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Original Research

Telemedicine in Anesthesiology: Using Simulation to Teach Remote Preoperative Assessment

Stacey A. Watt, MD, MBA, MHPE, FASA
Roseanne C. Berger, MD
Laura E. Hirshfield, PhD
Rachel Yudkowsky, MD, MHPE

Introduction

The field of virtual medicine, encompassing both telemedicine and telehealth, has grown immensely.[1,2] The number of potential nonemergency telemedicine visits in the United States is estimated at over 400 million per year, accounting for approximately one-third of annual ambulatory care visits within the country.[3-5] The specialty of anesthesiology is not exempt from this evolution within the practice of medicine.[6,7] Preoperative assessment consultations provided by anesthesiologists in the weeks before surgery have become a standard practice of many health care systems.[8] In addition to the push from patients for more extensive virtual offerings, anesthesiologists are also under pressure from educational accrediting bodies to provide instruction on the practice of virtual medicine to their residents.[9-12]

Simulation offers a hands-on opportunity for anesthesiology residents to learn how to connect with patients on a virtual platform. It also facilitates the provision of feedback from a standardized patient (SP) regarding the resident's performance from a patient perspective. At the same time, simulation provides a controlled learning environment in which the techniques of telemedicine are practiced.[13,14] Thus, simulation is an excellent method for educating residents in an environment that takes a high-stakes encounter and places it within a learning environment, free from the potential for patient harm.[15] For these reasons, the American Board of Anesthesiology has embraced simulation as a means of assessment within board certification examinations and Maintenance of Certification in Anesthesiology programs.[9,10]

As the field of telemedicine has expanded, educators have developed tools to provide learners with feedback on their performance.[16,17] The American Medical Association has developed a Digital Health Implementation Playbook to share best practices on how to conduct telemedicine visits.[18,19] The pilot curriculum described in this study used the best practices outlined in this playbook and combined them with the American Board of Anesthesiology Applied Examination Objective Structured Clinical Examination (OSCE) content outline to create a performance checklist.[9,10] This checklist was designed as a formative assessment tool to be used by anesthesiology faculty during and after a virtual preoperative patient visit to guide faculty members in providing formative feedback to residents.

In this study, we sought to demonstrate the feasibility and value of using simulation on cloud-based platforms to teach telemedicine skills. We intentionally focused on developing a pilot curriculum for second postgraduate year (PGY2) anesthesiology residents, because we wanted to select a class of residents who had learned the basics of preoperative evaluation and had some exposure to simulation training but were not sufficiently far into their training to be considered advanced learners.

Methods

The institutional review boards of the University at Buffalo and University of Illinois at Chicago approved this study. All 12 PGY2 anesthesiology residents (first-year clinical anesthesia residents [CA-1]) at the University at Buffalo participated in the pilot curriculum in July 2021. Figure 1 summarizes the study time course. The curriculum began with a 20-minute online didactic session on how to conduct an anesthetic preoperative evaluation using a telemedicine platform. The didactic session reviewed both how to perform a preoperative assessment and how to conduct a patient encounter on a virtual platform. This session was conducted on a telemedicine platform with all participants participating virtually. It was recorded and uploaded onto the anesthesiology residency administrative software platform so it was accessible to any resident unable to attend the live didactic session. All residents were able to attend the session, and the recording did not have to be used by study participants. The didactic session, which occurred in the first week of July, was led by the faculty instructor (S.W.) and concluded with a 5-minute role-play exercise with one of the resident participants. This exercise began with the instructor conducting a brief interview of a resident to provide an example of how to perform the encounter. The roles were then switched so the resident assumed the role of the interviewer, and the instructor assumed the role of the patient. This role-play exercise

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demonstrated best practices[23,24] to be used during a telemedicine encounter (when the instructor was the interviewer) and allowed the faculty instructor to provide direct feedback regarding the resident's performance. At the conclusion of the didactic session, each resident completed an anonymous post–didactic survey online consisting of 4 items rated on a scale from 1 (*not at all*) to 5 (*extremely*; Table 1).

Two to 3 days after the didactic session, each resident participated in an individual 25-minute simulation training session with an SP. The SP case and patient chart was created with input from the SP. The case scenario selected for the simulation was a standard orthopedic case many PGY-2 residents will encounter during their basic rotations. The encounter was then edited to mirror our SP's age, physical characteristics, and medical history.

