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REVIEW ARTICLE

Current teaching methods for training surgical residents in the operating room: A narrative review

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Abstract

Structured surgical training is vital to ensure that the next generation of surgeons is equipped with the skills necessary to guarantee safe patient care, as well as the skills required to ensure effective ongoing professional development. Numerous instructional strategies and educational approaches, which are commonly used in the operating room, have recently been described in the literature. The aim of this review article is to highlight current teaching methods for training surgical residents in the operating theatre. A literature search on the current teaching methods for training surgical residents in the operating room was carried out using PubMed, Scopus, Google Scholar, ScienceDirect, and ERIC databases between the years 1990 and 2018, and selected articles were retrieved. This review demonstrates that most surgical training programs make use of a variety of teaching methods and models for training surgical residents in the operating room, including the apprenticeship model, the BID model, the Zwisch model, the one-minute preceptor, Koens et al.'s model, and Morbidity and Mortality Meetings. Effective use of these novel educational tools by surgical educators may serve to improve the quality and efficiency of intraoperative resident education.

Key Words: Teaching; Education; Operating Room

Introduction

The operating room (OR) has been acknowledged as a central venue for resident learning. The location of the OR as a learning environment is complex (1). Surgical residents underlie the pressures of dual, occasionally conflicting, roles. These roles include the need to provide high quality medical care during their everyday professional duties and constraints due to the need to personally grow as a professional, expanding their knowledge and skills through structured "curricular", and unstructured "on the job" learning. Surgeon educators must balance

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society's need for new doctors against demands to ensure that the highest level of patient care is delivered to each and every patient (2).

Evidence suggests that training in the OR is less purposeful and occurs infrequently (3), and although trainees are provided with ample opportunities to engage in practical experiences, learning may be limited by a lack of analytic reflection on these experiences because of inaccurate self-assessment (4).

The need for a more deliberate approach to OR teaching becomes an imperative as duty hour restrictions (5,6), a heightened sense of public accountability (7), and an emphasis on operating theatre efficiency (8) further challenges training. For the past decade, furthermore, changes in surgical residency have brought to light the need for innovative teaching methods in the operating room. Today's residents are seeing a greater variety of surgical procedures during their training—for example, operative volume for graduates increased 21 percent from 2005 to 2010 (9).

Structured surgical training is vital to ensure that the next generation of surgeons is equipped with the skills necessary to guarantee safe patient care, as well as the skills required to ensure effective ongoing professional development. Numerous instructional strategies and educational approaches, which are commonly used in the OR, have recently been described in the literature. Therefore, the key question identified for this review article was what the current teaching methods are for training surgical residents in the operating room. The aim of this review article is to highlight current teaching methods for training surgical residents in the operating theatre. Effective use of these novel educational tools by surgical educators may serve to improve the quality and efficiency of intraoperative resident education.

Methods

We conducted a literature review to explore the study aim. The literature search on the current teaching methods for training surgical residents in the OR was carried out using PubMed, Scopus, Google Scholar, ScienceDirect, and ERIC databases between the years 1990 and 2018 whereby the selected papers were retrieved. A literature search was performed using the keyword 'surgical residents' in conjunction with each of the following keywords: 'teaching methods', 'teaching models', 'education', 'operating theatre', 'clinical teaching', 'new models', 'learning', 'educational strategy', 'training', 'surgical skills' and 'operating room'. For example, the search strategy for PubMed database include: ("teaching"[MeSH Terms] OR "teaching"[All Fields] OR ("teaching"[All Fields] AND "methods"[All Fields]) OR "teaching methods"[All Fields]) AND ("education"[Subheading] OR "education"[All Fields] OR "training"[All Fields] OR "education"[MeSH Terms] OR "training"[All Fields]) AND ("surgical procedures, operative"[MeSH Terms] OR ("surgical"[All Fields] AND "procedures"[All Fields] AND "operative"[All Fields]) OR "operative surgical procedures"[All Fields] OR "surgical"[All Fields]) AND resident[All Fields] AND ("operating rooms"[MeSH Terms] OR ("operating"[All Fields] AND "rooms"[All Fields]) OR "operating rooms"[All Fields] OR ("operating"[All Fields] AND "room"[All Fields]) OR "operating room"[All Fields]). A manual search of the reference sections of relevant review articles was also performed to identify additional studies. All searches were limited to English language publications. Publications that related to search elements were retained. Unreferenced and unrelated articles were excluded. Studies were included regardless of the form of the study design.

