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Operating room preparation by general surgery residents: A qualitative analysis

Jenaya L. Goldwag^{a,*}, Sarah Jung^b

^a Department of Surgery, Dartmouth-Hitchcock Medical Center, 1 Medical Center Drive, Lebanon, NH, 03756, USA

^b Department of Surgery, University of Wisconsin-Madison, 600 Highland Ave, Madison, WI, 53792, USA



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ABSTRACT

Background: Surgical education is changing, with residents having less time to learn more procedures. We aim to explore how residents prepare for the operating room and what factors impact their preparation.

Methods: A qualitative study was conducted using conventional content analysis. General surgery residents at one institution were invited to participate in semi-structured interviews. Each interview was recorded, transcribed verbatim, and then inductively examined to generate themes.

Results: Fourteen residents elected to participate. Six themes were identified: (1) All participants similarly defined preparation, (2) Residents learned through trial and error and co-residents, (3) Factors impacting preparation were time, attendings, autonomy, case complexity, and difficulty finding resources, (4) Resource use varied, (5) PGY level impacted preparation and, (6) Optimal resources were high yield.

Conclusion: Although surgical residents similarly defined operating room preparation, they use a variety of different resources to achieve this, which is often difficult and time consuming.

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Introduction

Historically, residents have learned the art of surgery through an apprenticeship model. Trainees had a primary surgical mentor who was responsible for teaching them surgery and vouching for their readiness to practice.¹ However as surgical learning has shifted away from this model, there haven't been any clear consensus on the best way to teach surgical learners. Currently, there are concerns that surgical trainees are not as prepared to practice independently after completing the traditional five-year general surgery residency.² The American College of Surgeons Committee on Residency Training Survey showed that 57% of program directors had patient quality of care concerns about their residents moving on to independent practice.² Residents themselves also have significant concerns with almost 30% of categorical residents in 2009 worried about their ability to perform procedures independently.³ This perceived decline in resident ability can be attributed to a variety of factors such as duty hour restrictions, increased attending supervision, and policy changes.^{1,4} Although

these changes are meant to be beneficial for patient safety and quality of care, residency programs must adapt in order to fill in the gaps caused by the diminished operative experience and resident autonomy.

With these changes in the surgical training environment, educators have turned to other resources, such as modules and simulation, to supplement operating room time.^{1,5,6} All of these resources also take extra time to find and use, either outside of the daily clinical work or after hours.⁷ That leaves residents and residency programs with the challenge of finding and providing useful resources to maximize learning both inside and outside of the operating room.

In this study we investigated how residents report preparing for the operating room and what factors impact that preparation. Specifically, we wanted to understand not only what resources residents use to prepare, but also how and why they choose those resources. By defining how residents prepare, we can understand more about what challenges affect operating room preparedness and what facets of this preparation can be modified to increase resident readiness for supervised clinical practice in the operating room.

* Corresponding author.

E-mail address: jenaya.l.goldwag@hitchcock.org (J.L. Goldwag).

Materials and methods

Prior to investigation this study was approved by the Institutional Review Board at Dartmouth Hitchcock Medical Center (IRB #:00031247).

This qualitative study used conventional content analysis to identify themes on operating room preparation using semi-structured interviews with general surgery residents at one institution.⁸

The choice to pursuing semi-structured interviews and the development of an interview guide was guided by the framework developed by Kallio and colleagues.⁹ The interviews were semi-structured, meaning that an interview guide was used to direct open-ended questions. Thus, the interview questions were not asked exactly the same each time and the order of questions varied. This technique allows the conversations to be more fluid and potentially unidentified themes to develop naturally while still keeping the interviews similar enough to be compared. The preliminary interview guide was developed in conjunction with previously obtained themes identified in prior work where focus groups were conducted with residents on the topic of operating room preparation.¹⁰ Once developed, the interview guide was pilot tested with a volunteer vascular surgery resident and further improved. The interview guide was then modified on a rolling basis during the interviews in order to better identify developing themes (Appendix 1). The consolidated criteria for reporting qualitative research (COREQ) checklist was used to ensure comprehensive study design and reporting in this manuscript (Appendix 2).¹¹

