David S. Warner, M.D., Editor

Addressing the Mandate for Hand-off Education

A Focused Review and Recommendations for Anesthesia Resident Curriculum Development and Evaluation

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ABSTRACT

The Accreditation Council for Graduate Medical Education requires that residency programs teach residents about handoffs and ensure their competence in this communication skill. Development of hand-off curricula for anesthesia residency programs is hindered by the paucity of evidence regarding how to conduct, teach, and evaluate handoffs in the various settings where anesthesia practitioners work. This narrative review draws from literature in anesthesia and other disciplines to provide recommendations for anesthesia resident hand-off curriculum development and evaluation. **(ANESTHESIOLOGY 2014; 120:218-29)**

HANDOFFS' contribution to healthcare quality is being increasingly recognized as evidence grows linking communication defects to patient safety lapses.[1–3] The Joint Commission, the body that accredits hospitals and other healthcare organizations in the United States, recognized that hand-off standardization could improve communication quality; it designated hand-off standardization as a national patient safety goal in 2006.* The Accreditation Council for Graduate Medical Education (ACGME) also recognizes the importance of handoffs and requires that all ACGME-accredited programs ensure that their residents are competent in hand-off communications.† The purpose of this article is to review the literature about handoffs in anesthesia and related fields to develop curriculum development and evaluation recommendations for anesthesiology resident education leadership. These recommendations were developed to assist in compliance with current ACGME requirements for residency programs, including those in anesthesiology.‡

Hand-off communication is a high priority for regulatory and educational purposes; however, best practices with respect to anesthesia handoffs have not been established. Research addressing intraoperative handoffs is scant, with only five studies published in the past 40 yr specifically addressing these handoffs.[4–8] A somewhat larger number of studies examine handoffs to the postanesthesia care unit[1,9–22] and intensive care unit.[12,23–34] One retrospective analysis of recovery room incidents suggested that communication faults contributed to 14% of postoperative adverse events.[35] Other studies have shown that information omissions, errors, and distractions are common in postoperative anesthesia handoffs.[9,13] Published reviews have synthesized the

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* Joint Commission. National Patient safety Goals (2006). Requirement 2E. Available at: http://www.jointcommission.org/assets/1/6/2007_Annual_Report.pdf. Accessed October 3, 2013.

† Accreditation Council for Graduate Medical Education (2013). Common program requirements. Section VI.B. Available at: http://www.acgme.org/acgmeweb/Portals/0/PFAssets/ProgramRequirements/CPRs2013.pdf. Accessed October 3, 2013.

‡ Accreditation Council for Graduate Medical Education (2011). ACGME Program Requirements for Graduate Medical Education in Anesthesiology. Available at: http://acgme.org/acgmeweb/Portals/0/PFAssets/ProgramRequirements/040_anesthesiology_f07012011.pdf. Accessed October 3, 2013.

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limited body of literature about perioperative handoffs, but they do not offer guidance on hand-off curriculum development and evaluation.[36–40]

It is in the context of scant evidence that program directors and other educational leaders in anesthesia are tasked with developing curricula to teach hand-off communications and with evaluating residents' ability to conduct handoffs well. Fortunately, other specialties have considered the questions of what to teach residents about handoffs and how to effectively deliver hand-off curricular content.[41] We set out to conduct a systematic review of the literature on handoffs in anesthesia, but a paucity of evidence about intraoperative handoffs[4–8] precluded this approach. We therefore conducted a narrative review[42] of the literature including articles published before July 2013. This review synthesizes studies about anesthesia handoffs and hand-off curriculum design, offering recommendations for curriculum development and evaluation that account for the different types of handoffs in which anesthesia providers participate during the course of their practice.

Definition of a Handoff

The terms hand-off, handover, sign out, and transfer of care are often used interchangeably in medical literature.[43] Most commonly used definitions of hand-off include the transfer of information and responsibility of care for a patient from one healthcare professional to another.[44,45] Handoffs may also provide a positive form of stress relief and emotional support[46] and promote team building or group cohesion.[47] Ideally, each hand-off is a conversation rather than a one-way communication.[48] Studies on information transfer fidelity consistently show that verbally transmitted information is subject to degradation and loss,[49,50] so active engagement by the "recipient" is necessary to ensure adequate handoff.[51]

Connection between Handoffs and Harm

Cooper *et al.*[4] noted that handoffs can provide an important safety check that enables relieving providers to review care and potentially correct mistakes. There is, however, a strong connection between inadequate communication, information loss, and adverse patient outcomes.[35,37,52,53] There may be multiple mechanisms through which handoffs lead to harm. Arora *et al.*[54] presented a theoretical framework grounded in social sciences to explain how handoffs may negatively affect patient care. They discuss the possible erosion of professionalism that may occur in settings of discontinuity, also known as "shift work mentality." This may lead to healthcare providers not taking responsibility for the care of their patients.

