ORIGINAL RESEARCH

Comparison of In-Person and Telesimulation for Critical Care Training during the COVID-19 Pandemic

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ABSTRACT

Background: The coronavirus disease (COVID-19) pandemic has disrupted medical education for trainees of all levels. Although telesimulation was initially used to train in resource-limited environments, it may be a reasonable alternative for replicating authentic patient experiences for medical students during the COVID-19 pandemic. It is unclear whether a more passive approach through telesimulation training is as effective as traditional in-person simulation training.

Objective: Our aim was to evaluate the effectiveness of in-person versus remote simulation training on learners' comfort with managing critical care scenarios.

Methods: This was a prospective observational cohort study assessing the impact of an in-person versus remote simulation course on volunteer fourth-year medical students from February to April 2021 at the University of California San Diego School of Medicine. Precourse and postcourse surveys were performed anonymously using an online secure resource.

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Results: In the in-person learners, there was statistically significant improvement in learner comfort across all technical, behavioral, and cognitive domains. In remote learners, there was a trend toward improvement in self-reported comfort across technical and cognitive domains in the telesimulation course. However, the only statistically significant improvement in postcourse surveys of telesimulation learners, compared with baseline, was in running codes. Regardless of the training modality, the students had a positive experience with the critical care simulation course, ranking it, on average, 9.6 out of 10 (9.9 in in-person simulation vs. 9.3 in telesimulation; $P = 0.06$).

Conclusion: We demonstrated that implementation of a telesimulation-based simulation course focusing on critical care cases is feasible and well received by trainees. Although a telesimulation-based simulation course may not be as effective for remote learners as active in-person participants, our study provided evidence that there was still a trend toward improving provider readiness across technical and cognitive domains when approaching critical care cases.

Keywords:
telesimulation; remote simulation; COVID-19

The coronavirus disease (COVID-19) pandemic has disrupted medical education for trainees of all levels, especially medical students. In the early stages of the pandemic, the Association of American Medical Colleges recommended that all clinical rotations for medical students be halted (1) because of concerns for student safety as well as shortages of personal protective equipment (2). Although precautionary limitations to in-person training are necessary because of health considerations, these social restriction guidelines present a new challenge for clinician educators. Many educational avenues were forced to adapt from in-person to distance or even asynchronous learning (2). Although the preclerkship curriculum has easily embraced this transition from in-person to virtual format (2), this adaptation is especially difficult for other educational mediums.

Simulation, which has been an integral facet of medical education, allows for hands-on deliberate practice in a safe learning environment. These high-fidelity sessions incorporate life-like mannequins that mimic human responses in a realistic manner. Simulation, in which both common and uncommon clinical situations can be encountered, has been used to assess core competencies, enhance educational curricula, and prepare junior providers to face scenarios without risking harm to patients (3). However, even simulation training, which traditionally relies on in-person participation, has been limited because of restrictions on in-person gathering allowances.

Telesimulation, defined as a “a process by which telecommunication and simulation resources are utilized to provide education, training, and/or assessment to learners at an off-site location,” is a relatively new aspect of medical simulation (4, 5). Although telesimulation was initially used to train in resource-limited environments (6–9), it may be a reasonable alternative for replicating authentic patient experiences for medical students during the COVID-19 pandemic. There is still a paucity of literature on the effectiveness of telesimulation, with most studies focused on evaluating its feasibility (9–13). Only two studies directly compared in-person versus telesimulation techniques (10, 14). Although they focused on evaluation scores (10, 14), they did not evaluate provider readiness or other more specific domains of self-reported comfort, including technical, behavioral, and cognitive aspects of telesimulation. Additionally, it is unclear whether a more passive approach with remote learners in telesimulation is as effective as conventional in-person simulation. Our aim is to evaluate the effectiveness of in-person versus remote simulation on learner's comfort with managing critical care cases.

METHODS

Study Design

This was a prospective observational cohort study assessing the impact of an in-person versus remote simulation course on fourth-year medical students from February to April 2021 at the University of California San Diego School of Medicine. Randomization was not performed because of limitations to in-person student availabilities. The study is reported in accordance with simulation-based research guidelines (15) (*see* Appendix E1 in the data supplement). The study was determined to meet exempt status by the institutional review board.