All general surgery residents of all PGY levels were invited to participate in the interviews via email. Junior residents were defined as PGY 1–2 and senior residents defined as PGY 3–5. Research residents were categorized by their completed level of clinical training. In total, 29 general surgery residents were contacted and 14 (48%) elected to participate in the interviews. There were no participants who dropped out of the study. There were 3 (21%) female residents and 11 (79%) male residents. There were 4 PGY-1, 3 PGY-2, 2 PGY-3, 1 PGY-4, 2 PGY-5, and 2 research residents (one completed PGY-2, another PGY-3).

All the interviews were held in person at the hospital in fall of 2018. The first author, JLG, a female surgery resident on her year-long research rotation, was responsible for conducting all of the interviews with participants. Field notes were taken after each interview concluded. The interviews ranged from approximately 10 to 25 min (mean: 17 min) and were uninterrupted. All interviews were audio recorded and transcribed by Trint (<https://trint.com/>) and then reviewed for accuracy with the audio recording and modified if necessary. The anonymous transcripts were then uploaded into Word (Microsoft Standard Office 2013). Transcripts were open coded by JLG while data collection was occurring. These initial codes were ultimately developed into themes which were confirmed and supported by data that reflected these same themes in subsequent transcripts. Participants were not asked to review their own transcripts. There were no incomplete or repeat interviews performed. The 14 interviews allowed for the achievement of thematic sufficiency.

The transcripts were then imported into one Excel (Microsoft Standard Office 2013) document for data management and ease of coding. A codebook was developed by JLG after multiple rounds of open coding transcripts. This codebook was then used to recode transcripts by both authors JLG and SJ, a female surgical education researcher with a background in educational psychology. These independently coded transcripts were then compared between authors to check for agreement. Any disagreements were settled via discussion.

Results

There were 6 key themes that were developed: 1. definition of operating room preparation topics, 2. how residents learned to prepare, 3. factors that affect preparation, 4. resource specific use, 5. differences in preparation by PGY level, and 6. optimal resource description. Within these six key themes, a total of 22 subthemes were identified (Table 1).

Definition of operating room preparation (topics)

All participants similarly defined six topics they should know and prepare for prior to participating in an operation: 1, the patient and their specific history, 2, the pathophysiology of the surgical disease, 3, the indication for the procedure, 4, the surgical anatomy for the procedure, 5, the procedural steps, and 6, the possible complications. Most residents felt that these topics were necessary to understanding the operation and appropriately care for the patient afterwards.

Learned preparation

Residents stated that they started learning how to prepare as medical students. Although, no resident mentioned a specific curriculum in their training designed to teach them how to prepare for the operating room.

“I think a couple of people, when I was a med student, were just like this is a really good resource for looking anatomy or looking up techniques and other stuff like that, but it was mostly by myself trying to learn.” –Participant 5

In total, 9 residents (64%) specifically stated that they learned through “trial and error”. Most residents stated that they were self-taught, although some mentioned asking other residents for resources or other advice before specific cases.

“I think both trial and error. And if I was lucky the more senior member of my team directed me as to the expectations. But it

Table 1
Themes and subthemes.

