Archives of Anesthesiology and Critical Care (May-Jun 2026); 12(3): 299-309.

Available online at http://aacc.tums.ac.ir

Review Article

Structured Intraoperative Patient Handover among Anesthesia Providers and Its Role in Patient Safety and Team Communication: A Systematic Review

Mohammad Mehdi Azizi Darbandi[1], Mohammad Gholamzadeh[2], Alireza Mamizadeh[3], Zahra Ranjbar[4], Behnam Shiri Zilan[5]*

[1]Department of Anesthesia & Surgical Technology, School of Allied Medical Sciences, Urmia University of Medical Sciences, Urmia, Iran.

[2]Department of Anesthesiology, School of Allied Medical Sciences, Golestan University of Medical Sciences, Gorgan, Iran.

[3]Department of Critical Care Nursing, Faculty of Nursing and Midwifery, Urmia University of Medical Sciences, Urmia, Iran.

[4]Department of Anesthesiology and Operating Room, School of allied Medical Sciences, Mazandaran University of Medical Sciences, Sari, Iran.

[5]Department of Anesthesia & Surgical Technology, School of Allied Medical Sciences, Urmia University of Medical Sciences, Urmia, Iran.

ARTICLE INFO

Article history:
Received 27 December 2025
Revised 18 January 2026
Accepted 02 February 2026

Keywords:
Intraoperative handoff;
Intraoperative handover;
Anesthesia provider;
Structured handoff;
patient safety;
Communication;
Operating room

ABSTRACT

Background: Intraoperative handovers, the transfer of patient care between anesthesia providers, are common in the operating room and represent a critical juncture for communication failures. Ineffective handovers are associated with the loss of essential clinical information and an increased risk of adverse postoperative outcomes. This systematic review aimed to synthesize the existing evidence regarding the impact of structured intraoperative handovers on patient safety, communication quality, and continuity of care.

Methods: This systematic review was conducted according to the PRISMA guidelines. The study evaluated 17 published research studies (2000–2025) investigating structured intraoperative anesthesia handovers, including the utilization of checklists, SBAR (Situation-Background-Assessment-Recommendation), I-PASS, and cognitive aids. Data extraction focused on patient safety outcomes, communication quality, and the continuity of care.

Results: The findings demonstrate that non-standardized handovers commonly result in information loss and variability in clinical practice, thereby potentially compromising patient safety. In contrast, the use of standardized handover tools reliably promotes information transmission, bolsters team collaboration, and minimizes variability in patient-transfer procedures. Moreover, available data suggest that implementing structured intraoperative handovers is associated with reductions in postoperative morbidity, although study findings are heterogeneous.

Conclusion: Structured intraoperative handovers are a viable and economical technique to improve communication and patient safety under anesthesia. Standardization and targeted education may further optimize the outcomes. Future research should identify the optimal handover components, evaluate their long-term clinical impact, and guide the development of international implementation strategies.

The authors declare no conflicts of interest.
*Corresponding author.
E-mail address: behnamzilan1376@gmail.com
DOI: 10.18502/aacc.v12i3.21318

Introduction

The operating room is one of the highest-risk environments in healthcare settings for the occurrence of adverse events. National studies and reports have demonstrated that ineffective communication is the most prevalent factor contributing to such events [1]. Patient handover, defined as the transfer of clinical information and care responsibility from one healthcare professional to another, represents a recurring process in clinical practice, commonly referred to as "handover" or "care transition." Historically, the handover process has been linked to incomplete information transfer and preventable patient harm [2].

Preventable medical errors remain among the most significant sources of harm to hospitalized patients, causing an estimated 200,000–400,000 deaths annually. Communication failures and information loss, particularly during patient handovers, constitute the primary root causes of approximately 80% of medical errors and are similarly identified in closed-claim analyses of anesthesia-related incidents [3]. Although most medical specialties typically conduct a single patient handover, the perioperative setting involves sequential handovers that are commonplace and increasingly necessary [4]. Evidence shows that 21–65% of errors and care lapses during surgery are attributable to communication problems during patient handovers. Communication errors occur approximately once every seven to eight minutes in the operating room [5]. In 90% of cases, these errors have adverse effects on the surgical workflow, including delays, surgical errors, resource wastage, increased team tension, loss of critical information, and the occurrence of adverse events [6-8].

In 2006, the Joint Commission designated the implementation of standardized patient handovers as a National Patient Safety Goal (NPSG 2E). Within the perioperative field, the majority of research has concentrated on postoperative handovers, with several studies explicitly evaluating the effects of standardized postoperative handover tools. However, intraoperative handovers represent a potentially significant source of communication failure, and relatively limited research has been published addressing this critical component of the care process [9]. The dynamic operating room environment, in which anesthesia providers must exchange vital information while simultaneously maintaining safe patient care, increases the complexity of these transitions. Communication failure has been identified as the principal root cause of critical anesthesia-related adverse events [10].

