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Making the Jump: A Qualitative Analysis on the Transition from Bedside Assistant to Console Surgeon in Robotic Surgery Training

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Abstract

Objective—To determine barriers associated with the transition from bedside assistant to console surgeon for general surgery residents in the era of robotic surgery in general surgery training.

Design—Qualitative thematic analysis using one-on-one interviews of general surgery residents and attendings conducted between June 2018 and February 2019.

Setting—An urban, academic, multi-hospital general surgery residency program with a robust robotic surgery program.

Participants—Convenient and purposeful sampling was performed to ensure a variety of resident graduate-years and attending subspecialties were represented. Sample size was determined by data saturation, which occurred after 20 resident and 7 attending interviews.

Results—Residents identified the low volume of general surgery robotic cases, the infrequency of exposure to robotic surgery, and attending comfort with robotic surgery (and with teaching on the robot) as potential barriers in the transition from bedside assistant to console surgeon. Residents had to find a replacement bedside assistant in order to be the console surgeon, which was challenging. In addition, residents felt that the current culture surrounding robotic surgery is very hierarchal, limiting their exposure. Attendings' trust in the residents' console skills was a major determining factor in allowing residents on the console.

Conclusions—Most robotic surgery education curricula are sequential, requiring the resident to progress from bedside assistant to console surgeon. Unfortunately, there are many potential barriers for residents in the transition from bedside assistant to console surgeon. Some barriers apply to general surgery training overall, but are amplified in robotic surgery, while others are unique to robotic surgery education. Recognition of, and rectifying, these barriers may increase resident participation as the console surgeon.

Keywords

Robotic surgery; general surgery; residency; education; qualitative analysis; bedside assistant

INTRODUCTION

While the advantages of robot-assisted surgery (RAS) over laparoscopic surgery is debatable¹⁻³, there is no question that the number of RAS procedures performed annually has increased at an astonishing rate⁴. Despite the tremendous growth of RAS, its diffusion in general surgery has lagged behind that of other specialties⁴. Similar to the transition from open to laparoscopic surgery^{5,6}, integrating surgical trainees with an emerging technology has been challenging. The ideal RAS curriculum has not been well-defined, and currently, there is no validated RAS curriculum for general surgery residency programs. While there is high variability in the individual components of curricula nationwide⁷, the majority of curricula are sequential in design and consist of: 1) online tutorials, 2) simulation laboratory, 3) bedside assistant experience, and 4) console surgeon experience⁸⁻¹³. Our own curriculum mirrors this sequence.

The sequential nature of most curricula puts an emphasis on progression from one component to the next, and non-progression is both discouraging and frustrating to residents. For most residents, one of the most common roadblocks is the transition from bedside assistant (BA) to console surgeon (CS). While the role of the BA does have educational value^{14,15}, residents want to operate on the console. However, previous studies have suggested that despite high resident involvement as BAs, resident participation as the CS is low^{16,17}. Our institution is not immune to this phenomenon and the transition from BA to CS is often a source of consternation for residents.

To our knowledge, no study has explored the barriers to this important transition. The goal of this study is to use qualitative research methods to provide an in-depth analysis of perceptions among general surgery residents and attendings on the barriers that residents face when attempting to transition from BA to CS.

METHODS

Setting and Participants

This study was conducted at an urban, academic, multi-hospital general surgery residency program. Residents rotate at the two main university hospitals and at the Veterans Affairs (VA) hospital, all of which have RAS capabilities. In addition, resident and attending surgeons also have limited access to a large simulation laboratory that have multiple robotic platforms. All hospitals have at least one robotic platform with the da Vinci Surgery Skills Simulator (dVSSS) installed. Attending surgeons interviewed for this study only operate robotically at these three hospitals. The majority of RAS cases are performed on the minimally invasive and colorectal surgery services. During the most recent fiscal year, these two services performed 246 RAS cases, which accounted for 12.8% of all cases performed by these two services.

