Postoperative Information Transfers: An Integrative Review

Monica W. Rose, PhD, CRNA, Susan Newman, PhD, CRRN, Courtney Brown, PhD, CRNA

Purpose: *The purpose of this integrative review was to synthesize and critique the literature related to protocols, checklists, and tools designed to facilitate information transfers, that is,* handovers, *from the operating room to postanesthesia care unit clinicians and to provide guidance for selecting an appropriate instrument.*
Design: *Integrative review of the literature.*
Methods: *Guided by the framework of Whittemore and Knafl, an integrative literature search was conducted and included literature sources dated January 2000 to January 2015. Select search terms included the following: post-operative handover(s), handover(s), handoff, post-operative handoff, communication, information transfer, checklists, tools, measurement, communication, and PACU. Articles were selected that described development of postoperative handover instruments.*
Findings: *Seventeen articles were identified. Instruments described in the articles were tabled and synthesized based on a priori categories described by the Donabedian conceptual model.*
Conclusions: *Developing an instrument to improve postoperative handover should integrate recommendations from key stakeholders, include evidence-based practices, and reference information from existing instruments.*

Keywords: *information transfers, instruments, postanesthesia care unit, anesthesia, handoffs, handovers.*

INFORMATION TRANSFERS, that is, *handovers*, are defined as the interprofessional transfer of critical and essential patient information, professional responsibility, and accountability for patient care from one health care provider to another.[1-3] During perioperative care transitions, patient information is communicated among providers to support continuity of care and patient safety. Postoperative handovers (POHs) are an example of one such transfer that takes place among anesthesia providers (APs) and postanesthesia care unit (PACU) or intensive care unit (ICU) nurses.[4] Effective POHs are associated with continuity of patient care and safe provider transitions.[5] Ineffective fragmented POHs, which are essentially communication errors, result in gaps in patient care, information loss, delays in treatment, increased length of PACU stay, and potentially increased morbidity and mortality.[1,2,5,6]

Monica W. Rose, PhD, CRNA, at the time this article was written, Dr. Rose was a full-time nurse anesthetist at Medstar Washington Hospital Center, Washington, DC, currently Dr. Rose is an independent contractor nurse anesthetist; Susan Newman, PhD, CRRN, College of Nursing, Medical University of South Carolina, Charleston, SC; and Courtney Brown, PhD, CRNA, Nurse Anesthesia Program, Wake Forest University, Winston-Salem, NC.

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Address correspondence to Monica W. Rose, 2021 Mallard Lane, Raleigh, NC 27609; e-mail address: warrickconsultingllc@gmail.com.

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Surgical patients undergo preoperative, intraoperative, and postoperative care transitions, and these patients are vulnerable to communication errors.[7] In the postoperative phase, the AP transports patients recovering from surgery and the effects of anesthesia to the PACU, while monitoring the patient and performing additional therapeutic tasks. On arrival to the PACU, APs are tasked with reestablishing monitoring technology, maintaining vigilance over the patient, and communicating pertinent patient information to the receiving PACU nurse.[2] Often, the PACU nurse has little knowledge of the patient's history and condition before arrival to the PACU. Likewise, the PACU environment has been described as event-driven and time-pressured environment, making POH prone to distractions and interruptions.[8]

Lack of standardized POH has been associated with information omissions, decreased provider satisfaction with POH processes, and long-term consequences for the delivery of safe patient care.[6,9,10] Recognizing handovers as a high-risk area for patient safety, government and professional organizations have launched various quality improvement initiatives. In 2001, the Institute of Medicine issued a pivotal statement noting that inadequate handoffs are "where safety often fails first."[7(p 45)] Following this statement, the Joint Commission's 2006 National Patient Safety Goals required that all health care providers implement a standardized approach to handovers, and this goal is currently a patient safety standard.[11]

Standardization of POH, through the development of checklists and protocols, has been shown to increase provider satisfaction and improve the quality of information communicated during POH. Likewise, instruments have been developed to assess the quality and communication of essential information during POH.[2,12-17] The information content and processes associated with POH have been studied extensively, and the literature establishes a persuasive case for standardized protocol-directed POH processes. Selecting an instrument to assess and standardize POH is dependent on the facet of POH under investigation. Facets of POH include structuring information content by developing standardized checklists, structuring processes of the POH to organize and engage members of the surgical, anesthesia, and PACU teams, minimizing distractions and interruptions during POH information communications, reducing barriers to successful POH, and, developing checklists to decrease high-risk events and improve patient safety.[2]

Given the numerous POH protocols, checklists, and instruments available in the literature, perioperative providers, including AP and PACU nurses, seeking to standardize POH face the daunting task of selecting a content- and context-specific instrument. The primary aim of this integrative review was to synthesize and critique the literature related to protocols, checklists, and tools designed to evaluate and improve the quality of POH, specifically from the operating room (OR) to the PACU. Furthermore, this review aimed to report how POH protocols, checklists, and tools have been developed; to describe how POH instruments improve the quality of POH; and, to provide direction for AP, PACU nurses, and perioperative providers who seek to standardize POH. Herein, POH protocols, checklists, tools, and protocols will collectively be referred to as *instruments* if the instrument in the study is not formally named.

Conceptual Model

The Donabedian conceptual model (DCM) provides a framework for systematically evaluating health care quality and services.[18,19] According to the DCM, health care quality and innovation should be evaluated based on three quality of care dimensions[20]: *structure*, characteristics of the health care setting; *process*, clinical activities performed in the health care setting; and *outcomes*, patient and clinical outcomes resulting from a predetermined set of activities.[21] *Structure* is defined as the setting where health care is given.[22] The structural dimension can be applied to organizational and departmental levels depending on nature of the desired intervention.[23] The structural environment of the PACU is complex and influenced by unit policies, procedures, standards of care, and unit-specific POH practices.[23] Unit-specific policies include the organizational structure of POH, including methods to document POH information. In this review, *structure* refers to the information content of the handover that is guided by unit-specific practice standards. *Process* refers to the mechanisms, such as information transfer, communication strategies, and the sequencing of events, which affect the manners

in which POHs are conducted between AP and PACU nurse. Transferring patients from the OR to the PACU requires proper sequencing of information and events. The AP is responsible for transporting the anesthetized patient from the OR to the PACU, while performing therapeutic and monitoring tasks.[2] This sequencing of events takes place in what has been described as an event-driven and time-pressured environment.[2,8] *Process* mechanisms include verbal and nonverbal cues and interpersonal relations among team members. Furthermore, *process* refers to the tasks or activities necessary to safely and effectively complete a POH. Behaviors such as interruptions and distractions during POH are also related to process mechanisms. Processes related to POH are directly affected by *who* participates in POH as well as *when* (ie, timing) POH is conducted. The third dimension, *outcomes*, refers to the impact of POH on patient outcomes, patient safety, and quality of care. Figure 1 depicts the DCM applied to POH.

Methods

This integrative review was guided by the framework described by Whittemore and Knafl.[24] This methodological framework guided analysis and reporting of the current state of knowledge on complex constructs, such as POH. Data analysis and synthesizing strategies included identifying the problem, describing the literature search strategy, evaluating the data and its quality, and reducing/synthesizing the data.[24] Visualization of primary data sources indexed within a single table allowed for identification of common themes across multiple data sources.[24]

A systematic search of the Cumulative Index to Nursing and Allied Health Literature, PubMed, SCOPUS, the Agency for Healthcare Research and Quality, and the Cochrane electronic databases was performed using the following search terms: post-operative handover(s), handover(s), handoff, post-operative handoff, communication, information transfer, checklists, tools, measurement, communication, post-anesthesia care unit (PACU), post-operative, patient handoff, health communication, interdisciplinary communication, hospital communication systems, and inter-personal relations. Manual searches of the reference list of relevant systematic reviews were performed. The following MeSH search terms were entered into PubMed and integrated using the Boolean terms AND and OR: patient handoff, post anesthesia nursing, check list, and communication.

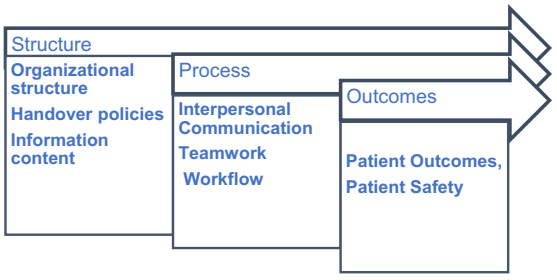

Figure 1. The Donabedian conceptual model applied to postoperative handover.[19] This figure is available in color online at www.jopan.org.