Handoffs in Anesthesiology and Critical Care

There are numerous handoffs that occur routinely in academic anesthesia practice, and these hand-off types can be conceptualized as shift-to-shift handoffs, duty relief (breaks), or as transitions in care (table 1). Most original research and review articles about anesthesia handoffs focus on transitions in care, specifically operating room (OR) to postanesthesia care unit[1,9–22,39,40] and OR to intensive care unit [12,23,25–34,39,40] handoffs. Research focused on perioperative transitions has demonstrated repeated communication errors that are ameliorated with the institution of standardized hand-off processes, tools, or protocols.[19,25–27,29]

Intraoperative handoffs, a type of shift-to-shift or duty relief, merit special mention because they have important features distinguishing them from transitions of care. First, intraoperative handoffs involve several dimensions of transfer (table 2). Care may be transferred between different personnel types, providers with varying levels of training, for various periods of time, and, in the case of attending physicians, handoffs may occur distant to the site of care. In cases with both a supervising attending and a resident or nonphysician anesthetist, two handoffs may occur simultaneously. Second, handoffs in the OR may encounter barriers to effective communication (table 3),[48,55,56] including poor lighting,

Table 1. Types of Handoffs Conducted in Anesthesia Practice

	Hand-off Type		
	Shift-to-shift	Duty Relief (Breaks)	Transition of Care
Anesthesia Setting	Duty Relief by Providers with Similar Training and Responsibilities	Short-term Transfer of Patient Care, with Planned Transfer Back to Original Care Provider	Transfer of Patient Care, with Patient Movement between Locations or Change in Level of Care
ICU	✓	✓	To/from OR
OB	✓	✓	To OR
OR	✓	✓	From ED, to/from PACU
PACU	✓	✓	To/from OR, ward
Pain	✓	X	To/from primary provider
Regional/block	✓	✓	To OR

✓ indicates that hand-off type occurs in a given setting; X indicates that hand-off type does not occur in a given setting.
ED = emergency department; ICU = intensive care unit; OB = obstetric anesthesia; OR = operating room; PACU = postanesthesia care unit.

Table 2. Dimensions (Categories) of Intraoperative Handoffs

Dimension	Example
Personnel	Resident → resident
	CRNA/AA → CRNA/AA
	Resident ↔ CRNA/AA
	Attending → attending
Level of training	Junior resident ↔ senior resident
	Resident ↔ CRNA/AA
	Resident ↔ attending provider
	Generalist attending ↔ subspecialty attending
Duration	Short-term duty relief (breaks)
	Definitive transfer of care
Location	In the operating room
	Outside the operating room (*e.g.*, attending → attending)

AA = anesthesiologist assistant; CRNA = certified registered nurse anesthetist.

chaotic environment, too much noise, and multitasking. Third, intraoperative handoffs may be prompted to occur at predetermined times of shift change unrelated to or in conflict with procedural milestones (*e.g.*, incision, closing), leading to shorter, hurried handoffs that lack vital patient information.

Despite the special concerns around OR handoffs, our review of the literature yielded only five studies specifically focused on handoffs between anesthesia providers in the OR (see Supplemental Digital Content 1, http://links.lww.com/ALN/B8, which is a table describing five studies of intraoperative handoffs),[4–8] none of which were designed or powered to determine best practices. Two of the five publications reported the results of anesthesiologists who were surveyed about their intraoperative hand-off practices.[5,6] Development and implementation of a standardized intraoperative hand-off checklist were described in two of the studies.[7,8] Only Cooper *et al.*[4] attempted to examine the association between patient outcomes and the intraoperative exchange of information between anesthesia personnel. Cooper[57] also published a protocol for intraoperative duty relief, but this was not based on empirical data.

Why Hand-off Curriculum Is Needed

In addition to complying with ACGME requirements, it is imperative to engage residents in conducting handoffs that promote safe care because they are frontline providers. Adequate handoffs represent fulfillment of providers' obligation to deliver safe and effective care. Implementation of a hand-off curriculum represents an opportunity to both reinforce institution-specific protocols (where they exist) and to teach trainees fundamental patient safety principles that will apply when specific protocols and checklists do not exist or when they become outdated or irrelevant.