Definition of operating room preparation (topics)
<ul style="list-style-type: none"> • Patient history • Pathophysiology • Surgical indications • Surgical anatomy • Procedural steps • Complications
How residents learned to prepare
<ul style="list-style-type: none"> • Expectations set in medical school • Trial and error • Advice from co-residents • Preparation changes over time
Factors that affect preparation
<ul style="list-style-type: none"> • Time available/work-life balance • Attending presiding over the case • Level of predicted autonomy in the case • Case complexity • Difficulty finding resources
Resource specific use
<ul style="list-style-type: none"> • Resources used per defined preparation topic • Simulation helpful for skills not specific procedures • Didactics not helpful for OR preparation
Differences in preparation by PGY level
<ul style="list-style-type: none"> • Resource utilization (review books vs current literature) • Teaching medical students or junior residents
Optimal resource description
<ul style="list-style-type: none"> • High-yield (concise, available, comprehensive, clear) • Inexpensive

was mostly trial and error, like guessing what I should know. Going to the operating room and learning if that was adequate, or not, the hard way.” -Participant 4

Residents also spoke about how their preparation has changed over time. They stated that the topics they focus on shift as they have progressed through training and have more experience.

“... how I’ve done things has just changed so much over time. As I’ve like gotten better and have a better sense for like the basics, and now I’m like trying to get the details. That’s the main reason my resources have changed.” -Participant 12

Factors that affect preparation

All 14 residents mentioned that available time impacted their operating-room preparation. All residents were asked how long it took them to prepare for a case with answers ranging from 30 minutes to over 6 hours depending on case complexity and personal preference. Time limitations came up in various ways such as how to find time to prepare after long shifts, prioritizing which case to prepare for if time is limited, and balancing personal and home life with work.

“I have to like front load my preparation days beforehand, as opposed to like the night before or when I might have better recall. And so ... it’s really about time management at that point ... And then also just having other work to do. Work for didactics or like eating dinner, sleeping ...” -Participant 12

Nearly all of the residents, 13 (93%) stated that the specific attending in charge of the case would alter their preparation. Many residents specifically stated that attending “nuances” or “quirks” were important to know prior to starting a case. More junior residents also mentioned “pimping” and how the fear of not knowing the answer would motivate them to prepare.

“That [attending op notes] is helpful though in terms of what specific attendings nuances because when you read through that you’re like, oh yeah this person likes to use this trocar or like whatever. Details that are not specific to the operation, but like specific [to the] person you were assisting.” -Participant 14

In addition, residents stated they prepared according to how much autonomy they predicted they would have in a given operating-room case. Specifically the attending in charge of the case, complexity of the case, and PGY level were often mentioned as reasons autonomy during a given case might be different.

“... look at kinda like how hard it’s going to be and how much of a case I’ll get to do.” -Participant 5

Several residents also discussed the desire to go over the specifics with an attending prior to the operating room. However participants that desired this often found that it was difficult to achieve due to scheduling and time constraints.

“... the attendings would say ... come talk to us before the day before the case so we can talk about what type of positioning we want and the types of things that are our approach. And I, and I think it’s great. But I don’t think it’s very feasible for an intern. And you know, I think it’s difficult to have those interactions the day before. Typically they’re busy, you’re busy. Not all attendings

are super approachable, so you don’t just want to text them or whatever call them and say hey do you have time to meet now.” -Participant 13

Case complexity in and of itself was a commonly mentioned reason why operating-room preparation would change. Residents also mentioned that the more complex a case the longer it would take to prepare for it.

“And then again, when it’s the first time I’m doing something, or like second time and it’s a rare or complex thing, I do refer back to like a textbook for the gestalt.” -Participant 4

Most residents also mentioned that finding adequate resources to use for preparation was often challenging and time consuming.

“I feel like it’s sometimes is hard to find like adequate resources ... but I mean there’s tons of resources out there, but finding one that like sort of incorporates everything that you need to, I think is often challenging.” -Participant 1

Many even voiced frustration after they used particular resources to prepare but then found out that they were not appropriately prepared when they participated in the operating room.