Interviewees included general surgery residents and attendings. There are approximately 50 categorical residents in the 5-year general surgery residency program. After obtaining Institutional Review Board approval, a brief recruitment presentation was delivered to all residents. After initial interviews were conducted from volunteers, purposeful sampling was performed based on resident graduate-years. Residents were categorized into interns (1st-year), junior residents (2nd- and 3rd-year), and senior residents (4th- and 5th-year). Because exposure to robotic surgery may be variable based on the level of the resident, it was important to obtain interviews from each graduate-year. Because of the limited number of attendings who perform RAS, purposeful sampling was performed to ensure a variety of specialties and opinions were represented. The number of participants were determined by data saturation, defined as when interviews no longer deepened or contradicted previous data¹⁸. We achieved data saturation after 20 resident interviews and 7 attending interviews.

Study Design and Data Collection

We performed a qualitative thematic analysis with semi-structured interviews. The interview guide used for all interviews was constructed iteratively among investigators (BZ, JL, and LP). All one-on-one interviews were conducted by the same investigator (BZ) to minimize group effect and maximize confidentiality¹⁹. All resident and attending interviews began with collection of demographic information. All interviews were audio recorded and transcribed by BZ. All transcripts were anonymized prior to data analysis.

Data Analysis

We performed thematic analysis on all interviews. Each resident interview was coded independently by BZ and LP, with a third coding performed by HH, JL, or AL. This was done to prevent potential bias from group coding and to expand diversity of interpretations. All coders were instructed to code in a line-by-line fashion using descriptive open coding techniques. After each resident interview was coded individually, discussion of the codes commenced, and disagreements were resolved until consensus was reached for each resident interview. Only BZ coded attending interviews because maintaining confidentiality would be challenging given the limited number of attendings who perform robotic surgery at our institution. Throughout the coding process for attending interviews, BZ regularly consulted LP for ongoing feedback on codes and to develop thematic models. Preliminary coding frameworks and themes were developed iteratively. Credibility was maintained by triangulation of data sources, including participant verification, discussion and debriefing by investigators, and comparison of themes extracted from the interviews to existing theories on RAS education. The dependability of the study was established by achieving data saturation^{18,20}.

RESULTS

Interviews were conducted with 20 residents and 7 attendings. Demographics of residents and attendings are shown in Table 1. Of the 20 residents interviewed, 11 had been the CS in the operating room (OR) for any amount of time (0/4 interns, 5/9 junior residents, 6/7 senior residents). Conversely, 19 out of 20 residents have been a BA in the OR. Three surgical subspecialties were represented by attending interviews (4 colorectal, 2 minimally-invasive,

and 1 surgical oncology). All of the attendings interviewed stated that they allowed residents to be the CS in the OR.

Data analysis yielded multiple themes, which were organized into three domains of potential barriers: 1) case volumes and curriculum design, 2) operating room workflow, and 3) current culture of robotic surgery education. We also present opposing opinions of residents and attendings in the context of the BA to CS transition.

Case Volumes and Curriculum Design

“One of the problems I found with the robot is that I’ll go six months or more without being on the robot, and your skills atrophy. Every time you pick it up again, you have to re-pass through the steps you already did. Certainly, you learn faster the second or third time, but it’s still frustrating because you’re always going backwards again.” (Resident 15, senior resident)

One of the barriers in the transition from BA to CS often cited by residents is the relative low number of RAS cases performed by general surgeons (Table 2). This is compounded by the fact that, at our institution, “there are really only two rotations who use the robot consistently.” This leads to a lack of continuity of exposure to RAS, where residents will go extended periods of time without encountering RAS, potentially leading to skill atrophy. In addition, residents noted that they often rotate in RAS-heavy rotations (e.g. colorectal, minimally-invasive surgery) as either interns or senior residents. Therefore, this gap in RAS exposure can be even worse for junior residents.

Operating Room Workflow

“The other barrier is having someone at the bedside. Because now, instead of requiring just one resident in the case as in laparoscopy, now in order to be on the console, I have to find another resident to be at the bedside assisting, because you can’t rely on a surgical tech usually to assist...if we could have scrub techs to bedside, that would really help the resident be involved at the console. At [the community hospital], they have technical assists. We don’t really have those; the residents are supposed to be the technical assist.” (Resident 15, senior resident)

RAS presents a unique challenge in the workflow within the ORs (Table 3). Because RAS requires a skilled BA, residents are often relegated to this role and are unable to transition to the console due to a shortage of qualified BAs. In most cases, for residents to operate on the console, there has to be either another resident or an advanced practitioner (AP, e.g. nurse practitioner) at the bedside. One potential solution brought up by both residents and attendings is the use of surgical technicians or dedicated robotic-surgery technicians (DRST) to perform the role of the BA, thereby allowing the resident to be the CS.