Given the frequent occurrence of intraoperative handovers and their potential implications for patient safety and the quality of team communication, a systematic review in this area is warranted. This review aimed to compile and synthesize existing evidence on structured handover approaches used by anesthesia providers during intraoperative transfers and to assess their effects on patient safety, communication quality, and continuity of care.

Methods

Study Design and Search Strategy

This systematic review was carried out following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines during the years 2024 and 2025. Searches of the literature were conducted across various databases, such as PubMed, Scopus, Embase, MEDLINE, the Cochrane Library, Google Scholar, and resources from institutional libraries. The search employed keywords related to "intraoperative handover," including:

"Intraoperative handover," "anesthesia provider transition," "structured handover," "handoff communication," "checklist," "SBAR," "I-PASS," "patient safety," "operating room."

and their Persian equivalents. Keywords were merged utilizing the Boolean operators (AND, OR, NOT). The search encompassed all published articles from 2000 to June 2025. The initial search yielded approximately 5,180 articles screened. Two independent reviewers assessed the titles, abstracts, and full texts of the retrieved studies. Disagreements among reviewers were resolved through deliberation and consensus, or through consultation with an independent third reviewer when necessary. Selected articles underwent evaluation to assess the efficacy of intraoperative handovers among anesthesia providers and their influence on patient safety metrics, communication effectiveness, and care continuity.

Inclusion Criteria

Studies eligible for inclusion must satisfy the following conditions:

1. Original empirical research articles addressing intra-operative handovers among anesthesia providers
2. Implementation of formalized handover methodologies or instruments (such as checklists, SBAR, I-PASS)
3. Human-based investigations published between 2000 and June 2025
4. Articles available in English or Persian language
5. Documentation of at least one outcome measure pertaining to patient safety, communication quality, reduction of medical errors, or continuity of intra-operative care

Exclusion Criteria

Studies were excluded based on the following reasons:

1. Inaccessibility of full-text publications
2. Focus on preoperative or postoperative handover processes rather than intraoperative transitions
3. Lack of a clearly defined handover structure
4. Ambiguous findings or failure to adequately address research inquiries
5. Editorials, conference abstracts/proceedings, or publications in non-indexed journals
6. Investigations involving animal models, laboratory-based studies, or non-systematic literature reviews

Results

The systematic review commenced with the identification of 5,180 studies through comprehensive database searches utilizing pertinent keywords. The screening process encompassed all disciplinary domains and article types without restrictive criteria.

Subsequently, based on title-level evaluation, 4,080 articles meeting the inclusion criteria were identified from the initial 5,180 studies and advanced to the first stage of the review process. The abstracts of these articles were further assessed. Following abstract-level screening, 424 articles proceeded to the second review phase. During this stage, articles of high relevance pertaining to the structured handoffs during anesthesia care in surgical procedures and their role in patient safety and team communication underwent detailed evaluation. Applying predefined inclusion and exclusion criteria, the principal investigator and two experienced co-investigators conducted further assessments, considering the accessibility of full-text publications. Subsequently, the number of articles was reduced to 17 studies in the third stage (Figure 1).