Hand-off Curriculum Requirements

In 1999, the ACGME specified six core competencies for resident education: patient care, medical knowledge, practice-based learning and improvement, interpersonal and communication skills, professionalism, and systems-based practice.[58] Each accredited residency program was charged with demonstrating that its trainees had acquired these competencies. More recently, the ACGME has added hand-off requirements, stating that "sponsoring institutions and programs must ensure and monitor effective, structured hand-over processes to facilitate both continuity of care and patient safety," and "programs must ensure that residents are competent in communicating with team members in the hand-over process."† Figure 1 relates handoffs to each of the core competencies.

Even though the ACGME has demonstrated an interest in residents' acquiring hand-off skills,§[59,60] individual programs must decide what hand-off curriculum to implement and how to evaluate whether their residents have sufficiently mastered the ability to hand-off patient care to another provider. The dearth of original research testing hand-off strategies relevant to anesthesia makes it difficult to design an evidence-based hand-off curriculum specific to our specialty. Nevertheless, principles from other disciplines may help anesthesia education leadership in designing hand-off curricula to meet ACGME requirements.

Hand-off Curriculum Development

Curriculum design should incorporate content selection, content delivery, and evaluation of the curriculum and assessment of trainees (fig. 2).[61] Establishing broad educational goals and specific measurable objectives for hand-off education is an important first step in developing a hand-off curriculum. The lack of literature focused on developing and delivering hand-off curriculum specific to anesthesia makes it necessary to draw from other disciplines that have considered these curriculum development issues. We adapted goals and objectives developed by a group that designed a comprehensive hand-off curriculum for pediatric residents.‖ The group and its curriculum are both entitled I-PASS, which is a mnemonic that stands for *I*llness severity, *P*atient summary, *A*ction list, *S*ituation awareness and contingency planning,

§ Whalen T, Wendel G. New Supervision Standards: Discussion and Justification. In: Philibert I, Amis S, eds. The ACGME 2011 Duty Hour Standards: Enhancing Quality of Care, Supervision, and Resident Professional Development. Chicago, IL, Accreditation Council for Graduate Medical Education; 2011:39–46. Available at: http://www.acgme.org/acgmeweb/Portals/0/PDFs/jgme-monograph[1].pdf. Accessed October 3, 2013.

‖ Spector N, Starner A, Allen A, Bale J, Bismilla Z, Calaman S, Coffey M, Cole F, Destino L, Everhart J, Hepps J, Kahana M, Lopreiato J, McGregor R, O'Toole J, Patel S, Rosenbluth G, Srivastava R, Stevenson A, Tse L, Yu C, West D, Sectish T, Landrigan C: I-PASS Handoff Curriculum: Core Resident Workshop. MedEdPORTAL; 2013. Available at: http://www.mededportal.org/publication/9311. Accessed October 3, 2013.

Table 3. Barriers to Effective Anesthesia Hand-off Communication

Standardization	Systems factors
• Absent or insufficient hand-off training	• Multitasking during report
• Lack of evidence-based research to guide hand-off best practices	• Interruptions and distractions
• Mnemonic difficulties: which one should be used and how should it be taught?	• Lack of privacy
• Staff resistant to changes in hand-off system	• Time constraints
• Lack of hand-off procedural protocols or tools	• Too much noise
• Problems with the standardized protocols or tools	• Poor lighting
• Poor recognition and/or understanding of protocol or tool in use	
General communication	Clinical factors
• Lack of understanding of how to engage in an effective hand-off dialogue	• Patients with multiple complex, medical problems
• Omissions, errors, or misunderstandings	• Too many patients (*e.g.*, ICU, pain, OB)
• Language communication barriers (*i.e.*, dialectic, accent, vernacular barriers)	• Rapid case turnover
• Social interactions occurring during handoffs	• Change in patient status during hand-off
• Incorrect information recall	Human factors
• Disorganized report	• Fatigue or illness
• Hierarchical culture that discourages questions	• Stressful shifts
• Differences in clinical knowledge	• Memory limitations
	• High staff turnover
	• Information and sensory overload

ICU = intensive care unit; OB = obstetrics.

and *S*ynthesis by receiver.[62] We condensed the published I-PASS goals from eight to five and provided examples of implementation in order to highlight their relevance to anesthesia practice (table 4).

Hand-off Curriculum Content

Curriculum content will be informed by the goals and objectives selected (table 4). It can be helpful to contextualize hand-off teaching by discussing how communication failures relate to errors, and the importance of teamwork (Goal 1), which will help underscore the importance of conducting effective handoffs. Teaching principles of verbal and written communication (Goal 2) can emphasize the common features of the numerous hand-off types encountered in anesthesia practice (table 1). Verbal hand-off elements, textual hand-off components (printed, written, or electronic documents), and contingency planning (Goals 3 and 4) also apply to all types of anesthesia hand-offs. Content such as perioperative hand-off tools and protocols[8,13,15] could be taught to further reinforce curricular objectives (Goal 5).