Each simulation session was conducted in the late afternoon, after their introductory lectures concluded. Sessions began with a 15-minute preoperative assessment encounter with the SP, followed by 5 minutes of feedback provided by the faculty instructor and 5 minutes of feedback provided by the SP. The same faculty instructor (S.W.) conducted all simulation training sessions. Before the start of each simulation session, the virtual platform was set to "hide all nonvideo participants," allowing the faculty member to remain out of sight during the encounter with the SP (although the resident and SP knew the instructor was observing the session). Before arrival of the SP to the virtual platform, the resident was given 2 minutes to review a brief door-chart summary shared with them on the virtual platform by the faculty instructor. The instructor then ceased sharing her video (hiding her from view), and the SP entered the virtual encounter with the resident. At the conclusion of the 15-minute telemedicine visit, feedback on the resident's performance was provided. Formative feedback provided by both the faculty and SP was guided by the performance checklist they received before each session for note-taking purposes during the encounter (Tables 2 and 3).

We created two exemplar videos (mock encounters) to facilitate training of faculty instructors and to obtain faculty feedback regarding the usefulness of the checklist for guiding formative feedback to a resident after a simulated preoperative assessment visit. These videos were not viewed by residents and were not intended for resident viewing. One exemplar video demonstrated a poorly performed virtual anesthesia preoperative assessment, whereas the other demonstrated best practices for both the telemedicine and anesthetic preoperative assessment portions of the virtual visit. Two faculty members skilled in preoperative assessment were asked to use the checklist while viewing these mock encounters to assist in planning how to provide feedback to the mock resident in each encounter. The faculty members completed a post–mock encounter survey to rate the realism of the SP encounter and the extent to which the checklist was clear and helpful in identifying gaps in resident performance.

After all simulated encounters were finished, each resident completed a postencounter survey containing 8 items rated on a scale from 1 (*not at all*) to 5 (*extremely*). The survey elicited their perceptions of the effectiveness and helpfulness of the didactic session in preparing them for the SP encounter (Table 4). It also assessed the residents' perception of the degree of realism and helpfulness of the SP encounter in their learning. Additional survey questions were adapted from the National Aeronautics and Space Administration (NASA) task load index to determine the subjective mental workload experienced by the residents during their encounter.[20-22]

Results

This study was conducted at the beginning of the PGY2 academic year during the residents' introduction to anesthesiology weeks, prior to starting clinical rotations. All 12 PGY2 anesthesiology residents attended the live didactic session, participated in an SP encounter, and completed all surveys. The post–didactic session resident survey data showed that the residents considered the didactic session to be *effective*, *very effective*, or *extremely effective* in introducing the topic and elements contained within a preoperative assessment (Table 1). Most (11/12) residents felt *confident*, *very confident*, or *extremely confident* in being able to conduct a telemedicine preoperative assessment after the didactic session, although 1 resident reported feeling only *somewhat confident*. The mean ratings for all items in the survey were 4 or higher (on a scale of 1 to 5).

According to evaluations by the faculty member, resident performance varied considerably between items of the performance checklist during the simulated encounter (Table 2). Whereas 100% of residents explained risks and benefits of treatment options during the encounter, only 42% ensured adequate lighting and only 33% ensured that the patients were in a private setting before conducting the visit. Overall, the residents performed well on anesthesia-specific topics during the encounter but less well on telemedicine-specific topics.

The postencounter resident survey data showed that residents thought the didactic session was *helpful*, *very helpful*, or *extremely helpful* in preparing for the simulated telemedicine encounter (mean rating, 4.42; Table 4). The residents reported that the encounter was realistic (mean rating, 4.25), with a high degree of helpfulness attributed to the SP encounter (mean rating, 4.5). Nearly all (11/12) residents scored the debriefing session after the encounter as *very helpful* or *extremely helpful* (mean rating, 4.58).

When queried about their subjective mental workload while performing the simulated encounter, 7 (58%) residents rated the encounter as being mentally *demanding* or *very demanding*. In further questions focused on the NASA task load index, all residents reported feeling either not at all or only somewhat rushed during the encounter. When asked to rate their perceived degree of being successful in accomplishing the task (ie, preoperative assessment using a virtual platform), almost all (11/12) residents reported feeling *successful*, *very successful*, or *extremely successful*, and only 1 reported feeling *somewhat successful*. Responses to the question regarding the amount of work required to accomplish the task were equally divided between residents: 50% reported that it required hard work to extremely hard work, whereas 50% reported that it required only somewhat hard work or no hard work.