Current Culture in Robotic Surgery Education

“I go in to these colorectal cases with the assumption that the attending is going to do the robotic portion. So just changing the culture, getting the residents to assume that they will get to do some of the robotic portion would be good. Or even just being more inclusive in getting more junior residents exposure to it. Even if

residents are doing it, it would be the chiefs or upper-levels who are doing any part of that...I don't know at what point would I be able to go from bedside assist to the console." (Resident 3, intern)

Like other aspects of general surgery training, RAS education is very hierarchical. Most residents felt that the current culture surrounding RAS education is that it is reserved for attendings, fellows, or very senior residents only (Table 4). To some residents, a RAS procedure is falsely "viewed as a higher-level case" than a comparable laparoscopic procedure. Both residents and attendings placed some onus to get on the console on the residents themselves (Table 4). However, some residents noted that "the less you do, the less you're comfortable in taking the initiative."

Residents Perspectives Regarding Attending Surgeons

"I think the attendings themselves are still learning it. For example, [the attending] was trying things out with the funduplications, so he was on the console and we didn't have the opportunities to try it. I think maybe it's different now, but once the attendings know and are competent enough to teach it, then it won't be such a big barrier. But a lot of times now, the attendings are only doing it the second time...as time passes, I think it'll change." (Resident 12, junior resident)

Attendings play a critical role in whether residents can transition from BA to CS, but several factors can affect this decision (Table 5). The most commonly cited barrier is that attendings are "still learning" RAS. Because attendings are still training on the RAS platform, and "are still changing how they do things", most residents accepted that it would be difficult for attendings to train *them* on the console. While this perception was prevalent throughout the interviews with residents, there were also a number of residents who thought that attendings were getting increasingly comfortable with RAS, and many were hopeful that this will lead to more resident involvement as the CS in the future.

"I think it depends on the attending level of trust in you, it depends on the procedure. It depends on what they think is appropriate for you to perform in the procedure." (Resident 11, junior resident)

In addition, residents recognized that in order to operate on the console, attendings must have trust in the abilities of the resident to perform the RAS operation skillfully and safely. In order to develop this trust, residents must have a working relationship with attendings. This can be challenging given the small number of robotic cases and lack of continuity as discussed previously. Residents also recognized that the complexity of the case will determine whether they are allowed to be the CS. Lastly, residents believed that their ability to get on the console is "up to the attending's level of interest in training residents" and attendings' willingness "to let the residents do things."

Perspectives from Attending Surgeons

"As a resident, I was just bedside assisting and that was exciting in itself. So, I did a lot of bedside assisting. I think I did that for a really long time, which I think it's not how things are now. Now the attendings are not really learning anymore,

they're more practiced and skilled and feel very comfortable with it. Now, it's different." (Attending 6)

Contrary to residents, most attendings did not cite their comfort level with RAS as a potential barrier in allowing residents to be the CS (Table 6). However, one attending did state that there are high-risk portions of cases that she was not comfortable with the resident performing. Attendings also stated that the best way to gauge resident safety and skill is through direct observation of their performance on the console. This may be accomplished by allowing them to perform "low-risk" portions of the procedure. Some attendings allowed all residents on the console in the operating room, while other attendings were more selective. Attendings often used the RAS curriculum as a way to determine eligibility for residents to be the CS. Most attendings also cited their perception of a resident's interest in being the CS as a requirement to get on the console. This extended to the resident's interest while performing the role of the BA.

DISCUSSION

The integration of RAS in general surgery training has been challenging. While no validated RAS education curriculum exist, the majority of curricula require trainees to perform BA prior to operating on the console⁸⁻¹³. However, the transition from BA to CS is challenging for many resident trainees^{16,17}. To perform an in-depth analysis of this transition, we conducted a qualitative study of 20 residents and 7 attendings, encompassing over 9 hours of interviews. Below are barriers we identified through these interviews.

