

Teaching in the Operating Room: Results of a National Survey

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BACKGROUND: With the institution of the work-hour restrictions in 2003, less time may be available for surgical residents to learn operative technique and judgment. While numerous studies have evaluated the use of surgical simulation training to enhance operative skills, little is known about the quality of teaching that takes place in the operating room (OR). The purpose of this study was to assess residents' perception of faculty teaching in the OR in order to target ways to improve operative education.

METHODS: A request for resident participation in an online survey was sent to the Program Coordinator at all 255 ACGME-accredited general surgery residency programs.

RESULTS: A total of 148 programs (59%) participated in the survey, and anonymous responses were submitted by 998 of 4926 residents (20%). Most residents reported that attending surgeons verbalize their operative approach (55%), include residents in intraoperative decisions (61%), and offer technical advice (84%). However, few residents reported that faculty help to identify the resident's personal educational operative goals preoperatively (18%) or discuss areas of improvement with residents (37%). Of all cases scrubbed in the past year, most residents feel as though they only actually performed the procedure between 26% and 50% (29%) or between 51% and 75% (32%) of the time. However, more than half of all residents (51%) log these procedures for ACGME as primary surgeon 76%–100% of the time.

CONCLUSIONS: This study demonstrates that from the residents' perspective, a number of opportunities exist to improve teaching in the OR, such as guiding residents with preoperative preparation and providing them with constructive feedback. These findings also suggest that residents may be logging cases without feeling as though they actually perform the operations. (*J Surg* 69:643-649. © 2012 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

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COMPETENCIES: Patient Care, Interpersonal and Communication Skills, Practice Based Learning and Improvement

BACKGROUND

With the initiation of the ACGME work-hour restrictions in 2003, less time may be available for surgical residents to learn operative technique and judgment. Surgical residency programs face additional constraints on time and resident autonomy in the OR, including concerns about patient safety, medical-legal responsibilities, and pressures to reduce OR cost and improve efficiency. Resident operative volume may also be affected by an increase in the number of clinical fellowships as well as by new operative technology, such as robotics, which allows attending surgeons to operate more independently.

The current model of learning how to operate is based on a "discovery learning" model focused on practice, accumulation of experience and volume over time, and self-directed learning.¹ However, educational gaps may exist within this model, as residents may miss opportunities to focus on specific, critical educational objectives or to receive feedback during or after an operation.¹ A prior study by Scallon and colleagues demonstrated that teaching of clinical, patient-related material in the OR occurred in less than 50% of cases observed and that there were times during procedures in which no useful surgeon–resident educational interaction occurred at all.² There also seems to be a disconnect between the perceived learning needs of the resident and the attending surgeons, with residents more focused on procedural learning and faculty more focused on pathology and anatomy, according to one recent study.³ Further, faculty and resident perceptions of the type, frequency, and quality of teaching that occurs in the operating room differ significantly.⁴⁻⁶

Educational time in the operating room is limited. Several studies have estimated that residents spend only between 6% and 14% of their total residency hours in the operating room.^{7,8} The impact of work-hour restrictions on case volume is controversial. Two recent studies, including one using national

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ACGME resident case logs, demonstrated a decline in the number of resident cases after the work-hour limitations.^{9,10} However, a recent review found that most of the other literature to date suggests that the work-hour restrictions have had a neutral effect on case volume.¹¹ The lasting effects of the 80-hour work week are not yet known.

In order to teach general surgery residents operative technique as well as judgment in the era of the 80-hour work week, it will be critical that time spent in the OR is used intentionally and efficiently. With this study, we sought to evaluate residents' perceptions of teaching in the OR by asking residents if a set of specific educational interactions occur between the residents and faculty in the OR. Then, with these results, we hoped to identify opportunities to improve operative teaching within the existing time constraints facing both residents and attending surgeons.

METHODS

A survey was developed with the goal of assessing whether a number of different teaching interactions occur in the operating room between faculty and residents. A comprehensive literature review of surgical teaching techniques and models was performed to facilitate survey design. Although there are no previously validated survey tools of this type in the literature, several studies or models of effective teaching strategies have been published, and these were used to inform survey development.^{1,3,4,6,12-16} Survey questions were then reviewed by surgical faculty educators and residents at the authors' institution for content validity and clarity and subsequently revised by the authors. The survey was created using an online survey tool and consisted of 32 questions, including multiple choice, 5-point Likert scale, and demographic questions.

