding information among nurses" [24] and "insufficient readiness of the receiving nurse" [27] were also identified. Commonly reported environmental factors included "interruptions from outsider visits, phone calls, non-handoff-related conversations with medical staff, and equipment alarms" [24–27, 29, 30, 33]. Additionally, "time pressure due to insufficient handoff time" [24, 27, 28, 30, 31] and "heavy workload" [27, 30, 31, 33] were identified as environmental factors. Commonly reported organizational factors included "absence of handoff guidelines," [25–27, 30, 31, 33] "insufficient nursing staff," [24, 33] "inconsistent and non-standardized handoff systems across units (e.g., electronic medical records)," [24, 27] and "inadequate time for handoff education" [25, 26]. "Lack of clinical experience among nurses" [26, 27, 31] was the most frequently reported individual factor. Other individual contributing factors included "education level" [26] and "unsatisfactory nurse relationships" [31]. Most factors were commonly reported, regardless of the study setting. However, increased information complexity due to patient acuity was identified only in specialized units

Table 1 Characteristics of studies included in the systematic review

First author (Year)	Country	Study design	Study setting	Participants					Handoff type	Findings
				Sample size (*n*)	Age, yr M (SD)	Female (%)	Type of nurses	Clinical or unit experience, yr M (SD)		
Drach-Zahavy (2015) [22]	Israel	Prospective cohort study	General medical wards (200 handoffs, 5 patients)	Not reported	Incoming: 39 (10.44) Outgoing: 44 (10.88)	Incoming: 90.0 Outgoing: 80.0	Not reported	- *Unit* - Incoming: 15 (11.49) Outgoing: 19 (11.90)	Handoff method - Face-to-face, bedside verbal handoff Handoff time per patient (sec, M (SD)) - complex patient = 73.45 (18.16) - non-complex patient = 50.65 (13.76)	***- Handoff errors -*** **• Type** - Treatment errors (deviations from prescribed care): Late/non-executed care order Dosage discrepancy Missing documentation **• Measurement method** - Patient chart-based dichotomous scale (Yes/No) **• Frequency (%)** (based on 200 handoffs) - Late/non-executed care order = 52.0 - Dosage discrepancy = 23.0 - Missing documentation = 33.0 ***- Contributing factors -*** **• Handoff behavior-related** - Handoff strategies negatively associated with handoff errors: Face-to-face verbal update with interactive questioning Update from non-outgoing practitioners Topics initiated by incoming and outgoing Outgoing team's care plan stance included Outgoing prepares summary before handoff
Jin (2023) [23]	China	Retrospective cross-sectional study	Hospital-wide across 3 acute care hospitals	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	***- Handoff errors -*** **• Type** - Medication errors: Information cognition failure Selection of the wrong information source Missing information cognition Failure to find the information source Total lapse of information memory Partial lapse of information memory **• Measurement method** - Secondary analysis of nurse-reported communication-related medication error records **• Frequency (n)** – 303 (50.8% of the 597 nursing medication errors)

Table 1 (continued)

First author (Year)	Country	Study design	Study setting	Participants					Handoff type	Findings
				Sample size (*n*)	Age, yr M (SD)	Female (%)	Type of nurses	Clinical or unit experience, yr M (SD)		
Kear (2016) [24]	USA	Cross-sectional study (with qualitative component)	Dialysis and nephrology care settings (across multiple environments)	744	Not reported	Not reported	RN-direct care: 57.0% Manager/ Administration: 29.0% Educator: 9.0% APRN: 5.0%	Not reported	Handoff method - Verbal (63.0%) - Recorded (10.0%) - Bedside (8.0%)	***- Handoff errors -*** **• Type** - Missing important information - Provided inaccurate or incomplete information - Lack of timely information exchange **• Measurement method** - Quantitative data: Structured items from AHRQ & JCCTH tool (% agreement) - Qualitative data: open-ended questions (content analysis) **• Frequency (%)** - Critical information missing during handoff = 51.0 agreed - Frequent issues in information exchange during handoff = 46.0 agreed - Inaccurate or incomplete information communicated during handoff = 39.0 agreed - Handoff not conducted in a timely manner = 33.0 agreed ***- Contributing factors -*** **• Handoff behavior-related** - Use of varied handoff methods: written paper, verbal report, etc. - Variation in nurses' information expectations - Ineffective communication of key information after handoff **• Environmental** - Interruptions during handoff - Lack of time for handoff **• Organizational** - Non-standardized handoff procedures in some units - Lack of nursing staff - Low perceived importance of handoff