“And I don’t really realize I’m missing that tidbit until I get into the operating room and have that feeling like, ‘Oh yeah that would have been nice to have included in the source that I was using.’” -Participant 3

Resource specific use

Residents use a variety of different resources in order to prepare for the operating room. They were hesitant to define one resource as their favorite, but when pushed most chose *Operative Techniques in Surgery*.¹² For the purposes of this study, preferred resource use was divided into the 6 categories that participants defined as being important components to know before participating in an operating room case (Table 2). In the interviews it was notable how many different resources residents felt they needed to consult before considering themselves prepared for a case. Most residents mentioned accessing the patient’s chart, often times as the first step in preparation. Next, many would go to a textbook or other broad source for background information such as pathophysiology and indications for surgery. Surgical anatomy was commonly learned through atlases, Google images, and videos. In particular, residents mentioned using the videos to obtain an idea of the 3-dimensional anatomy that was difficult to understand via a flat picture. Many residents specifically mentioned the textbook *Operative Techniques in Surgery*¹² as their resource of choice when trying to learn steps of an operation, although many others mentioned referring to old operative notes, operative dictation books, and other resources like articles and apps. Complications were often learned through textbooks. A few residents spoke about looking up bail-out maneuvers for complex cases, but many said they learned this aspect of surgery through experience.

Residents felt that simulation, either in the simulation center or at home, was useful for specific operating-room skills, such as knot tying or laparoscopic suturing, but did not feel that it was useful for practicing an entire case.

“Only [used simulation] for endoscopies. I guess I have [used simulation] in terms of suturing, so doing Nissan and stuff and

Table 2
Resources used per preparation topic.

Preparation topic	Resource use
Patient specific	
Patients chart	<ul style="list-style-type: none"> o Information on patient o Attending assessment and plan o Can guide further resources
Pathophysiology and indications for surgery	
Textbooks	<ul style="list-style-type: none"> o Camerons^a, Sabiston^b, Schwartz^c, Greenfield's^d, etc o Background information o Good overview
Web search	<ul style="list-style-type: none"> o Search engine: Google o Can look up specific disease process
Databases	<ul style="list-style-type: none"> o Up-to-Date, Medscape, E-medicine o Can look up specific disease process
Surgical anatomy	
Anatomy atlas	<ul style="list-style-type: none"> o Netters^e, Zollinger's^f, etc. o Both surgical site specific and just general anatomy images
Web images	<ul style="list-style-type: none"> o Search engine: Google images o Can look up specific pictures when looking for specifics
Videos	<ul style="list-style-type: none"> o Videos of resident cases, SAGES website^g, YouTube o Used for 3-dimensional anatomy to understand contextual relationships o Familiarize the region the surgery is going to be taking place
Procedural steps	
Textbooks	<ul style="list-style-type: none"> o Operative Techniques in Surgery^h o Step by step descriptions
Articles	<ul style="list-style-type: none"> o Specialty journals or searches for hard to find cases o Generally very specific
Operative dictation	<ul style="list-style-type: none"> o Either operative dictation books or historical op notes o Helpful to understand key components o Also gives more context for particular surgeons' habits
Apps	<ul style="list-style-type: none"> o Touch surgeryⁱ, etc. o Helpful to go through steps of a procedure and a visual way o Not always specific enough
Complications	
Textbooks	<ul style="list-style-type: none"> o Camerons^a, Sabiston^b, Schwartz^c, Greenfield's^d, <i>Operative Techniques in Surgery</i>^h etc. o Good overview of common or devastating complications
Articles	<ul style="list-style-type: none"> o Specialty journals or searches for specific complications o Generally very specific

^a Cameron AM, Cameron JL. *Current surgical therapy*. 12th ed. Philadelphia: Elsevier, 2017.

^b Sabiston DC, Townsend CM, Beauchamp RD et al. *Sabiston Textbook of Surgery: The Biological Basis of Modern Surgical Practice*. 20th ed. Philadelphia: Elsevier, 2017.

^c Brunicaardi FC. *Schwartz's Principles of Surgery*. 11th ed. New York: McGraw-Hill, 2018.

^d Mulholland MW. *Greenfield's Surgery*. Philadelphia, London: Lippincott Williams & Wilkins, 2010.