The cornerstone of the I-PASS hand-off curriculum is the core resident workshop, which includes a didactic session developed by the I-PASS study team. Peer-reviewed material (*e.g.*, lecture slides and videos) for this curriculum has been published on the Association of American Medical Colleges' MedEdPORTAL Web site.‖ The I-PASS curriculum was originally designed for use by pediatric residents in the inpatient setting, but anesthesiology residency educators without an established hand-off curriculum may find the I-PASS materials especially helpful because it offers a detailed, evidence-based curriculum that can be tailored to fit the needs of a specific residency program. The I-PASS curriculum is currently undergoing a multicenter national study designed to measure its impact on medical errors, verbal and written miscommunications, and resident physician workflow and satisfaction.

The I-PASS curriculum highlights one approach to teaching handoffs: the use of a mnemonic. Mostly acronym-based, hand-off mnemonics serve to standardize handoffs, reinforcing principles of communication and ensuring that important hand-off components are not forgotten.[63] No single mnemonic has been shown to be universally beneficial, which may account for the proliferation of mnemonics in the literature. A systematic review of hand-off mnemonics yielded 46 articles using 24 mnemonics.[63] A recent update revealed an additional 11 articles and 12 more mnemonics# for a total of 36 mnemonics. The I-PASS mnemonic incorporates contingency planning (also called anticipatory guidance), patient acuity, and synthesis of information by the receiver of hand-off (time for clarification and confirmation), which we believe are all essential components of an effective anesthesia hand-off.

Riesenberg LA: Shift-to-shift handoff research: Where do we go from here? Journal of Graduate Medical Education 2012; 4: 4–8. Online supplement. Available at: http://www.jgme.org/doi/suppl/10.4300/JGME-D-11-00308.1. Accessed October 3, 2013.

Fig. 1. Relationship of handoffs to residency core competencies. ACGME = Accreditation Council for Graduate Medical Education. *Accreditation Council for Graduate Medical Education. Common program requirements. Available at: http://www.acgme.org/acgmeweb/Portals/0/PFAssets/ProgramRequirements/CPRs2013.pdf. Accessed October 3, 2013.

Hand-off Curriculum Delivery

Once objectives and content are established, content delivery approaches must be considered. A variety of strategies for teaching hand-off skills have been published, including didactics alone,[64] didactics sessions and role-playing,[65–70] simulation,[71–73] and Web-based activities.[74–76] It is unclear which of these strategies will be most effective in an anesthesia-specific hand-off curriculum, because educational strategies have differential effectiveness depending on the chosen goals and objectives. Lipsett and Kern[77] describe three types of learner objectives and the methods used to achieve them. Methods that are commonly used to achieve *cognitive* objectives include readings, lectures, audiovisual materials, programmed learning (*e.g.*, practice tests with feedback), discussion, and problem-based learning. *Affective* objectives may be achieved with exposure (*e.g.*, readings, discussions, and experiences), facilitation of openness, introspection, reflection, and use of role models. *Psychomotor* objectives are achieved with supervised clinical experience, simulations, artificial models, role-plays, standardized patients, and audio or visual review of skills.

Gordon and Findley[78] conducted a systematic review of the literature that examined hand-off curriculum educational interventions that address all three domains of Lipsett and Kern[77] (affective, cognitive, and psychomotor). Nine of the 10 studies reported outcomes demonstrating improved attitudes (affective objective) or knowledge and skills (cognitive objective), and only one study demonstrated transfer of skills to the workplace (psychomotor objective).[78] The most commonly used teaching method was simulation or role-play. Other shared modalities were the use of observation, evaluation, and feedback. Group lectures and online materials were used in several of the interventions.

Ultimately, curriculum developers must choose content delivery approaches appropriate for the target audience, accounting for institutional capability. It should be emphasized that conducting handoffs constitutes a skill requiring a cognitive base and an appreciation of the importance of communication. As with any other skills in anesthesia practice (*e.g.*, intubation, arterial line placement), didactic programming alone is likely insufficient to teach effective hand-off skills.