A title and abstract review of the 497 articles retrieved identified 54 articles requiring further analysis using the following inclusion criteria: studies published between January 2000 and January 2015 that described instruments, including checklists and tools, developed to improve the quality of POH. Instruments developed to improve the quality of the information content and structure of POH as well as instruments developed to assess processes related to transferring the care of patients from the OR to the PACU in the adult setting were eligible for review. Retrieved systematic reviews were manually examined for empirical research related to POH instruments. Instruments developed to facilitate POH involving pediatric and cardiac patients were excluded. After review of the articles, 17 research studies that described instruments designed to evaluate and improve the quality of POH between AP and PACU nurses were retained for inclusion (Figure 2; Preferred Reporting Items for Systematic Reviews and Meta-Analyses diagram).[25]

Data Extraction

Data extraction was independently completed by the primary author, who thoroughly read and categorized each article according to study design, setting, sample, aims, instrument description, level of evidence, and results (Table 1). Finally, each instrument described within the article was classified per the three dimensions of the DCM, which are *structure*, *process*, *and outcomes*. One of the goals of classifying the instruments was to identify instruments that were developed

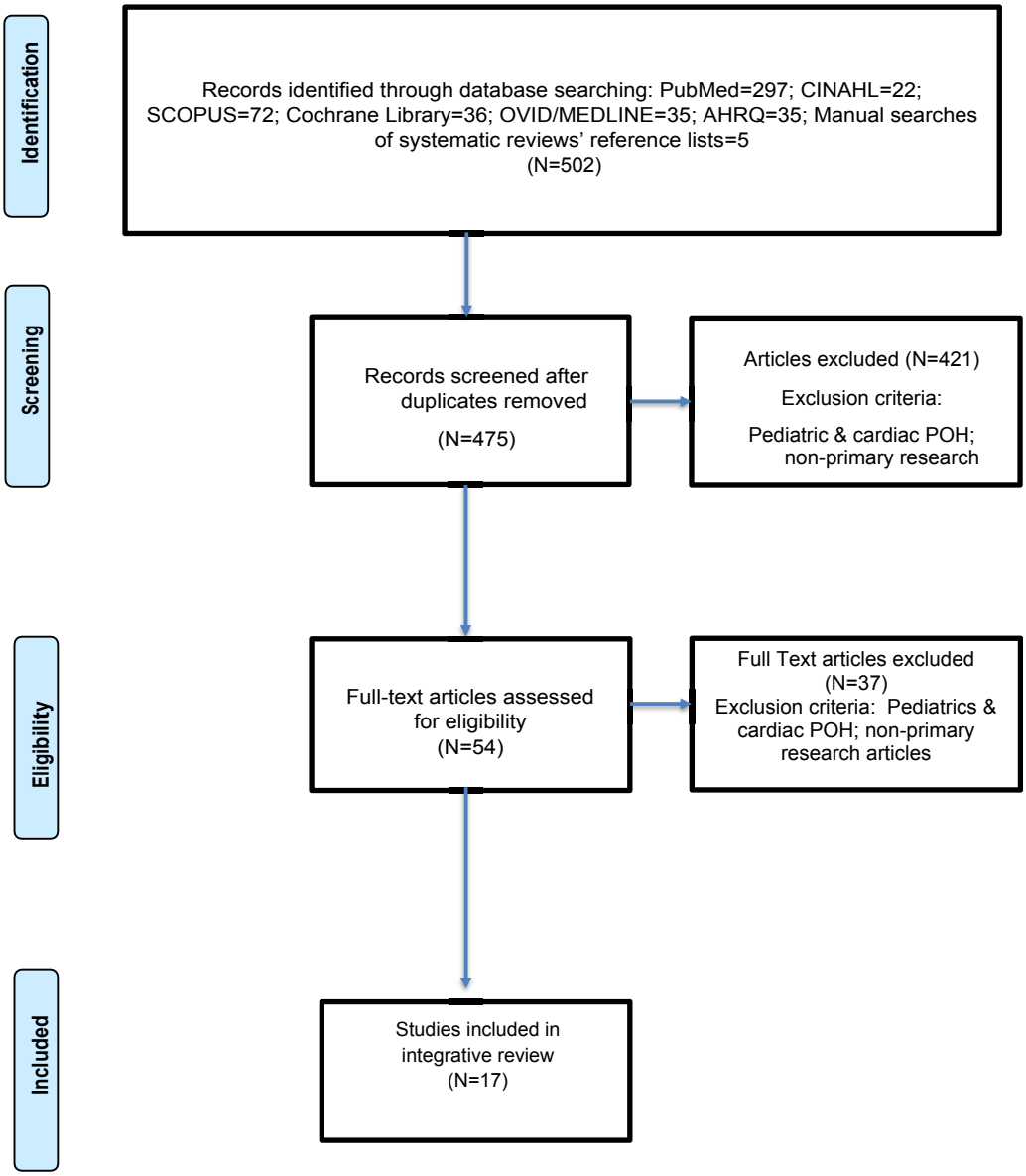

Figure 2. Preferred reporting items for systematic reviews and meta-analyses (PRISMA) flow diagram.[25] This figure is available in color online at www.jopan.org

to improve the structure, process, or outcomes related to POH, or a combination of these three dimensions.

Level of Evidence Appraisal

The levels of evidence of retrieved studies were classified into one of four categories, as proposed by Wong et al[26] (Table 2). The fifth category proposed by Wong et al, which is published reports, was not applicable to classify studies included in this review. The categories constructed by Wong et al[36] were designed to enable the reader to easily differentiate between different types of intervention-based studies, including preintervention and postintervention. Observational studies were also classified based on the categories.

Results

Synthesis of findings was classified based on the three dimensions of the DCM followed by

Table 1. POH Articles Included in This Review

Reference	Study Design	Sample	Setting	Aim	Instrument Description	Level of Evidence[26]	Results	Donabedian Framework[21,22]
Anwari[27]	Survey	After receiving every fourth patient, the PACU nurse caring for the patient completed a survey related to the quality of the handover of the patient on admission	PACU Armed Forces Hospital	To assess the quality of handovers delivered by anesthetists to PACU nurses Purpose: Evaluate quality of POH	Survey description: four subgroups: VIS, PCS, ABS, and NSS	Category 3	VIS: 14% of anesthetists failed to communicate information regarding patient and intraoperative course; 33% communicated all five points of patient and intraoperative information; most anesthetists left their patients in the PACU in a stable and satisfactory condition, 80% of cases included clear instructions about patient management, and overall quality of handover was poor	Structure; process
Gillikin & Apatov[28]	Pre/post observational intervention within-subjects design	16 full-time and part-time CRNAs; 82 patient care transfers observations preintervention; 75 postintervention patient care transfers	Community hospital	To compare the incidence of information omissions before and after implementation of an electronic patient care transfer tool	Electronic instrument contained within the EMR; information recorded included name, allergies, health history, surgical procedure, airway, intraoperative events, hemodynamic status, medications, state of muscle relaxation, fluid status, laboratory values, and anticipatory guidance	Category 3	Information omissions significantly reduced after implementing the tool	Structure; process
Manser et al[17]	Unstructured field observations	126 handoffs, three handoff settings; Kaiser-Meyer-Olkin measure of sampling adequacy of 0.81	Three different tertiary care settings: paramedics to emergency room, AP	To determine the characteristics of a safe and quality handover, which handover	19-Item tool: 16 items rated on a four-point scale, 1 item handoff quality, and 2 items	Category 3	EFA: Three eigenvalues >1. Three factors extracted include information transfer, shared	Structure; process

(Continued)

Table 1. Continued

Reference	Study Design	Sample	Setting	Aim	Instrument Description	Level of Evidence[26]	Results	Donabedian Framework[21,22]
			to PACU nurse, PACU nurse to ward nurse	characteristic(s) predict handover quality, and how do behaviors affect POH	assessed time pressure		understanding, and working atmosphere, which account for 49.9% of the variance	
Mazzocco et al[29]	Qualitative observational with retroactive chart review	293 observed cases a priori power analysis 0.95	OR at two medical centers and two ambulatory surgery settings; total of four sites	To determine if patients of surgical teams who exhibited strong teamwork had better outcomes than patients of teams with poor teamwork	Instruments: BMI, BMRI: Observed scores from BMI converted to a single score Teamwork behaviors of the perioperative team Behavior domains: 1. Briefing 2. Information sharing 3. Inquiry 4. Assertion 5. Vigilance/awareness 6. Contingency management	Category 2	Patients whose surgical teams exhibited poor teamwork were at higher risk for death or complications	Process; outcomes
Milby et al[6]	Prospective observational study—handovers were observed before and after implementing the checklist	Single observer observed 798 POHs; 790 POHs included in the study	Large teaching hospital in Germany	To evaluate the quality of information transfer during POH	59-Item checklist divided into preoperative (patient data, ASA status, coexisting diseases, medical history), intraoperative (postoperative nausea and vomiting prophylaxis, airway management, type of surgery, antibiotic management, blood loss, and anesthesia-related events), and postoperative information	Category 3	The amount of preoperative information communicated to PACU nurses varied, information communicated the most included patients with pacemakers, infectious diseases, whereas the ASA status of only 7% of patients was reported; the type of surgery was most frequently communicated; in most cases, information content was incomplete	Structure