^e Netter FH. *Atlas of Human Anatomy*. Philadelphia: Elsevier 2019.

^f Ellison EC, Zollinger RM. *Zollinger's Atlas of Surgical Operations*. 10th ed. New York: McGraw-Hill Education, 2016.

^g SAGES Video Atlas of Endoscopy. <https://www.sages.org/sages-video-atlas-endoscopy/>. Accessed December 09, 2019.

^h Mulholland MW, Albo D, Dalman RL et al. *Operative Techniques in Surgery*. Philadelphia: Wolters Kluwer Health, 2015.

ⁱ Touch Surgery. <https://www.touchsurgery.com/>; 2019 Accessed December 09, 2019.

just practicing in the SIM lab. So for particular skills, but not for an entire operation.” -Participant 8

Many residents also felt that the weekly didactic sessions were not particularly helpful for operating-room preparation. The junior didactics consist of reading chapters of a textbook and answering questions while the senior didactics consist of the Surgical Council on Resident Education (SCORE) curriculum. Residents did feel however that these sessions were helpful in preparing for other facets of residency such as the American Board of Surgery In-Training Examination (ABSITE) and other aspects of clinical care.

“I mean the didactics are more geared towards preparation for the ABSITE. In fact I think the most helpful part is going over the questions at the end.” -Participant 9

Differences by PGY level

Throughout the interviews, junior residents and senior residents seemed to use different resources. Junior residents

mentioned using review books such as *Surgical Recall*¹³ more often than more advanced residents. They also were more likely to feel that oral board practice, or watching others participate in oral boards was helpful. Senior residents often mentioned that the oral-board practice was not detailed enough to help them prepare for cases. The senior residents were also more likely to report using current literature or specialty journals when preparing. They also discussed using visualization as a technique to go through cases in their minds prior to being in the operating room to help solidify steps of the procedure and test their knowledge. In addition, senior residents were more likely to report going to specific resources, such as journal articles, to learn about complications.

Senior residents were also more likely to bring up the technique of teaching less experienced members of the team to help solidify their own knowledge. They added that teaching forced them to confront things they didn't completely understand, and overall made the experience in the operating room better when all members had similar knowledge and expectations. Interestingly, some junior residents also stated that going over the case with more senior residents was also helpful to focus on important aspects.

Optimal resource description

Residents described their favorite resources as being high-yield. Specifically residents stated that they wanted resources that were easily available, detailed, concise, versatile, clear, and accurate. Some residents also mentioned that the expense of resources was sometime prohibitive.

“I’ve referred to them [textbooks] a couple times. They’re in our common area. But I have not had the funds ...” - Participant 2

Discussion

Our research demonstrates that resident operating room preparation is a multifactorial process with many areas open for improvement. We found that although residents similarly defined what they should know to prepare for the operating room, they felt they had no external guidance on how to actually achieve adequate preparation. In addition, we identified many external factors that impact preparation such as available time, specific attending, level of predicted autonomy, case complexity, and difficulty finding and accessing resources. The use of resources was varied by participant and PGY level, but overall there was a general consensus that no one resource was enough. In fact, residents used a variety of modalities such as textbooks, online searching, and videos to integrate information from several sources to achieve a complete picture.

The participating general surgery residents in our study learned how to prepare for the operating room through trial and error, which is consistent with survey results from residents in other surgical subspecialties.¹⁴ This finding, though not surprising, highlights the need for a more standardized approach towards supporting surgical residents in developing preparation skills. Along with this, support is also required for finding and accessing pertinent resources for preparation for surgical cases that will allow them to participate in supervised practice at an appropriate level. This is especially true since medical training is moving towards competency-based medical education, in which residents’ education is driven primarily by their individual progress in skill attainment and demonstration of autonomy.¹⁵ Given that residents noted that available time for preparation and finding adequate resources were barriers for preparation, teaching residents how to quickly and accurately find useful resources could drastically impact the quality of current preparation.

