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Original Research

Defining and Addressing Anesthesiology Needs in Simulation-based Medical Education

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Introduction

Multiple articles have linked simulation-based medical education (SBME) with improved clinical outcomes[1-13] such as improved self-confidence,[1-3] reduced time to achieve proficiency,[4] reduced errors,[5] and improved patient safety outcomes.[6-7] SBME is also naturally suited for scaffolding, whereby educators taper off support as learners advance through zones of proximal development and gradually acquire proficiency.[14-16]

With the myriad of benefits associated with SBME, having the infrastructure to appropriately accommodate SBME is vital to educating residents. Having accessible simulation and skills training spaces also facilitates opportunities to practice just-in-time (JIT) simulation training to address procedural skill decay, with several studies showing the value of JIT simulation training in health care. A 2015 systematic review of JIT simulation training for clinicians found it led to improved provider performance.[17] A randomized controlled trial published by Branzetti et al[18] in 2017 showed that a JIT simulation-training intervention for board-certified physicians performing transvenous pacemaker placement led to significant improvements in various aspects of procedure performance during simulated patient events. These include procedure preparation, achieving capture, troubleshooting for failed captures, postprocedure tasks, and reduction of critical omissions.[18] Having a readily available space for JIT simulation training can also be a great boon for trainees in the process of acquiring proficiency and self-confidence: A cross-sectional survey study published by Thomas et al[19] in 2016 found that their inclusion of an in situ JIT training room in their pediatric emergency department led to improvements in trainees' confidence and procedural skills. Furthermore, supervising providers reported they were less inclined to intervene during a trainee's procedure if the JIT room had been used.[19]

Despite SBME's advantages, logistical and financial issues may hamper its incorporation into curricula.[20] Whereas institutions may have access to simulation centers, costs and human resources to host high-fidelity centers mean they are typically shared by multiple departments, and they may be located off campus.[20,21] This can result in limited SBME opportunities due to inadequate scheduling availability and difficulties traveling to off-campus locations, as well as lack of supplies needed for specialty-specific tasks such as epidural placement. Simulation centers are often designed for full-body physiologic simulations and therefore may not be suited for training specialty-specific procedural skills such as epidural placement and advanced airway rescue. Should faculty or trainees be unable to attend simulations, it may be difficult to reschedule in a timely manner. Faculty may also fear the financial consequences of diverting time to spend on SBME.[20]

A departmental education laboratory, which is a space dedicated to a specific department's educational efforts, can be one solution to these issues because it can serve as a dedicated location in proximity to service sites, its unshared nature prevents scheduling conflicts with other departments, and it can host specialty-specific task-training equipment. Beth Israel Deaconess Medical Center (BIDMC)'s Department of Anesthesia, Critical Care, and Pain Medicine created the Anesthesia Education Laboratory (AEL) to serve as a combination skills laboratory, lecture hall, and education research hub. Supplemental Figure 1 shows a photograph of the AEL, Supplemental Figure 2 depicts the AEL's initial concept image, and Supplemental Figure 3 illustrates the AEL's current layout.

The AEL is supported by a dedicated laboratory manager and a rotation of senior residents completing a 1-month simulation education elective, and there is ample space for didactics, open laboratories, and procedure skill-competency checkoffs. It houses various mannequins and procedural trainers to facilitate practice of airway management; fiberoptic techniques; ultrasound image acquisition; intravenous and arterial access; and regional anesthesia. The AEL is also used to practice nontechnical skills via simulation, such as leading codes, communicating with agitated patients, and addressing difficult interactions with perioperative staff.

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Although BIDMC has used the AEL extensively to incorporate SBME into its anesthesiology education efforts, we were uncertain of how other programs used SBME. To better understand the status of and potential barriers to SBME in the United States, a national needs assessment survey was undertaken. Although preexisting surveys have assessed SBME utilization,[20-22] to our knowledge only 1 published findings regarding SBME use among anesthesiologists[21] since the 2020 changes to Accreditation Council for Graduate Medical Education (ACGME) milestones, which emphasize competency-based training and objective performance measures.[23] Because the aforementioned study focused on pediatric anesthesia fellowship programs,[21] there is a knowledge gap in assessing anesthesiology residency programs' SBME utilization. The survey's goals were to (1) identify settings where SBME took place; (2) identify available and desired resources for SBME; (3) identify barriers to SBME; and (4) establish whether a departmental education laboratory such as BIDMC's AEL was perceived as useful for other institutions.

Methods

The study was approved by BIDMC's institutional review board as exempt protocol No. 2020P001137 (Needs Assessment of Anesthesia Residency Programs Simulation-Based Training) with a waiver for documentation of informed consent. BIDMC's REDCap electronic data capture tools were used to create and distribute anonymous surveys to program directors of anesthesiology residency programs.[24] The recipient list was generated from publicly available information on existing United States anesthesiology residency program leadership on the Fellowship and Residency Electronic Interactive Database.[25] After reviewing existing literature, the survey was designed by a practicing anesthesiologist educator experienced in simulation and task trainers for education (J.D.M.) and an experienced education laboratory manager (M.J.C.). No preexisting surveys were used as specific templates. We made our survey relatively simple to improve response rates by reducing the survey's potential burden.

As detailed in Table 1, the final survey consisted of 8 questions assessing where and how SBME took place, resource availability, frequency of use, and barriers to use; and 2 questions assessing perceived utility of and desired resources for a departmental education laboratory. Survey reminders were sent twice (once weekly) after initial distribution on December 7, 2020, followed by targeted emails to 9 recipients over approximately 3 weeks (April 22 to May 7, 2021). Targeted recipients included anesthesiology program directors that the senior author (J.D.M.) had interacted with in the past and therefore believed them to be receptive to a targeted email request to complete the survey, as well as directors who had recently assumed positions from preceding directors we initially sent surveys to but who did not complete the survey themselves. However, we are unable to link any single respondent with their set of survey responses due to setting up our RedCAP survey. Data are reported as frequencies and/or percentages of responses.

Results

Survey Response Rate

Contact information for program directors was obtained for 148 of 161 listed United States anesthesiology residency program directors. Not all programs listed contact information for their directors, and some listings were outdated with the listed director having left the institution and/or stepped down from their position. Several listed contacts who stepped down from their position informed us of their successors, who we then forwarded invitations to and included within our count of contact information for 148 of 161 program directors. Survey response rate was 30.4% (45/148). Full survey results are described in Table 1; a copy of the survey is in Supplemental File 1.

