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Original Research

Simulation Training Effects on Resident-Perceived Readiness for Obstetric Anesthesia Rotation

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Introduction

Medical students and resident physicians often rotate between several subspecialty rotations during their training. Beginning an unfamiliar rotation can be challenging as leaners must expand their knowledge and skills to meet new clinical expectations, work with a new team of providers, and care for a new patient demographic. As a result, many learners across medical specialties and institutions feel unprepared for residency in general and also feel unprepared for their subspecialty rotations.[1-3] Feeling unprepared during residency creates anxiety and confusion and increases resident burnout, which negatively affects residents and their patients.[4,5] Therefore, increasing residents' readiness for training rotations may prove critical to both residents and residency programs, and it may ultimately improve the care that residents provide their patients.

Medical simulation is one method to improve preparedness among health care workers, including residents. Simulation involves recreating hypothetical clinical scenarios for the purpose of education or assessment. Simulation education addresses several shortcomings of the traditional, clinical practice-based method of resident education, and has become increasingly popular.[6] For example, specific clinical scenarios can be generated without the need to wait for them to naturally arise in actual practice. This allows trainees to gain experience with any desired situation, including those that may occur sporadically or rarely. Simulation training also eliminates the risks of having inexperienced learners provide care for real patients.[7] In addition, debriefing sessions at the end of simulations provide learners with valuable feedback and time for reflection on how to perform in the future. In contrast, debriefing sessions in clinical practice are often superseded by a large workload and/or strong emotions following a particular case, ultimately detracting from the learning experience.[8]

Simulation has been shown to be an effective method for teaching medical school students, residents, and attending physicians across many specialties.[9-12] Within the field of anesthesiology, simulation has been used for resident education in obstetric (OB), cardiac, neuroanesthesia, and regional anesthesia subspecialties.[13] In OB anesthesiology in particular, simulation has been used to teach residents epidural placement, to assess anesthesiologists' efficacy in providing general anesthesia for cesarean delivery, to improve teamwork during OB crises, and in identifying miscommunication and medical errors during eclampsia situations.[7] However, the effect that a rotation-specific simulation session has on residents' preparedness for a subspecialty rotation has yet to be determined. Therefore, we implemented a simulation session for first-year anesthesiology residents and measured changes in residents' perceived readiness for their first OB anesthesia rotation. Our primary outcome was the change in perceived preparedness for their OB anesthesia rotation following simulation training. Secondary outcomes included changes in perceived preparedness for discussing labor analgesia, setting up an epidural kit, placing a lumbar epidural, and converting a labor epidural to surgical anesthesia.

Materials and Methods

This study was reviewed by the Mayo Clinic Institutional Review Board and determined to be exempt. Simulation sessions were conducted in May and June 2020, May and June 2021, and May and June 2022, with a convenience sample of 3 distinct cohorts of postgraduate year 2 (PGY-2) and clinical anesthesia year 1 (CA-1) anesthesiology residents from a single, large academic medical center in the Midwest United States who had not yet participated in their first clinical OB anesthesiology rotation. One week before the simulation session, residents were invited to complete an online survey through the REDCap database (Nashville, TN) (Appendix). Each resident was assigned a unique number to maintain anonymity and prevent duplicate surveys. Survey questions were created by Dr Hans Sviggum and assessed residents' self-perceived preparedness for the upcoming rotation and cognitive patterns such as feelings of being scared or nervous for, excitement for, and expected enjoyment of the rotation. Survey questions were based on informal feedback from previous residents about what things they wish they had known prior to their OB anesthesia

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rotation. Responses were reported on a 0 to 100 visual analog scale (0 = *disagree*, 100 = *agree*). A reminder to complete the survey was sent by email the day prior to the simulation session. Residents then attended the OB anesthesia simulation session. One week after the simulation, residents were again invited to complete a survey containing the same questions as the presimulation survey. A final reminder to complete the survey was sent via email a week following this. Results from the surveys were exported for statistical analysis.