Discussion

The surgical learning environment is complex. The presence of a patient, as an integral part of their OR teaching, places different responsibilities on surgeons as teachers when compared to the classroom, where the primary 'consumers' are the learners. This produces a tension between caring for the patient and the learner, which challenges and stresses surgical residents. In other words, OR has been designed to deliver patient care in a safe and effective manner. In contrast, the classroom is an environment designed for learning and teaching. The OR is designed with patient care in mind and with little consideration of the learner.

A variety of teaching methods and models for training surgical residents in OR, including the apprenticeship model, the BID model, the Zwisch model, the one-minute preceptor, Koens et al.s' model, and Morbidity and Mortality Meetings have recently been described in the literature. These teaching methods and models will be explored in the subsections below.

The Apprenticeship model

The method of teaching and learning surgery has been for centuries the apprentice model in which surgical residents follow specialist surgeons and learn and develop their skills with the "see-

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one, do–one" method. The residents' learning opportunities are extremely workplace- and situation-dependent. Each learning situation depends on each hospital's working culture and the responsible supervising senior's guidance and work assignments. For decades, this apprentice training model has become incorporated into each hospital's everyday routines. Now, the new skill requirements of video-assisted surgery have challenged this historical tradition of learning, and the master-apprentice model has proven insufficient for developing the required skills for several reasons (8,10).

The apprenticeship represents a core instructional paradigm where the novice is introduced to the realm of the expert, and by actively participating in this environment, s/he gradually becomes the expert himself (11).

Today, apprenticeship still represents a core aspect of surgical postgraduate education. The apprentice learns over a prolonged period by observing the "master." Following principles of graded responsibility, the apprentice is afforded opportunities to at first complete steps of a procedure under supervision and subsequently with growing experience goes on to complete entire procedures under supervision (12). The level of oversight deemed necessary by the supervising "master" is gradually reduced until the apprentice is considered competent for independent practice. This process requires a close bond between "master" and "apprentice" and requires extensive opportunities for the apprentice to observe procedures (12). One caveat mentioned by Schneider et al. (2007) though, was that apprenticeship models required significant faculty involvement. Also, evaluation of the individual's teaching skills and practice profile are necessary before a particular faculty member should be matched with an apprenticeship rotation (13).

THE BID MODEL

BID Model describes three phases of operative teaching: Briefing, Intra-operative Teaching, and Debriefing.

Briefing:

This phase occurs before the case and is typically a short (2- to 3-minute) interaction between learner and teacher. The purpose of the briefing phase is to "assess the needs of the learners, to cause the learner to assess her own learning needs, and to jointly establish learning objectives to guide both learner and teacher." While a learner may have several learning goals specific to that case, a universal goal is for the trainee to make progress towards safe independence. This goal can and should be explicitly discussed for every case.

Intra-Operative Teaching:

While doing a case, the focus of most of the didactic talk should be the learning objectives defined during the briefing phase. This ensures that the teaching is not simply a nonspecific flow of talk, but instead, discussion focused on mutually shared learning goals.

Debriefing:

Debriefing has been recognized as an important part of teaching surgery in the OR. After the operation is finished the teacher and the learner should discuss the case, ideally in reference to the goals set out during the briefing phase. This debriefing conversation should consist of four elements: reflection, rules, reinforcement, and correction (14).

Table 1 describes each of the elements of the BID model (briefing, intraoperative teaching, and debriefing).

Table 1: Briefing, Intraoperative Teaching, Debriefing Model

Stage	Step	Script
Briefing: 2 min	Set learning objectives for encounter.	"What would you like to focus on?" OR "Today I want you to focus on . . . ."
Intra-operative teaching; brief, focused interactions during the operation (1-5 min each)	Teaching during the encounter	Focused on stated objectives
Debriefing: 1-3 min	Stimulate reflection on part of the learner Teach general rules Reinforce what was right Correct mistakes	"How do you think you did? Why?" "What did you learn for next time?" "You did well at . . ." "Next time, do this . . ."