Evaluation of Curriculum, Educational Outcomes

Once a curricular plan is implemented, evaluation of the curriculum allows stakeholders to determine whether the

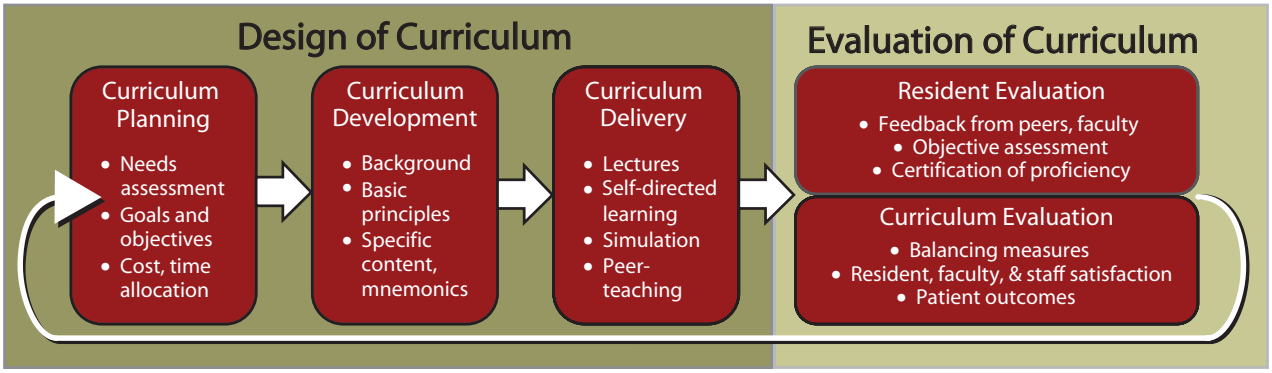

Fig. 2. Components of hand-off curriculum design and assessment. On the basis of studies by Wong[61] and Gordon and Findley.[78]

goals and objectives are being achieved. Evaluation guides curriculum developers in the cycle of ongoing improvement.[77] Wong[61] describes curriculum development as a "cyclical iterative process which is informed and changed by curriculum evaluation."

In their chapter on "Evaluation and Feedback," Lipsett and Kern[77] describe 10 tasks in a methodological approach to designing curriculum evaluation: identify users, identify uses (individual *vs.* program, formative *vs.* summative), identify resources, identify evaluation questions, choose evaluation designs, choose measurement methods and construct instruments, address ethical concerns, collect data, analyze data, and report results. They suggest this approach will help ensure an evaluation that meets the needs of its users and that balances methodological rigor with feasibility.

Conceptualizing program evaluation through these tasks can guide development of an anesthesia hand-off curriculum. For example, evaluation questions are most effectively framed in relation to the specific, measurable clinical objectives of the curriculum: Who will do how much of what, by when, and how well will they do it? Evaluation designs ideally have internal validity, defined as accurately assessing the impact of an intervention on subjects in a specific setting.[77] Lipsett and Kern[77] write that the most commonly used evaluation designs are posttest only, pretest–posttest, nonrandomized controlled pretest–posttest, randomized controlled posttest only, and randomized controlled pretest–posttest. They note that as the designs increase in methodological rigor, they also increase in the amount of resources required to execute them.[77]

Table 4. Sample Goals and Objectives* for Resident Hand-off Curriculum in Anesthesia (Adapted from I-PASS Pediatric Hand-off Curriculum†)