Nagpal et al[10]	Qualitative semistructured interviews	Phase I: 18 health care professionals (surgeons, anesthetists, nurses, theater, recovery, and ward) Phase II: 50 professionals from three hospital sites, used a qualitative sampling frame	Various hospitals where providers worked	To determine information transfer failures and problems, define responsibilities for information transfers, to develop and validate an evidence-based handover protocol	POP: 28-item checklist; checklist designed to identify most relevant information related to handovers to improve handovers	Category 3	Development and validation of a 28-item checklist (POP)	Structure; process
Nagpal et al[16]	Qualitative observational	Multidisciplinary team of surgeons, anesthetists, nurses, psychologists, and handovers of 20 patients	Large teaching hospital in London; gastrointestinal surgical department	To develop a framework to evaluate ITC across the surgical pathway including POH	POH portion of the framework divided into patient-specific, surgery-specific, and anesthesia-specific information	Category 1	66% of PaI (patient-specific information) communicated; 30% of PrIS surgery-specific information communicated; 67% of PrIA anesthesia-specific information; information degraded during POH	Structure; process; outcomes
Nagpal et al[13]	Observational	100 handovers; two study sites ($N = 50$ at each site)	Data collected across two large acute teaching hospital sites	To develop an instrument that evaluates the quality of POH	PoHAT, 24-item checklist	Category 1	***Results are comparisons between two hospital sites ***Information omissions ($\chi^2 = 0.06$, $P = .807$); anesthesia information omissions (3.4 vs 2.8, $\chi^2 = 5.65$); task errors: more overall task errors at the London site (3.5 vs 2.5, $\chi^2 = 12.67$, $P < .001$); equipment task errors: (3.1 vs 2.2, $\chi^2 = 13.14$, $P < .001$), duration of handover: Mann-Whitney Z test = 2.20, $P < .05$); distractions and task errors (rho = 0.002, $P = .99$)	Structure; process

(Continued)

Table 1. Continued

Reference	Study Design	Sample	Setting	Aim	Instrument Description	Level of Evidence[26]	Results	Donabedian Framework[21,22]
Nagpal et al[7]	Prospective pre/post intervention; direct observation of handovers	Total 90 handovers; 50 before and 40 after introduction of handover protocol	PACU of an acute teaching hospital	To develop a handover protocol to improve the quality of POH	PoHAT, 24-item checklist	Category 1	Significant reduction in the number of information omissions, task errors, and duration of handover; significant improvement in teamwork, nurses' satisfaction ($P < .001$)	Structure; process
Petrovic et al[30]	Exploratory; quantitative and qualitative exploration	APs, surgeons, and nurses at all levels of training; multidisciplinary team including nurse practitioners, physician assistants and intensivists, anesthesiologists, and surgeons	Anesthesiology, surgery and nursing in the cardiac surgical ICU; Johns Hopkins Hospital	To develop a checklist to guide anesthesia and surgery reports, patient handovers, from the OR to the ICU/PACU	The anesthesia checklist is part of a larger POP. The anesthesia checklist includes preoperative information, intraoperative information, and postoperative guidance information; the AP delivers their report after the surgical report delivered by the surgeon	Category 2	Successful development of an OR to ICU/PACU protocol that includes a surgical and anesthesia report checklist	Structure; process
Petrovic et al[31]	Prospective, pre/post intervention, unblended study	About 53 handovers were observed preintervention, 50 handovers were observed postintervention; 105 surveys completed preintervention, and 142 surveys completed postintervention; providers who completed the survey were members of the surgery, anesthesia, OR nurse, and PACU nurse teams	Perianesthesia care unit, tertiary-level facility	To design and evaluate the use of a perioperative handoff protocol implemented in the PACU	Instrument developed through input from perioperative providers; checklist items related to anesthesia were as follows: medical and surgical histories, allergies, baseline vital signs height and weight, laboratory results, regional anesthesia, invasive monitoring, venous access, fluids, paralytics, narcotic totals, antibiotics and paralytic status; surgical and OR nursing checklists included	Category 3	Significant reduction in the number of defects per handoff pre/post intervention, significant reduction in missed information items from anesthesia report, significant reduction in technical defects, significant increase in PACU nurse satisfaction with the instrument, nonsignificant results reported for AP satisfaction	Structure

Potestio et al[32]	Observational, interventional	About 22 anesthesiology residents; 50 POHs in the control group	Large teaching hospital in Washington, DC	To design a succinct user-friendly handover checklist and determine if the checklist increased meaningful communication during POH	17-Point checklist organized into three sections: patient procedure and medication; included a closed loop communication question to allow providers to allow to address two-way communication between AP and PACU nurse	Category 3	The percentage of overall items handed off increased significantly with the use of the PACU checklist (group B: average, 69.5% ± 16.5%; group A: average, 51.50% ± 8.28%, $P = .018$); residents who used a checklist (group B) handed off eight items on the checklist with a significantly higher frequency compared with residents who did not use a checklist (group A). These items were as included antibiotics ($P = .016$), standing medications ($P < .001$), residents who used the checklist spent significantly more time in the PACU when compared with residents who did not use the checklist	Structure
Robins & Dai[33]	Randomized controlled trial	APs were randomized to conduct the handover with or without the formulated checklist; PACU nurses completed a data collection sheet to assess the handover. A priori power analysis was performed; 60 APs (30 APs performed handover with checklist, 30 APs	Adult PACU	To determine whether utilization of a formulated checklist decreases information loss, improves adequacy of the handoff, decreases the need for information clarification, and decreases time spent in transfer of care	Checklist created through input from PACU nurses, CRNAs, and safety committee; instrument assessed readiness for report, patient identifying information, medical history information, type of anesthesia including airway management, antibiotics, vascular access,	Category 1	Use of the checklist by the AP lowered the rate of callbacks for information, increased satisfaction rating of the handover from PACU nurse; no significant difference between the APs' time in the PACU between the checklist and nonchecklist groups	Structure; process

(Continued)

Table 1. Continued

Reference	Study Design	Sample	Setting	Aim	Instrument Description	Level of Evidence[26]	Results	Donabedian Framework[21,22]
		performed handover without checklist)			intraoperative course, postoperative course, opportunity for clarification, and ending the handoff			
Salzwedel et al[1]	Prospective, pre/post intervention* randomized controlled trial	Total of 120 PACU patient handovers recorded, 40 handovers using the checklist; anesthesiologist to PACU nurse	PACU of the University Hospital	To develop a POH checklist and determine if the checklist would increase the amount of information transferred during patient handover	Tool developed through observation videotaping of residents' handover to PACU nurses, phase II introduction and implementation of tool, phase III: videotaping of handover with and without the tool	Category 1	Overall percentage of overall items handed over using checklist increased ($P < .0001$)	Structure
Siddiqui et al[34]	Observational	Convenience sample of five to eight sequential handovers per day selected	PACU of teaching hospital University of Toronto	To explore POH practices between anesthesiologists and PACU nurses, to determine information content of the POH, and to explore and describe POH failures and problems	Checklist developed to identify communication of specific data items during the handover between anesthesiologists and PACU nursing; comprising 4 sections, 29 items, yes/no answers: patient's preoperative physical status and demographics, intraoperative details and anesthesia management, intraoperative events and postoperative directives	Category 1	Handover process not consistent, in many cases, information is not communicated, items perceived to be essential are not consistently communicated Study piloted	Structure; process
Weinger et al[4]	Observational multimodal intervention including standardized electronic handover form, didactic	Cohort of APs (including residents and CRNAs) and PACU nurses	Adult PACU	To develop a structured electronic handover and to improve interprofessional handover practices through simulation training	Based on SBAR; handover communication and a global rating of handover effectiveness	Category 3	Global rating of an acceptable handover improved with multimodal interventions including a	Structure; process

	webinar, and simulation training			Purpose: To develop an electronic handover instrument and to develop an instrument to evaluate the eHandover instrument			standardized checklist
Wright[35]	Nonexperimental exploratory/ interventional	Exploratory phase: 302 CRNAs were surveyed; evaluation of PATIENT tool; 30 CRNAs evaluated the tool by survey	One large teaching hospital; two community hospitals	To examine POH practices; to develop, implement, and evaluate a communication checklist; to improve the quality of postoperative handovers	PATIENT transfer of care checklist tool; P = procedure, patient, position; A = anesthesia, antibiotic, airway, allergies; T = temperature; I = IV, invasive lines; E = $ETCO_2$, N = narcotics; and T = twitches	Category 2	Most CRNAs liked using PATIENT, indicated the information content of the tool was sufficient, and felt the tool increased organization of information	Structure

POH, postoperative handover(s); PACU, postanesthesia care unit; VIS, verbal information score; PCS, patient condition score; ABS, anesthetist behavior score; NSS, nurse's satisfaction score; CRNAs, certified registered nurse anesthetists; EMR, electronic medical record; AP, anesthesia provider; EFA, exploratory factor analysis; OR, operating room; BMI, behavioral markers instrument; BMRI, Behavioral Marker Risk Index; ASA, American Society of Anesthesiology; POP, postoperative handover protocol; ITC, information transfer and communication; PoHAT, postoperative handover assessment tool; ICU, intensive care unit; SBAR, situation, background assessment and recommendation; PATIENT, P: procedure, patient, position; A: anesthesia, antibiotic, airway allergies; T: temperature; I: invasive lines; E: end-tidal carbon dioxide; N: narcotics; T: twitches.