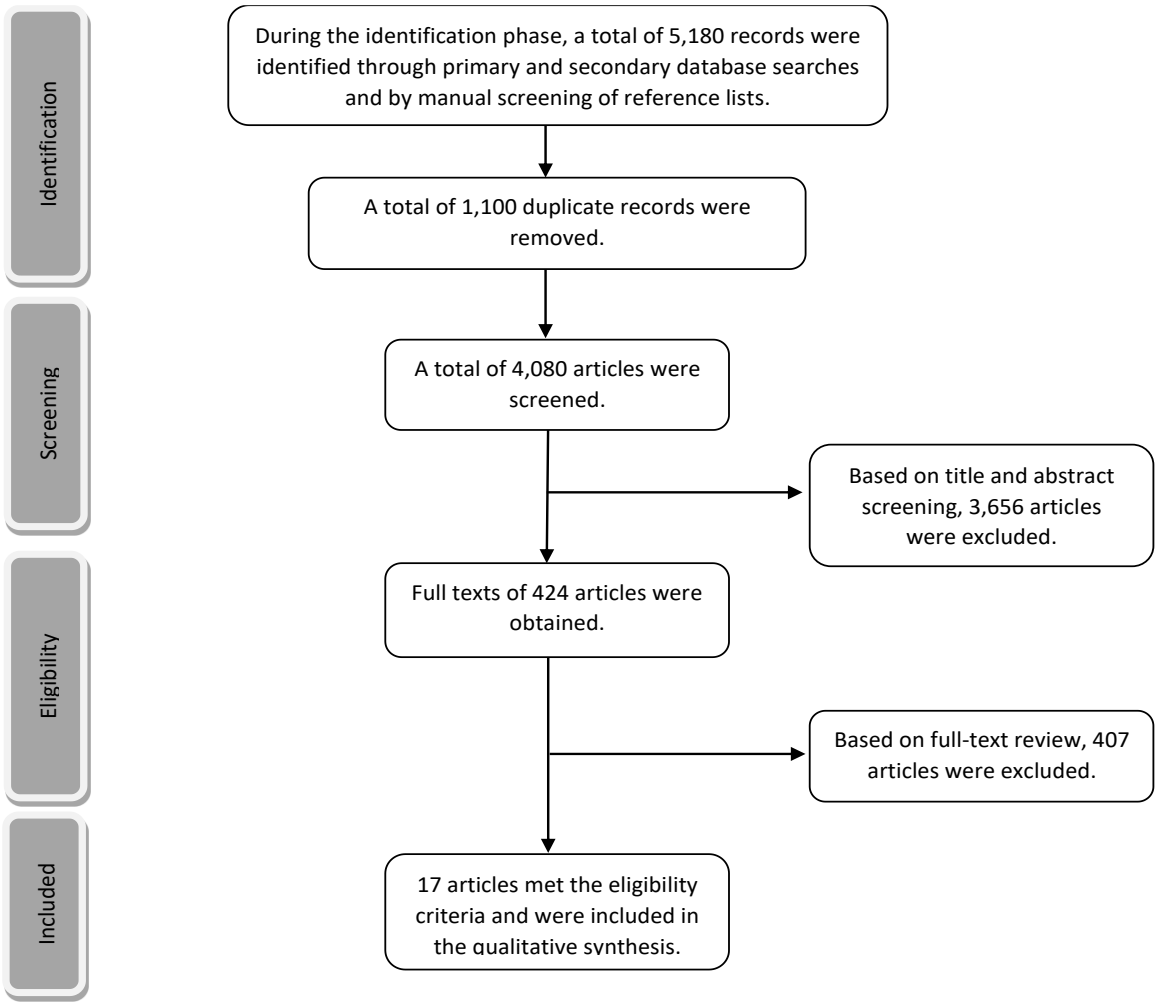

Figure 1- PRISMA flow diagram illustrating the identification, screening, eligibility assessment, and inclusion of studies.

The articles were then systematically reviewed for data extraction utilizing the PICO framework (PICO: P, patient/population; I, intervention; C, comparison; O, outcome), which addressed the following research question: In surgical patients (P), does the implementation of structured anesthesia care handoffs during the operative period (I), compared with unstructured or non-standardized handoffs (C), improve patient safety, quality of team communication, and continuity of care (O)?) The data extraction process identified pivotal factors pertaining to the structured handoffs provided by anesthesia personnel during surgical procedures and their impact on patient safety and team dynamics. The extracted article characteristics are presented in (Table 1).

Table 1- Related articles

Author Name	Year	Place of study	Collection tool and type of study	Title	Results
Adam Schiavi et al. [3]	2023	USA	Original Article	Measurement of Information Transfer During Simulated Sequential Complete Shift-to-Shift Intraoperative Handoffs	During sequential handoffs, a substantial portion of clinical information is often lost; however, the use of structured tools partially mitigates this issue. These tools primarily offer the advantage of reducing variability and preserving critical information. They are useful for assessing and comparing different handoff strategies under controlled conditions. Furthermore, they hold significant educational value for instructors responsible for training and assessing learners in clinical settings.
Aalok V. Agarwala et al. [9].	2015	USA	Original Article	An Electronic Checklist Improves Transfer and Retention of Critical Information at Intraoperative Handoff of Care	The use of a structured handoff checklist based on the Anesthesia Information Management System (AIMS) during intraoperative care transitions improved the transfer and retention of critical information. With consistent use of the checklist, clinicians reported that in approximately 75% of handoffs, the quality of communication and identification of perioperative concerns at end-of-case handoffs were significantly better than those before the checklist implementation. These findings suggest that employing a simple intraoperative handoff checklist enhances communication quality.
Shivani Jayaswal, MD, et al. [11].	2011	USA	Original Article	Evaluating Safety of Handoffs Between Anesthesia Care Providers	This literature review underscored the imperative for handoff standardization to augment communication efficacy and diminish iatrogenic errors. Survey data revealed substantial dissatisfaction among anesthesia practitioners regarding extant protocols, with a demonstrable preference for hybrid modalities incorporating both electronic documentation and direct interpersonal communication. Consequently, institutional leadership instituted a mandatory handoff verification protocol integrated within the anesthesia electronic health record system, thereby establishing a more systematized and secure mechanism for patient transfer. Furthermore, electronic standardization is expected to effectively support patient safety. Ultimately, future data from broader surveys will contribute to the