Case Volumes and Curriculum Design

Just as case volume is the bedrock of general surgery training overall, one of the biggest barriers in the BC to CS transition is the relative low number of RAS cases performed by general surgeons. At our institution, RAS is mostly performed by minimally-invasive and colorectal surgeons and on only three rotations: minimally-invasive/bariatric surgery, colorectal surgery, and VA general surgery. Therefore, it is possible that residents not perform RAS for >6 months because the majority of general surgery rotations do not utilize the robot (e.g. breast, trauma, vascular). Currently, residents rotate on RAS-heavy services as interns or senior residents, so the gap may be worse for junior residents. This gap is prolonged further for residents who step out for dedicated research, a common practice in our program. The low case volume and lack of continuity in exposure to RAS hampers development of RAS skills, where residents have to continually relearn and reorient themselves to the RAS platform. They can appear "rusty" and "don't look as competent", leading to decreased participation. The lack of continuity also applies to "continuity with attendings", which may hinder the development of relationships and entrustability that is so key in surgical training^{21,22}.

Careful consideration of resident rotations (e.g. spacing out RAS-heavy services, placing junior resident on RAS-heavy services) may improve continuity of exposure for residents. Simulation and simulators may play a role in supplementing resident exposure to robotic surgery²³⁻²⁷. Increasing RAS volume is more challenging. One solution may be to apply RAS to procedures that are more often performed laparoscopically (e.g. cholecystectomy,

inguinal hernia)^{28–30}, though this approach may be limited by the higher costs of robotic surgery³¹. While slow, the diffusion of RAS into general surgery subspecialties is increasing^{32–34}, which is encouraging for robotic education in the future.

Operating Room Workflow

RAS presents a unique challenge in terms of OR workflow. Because of the importance of the BA^{14,15,35}, many attendings require a resident or AP to perform that role. If a resident wants to be the CS, he/she will need to find a second resident or an AP to be the BA. In a busy surgical service, this may be difficult and can be a substantial barrier in allowing residents to be the CS. The physical arrangement of the bedside resident and the console attending is another potential barrier. One resident stated that “the attending has to make a conscious decision to let the resident on the console” because the resident and attending are not physically close “and doing the case together”. Contrary to laparoscopic surgery, where the attending has to actively engage with the resident to move the camera or retract, attendings on the RAS platform are able to perform these tasks by themselves. Therefore, this physical barrier may become a subconscious barrier between residents and the console.

One way to move residents out of the BA role is for the surgical technicians to be the BA, though scope-of-practice concerns and hospital-specific policies are potential obstacles. Some institutions have employed DRSTs who perform all bedside duties. However, this requires a substantial investment. Future studies exploring the cost-effectiveness of DRST, and their effect on RAS training, is needed.

Current Culture in Robotic Surgery Education

RAS education is not immune to the hierarchical nature of surgical training. Often, this is appropriate given the skill required for some highly complex procedures. However, residents believe that there is a false notion of complexity whenever RAS is used. For example, a robotic colectomy is considered a “chief-level” case, while previously, laparoscopic colectomies were often cases for junior residents. This is despite the fact that most attendings believe that RAS is “easier” than laparoscopic surgery. To residents, this pattern has generated a perception (in residents and attendings) that RAS is reserved for attendings, fellows, or very senior residents.

A potential solution is the modular teaching approach, which has been shown to be an effective training tool for novice robotic surgeons^{36–38}. In the modular teaching approach, highly complex RAS cases can be separated into discrete portions, and the less complex portions (e.g. dissecting the “white line of Toldt” in a robotic colectomy, sewing the peritoneum in a robotic inguinal hernia) can be given to junior residents. While junior residents likely won’t complete the entire case, modularizing the procedure can allow them more opportunities to be the CS. In addition, some attendings have proposed using “simple” cases, such as the robotic inguinal hernia, to challenge the stigma of the highly complex RAS procedure³⁹.

Perceptions of Residents and Attendings

One of the most commonly cited barriers in the BA to CS transition is the attendings' comfort with RAS. This is undoubtedly related to the relative slow diffusion of RAS in general surgery. Conversely, most attendings, and some residents, stated that this "learning" period is coming to an end. Even if attendings are comfortable with the RAS procedure they are performing, it is important to highlight that attendings must still be comfortable and interested in the education of residents on the RAS platform. While most residents cited "comfort" as a potential barrier, most attendings did not cite it as a major determinant in allowing residents on the console. It is possible that residents are merely assuming that comfort level is the reason for their lack of participation as the CS, while the real reason may be that the attending has concerns regarding the resident. Conversely, it is also possible that the attending is truly not comfortable with the RAS procedure, but does not realize that this is the reason they are reticent to allow residents on the console. In either case, clear and honest communication between the resident and attending regarding the reasons for their level of involvement would be highly beneficial.