Frequency of Training

Most programs stated residents experienced simulation 1 to 4 times per year (64.4%), with the second highest reported frequency being approximately once a month (22.2%). All but 1 disclosed that residents had ≥ 60% participation rate with scheduled SBME events (97.8%), with most noting ≥ 80% participation rates (80%). The remaining program stated their participation rate as 20% to 39%.

Locations of Training

SBME occurred across various locations, as depicted in Figure 1. Most programs reported an "on-campus central simulation laboratory shared with other departments" as 1 of their simulation training locations (84.4%); furthermore, most programs noted such places were where SBME primarily occurred (64.4%). Of note, all 6 respondents who noted their primary SBME location was at a dedicated space designed exclusively for their anesthesia department reported an estimated 80% to 100% resident participation rate category—as did the 5 respondents who reported off-campus simulation laboratories as their primary SBME locations. Also, 14 of the 16 respondents who reported having a dedicated space exclusive to their anesthesia department reported 80% to 100% resident participation (the other 2 had 1 reporting 20%-39% and 1 at 60%-79%).

Types of Training

Programs reported a broad range of skills and activities practiced at their primary center for SBME, as depicted in Figure 2.

Resources for Training in the Primary Center

Mannequins, dedicated task trainers, and ultrasound/echocardiography simulators were frequently noted among resources available at programs' primary SBME centers (100%, 84.4%, and 77.8% respectively). In contrast, virtual reality (VR) and augmented reality (AR) software availability and three-dimensional (3D) printing capability were rarely noted as available resources (24.4% and 13.3%, respectively). Dedicated staff to manage the space was reported in 77.8% of centers. Full responses for this question are depicted in Figure 3.

Barriers to Training

Top reported SBME barriers were COVID-19 precautions (75.6%), scheduling difficulties with participants (57.8%), and lack of trainers/staff availability to facilitate training (48.9%). Costs for supplies, inadequate equipment, costs for renting laboratories, inadequate space, and travel difficulties were each reported as barriers by

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fewer than 30% of programs. Full responses for this question are depicted in Figure 4.

Education Laboratory Concept

When asked whether a dedicated education laboratory space would be a useful resource, 77.8% of respondents indicated it would be *useful* or *very useful*, with most (62.2%) indicating it would be *very useful*. Two programs indicated it would be *not very useful* (4.4%), and 2 programs indicated a dedicated space would be *not useful* (4.4%). The resources most frequently selected as desirable for a department-based education laboratory were *airway management mannequins/trainers*, *fiberoptic bronchoscopes*, *ultrasound/echocardiography simulators*, *ultrasound machines*, and *airway management equipment* (75.6%-82.2%). Several respondents marked *VR/AR* and *dedicated staff to manage the space* as useful resources (60.0% each), whereas few respondents selected *3D printing capabilities* as a useful resource (26.7%). Respondents could select multiple resources for the aforementioned survey item.

Discussion

Our survey's goals were to identify where SBME takes place for anesthesiology residency programs, identify available and desired resources for SBME, barriers to SBME, and perceptions of a dedicated education laboratory like ours. From our 45 respondents, we gathered that SBME is widely incorporated, though typically only 1 to 4 times per year, in institutional or shared simulation centers; prominent barriers included COVID-19 precautions, scheduling difficulties, and a lack of trainer availability; task trainers for airway management and ultrasound/echocardiography simulators were among the most prominently used and desired SBME resources; and most programs would value a dedicated education laboratory. As our specialty moves toward competency based-training, it is increasingly important to provide learners with opportunities to improve skills with greater frequency and flexibility. Although COVID-19 restrictions and scheduling issues were cited as the top barriers to SBME, these barriers can be addressed by using dedicated education laboratories for smaller-sized, more frequent training sessions at times amenable to schedules.

A notable finding was that the vast majority of respondents reported an estimated 80% to 100% resident participation rate in scheduled simulation training events (n = 36; 80%). It could be that certain factors are associated with resident participation rates at or near 100%, such as presence of dedicated departmental SBME spaces or particular resource availabilities. Conversely, certain barriers may be what keep programs from reaching 100% or near-100% participation rates. In addition, the fact that all 5 respondents who reported dedicated SBME spaces as their primary SBME space also reported 80% to 100% participation rates might be a signal of a correlation between departmental education laboratories and increased resident participation in scheduled SBME, but we can by no means assert this supposition with our limited sample size.

A meta-analysis of instructional approaches in procedural training found studies involving simulation and competency-based approaches were effective forms of training, and noted that "All procedures, whether simple or complex, involve a stepwise progression of technical steps for which knowledge of anatomy, familiarity with equipment and fluency of movement are equally important."[16] Having readily available spaces such as departmental education laboratories facilitates stepwise progression in learners and allows reliable opportunities for JIT training prior to starting specialty rotations. This approach has proven useful to our residency program at BIDMC and led to more frequent and consistent SBME.

The AEL at BIDMC was developed to address SBME barriers we experienced. Although the AEL was not created specifically to address COVID-19 precautions, it being a fairly large space with ample room to maintain social distancing and the ability to host several small group sessions with relative ease due to having full control over scheduling proved to be a great boon during the COVID-19 pandemic. For example, during our intern course's ultrasound training we were able to block off an entire day for interns to cycle through stations set up in the AEL for simulator practice with faculty, independent simulator practice, and live-model practice/testing sessions. This allowed for keeping a low number of people in the room simultaneously while affording each trainee ample time for focused one-on-one time with staff; independent learning; and reducing the number of faculty and live models that a larger simultaneous training event would necessitate. Similarly, greater ease of scheduling SBME and impromptu JIT training in the AEL over a shared space helped accommodate the busy schedules of faculty and residents.

Survey respondents perceived the AEL's concept favorably. Only 4 indicated a departmental education laboratory such as BIDMC's would be *not very useful/not useful* to their department (8.8%). Two of those respondents appeared to have no issues integrating SBME into their program, given that they reported having robust, regularly scheduled SBME and abundant resources at their primary simulation centers; their only reported barriers to SBME were a *lack of trainers/staff availability to facilitate training* and *COVID-19 Precautions*. In contrast, we surmise the other 2 programs do not actively incorporate SBME into their programs, because 1 reported only 20%-39% resident participation and the other reported only using simulation for "crisis resource management."

