



Resident training in a teaching hospital: How do attendings teach in the real operative environment?



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ABSTRACT

Background: The study aim was to explore the nature of intraoperative education and its interaction with the environment where surgical education occurs.

Methods: Video and audio recording captured teaching interactions between colorectal surgeons and general surgery residents during laparoscopic segmental colectomies. Cases and collected data were analyzed for teaching behaviors and workflow disruptions. Flow disruptions (FDs) are considered deviations from natural case progression.

Results: Across 10 cases (20.4 operative hours), attendings spent 11.2 hours (54.7%) teaching, using directing ($M = 250.1$), and confirming ($M = 236.1$) most. FDs occurred 410 times, accounting for 4.4 hours of case time (21.57%). Teaching occurred with FD events for 2.4 hours (22.2%), whereas 77.8% of teaching happened outside FD occurrence. Teaching methods shifted from active to passive during FD events to compensate for patient safety.

Conclusions: Understanding how FDs impact operative learning will inform faculty development in managing interruptions and improve its integration into resident education.

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1. Introduction

Traditionally, residents receive training on the job, learning in the operating room (OR) as attending surgeons (referred to as “attendings”) provide instruction. However, no formal curriculum exists for training attendings how to be instructors, and as a result, they provide intraoperative education idiosyncratically.^{1–3}

Intraoperative education effectiveness has been debated over the years, and there is a growing discussion and necessity to evaluate how surgeons are trained due to work-hour reforms, an increased acuity and throughput of patients, and emphasis on competency-based and outcomes-driven education.^{4–6} To make such advances, understanding the nature of operative teaching as it currently exists needs to be improved. Studies have previously

investigated intraoperative teaching,^{7–10} though current instructional practices of surgeons are still poorly understood.

Roberts et al⁷ examined 4 operations and grouped interactions into 4 categories based on intention of the surgeon and how much time was spent within each category. Blom et al⁸ analyzed type and content of communication during laparoscopic cholecystectomies; however, analysis was predominantly done during dissection. Others have focused on specific content and methods of instruction—examining how the Accreditation Council of Graduate Medical Education Core Competencies are taught in the OR and understanding the role of intraoperative “war stories” in trainee education—demonstrating how intraoperative teaching primarily centers around clinical management, specifically operative technique.^{9,10} Further developing this research area will help clarify the educational behaviors used in the OR.

The OR environment provides inherent challenges to effective education and training. Distractions and interruptions pose potential challenges that do not exist in more static educational

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environments.¹¹ Research suggests flow disruptions (FDs) occur 11 times per case during cardiac surgery¹² and upward of 61 times per case during trauma surgery.¹³ These events can deter from intraoperative education, as attendings must balance patient safety and resident educational needs. However, FDs may also provide unique opportunities for attendings to model nontechnical skills and enhance instruction in the OR.

The intersection of education in health care delivery with a work system approach has not been previously examined. This study aims to study the nature of intraoperative education as it currently exists, particularly as it relates to the environment in which the intraoperative education is occurring.

2. Methods

2.1. Setting and participants

The study was conducted at a 566-bed academic medical center located in the Midwest. Laparoscopic segmental colectomy cases were video and audio recorded for teaching interactions between 4 colorectal attendings and postgraduate year (PGY)-3 and PGY-5 general surgery residents (referred to as “residents”) on colorectal rotation. Residents were allowed to opt out of the study; however, no residents chose to do so during the study period. Attendings provided verbal consent before video capture of each case. Other health care providers present in the OR did not meet criteria for study subjects and were not consented. Permission to record patients was obtained as part of operative consent, but patient information was not included in analysis. The study was granted an education exemption and was approved by the University of Wisconsin Hospital and Clinics Institutional Review Board.

2.2. Case selection

The laparoscopic segmental colectomy was selected as the procedure for analysis. Cases included elective ileocecal, right colon, left colon, and sigmoid colon resections performed by colorectal attendings. Laparoscopic and single incision laparoscopic surgery cases were included, as were cases that converted to open surgery. Robotic cases were excluded, because resident involvement during the cases is limited.