Residents also acknowledge that attendings must develop a level of trust before allowing residents on the console. As discussed previously, due to the lack of continuity of RAS exposure, accomplishing this level of trust and familiarity may be challenging. Most attendings rely on completion of the RAS curriculum as a "certification" to allow residents on the console. This increases attending trust in residents' abilities as a CS, which can increase residents' autonomy^{21,22}. This also highlights the importance of a robust RAS curriculum, which has been shown to increase resident participation as the CS^{13,40}.

Both residents and attendings believed that resident motivation to be the CS is a big determining factor. While some residents are intrinsically unmotivated to be trained in RAS, it may be that other residents are discouraged given the lack of opportunities to advance beyond the role of the BA. Most attendings also stated that the best way to evaluate residents' console skills is to allow them to operate on the console. Ideally, the combination of the modular teaching approach and confidence in the residents' experience (due to a robust RAS curriculum) will temper attendings' hesitations in allowing residents to operate as the CS, leading to better evaluation of residents' skills by attendings.

Limitations

Our study has limitations that are inherent to qualitative research. We employed a combination of convenient and purposeful sampling of a specific study population, which may limit generalizability⁴¹. The majority of the RAS exposure for residents takes place within the training program of large tertiary hospitals. While residents do rotate at a community hospital that also utilizes robotic surgery, they are not involved in RAS cases due to credentialing policies. It is unknown how much of their experience at this hospital affected their opinions regarding RAS. None of the attendings interviewed operate at this community hospital. All participants are from a single institution, which may limit generalizability of our findings. Future studies will include trainers and trainees from multiple institutions, including those in the community setting. Our sampling technique may also introduce bias, in that interviewees with strong opinions may be more likely to

participate. For example, 8 out of the 20 residents interviewed are interested in either minimally invasive or colorectal surgery, which may indicate an inherent interest in RAS. However, it should be noted that the same number of residents are also interested in surgical sub-specialties with low robotic penetration (e.g. trauma, breast, and pediatric surgery). Variability in data interpretation is another limitation inherent to qualitative research. To combat this, our protocol employed coding by consensus for resident interviews, which has been recommended to improve validity⁴². Unfortunately, to maintain interviewee anonymity, coding by consensus could not be employed for attending interviews.

CONCLUSIONS

Despite the increasing ubiquity of RAS in academic hospitals, its integration into general surgery training has been challenging. One of the biggest sources of consternation among residents regarding RAS is the transition from BA to CS. Through this in-depth qualitative analysis, we identified several barriers, including the low case volume, poor continuity of exposure, different OR workflow, and current culture surrounding RAS. Some barriers apply to general surgery training overall, but are amplified in RAS education, while others are unique to RAS education. Nonetheless, recognition of these barriers, and implementing changes to mitigate them, may increase resident participation as the CS and add to the surgical armamentarium that they will acquire during general surgery residency training.

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HIGHLIGHTS

- Robotic surgery is becoming a larger part of general surgery residency training.
- In this qualitative analysis of general surgery residents and attendings, we explored the barriers in the transition from bedside assistant to console surgeon in robotic surgery.
- Barriers include: 1) case volumes and curriculum design, 2) operating room workflow, and 3) current culture of robotic surgery education.

Table 1.

Demographics of resident and attending interviewees

Demographic	Number of Interviewees
General Surgery Attendings	
Gender	
Female	4
Male	3
Specialty	
Colorectal	4
Minimally Invasive	2
Surgical Oncology	1
Mean Years Since Last Training (Range)	11.7 (2–24)
Mean Years Since Starting Robotic Surgery (Range)	7.7 (1–19)
Median Approximate Number of Robotic Cases Performed (Range)	100 (20–1000)
General Surgery Residents	
Resident Level	
Intern (1 st Year Resident)	4
Junior Resident (2 nd /3 rd Year Residents)	9
Senior Resident (4 th /5 th Year Residents)	7
Gender	
Female	13
Male	7
Future Surgical Sub-Specialty	
Breast	1
Cardiothoracic	1
Colorectal	3
General	1
Minimally Invasive	5
Oncology	1
Pediatric	2
Transplant	1
Trauma	5

Table 2.