Table 2. Classification of Intervention-Based Studies

Category 1	Comprehensive intervention-based study	Clear articulation of entire approach to improve clinical handover covering data collection, intervention design, implementation, and evaluation and insights into lessons learned. High level of potential transferability
Category 2	Intervention-based study	Approach to clinical handover improvement intervention not comprehensive or limited in depth/clarity in published study. Medium to low level of potential transferability
Category 3	Preintervention study	Studies variously engaging in data collection, analysis, and evaluation to investigate different aspects of clinical handover. Focused on enhancing understanding, identifying issues/gaps/challenges, or the utility of particular research approaches. Some studies provide recommendations for change management, handover improvement interventions, or system reform. High to low level of potential transferability of preintervention approaches
Category 4	Published opinions or reviews	Publications not involving any primary research often non–peer-reviewed. Can provide potentially useful insights/perspectives on different aspects of clinical handover including high-risk scenarios, evidence gaps, and factors imposing limitations on sustainability/transferability of handover initiatives

Modified version of the classification system by Wong et al.[36]

subclassification of studies based on the instrument's purpose. Primary synthesis of the findings was conducted by the first author. Secondary review and synthesis of the findings was completed by the contributing authors. There were instances where the POH instrument could be classified based on more than one dimension of the DCM. Instruments that were not formally named by the author were referred to by using the primary author's last name. A detailed description of the instruments is displayed in Table 1. Table 2 refers to a summary of the information content included on each instrument.

Structure of POH

STANDARDIZED COMMUNICATION. Applying the DCM to POH, structure refers to the information content of POH and frameworks to standardize information transfers. The development of standardized instruments was a common theme in the literature.

Wright[35] surveyed certified registered nurse anesthetists (CRNAs) to identify current POH practices, identify critical information content, and assess the need for a standardized perioperative transfer tool. Based on results from their survey, the authors developed and pilot tested the PATIENT checklist tool during POH. Table 1 displays a description of each parameter of the PATIENT checklist tool, which was communicated during POH.[35] After implementing the PATIENT tool into POH, CRNAs who used the tool were invited to evaluate its usefulness. Ninety percent of CRNAs who used the tool believed that the length and scope of content were appropriate. All respondents indicated that the tool provided an effective way to organize POH.[35]

Potestio et al[32] designed a 17-item instrument, which was divided into patient, procedure, and medication sections, to guide anesthesiology residents through POH. Baseline data were collected

by observing POH before implementing the instrument. After implementing the instrument, anesthesiology residents communicated eight items significantly more when compared with residents who did not implement the instrument. Residents who implemented the instrument spent a significantly longer time in the PACU when compared with the control group.

Robins and Dai[33] created an instrument with input from PACU nurses, CRNAs, and members of the patient safety committee. The instrument was divided into seven sections: assess for readiness, patient identifying information, medical history, type of anesthesia, intraoperative course, postoperative information, and a clarification section. In their randomized study, APs were assigned either to the control group, which performed the handover without the instrument, or to the study group, which performed the handover with the instrument. Outcome measures included the PACU nurses' ability to recall key elements of the handover, handover satisfaction assessed by the PACU nurse, and the rate of PACU nurse–initiated callbacks for clarification of handover information. The use of the checklist by APs in the study group lowered the rate of callbacks and led to higher satisfaction among PACU nurses with the structured handover.[33]

Salzwedel et al[1] sought to determine if there was a significant difference in the amount of information transferred between the AP and PACU nurse with and without implementing a POH checklist. The final 37-item instrument was divided into three categories: preoperative (preoperative risk factors, present surgical illness, and surgical procedure), intraoperative (airway management, type of anesthesia hemodynamics, and surgery-related problems), and postoperative management (antibiotic management, postoperative investigations, and availability of blood products). POHs were video recorded before implementing the instrument. After implementing the instrument, 40 handovers were randomized to the control group and 40 handovers were randomized to the study group, which used the instrument during POH. All handovers eligible for the study were video recorded and evaluated by independent observers using a score sheet with content items equal to the instrument. Although the overall percentage of items communicated during the POH increased significantly with implementing the standardized instrument, communication of individual items, such as "name" and "type of anesthesia," showed no significant difference. POH took significantly longer when the instrument was used during the handover when compared with handovers without the checklist.[1]

In their multimodal intervention-based study, Weinger et al[4] developed *eHandover*, a standardized electronic POH instrument organized into the situation-background-assessment-recommendation (SBAR) format. The *eHandover* was divided into four sections of the SBAR format. The first section comprised patient demographic information, type of surgery and anesthesia, medical history, preoperative vital signs, and airway management. The second section included medication administration, intraoperative and postoperative vital signs, fluid intake and outputs, and intraoperative laboratory results. Intraoperative events, complications, special precautions, and postoperative directives comprised the final two sections. When the surgeon was closing, the circulating nurse clicked on "*surgeon closing*," which was found in a perioperative electronic documentation system, and the *eHandover* printed in the PACU.[4]

Gillikin and Apatov[28] implemented an *Electronic Patient Care Transfer Tool* contained within the electronic anesthesia record and compared information omissions and deficiencies before and after implementation. Information recorded within the tool included patient demographics, medical history, surgical procedure, airway/intubation, intraoperative events, hemodynamic status, medications, fluid status, laboratory values, and anticipatory guidance. POHs were observed before and after introduction of the tool. Information omissions were significantly reduced after introduction of the tool in the following information categories: patient name, allergies, medical history, surgical procedure, airway, intraoperative events, hemodynamic status, medications, fluid status, and anticipatory guidance.[28]

Nagpal et al[13] developed *The Postoperative Handover Assessment Tool* (PoHAT) to prospectively detect latent POH process errors and address potential process failures before they lead to adverse events. PoHAT was designed to assist clinicians in evaluating the quality and efficiency of POH.[13] The

final instrument consisted of 24 information items that were subdivided into patient-specific information, anesthetic information, and surgical information categories. POHs were observed by trained researchers who rated the quality of POH using items on the PoHAT that were completed by indicating *yes* or *no* during the observation. Evaluation of POH at two study sites using PoHAT revealed a median of eight information omissions per handover.[13]

Process of POH

FAILURE MODE AND EFFECT ANALYSIS. Content for two POH instruments was developed through failure mode and effect analysis (FMEA).[13] Using FMEA and information obtained from expert interviews, Nagpal et al[13] developed a 24-item tool, PoHAT (see previous description). In addition to patient-, anesthetic-, and surgery-specific information, eight task items were identified from the literature. These tasks included preparing monitors, intravenous pumps, and lines before patient arrival to the PACU.[13] POHs were observed by trained researchers who rated the quality of POH using items on the PoHAT that were completed by indicating *yes* or *no* during the observation. In addition, teamwork was evaluated based on the following five behavioral components and rated on a seven-point Likert scale: communication, coordination, cooperation, situational awareness, and leadership. Findings from the study indicated 2.9 median errors per handover.[13]

Nagpal et al[16] mapped information transfer and communication (ITC) failures across the surgical pathway to develop and conduct feasibility testing of a framework to analyze communication within the perioperative setting. In addition to interviews and review of pre-existing POH guidelines, health care FMEA was used to develop the framework.[16] The framework created structure for the following four distinct phases, which coincided with patient care across the surgical pathway: preoperative assessment and optimization, preprocedural teamwork, POH, and daily ward care. Furthermore, the POH phase was subdivided into three categories: patient-specific information, surgical procedure-specific information, and anesthesia procedure-specific information. POHs were observed, and the quality of patient-specific information communicated during the POH between providers was compared against the patient-specific category.[16]

TEAM MEMBERS PRESENT DURING POH. Petrovic et al[30] designed the perioperative handoff protocol to standardize perioperative handovers by delineating a five-step process. All team members, including the AP, surgeon or designee, OR nurse, and PACU nurse, were required to be present at the time of the handoff report. The AP initiated the POH, followed by the nurse re-establishing monitoring technology, the surgeon communicating the surgical report, followed by the anesthesia and OR nurse reporting and the POH concluded after the PACU nurse clarified remaining issues. The anesthesia component of the protocol included preoperative, intraoperative, and postoperative guidances.[30] In a later prospective unblinded study, Petrovic et al[31] implemented the protocol during POH between the OR and the PACU. When compared with the pre-implementation group, the average number of information omissions and technical defects was significantly less ($P < .01$).