Study Population

A cohort of fourth-year medical students enrolled at the University of California San Diego School of Medicine were recruited for the study. These fourth-year medical students volunteered to participate in this simulation course as a part of a residency transition course during their last month of clinical training. Sixteen of the medical students participated in simulation in person, whereas 16 participated by telesimulation. Total participant census was constrained by institutional restrictions on in-person gathering allowances.

Curriculum Development

We designed a formal curriculum that included 8 hours of simulation and implemented these cases as part of two half-day simulation courses. We constructed eight separate cases. Each case scenario included learning objectives, personnel and equipment, role descriptions for embedded participants, patient information, diagnostic studies, critical actions, and debriefing materials. Table 1 lists the modules and associated learning objectives. We developed the scenarios for use with a mannequin simulator (SIM Man 3G Plus, Laerdal Medical) with life-like physical manifestations such as reactive pupils and auscultatory heart and lung sounds. The embedded software used hemodynamic monitoring and allowed real-time responses to learners' actions. Three pan-tilt-zoom cameras were used for video streaming with one focusing on the mannequin, one on the patient monitor, and one on the diagnostic studies. The remote learners were also provided with a separate digital copy of laboratory and imaging results immediately prior to the session to ensure parity in image quality between in-person and remote learners. In addition, these results were introduced in a stepwise fashion for each scenario, and the remote learners were prompted by the facilitator to view relevant data to ensure concurrent release of diagnostic tests among all participants.

Simulation Implementation

The simulation course was conducted in the simulation center at the medical school. A total of four simulation sessions

Table 1. Learning objectives by simulation module

Module	Learning Objectives
Atrial fibrillation with rapid ventricular response	1. Demonstrate an organized approach to the initial evaluation of a tachycardiac patient 2. Evaluation of the possible etiologies of new-onset atrial fibrillation 3. Review management of atrial fibrillation with RVR 4. Initiate appropriate ACLS management for unstable atrial fibrillation
Hyperkalemia	1. Recognize EKG changes as indicative of hyperkalemia 2. Review management of severe hyperkalemia 3. Appropriately communicate with consultation services in concise manner
COPD exacerbation	1. Demonstrate an organized approach to the initial evaluation of a patient with shortness of breath 2. Review management of COPD exacerbation, including NIV and intubation 3. Appropriately plan for intubation in patient with respiratory distress 4. Demonstrate an organized approach to hypoxemia in an intubated patient 5. Recognize a right mainstem intubation
Septic shock	1. Demonstrate an organized approach to the initial evaluation of shock 2. Review management of septic shock
Symptomatic third-degree AV block	1. Demonstrate an organized approach to the initial evaluation of syncope 2. Evaluation of the possible etiologies of syncope 3. Review management of third-degree heart block 4. Initiate appropriate ACLS management for unstable bradycardia 5. Appropriately communicate with consultation services in concise manner
Pulmonary edema	1. Demonstrate an organized approach to the initial evaluation of a patient with shortness of breath 2. Evaluation of the possible etiologies of shortness of breath 3. Review management of pulmonary edema
Upper GI bleed	1. Prioritizing the initial therapies of GI bleed 2. Consider procedural interventions in patient with unstable hemorrhage 3. Initiate appropriate ACLS management for PEA arrest 4. Practice placement of intraosseous devices 5. Appropriately communicate with team during cardiac arrest including role assignment and closed loop communication
Seizure	1. Evaluation of the possible etiologies of seizures 2. Review management of seizures 3. Initiate appropriate postintubation care 4. Appropriately communicate with consultation services in concise manner

Definition of abbreviations: ACLS = advanced cardiovascular life support; AV = atrioventricular; COPD = chronic obstructive pulmonary disease; EKG = electrocardiogram; GI = gastrointestinal; NIV = noninvasive ventilation; PEA = pulseless electrical activity; RVR = rapid ventricular response.

were held over a period of 2 weeks. Each student attended two separate sessions to ensure participation in all eight cases. Each session was attended by approximately eight in-person learners along with eight remote learners participating via the video conferencing service Zoom. A brief 10-minute orientation reviewing objectives, expectations, and recommendations to all learners was performed before the course. Students were assured a safe learning environment, introduced to the simulation equipment, and were provided with recommendations on team role assignments. Additionally, telesimulation-specific objectives, expectations, and recommendations were provided to the remote learners. The audio/video was tested to ensure appropriate functioning for the remote learners before the simulation.