Table 1 (continued)

First author (Year)	Country	Study design	Study setting	Participants					Handoff type	Findings
				Sample size (*n*)	Age, yr M (SD)	Female (%)	Type of nurses	Clinical or unit experience, yr M (SD)		
Kim (2016) [25]	South Korea	Cross-sectional study	General ward in 201 hospitals (> 300 beds), multi-center	703	28.2 (6.2)	98.0	Staff nurse: 88.9% Charge nurse: 11.1%	5.73 (5.75)	Handoff method - One-on-one handoff between outgoing and incoming nurses (66.4%) - Outgoing nurses taking turns (18.1%) - From a head/charge nurse to all nurses (15.5%) Handoff location - Nursing station (92.7%) - Separate room (7.3%) Preparation time (min, M (SD)) = 39.4 (36.4) Handoff time (min, M (SD)) = 39.2 (14.0) Handoff guideline: - Absent (75.8%)	***- Contributing factors -*** **• Handoff behavior-related** - Excessively lengthy handoff, including preparation time - Overlap of handoff content - Inclusion of unnecessary content - Inclusion of non-clinic matters **• Environmental** - Frequent interruptions by outsiders' visits **• Organizational** - Absence of handoff-related guidelines - Lack of systematic education on handoff

Table 1 (continued)

First author (Year)	Country	Study design	Study setting	Participants					Handoff type	Findings
				Sample size (*n*)	Age, yr M (SD)	Female (%)	Type of nurses	Clinical or unit experience, yr M (SD)		
Kim (2021) [26]	South Korea	Cross-sectional study	Mixed wards in 8 small /medium hospitals (150–400 beds)	425	31.6 (8.33)	91.3	Staff nurses: 90.1%	6.53 (6.31)	Handoff method - Verbal handoffs using Kardex or EMR (96.1%)	**- *Handoff errors* -** **• Type** - Omission of information **• Measurement method** - Self-reported survey 'Accurate' or 'omissions occurred' was selected regarding errors **• Frequency (%)** - Transferring = 95.0 - Receiving = 88.7 **- *Contributing factors* -** **• Handoff behavior-related** - Lengthy preparation and excessive handoff duration - Overload of unnecessary content in handoff - Interactional limitations hindering information transfer **• Environmental** - Frequent interruptions: visitors, phone calls, etc. - Insufficient space for handoffs **• Organizational** - Absence of handoff guidelines - Inadequate handoff education time **• Individual** - Dissatisfaction with the current handoff method - Education level - Duration of hospital employment

Table 1 (continued)

First author (Year)	Country	Study design	Study setting	Participants					Handoff type	Findings
				Sample size (*n*)	Age, yr M (SD)	Female (%)	Type of nurses	Clinical or unit experience, yr M (SD)		
Powell (2020) [27]	Australia	Prospective cross-sectional study (with qualitative component)	ICU-to-ward traumatic transfer, metropolitan public hospital	20	Not reported	85.0	ICU nurses: 50.0% Ward nurses: 50.0%	ICU nurses: 22.63 (14.74) Ward nurses: 3.33 (1.85)	Handoff method - Bedside face-to-face handoff - Phone handoff + bedside face-to-face handoff Handoff time (min, M (SD)) = 17.0 (4.44)	***- Handoff errors -*** **• Type** - Missing information - Inaccurate information **• Measurement method** - Observation by research nurse using ISBAR-based tool: Yes (handed over), No (not handed over), N/A (not applicable) - Cross-checked with the medical record **• Frequency (%)** (based on 10 handoffs) - Defined as missing at least one mandatory handover item – 100.0 ***- Contributing factors -*** **• Handoff behavior-related** - High information complexity from patient acuity - Lack of preparation by receiving nurse **• Environmental** - Time pressure - Other patients' needs - Workload pressure - Interruptions: Many people present during handoff, background noise, etc. **• Organizational** - Inconsistent and non-standardized EMR systems across hospital units - Absence of handoff guidelines **• Individual** - Level of nurses' experience

Table 1 (continued)