Comments regarding the case volume of robotic general surgery and curriculum design as potential barriers

	Representative comments
<i>Case Volume</i>	<p>“I don’t know if we do enough robotic cases for all residents to get on [the console].” (Resident 3, intern)</p> <p>“There’s only certain rotations that we’re doing a lot of robotic cases. We’re doing more than just robotic cases on those rotations too.” (Resident 5, senior resident)</p> <p>“As a resident, you learn some by watching, but there isn’t enough repetition to then apply what you watched on the console.” (Resident 14, senior resident)</p> <p>“I think another barrier for robotics is that not that many attendings have that much robotic time. On the MIS service, they only have a robotic day every other week. It’s not like you get the repetition to go on there. And there’s only two services that really use the robot.” (Resident 17, junior resident)</p> <p>“Just my own volume, if I was doing more robotic cases myself then I would be more comfortable handing over the controls. I don’t have formal robotic block time, so it’s rare that I can actually get to [operate on] the robot.” (Attending 1)</p> <p>“If we get a fellowship, then that’ll completely cut off the residents from the robot. So that’s something we have to think about. We’ll then become more dependent on the simulator to fill in the gap. The simulator is not great, but it’s something.” (Attending 4)</p>
<i>Curriculum Design</i>	<p>“You would get a sim lab, and then you’d be on another service for half a year, and then you’d show up on the colorectal service, and then somebody would remind you how to dock the robot and it would come back, and you spend some other time away from it. It was never like you can build a foundation on it.” (Resident 4, senior resident)</p> <p>“If you can get console time earlier, you would be better off. But because of just how things are set up in the residency, it’s hard to get on the console until you’re a fourth year.” (Resident 6, senior resident)</p> <p>“I think it helps to have continuity [with robotic rotations], which we often don’t have because our schedules are pre-determined...but also continuity with attendings. So, they know you, and they know they can let you on the console.” (Resident 11, junior resident)</p> <p>“I think the robot is not something we see a lot of and there’s a learning curve associated with it. Even when you’re a higher-level resident, there’s a slowing down from re-orienting yourself to a new style. I think there’s really only one service, colorectal, that we get a lot of robotic experience. So, if you’re only getting that 1–2 months in your 4th and 5th year, very rarely as an intern or 2nd year, your experience on the robot is very limited.” (Resident 18, junior resident)</p> <p>“I think a lot of it is that there’s only so many robotic cases in the services that they’re on. On those services, you’re either really junior or really senior. So, if you’re very junior, you’re usually assisting...and if you haven’t done it in 6 months, then you’re rusty, and you don’t look as competent, then you don’t get to do as much.” (Resident 19, junior resident)</p>

Table 3.

Comments regarding the operating room workflow as a potential barrier

Representative comments
<p>“I would say for the average case, the scrub tech usually is familiar enough with the instruments that they can do bedside. So, you don’t necessarily need a second resident, unless something unexpected is going on.” (Resident 16, senior resident)</p>
<p>“When it’s the robot, the attending is sitting down and doing the case. While it’s easy to switch, there has to be somebody bedside assisting, so the attending has to make a conscious decision to let the resident on the console. It’s not like you’re already there and doing the case together. It’s more like ‘I’ll step aside now and let you do it.’ So, it has to be a much more conscious decision to let you do it.” (Resident 17, junior resident)</p>
<p>“A lot of times, I felt like I could be on the console, but I don’t have anyone to do bedside. So, it wasn’t always a lack of opportunities to do things on the console, it was a lack of opportunities to be on the console. There were times that we would try to call in an intern or to bedside, and sometimes people are just not available.” (Resident 18, junior resident)</p>
<p>“We’re a relatively well-staffed service, so we’ve always had a resident [at bedside]. But it’s not the best use of that resident. And at times, we’ve also had the medical student or scrub tech. We’ve had a medical student do the entire case at bedside.” (Attending 2)</p>
<p>“That’s another thing that they have to do when they’re on the console is you have to have someone at the bedside. You have to have someone trustworthy. Most of the time that’s the intern. Sometimes it’s the nurse practitioner. Rarely it can be the scrub tech. They have to have another body in the room.” (Attending 3)</p>
<p>“The only rule I have is that they must have a physician at bedside. So, they need to get one of the NPs or the intern at bedside. Before the intern starts, they have to show them how to do everything at bedside. As long as they do that, they can sit on the console.” (Attending 4)</p>
<p>“My residents are always on the console. If there isn’t an intern and the scrub is not comfortable, then I go to the bedside. That’s from how I trained... In fact, it’s better for me because I can control the operation a bit more. I can show the resident how to retract things through the lap port. If I had my choice, and it wasn’t annoying to scrub in and out, I would do bedside.” (Attending 6)</p>
<p>“Either the other resident or the med student sometimes [are on bedside]. I usually sit close enough to jump in, though I’m not scrubbed. And the scrub techs are awesome here. If you empower them with how to do it, I think some of them can do the operation.” (Attending 7)</p>