Simulation sessions were conducted at our institution's simulation center. Each session had 4 to 6 residents, lasted between 2 and 3 hours, and consisted of 4 simulated OB anesthesia scenarios. An actor stood in as a standardized patient (SP) in 3 of the 4 simulation sessions while the fourth session used a high-fidelity mannequin. The SPs all had previous experience with educational simulation sessions and received a copy of the scenarios at least 1 day prior to the sessions. One hour prior to each session, Dr Sviggum met with the SP to go over the scenarios and expectations and to answer questions. Participants did not know the scenarios before entering the simulation room. Each resident participated in 1 simulation alone or in conjunction with another resident (herein referred to as the *hotseat learners*) while the other residents watched a live video feed of the hotseat learners' performance from the debriefing room. Observers were encouraged to discuss the hotseat learner's actions in real time. Each simulation was followed by a debriefing session facilitated by an OB anesthesiologist who has experience as a TeamSTEPPS (Rockville, MD) Master Trainer as well as being an instructor for Anesthesiology Maintenance of Certification (MOCA) simulation courses (H.P.S.). During the debriefing session the just-completed scenario was reviewed, the scenario's learning objectives were discussed, predetermined topics of discussion were reviewed, and residents' questions were answered. Although there was no formal evaluation of the residents' performances, feedback was given to them based on a rubric that listed *best behaviors*, which coincided with major events within each scenario and the faculty member's judgement.

Simulation Scenarios

The 4 simulation scenarios build off one another as they follow the hypothetical course of a parturient presenting for delivery. Each scenario was approximately 10 minutes in length, followed by a 20-minute to 25-minute debriefing session.

Scenario 1: Informed Consent for Labor Analgesia

A term parturient with spontaneous onset of labor desires information about labor analgesia. The hotseat learner is called to consult and consent the patient for labor analgesia. The labor nurse provides the hotseat learner with the patient's medical history, physical exam, and labs. The hotseat learner must discuss the options for labor analgesia with the patient and their significant other. The debriefing session follows with a discussion about nonpharmacologic and pharmacologic options for labor analgesia and the risks and benefits of each. For this scenario, Dr Sviggum played the role of the patient's husband. The role of the patient was played by a SP. The role of the labor nurse was played by a simulation technician.

Scenario 2: Labor Epidural Placement

The hotseat learner is notified that the patient from Scenario 1 is requesting epidural analgesia. The hotseat learner must position the patient, set up an epidural tray, communicate with the patient, and then place an epidural in a mannequin simulation model (Genesis Epidural-Spinal Injection Simulator; Epimed International, Inc, Dallas, TX). The scenario ends after the hotseat learner administers 0.125% bupivacaine with 2 mcg/mL fentanyl through the epidural as an epidural loading dose. During the debriefing session, all residents receive instruction and practice in setting up an epidural kit, placing an epidural on the simulation model, and instruction on how to use an epidural for labor analgesia. For this scenario a SP played the role of the patient, Dr Sviggum played the role of the patient's husband, and a simulation technician played the role of the labor nurse.

Scenario 3: Augmentation of Labor Epidural for Cesarean Delivery

The patient from Scenario 2 has failed to progress, and her fetal heart rate tracing shows deep variable decelerations. The obstetrician calls for an urgent cesarean delivery. The hotseat learner must help move the SP from the labor room to the operating room, attach American Society of Anesthesiology standard monitors, and augment the epidural for cesarean delivery by choosing an appropriate type and amount of local anesthetic while the surgeon reminds the hotseat learner that the operation needs to proceed urgently. If the patient does not develop an appropriate anesthetic level by the time the surgeon is ready to make incision, the nurse informs everyone that the fetal status is improving which gives the hotseat learner more time to augment the epidural to an appropriate anesthetic level. When the patient becomes hypotensive, the hotseat learner must respond with fluids and vasopressors. Eventually the cesarean delivery is carried out and the scenario ends after the hotseat learner administers oxytocin following delivery. The debriefing session includes a discussion of how to use an in-situ labor epidural catheter for surgical anesthesia and how to communicate effectively with the OB and nursing teams in a stressful situation. For this scenario a SP played the role of the patient, a simulation technician played the role of the operating room nurse, and an anesthesiology resident played the simulated surgeon. Dr Sviggum was in direct communication with the surgeon via headset.

Scenario 4: Failed Augmentation of Labor Epidural for Cesarean Delivery

This scenario uses a high-fidelity simulation mannequin instead of a SP. Like Scenario 3, an urgent cesarean delivery is planned for a parturient with an in-situ labor epidural catheter. However, this epidural catheter proves to be nonfunctioning despite a standard augmentation with appropriate local anesthetic. The hotseat learner must make the decision to induce general anesthesia and carry this out on the simulation mannequin, including the administration of induction medications and intubation. The scenario ends with

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delivery of the baby. The debriefing session discusses techniques for managing epidural failure and the decision-making process that occurs in this situation. For this scenario a simulation technician played the role of the operating room nurse, an anesthesiology resident played the simulated surgeon, and Dr Sviggum was the voice for the mannequin and was in direct communication with the surgeon via headset.