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Comments shared by residents in the surveys highlighted the benefits of our pilot curriculum. They indicated that the curriculum provided them with knowledge and skills required to conduct a preoperative assessment using a virtual platform and found the feedback after the encounter to be especially useful. The residents also indicated that the SP encounter was of greater value (more effective and helpful) than the didactic session. Their comments emphasized the usefulness of the feedback, noting how it was systematic and provided them with multiple areas for improvement.

In the postencounter SP survey, the SP indicated that he felt well prepared for the encounter. He noted that the activity of building the SP case with the research team allowed him to take ownership of his character and customize his performance with items available in his home to pose challenges to the residents. He felt it would further improve the fidelity of the experience if we introduced him as an actual patient, rather than as an SP. He thought that residents knowing before the encounter that he was an SP diminished the fidelity of the session. Although the SP reviewed and used the checklist while providing feedback, he did not complete a feedback assessment during the encounter. He wanted to focus on being in character during the encounter and felt that trying to complete the checklist while the simulation was occurring would detract from the fidelity of the process.

In the post–mock encounter survey, the 2 anesthesiology faculty who viewed the mock encounters indicated that these encounters were realistic. They also indicated that the checklist used as a tool for providing feedback in the preoperative telemedicine encounter was clear and useful for providing this feedback. They noted that the checklist served as a guide for important opportunities for formative feedback and also aided the faculty member to recognize resident performance gaps during the assessment activity. The faculty suggested that future practice encounters include SPs with a wider range of medical disorders and planned surgical procedures to provide residents with a broader learning experience.

Discussion

The use of telemedicine has grown significantly over the past 2 years due, in part, to the COVID-19 pandemic.[17] As educational bodies work to develop, test, and endorse effective curriculums to address the growing need for telemedicine, the field of anesthesiology has used educational advancements from other specialties as guideposts for anesthesiology curriculum design.[23] As anesthesiology residency programs continue to explore new ways to incorporate telemedicine training to instruct faculty and educate residents on the importance, knowledge, skills, and best practices of telemedicine, our patients are becoming increasingly eager for implementation of preoperative assessment visits that obviate the need to miss work or leave home.[24,25] In addition, we need to reevaluate current preoperative evaluation practices to determine whether greater virtual access may be necessary.

Our pilot curriculum used a combination of didactic instruction and SP encounters on a telemedicine platform as a way to introduce the principles of preoperative assessment using a telemedicine platform. The anesthesiology residents participating in this curriculum reported that the combination of instruction methods was effective for teaching them how to perform a telemedicine preoperative assessment. Their survey results, including comments, reflected their enjoyment of the pilot curriculum and their belief that it was helpful in their journey toward mastering this skill.

From the perspective of perceived workload (assessed using the adapted NASA task load index), the residents reported the task as being mentally demanding and requiring hard work, but they did not feel rushed. They also reported feeling successful in accomplishing the task of performing a preoperative assessment using a virtual platform. This curriculum, therefore, provided our residents with an opportunity to expand their knowledge and skills of preoperative assessment by presenting an activity that challenged them and pushed them to work hard to accomplish their goal but was not too difficult (ie, it did not produce feelings of extreme cognitive load or lack of success).

In this study, we were fortunate to have a single SP available for all encounters. In addition to his participation in the simulated encounters, the SP added value to the curriculum through his involvement in co-creating the SP case. Reviewing the performance checklist before development of the simulation scenario enabled him to offer suggestions and use his background in simulation to assist in creating a scenario that would accurately elicit and assess the skills in the checklist. However, SPs may not always be cognizant of best practices in simulation[26] or instructional design. For example, this SP's suggestion that he be introduced as a real patient would not accord with best practices. Deception is not warranted in this context; furthermore, knowing that the "patient" is an SP is essential to creating a safe learning environment that affords residents the ability to freely experiment with new behaviors and learn from their mistakes.