					continuous improvement of this process and the reduction of anesthesia-related complications.
James P. Bagian, MD et al. [12]	2018	USA	Opinion Article	Handovers During Anesthesia Care: Patient Safety Risk or Opportunity for Improvement?	Improving patient safety depends on the planning, actions, and professional conduct of the healthcare providers. Traditional, unstructured handoffs are a primary cause of communication failures and transfer-related harm. Continuing with past practices makes meaningful improvements in patient safety unlikely, as the core issue lies in poor team communication during handoffs rather than the handoff itself. Real progress can be achieved only when healthcare systems broadly adopt standardized, technology-based methods and tools to enhance communication. Ultimately, the level of safety that patients deserve can only be attained through structural transformation.
Sylvain Boet et al. [10]	2020	Canada	A Systematic Review and Meta-analysis	Association of intraoperative anesthesia handovers with patient morbidity and mortality: a systematic review and meta-analysis	Although intraoperative anesthesia handovers are conventionally correlated with elevated morbidity and mortality indices in surgical populations, emerging evidence suggests potential safety enhancements in circumscribed clinical contexts. Further research is needed to identify the specific characteristics of handoffs that impact patient safety to better inform policies and practical interventions.
Jiale Hu et al. [13]	2020	China	A Systematic Review and Meta-analysis	Adverse Outcomes Associated With Intraoperative Anesthesia Handovers: A Systematic Review and Meta-analysis	The meta-analysis conducted in this review indicated that each additional intraoperative handoff among anesthesia providers increases the risk of composite morbidity but does not elevate the risk of composite mortality and morbidity or in-hospital mortality. These findings challenge the traditional assumption that handoffs should be neutral events in terms of patient care. However, the current meta-analytic results are by no means definitive due to the quality of the evidence, unstable sensitivity analyses, and unclear causal relationships. Future studies examining intraoperative anesthesia handoffs could benefit from leveraging more comprehensive databases, advanced big data analytics, and insights from the fields of communication science, psychology, sociology, business, and anthropology.
Joseph A. Hyder et al. [14]	2016	USA	Original Article	Anesthesia Care Transitions and Risk of Postoperative Complications	The present study found that a greater number of anesthesia providers was associated with higher rates of postoperative complications after colorectal surgery, although the precise mechanism remains uncertain. Given the ubiquity of care handoffs in anesthesia, there is a need for independent research to identify the critical components of these handoffs. It is essential to investigate how care transitions can be neutral or beneficial. Moreover, the impact of intraoperative checklists on patient

					outcomes needs to be evaluated. Future research should focus on local handoff characteristics and communication processes related to specific types of surgery.
Jason Silva et al. [15]	2019	USA	Original Article	Improving Nurse Anesthetist Intraoperative Handoff Process by Developing and Implementing an Evidence-Based, Facility-Specific Cognitive Aid	Standardizing intraoperative handoffs among nurse anesthetists using a center-specific, evidence-based cognitive aid improved communication expectations and the transfer of relevant clinical information during high-pressure intraoperative periods. The success of this initiative provided a foundation for developing and implementing an interprofessional perioperative handoff cognitive aid.
Leif Saager et al. [16]	2014	USA	Original Article	Intraoperative Transitions of Anesthesia Care and Postoperative Adverse Outcomes	Intraoperative care handoffs among anesthesia providers are associated with significantly worse patient outcomes. The magnitude of this effect was similar for attendings, residents, and certified registered nurse anesthetists (CRNAs). These findings indicate that reducing the number of care handoffs has the potential to improve the quality of patient care. Furthermore, formalizing the handoff process is likely to be beneficial.
Dominik Choromanski et al. [17]	2014	USA	Original Article	Intraoperative patient information handover between anesthesia providers	Our preliminary study indicates that the current intraoperative handoff practices among anesthesia providers are suboptimal, and the development of national patient handoff guidelines is essential to enhance patient safety.
Philip M. Jones et al. [4].	2018	England	Original Article	Association Between Handover of Anesthesia Care and Adverse Postoperative Outcomes Among Patients Undergoing Major Surgery	Among adults undergoing major surgery, complete intraoperative anesthesia handoffs were associated with a higher risk of adverse postoperative outcomes than no handoffs. These findings may support the limitation of complete anesthesia handoffs.
Katherina Jurewicz et al. [18]	2018	USA	Original Article	Investigating Intraoperative and Intraprofessional Handoffs in Anesthesia	This study revealed variability in intraoperative handoffs during the maintenance phase of anesthesia and emphasized that intraoperative intraprofessional handoffs warrant further investigation to develop effective strategies or tools for high-quality anesthesia handoffs.
Sophia Lane et al. [19]	2022	Canada	Original Article	What are we missing? The quality of intraoperative handover before and after the introduction of a checklist	The use of a checklist during intraoperative handoffs improved the completeness of the data transfer. Handoff checklists should be considered to enhance the thoroughness of the intraoperative handoffs.