Some of our findings mirror those of Savoldelli and colleagues' 2005 survey[20] of a single institution with 2 simulation centers. Notably, both surveys indicated nontechnical skills are frequently practiced via SBME and identified scheduling difficulties as a SBME barrier.[20] In contrast, Savoldelli and colleagues' survey is notable for having only 25% of respondents classifying "teaching technical skills (e.g., airways, chest tubes, etc.)" as a high-priority course; whereas in our survey, procedural skills such as airway management and ultrasound imagining were frequently reported as activities (93.3% and 80%, respectively).[20] This may be reflective of increased SBME, or perhaps the evolution of technology and clinical practice over these past 15 years. Likewise, findings from our survey matched that of Ambardekar and colleagues' 2018 national survey of ACGME-accredited pediatric anesthesiology fellowship programs.[21] Both surveys noted that programs typically implemented SBME 1 to 4 times per year

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in on-campus or hospital-based simulation centers and frequently identified scheduling as a barrier.[21] Ambardekar and colleagues'[21] survey notably reported that 87% of respondents believed standardized simulation curricula should be developed for voluntary use within all pediatric anesthesiology fellowship programs. The revelation of high interest in standardized simulation curricula by the Ambardekar et al[21] survey may coincide with our survey's revelation that most anesthesia residency programs consider dedicated education laboratories as useful or very useful resources, because dedicated education laboratories could improve access and facilitate implementation of standardized simulation curricula.

Justifying the cost of establishing a departmental skills laboratory may be challenging for programs. However, costs for BIDMC's AEL were substantially reduced via support from engineering and anesthesia technicians in providing phased-out equipment and expired supplies, respectively. Although dedicated staff to support the education laboratory represents an expense and only 60% of programs reported interest in this for a departmental education laboratory, we believe it adds significant value. Laboratory managers can aid in procuring expired supplies and maintaining equipment to reduce annual expenditure. They can also create low-cost alternative task trainers including gel block phantoms, intravenous trainers, and 3D models to reduce supply costs.[26-28] Laboratory managers can also help coordinate administrative and research efforts, reducing burdens and costs in these areas. Departments seeking laboratory managers can create a part-time position if they do not expect a need to staff laboratories throughout workweeks or have budgetary concerns; furthermore, creating such positions presents growth opportunities for existing departmental staff.

Having a space with flexible scheduling and a laboratory manager who can provide research support has helped markedly expand our efforts in teaching and assessing technical skills using hand motion metrics, video assessments, VR skills training, and 3D modeling.[29-31] Prior to the AEL's inception, it was logistically challenging to book small group sessions to accomplish these intensive training and research programs. An example of this is our skills checkoff program, where residents are required to complete relevant technical skills checkoffs prior to starting subspecialty rotations on cardiac, vascular, and thoracic surgery. Prior to the AEL, participation was poor (averaging < 30%) and checkoffs occurred in a shared, central simulation center. However, since the AEL's inception, participation has improved to 100%. Furthermore, the AEL avoids costs associated with booking time in shared laboratories, as well as personnel costs to have their simulation staff present. Anecdotally, our faculty and trainees have expressed appreciation in the AEL's ability to support essentially on-demand, ad hoc opportunities to practice skills.

There are several limitations to this study. We did not use a validated survey tool nor did we model this survey after any preexisting surveys on SBME, because we wished to use questions specific to our study's goals of assessing SBME issues and wished to do so in a timely manner to assess how COVID-19 affected SBME efforts. In addition, the survey response rate was low, with only 45 responses out of 148 potential respondents. This may be due to the dissemination coinciding with the COVID-19 pandemic and/or the end of the calendar year, given that prior research into why physicians may not respond to surveys identified a major reason as receiving too many survey requests and a lack of time to complete them.[32] Furthermore, to comply with our institutional review board's requirements for recruitment emails, we used standardized language to ensure certain aspects of the study were noted in detail, such as the protocol number and full title; to communicate that participation was optional and voluntary; and to list whom to contact with questions about rights in participating with research. This resulted in the generalized survey invite that was 4 paragraphs long. Although our response rate was low at 30.4%, such a rate was still in line with previously published surveys.[33]

We acknowledge our respondent pool was likely biased toward program directors with greater interests in simulation and/or who were more concerned about barriers to implementing SBME; the fact that we included 9 targeted recipients likely to respond to a personal request to complete the survey and/or who recently succeeded their position as program director likely exacerbates these potential biases as well. Whereas respondents could provide custom answers to questions by selecting *other*, this survey did not accommodate follow-up assessments due to its anonymous nature. Whereas repeated survey methods such as a Delphi method may have elicited in-depth information on how residency programs use and view SBME, it would have added concerns of respondent dropout over repeated rounds of questioning, in addition to preexisting concerns about achieving adequate response rate.

Conclusion

Our survey of anesthesiology residency program directors hailing from all US census regions shows SBME is a widely used tool in anesthesiology residency programs. Most respondents believed a department education laboratory would be valuable for facilitating SBME. The establishment of our AEL led to increased capabilities to support structured SBME events more frequently and in smaller groups, so as to align better with deliberate practice, mastery-based learning principles and to remain compliant with class size limitations during the COVID-19 pandemic. We therefore believe that other academic departments would also benefit from establishing dedicated departmental SBME spaces.

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Abstract

Background: This study's primary aim was to determine how training programs use simulation-based medical education (SBME), because SBME is linked to superior clinical performance.

Methods: An anonymous 10-question survey was distributed to anesthesiology residency program directors across the United States. The survey aimed to assess where and how SBME takes place, which resources are available, frequency of and barriers to its use, and perceived utility of a dedicated departmental education laboratory.

Results: The survey response rate was 30.4% (45/148). SBME typically occurred at shared on-campus laboratories, with residents typically participating in SBME 1 to 4 times per year. Frequently practiced skills included airway management, trauma scenarios, nontechnical skills, and ultrasound techniques (all ≥ 77.8%). Frequently cited logistical barriers to simulation laboratory use included COVID-19 precautions (75.6%), scheduling (57.8%), and lack of trainers (48.9%). Several respondents also acknowledged financial barriers. Most respondents believed a dedicated departmental education laboratory would be a useful or very useful resource (77.8%).

Conclusion: SBME is a widely incorporated activity but may be impeded by barriers that our survey helped identify. Barriers can be addressed by departmental education laboratories. We discuss how such laboratories increase capabilities to support structured SBME events and how costs can be offset. Other academic departments may also benefit from establishing such laboratories.