Our findings are consistent with those of Cantone et al,[13] who found that creation of a telemedicine OSCE (TeleOSCE) simulation provided medical students with an opportunity to experience telemedicine in a simulated environment and assessed their competencies in communication, patient care, medical knowledge, professionalism, and systems-based practice. Of note, both our study and that of Cantone et al included checklists that were used by faculty observers to scaffold feedback to students.

In conducting this study, our team learned important lessons, including the value of engaging an SP in the creation of the SP case; this added fidelity to the scenario and increased overall SP engagement in this study. If possible, residency programs should investigate opportunities to have an SP educator train additional SPs to offer a diverse array of opportunities for patient encounters. The SPs should be trained not only to act as an SP but to also provide feedback to residents. This feedback would ideally be in written (as well as verbal) form so it can be included in formative assessment documentation of the residents' activities.

In summary, using simulation (an SP) to teach preoperative assessment may be a valuable addition to an anesthesiology

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residency curriculum, allowing safe practice of telemedicine skills and providing a formative assessment tool. A similar approach can be applied to many fields within medicine, given the focus on core competencies across medical specialties. The structured telemedicine assessment checklist we developed on the basis of best practices in telemedicine can be easily adapted to other specialties and telemedicine tasks by modifying the "anesthetic-specific" section only; the other sections are applicable across telemedicine tasks.

Limitations

One limitation of this pilot study is that it offered only 1 simulation scenario. Having more than 1 case scenario would have offered residents more opportunities to practice their preoperative assessment skills in telemedicine and potentially enable a more comprehensive evaluation of learning outcomes. An additional limitation is the small number of PGY2 anesthesiology residents in the study, at only 1 institution. Although having 12 participants performing a single SP encounter allowed us to perform formative assessments, enrollment of a larger number of residents would have provided additional data to form more definitive conclusions. The feedback instruments were based on well-developed tools, but this limited, small-scale feasibility pilot did not enable us to conduct any validity studies of the new instruments; this is a task for future work.

Conclusions

Our pilot curriculum provides a foundation on which to construct future programs, using didactic learning, simulation, and checklists to optimize formative feedback opportunities for residents. The inclusion of an SP offered an adjunct to the curriculum. A next step for this project might be to evaluate retention of learning over time, as well as the ability to apply what was learned in the telemedicine setting with real patients.

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The following authors are at the University at Buffalo Jacobs School of Medicine and Biomedical Sciences, Buffalo, NY: ***Stacey A. Watt*** *is Clinical Professor of Anesthesiology;* ***Roseanne C. Berger*** *is Associate Professor of Family Medicine. The following authors are at the The University of Illinois College of Medicine at Chicago:* ***Laura E. Hirshfield*** *is Associate Professor of Medical Education;* ***Rachel Yudkowsky*** *is Professor and Director of Graduate Studies Department of Medical Education.*

Corresponding author: *Stacey Watt, MD, MBA, FASA, Department of Anesthesiology, University at Buffalo Jacobs School of Medicine and Biomedical Sciences, 77 Goodell Street, Suite 550. Buffalo, NY 14203. Telephone: (716) 323-6570*

Email address: *Stacey Watt: swatt@buffalo.edu*

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Abstract

Background: The move toward telemedicine has markedly accelerated with the COVID-19 pandemic. Anesthesia residents must learn to provide preoperative assessments on a virtual platform. We created a pilot telemedicine curriculum for postgraduate year-2 (PGY2) anesthesiology.

Methods: The curriculum included a virtual didactic session and a simulated virtual preoperative assessment with a standardized patient (SP). A faculty member and the SP provided feedback using a checklist based on the American Medical Association Telehealth Visit Etiquette Checklist and the American Board of Anesthesiology Applied Examination Objective Structured Clinical Examination content outline. Residents completed surveys assessing their perceptions of the effectiveness and helpfulness of the didactic session and simulated encounter, as well as the cognitive workload of the encounter.

Results: A total of 12 PGY2 anesthesiology residents in their first month of clinical anesthesia residency training participated in this study. Whereas most (11/12) residents felt *confident, very confident,* or *extremely confident* in being able to conduct a telemedicine preoperative assessment after the didactic session, only 42% ensured adequate lighting and only 33% ensured patient privacy before conducting the visit. Postencounter survey comments indicated that the SP encounter was of greater value (more effective and helpful) than the didactic session. Residents perceived the encounter as demanding, but they felt successful in accomplishing it and did not feel rushed. Faculty and SP indicated that the checklist guided them in providing clear and useful formative feedback.