INFLUENCE OF BEHAVIORS AND TEAMWORK. In the context of POH, the *process* dimension of the DCM refers to the tasks or activities necessary to safely and effectively complete a POH. Processes related to POH are directly affected by *who* participates in POH as well as *when* (ie, timing) POHs are conducted. Investigating the influence of technical and nontechnical skills as well as the teamwork behaviors of surgical teams guided the development of two instruments. Mazzocco et al[29] aimed to determine if patients of surgical teams who exhibited strong teamwork had superior outcomes when compared with patients of teams with poor teamwork. Using an instrument adapted from another study, registered nurses observed and assessed surgical teams for six behavior domains, including briefing, information sharing, inquiry, assertion, vigilance and awareness, and contingency management. Results revealed that patients whose surgical teams exhibited poor teamwork behaviors were at higher risk for poor outcomes. Nagpal et al[13] developed PoHAT to assess the quality and efficiency of POH (see previous description of PoHAT). The teamwork component of the instrument consisted of

five behavioral components: communication, coordination, cooperation, situational awareness, and leadership.

CLOSING THE COMMUNICATION LOOP. One unique feature of three instruments identified in this review was inclusion of a *closing the communication loop* item.[32] Potestio et al[32] included a closed loop communication item to address interpersonal communication between the AP and PACU nurse. At the conclusion of the POH, the AP queried the PACU nurse by asking "*Do you have any questions or concerns?*".[32] Petrovic et al[30] designed an instrument for conducting perioperative handovers that encompassed OR to ICU/PACU POH and guided surgical and nursing reports. The comprehensive instrument prompted handover team members to remain at the patient's bedside during the POH. After a scripted approach, the receiving PACU nurse prompted team members to clarify unresolved issues and formally concluded the handover with an ending statement.[30] Manser et al[17] developed and tested a 19-item handover rating tool to determine components of a quality and effective handover. The study hypothesized that the items included in the rating tool would predict clinicians' and human factors observers' perceptions of the quality of handovers from AP to PACU nurses. Three factors—information transfers, shared understanding, and working atmosphere—accounted for approximately 50% of the variance in the items. Shared understanding was defined as closing the communication loop between providers, clarifying questions, and establishing a mutual understanding of the information transferred between providers. Robins and Dai[33] included a clarification' section on their checklist, which provided an opportunity for AP and PACU nurses to address questions.

ANTICIPATORY GUIDANCE. Anticipatory guidance is information given by AP to receiving PACU nurses to assist PACU nurses with managing impending and potential changes in patient status.[37] Several instruments included sections to guide postoperative care, offer contingency planning, and provide anticipatory guidance during and after the POH. Petrovic et al[30] developed the OR to ICU/PACU protocol, which incorporated anticipatory guidance statements communicated from the surgical and anesthesia teams to the receiving PACU nurse. The *eHandover* report form by Weinger et al,[4] which was based on the SBAR format (see previous description of *eHandover*) ended with a recommendation section where providers could enter anticipatory planning statements. Gillikin and Apatov[28] included an anticipatory guidance information field on their electronic patient care transfer tool. After implementing the tool, there was a significant reduction in the number of omissions of anticipatory guiding statements.[28]

LENGTH OF TIME SPENT IN PACU. Two studies describe AP length of time in the PACU when using a POH instrument.[32,33] Potestio et al[32] found that the AP spent a significantly longer amount of time completing the POH when using the instrument. In addition, the more time spent during POH, the more information was transferred.[32] In contrast, Robins and Dai[33] found no statistically significant difference in the amount of time AP spent in the PACU between AP who used the instrument and those AP who did not.

Outcomes

PATIENT OUTCOMES. The third dimension of the DCM is *outcomes* and refers to patient outcomes. Evaluation of observed POH through the use of instruments suggested that adverse patient outcomes were associated with lack of teamwork and failure to communicate pertinent patient information during information transfers. Mazzocco et al[29] found that patients of surgical teams who exhibited strong teamwork behaviors were more likely to have less frequent episodes of morbidity and mortality (see previous description of the instrument). Nagpal et al[16] identified four transition phases across the surgical pathway after mapping information transfers and communication across the surgical pathway (see previous description of the instrument). In their study, the ITC assessment tool for surgery (ITCAS) was developed to collect data on information transfers and communication during the perioperative phase. Data were collected on adverse medical events causing unintended injury and clinical events that could have caused harm. Failure of the POH to communicate the postoperative plan for deep vein thrombosis prophylaxis led to omission of drug

administration. Likewise, prescribed patient blood draws not communicated during the POH resulted in unnoticed hypokalemia and transient arrhythmias. Both adverse outcomes were linked to information transfer failures.[16]

PROVIDER SATISFACTION. The degree of PACU nurse satisfaction was measured and recorded after the POH in four studies. Nagpal et al[7] conducted a prospective preintervention and postintervention study by observing POH before and after implementing PoHAT (see previous description of the instrument). PACU nurses rated their overall satisfaction with the POH on a five-point Likert scale. A total of 90 POHs were evaluated; 50 before and 40 after introducing PoHAT. With implementation of the PoHAT, PACU nurses awarded 58% of the handovers a score of 5/5 compared with only 8% of the handovers before implementing the PoHAT.[7]

Robins and Dai[33] created an instrument with input from PACU nurses, CRNAs, and members of the patient safety committee (see previous description of the instrument). Outcome measures included the PACU nurses' ability to recall key elements of the handover, handover satisfaction assessed by the PACU nurse, and the rate of PACU nurse–initiated callbacks for clarification of handover information. POH adequacy was rated higher by PACU nurses in the group of AP and PACU nurses who used the instrument when compared with the control group (100% vs 85%; $P = .11$).[33] However, the difference was not statistically significant.[33]

Anwari[27] evaluated the quality of POH of 276 patients admitted to the PACU. PACU nurses assigned a nurse satisfaction score (NSS), which reflected their level of satisfaction with the POH. The NSS was based on two factors: (1) the presence of instructions about PACU management of the patient and (2) perceived level of satisfaction with the handover. Findings indicated that instructions about patient management were clear to the PACU nurse in 80% of cases. PACU nurses rated the POH as good; only 48% of cases were evaluated.[27]

Petrovic et al[31] designed the perioperative handoff protocol to standardize perioperative handovers by delineating a five-step process (see previous description of the instrument). Members of the POH team, including the surgeon, AP, OR nurse, and PACU nurse completed a team member satisfaction survey at the completion of the study. PACU nurses' responses reached statistical significance for questions related to satisfaction with POH, receiving information about potential patient problems and follow-up items, physical transfer of the patient, and anticipatory guidance.[31]

Instrument Purpose

QUALITY EVALUATION OF POH. The development of POH instruments to evaluate the quality of POH between AP and PACU nurses and to identify failures in ITC was consistently described in the literature. In a descriptive study, Anwari[27] surveyed PACU nurses after receiving the handover report from the AP. The survey, which was completed by PACU nurses, was divided into four subsections and included a verbal information score, a patient condition score, an anesthetist behavior score, and PACU NSS (Table 1; full description of the subsections). The study highlighted that 67% of anesthetists failed to transfer all the essential information during the transfer and that information during the POH was not transmitted in 40% to 60% of cases.[27]

Nagpal et al[13] developed and validated PoHAT to objectively evaluate POH and provide data for actionable feedback and future improvements (see previous description of PoHAT). Final outcome measures were information omissions, task errors, and a teamwork score. A trained researcher observed POH at two different study sites using PoHAT and compared the quality of the handover against the components of instrument. Overall, the PoHAT was effective in evaluating information omissions, task errors, and the quality of teamwork during POH.[13]

Another study by Nagpal et al[16] developed and tested the feasibility of the ITCAS framework. Similar to the PoHAT, the authors used triangulation of research methodologies, including health care FMEA, and qualitative inquiry with health care professionals to develop the ITCAS. The ITCAS framework evaluated ITC failures in 22 patients undergoing major gastrointestinal surgeries. Patients were followed and observed

through the preoperative, intraoperative, and postoperative phases of surgery. POHs were observed and classified based on the transfer of patient-specific information, procedure-specific information, and anesthesia-specific information. Results indicated communication of patient information degraded from the surgical suite to the PACU.[16]

In a prospective observational study, Milby et al[6] analyzed information transfer during POH by observing 798 POHs and comparing the quality of information transferred against a 59-item instrument, structured in three sections: preoperative, intraoperative, and postoperative items. Subsequently, observations compared with the checklist were compared with patient information recorded in the anesthesia record. In most cases, the quantity of information transferred was largely heterogeneous and incomplete. Likewise, Manser et al[17] developed a 19-item instrument to aid clinicians' and human factors observers' assessment of the quality of POH from anesthesia care providers to PACU nurses. The first 16 items of the instrument assessed information transfer and teamwork on a four-point Likert scale. The remaining items addressed handover quality and the impact of PACU environmental influences on POH. Three factors, information transfer, shared understanding, and working environment, were identified to assess quality across POH observations.