Statistical Analysis

Power analysis assessment was based off preliminary data showing an average presimulation perceived readiness score of 30. The experiment was designed with 90% power to detect a difference in pre and post event perceived readiness scores. This power estimate assumed an average presimulation perceived readiness score of 30 and a change of 22.5 (75%) or more in perceived readiness post exposure. Presimulation and postsimulation survey results were summarized as median (25th percentile, 75th percentile) and compared with paired *t* tests. Mean postsimulation minus presimulation values were summarized as means with 95% confidence intervals. Kruskal-Wallis rank-sum tests were used to compare presimulation survey results between those participants who did and did not go on to complete the postsimulation survey. *P* values <.05 were considered statistically significant. All analyses were done using R version 4.1.2 (R Foundation for Statistical Computing, Vienna, Austria).

Results

All residents completed all 4 simulation scenarios in the same session, in the same order. In total, participants completed 50 presimulation and 45 postsimulation surveys (Appendix). After removing duplicate surveys there were 49 and 44 unique participants with presimulation and/or postsimulation survey data. Of these, there were 41 participants with both presimulation and postsimulation survey data to use in the paired analysis. Results from the 8 unpaired presimulation surveys were not significantly different from the 41 paired presimulation (Supplemental Table). Following the simulation session there was an increase in residents' perceived preparedness to start their OB anesthesia rotation (median difference, 43; interquartile range [IQR], 38-49; *P* < .001). Residents reported improvements in self-perceived readiness for discussing epidural analgesia with a parturient (paired postsimulation minus presimulation survey median difference, 40 [35-45]; *P* < .001), setting up an epidural kit (37 [31, 43]; *P* < .001), correctly placing a lumbar epidural catheter (31 [25, 37]; *P* < .001), and in converting epidural labor analgesia to surgical anesthesia for cesarean delivery (53 [46, 60]; *P* < .001) (Table 1). There was no difference in resident excitement for the OB anesthesia rotation following the simulation session (3 [−2, 8], *P* = .223). Following the simulation session, residents felt that OB anesthesia would be more likely to be their favorite rotation in residency (8 [4, 11]; *P* < .001), and there was a decrease in the residents' scores of feeling nervous or scared about starting their OB anesthesia rotation (−13 [−21, -6]; *P* < .001) (Figure 1).

Discussion

In this study, we found that implementation of a content-specific anesthesia simulation session prior to a resident's first OB anesthesia rotation substantially increased residents' general feeling of preparedness for their first OB anesthesia rotation. This was particularly true for the practical skills covered in the simulation session that are commonly employed during an OB anesthesia rotation. Residents reported improvements in perceived preparedness for specific tasks including the nontechnical skill of discussing epidural anesthesia with a parturient as well as the technical skills of assembling, placing, and converting a lumbar epidural catheter for surgical anesthesia. Importantly, the skills acquired through simulation have previously been shown to transfer into clinical practice.[13]

Simulation as a method of medical training has gained popularity in recent years. In anesthesiology training programs specifically, data continues to show the efficacy of simulation in teaching residents.[14] We chose to run 4 scenarios for our residents based upon what we deemed the most important concepts to learn prior to the start of their OB anesthesia rotation within our goal of a 3-hour session. Simulation training can be effective in teaching both technical or nontechnical skills.[11,15] Indeed, our findings confirm that the scenarios we created improved comfort with both communication skills and technical skills. Both are vital in an OB anesthesia rotation as residents must become proficient in technical skills such as administering epidural anesthesia and in nontechnical skills such as discussing an anesthesia plan with a parturient.

Prior to their simulation session, our residents clearly felt unprepared to start an OB anesthesia rotation, as evidenced by the median value of 20 in response to the statement *I feel prepared to start my OB anesthesia rotation*. This is in line with other studies showing that residents from a variety of subspecialties have reported feeling unprepared while in residency.[1-3] While their study did not specifically assess residents' perceived readiness, Jena et al found a significant increase in mortality in high-risk acute myocardial infarction patients when new residents come on staff at teaching hospitals, but no difference at nonteaching hospitals, and attributed this to residents' inexperience.[16] Additionally, feeling unprepared during residency nearly doubles the risk of resident burnout.[3] Studies report that anywhere from 27% to 75% of residents across specialties experience burnout, which has consequences including increased rates of resident depression, suicidal ideation, substance abuse, and medical errors.[4,5] Thus, there is value in investigating methods to better prepare residents throughout their training.