Conclusions: A virtual SP encounter can augment didactics to help residents learn and practice essential telemedicine skills for virtual preoperative assessments.

Keywords: Telemedicine, telehealth, graduate medical education, simulation, anesthesiology, standardized patient

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Figure

Figure 1. *Time course of the curriculum and assessments.*

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Tables

Table 1. *Post–Didactic Session Resident Survey Results*

Question	Resident Responses[a]					Mean (SD)
	1	2	3	4	5	
	n (%)	n (%)	n (%)	n (%)	n (%)	
How effective was the didactic session in introducing you to a virtual preoperative assessment?	Not at all effective	Somewhat effective	Effective	Very effective	Extremely effective	4.33 (0.78)
	0 (0)	0 (0)	2 (17)	4 (33)	6 (50)	
How effective was the didactic session in reviewing the elements of the preoperative assessment?	Not at all effective	Somewhat effective	Effective	Very effective	Extremely effective	4.25 (0.87)
	0 (0)	0 (0)	3 (25)	3 (25)	6 (50)	
How effective was the didactic session in conveying best practices of communication in a telemedicine setting?	Not at all effective	Somewhat effective	Effective	Very effective	Extremely effective	4.42 (0.79)
	0 (0)	0 (0)	2 (17)	3 (25)	7 (58)	
How confident do you feel in conducting a virtual preoperative assessment after viewing this presentation?	Not at all confident	Somewhat confident	Confident	Very confident	Extremely confident	4.00 (0.95)
	0 (0)	1 (8)	2 (17)	5 (42)	4 (33)	

[a] Responses were rated on a scale from 1 to 5 for each question.

Table 2. *Faculty Performance Checklist*[a]

Item	Topic	Resident Performance	
		N = 12	
		Yes	No
		n (%)	n (%)
Environment			
1.	Ensures privacy (resident asks if the patient is in a safe, private location)[b]	4 (33)	8 (67)
2.	Clinically appropriate exam room location (resident's virtual background)[b]	11 (92)	1 (8)
3.	Avoids background noise (no other electronic devices are audible)[b]	7 (58)	5 (42)
4.	Ensures adequate lighting for clinical assessment (minimal shadows and can see facial expressions clearly)[b]	5 (42)	7 (58)
Dress			
5.	Professional attire (same level of professional attire as in-person care)[b]	12 (100)	0 (0)
Communication			
6.	Verbalizes they have reviewed the patient complaints and records prior to the call[b]	5 (42)	7 (58)
7.	Speaks clearly and deliberately[b]	12 (100)	0 (0)
8.	Narrates actions with the patient (performs an airway scoring portion of the exam)[b]	9 (75)	3 (25)
9.	Verbalizes and clarifies next steps (next steps of the clinical pathway, what to expect on the day of surgery)[b]	10 (83)	2 (17)
10.	Communicates in lay terms (avoids medical jargon)[b]	7 (58)	5 (42)

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Interpersonal skills			
11.	Chooses empathetic language[b]	12 (100)	0 (0)
12.	Uses nonverbal language to signal they are listening (nods and/or smiles during interview)[b]	11 (92)	1 (8)
13.	Elicits questions and concerns[b]	12 (100)	0 (0)
14.	Demonstrates understanding of and concern for the patient's situation[b]	10 (83)	2 (17)
Technology			
15.	Verbalizes they have turned off other web applications and all notifications[b]	5 (42)	7 (58)
16.	Pauses to allow for transmission delay[b]	5 (42)	7 (58)
17.	Adjusts webcam to eye level to ensure eye contact and proper spacing to camera (complete visualization of person in the frame)[b]	11 (92)	1 (8)
Anesthetic-specific topics			
18	Explains the indications for the proposed treatment options[c]	11 (92)	1 (8)
19.	Explains conduct of the proposed treatment options[c]	11 (92)	1 (8)
20.	Explains benefits and risks of treatment options[c]	12 (100)	0 (0)
21.	Discusses strategies for minimizing risks of the treatment options[c]	9 (75)	3 (25)
22.	Confirms a final decision with the patient regarding the treatment options and obtains affirmative consent without coercion[c]	9 (75)	3 (25)
Comments:			
23.			