An electronic request for participation in the survey was sent to the Program Coordinator and Program Director at all 255 ACGME-approved general surgery residency programs listed on the Association of Program Directors in Surgery (APDS) web site in April 2010. Three programs identified themselves as closed at the time of the survey, leaving 252 programs potentially available to participate. Program coordinators at participating institutions then forwarded an e-mail with a link to the online survey to all residents at their program. This e-mail also included instructions that briefly outlined the purpose of the survey and clearly explained that participation was completely voluntary and anonymous. Data were collected electronically from May to September 2010. Pearson χ^2 test was performed to test for statistical significance by program type, and year of training. All analysis was conducted using R ver. 2.11.1 (2010-05-31).

RESULTS

One hundred forty-eight programs (59%) agreed to participate in the study. Of those participating programs, a total of 998

responses were collected. The response rate for the survey was 20% ($n = 998/4926$). The response rate was calculated based on information provided by each Program Coordinator regarding the total number of residents to whom the survey was distributed. Participants were allowed to opt out of any question at their discretion.

The majority (70%) of study participants were residents at an academic general surgery program, 28% at a community program, and 2% at a military program. Most residents completing the survey were categorical general surgery residents (85%), with a small proportion of designated (5%) and nondesignated (7%) preliminary residents. Men made up 61% of respondents. Responses were collected from residents at all PGY years, with a higher proportion comprised of junior residents (PGY 1, 25%, PGY 2, 23%, PGY 3, 20%). Demographic information is detailed in Table 1.

When asked to select the 3 clinical services on which they received the best technical training, residents most commonly selected general surgery (64%), vascular surgery (45%), and pediatric surgery (28%) rotations. Residents reported that they received the best technical training at a university hospital setting (36%), followed by a private hospital (33%), a county/public hospital (21%), and a VA Hospital (10%). However, we acknowledge that not every resident may have access to each of these training facilities to compare their effectiveness.

Residents were asked whether a number of specific teaching interactions occurred between faculty and residents surrounding the OR. These survey data are presented in detail in Table 2. Many residents agreed or strongly agreed that attending surgeons review a patient's indications for a procedure (52%) and review a patient's films and studies (48%) with a resident before a case. Residents also report that faculty assess their level of

TABLE 1. Demographics

	Percentage (%)	Number (N)
Program type		931
Academic	70%	653
Community	28%	264
Military	2%	14
Type resident		928
Categorical	85%	791
Designated preliminary	5%	48
Nondesignated preliminary	7%	67
Gender		923
Male	61%	562
Female	39%	361
Clinical postgraduate year		930
PGY 1	25%	233
PGY 2	23%	212
PGY 3	20%	186
PGY 4	16%	146
PGY 5	12%	109
PGY 6	2%	21
PGY 7	2%	19
PGY 8+	< 1%	4

TABLE 2. Survey Results

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Review a patient's indications for a procedure before the case	5%	23%	20%	46%	6%
Review a patient's films and studies before the case	4%	25%	23%	42%	6%
Recommend specific educational materials or guides to help prepare for a case	23%	62%	0%	13%	2%
Assess resident's level of experience with an operation before the case	3%	19%	22%	47%	10%
Discuss operative planning, such as order of operative maneuvers or possible pitfalls before the case	9%	31%	26%	31%	4%
Identify resident's personal educational goals specific to level of training before a procedure	14%	45%	23%	16%	2%
"Think out loud" and verbalize operative approach	5%	18%	22%	47%	8%
Include residents in making level-appropriate intraoperative decisions	3%	15%	21%	53%	8%
Offer constructive technical tips during procedures	1%	4%	10%	62%	22%
"Take over the case" after a mistake occurs	1%	22%	30%	35%	11%
Reinforce the educational points of the case after completion	9%	31%	26%	32%	2%
Provide positive feedback after a case	5%	18%	36%	38%	3%
Discuss areas for improvement or future learning objectives after a case	6%	25%	31%	34%	3%

experience with a particular procedure before the onset of the operation (57%). Most residents agreed that attending surgeons "think out loud" and verbalize their operative approach (55%), include the resident in level appropriate intraoperative decisions (61%), and offer constructive technical tips during procedures (84%).

However, few residents reported that faculty recommend specific educational materials or guides (i.e., atlas, journal articles) to help a resident prepare for a case (15%) or help identify a resident's personal educational operative goals preoperatively (18%). Only 35% of residents reported that faculty discuss operative planning (i.e., the order of maneuvers and possible pitfalls), and 46% of residents agreed that attending surgeons "take over a case" after a mistake occurs. Regarding postoperative feedback, few residents reported that attending surgeons reinforce the educational points of a case with them (34%), give a resident positive feedback (41%), or discuss areas for improvement with a resident (37%) at the completion of an operation.