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The Zwisch model

The most important way to support progressive resident autonomy in the OR is to get the faculty and residents talking about it. The Zwisch model provides a language with which to have that conversation. Zwisch model is a conceptual model that presents a framework for teaching faculty how to safely grant more autonomy to residents. The model provides both faculty and residents a lexicon with which to discuss the expected role of the resident in an upcoming case. It also provides a structure that faculty can use to adjust their guidance behaviors during a case. And the same framework also provides residents with a roadmap for how they should be progressing during training. The goal of the Zwisch model is to provide both faculty and residents with specific stages of supervision allowing for adequate, safe training in a graduated manner to develop fully trained surgeons. This model has been refined over the past several years, and now consists of four stages of supervision named "Show & Tell," "Smart Help," "Dump Help," and "No Help." Each stage describes the amount of guidance provided by faculty to residents (15). (See Table 2).

A major benefit of the Zwisch model is the simplicity with which it can be implemented and used to train and assess residents in the OR. In fact, many attending surgeons may feel they already use this teaching modality. In particular, this tool can provide residents with a specific measurement of their expected level of competence for a specific operation. It allows assessments to be more concrete, thus pointing out residents' strengths and potential areas of improvement. It also can be used as a method of resident evaluation, as procedure-specific expectations for certain Zwisch stages can be established for each postgraduate year level (15-17).

Table 2: Zwisch model

Zwisch stage	Attending surgeon behaviors	Resident learner behaviors
Show and tell	• Performs key portions of procedure • Narrates the case ("thinks out loud") • Demonstrates key steps and anatomy	• Performs opening and closing of procedure • Acts as first assistant and observes procedure
Smart help	• Shifts roles between surgeon and first assistant • When first assisting, leads resident in surgeon role • Optimizes the field and exposure • Coaches on next steps of procedure	• Shifts roles between surgeon and first assistant • Demonstrates increasing ability to perform key steps of procedure with attending assistance • Is knowledgeable of all the component technical skills
Dumb help	• Follows lead of the resident • Coaches regarding refinement of technical skills	• Accomplishes the next step of the procedure with increasing efficiency • Recognizes critical transition point issues
No help	• Provides no unsolicited advice • Monitors progress • Ensures patient safety (as during all stages)	• Performs the procedure with an experienced first assistant • Safely completes the procedure without faculty • Recovers from most errors • Recognizes when to ask for help or advice

Adapted from: DaRosa DA, Zwischenberger JB, Meyerson SL, et al. A theory-based model for teaching and assessing residents in the operating room. J Surg Educ. 2013;70(1):24-30

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The one-minute preceptor

Neher et al. presented a five step model that utilizes simple, discrete teaching behaviors or "microskills". The skills that make up the model are (1) getting learner commitment, (2) probing for clinical reasoning, (3) teaching of general rules, (4) reinforcing good performance or providing positive feedback, and (5) correcting poor performance. The first two microskills (getting learner commitment and probing for clinical reasoning) diagnose learner knowledge and reasoning. The last three microskills (teaching of general rules, reinforcing good performance or providing positive feedback, and correcting poor performance) offer tailored instruction. The model can be used as a ready frame work for most clinical teaching encounters (18). The five microskills of the one-minute preceptor teaching model enable attending surgeons to effectively assess, instruct and provide feedback more efficiently. This model is used when the teacher knows something about a case that is being presented that the learner either needs or wants to know. The One-Minute Preceptor is a useful combination of proven teaching skills combined to produce a method that is very functional in the clinical setting. It provides the preceptor with a system to provide efficient and effective teaching to the learner around the single patient encounter.

Koens et al.s' model

Koens et al. (2005) developed a model for considering the role of context within medical education. They suggest that there are three dimensions to context: physical, semantic and commitment. Each of these dimensions spans a continuum from very reduced to enriched contexts (Table 3).