First author (Year)	Country	Study design	Study setting	Participants					Handoff type	Findings
				Sample size (*n*)	Age, yr M (SD)	Female (%)	Type of nurses	Clinical or unit experience, yr M (SD)		
Reine (2019) [28]	Norway	Cross-sectional study	14-bed adult PACU in a university hospital	Not reported	Not reported	Not reported	Staff nurses (trained nurse anesthetists or critical care nurses): 84.0%	10 ≤ -Transferring: 73.0% - Receiving: 75.0%	No specific handoff type reported	***- Handoff errors -*** **• Type** - Omission of patient-related information - Omission of handoff-related documents **• Measurement method** - Self-reported survey (per handoff): N-HQRF and handoff context items, % agreement **• Frequency (%)** - Omission of patient-related information: (based on 191 handoffs) 20.1 agreed (Transferring) 32.9 agreed (Receiving) 48.9 agreed (Total) - Omission of handoff-related documents: (based on 188 handoffs) 7.0 agreed (Transferring) 18.0 agreed (Receiving) 12.2 agreed (Total) ***- Contributing factors -*** **• Handoff behavior-related** - Case complexity - Excessive information included - Poor teamwork between handing-over and receiving nurses: Interpersonal conflict, difficulty initiating contact, lack of interactive questioning **• Environmental** - Time pressure
Spooner (2013) [32]	Australia	Prospective cross-sectional study	21-bed ICU in a tertiary hospital	40	Not reported	Not reported	Staff nurses: 92.5% Clinical nurses: 7.5%	Not reported	Handoff method: - Bedside handoff Handoff time (min, M (SD)) = 10.95 (4.0)	***Handoff errors -*** **• Type** - Omission of key handoff contents **• Measurement method** - Structured observation using 22-item tool by clinical research nurse: 19 items = key content presence (Yes/No) 3 items = performance level (Likert, 0 ~ 5) **• Frequency (%)** (based on 20 handoffs) - Defined as missing at least one mandatory handover item – 99.7

Table 1 (continued)

First author (Year)	Country	Study design	Study setting	Participants					Handoff type	Findings
				Sample size (*n*)	Age, yr M (SD)	Female (%)	Type of nurses	Clinical or unit experience, yr M (SD)		
Spooner (2015) [29]	Australia	Prospective cross-sectional study	21-bed ICU in a tertiary hospital	40	Not reported	Not reported	Staff nurses: 92.5% Clinical nurses: 7.5%	- *Unit* - ≥ 3: 57.5% 1 ≤ & < 3: 25.0% < 1: 17.5%	Handoff method: - Bedside handoff Handoff time (min, M (SD)) = 11 (4.0)	***- Contributing factors -*** **• Environmental** - Interruptions during handoff: Mean frequency per handoff (SD) = 2.0 (2.0) Caused by conversation with staff (not handoff-related) = 77.0% Caused by equipment (e.g., intravenous pump alarms) = 20.0%

Table 1 (continued)

First author (Year)	Country	Study design	Study setting	Participants					Handoff type	Findings
				Sample size (*n*)	Age, yr M (SD)	Female (%)	Type of nurses	Clinical or unit experience, yr M (SD)		
Tosunöz (2025) [30]	Turkey	Cross-sectional study	Medical/surgical wards, provincial city hospital	249	38.4 (8.3)	87.1	Not reported	≤5: 16.9% 6 ≤ & ≤ 15: 33.4% ≥16: 49.7%	Handoff method - Verbal (5.6%) - Written (2.0%) - Verbal & written (92.4%) Handoff location - Bedside (79.5%) - Nurse's desk (10.8%) - Corridor (6.8%) - Nurse's room (2.9%) Handoff form used - Nurse-recorded form (41.7%) - Standardised form (20.2%) - EMR (11.1%) Handoff participation - All-inclusion (65.1%) - Assigned-only (34.9%)	***- Contributing factors -*** **• Handoff behavior-related** - Discussion of irrelevant matters - Late arrival for handoff - Illegible handwriting - Disinterested attitude - Communication problems - Use of non-standard abbreviations **• Environmental** - Insufficient time - Workload pressure - Presence of patient's relative - Interruptions: Noise, doctor visits, new admission during handoff, patient's questions/requests, etc. **• Organizational** - Lack of standard handoff form **• Individual** - Tiredness