Keywords: Simulation, education, anesthesia, residency, survey, milestones

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Figures

Figure 1. *Primary simulation space for programs. The pie chart in Figure 1 depicts the distribution of respondents' answers for question 5 of our survey (n = 45): "In which location does the majority of simulation-based training take place at your program?" Respondents were only able to select 1 answer. Other responses to this question consisted of 1 of each of the following responses: an off campus, affiliated, shared lab; empty operating rooms; and a central shared laboratory that is on campus for the medical school but off campus for the center's department.*

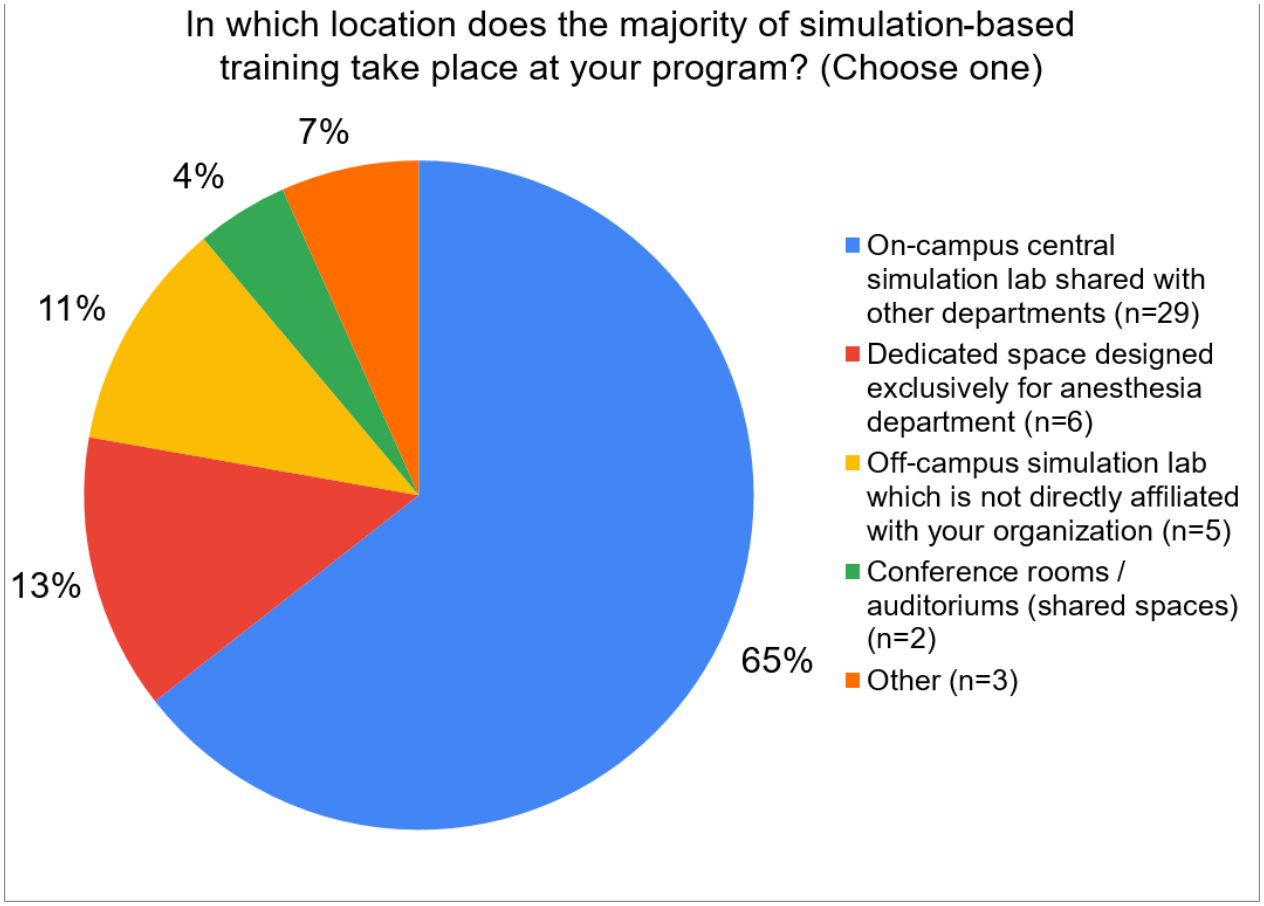

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Figure 2. *Skills and activities at primary simulation spaces. The bar chart in Figure 2 depicts the distribution of respondents' answers for question 6 of our survey (n = 45): "Which skills are practiced/which activities occur in the place you listed above [i.e., at the primary simulation space]," in descending order by percentage of respondents who selected each skill. This question allowed respondents to select multiple options simultaneously, as applicable; thus, percentages for the answers total to over 100%. Other responses to question 6 consisted of 1 of each of the following responses:* introduction to pediatrics rotation; clinical scenarios, OSCE *[Objective Structured Clinical Examination]* preparations, and cadaver lab; specific anesthesia complications; point-of-care ultrasound; *and* crisis resource management. *One respondent did not provide details for their selection of* other *for this question.*