Vikas N. O'Reilly-Shah et al. [20]	2019	USA	A retrospective observational study	Lack of association between intraoperative handoff of care and postoperative complications: a retrospective observational study	The research suggests that methodological variations in confounding factor adjustment contribute substantially to observed heterogeneity within the literature. This study expands upon antecedent investigations by examining handoff ramifications within integrated care team frameworks and stratified by methodology, with particular emphasis on perioperative management strategies. Further research is needed to better understand the effects of anesthesia handoffs on postoperative outcomes. Such studies should also evaluate the roles of performance patterns and structured communication tools.
Mallory M. Light et al. [21].	2023	USA	Original Article	Standardizing Intraoperative Handoffs Amongst Certified Registered Nurse Anesthetists	Inadequate intraoperative handoffs can lead to serious adverse events and even death. Anesthesia providers have access to a simple, low-cost, evidence-based intervention that can reduce these risks while simultaneously improving job satisfaction and lowering costs. This study identified multiple facilitating factors, despite certain implementation barriers. The preliminary results are promising, and further refinements to the handoff tool are expected to enhance these outcomes. Additionally, proper training and easy access via electronic health records (EHR) play crucial roles in the adoption and success of this tool.
Maxim A. Terekhov et al. [22]	2016	USA	Original Article	Intraoperative Care Transitions Are Not Associated with Postoperative Adverse Outcomes	Anesthesia care handoffs were not associated with an increased risk of adverse postoperative outcomes, whereas anesthesia team breaks were associated with a reduced risk of such outcomes. Further research is needed to better understand the relationship between the anesthesia team's breaks and patient outcomes.
Marion Jullia et al. [23]	2017	France	Original Article	Training in intraoperative handover and the display of a checklist improves communication during the transfer of care.	Intraoperative handoff training and displaying a checklist in the operating room improved the checklist scores for anesthesia care handoffs.

Discussion

This systematic review synthesizes evidence from 17 studies that examined the impact of intraoperative anesthesia care handoffs on communication quality, information transfer, team dynamics, and patient outcomes. Collectively, the evidence indicates that intraoperative handoffs constitute both a critical juncture of vulnerability and a consequential opportunity for patient safety optimization. Whilst numerous investigations have documented associations between handoffs and adverse sequelae, additional research demonstrates that appropriately structured and standardized anesthesia handoff protocols can fortify interprofessional communication, mitigate informational degradation, and conceivably attenuate adverse event risk.

Information Loss During Handoffs and Its Clinical Significance

A particularly salient and replicable observation across reviewed studies pertains to the substantial loss of pertinent clinical information during intraoperative anesthesia handoffs. Adam Schiavi et al. (2023) demonstrated through simulation methodology that considerable proportions of clinical data deteriorate through successive anesthesia provider transitions. Although structured assessment instruments partially ameliorated information attrition, the authors concluded that data degradation persisted as a formidable concern, especially when multiple sequential transitions ensued. This observation carries particular significance for prolonged or technically complex surgical interventions wherein multiple provider transitions prove inevitable [3].

Similarly, Dominik Choromanski et al. (2014) demonstrated that handoff practices among anesthesia providers are frequently nonstandard and irregular, with substantial omissions in patient vital data documentation. Their work strongly supports the need for standardized national or institutional protocols to enhance the safety and consistency of anesthesia care handoffs [17].

Katherina Jurewicz et al. (2018) documented substantial heterogeneity in handoff execution during the anesthesia maintenance phase, manifesting not merely between institutions but also amongst individual clinicians within identical institutional settings. This inconsistency engenders unpredictability in clinical care delivery and augments the probability of communicative dysfunction [18].

These findings collectively substantiate that information loss represents a tangible, quantifiable, and clinically consequential phenomenon, with practice variability intensifying the inherent risk.

The Relationship Between Handoffs and Postoperative Outcomes

Multitudinous observational investigations and meta-analytic syntheses incorporated in this review have established that intraoperative anesthesia handoffs correlate with diminished postoperative outcomes.