Table 1 (continued)

First author (Year)	Country	Study design	Study setting	Participants					Handoff type	Findings
				Sample size (*n*)	Age, yr M (SD)	Female (%)	Type of nurses	Clinical or unit experience, yr M (SD)		
Tran (2010) [33]	Australia	Retrospective cross-sectional study (with qualitative component)	Hospital-wide (Metropolitan hospital)	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	**- *Handoff errors* -** **• Type** - Inadequate provision of information during handoff - Breakdown in nurse-to-nurse communication **• Measurement method** - Secondary analysis of incident reports from the hospital database **• Frequency (%)** – 7.0 (of the 285 nursing errors) **- *Contributing factors* -** **• Environmental** - Noisy room - Heavy workload at the time **• Organizational** - Staff shortage - Unavailable or unclear protocol/procedure manuals

Table 1 (continued)

First author (Year)	Country	Study design	Study setting	Participants					Handoff type	Findings
				Sample size (*n*)	Age, yr M (SD)	Female (%)	Type of nurses	Clinical or unit experience, yr M (SD)		
Yu (2018) [31]	South Korea	Cross-sectional study	Delivery rooms/ neonatal units in 75 hospitals (≥ 500 beds)	291	29.95 (7.06)	98.3	Not reported	7.69 (7.13)	Handoff method - Verbal handoff with EMR or Kardex (87.9%) - Documented checklist (4.8%)	***- Handoff errors -*** **• Type** - Handoff error experience : Omission of information Excessive unnecessary information Inaccurate information Misunderstanding Work delays due to handoff errors Blame from others due to handoff errors - Handoff information quality: Outdated or insufficient information Unclear information Difficult-to-follow information Missing important information **• Measurement method** - Self-reported survey on handoff error experience (past 6 months): Likert, 1 ~ 4 (not at all ~ almost always) - Self-reported survey on information quality during handoff: Likert, 1 ~ 7 (strongly disagree ~ strongly agree) **• Frequency (M (SD))** - Handoff error experience = 1.64 (0.29) - Handoff information quality = 5.94 (0.72) ***- Contributing factors -*** **• Handoff behavior-related** - Limited interaction and support during handoff - Insufficient delivery of information **• Environmental** - Insufficient time - Overload of work **• Organizational** - Incomplete handoff system - Absence of handoff guidelines - Absence of standardized checklist **• Individual** - Lack of nurses' competencies - Unsatisfied nurse's relationship

AHRQ=Agency for Healthcare Research and Quality; ANNA=American Nephrology Nurses Association; APRN=Advanced Practice Registered Nurse; EMR=Electronic Medical Record; ICU=Intensive Care Unit; ISBAR=Identity, Situation, Background, Assessment, Recommendation; JCCTH=Joint Commission Center for Transforming Healthcare; M=mean; Min=minutes; N=numbers; N-HQRF=Norwegian-Handoff Quality Rating Form; PACU=Postanesthesia Care Unit; RN=Registered Nurse; SD=Standard Deviation; sec=seconds; yr=years

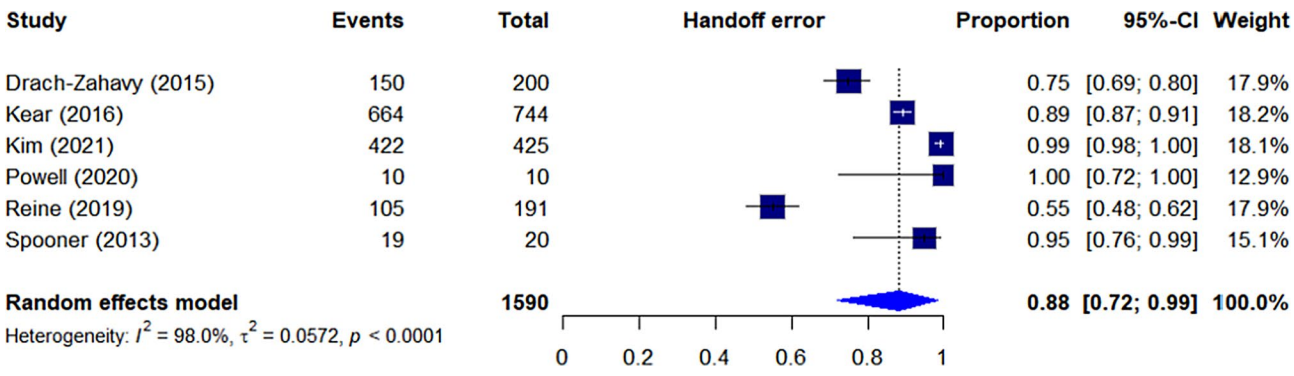

Fig. 2 Forest plot showing the pooled proportion of nursing handoff across six studies. In this plot, squares represent individual study estimates with Wilson score confidence intervals. The diamond shows the pooled estimate using Freeman–Tukey transformation