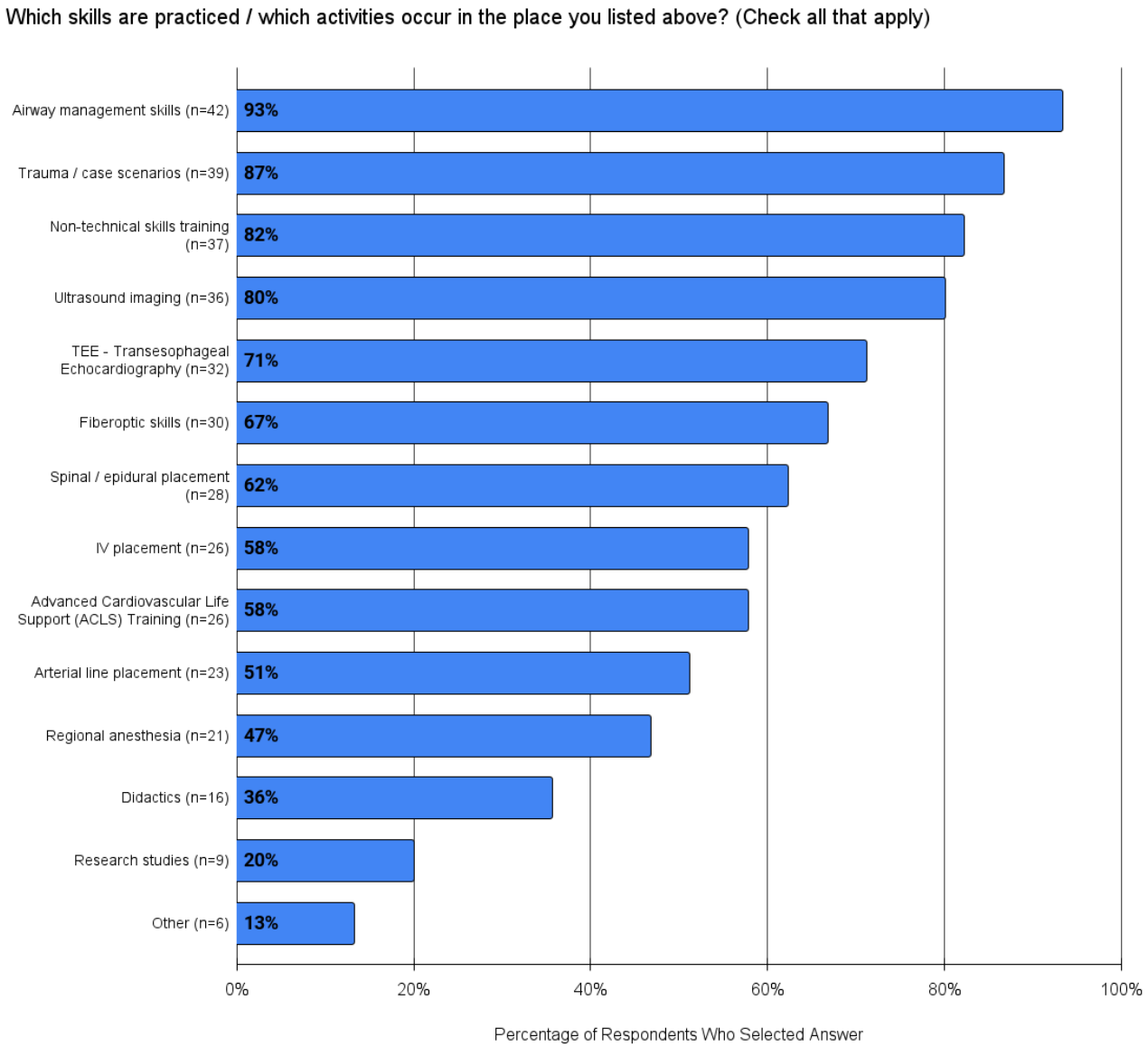

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Figure 3. *Resources at primary simulation spaces. The bar chart in Figure 3 depicts the distribution of respondents' answers for question 7 of our survey (n = 45): "What resources are available at the primary center for simulation-based training," in descending order by percentage of respondents who selected each resource. This question allowed respondents to select multiple options simultaneously, as applicable; thus, percentages for the answers total to over 100%. Other responses to question 7 consisted of 1 of each of the following responses:* video *and* standardized patients.