[a] This is the formative assessment tool used by the anesthesiology faculty member during and after the virtual simulated preoperative patient visit to guide the faculty member in providing feedback to residents after completion of the encounter. The number and percentage of residents who successfully completed each item are shown.

[b] Based on the American Medical Association Telehealth Etiquette Checklist.

[c] Based on the Anesthesiology Applied Examination Objective Structured Clinical Examination Content Outline.

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Table 3. *Standardized Patient Performance Checklist*[a]

Item	Topic	Yes	No
Environment			
1.	Ensures privacy (resident asks if the patient is in a safe, private location)[b]		
2.	Clinically appropriate exam room location (resident's virtual background)[b]		
3.	Avoids background noise (no other electronic devices are audible)[b]		
4.	Ensures adequate lighting for clinical assessment (minimal shadows and can see facial expressions clearly)[b]		
Dress			
5.	Professional attire (same level of professional attire as in-person care)[b]		
Communication			
6.	Verbalizes they have reviewed the patient complaints and records prior to the call[b]		
7.	Speaks clearly and deliberately[b]		
8.	Narrates actions with the patient (performs an airway scoring portion of the exam)[b]		
9.	Verbalizes and clarify next steps (next steps of the clinical pathway, what to expect on the day of surgery)[b]		
10.	Communicates in lay terms (avoids medical jargon)[b]		
Interpersonal Skills			
11.	Chooses empathetic language[b]		
12.	Uses nonverbal language to signal they are listening (nods and/or smiles during interview)[b]		
13.	Elicits questions and concerns[b]		
14.	Demonstrates understanding of and concern for the patient's situation[b]		
Technology			
15.	Verbalizes they have turned off other web applications and all notifications[b]		
16.	Pauses to allow for transmission delay[b]		
17.	Adjusts webcam to eye level to ensure eye contact and proper spacing to camera (complete visualization of person in the frame)[b]		
Comments:			
18.			

[a] This is the formative assessment tool used by the standardized patient (SP) after the virtual preoperative patient visit to guide the SP in providing feedback to residents after completing the encounter.

[b] Items based on the American Medical Association Telehealth Etiquette Checklist.

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Table 4. *Postencounter Resident Survey Results*

Question	Resident Responses[a]					Mean (SD)
	1	2	3	4	5	
	n (%)	n (%)	n (%)	n (%)	n (%)	
How helpful was the didactic session in preparing you for this encounter?	Not at all helpful	Somewhat helpful	Helpful	Very helpful	Extremely helpful	4.42 (0.67)
	0 (0)	0 (0)	1 (8)	5 (42)	6 (50)	
How realistic was the SP encounter?	Not at all realistic	Somewhat realistic	Realistic	Very realistic	Extremely realistic	4.25 (0.75)
	0 (0)	0 (0)	2 (17)	5 (42)	5 (42)	
How helpful was the SP encounter?	Not at all helpful	Somewhat helpful	Helpful	Very helpful	Extremely helpful	4.5 (0.80)
	0 (0)	0 (0)	2 (17)	2 (17)	8 (67)	
Was the postscenario debriefing helpful to your learning?	Not at all helpful	Somewhat helpful	Helpful	Very helpful	Extremely helpful	4.58 (0.67)
	0 (0)	0 (0)	1 (8)	3 (25)	8 (67)	
How mentally demanding was the encounter?	Not at all demanding	Somewhat demanding	Demanding	Very demanding	Extremely demanding	2.5 (0.90)
	2 (17)	3 (25)	6 (50)	1 (8)	0 (0)	
How hurried or rushed was the pace of the encounter?	Not at all rushed	Somewhat rushed	Rushed	Very rushed	Extremely rushed	1.67 (0.39)
	10 (83)	2 (17)	0 (0)	0 (0)	0 (0)	
How successful were you in accomplishing a preoperative assessment using a virtual platform?	Not at all successful	Somewhat successful	Successful	Very successful	Extremely successful	3.5 (0.90)
	0 (0)	1 (8)	6 (50)	3 (25)	2 (17)	
How hard did you have to work to accomplish your level of performance?	Not at all hard work	Somewhat hard work	Hard work	Very hard work	Extremely hard work	2.42 (0.90)
	2 (17)	4 (33)	5 (42)	1 (8)	0 (0)	

Abbreviation: SP, standardized patient.

[a] Responses were rated on a scale from 1 to 5 for each question.