Leif Saager et al. (2014) documented a statistically significant relationship between intraoperative anesthesia transitions and augmented postoperative adverse event incidence. This association demonstrated consistency across diverse provider categories—including attending anesthesiologists, anesthesia residents, and certified registered nurse anesthetists (CRNAs)—suggesting that the underlying risk derives from the transfer mechanism intrinsically rather than constituting provider-specific phenomenon [16].

Philip M. Jones et al. (2018) identified that comprehensive anesthesia handoffs during major surgical procedures correspond with elevated postoperative adverse outcome risk. The investigators proposed that circumventing superfluous complete handoffs may constitute a salient risk-reduction intervention for high-risk procedures [4].

Joseph A. Hyder et al. (2016) extended these findings by demonstrating that increasing numbers of anesthesia care transitions correlate with higher rates of postoperative complications in patients undergoing colorectal surgery. Whilst definitive causal inference remains elusive, the consistency with longitudinal investigations fortifies the contention that iterative handoffs may confer iatrogenic risk [14].

Meta-analytic evidence supports this association. Sylvain Boet et al. (2020) executed a systematic review with meta-analytic integration demonstrating that intraoperative handoffs associate with heightened patient morbidity and mortality indices [10]. Concordantly, Hu et al. (2020) established that incremental handoffs proportionally augment composite morbidity odds ratios, though not invariably mortality. Significantly, Hu et al. emphasized inherent evidentiary limitations encompassing methodological heterogeneity and unmeasured confounding, advocating for rigorous prospective investigation [13].

These cumulative findings refute the historical paradigm portraying handoffs as inconsequential clinical practices and posit instead that they may constitute an autonomous risk determinant for patient compromise.

Studies Demonstrating Non-Association and the Role of Contextual Factors

Conversely, a minority of investigations demonstrated no statistically significant correlation between intraoperative handoffs and postoperative adverse outcomes.

Vikas N. O' Reilly Shah et al. (2019) found no relationship between intraoperative handoffs and postoperative complications in their retrospective observational study. However, these studies underscored that statistical model adjustment for confounding variables—including patient acuity indices, operative duration, and practitioner experience—could substantially modify the observed effect magnitude of handoffs. Their findings suggest that the clinical milieu in which handoffs transpire may prove equally consequential as the handoff mechanism itself [20].

Similarly, Maxim A. Terekhov et al. (2016) reported that intraoperative transfers were not associated with worse outcomes and specifically found that provider breaks were associated with a reduction in adverse events, suggesting that provider fatigue may serve as an important mediating factor. This raises a critical point: in some circumstances, handoffs may not constitute a risk but rather a protective intervention if they reduce cognitive load and fatigue [22].

These discordant findings illuminate the multifaceted nature of this phenomenon and reinforce the proposition that handoff quality, temporal appropriateness, structural organization, and contextual circumstances may supersede the mere occurrence of a handoff in determining clinical outcomes.

Effectiveness of Structured Handoff Tools, Checklists, and Memory Aids

A preponderant theme emerging from multiple investigations incorporated in this review concerned the utility of structured handoff mechanisms in augmenting communicative effectiveness and attenuating informational loss.

Aalok V. Agarwala et al. (2015) demonstrated that an electronic intraoperative handoff verification protocol predicated upon the Anesthesia Information Management System (AIMS) substantially enhanced the transmission and preservation of critical clinical data. Clinicians have reported improvements in clarity, better identification of operative concerns, and enhanced situational awareness [9].

Sophia Lane et al. (2022) similarly established that checklist operationalization significantly augmented the comprehensiveness and caliber of intraoperative handoffs. These enhancements persisted even within high-acuity operating room contexts characterized by temporal constraints recognized as substantial impediments to communicative efficacy [19].

Marion Jullia et al. (2017) demonstrated that educational interventions coupled with real-time checklist visualization within the operative environment substantially improved handoff communicative proficiency metrics. Their investigation underscores the imperative of not exclusively furnishing instruments but additionally providing clinical practitioners with requisite competency training for optimal implementation [23].

Jason Silva et al. (2019) and Mallory M. Light et al. (2023) focused on the certified registered nurse anesthetist population and demonstrated that evidence-based, center-specific cognitive aids improved both the structure and content of communication. Furthermore, Light et al. posited that systematized handoffs may augment professional satisfaction and diminish institutional expenditures, indicating that beneficial effects may transcend patient outcomes exclusively [15,21]. Shivani Jayaswal et al. (2011) similarly documented pronounced practitioner dissatisfaction regarding extant handoff protocols coupled with demonstrable preference for standardized, documented modalities. Their investigation ultimately catalyzed implementation of a mandatory checklist-predicated handoff system incorporated within the electronic anesthesia documentation repository, thereby substantiating the practical feasibility of institutional-level interventions [11]. From a conceptual framework, James P. Bagian et al. (2018) contended that deficient handoffs constitute a cardinal contributor to iatrogenic harm; however, systematization, technological integration, and organizational cultural realignment can transmute handoffs from a liability into a catalyst for amelioration [12]. Collectively, these investigations furnish compelling corroborative evidence that structured handoffs constitute not merely feasible but exceptionally efficacious, economically efficient interventions capable of substantially advancing communicative quality and conceivably attenuating adverse event incidence.