such as the ICU and PACU, whereas a lack of nursing staff was reported only in units including general wards. The main contributing factors are presented in Supplementary Fig. 1.

Conversely, factors associated with reduced nursing handoff errors included "face-to-face verbal updates with interactive questioning," "update from non-going practitioners," "topic initiation by both incoming and outgoing teams," "inclusion of the outgoing team's care plan stance," and "preparation of a summary before handoff" [22].

Synthesized results

To address the aim of identifying the frequency of nursing handoff errors across studies, a meta-analysis was conducted on six studies involving 1,590 nursing handoff cases. The pooled proportion of errors occurring during handoffs was approximately 88% (pooled proportion = 0.88, 95% CI = 0.72 ~ 0.99). Figure 2 presents the forest plot of this meta-analysis. This high pooled proportion should be interpreted in light of variability in how "handoff error" was defined and measured across studies.

Assessment of heterogeneity and publication bias

Given the variations in measurement approaches and clinical environments across studies, a substantial level of heterogeneity was anticipated. Substantial heterogeneity was identified among the studies included in the meta-analysis of nursing handoff error proportions (Q = 255.38, p < .001, I^2 = 98.0%, τ^2 = 0.06). The 95% prediction interval ranged from 0.26 to 1.00, indicating that the true proportion of nursing handoff errors may vary widely across clinical settings due to the considerable between-study variability. Subgroup analyses were conducted to explore heterogeneity across studies, based on the type of handoff error, measurement method, and patient severity. Differences in effect sizes across subgroups were not statistically significant for any of the three subgrouping criteria. However, in the analysis based on patient severity, one study was excluded because it had only a single study in one of the subgroups. A sensitivity analysis including this study was subsequently conducted. Patient severity was categorized into three groups: "high" (ICU), "moderate" (PACU), and "low-to-moderate" (general ward), using care setting as a proxy indicator of clinical acuity based on the study context and prior literature [34, 35]. Although these units are generally associated with different levels of patient acuity, this classification may not fully capture within-unit variability or mixed-acuity patient populations. In the initial analysis, no significant difference was found between the "high" and "low-to-moderate" groups (p = .570). However, when the "moderate" group was included in the sensitivity analysis, differences in effect sizes across the three groups became statistically significant (p < .001). The results are illustrated in Supplementary Fig. 2.

In the publication bias analysis, although some small studies appeared in the lower part of the funnel plot, the overall distribution was approximately symmetric. Supplementary Fig. 3 shows the funnel plot used to assess potential publication bias among the included studies. Egger's regression test also indicated no statistically significant funnel plot asymmetry (t = −0.38, p = .721). However, funnel plot-based methods and Egger's regression test are known to have inherent limitations and low statistical power in detecting publication bias, particularly when the number of included studies is small [16, 21]. Therefore, we did not interpret the absence of statistically significant asymmetry as evidence of the absence of publication bias; rather, we regarded these findings as inconclusive regarding the presence of publication bias.

Discussion

Major error types and frequency of nursing handoff errors

This study explored overall trends and potential contributing factors related to nursing handoff errors in clinical settings. Omission of information was the most

frequently identified error type, reported in six of the nine studies that examined handoff error types. This finding suggests that the fundamental nature of nursing handoffs is an interactive process primarily centered on information transmission [1–3, 36]. In clinical practice, handoffs are typically performed under time constraints, rely heavily on verbal communication, and require the sender to selectively summarize patient information based on memory and situational judgment [12, 37]. Under such conditions, certain details are likely to be unintentionally omitted. These structural characteristics are associated with incomplete information transfer and help explain why omission is commonly reported as a primary error type. In this context, information transfer errors can be understood not merely as incidental events but as outcomes related to the inherent structure of handoff processes. Information omission refers to the complete absence of information transfer and tends to occur more frequently than discrepancies in the conveyed information [24, 27, 38, 39]. Discrepancies arising from inaccurate delivery or receiver misinterpretation may be corrected during handoffs through documentation review or bidirectional communication and are therefore less likely to be recognized as errors [12, 40, 41]. As a result, omission is more readily perceived as the dominant type of handoff error.