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Table 4.

Comments regarding the current culture of robotic surgery education as a potential barrier

	Representative comments
<i>Hierarchical Education</i>	<p>“You have to pay your dues, get your bedside assists but also let your seniors do what they need to do for their education. But it would be nice if we could get on the console earlier.” (Resident 6, senior resident)</p> <p>“Obviously, the chiefs [get on the console]. My sense is that we’re expected to grow into that, and they just don’t give away opportunities to go on the console...there’s certainly less for the junior residents to be able to be involved in because it’s usually the attending and the chief or senior resident, who is usually on the console. And sometimes, the scrub nurse is doing the bedside assisting.” (Resident 8, junior resident)</p> <p>“The reality of residency is that there are certain things that are expected of you at certain times. [Robotics reserved for senior residents is] an attitude I have in my head. I don’t know if that’s because of my experience in medical school or if that’s more from other people’s experiences as well.” (Resident 13, intern)</p> <p>“I don’t see why it should be a higher-level case on the robot than laparoscopically, but I feel like it’s viewed as a higher-level case. Which doesn’t really make sense, except maybe you don’t have as much robotic experience as you have lap experience.” (Resident 19, junior resident)</p>
<i>Motivation of Residents</i>	<p>“I think a lot of it will have to be resident directed. Robot cases can be difficult, and we have to show interest. I don’t think everybody is interested in doing the entire robot curriculum, so if you are, we need to tell our attendings.” (Resident 10, junior resident)</p> <p>“[One barrier is] having the initiative to ask ‘hey, can I try being on the console?’ The less you do, the less you’re comfortable in taking the initiative.” (Resident 14, senior resident)</p> <p>“I think residents getting on the console is entirely up to the residents and how much they want to get on the console.” (Resident 16, senior resident)</p> <p>“Some [residents] just want to sit at the bedside and exchange instruments, they don’t really ask [to be on the console].” (Attending 4)</p>

Table 5.

Comments from residents regarding attending surgeons as potential barriers

	Representative comments
<i>Attending Comfort with Robotic Surgery</i>	<p>“[Attendings are] still learning it. The attendings are still changing how they do things too. So, they want to be able to learn as well.” (Resident 5, senior resident)</p> <p>“I think it’s still an evolving technology, even for the attendings who have done it for a while. So, my perception is that even though the surgeons are great at it, it’s still a little new to them, and they’re reticent to let a junior resident on the console.” (Resident 8, junior resident)</p> <p>“If you’re not super comfortable on the thing, then you’re probably not going to be super comfortable trying to teach that to somebody else.” (Resident 13, intern)</p> <p>“I think the biggest barrier is probably attendings’ comfort with the robot. I’ve seen attendings who are totally comfortable with residents doing everything open or laparoscopic, be hesitant to hand over the robotic controls based on where they’re at in their learning curve. A lot of attendings, even new attendings, didn’t train a lot with the robot in their fellowship or initial practice. It’s highly variable.” (Resident 16, senior resident)</p> <p>“Attendings are super comfortable with lap surgery, knowing when to step in. But because this is so new, it’s hard for them to know what they’re comfortable with right now.” (Resident 20, intern)</p>
<i>Relationship with Residents</i>	<p>“It’s up to the attendings level of interest in training residents... I have the impression that most of our attendings that perform robotic surgery are reasonably comfortable with the procedures they perform... Ideally that will no longer be a factor.” (Resident 1, junior resident)</p> <p>“Our attendings have been very helpful in letting us on the console if you’ve shown that you’ve done the exercises. Most of them want a certificate as proof. There’s a piece of it of ‘are you competent or not.’ I’m sure you can bypass the system if you can figure it out on your own. But why bother when there’s already a clear path for it... I think you have to be given some opportunities to show what you can do. Which is always a challenge.” (Resident 4, senior resident)</p> <p>“I think that’s an attending decision. And what they’re comfortable with, and what the case is. Some attendings are more comfortable giving you the space to let you do some things and others just aren’t as comfortable.... Some attendings will let us struggle more and figure it out, which I think is very valuable. I also think it depends on the case – if you have a redo or a case that’s going to very hard, something that’s going to be more delicate, there’s going to be less opportunity in a case like that.” (Resident 9, senior resident)</p> <p>“Resident involvement has grown with the number of cases. It’s a little attending-dependent in regard to how familiar they are or how much they’ve had to practice with the technology. How willing they are to let the residents do things... Part of it is the attending has to be committed to letting the resident be involved.” (Resident 15, senior resident)</p> <p>“Attending comfort with what they feel like the residents can do [is a barrier]. Probably depends on the residents’ experience using the console. And the attending seeing the resident using the console. So if they know that by the time they were a 4 or 5 and they’ve been on the console a lot, then maybe they would get them more in there... [also] probably how often they work with them, if they’ve seen them on other types of cases, how comfortable they are with their skill set, probably how comfortable they are managing floor patients... You have to be with an attending for a certain number of cases, so they can see you perform. Nobody is going to let you walk in and start doing the whole case” (Resident 17, junior resident)</p>