The postoperative handover protocol (POP) was developed after qualitatively identifying ITC failures in the POH process.[10] Eighteen health care providers, including surgeons, anesthetists, and nurses, were queried to explore and describe failures in ITC and offer solutions to reduce ITC failures. The final POP was a 21-item instrument organized under the following headings: patient-specific information, surgical information, and anesthetic information. When operationalized into practice, the POP was designed to serve as a checklist for POH.[10] After implementing the POP in a subsequent study, Nagpal et al[13] found that patient- and equipment-specific task errors were reduced significantly, whereas teamwork (ie, leadership, communication, situational awareness) improved significantly.

Siddiqui et al[37] developed an instrument to identify information omissions during POH. Items included on the instrument were identified from the anesthesia record, a literature review, and were finalized using the Delphi method to gain consensus among anesthesiologist contributors. The 29-item checklist comprised four sections: preoperative and patient demographic information, anesthesia management and intraoperative information, significant intraoperative events, and postoperative directives. POHs were observed by a single observer, and the verbal content of the handover was compared against the data items on the instrument. Items were coded *yes* or *no*, indicating whether an item was communicated. Items were coded *not applicable* if an item was neither present, meaning the event did not occur such as a difficult intubation, or the event was not communicated. Items not communicated in 88% or greater of the POHs were patient positioning, the American Society of Anesthesiologists' classification, and estimated blood loss. The only items communicated in more than 90% of the POHs were type of surgery and intraoperative analgesia. At the conclusion of the observation period, anesthesiologists were surveyed and agreed that coexisting medical diseases, patient allergies, type of surgery, and degree of difficulty with intubation need to be communicated during POH. PACU nurses agreed that 17 of the 29 items needed to be communicated during POH. In addition to items identified by anesthesiologists, PACU nurses felt ST segment changes, hypothermia, urine output, analgesics, and types of intravenous access should be reported during POH.

Weinger et al[4] hypothesized the introduction of a multimodal intervention that included an electronic POH instrument, the *eHandover*, didactic webinar, simulation training, and postsimulation training feedback would improve the overall quality of POH. To assess the impact of implementing the *eHandover*, research nurses who were not involved in the study observed and rated the POH using the Post-Anesthesia Handover Evaluation Tool. The Post-Anesthesia Handover Evaluation Tool was organized into the following major sections: introduction, readiness for report, elements of handover information based on the SBAR format, handover communication, and a global rating of handover effectiveness. Handover communication was subdivided into content and organization, completeness of content, confirming comprehension, level of engagement and

coordination, and conflict resolution. After implementing the *eHandover*, the observers' ratings of POH indicated that the proportion of acceptable handovers increased significantly from 7% (95% confidence interval, 3%-17%) to 70% (95% confidence interval, 63%-76%) from the baseline to the postimplementation phase in the adult PACU.

Discussion

Most instruments identified in this review were designed to standardize information transfers between APs and PACU nurses, evaluate processes related to POH, or evaluate the quality of POH. Instruments developed to standardize the structure of POH demonstrated increases in the amount of critical information transferred during POH, decreases in information omissions, and decreases in both high-risk events and task errors.[1,4,28-31,33] Studies that addressed two or more dimensions of the DCM demonstrated similar positive results when compared with instruments that addressed one dimension. Instruments that were tested at more than one study site demonstrated similar positive results when compared with instruments tested at a single study site. Weinger et al,[4] Nagpal et al,[13] and Mazzocco et al[34] conducted studies at two or more sites and had similar positive and significant results. Assessing the impact of POH instruments and behaviors of surgical teams at more than one study site could increase the generalizability of the results to other practice settings. The body of evidence presented in this article offers strong evidence-based research that supports standardization of POH.

Patient Outcomes

An important gap in the body of evidence related to POH was a lack of studies that assessed patient outcomes after implementing POH instruments. Most studies measured communication of specific content items, teamwork, duration of POH, and provider satisfaction.[1,4,13,28,30,31] Health care is shifting its focus from the volume of care delivered to patients to the value of care delivered to patients, where value is defined as patient outcomes relative to health care cost.[38] Because of this shift, next developments in researching POH should be directed toward clinically important outcomes that directly affect patient morbidity and mortality.[9] Designing studies that link relationships between the quality of POH and patient outcomes could demonstrate the impact of poor quality POH on morbidity and mortality. The goal of successful POH is to safely and reliably transfer the care of vulnerable patients from the AP to the receiving team. In designing future studies, it will be prudent to drill down and measure patient-specific parameters, such as the incidence of reintubations in the PACU, and assess for potential linkages of such events to communication of information directly related to airway management and arterial blood gases.

Team Dynamics

Although this review identified several instruments in extant literature that were developed to standardize the structure of POH,[1,4,28,31] only two studies explicitly investigated behavioral and environmental factors influencing POH. Evidence to support the importance of teamwork and concise communication of perioperative patient information during POH was identified in two studies.[17,29] Teamwork, adaptability, integration, and environmental characteristics were shown to be important factors that influence the quality of POH and patient outcomes.[17,29] Mazzocco et al[29] found that morbidity and mortality was higher among patients whose surgical teams exhibited less teamwork behaviors. Deficits in teamwork and interpersonal communication among providers may lead to unsuccessful use of standardized POH procedures.[39] Furthermore, the dynamics of perioperative team communication and behaviors during POH could serve as barriers to implementing even the highest quality of POH instruments. Sociologic challenges, such as hierarchy, perceived importance of the POH, and power imbalances, can undermine the process of implementing standardized POH practices.[39] Integration of multimodal approaches to improving the structures, processes, and outcomes of POH is more likely to create a milieu where structured POH instruments can be successful.[39]

Electronic POH Instruments

Two studies described implementation of electronic POH instruments.[4,28] Implementation of electronic health records, including electronic Anesthesia Information Management System, has gained momentum over the last decade.[40] In

2009, The Health Information Technology for Economic and Clinical Health Act laid the foundation for growth in the use of electronic health records by incentivizing health care institutions who adopted electronic health records.[41] Potential advantages of implementing electronic anesthesia information management systems include improved patient safety, quality of care, and enhanced exchange of complex health information.[40] Additional research is needed to investigate the impact of implementing electronic POH instruments on clinical outcomes.

Studies involving traditional paper and electronic POH instruments were described in this review. Findings indicated that both formats had similar positive outcomes when implemented. One explanation could be that a comprehensive POH instrument implemented among providers who exhibit strong teamwork characteristics underpins the success of the POH regardless of the format. Advantages to electronic POH instruments include written clarity, centralized information format, organized presentation of patient information, and ease of access.[42] However, an existing electronic medical record would need to be in place before developing an electronic POH instrument.

Instrument Selection

Any of the reviewed instruments can be adapted to meet the local needs of providers. The question then becomes, "How does an investigator or clinician choose the right instrument?" The type of instrument an investigator or a clinician chooses depends on the intended use, the type of information desired, and the goals for improving the POH. For instance, if the goal is to improve the quality of information transferred, meaning ensuring critical patient information points are communicated during POH, then an instrument that addresses the structure of POH should be selected. Points to consider when selecting a POH instrument are as follows: (1) engage key stakeholders (AP and PACU nurses), (2) consider the environment where the instrument will be implemented, and (3) review the content of existing POH instruments. Furthermore, tailoring one or more of the aforementioned instruments offers an alternative to selecting a single existing instrument. Tailoring an existing instrument involves reviewing the content of the instrument, extracting relevant information, and developing a format conducive to the needs of local providers.

Another point to consider when selecting a POH instrument is the potential impact of implementing an instrument on the amount of time spent in the PACU. Based on the results of the two studies described in this review that measured length of time spent in the PACU, it is not clear if increased time spent in the PACU has a positive or a negative effect on the process of POH. Although more information was transferred when using an instrument,[32] spending more time in the PACU could potentially delay room turnover times and next case start times.

Evidence-Based Practices

Before standardizing POH, systematic evaluation and assessment of current POH practices is essential. Qualitative assessment of current POH practices can be performed by conducting key informant interviews with AP and PACU nurses and through observational methods. After identifying gaps in current POH practices, goal-directed strategies based on evidence-based literature can be developed. It is, however, important to go one step further to evaluate the effectiveness of planned interventions. Points to consider when evaluating the effectiveness of goal-directed POH interventions include evaluating feasibility outcomes such as usability, sustainability, and transferability.

Perioperative departments seeking to implement standardized POH protocols should consider instruments influenced by their patient population, information needs of the providers, and environmental factors. Because POHs are multifaceted and influenced by individual, interpersonal, and environmental factors, an understanding of POH may require a broader and more comprehensive approach rather than focusing on one aspect of POH. Weinger et al developed a successful multimodal approach to investigate POH. In their study, providers were introduced to a standardized handover protocol, attended a didactic webinar, and participated in POH scenarios developed to prepare providers for a variety of POH processes. Likewise, providers were periodically given feedback about the effectiveness of their POH. One reason for the success of this study may be that providers were engaged on multiple learning and orientation levels.