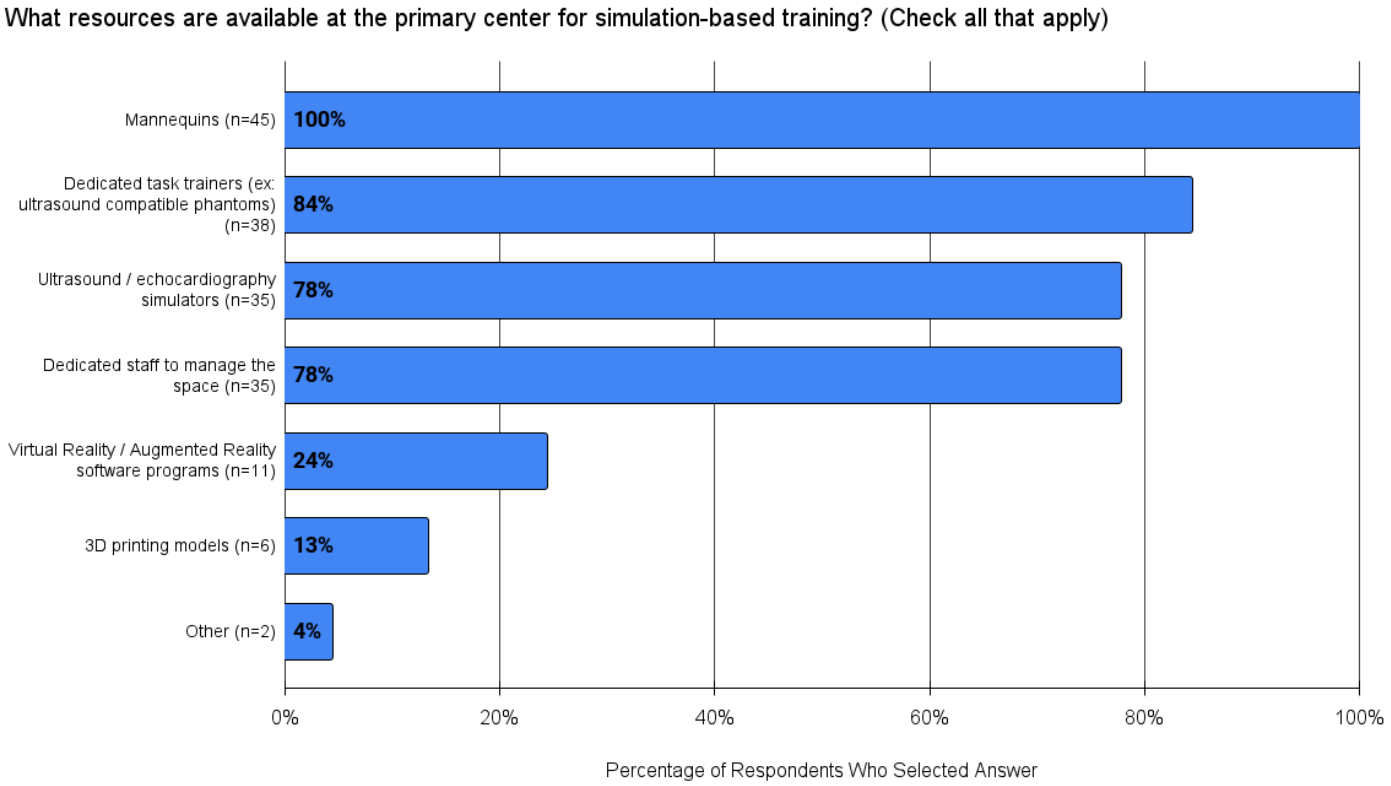

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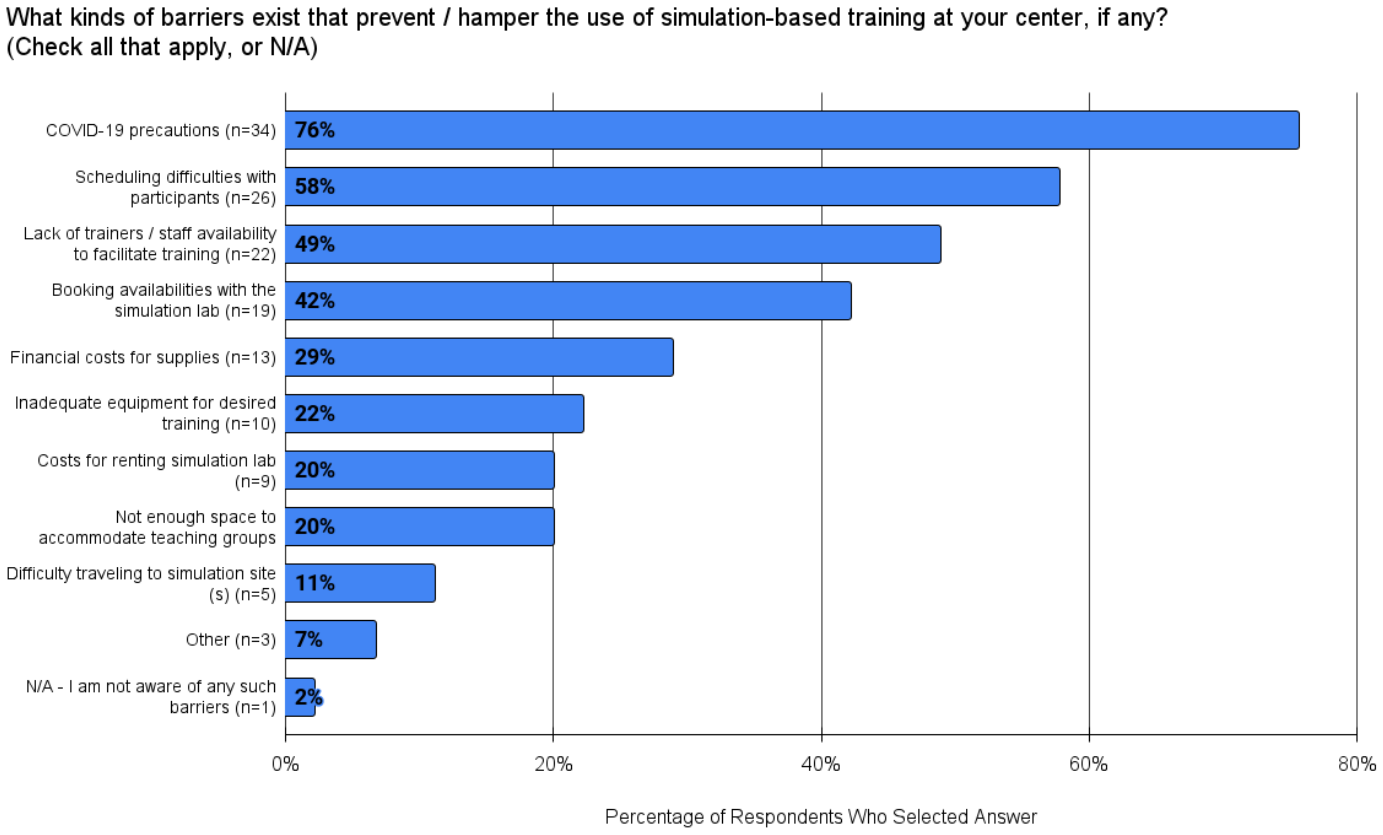
Figure 4. *Barriers to simulation. The bar chart in Figure 4 depicts the distribution of respondents' answers for question 8 of our survey (n = 45): "What kinds of barriers exist that prevent/hamper the use of simulation-based training at your center, if any," in descending order by percentage of respondents who selected each resource. This question allowed respondents to select multiple options simultaneously, as applicable, or select* N/A - I am not aware of any such barriers; *thus, percentages for the answers total to over 100%. Other responses to question 8 consisted of 1 of each of the following responses:* faculty time availability, time away from clinical duties, *and* clinical schedule and clinical work demands.



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Supplemental Online Material

Supplemental Figure 1. Anesthesia Education Laboratory photograph. The photograph shows the Anesthesia Education Laboratory (AEL) at Beth Israel Deaconess Medical Center (BIDMC). The photograph was taken by the entrance to the AEL.

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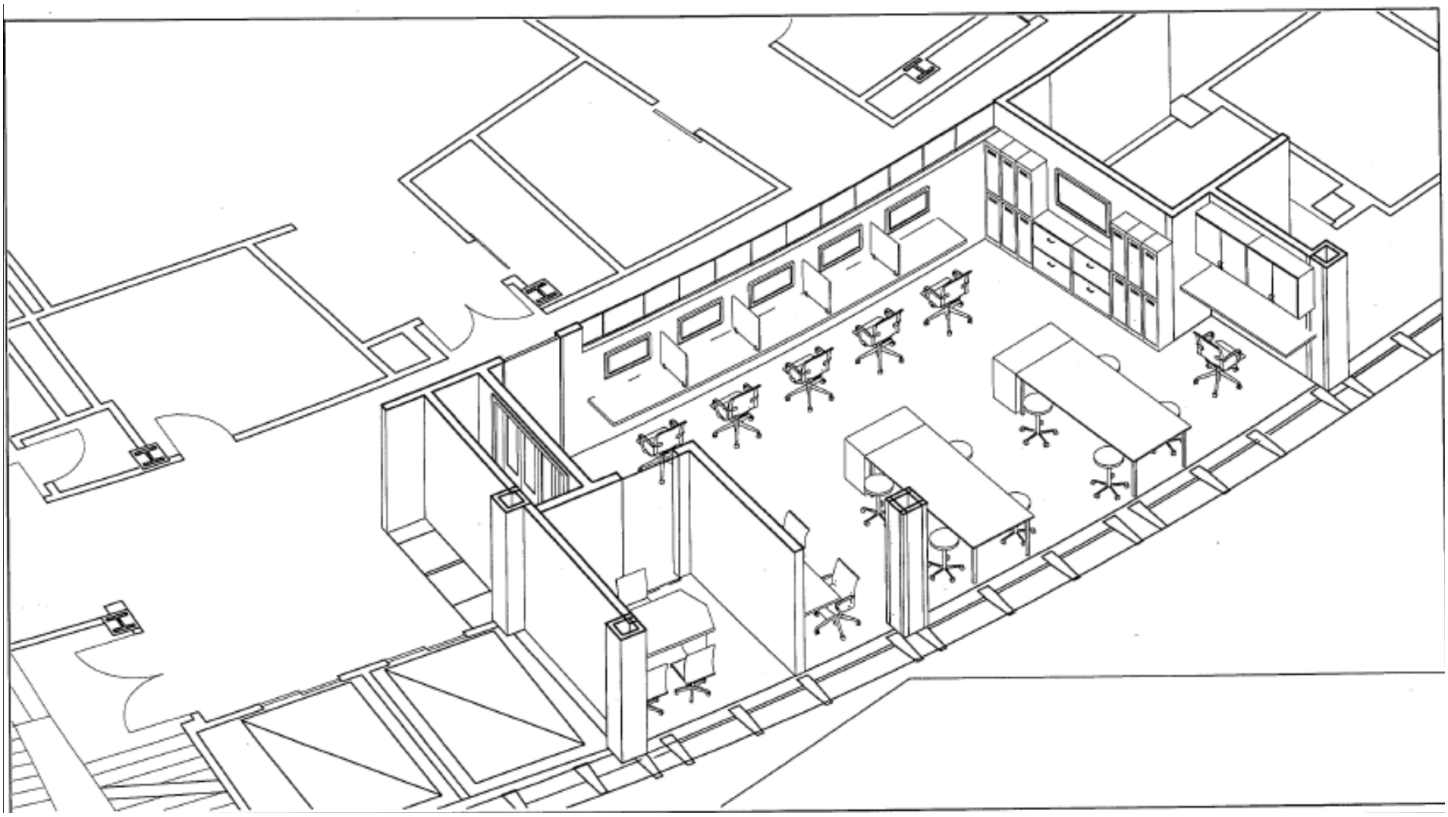
Supplemental Online Material *continued*