Educational and Systemic Implications

Beyond immediate clinical ramifications, certain investigations have accentuated the instructional utility of structured handoff instruments. Adam Schiavi et al. (2023) emphasized that handoff mechanisms can function as potent pedagogical apparatuses for trainees, consolidating the prioritization of essential clinical data and methodical analytical reasoning [11].

Heightened recognition of handoffs as a patient safety concern has important implications at the systems level. Multiple authors in this review emphasized the necessity of developing institutional and national protocols for intraoperative handoffs (Dominik Choromanski et al., 2014; James P. Bagian et al., 2018). Furthermore, the increasing integration of such tools into electronic health record systems demonstrates that handoff standardization can be effectively scaled within large healthcare organizations.

Jiale Hu et al. (2020) additionally propose that forthcoming investigation should synthesize perspectives from collateral disciplines encompassing communication science, behavioral psychology, sociological inquiry, and human factors ergonomics to construct handoff architectures that embody not merely structural systematization but congruence with fundamental human cognitive architecture [13].

Future Research Directions

Even though there is a considerable amount of evidence available, there are still significant gaps that exist. Future investigations should target the following:

- Definition of core components of an optimal intraoperative handoff
- Determination of the minimum dataset required for safe care transfer
- Assessment of long-term effects of standardized handoffs on mortality and major morbidity
- Evaluation of the role of artificial intelligence and real-time alerts in handoff protocols
- Adaptation of handoff protocols for specific surgical subspecialties and high-risk populations

- Examination of the interaction among fatigue, cognitive load, and handoff safety

High-quality, prospective, multicenter studies addressing these questions will be essential to support the development of internationally endorsed handoff guidelines.

Conclusion

The 17 studies included in this systematic review clearly demonstrate that intraoperative anesthesia care handoffs are not neutral events. When poorly executed, they are associated with information loss, communication failures, increased variability, and, in many cases, worse postoperative outcomes. However, when supported by structured tools, checklists, cognitive aids, and appropriate education, handoffs can be transformed into a powerful mechanism for strengthening communication, promoting team cohesion, and enhancing patient safety.

Therefore, structured intraoperative handoffs should be considered a standard of care in modern anesthesia practice and a vital component of perioperative patient safety strategies.

Acknowledgment

The authors acknowledge the use of artificial intelligence–assisted tools (Claude 4.5 and Paperpal) solely for language editing and improving the clarity of the Discussion section. These tools were not used for study design, data analysis, interpretation of results, or drawing conclusions. The authors are fully responsible for the content of the manuscript.

Patient and public involvement

Patients and/or the public were not involved in the design, conduct, reporting, or dissemination of this study.

Statistical data analysis.

The present article has been approved by all authors, and all authors take responsibility for the accuracy and integrity of the content.

Authors' contributions

Behnam Shiri Zilan: Data collection and interpretation, writing the article.
Mohammad Mehdi Azizi Darbandi: Idea conception and study design.
Mohammad Gholamzadeh and Alireza Mamizadeh: Data collection and interpretation.
Zahra Rangbar: Statistical data analysis.

The present Article has been approved by all authors, and all authors take responsibility for the accuracy and integrity of the content.