Continuous education and training throughout the process of introducing a new POH instrument proved to be beneficial to the success of the study.[4]

Failure Mode and Effect Analysis

Conducting FMEA offered a valuable approach to analyzing POH.[43] Through FMEA, high-risk and vulnerable areas can be identified. Once identified, those high-risk areas can be evaluated for process changes and corrective measures.[44] A benefit of the FMEA approach is its ability to foresee potential failures and deficits in POH and to address those deficits, in theory, before patient safety is compromised. To conduct FMEA and for other quality improvement purposes, simulator training may be an effective approach to identifying high-risk areas during POH. Developing high-risk simulation scenarios in which interpersonal communication is compromised presents a model where potential failures may be identified when patient safety is not compromised.[4] By consulting APs and PACU nurses, a systematic approach to identifying near-miss scenarios could be identified and studied in simulation.

Participatory Action Research

One of the strengths of the instruments described in this review was utilization of processes associated with participatory action research in eight studies to determine the structure and outline the processes of POH as well as to identify critical patient outcomes.[1,4,10,13,16,30,33,34] The studies used a variety of provider engagement strategies, including conducting semistructured interviews and focus groups with key stakeholders. Although conducting semistructured interviews were one way to determine the information needs of providers during POH, one of the studies explicitly stated that individual interviews were conducted with providers to determine information needs. When feasible, investigators may elicit more in-depth information when providers are interviewed individually.

The value in engaging key stakeholders, including AP and PACU nurses, surgeons, and residents, is that these providers become actively involved in developing the instrument from its inception.[45,46] Providers who routinely participate in POH have valuable insight into information needs during this critical time of transition. Involving key stakeholders and providers early in the development of POH instruments increases the usability and sustainability of the interventions. Likewise, providers are more likely to implement instruments that they were actively involved in developing.[45,46] The goal of POH is to ensure patient safety during the vulnerable handover process. Incorporating the priorities of various providers who participate in POH ideally results in more comprehensive information transfer episodes.

Limitations

A single researcher (MWR, the first author) completed the literature search and data extraction and primary synthesis of studies identified in this review, and no reliability measures were performed. The search strategy may have failed to identify all relevant studies. Important to note is that handovers take place in other practice settings, such as in the emergency department and between hospitalists during shift changes. There may be similarities and differences between handovers conducted in other practice settings that could be used to inform quality improvement initiatives in POH. Thus, inclusion of studies exploring handovers conducted in other anesthesia practice settings could yield additional adaptable instruments. Likewise, POHs in pediatric and cardiac anesthesia settings were not included in this review because POHs in these settings are highly specialized and require different considerations. Article selection was limited to POH between APs and PACU nurses. The review acknowledges that POH also occur between APs and ICU nurses in ICU settings. Studies included were limited to those written in English; therefore, selection bias may have occurred, and relevant studies published in other languages may have been omitted. Because POHs are influenced by individual, interpersonal, and organizational factors, it was challenging to classify each instrument into one dimension of the DCM. Likewise, there was overlap when classifying the purpose of the instrument and subsequently classifying instruments based on the DCM.

Future Research

The studies described in this review suggest that future research should focus on not only the structure of POH but also the processes involved with POH. Likewise, measureable patient

outcomes should be identified and incorporated into the development of POH instruments. POH research would benefit from development of additional multimodal interventions to address the structures, processes, and outcomes of POH. Future research should use participatory action research to identify information transfer deficits, identify barriers and facilitators to POH, and design context-specific user-friendly POH instruments. To increase the rigor of future studies, POH should be randomized to a study group, which implements a POH instrument, and to a control group. Then, patient outcomes can be compared between the study and control groups. This review identified only two studies where APs were to a control group, which conducted POH without instruments, or to study groups that conducted POH using an instrument.[1,33]

Conclusion

Although it has been established that standardizing POH improves the quality of information transfer, arbitrary selection of a POH instrument should be avoided. Purposeful selection of a POH instrument should follow a systematic process that begins with identification of core deficits by consulting with key stakeholders. The multimodal research design proposed by Weinger et al[4] offers a logical and systematic approach to standardizing POH because the design integrates the structure, processes, and outcomes of POH. Their research design could be scaled down to conserve time and costs associated with developing and implementing a new instrument. Importantly, the research design by Weinger et al is comprehensive and engages APs and PACU nurses whose input is critical when discovering what works best to improve a complex care event.

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Supplementary Data

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References

1. Salzwedel C, Bartz H-J, Kühnelt I, et al. The effect of a checklist on the quality of post-anaesthesia patient handover: A randomized controlled trial. *Int J Qual Health Care*. 2013;25:176-181.

2. Segall N, Bonifacio AS, Schroeder RA, et al. Can we make postoperative patient handovers safer? A systematic review of the literature. *Anesth Analg*. 2012;115:102-115.

3. Friesen MA, White SV, Byers JF. Handoffs: Implications for nurses. In: Hughes RG, ed. *Patient Safety and Quality: An Evidence-Based Handbook for Nurses. Advances in Patient Safety*. Rockville, MD: Agency for Healthcare Research and Quality; 2008.

4. Weinger MB, Slagle JM, Kuntz AH, et al. A multimodal intervention improves postanesthesia care unit handovers. *Anesth Analg*. 2015;121:957-971.

5. Abraham J, Kannampallil T, Patel B, Almoosa K, Patel VL. Ensuring patient safety in care transitions: An empirical evaluation of a Handoff Intervention Tool. *AMIA Annu Symp Proc*. 2012;2012:17-26.

6. Milby A, Böhmer A, Gerbershagen MU, Joppich R, Wappler F. Quality of post-operative patient handover in the post-anaesthesia care unit: A prospective analysis. *Acta Anaesthesiol Scand*. 2014;58:192-197.

7. Nagpal K, Abboudi M, Manchanda C, et al. Improving postoperative handover: A prospective observational study. *Am J Surg*. 2013;206:494-501.

8. Smith AF, Pope C, Goodwin D, Mort M. Interprofessional handover and patient safety in anaesthesia: Observational study of handovers in the recovery room. *Br J Anaesth*. 2008;101:332-337.

9. Gardiner TM, Marshall AP, Gillespie BM. Clinical handover of the critically ill postoperative patient: An integrative review. *Aust Crit Care*. 2015;28:226-234.

10. Nagpal K, Arora S, Abboudi M, et al. Postoperative handover: Problems, pitfalls, and prevention of error. *Ann Surg*. 2010;252:171-176.

11. Patterson ES, Wears RL. Patient handoffs: Standardized and reliable measurement tools remain elusive. *Jt Comm J Qual Patient Saf*. 2010;36:52-61.

12. Catchpole KR, de Leval MR, McEwan A, et al. Patient handover from surgery to intensive care: Using Formula 1 pit-stop and aviation models to improve safety and quality. *Paediatr Anaesth*. 2007;17:470-478.

13. Nagpal K, Abboudi M, Fischler L, et al. Evaluation of postoperative handover using a tool to assess information transfer and teamwork. *Ann Surg*. 2011;253:831-837.

14. Zavalkoff SR, Razack SI, Lavoie J, Dancea AB. Handover after pediatric heart surgery: A simple tool improves information exchange. *Pediatr Crit Care Med*. 2011;12:309-313.

15. Joy BF, Elliott E, Hardy C, Sullivan C, Backer CL, Kane JM. Standardized multidisciplinary protocol improves handover of cardiac surgery patients to the intensive care unit. *Pediatr Crit Care Med*. 2011;12:304-308.

16. Nagpal K, Vats A, Ahmed K, Vincent C, Moorthy K. An evaluation of information transfer through the continuum of surgical care: A feasibility study. *Ann Surg*. 2010;252:402-407.

17. Manser T, Foster S, Gisin S, Jaeckel D, Ummenhofer W. Assessing the quality of patient handoffs at care transitions. *Qual Saf Health Care*. 2010;19:e44.

18. Jeffcott SA, Evans SM, Cameron PA, Chin GSM, Ibrahim JE. Improving measurement in clinical handover. *Qual Saf Health Care*. 2009;18:272-277.

19. Gardner G, Gardner A, O'Connell J. Using the Donabedian framework to examine the quality and safety of nursing service innovation. *J Clin Nurs*. 2014;23:145-155.

20. McQuestion MJ. Quality of care. Paper presented at: The Johns Hopkins University Bloomberg School of Public Health. 2006; Baltimore, MD.

21. Moore L, Lavoie A, Bourgeois G, Lapointe J. Donabedian's structure-process-outcome quality of care model: Validation in an integrated trauma system. *J Trauma Acute Care Surg*. 2015;78:1168-1175.

22. Haj HIE, Lamrini M, Rais N. Quality of care between Donabedian model and ISO9001V2008. *Int J Qual Res*. 2013;7:17-30.

23. Delrue KS. An evidence based evaluation of the nursing handover process for emergency department admissions. Allendale Charter Township, MI: Grand Valley State University; 2013 [doctoral dissertation].

24. Whittemore R, Knafl K. The integrative review: Updated methodology. *J Adv Nurs*. 2005;52:546-553.

25. Moher D, Liberati A, Tetzlaff J, Altman DG, PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLoS Med*. 2009;6:e1000097.