Supplemental Figure 2. Anesthesia Education Laboratory concept image. The figure is the actual concept image of the Anesthesia Education Laboratory (AEL) at Beth Israel Deaconess Medical Center from the planning phase for establishing this space. Note that only the areas in the center of this figure represent the AEL (including the huddle room depicted on the bottom left corner) and that the cabinets depicted toward the upper right were ultimately omitted to accommodate computer screens.



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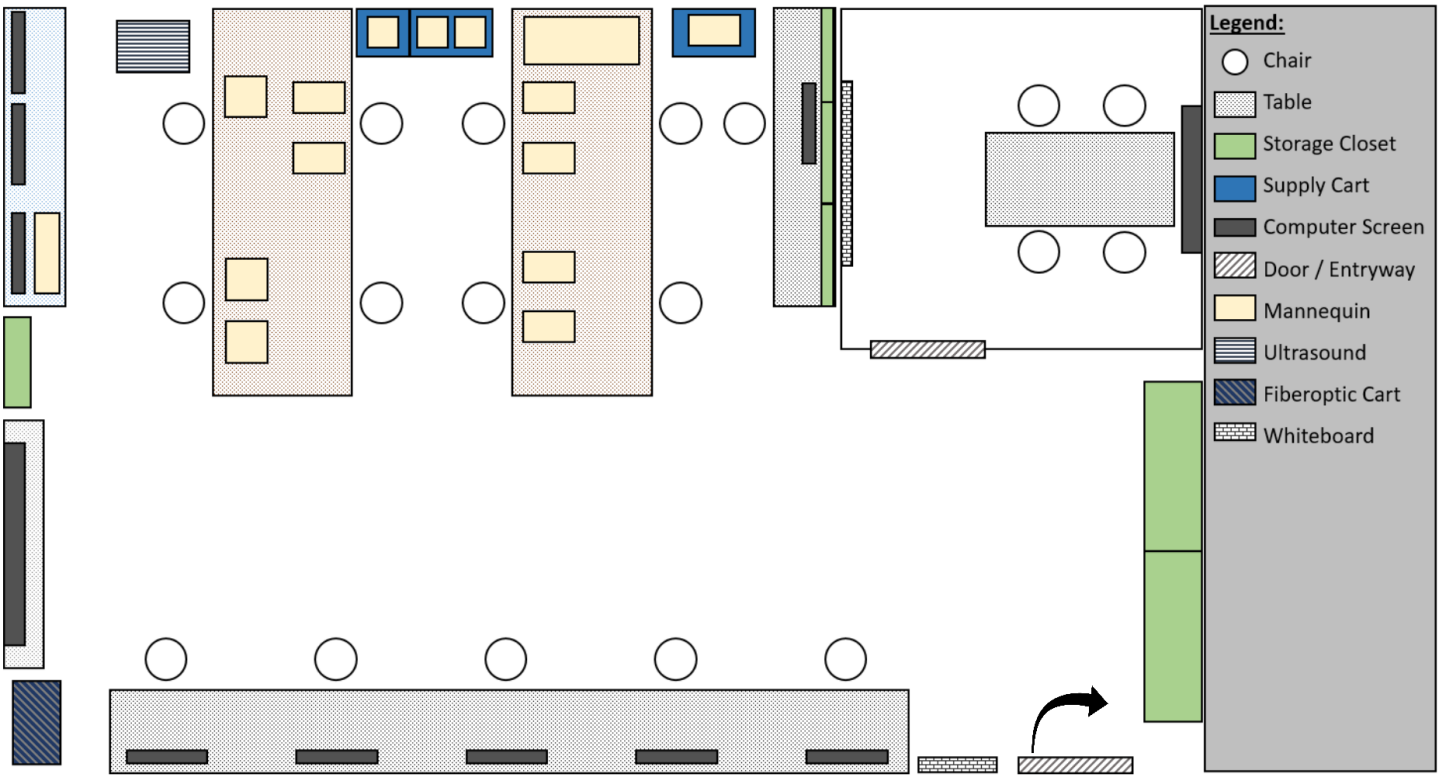
Supplemental Online Material *continued*

Supplemental Figure 3. Anesthesia Education Laboratory blueprint. The blueprint of the Anesthesia Education Laboratory (AEL) at Beth Israel Deaconess Medical Center is not drawn to scale. The dimensions of the entire space are 18 ft 6 in × 29 ft (540 sq ft), whereas the huddle room depicted in the top left is 8 ft 3 in × 8 ft 9 in. A photograph of the AEL can be seen in Supplemental Figure 1; concept art for the AEL can be seen in Supplemental Figure 2.