References

[1] Frasier LL, Pavuluri Quamme SR, Wiegmann D, Greenberg CC. Evaluation of Intraoperative Hand-Off Frequency, Duration, and Context: A Mixed Methods Analysis. J Surg Res. 2020; 256:124-30.
[2] Riesenberg LA, Davis R, Heng A, Vong do Rosario C, O'Hagan EC, Lane-Fall M. Anesthesiology Patient Handoff Education Interventions: A Systematic Review. Jt Comm J Qual Patient Saf. 2023; 49(8):394-409.
[3] Schiavi A, Hong Mershon B, Gottschalk A, Miller CR. Measurement of Information Transfer During Simulated Sequential Complete Shift-to-Shift Intraoperative Handoffs. Mayo Clin Proc Innov Qual Outcomes. 2022; 7(1):9-19.
[4] Jones PM, Cherry RA, Allen BN, Jenkyn KMB, Shariff SZ, Flier S, et al. Association Between Handover of Anesthesia Care and Adverse Postoperative Outcomes Among Patients Undergoing Major Surgery. JAMA. 2018; 319(2):143-53.
[5] Haller G, Laroche T, Clergue F. Évènements indésirables et problèmes de communication en périopératoire [Undesirable events during the perioperative period and communication deficiencies]. Ann Fr Anesth Reanim. 2011; 30(12):923-9.
[6] Hu YY, Arriaga AF, Peyre SE, Corso KA, Roth EM, Greenberg CC. Deconstructing intraoperative communication failures. J Surg Res. 2012; 177(1):37-42.
[7] Lingard L, Espin S, Whyte S, Regehr G, Baker GR, Reznick R, et al. Communication failures in the operating room: an observational classification of recurrent types and effects. Qual Saf Health Care. 2004; 13(5):330-4.
[8] Etherington C, Wu M, Cheng-Boivin O, Larrigan S, Boet S. Interprofessional communication in the operating room: a narrative review to advance research and practice. Can J Anaesth. 2019; 66(10):1251-60.
[9] Agarwala AV, Firth PG, Albrecht MA, Warren L, Musch G. An electronic checklist improves transfer and retention of critical information at intraoperative handoff of care. Anesth Analg. 2015; 120(1):96-104.
[10] Boet S, Djokhdem H, Leir SA, Théberge I, Mansour F, Etherington C. Association of intraoperative anaesthesia handovers with patient morbidity and mortality: a systematic review and meta-analysis. Br J Anaesth. 2020; 125(4):605-13.
[11] Jayaswal S, Berry L, Leopold R, Hart SR, Scuderi-Porter H, Digiovanni N, et al. Evaluating safety of handoffs between anesthesia care providers. Ochsner J. 2011; 11(2):99-101.
[12] Bagian JP, Paull DE. Handovers During Anesthesia

Care: Patient Safety Risk or Opportunity for Improvement? JAMA. 2018; 319(2):125-7.

[13] Hu J, Yang Y, Li X, Yu L, Zhou Y, Fallacaro MD, et al. Adverse Outcomes Associated With Intraoperative Anesthesia Handovers: A Systematic Review and Meta-analysis. J Perianesth Nurs. 2020; 35(5):525-32.

[14] Hyder JA, Bohman JK, Kor DJ, Subramanian A, Bittner EA, Narr BJ, et al. Anesthesia Care Transitions and Risk of Postoperative Complications. Anesth Analg. 2016; 122(1):134-44.

[15] Silva J, Arnaud M. Improving nurse anesthetist intraoperative handoff process by developing and implementing an evidence-based, facility-specific cognitive aid. J Nurs Interprof Leadersh Qual Saf. 2019; 2(2):1.

[16] Saager L, Hesler BD, You J, Turan A, Mascha EJ, Sessler DI, et al. Intraoperative transitions of anesthesia care and postoperative adverse outcomes. Anesthesiology. 2014; 121(4):695-706.

[17] Choromanski D, Frederick J, McKelvey GM, Wang H. Intraoperative patient information handover between anesthesia providers. J Biomed Res. 2014; 28(5):383-7.

[18] Jurewicz K, Alfred M, Neyens DM, Catchpole K, Joseph A, Reeves ST. Investigating intraoperative and intraprofessional handoffs in anesthesia. Proc Hum Factors Ergon Soc Annu Meet. 2018; 62(1):469-73.

[19] Lane S, Gross M, Arzola C, Malavade A, Szadkowski L, Huszti E, et al. What are we missing? The quality of intraoperative handover before and after introduction of a checklist. Can J Anaesth. 2022; 69(7):832-40.

[20] O'Reilly-Shah VN, Melanson VG, Sullivan CL, Jabaley CS, Lynde GC. Lack of association between intraoperative handoff of care and postoperative complications: a retrospective observational study. BMC Anesthesiol. 2019; 19(1):182.

[21] Light M. Standardizing Intraoperative Handoffs amongst Certified Registered Nurse Anesthetists [dissertation]. Doctor of Nursing Practice (DNP) Student Projects; 2023. Paper 9.

[22] Terekhov MA, Ehrenfeld JM, Dutton RP, Guillamondegui OD, Martin BJ, Wanderer JP. Intraoperative Care Transitions Are Not Associated with Postoperative Adverse Outcomes. Anesthesiology. 2016; 125(4):690-9.

[23] Jullia M, Tronet A, Fraumar F, Minville V, Fourcade O, Alacoque X, et al. Training in intraoperative handover and display of a checklist improve communication during transfer of care: An interventional cohort study of anaesthesia residents and nurse anaesthetists. Eur J Anaesthesiol. 2017; 34(7):471-6.