Goals and Objectives	Instructional Strategy
Goal 1‡: Understand the context of medical errors associated with communication failures and the importance of teamwork *Objectives:* • Explain the relationship between hand-off and communication failures and sentinel events in U.S. hospitals • Illustrate how situation monitoring and situation awareness create a shared mental model to provide safe patient care	• Didactic presentation • Example video presentation and discussion • Role-play and/or simulation • Faculty and/or senior resident observations of verbal handoffs with formative feedback
Goal 2: Learn the global elements of effective verbal handoffs and textual hand-off information§ *Objectives:* • List the important elements in an effective hand-off process ◦ Provide protected time and space (ICU, OB, pain), or optimize conditions (OR, PACU) ◦ Standardize format for relaying information to prevent omissions ◦ Include specific contingency plans in case of physiologic instability, change in planned procedure ◦ Ensure unambiguous transfer of responsibility: identify primary surgical service and responsible attendings (anesthesia and surgery) ◦ Agree upon a specific order for reviewing patients (ICU, OB, pain)	• Didactic presentation • Example video presentation and discussion • Role-play and/or simulation • Faculty and/or senior resident observations of verbal handoffs with formative feedback • Faculty and/or senior resident review of textual hand-off information§
Goal 3: Know the elements of an effective verbal handoffs, textual hand-off information,§ and patient summaries *Objectives:* • Create an appropriate environment (as quiet as practicable, face-to-face) before starting • Minimize unnecessary interruptions ◦ Notify others in advance to minimize unnecessary interruptions ◦ Ensure that hand-off is occurring at an appropriate time (OR, PACU) ◦ Handle interruptions professionally ◦ Identify potential pitfalls (*e.g.*, incomplete information, skipped steps, tangents, forgetting to ask questions, tangential conversations) • Use structured format to relay the information ◦ Begin with a high-level overview as a team summary (ICU, OB, pain) ◦ Describe the current situation of team (*e.g.*, number of sick and unstable patients and pending admissions or discharges) ◦ Identify the attending-on-call or other medical backup • Ensure optimal receiver communication ◦ Describe role of nonverbal communications such as "huh," "hmm," eye contact, nodding, or frowning ◦ Solicit specific read back of salient points ◦ Provide time for clarifying questions • Employ closed-loop communication, for example, read back, questions • Discuss the use of patient summaries in clinical decision making ◦ Develop a shared mental model of the patient's condition ◦ Ensure patient ownership • List the components of an effective patient summary including: summary statement, events leading up to admission or procedure, hospital course, ongoing assessment plan	• Didactic presentation • Example video presentation and discussion • Role-play and/or simulation • Faculty and/or senior resident observations of verbal handoffs with formative feedback • Faculty and/or senior resident review of textual hand-off information§ and patient summaries

(*Continued*)

Table 4. Continued

Goals and Objectives	Instructional Strategy

Goal 4: Incorporate contingency planning in clinical care, including handoffs
Objectives:
• Discuss benefits of contingency planning in clinical care
• List the components of effective contingency planning
  ○ What may go wrong and what to do about it
  ○ What has or has not worked before
  ○ Resources for help
  ○ Difficult family or psychosocial situations
  ○ Code status (recent changes, family discussions)
  ○ Nursing concerns
• Describe methods to provide an effective contingency plan
Assess receiver's level of experience with disease process or procedure (OR example: "Have you done a craniotomy before?")
Prioritize which problems (if any) need contingency planning
	• Didactic presentation
	• Example video presentation and discussion
	• Faculty and/or senior resident observations of verbal handoffs and textual hand-off information with formative feedback

Goal 5: Adopt a single hand-off protocol *Objectives:* • Be able to describe each element of the protocol • Populate the protocol with appropriate data for a mock patient • Demonstrate usage of the protocol in a face-to-face handover, as giver and receiver, and be rated as satisfactory by partner and observer	Use a single protocol to standardize hand-off process • Didactic presentation • Example video presentation and discussion • Role-play and/or simulation • Faculty and/or senior resident observations of verbal handoffs with formative feedback

* Goal: a statement that describes in broad terms what the learner (participant) will gain from the instruction. Objective: a statement that describes the planned outcomes of a learning experience in specific, measurable terms. † Spector N, Starner A, Allen A, Bale J, Bismilla Z, Calaman S, Coffey M, Cole F, Destino L, Everhart J, Hepps J, Kahana M, Lopreiato J, McGregor R, O'Toole J, Patel S, Rosenbluth G, Srivastava R, Stevenson A, Tse L, Yu C, West D, Sectish T, Landrigan C: I-PASS Handoff Curriculum: Core Resident Workshop. MedEdPORTAL; 2013. Available at: www.mededportal.org/publication/9311. Accessed April 15, 2013. Adaptations are themselves works protected by copyright. So in order to publish this adaptation, authorization must be obtained both from the owner of the copyright in the original work (I-PASS study team) and from the owner of copyright in the translation or adaptation. ‡ Goals 1, 2, 3, and 4 correspond to original I-PASS goals 1, 3, 4, and 8, respectively. § "Textual hand-off information" refers to printed, handwritten, or electronic hand-off information that can be used to reinforce and supplement verbally transmitted hand-off information.

ICU = intensive care unit; OB = obstetrics; OR = operating room; PACU = postanesthesia care unit.

Curriculum evaluators must also craft measurement methods and create instruments. Lipsett and Kern[77] recommend choosing an evaluation method that is congruent with the evaluation question and has optimal accuracy (reliability and validity), credibility, and importance. By "importance," they write that, "[g]enerally speaking patient/healthcare outcomes are considered most important, followed by behaviors/performance, skills, knowledge or attitudes, and satisfaction or perceptions, in that order. . . . However, it is more important for what is measured to be congruent with the program or learning objectives than to aspire to measure the 'highest' level in the outcome hierarchy."[77]

The challenges of evaluation design and measurement methods are apparent in the extant literature on hand-off curriculum educational interventions. For example, in Gordon and Findley's[78] systematic review of hand-off curriculum educational interventions, 9 of 10 studies used posttest only or pretest–posttest designs. These designs are most feasible in a busy residency program, but are the lowest on the hierarchy of methodological rigor.