Each simulation scenario lasted approximately 15 minutes. The in-person learners were divided into two even teams, whereas the remote learners participated collectively for each scenario. During the simulation, the in-person medical students performed actions and interventions while the remote participants concurrently detailed their next-step diagnostic interventions and therapies in the chat feature of the video conferencing software for that session. While the case progressed based on the actions and interventions of the in-person group, the remote participants observed the live simulation, discussed their collective thoughts on the proposed plan, and submitted their own recommendations. The recommendations of the remote learners did not affect the progression of the simulation but allowed for some component of active engagement of these individuals. There was no direct interaction between the in-person and remote learners. One facilitator roleplayed as the patient's primary nurse to improve the fidelity of the environment. A second facilitator in the control room provided dynamic simulator responses to in-person learners' actions and moderated the chat for the remote students.

Each simulation exercise concluded with a 20- to 25-minute structured team debrief to evaluate team performance and the observed clinical management. The debriefing for in-person and remote learners was performed separately, each with a designated in-person or remote facilitator. The facilitators rotated between the two groups to ensure even exposure by all learners. Debriefings focused on the same predetermined learning objectives for both groups. The facilitators used the Promoting Excellence and Reflective Learning in Simulation debriefing framework that advanced through four phases: reaction, description, analysis, and summary (16). In brief, the facilitators began by asking for initial thoughts and reactions using open-ended questions and subsequently guided the participants to reflect on their performance with a focus on learner self-assessment. In the remote group, the facilitator also used the prior chat responses entered during the simulation to guide further discussions. The facilitators reviewed common pitfalls and key learning points with prespecified questions. Written debriefing materials summarizing key principles in the management for each case were also provided to the participants. Additional resources were sent to the participants at the conclusion of the course.

Survey Administration

Precourse and postcourse surveys were constructed (Appendix E2 and E3). The questions were reviewed by a group of physicians to assess validity of self-reported items and assess for suitability and completeness based on previously published recommendations (17). As questions were reviewed by the study design team and based on previously validated methodology, no pilot validation study was performed. The surveys were distributed immediately before and after the course using an online secure resource (Qualtrics.com) in accordance with guidelines on proper web-based administration (18). All of the postcourse surveys were completed within 1 week.

The precourse survey established a baseline of trainee experience with simulation and assessed feelings of preparedness using specific performance measures. These performance measures were categorized as technical (i.e., performing a skill such as interpretation of electrocardiograms [EKGs] and chest X-rays [CXRs]), behavioral (i.e., communication with other team members), and cognitive (i.e., decision-making activity, such as recognizing a change in status and implementing an appropriate response). The postcourse survey reexamined their feelings of preparedness and also evaluated their overall satisfaction and perceived effectiveness of the course. The primary outcome measure was self-reported comfort level in the identification of critically ill patients after simulation, and secondary outcomes were comfort levels in recognizing respiratory distress, interpretation of EKGs and CXRs, administration of intravenous fluid, escalation of care, running codes, and communication. Comfort was assessed using a 5-point Likert-like scale (1 = extremely uncomfortable, 5 = extremely comfortable) with higher scores indicating a higher level of comfort and confidence. This assessment focused on learner perception only, and knowledge assessment was not performed.

Statistical Analysis

Statistical analysis was performed using Graph Pad Prism 9.0. Quantitative variables were expressed as mean ± standard deviation and qualitative variables as counts and percentage. The analysis was based on the initial assignment of patients to either in-person simulation or telesimulation. Unpaired t tests were reported. The violin plot was generated by Graph Pad Prism 9.0. A one-sided P value <0.05 was considered statistically significant.

RESULTS

Sixteen of the medical students participated in in-person simulation, whereas 16 participated by telesimulation at the start. Twenty-eight of the 32 participants (88%) completed both the pre- and postcourse survey, with 29 completing the precourse survey alone. There was a female (72%) predominance in the learners. Most of the medical students (69%) had minimal prior simulation training, participating in <5 simulations in their lifetime. Of the survey respondents, 14 performed both simulations in person and 11 performed both simulations remotely. Three trainees participated in one in-person simulation and one telesimulation because of unforeseen circumstances.