Results were then compared by type of program: academic or community. Responses from military programs were excluded from this particular analysis given the small number ($N=14$). A trend towards better teaching was reported by residents who attended a community program compared with residents at an academic program (Table 3). For example, residents at a community program were more likely to agree or strongly agree that attending surgeons "help a resident identify their personal goals prior to a procedure" (26 vs 14%, $p < 0.001$), "verbalize their

operative approach" (67% vs 49%, $p < 0.001$), or "discuss areas for improvement after a case" (49% vs 33%, $p < 0.001$).

Residents rated attending surgeons <5 years, 6-10 years, or >10 years out of training similarly in regards to their teaching ability in the OR (19%–31% excellent, 43%–56% good, 20%–21% adequate, and 4%–6% poor). Only 12% of residents felt that attending surgeons with whom they have worked are "intimidating" in the operating room. When asked how their educational experience was affected by an intimidating attending, many felt that their experience was diminished either "a lot" (30%) or "somewhat" (36%). Just 12% of residents felt that their experience was improved.

Only 5% of residents reported that their program offered live video taping with opportunity for subsequent review or critique as an educational tool. Of those, 40% found it to be extremely or very helpful, and 54% found it to be somewhat helpful. Of the residents whose programs do not currently offer video review, 32% expected that it would be extremely or very helpful and 48% somewhat helpful.

Finally, we asked residents to reflect on the total number of cases in which they had scrubbed over the past clinical year, and to estimate in what proportion of those cases they felt as though they had performed the procedure or operation. The purpose of this component of the survey was to measure residents' perception of autonomy and independence in the operating room and to compare this to how they report cases to the ACGME. Most residents reported that they felt as though they only actu-

TABLE 3. Survey Results by Program Type*

	Academic Program	Community Program	p Value
Review a patient's indications for a procedure before the case			0.002
Agree	43%	52%	
Strongly agree	5%	9%	
Review a patient's films and studies before the case			0.130
Agree	40%	45%	
Strongly agree	5%	8%	
Recommend specific educational materials or guides to help prepare for a case			0.001
Agree	11%	20%	
Strongly agree	1%	3%	
Assess resident's level of experience with an operation before the case			0.002
Agree	46%	51%	
Strongly agree	8%	15%	
Discuss operative planning, such as order of operative maneuvers or possible pitfalls before the case			<0.001
Agree	27%	39%	
Strongly agree	3%	5%	
Identify resident's personal educational goals specific to level of training before a procedure			<0.001
Agree	13%	23%	
Strongly agree	1%	3%	
"Think out loud" and verbalize operative approach			<0.001
Agree	42%	56%	
Strongly agree	7%	11%	
Include residents in making level appropriate intraoperative decisions			<0.001
Agree	50%	58%	
Strongly agree	7%	12%	
Offer constructive technical tips during procedures			0.083
Agree	61%	64%	
Strongly agree	21%	25%	
"Take over the case" after a mistake occurs			0.193
Agree	37%	31%	
Strongly agree	10%	15%	
Reinforce the educational points of the case after completion			0.002
Agree	29%	41%	
Strongly agree	2%	3%	
Provide positive feedback after a case			<0.001
Agree	33%	50%	
Strongly agree	2%	4%	
Discuss areas for improvement or future learning objectives after a case			<0.001
Agree	30%	44%	
Strongly agree	3%	5%	

*Data has been simplified in the table to show only the "Agree" and "Strongly agree" responses. Statistical analysis was performed using all responses ("Agree," "Strongly agree," "Neutral," "Disagree," and "Strongly disagree").

ally performed the procedure between 26% and 50% (29%) or between 51% and 75% (32%) of the time. However, more than half of all residents (51%) log these procedures for ACGME as primary surgeon 76%–100% of the time. This is illustrated in Table 4.

We performed a separate analysis by PGY year and found that a greater proportion of senior residents reported that they felt as though they were performing procedures or operations more often than junior residents ($p < 0.001$). As expected, a greater proportion of senior residents reported logging proce-

dures as primary surgeon more often compared with junior residents ($p < 0.001$). Despite PGY year, however, residents more often logged a case as "primary surgeon" than they necessarily felt they "performed the procedure" (Table 4).