Gordon and Findley[78] also analyzed measurement methods by grading the importance of the outcomes measured according to Kirkpatrick's hierarchy. Kirkpatrick describes four levels of educational outcomes: level 1—learners' reactions; level 2—acquisition of knowledge, skills, and attitudes; level 3—changes in behavior; and level 4—changes in organizational practice.** Most studies included in Gordon and Findley's review reported outcomes at level 2, one at level 3, and no study showed that hand-off education could improve patient outcomes.[78] The article that reported outcomes at level 3 of Kirkpatrick's hierarchy detailed the development of a curriculum to address both the individual- and system-level issues shown as needed at the institution by a formal preimplementation evaluation.[66] Some of the issues addressed included training and feedback regarding proper hand-off, demonstrating the importance of proper hand-off, implementation of an electronic hand-off system, and improvement in communication skills for both written and spoken hand-off. The results showed statistically significant changes in all seven measures of the completeness of spoken hand-off, three of four measures of accuracy of written hand-off, and the overall completeness of written hand-off.

Of studies conducted to evaluate hand-off curriculum effectiveness,[65–71,73,76,79–84] half have used surveys only as an

** Kirkpatrick Partners. Available at: http://www.kirkpatrickpartners.com. Accessed October 3, 2013.

outcome measure.[65,67,68,70,79–82] These surveys are useful for assessing levels 1 and 2 in Kirkpatrick's hierarchy, but provide no real assessment of behavior, organizational practice, or patient outcomes. Future directions of hand-off curriculum education evaluation must address the challenges of feasibility *versus* methodological rigor, and the challenges of determining the most effective measurement methods and outcomes.

Trainee Assessment

The ACGME now requires that residency programs assess the competency of trainees in hand-off communication.† Educational interventions associated with hand-off improvement incorporate ongoing formal feedback of resident handoffs.[85] Yet, the best way to assess resident hand-off communication skills remains unclear. Trainee assessment should be linked to educational goals and objectives (table 4). Assessment can be accomplished using written tests or scoring of performance (either subjective or objective) in actual clinical situations, role-play situations, or during simulation. Assessment may be performed by trained faculty or by senior residents who have already demonstrated hand-off competency.

In 2007, the ACGME convened an advisory committee to address the question of how to assess resident competencies.[86] The committee reviewed literature about curriculum assessment and developed guidelines to be used in evaluating the effectiveness of resident curricula. One of the products of the committee's work was the development of "Summary Rules for Evidence-based Grading of Assessment Methods,"[87] similar to the Grading of Recommendations Assessment, Development and Evaluation†† criteria for classifying the strength of medical evidence. In the Summary Rules, assessment methods are graded with class 1 (recommended), 2 (can be considered), or 3 (can be used provisionally), corresponding to decreasing strength of recommendation regarding the use of that assessment method. The ACGME committee evaluated eight resident assessment methods. No methods were graded as class 1; three methods were graded as class 2; and five methods were graded as class 3.[86]

An assessment method specific to anesthesia was introduced in 2003. The Anesthetists' Non-Technical Skills, or ANTS system, was designed to bring Crew Resource Management-type training to anesthesia education.[88] ANTS is based on assessment of behavioral markers, characterized as "observable, nontechnical behaviors." Specific behaviors are identified in each of four categories: (1) task management, (2) team working, (3) situation awareness, and (4) decision making. These behaviors can be used to identify a learner's competency with regard to a skill of interest. Although handoffs are not specifically addressed in the ANTS system, other investigators have used the principles from ANTS in studying handoffs.[11,89] In the ACGME's Summary Rules, ANTS was graded as class 3.[86] A newer, hand-off–specific assessment method has been developed and validated: the Handoff Clinical Evaluation Exercise (CEX).[90,91] The Handoff CEX is based on the mini-CEX developed by Norcini *et al.*[92] The Handoff CEX is an easily administered instrument that assesses both the hand-off "provider" and "recipient," which emphasizes the two-way communication that ideally occurs during handoffs. Hand-off participants are assessed by using a 9-point Likert scale in each of multiple domains. The domains are slightly different for givers and receivers, and include organization, communication skills, and setting. The instrument can be administered by peers or by uninvolved observers. In the ACGME's Summary Rules, the mini-CEX (the basis for the Handoff CEX) was graded as class 2.[86]

Regardless of the tool used, the ACGME suggests that learners be assessed with a validated and reliable tool to measure the learner's acquisition of knowledge, skills, attitudes, and changes in behavior.[86] The Handoff CEX is one such tool that has been validated in internal medicine and can be readily adapted for use in anesthesia education.