The exceptionally high pooled proportion of handoff errors should be interpreted cautiously, given substantial differences in definitions, measurement approaches, and clinical contexts across studies. The conceptual definitions of nursing handoff errors in studies reporting error proportions can be broadly categorized into two domains: information transfer-level errors (process), such as omission or inaccuracy of information during handoff, and clinical consequence-level errors (outcome), such as deviations from prescribed care following handoff. Measurement methods ranged from structured observation to chart review and self-report surveys. Clinical settings also varied, including general wards, nephrology units, PACUs, ICUs, and ICU-to-ward transfers. In higher-severity environments such as ICUs and PACUs, the complexity of patient conditions and the time-sensitive nature of care may require more rapid and extensive information exchange. This suggests an increased likelihood of omission or communication-related errors in such settings. These differences likely contributed to the elevated pooled estimate. Therefore, this value should be interpreted as an overall indication of reported handoff errors across diverse clinical settings rather than a direct estimate of clinically significant handoff failures.

Factors contributing to the occurrence of nursing handoff errors

The various types of nursing handoff errors identified in this review appear to stem from the complex interaction among handoff process complexity, environmental, organizational, and individual factors. These four categories provide a structured framework for understanding the multifaceted context of handoff errors and for informing prevention strategies. The following sections interpret these factors in relation to potential areas for improvement. Because this review included only observational studies, many of which did not extensively adjust for confounders, the identified factors should be interpreted as associated conditions rather than definitive causal determinants.

Handoff process complexity factors

In this review, among handoff process complexity factors related to the structure, content, and inherent intricacy of the handoff process, the inclusion of excessive non-essential information and insufficient nurse-to-nurse interaction were identified as key issues. Ahn et al. [11] reported that unidirectional handoff communication often leads to repetition of documented information and inclusion of irrelevant content. Desmedt et al. [8], in their systematic review, highlighted that limited receiver engagement increases the likelihood of omission. Additionally, Troyer and Brady [42] found that excessive non-essential information can obscure critical details, potentially impeding effective handoff. These findings indicate that nursing handoffs function as interactive communication processes rather than simple unidirectional transmissions. Limited interaction and excessive non-essential information may obscure critical details, thereby increasing the risk of errors during handoffs. Structured communication strategies may help address these issues. To minimize the risk of errors, particularly the omission of critical information, transferring nurses can improve clarity by providing concise summaries of key information necessary for care continuity, while receiving nurses can enhance understanding through active engagement and preparation. Although patient severity may influence the complexity of handoff information, it was analyzed separately as a conditional variable associated with the proportion of errors and was therefore addressed in a separate section.

Environmental factors

Environmental conditions within the handoff setting, such as frequent interruptions, time pressure, and heavy workload, were consistently identified as significant contributors to handoff errors. In particular, frequent interruptions during handoffs were highlighted across multiple studies. Vanderzwan et al. [10] identified human

elements, including patients and family members, as well as equipment alarms, as major sources of disruption. Similarly, Abraham et al. [43] highlighted high workloads, the complexity of managing multiple concurrent tasks, and the relatively limited time available for handoffs as major barriers to effective handoffs. External disturbances, excessive workload, and the absence of protected handoff time may compromise concentration during handoffs, potentially increasing the risk of handoff errors. Therefore, structurally improving and managing the handoff environment may represent an important component of strategies aimed at reducing nursing handoff errors.

Organizational factors

Key organizational factors identified in this study as contributing to handoff errors include the absence of standardized handoff guidelines, inconsistencies in handoff systems, and limited structured education on handoff practices. These findings align with Clapper and Ching [44], who reported that variation in handoff systems across departments increases the risk of information omission. They also support prior studies emphasizing the importance of implementing standardized and structured handoff procedures and providing formal training to improve handoff quality [8, 11, 14, 15, 45]. Inconsistent systems and lack of standardization may lead to variability in information transfer, which may in turn contribute to the occurrence of handoff errors. Therefore, improving handoff quality requires the development of standardized guidelines tailored to the clinical context of each hospital, along with the establishment of a consistent organizational handoff system. Furthermore, developing and continuously implementing structured handoff education programs is essential.