CONCLUSIONS

With this study, we sought to evaluate the extent to which teaching behaviors occur in the operating room and to identify specific methods to improve the quality of the educational in-

TABLE 4. Percentage of Cases Performed and Logged as Primary Surgeon by PGY Year

	Few (0%–25%)	Some (26%–50%)	Many (51%–75%)	Most (76%–100%)
All (n = 938)				
performed procedure	20%	29%	32%	19%
logged as primary surgeon	10%	11%	28%	51%
PGY 1 (n = 233)				
performed procedure	47%	38%	13%	1%
logged as primary surgeon	32%	26%	24%	18%
PGY 2 (n = 212)				
performed procedure	19%	38%	33%	10%
logged as primary surgeon	5%	13%	41%	40%
PGY 3 (n = 186)				
performed procedure	8%	30%	47%	16%
logged as primary surgeon	3%	4%	36%	57%
PGY 4 (n = 146)				
performed procedure	5%	19%	42%	34%
logged as primary surgeon	0%	2%	23%	74%
PGY 5 (n = 109)				
performed procedure	5%	13%	38%	45%
logged as primary surgeon	2%	1%	15%	83%
PGY 6 (n = 21)				
performed procedure	10%	19%	29%	43%
logged as primary surgeon	5%	5%	0%	90%
PGY 7 (n = 19)				
performed procedure	16%	11%	21%	53%
logged as primary surgeon	0%	0%	0%	100%
PGY 8 + (N = 4)				
performed procedure	25%	0%	25%	50%
logged as primary surgeon	0%	0%	0%	100%

teraction between residents and attending surgeons in the OR. Our results suggest that there appears to be a lack of guidance or discussion about residents' preoperative preparation. Further, residents do not appear to be receiving feedback about their performance. Interestingly, residents at community programs were more likely to agree that positive teaching behaviors took place in the OR compared with residents at academic programs. This may indicate that more intentional teaching takes place in the OR at community programs or may suggest a "halo effect," meaning that residents at community programs are more satisfied in general with their operative training. One hypothesis might be that because these programs tend to be smaller, the attending faculty and residents may develop more established relationships, leading to more investment in resident teaching.

The goal of surgical residency programs should be to train residents to become safe, competent surgeons who can perform an operation well, providing good outcomes for patients, and minimizing complications.⁷ This involves teaching residents both the cognitive and technical skills to care for surgical patients. The technical motor skills (dissecting, suturing, knot tying) required to perform an operation differ significantly from "operative competence" or the ability to perform an operative procedure in its entirety (from patient positioning to closure).¹⁴ While skills laboratories and simulation training can teach residents to master the motor skills necessary to perform the individual components of an operation, residents may learn tissue handling, anatomy, pathology, and the orchestration of

an entire procedure better in the operating room. Early and more meaningful participation in the operating room is critical to learn operative competence.¹⁴

Graduated levels of resident autonomy are a crucial component of this education. In 2005, Ko and colleagues performed a survey of clinical fourth and fifth-year surgery residents in academic general surgery programs and found that residents consider resident autonomy or "being the operating surgeon" as a positive teaching behavior and being "overly supervised" in the OR as negative.¹⁶ In that study, 40% of residents sometimes felt overly supervised and another 21% often or always felt overly supervised.¹⁶ Almost half of the residents participating in our study reported that attending surgeons "take over a case" after a mistake occurs. Safe patient care is the utmost priority; however attempts should be made to allow residents to correct their own mistakes, attempt a challenging maneuver, or make difficult intraoperative decisions in order for residents to gain the maturity and experience to ultimately handle those situations independently.

In the survey, we attempted to capture resident perception of autonomy and independence by asking residents how often they feel like they actually perform a given procedure. We then wanted to compare this with how often residents log cases as primary surgeon for the ACGME to understand whether ACGME case logs accurately reflect resident participation and experience. According to our survey results, residents log cases as "primary surgeon" more often than they report feeling like

they actually performed the given procedure. More senior residents reported that they both performed procedures and logged cases as primary surgeon than junior residents, although a significant discrepancy still exists between the 2 numbers, even for senior residents. The ACGME has established that residents must complete a minimum number of total cases as well as a required number of cases in a variety of categories. Obviously, the data from our survey are subjective, depending on the resident's perception of his or her own participation in an operation. However, a concerning issue that we discerned is that residents may be logging cases for credit that they do not feel as though they performed, which suggests that ACGME operative logs may not be an accurate way to measure resident competence.