Discussion

Given the professional responsibility and hospital and residency accreditation requirements, it is imperative that anesthesiology residency programs develop and implement hand-off curricula, evaluate these curricula, and assess their residents' ability to conduct effective handoffs. Despite the lack of original research about how to teach anesthesia-relevant handoffs, it is possible to draw from the existing literature to develop goals and objectives (table 4) and to identify the domains (affective, cognitive, and psychomotor) that should be included in anesthesia resident hand-off instruction. Lectures alone are probably insufficient to teach hand-off skills. Achieving curricular objectives within these domains likely will require use of multiple modalities, including lectures, role-play or simulation, and direct observation with feedback. The assessment of residents' competency in handoffs may similarly employ multiple tactics including objective assessment using validated tools such as the Handoff-CEX[90] and subjective assessment using direct observation by faculty or peers, first in simulation and then actual clinical settings.

Although we do not discuss the steps needed to implement curriculum, attention should be given to institutional capabilities for the different content delivery approaches considered. For instance, lecture space and audiovisual projecting systems would be needed for didactic programming. For simulation, programs should consider whether to use low-fidelity[93] (inexpensive, with low or no resemblance to actual clinical situations) or high-fidelity[93] (more expensive, very similar to actual clinical situations) simulation scenarios. Irrespective of the content delivery mode, adequate nonclinical time should be provided for faculty to enable development of curricular goals, objectives, and content.

†† GRADE Working Group. Available at: http://www.gradeworkinggroup.org/index.htm. Accessed October 3, 2013.

Moving forward, there are at least three research priorities regarding anesthesia hand-off training. First, original research linking handoffs to clinical and patient-centered outcomes is needed to contextualize and prioritize hand-off training. For instance, if most anesthesia hand-off–related adverse events occur on transfer from the OR to the intensive care unit, the hand-off curriculum should prioritize these handoffs over the other types conducted by anesthesia practitioners.

Second, best practices with regard to anesthesia handoffs are yet to be defined, presenting a challenge for resident teaching. Although some general hand-off principles such as creation of a "shared mental model,"[94] may apply to anesthesia, others, such as the "sterile cockpit,"[95] may need to be altered to apply to actual practice. The increasing adoption of electronic medical records[96] (including anesthesia information management systems) offers opportunities to automate and standardize some components of the hand-off process. Although these information technology tools have the potential to streamline hand-off processes, they are unlikely to replace the need to teach practitioners about fundamental communication principles such as anticipatory guidance and the value of synchronous communication.[97] We believe that residents should have a deep understanding of the communication principles underlying the hand-off curriculum for at least three reasons: (1) electronic tools have not been universally adopted, (2) electronic tools may vary between institutions, and (3) electronic tools occasionally malfunction. Further research is needed to identify effective methods of conducting handoffs in contemporary anesthesia practice and to determine the extent to which electronic tools can facilitate the hand-off process.

Third, the effectiveness of hand-off curricula should be evaluated to determine whether they are able to achieve desired educational outcomes, specifically, the development of competency in conducting handoffs.

The ACGME hand-off curriculum requirement is emblematic of a shift in graduate medical education, which transforms the traditional six core competencies introduced in 1999 into specific, demonstrable, and measurable outcomes-based milestones. Specialty-specific milestones form one of the centerpieces of the ACGME's Next Accreditation System, which was phased in for seven specialties (emergency medicine, internal medicine, neurologic surgery, orthopedic surgery, pediatrics, diagnostic radiology, and urology) in July 2013.[98] The remaining 19 specialties, including anesthesiology, will implement the Next Accreditation System in July 2014. It is likely that anesthesia residency education leadership will need to reconsider the entirety of the anesthesia curriculum, reframing goals and objectives so that it addresses competencies, milestones, and entrustable professional activities.[99]

This review has defined the numerous handoffs that occur in anesthesia practice and outlined the development of curricular goals and objectives, content, delivery, and evaluation. Despite the incomplete evidence base about handoffs in anesthesia, lessons from other specialties can inform the way that handoffs are taught to anesthesia residents. The curriculum approach described in this review may offer guidance in teaching this vital communication skill to anesthesiologists in training.

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Competing Interests

The authors declare no competing interests.

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