Table 6.

Comments from attending surgeons regarding residents as console surgeons

	Representative comments
<p><i>Attending Comfort with Robotic Surgery</i></p>	<p>“Complexity of the case, experience of the surgeon, and the comfort level of the surgeon [are all barriers]. I’m not super comfortable letting the resident dissect out the esophagus around the airway and the heart.” (Attending 1)</p> <p>“That may have been the case in the beginning when people were not comfortable. The attending is learning, and the resident is learning. But we’re past that. Now it’s time for the residents to learn robotics.” (Attending 5)</p>
<p><i>Residents as Console Surgeons</i></p>	<p>“I think having a formal way to know what kind of training a resident has had would be helpful. If I knew a resident has been through the steps and were certified in some way.” (Attending 1)</p> <p>“It’s not about the PGY year, it’s about the experience. Just right now, it’s only been chiefs that have that experience...I’ll ask them what they’re comfortable with. And then we can start out and do some dissection...part of working with residents is getting the feel of what someone is actually comfortable with.” (Attending 2)</p> <p>“The key to get on the console is you have to do the stuff to get on the console. So, we have a very defined training program here. You have to do your sims, you have to do your bedside assists. And then you get on the console. They’ve got to have the skill set. And they have to demonstrate some interest to be on the console. Sometimes I walk into the room and they’re completely disinterested in the case. In which case, if they’re not interested on getting on the console, they don’t have to get on the console.” (Attending 3)</p> <p>“I want to make sure they’re safe with what they’re doing. I’ll start with basic stuff, like taking down the white line. And I just watch them, how they’re clutching, are they swinging too fast or too slow. If their movements are purposeful and safe, then I let them keep operating. If I get uncomfortable with what they’re doing, then I start to take the case away from them...for me to let the resident operate, I have to watch and let them operate. By the time they’re a chief, they should know how to do a right colon. All I’m going to be watching is if they’re using the robot effectively on the tissue.” (Attending 4)</p> <p>“Now that we have 4th year residents, the decision is easy. Because I know you have experience in the lab. With a 2nd year resident, it’s more difficult. The hernia is a different thing, but for advanced surgeries, you should be more senior.” (Attending 5)</p> <p>“Well, I let them on the console every time because otherwise I don’t know what they can do. I let them start with the easiest part. If they show me they can do it, I let them continue. If it’s taking too long and getting into the wrong planes and causing bleeding, then I’ll take over.” (Attending 6)</p> <p>“[Residents are on the console] whenever they’re in my room...I kind of just watch them, I get a feel if they’re understanding the procedure. Get a gist of it when they’re at the bedside, if they’re engaged in the operation, if they’re willing to be proactive. Then I know next time they’re going to get to do the [peritoneal] flap.” (Attending 7)</p>

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