Individual factors

Individual characteristics, particularly nurses' clinical experience, were also found to influence the occurrence of nursing handoff errors. Drawing on prior studies, Galatzan and Carrington [12] highlighted nursing experience as a key determinant of handoff quality, and Holly and Poletick [4] emphasized that nurses serve as gatekeepers of patient-related information, with their experience playing a critical role in the quality of information conveyed. Limited clinical experience may be linked to variations in the accuracy and completeness of information exchange. This suggests that such variations may contribute to handoff errors. These findings highlight the need for organizational handoff education that goes beyond standardized delivery methods and is instead tailored to the clinical experience levels of individual nurses. In particular, novice nurses may benefit from regularly participating in simulation-based training that incorporates feedback.

Across these identified categories of contributing factors, certain elements were reported more frequently than others. However, the observational nature of the included studies and heterogeneity in measurement approaches limit direct comparison of their relative impact. Accordingly, these findings indicate which factors were most frequently identified across studies but do not establish a clear priority for intervention.

Contextual Interpretation of the synthesized findings

Since the World Health Organization (WHO) and The Joint Commission emphasized standardized handoffs to enhance patient safety [46], numerous studies have sought to reduce nursing handoff errors by developing new handoff models [47, 48] and implementing handoff tools [49, 50]. Despite these efforts, this study found that handoff error rates remain substantial in clinical settings. Studies published between 2013 and 2019 [22, 24, 28, 32] reported a gradual decline in handoff error rates, whereas studies conducted during 2020 and 2021 [26, 27] indicated a renewed increase. Powell et al. [27], examining ICU handoffs involving patients with moderate to high acuity, suggested that patient acuity may have contributed to higher error rates. Kawamoto et al. [51] reported that higher patient acuity increases the informational demands of interprofessional communication, potentially increasing workload-related stress. Desmedt et al. [8] reported that the increased complexity of information exchange associated with high patient acuity may negatively affect the handoff process. Together, these findings suggest that patient acuity may contribute to increased handoff errors. This interpretation is supported by sensitivity analysis in the present study, which revealed significant differences between groups with varying levels of patient severity, suggesting that patient severity may influence the proportion of nursing handoff errors. A similar pattern was observed in a study conducted during the early phase of the coronavirus disease 2019 (COVID-19) pandemic [26]. According to Lucchini et al. [52], this period was characterized by increased patient acuity and nurses' workload, which may help explain the higher reported handoff error proportions. In this study, patient severity was operationalized using care setting as a proxy for clinical acuity. Although ICUs, PACUs, and general wards generally reflect different levels of patient severity, this approach may not fully account for within-unit variability or mixed-acuity settings and should therefore be interpreted with caution.

Implications for practice and future research

Compared with previous systematic reviews on nursing handoffs [4, 8, 10–13, 43, 53, 54], this study identified