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Supplemental Online Material *continued*

Table 1. *Survey Results*

Question[a]	Responses[b]
1) Geographic area	• Northeast US (eg, Massachusetts, New York, Pennsylvania): 15 (33.3%) • South US (eg, Texas, North/South Carolina, Florida): 13 (31.1%) • Midwest US (eg, Michigan, Wisconsin, Illinois): 9 (20.0%) • West US (eg, California, Oregon, Colorado, Hawaii): 7 (15.6%)
2) Frequency of scheduled simulation education for residents	• 1 to 4 times per year (ie, annually/quarterly): 28 (62.2%) • Approximately once a month: 10 (22.2%) • 2 to 4 times per month (ie, every other week/weekly): 3 (6.7%) • Other[c]: 4 (8.9%)
3) Estimated participation rate of residents and scheduled simulations	• 80%-100%: 36 (80%) • 60%-79%: 8 (17.8%) • 40%-59%: 0 (0%) • 20%-39%: 1 (2.2%) • 0%-19%: 0 (0%)
4) Locations of simulation-based training (check all that apply)[d]	• On-campus central simulation laboratory shared with other departments: 38 (84.4%) • Off-campus simulation laboratory that is not directly affiliated with your organization: 9 (20.0%) • Dedicated space designed exclusively for anesthesia department: 16 (35.6%) • Anesthesia departments break rooms/lounges: 8 (17.8%) • Conference rooms/auditoriums (shared spaces): 11 (24.4%) • Other[e]: 13 (28.9%)
5) Primary simulation-based training location (choose one)	• On-campus central simulation laboratory shared with other departments: 29 (64.4%) • Off-campus simulation laboratory which is not directly affiliated with your organization: 5 (11.1%) • Dedicated space designed exclusively for anesthesia department: 6 (13.3%) • Conference rooms/auditoriums (shared spaces): 2 (4.4%) • Other[f]: 3 (6.7%)
6) Simulation skills and activities practiced at primary location (check all that apply)[d]	• Airway management skills (eg, direct laryngoscopy, supraglottic airway placement): 42 (93.3%) • Trauma/case scenarios: 39 (86.7%) • Nontechnical skills training (eg, communication, leadership skills): 37 (82.2%) • Ultrasound imaging: 36 (80.0%) • transesophageal echocardiography (TEE): 32 (71.1%) • Fiberoptic skills: 30 (66.7%) • Spinal/epidural placement: 28 (62.2%) • Arterial line placement: 23 (51.1%) • IV placement: 26 (57.8%) • Advanced cardiovascular life support (ACLS) training: 26 (57.8%) • Regional anesthesia: 21 (46.7%) • Didactics: 16 (35.6%) • Research studies: 9 (20.0%) • Other[g]: 6 (16.7%)
7) Resources at primary simulation location (check all that apply)[d]	• Mannequins: 45 (100%) • Dedicated task trainers (eg, ultrasound-compatible phantoms): 38 (84.4%) • Ultrasound/echocardiography simulators: 35 (77.8%) • Dedicated staff to manage the space: 35 (77.8%) • Virtual reality/augmented reality software programs: 11 (24.4%) • Three-dimensional (3D) printing models: 6 (13.3%) • Other[h]: 2 (4.4%)

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8) Barriers to simulation (check all that apply, or not applicable [N/A])[d]	• COVID-19 precautions: 34 (75.6%) • Scheduling difficulties with participants: 26 (57.8%) • Lack of trainers/staff availability to facilitate training: 22 (48.9%) • Booking availabilities with the simulation laboratory: 19 (42.2%) • Financial costs for supplies: 13 (28.9%) • Inadequate equipment for desired training: 10 (22.2%) • Costs for renting simulation laboratory: 9 (20.0%) • Not enough space to accommodate teaching groups: 9 (20.0%) • Difficulty traveling to simulation site(s): 5 (11.1%) • N/A, I am not aware of any such barriers: 1 (2.2%) • Other[i]: 3 (6.7%)
9) Utility of a departmental education laboratory as described	• 5, *very useful*: 28 (62.2%) • 4: 7 (15.6%) • 3: 6 (13.3%) • 2: 2 (4.4%) • 1, *not very useful*: 2 (4.4%)
10) Desired resources for a departmental education laboratory (check all that apply, or N/A)[d]	• Fiberoptic scope (or equivalent simulator): 37 (82.2%) • Ultrasound/echocardiography simulator: 36 (80.0%) • Ultrasound machine: 35 (77.8%) • Airway management mannequins/trainers: 34 (75.6%) • Regional anesthesia trainers: 31 (68.9%) • Virtual reality/augmented reality simulators: 27 (60.0%) • Staff dedicated to managing the space: 27 (60.0%) • 3D printer: 12 (26.7%) • N/A, I do not believe such a center is necessary for our department at this time: 2 (4.4%) • Other[j]: 1 (2.2%)

[a] Abbreviations for the question's core concept are listed in this table; the full text of each question can be seen in Supplemental File 1.

[b] Responses are reported in the following format: Answer selected, number of responses (percentage of respondents who selected answer).

[c] Other responses to question 2 consisted of 1 of each of the following responses: "quarterly beginning in June of intern year," "6-8 times a year," "five labs in 12 months," and "6 1 ½ hour sessions during internship, 50 hours during [clinical anesthesia] orientation, intermittent manikin, [point-of-care ultrasound] and [transesophageal echocardiography] throughout residency."

[d] These questions allowed respondents to select multiple options simultaneously, as applicable; thus, percentages for those questions total to over 100%. Otherwise, respondents could only select 1 of the available options.

[e] Other responses to question 4 consisted of in situ at actual clinical locations/operating rooms (n = 8); central simulation laboratory for course staff and virtual participation for learners (n = 1); an off-campus, affiliated center shared between departments (n = 2); cadaver laboratory (n = 1); and virtual simulation training (n = 1).

[f] Other responses to question 5 consisted of 1 of each of the following responses: an off-campus, affiliated, shared lab; empty operating rooms; and a central shared laboratory that is on campus for the medical school, but off campus for the center's department.

[g] Other responses to question 6 consisted of 1 of each of the following responses: introduction to pediatrics rotation; clinical scenarios, OSCE (Objective Structured Clinical Examination) preparations, and cadaver lab; specific anesthesia complications; point-of-care ultrasound; and crisis resource management. One respondent did not provide details for their selection of *other* for this question.

[h] Other responses to question 7 consisted of 1 of each of the following responses: "video" and "standardized patients."

[i] Other responses to question 8 consisted of 1 of each of the following responses: "faculty time/availability," "time away from clinical duties," and "clinical schedule and clinical work demands."

[j] Other response to question 10 consisted of 1 respondent who wrote "Neuraxial."