2.3. Frameworks

The coding schema developed by Hauge et al¹⁴ was adopted a priori to classify and quantify the types of teaching behaviors in the OR. Minor modifications were made to the schema using consensus approach of the research team for purposes of clarification and to capture all observed teaching behaviors. As a teaching moment was identified, it was tagged, annotated, and categorized based on teaching type used by the attending. [Table 1](#) outlines the definitions used to categorize teaching behaviors.

Cases were also reviewed using a modified version of the Surgical FD Tool (SFDT).¹⁵ The SFDT is a previously validated tool for measuring workflow disruptions in the OR. It was adapted from initial use during cardiac surgery to laparoscopic general surgery cases to capture FD events that affected the attending and/or resident. As an FD was identified, it was tagged, annotated, and categorized based on disruption type and impact on the attending and resident. The FD types are defined in [Table 2](#).

2.4. Research protocol

Cases that fit inclusion criteria were audio and video recorded for later analysis. The recording system involved an in-light camera,

laparoscopic camera, and lapel microphone worn by the attending. A research team member setup the system before each case, then collected and transferred the files to a secure hard drive after the operation was complete. The video-recorded cases and subsequent data were analyzed using the Multimedia Video Task Analysis (University of Wisconsin-Madison) operating system.

Operation stages were coded and used as time anchors for analysis. The stages of operation were defined as (1) start of case: time of incision until laparoscopic camera inserted into abdomen; (2) laparoscopic surgery: surgical time spent in laparoscopy until lights are turned on for converting to open surgery portion of procedure; (3) opening: time when lights are turned on until start of anastomosis; (4) creation of the anastomosis: time when both ends of bowel are ready to be joined together until completion of anastomosis; and (5) closing: time of anastomosis completion until the skin is closed. Recorded segments where either attending or resident were not scrubbed-in were excluded from further analysis.

The research team was trained on coding schema and SFDT. One researcher with a surgery and education background (C.E.G.) coded all cases independently for teaching moments and FDs. A second researcher with an education background (A.B.Z.) independently coded random 10-minute segments of coded video for teaching moments to check for agreement. Two researchers with a background in human factors (K.E.L. and H.E.G.) each independently coded half of the cases for FDs. This method ensured case review for FDs by researchers in both engineering and surgical fields. The FD events were marked based on type and impact score (1 to 6), as summarized in [Table 2](#).

Questions or discrepancies were reviewed by the coders for consensus agreement. Remaining questions and items where agreement could not be reached between the coders were brought to the larger research group for review and consensus.

2.5. Analysis

Descriptive statistics were used to analyze teaching moments. Frequency counts of teaching behaviors and time spent using different teaching behaviors during the entire case and during each stage of the operation were computed.

Using data generated with SFDT, descriptive analyses were performed to describe the type and timing of FD events. The FD durations and impact scores during the entire case and for each stage were calculated. Teaching behaviors that occurred concurrently with FD events were examined in comparison with when no FDs occurred.

3. Results

Between January 2012 and February 2013, 44 scheduled elective laparoscopic segmental colon resection cases that met the inclusion criteria for the study were identified in the electronic OR schedule. Twenty cases contained complete video recordings suitable for review. A stratified sample of 10 recordings was selected for analysis to capture each procedure type and individual attending.

Ten cases captured 20.4 hours of total operative time, yielding 10,546 discrete teaching events and 410 discrete FDs. Four attendings were observed, with experience ranging from 6 to 29 years in practice. Three cases involved a PGY-3 resident, and 7 were performed with a PGY-5 resident. Six operations were right-sided resections, and 4 were left-sided.

3.1. Teaching

Overall, 11.2 hours (54.7%) of case time was spent teaching, as defined by the coding schema. Time not coded as teaching

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