In contrast to the substantial increases in resident confidence with practical OB anesthesia skills, residents' emotions toward their upcoming OB anesthesia rotation were less affected by the simulation session. There was a significant but overall small decrease in residents feeling nervous or scared for their upcoming OB anesthesia rotation. We also found a small increase in residents who believed that OB anesthesia would be their favorite rotation of residency following the simulation session. Resident excitement for the rotation was not affected by the simulation session. Overall, the magnitudes of change in these emotional domains were less substantial than in the domains dealing with more practical skills.

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While we only surveyed residents 1 week after the simulation session, Smith et al[11] has previously shown that residents report a sustained increase in confidence from simulation training at 11 months postsimulation training. This is important because some of our residents who participated in the simulation sessions will not start their OB anesthesia rotation for nearly a year following the session. Ideally, we would have been able to survey these residents during or after their actual OB anesthesia rotation to see more accurately how the simulation session prepared them and how much of the education was retained. Theoretically, there could be a discrepancy between residents' perceived preparedness and their actual preparedness if the requirements of the OB anesthesia rotation turn out to be different from what residents believe them to be in advance of the rotation. Considering that the simulation scenarios in this study were based on common clinical scenarios in OB anesthesia, however, it is likely that this increase in perceived preparedness correlates with an actual increase in preparedness. Regardless, improvements in either perceived or actual preparedness have been shown to reduce resident burnout and its consequences. Therefore, simulation training for specific rotations in residency may be an avenue to improve residents' well-being, educational experience, and the care that they provide for their patients.

It is difficult to ascertain how much of the benefit of simulation exercises is because of the *content* of the scenarios and how much is because of the *context* of being in an environment conducive to asking questions, making mistakes, and seeing how one's peers respond to scripted cases. Context and content likely work synergistically and cannot be completely separated. Our study does not provide clarity about whether simulation training is superior to traditional teaching methods such as lectures or one-on-one training with a faculty member. However, the debriefing at the end of each scenario includes a discussion that highlights the learning objectives but also leaves ample time for learners to discuss ideas and questions that may be tangential but important to their thought processes. Given the numerous advantages of simulation training, it is not surprising that there is currently widespread desire among residents for more simulation training in their residency programs.[17,18]

Our results show that a carefully designed and implemented simulation education session can be advantageous in preparing residents for residency rotations. However, there are many things to consider when implementing simulation into a training program. A primary consideration is cost, specifically space, equipment, and personnel. For example, the minimum equipment needed for anesthesia simulations includes beds, monitors, anesthesia machines, high-fidelity mannequins, surgical supplies, carts, and computers. A full assessment of cost is outside the scope of this manuscript. Additionally, the time needed to develop scenarios, train personnel, and have practice sessions is not negligible. Certainly, this is an endeavor that requires institutional and program buy-in and support.

There are limitations to our study. The survey used was unvalidated and only addresses perceived preparedness as previously mentioned. No survey was performed after the residents completed their OB anesthesia rotation. Although each simulation session followed the same schedule, residents may have had different experiences based on what spontaneously happened in each simulation session. Additionally, not all residents filled out both surveys. Eight residents completed the presimulation survey but not the postsimulation survey, and 3 residents completed the postsimulation survey but not the presimulation survey. Analysis of all presimulation surveys showed no difference between those that had a paired postsimulation survey and those that did not. Finally, after administering presimulation and postsimulation surveys it was realized that there was a discordance between the scale on the survey and recorded output. The scale was listed from 1 to 10 on the survey, but provided corresponding outputs from 1 to 100 (eg, 6.7 = 67). However, we do not believe this discrepancy affected survey responses as the visual analogue scale visually demonstrated how close to *disagree* or *agree* participants were answering (Appendix).

In summary, this study shows that an OB anesthesiology simulation session improves anesthesiology residents' perceived preparedness, for at least 1 week, for their first OB anesthesiology rotation. To our knowledge, this is the first study that has assessed the effect of a prerotation, rotation-specific simulation training session on residents' feelings of preparedness for a given rotation. The positive effect the simulation session had on residents' perceived preparedness suggests the possibility of using rotation-specific simulation training sessions for other anesthesiology subspecialty rotations, for residency programs in other specialties, and for medical school students prior to their clinical rotations. Future studies should expand our sample size, explore retention of preparedness perception, and determine if outcomes are improved, both for trainees and patients, following simulation preparation sessions.