26. Wong MC, Yee KC, Turner P. A structured evidence-based literature review regarding the effectiveness of improvement interventions in clinical handover. The Group; 2008. Available at: http://www.thoracic.org.au/documents/papers/clinicalhandoverliteraturereview.pdf. Accessed April 6, 2015.

27. Anwari JS. Quality of handover to the postanaesthesia care unit nurse. *Anaesthesia*. 2002;57:484-500.

28. Gillikin KE, Apatov N. The effectiveness of an anesthesia handoff tool: An electronic health record application to enhance patient safety. *Anesth J*. 2016;4:6-15.

29. Mazzocco K, Petitti DB, Fong KT, et al. Surgical team behaviors and patient outcomes. *Am J Surg*. 2009;197:678-685.

30. Petrovic MA, Martinez EA, Aboumatar H. Implementing a perioperative handoff tool to improve postprocedural patient transfers. *Jt Comm J Qual Patient Saf*. 2012;38:135-142.

31. Petrovic MA, Aboumatar H, Scholl AT, et al. The perioperative handoff protocol: Evaluating impacts on handoff defects and provider satisfaction in adult perianesthesia care units. *J Clin Anesth*. 2015;27:111-119.

32. Potestio C, Mottla J, Kelley E, DeGroot K. Improving post anesthesia care unit (PACU) handoff by implementing a succinct checklist. *APSF Newsl* 2015;13-15.

33. Robins H-M, Dai F. Handoffs in the postoperative anesthesia care unit: Use of a checklist for transfer of care. *AANA J*. 2015;83:264-268.

34. Siddiqui N, Arzola C, Iqbal M, et al. Deficits in information transfer between anaesthesiologist and postanaesthesia care unit staff: An analysis of patient handover. *Eur J Anaesthesiol*. 2012;29:438-445.

35. Wright SM. Examining transfer of care processes in nurse anesthesia practice: Introducing the PATIENT protocol. *AANA J*. 2013;81:225-232.

36. Wong MC, Yee KC, Turner P. *Clinical Handover Literature Review*. University of Tasmania, Australia: eHealth Services Research Group; 2008.

37. Hornor G. Child maltreatment: Screening and anticipatory guidance. *J Pediatr Health Care*. 2013;27:242-250.

38. Porter ME. What is value in health care? *N Engl J Med*. 2010;363:2477-2481.

39. Catchpole K, Russ S. The problem with checklists. *BMJ Qual Saf*. 2015;24:545-549.

40. Stabile M, Cooper L. Review article: The evolving role of information technology in perioperative patient safety. *Can J Anaesth*. 2013;60:119-126.

41. Gálvez JA, Rothman BS, Doyle CA, Morgan S, Simpao AF, Rehman MA. A narrative review of meaningful use and anesthesia information management systems. *Anesth Analg*. 2015;121:693-706.

42. Matic J, Davidson PM, Salamonson Y. Review: Bringing patient safety to the forefront through structured computerisation during clinical handover. *J Clin Nurs*. 2011;20:184-189.

43. Pucher PH, Johnston MJ, Aggarwal R, Arora S, Darzi A. Effectiveness of interventions to improve patient handover in surgery: A systematic review. *Surgery*. 2015;158:85-95.

44. Shaqdan K, Aran S, Daftari Besheli L, Abujudeh H. Root-cause analysis and health failure mode and effect analysis: Two leading techniques in health care quality assessment. *J Am Coll Radiol*. 2014;11:572-579.

45. Baum F, MacDougall C, Smith D. Participatory action research. *J Epidemiol Community Health*. 2006;60:854-857.

46. Brydon-Miller M. Participatory action research: Psychology and social change. *J Soc Issues*. 1997;53:657-666.

Supplementary Data

Appendix. Recommendations for Information Content of POH

Assess for Readiness for POH	Petrovic et al[31]; Robins & Dai[33]; Weinger et al[4]
Patient information	
• Age • Gender • Patient name • Allergies • ASA physical status • Name band check	Anwari[27]; Gillikin & Apatov[28]; Milby et al[6]; Nagpal et al[10,13,16]; Potestio et al[32]; Robins & Dai[33]; Salzwedel et al[1]; Siddiqui et al[34]; Weinger et al[4]; Wright[35]
Preoperative information	
• Diagnosis • Preoperative status • Premedication • Medical history • Preoperative level of activity, METS • Limb restrictions • Surgical history • ASA classification • Baseline neurologic status, vital signs, height, weight • Baseline physical examination • Baseline weight • Pertinent laboratory values • Underlying/pre-existing diseases: neurology, cardiology, pulmonology, myopathies, renal, liver, metabolic disorders, infectious disease, drug and alcohol abuse • Anesthesia risk assessment • Pacemaker/ICD • The presence of obesity • Code status • Current medications (especially beta-blockers)	Anwari[27]; Gillikin & Apatov[28]; Milby et al[6]; Nagpal et al[10,13,16]; Petrovic et al[30,31]; Potestio et al[32]; Robins & Dai[33]; Salzwedel et al[1]; Siddiqui et al[34]; Weinger et al[4]
Anesthesia information	
• Type of anesthesia (GA, TIVA, regional) • Type of analgesia • Airway management • Intubating conditions • Intraoperative anesthesia events • Medications administered (narcotic totals, anticoagulant, antibiotics, anticonvulsants, neuromuscular blockade) • PONV prophylaxis • Complications • Vascular access/invasive monitoring • Current blood type and crossmatch • ST segment changes	Anwari[27]; Gillikin & Apatov[28]; Milby et al[6]; Nagpal et al[10,13,16]; Petrovic et al[30,31]; Potestio et al[32]; Robins & Dai[33]; Salzwedel et al[1]; Siddiqui et al[34]; Weinger et al[4]

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Appendix. Continued

Assess for Readiness for POH	Petrovic et al[31]; Robins & Dai[33]; Weinger et al[4]
Intraoperative information • Type of anesthesia • Airway management • Catheter insertion • Hemodynamic occurrences • Volume management (intake and output) • Antibiotic therapy • Anesthesia-related events, management, concerns: allergic reaction, tooth damage • Blood loss • The presence of drains • Postoperative pain management initiated • Blood transfusion (has/needs) • Unexpected events (ie, arrhythmias, hypotension) • Laboratory results and analysis • Vasoactive medications	Milby et al[6]; Nagpal et al[13,16]; Petrovic et al[30,31]; Robins & Dai[33]; Salzwedel et al[1]; Siddiqui et al[34]; Weinger et al[4]; Wright[35]
Surgery information • Surgeon • Type of surgery • Reason for surgery, diagnosis • Surgical complications/events/concerns • Antibiotic plan • Blood loss • Medications to be restarted • DVT prophylaxis • Tubes and drains, catheters, shunts • NG tube • Postoperative diet • Fluid management (intake/output/EBL) • Positioning	Anwari[27]; Gillikin & Apatov[28]; Milby et al[6]; Nagpal et al[10,13]; Potestio et al[32]; Robins & Dai[33]; Salzwedel et al[1]; Siddiqui et al[34]; Weinger et al[4]; Wright[35]
Postoperative arrival to PACU • Patient's level of consciousness/status • Hemodynamic status • Neuromuscular blockade status • Pertinent laboratory values • Fluid status • Patient position • Vital signs • Pain score • Language barriers • Patient with legal guardian • Oxygen status and amount • Thermodynamic control • Respiratory ventilator settings • Arrival time to PACU • Postoperative anesthesia orders present • Medications due in PACU	Nagpal et al[13,16]; Petrovic et al[30,33]; Potestio et al[32]; Salzwedel et al[1]; Siddiqui et al[34]; Weinger et al[4]

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Appendix. Continued

Assess for Readiness for POH	Petrovic et al[31]; Robins & Dai[33]; Weinger et al[4]
• Patient disposition • Point out failed punctures • Location of patient's personal belongings	
Team members and roles • Provider transferring patient to PACU • Team members present during POH • Leadership • Communication • Coordination • Cooperation • Situational awareness	Anwari[27]; Nagpal et al[13]
Anticipatory guidance/clarification/contingency management • Anticipated bleeding, pain, and airway problems • Analgesia plan/PONV plan • Plan for intravenous fluids • Contact information for anesthetic problems • Contact information for surgical complications • Antibiotic plan • Postoperative consults and investigations • Plan for monitoring vital signs and parameters • Plan for invasive lines and monitoring	Mazzocco et al[29]; Petrovic et al[30,31]; Robins & Dai[33]; Gillikin & Apatov[28]; Nagpal et al[10,13,16]; Salzwedel et al[1]; Weinger et al[4]
Electronic format	Gillikin & Apatov[28]; Weinger et al[4]

POH, postoperative handover; ASA, American Society of Anesthesiology; METS, metabolic equivalents; ICD, internal cardio defibrillator; GA, general anesthesia; TIVA, total intravenous anesthesia; PONV, postoperative nausea and vomiting; DVT, deep vein thrombosis; NG, nasogastric tube; EBL, estimated blood loss; PACU, postanesthesia care unit.