There seems to be a trend toward the trainee not feeling comfortable with his or her final accumulated skill set at the end of training. As many as 27% of graduating residents report worrying that they will not feel comfortable performing procedures independently after they graduate.¹⁷ The percentage of general surgery residency graduates who are pursuing fellowship training has increased significantly from 67% in 1993 to 77% in 2005.¹⁸ Although many factors likely contribute to this trend, residents may pursue additional clinical training, particularly in fields like minimally invasive surgery, to attain a level of technical mastery that could not be achieved within the 5-year general surgery residency.¹⁹ Additionally, as more academic institutions add clinical fellowships, operative volume traditionally captured by residents is diverted to fellows, and resident case volume may be diluted.²⁰ Not surprisingly, academic programs, programs in the Northeast United States, and programs with more chief residents all report lower numbers of cases.²⁰

A number of educational strategies have been proposed to maximize teaching opportunities in the operative setting. The Briefing, Intraoperative Teaching, Debriefing (BID) model described by Roberts and colleagues proposes that faculty discuss learning objectives with the learner before the case, provide didactic communication focused on the preset objectives during the case, and debrief with the resident after the operation.¹ The goal is to shift operative instruction from pure discovery learning towards guided discovery learning, and to do so efficiently by using time at the scrub sink and while closing to perform the briefing and debriefing.¹ Given that residents and faculty do not always share the same educational goals, a pre-operative briefing could better align the focus of both the resident and faculty.^{3,21} In this study, residents agree that faculty assess the resident's previous experience before the case, but few report that attending surgeons review the resident's personal operative goals beforehand or provide constructive feedback after the case. These teaching opportunities could be easily incorporated into the pre- and postop settings as suggested by the BID model.

Additionally, educating faculty about effective teaching techniques and providing them with clear, direct guidance about how to utilize time in the OR to teach efficiently is vital. This

might include several didactic lectures about teaching technique or an annual faculty teaching workshop. Each program might create a consistent way to provide each attending with accurate and meaningful feedback about his/her teaching techniques, especially because faculty self-evaluations may not be accurate. According to a study by Claridge and colleagues, faculty self-perceptions differed significantly from resident evaluations; none of the faculty rated as below the mean by residents identified this in their self-evaluations.⁴ In addition to using resident evaluations, other possibilities might include observation by the program director or periodic video-taped evaluation and review.

To encourage faculty members to prioritize teaching, external incentives are needed as well. At Northwestern University, faculty members must achieve a certain score on their resident evaluations to qualify to receive the annual Outstanding Teaching Award.¹⁵ Teaching performance is used at many institutions as part of a faculty member's evaluation for promotion or for a tenure-track position. However, one study demonstrated that while this resulted in an improvement in teaching performance, the effect was transient once promotion was granted.⁵ Faculty could also be rewarded for good teaching with a salary bonus. Others have recommended that faculty with poor scores should be restricted from having residents assist them with cases or with patient care.^{7,15} Finally, faculty should not bear all the educational burden. Residents must assume responsibility for their own preparation and be active, rather than passive, learners, in order to maximize their learning in the OR.

Although this study involves data from nearly 1000 general surgery residents from a variety of residency programs, including academic, community, and military institutions, there are several limitations. In using survey data with a 20% response rate, there is always the possibility of non-responder bias, as not all subjects invited to participate choose to do so. Given the diversity of our respondents by geographic location and training environment, we hope to have minimized the effects of such bias. Finally, we solicited feedback about teaching experiences from residents but not from faculty, so we can only present our findings in the context of the residents' perspective. It is certainly possible that residents do not recognize all teaching interactions that take place. In one study, residents reported that they received feedback much less often than faculty reported giving it, suggesting that perhaps residents do not always "hear" feedback, particularly when that feedback includes constructive criticism.²²

In summary, this study identifies a number of positive teaching behaviors that are commonly employed by faculty surgeons. Additionally, several opportunities to improve operative education from the resident perspective have been identified. Most of these teaching interactions could be easily integrated into the brief time spent scrubbing in at the sink or closing an incision without creating an additional burden on an attending surgeon's time. Further, our survey findings also indicate that residents may be logging cases as primary surgeon without feeling as though they really performed the operations, suggesting that

residents may not experience the level appropriate autonomy that is critical to becoming proficient in the operating room. Ideally, by improving operative teaching interactions, residents could be awarded gradually increasing autonomy in the OR under careful supervision of a faculty surgeon. In the current teaching model, however, the ACGME might consider increasing the general surgery requirements for operative volume to provide a more accurate assessment of residents' operative experience.

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