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Abstract

Background: Beginning an unfamiliar rotation can be challenging as residents must expand their knowledge and skills to meet new clinical expectations, work with a new team of providers, and sometimes care for a new patient demographic. This may detract from learning, resident well-being, and patient care.

Methods: We implemented an obstetric anesthesia simulation session for anesthesiology residents prior to their first obstetric anesthesia rotation and measured the effect on residents' self-perceived preparedness.

Results: The simulation session increased residents' feelings of preparedness for the rotation and increased residents' confidence in specific obstetric anesthesia skills.

Conclusions: Importantly, this study shows the potential for the use of a prerotation, rotation-specific simulation session to better prepare learners for rotations.

Keywords: Resident preparedness, resident readiness, obstetric anesthesia simulation, resident simulation

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Figure

Figure 1. *Forest plot of mean post- minus pre-simulation session differences in survey responses (N = 41).*

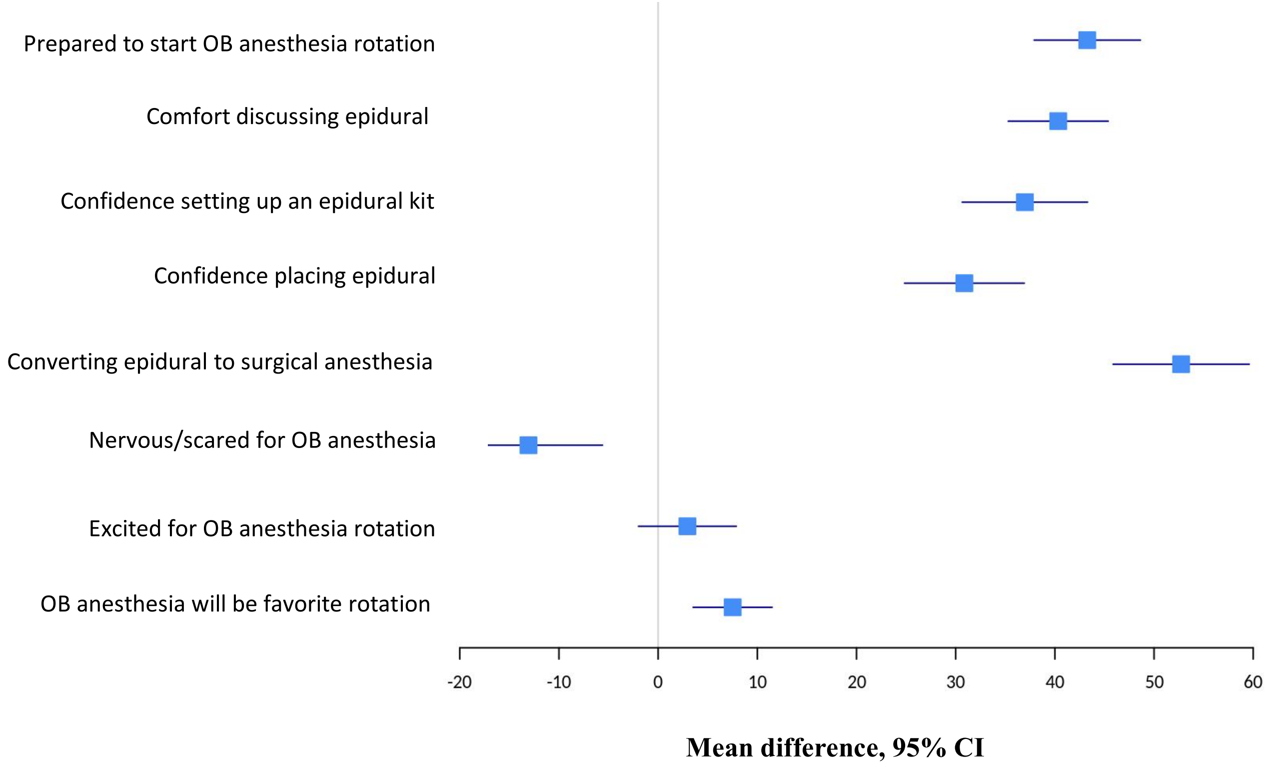

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Table

Table 1. *Summary of Presimulation, Postsimulation, and Paired Survey Results (N = 41)*[a]