similar patterns in factors related to handoff errors. These findings suggest that such errors may follow consistent patterns across clinical contexts. Although interventions such as structured handoff tools, bedside handoffs, and handoff education have shown effectiveness in several studies [13, 53, 55], the overall impact of these interventions on improving clinical handoffs remains inconclusive [56]. Based on the present findings, efforts to reduce clinical nursing handoff errors should adopt a multidimensional approach integrating communication processes, the physical environment, organizational systems, and individual nurse competencies. Unlike previous studies that primarily emphasized the adoption of specific handoff tools or formats, these findings underscore the need for integrated, practice-level strategies derived from these interacting domains. Specifically, strategies to reduce nursing handoff errors include the following. At the communication level, nurses can implement structured, bidirectional handoff protocols in which critical patient information, including current status, pending tasks, and high-risk concerns, is explicitly verified using closed-loop communication, with the receiving nurse repeating and the sending nurse confirming the accuracy of the information before completion of the handoff. At the environmental level, clinical units can establish protected handoff periods during shift changes by temporarily deferring non-urgent tasks and assigning designated staff to handle urgent calls and requests from patients, family members, or other healthcare professionals during handoff. At the organizational level, healthcare institutions can develop unit-specific standardized handoff protocols, such as SBAR formats adapted to the characteristics of each clinical unit, and integrate them into electronic medical record systems where possible. These protocols can be supported by regular audit and feedback cycles, including periodic monitoring of handoff completeness and error reports. At the individual level, competency-based training programs can be implemented using simulation or case-based scenarios. Training content can be differentiated, focusing on basic information structuring for novice nurses and clinical prioritization and risk anticipation for experienced nurses. Taken together, these strategies highlight that improving handoff quality requires addressing multiple interacting conditions surrounding the handoff process, rather than relying on single interventions. Future research should prioritize multidimensional intervention studies addressing the factors identified in this study. Such interventions may include the development of AI-assisted handoff-support systems to facilitate structured prioritization of essential patient information and bidirectional communication, the establishment of context-specific organizational protocols aligned with clinical environments, and the implementation of training programs tailored to nurses' competency levels. These interventions should be evaluated using longitudinal designs to assess their sustained effects on handoff error rates, nurse job satisfaction, and clinically meaningful patient outcomes, such as preventable adverse events and length of hospital stay.

Limitations

This study has several limitations. First, many included studies relied on self-reported data to identify nursing handoff errors, which may have introduced subjectivity. Second, most studies reported contributing factors narratively, limiting the ability to quantify the impact of individual factors or to compare their relative importance. Third, inconsistencies in the definitions and classification criteria of nursing handoff error types across studies may have contributed to the substantial between-study heterogeneity, which in turn limits the interpretability of the pooled estimate.

Strengths and contributions

Despite these limitations, this study provides a comprehensive perspective on nursing handoff errors by systematically analyzing their major types and contributing factors and by identifying overall trends in reported error proportions through quantitative meta-analysis. Furthermore, it offers practical implications by highlighting high-frequency error types and key contributing domains that warrant prioritization in intervention development, thereby providing a structured basis for designing more targeted error prevention strategies in clinical settings.

Conclusions

This study aimed to provide a comprehensive understanding of nursing handoff errors by integratively examining their major types, occurrence rates, and contributing factors. The findings indicated that "omission of information" was the most frequently reported error type and that handoff process complexity, environmental, organizational, and individual factors associated with the occurrence of these errors. Although substantial heterogeneity was observed across studies, the pooled estimate suggests a relatively high proportion of reported nursing handoff errors across diverse clinical contexts. Unlike prior systematic reviews that focused on specific aspects or isolated intervention effects, this study offers a more comprehensive and structured perspective on nursing handoff errors, thereby providing practical implications for clinical practice. To reduce nursing handoff errors, commonly manifested as information omissions, a multifaceted strategy may be warranted. This includes implementing structured handoff processes, improving the physical and organizational environment, developing standardized handoff guidelines tailored to clinical settings, and introducing training programs aligned with

individual nurses' competencies. Future research should aim to evaluate the long-term effects of such multidimensional strategies on error reduction and patient safety in clinical practice.

Abbreviations

PROSPERO	International Prospective Register of Systematic Reviews
JBI	Joanna Briggs Institute
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PubMed	Public MEDLINE
EMBASE	Excerpta Medica Database
CINAHL	Cumulative Index of Nursing and Allied Health Literature
MeSH	Medical Subject Headings
ICU	Intensive care unit
PACU	Post-anesthesia care unit
CI	Confidence interval
WHO	World Health Organization
COVID-19	Coronavirus disease 2019

Supplementary Information

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Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

Supplementary Material 4

Supplementary Material 5

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Author contributions
All authors on this paper meet the four criteria for authorship as identified by the International Committee of Medical Journal Editors. All authors have contributed to the conception and design of the study, drafted or have been involved in reviewing this manuscript, reviewed the final version of this manuscript before submission, and agree to be accountable for all aspects of the work. Specifically, the contributions of each author are as follows: Study conceptualization and design: SY, JHP, MGK; Data collection: SY, JHP; Data analysis and interpretation: SY, MGK; Drafting of the article: SY, MGK; Critical revision of the article: SY, JHP; Funding acquisition: SY, JHP, MGK.

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Data availability
The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
This study is a systematic review and meta-analysis. Because no human participants were directly involved, ethical approval was not required.

Consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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