The physical dimension relates to the physical surroundings of the learner. For example, reading about the anatomy of the knee joint, alone in the library, will be at the reduced end. In contrast, learning within the OR as a surgeon operates on a knee, when the learner can see the anatomy, will be at the enhanced end. The semantic or cognitive dimension relates to the connection between the learner's knowledge and the learning task. For example, a simple task of learning facts, such as three causes of a low blood pressure, will be at the reduced end. In contrast, constructing a physiological explanation of why a real patient, in hospital, has a low blood pressure will be at the enhanced end. The commitment dimension relates those aspects of learning that determine the learner's motivation. For example, listening to medical news on the radio, such as the problems of miscarriages, will be at the reduced end. In contrast, the experience of the learner, who has to deal directly with a couple struggling with multiple miscarriages, will provide a commitment to learn at the enhanced end.

This model also relates to doctors learning to be teachers. In the physical dimension, reading in the library about how to teach in the clinical arena, will be at the reduced end. In contrast, a skilled teacher showing and guiding the learner to teach effectively at the bedside will have an enhanced context. In the cognitive dimension, the learner who learns a list of the key points about how adults learn would be at the reduced end. In contrast, the context is enhanced for the learner who delivers bedside teaching for a group of medical students based on the principles of adult education. Within the commitment dimension, reading about the importance of assessing trainees may have reduced contextual importance. However, when the learner has to assess others, whose careers may depend on their decisions, it is at the enhanced end (19).

Table 3: Dimensions of context model with examples from medial education (Koens et al., 2005)

Dimension	Reduced context	→→→→→→→→→→	Enhanced context
Physical	Learning in the Library	Learning in a skills Laboratory	Learning in the OR
Semantic/cognitive	Learning facts unrelated to clinical practice	Reading and understanding a basic science text	Constructing a physiological explanation of a clinical case
Commitment	Listening to medical news on the radio	Reading a text to report to peers	Learning with responsibility for patient care

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This model would benefit from an expansion of the physical dimension to include the location of the teaching. The enhanced end of each dimension could include a gradation into where the teaching interaction takes place such as; classroom, clinic, bedside or OR.

Morbidity and Mortality Meetings

Morbidity and mortality (M&M) meetings, also referred to as clinical review meetings, are a necessary component of contemporary surgical practice (20, 21). An M&M meeting is a regular conference held by medical services in hospitals which involves a peer review discussion of issues that occurred during the care of patients, resulting in a complication or death. The primary purpose of an M&M meeting is to allow learning from issues by modifying judgment and clinical decision making, to prevent the repetition of these events, and to improve patient care. M&M meetings consistently provide surgeons with a forum to confidently discuss medical complications and adverse events in a non-punitive environment, to improve patient safety (22-24).

There is compelling evidence that M&M meetings lead to meaningful improvement in patient safety. Antonacci et al (2009) reported a 40 per cent reduction in gross mortality over 3 years following the implementation of a mandatory M&M review process, combined with a surgeon 'report card' tool that allowed individual surgeons to reflect on their performance (25). Another study reported a significant reduction in anastomotic leak (5.7% vs 2.8%, P=0.05) following the implementation of a structured M&M review process (26).

In addition to patient safety, M&M meetings are valuable tools for surgical education. Surveys consistently report that surgical and medical staff view structured M&M meetings to be valuable educational tools (27-29).

Our study has some important strength. The review process was 'time-limited' and reflects the literature from 1990 until 2018. A manual search of the reference sections of relevant review articles was also performed to identify additional studies. Moreover, Studies were included regardless of the form of the study design. Despite these strengths, our study has two important limitations. First, all of the reviewed studies were found in the English language. As noted in other reviews (30), this may reflect a publication bias. Second, the quality of each article was not assessed. Thus, there was a need for future researches to remove these limitations.

Conclusions

The issue of teaching and learning in the OR is complex. Structured surgical training is vital to ensure that the next generation of surgeons is equipped with the skills necessary to guarantee safe patient care and the skills required to ensure effective ongoing professional development. This review demonstrates that there are a variety of different teaching methods and models for training surgical residents in the operating room, such as the apprenticeship model, the BID model, the Zwisch model, the one-minute preceptor, Koens et al.s' model and Morbidity and Mortality Meetings.

Conflict of Interest: None declared

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