	Presimulation	Postsimulation	Post – Pre Estimate (95% CI)	*P* Value
I feel prepared to start my OB anesthesia rotation.	20 (3, 30)	65 (50, 80)	43 (38, 49)	<.001
I feel comfortable discussing epidural analgesia with a parturient.	30 (20, 37)	71 (65, 80)	40 (35, 45)	<.001
I feel confident in my ability to set up an epidural kit.	30 (20, 50)	70 (58, 90)	37 (31, 43)	<.001
I feel confident in my ability to correctly place a lumbar epidural catheter.	25 (10, 45)	61 (41, 71)	31 (25, 37)	<.001
I understand how to convert epidural labor analgesia to surgical anesthesia for cesarean delivery.	10 (0, 27)	70 (59, 80)	53 (46, 60)	<.001
I am nervous/scared about starting my OB anesthesia rotation.	65 (50, 80)	50 (40, 62)	−13 (−21, −6)	.001
I am excited for my OB anesthesia rotation.	73 (61, 80)	70 (60, 87)	3 (−2, 8)	.233
I feel that OB anesthesia will be my favorite rotation in residency.	50 (20, 62)	50 (40, 61)	8 (4, 11)	<.001

Abbreviations: CI, confidence interval; OB, obstetric.

[a] Presimulation and postsimulation survey results are summarized as median (25th percentile, 75th percentile). Postsimulation minus presimulation differences is summarized as mean (95% CI) and compared using paired *t* tests.

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Appendix

Appendix. *Presimulation and Postsimulation Session Survey*[a]

Have you finished participation in the CA-1 OB Anesthesia Simulation Session? * must provide value	(•) Yes ( ) No — reset
I feel prepared to start my OB anesthesia rotation. * must provide value	0 — 5 — 10: 79 — reset — 0 is Disagree and 10 is Agree
I feel comfortable discussing epidural analgesia with a parturient. * must provide value	0 — 5 — 10: 61 — reset — 0 is Disagree and 10 is Agree
I feel confident in my ability to set up an epidural kit. * must provide value	0 — 5 — 10: 39 — reset — 0 is Disagree and 10 is Agree
I feel confident in my ability to correctly place a lumbar epidural catheter. * must provide value	0 — 5 — 10: 64 — reset — 0 is Disagree and 10 is Agree
I understand how to convert epidural labor analgesia to surgical anesthesia for cesarean delivery. * must provide value	0 — 5 — 10: 90 — reset — 0 is Disagree and 10 is Agree
I am nervous/scared about starting my OB anesthesia rotation. * must provide value	0 — 5 — 10: 20 — reset — 0 is Disagree and 10 is Agree
I am excited for my OB anesthesia rotation. * must provide value	0 — 5 — 10: 96 — reset — 0 is Disagree and 10 is Agree
I feel that OB anesthesia will be my favorite rotation in residency. * must provide value	0 — 5 — 10: 59 — reset — 0 is Disagree and 10 is Agree

[a] After administering presimulation and postsimulation session surveys, it was realized that there was a discordance between the scale on the survey and recorded output. As seen above, the sliding scale was listed from 1 to 10 but provided corresponding outputs from 1 to 100 (eg, 6.7 = 67). However, we do not believe that this discrepancy affected survey responses as the visual analogue scale visually demonstrated how close to *disagree* or *agree* participants were answering.

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Supplemental Online Material

Supplemental Table. *Summary of all presimulation surveys according to inclusion and exclusion in the final paired analysis*[a]

	Excluded Survey (n = 8)	Included Survey (n = 41)	*P* Value
I feel prepared to start my OB anesthesia rotation.	23 (8, 43)	20 (3, 30)	.481
I feel comfortable discussing epidural analgesia with a parturient.	31 (22, 50)	30 (20, 37)	.635
I feel confident in my ability to set up an epidural kit.	25 (8, 46)	30 (20, 50)	.533
I feel confident in my ability to correctly place a lumbar epidural catheter.	21 (9, 33)	25 (10, 45)	.684
I understand how to convert epidural labor analgesia to surgical anesthesia for cesarean delivery.	10 (2, 33)	10 (0, 27)	.743
I am nervous/scared about starting my OB anesthesia rotation.	55 (38, 67)	65 (50, 80)	.212
I am excited for my OB anesthesia rotation.	70 (45, 81)	73 (61, 80)	.490
I feel that OB anesthesia will be my favorite rotation in residency.	58 (28, 71)	50 (20, 62)	.447

Abbreviation: OB, obstetric.

[a] Data are from all completed presimulation survey results. Participants who did not fill out the postsimulation survey (n = 8) were excluded from the paired analysis. Presimulation survey results are presented as median (25th percentile, 75th percentile) and compared using Kruskal-Wallis rank-sum tests.