Many residents in our study also spoke about the complex relationship between attending expectations, autonomy, and “nuances” in the operating room. There is literature to suggest that part of the reason residents might not feel they are prepared is because operative expectations and goals between residents and attendings differ.^{16,17} This is important because residents who are perceived to be unprepared by their observed clinical skill, confidence, and recitable knowledge base are less likely to be granted autonomy by the surgeon.¹⁸ This contributes to why the actual resident autonomy experienced in the operating room is often much less than the amount expected and desired by both the resident and the attending surgeon.^{19,20} Conversations preoperatively with attendings were desired by our participants and could help set expectations and guide residents towards better preparation, and accordingly, this improved preparation could contribute to increased operative autonomy.

There are multiple teaching modalities and resources that can be used to augment surgical preparation such as lectures, textbooks, videos, modules, or simulation, to name a few, but it is unclear what role each of these modalities have for operating room preparation. Perhaps the most studied modality is dedicated

simulation built into the surgery curriculum, which has been associated with increased resident satisfaction.^{21–23} Although simulation is the closest to the operating room in terms of user interface, its utility is often limited by resources, expense, and location.^{24,25} In addition, our participants found that it was helpful for learning particular skills but not helpful for simulating entire cases. In fact our participants were more likely to use resources such as videos to help get a sense of 3-dimensional anatomy and general flow of an operation, which is consistent with prior survey data.^{26,27} Overall, our participants used a variety of techniques to achieve their goals depending on what topic they were researching and their prior experiences. The results of our study indicate that designing resources with the ideal qualities desired by residents is likely to increase their usefulness and impact.

Our study is limited by its small sample size as well as the fact that it was performed at only a single institution and thus might not be generalizable. In addition, the author who conducted the interviews was a general surgery resident who knew most participants prior to conducting this research. In this context, the resulting themes were co-created as both the interviewer and participant came from similar professional backgrounds. Although this approach to the data could have resulted in new themes that might have otherwise not been identified, it could have also altered participant’s comments due to the previous relationship with the interviewer. Our study is also at risk for selection bias since only half of the residents at our institution were interviewed. Specific practice patterns in our hospital, particularly since residents share ideas and resources, could drastically impact resource use and preparation patterns. In addition, we did not attempt to assess how prepared the participants actually are when they participate in the operating room. Resident perceived preparedness and actual preparedness could be very different and could impact the meaning of our results.

In the future, larger studies will need to be done in order to evaluate how resident preparation changes based on location, different size programs, and academic versus community hospitals. In addition, it would be useful to further study the attending perspective as there may be discrepancies between how educators feel they are guiding residents in terms of resources for OR preparation and how residents are perceiving this guidance. This expanded assessment based on our initial findings can provide the background for creating curriculum that can be used to enhance resident operating room preparation and ultimately resident preparedness for practice.

Conclusion

Our study demonstrates that at least at one institution, resident operating-room preparation is multifactorial, and there has not yet been a widely used approach to guide residents in developing this skill. We found that residents teach themselves and their colleagues how to prepare. In addition, available time, attendings’ preferences, resident predicted autonomy, case complexity, and difficulty finding accurate resources greatly impact operating room preparation. Multiple resources are used for various aspects of preparation, and as residents move up in PGY level, their preparation changes. Further studies must be done to determine differences in how residents approach preparation for surgical cases across residency programs as well as to address perceived barriers to preparation and resource use.

Declaration of competing interest

The authors have no financial disclosures.

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Appendix A. Supplementary data

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Author Contributions

All authors have substantial contributions to the conception or design of the work. Specifically JLG was responsible for the data acquisition and JLG and SJ for the design, analysis, and interpretation of data for the work. JLG and SJ drafted the work and revised it critically for important intellectual content including final approval of the version to be published. All authors are in agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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