Before the simulations, trainees reported the lowest level of comfort in running codes (1.26 ± 0.86) and the highest level of comfort in communication with other members (3.85 ± 0.66) (Table 2). In general, trainees reported higher levels of comfort after simulation across most areas, with a statistically significant improvement in learner comfort with identification of critically ill patients ($P = 0.0002$), recognizing respiratory distress ($P = 0.0013$), interpretation of EKGs and CXRs ($P = 0.0037$ and $P = 0.0007$,

Table 2. Comparison of average comfort levels pre- and postsimulation

	Presimulation	Postsimulation					
		In-Person		Remote		All Learners	
Category	Mean ± SD	Mean ± SD	*P* Value	Mean ± SD	*P* Value	Mean ± SD	*P* Value
Identification of critically ill patients	3.07 ± 1.07	4.07 ± 0.46	0.0005	3.92 ± 0.76	0.1057	4.00 ± 0.61	0.0002
Recognizing respiratory distress	3.55 ± 0.78	4.33 ± 0.49	0.0004	4.08 ± 0.86	0.3346	4.21 ± 0.69	0.0013
Interpretation of EKGs	2.48 ± 0.99	3.87 ± 0.74	0.0006	2.62 ± 0.87	0.3969	3.29 ± 1.01	0.0037
Interpretation of CXRs	2.93 ± 1.09	4.00 ± 0.00	0.0022	3.54 ± 0.88	0.0998	3.79 ± 0.63	0.0007
Administration of IV fluid	2.89 ± 0.79	4.00 ± 0.65	0.0002	3.62 ± 0.96	0.0752	3.82 ± 0.82	<0.0001
Escalation of care	3.29 ± 0.85	4.20 ± 0.77	0.0006	4.00 ± 1.23	0.3273	4.11 ± 0.99	0.0016
Running code	1.26 ± 0.86	2.40 ± 1.24	0.0003	2.54 ± 0.78	0.0186	2.46 ± 1.04	<0.0001
Communication	3.85 ± 0.66	4.33 ± 0.62	0.035	3.85 ± 0.90	0.8037	4.11 ± 0.79	0.1992

Definition of abbreviations: CXR = chest X-ray; EKG = electrocardiogram; IV = intravenous; SD = standard deviation.
Tabular comparison of comfort levels between presimulation and postsimulation course surveys, separated among in-person learners, remote learners, and all learners. Comfort level was assessed using 5-point Likert-like scale (1 = extremely uncomfortable, 2 = somewhat uncomfortable, 3 = neither comfortable nor uncomfortable, 4 = somewhat comfortable, 5 = extremely comfortable).

respectively), administration of intravenous fluids ($P < 0.0001$), escalation of care ($P = 0.0016$), and running codes ($P < 0.0001$).

Further statistical analyses were performed to evaluate the effectiveness of in-person versus remote simulation training. The in-person simulation learners, in particular, reported statistically significant improvement in mean comfort levels across all technical, behavioral, and cognitive domains in the postcourse survey compared with the precourse survey (Table 2, Figure 1). In the telesimulation learners, there was a trend toward improvement across technical and cognitive domains; however, the only statistically significant improvement in postcourse surveys of telesimulation learners compared with precourse surveys was in running codes ($P = 0.0186$). In the behavioral category, there was no difference in mean comfort levels with communication with other members (3.85 ± 0.90 postcourse vs. 3.85 ± 0.66 precourse, $P = 0.8037$). In a direct comparison between the in-person simulation and telesimulation learners, the mean postcourse comfort level scores were lower in the telesimulation learners than the in-person learners in most domains; however, there was no statistically significant differences in these cognitive and behavioral performance measures (Table 3). Within the technical domain, there was a statistically significant difference with in-person learners reporting higher postcourse mean comfort levels in

Figure 1. Violin plot demonstrating overall learning objectives categorized into behavioral, cognitive, and technical performance measures. Plots are provided for presimulation and postsimulation course surveys, separated by in-person and telesimulation learners. The distribution of each score is indicated by the density curve.

interpreting EKGs than telesimulation learners ($P = 0.0004$).

Overall, when polled about whether simulation was a good way to learn critical care skills in a safe learning environment, students strongly agreed with an average score of 5.0 out of 5.0 in in-person learners and 4.9 in remote learners. Regardless of the training modality, the students had a positive experience with the simulation course, ranking it 9.6 out of 10 (9.9 in in-person vs. 9.3 in telesimulation; $P = 0.06$). All of the students recommended the addition of this simulation course to their medical curriculum. Trainees also provided anonymous comments describing their experience, with representative comments including, "I hope I get to do more sim in the future as it definitely provides a safe environment to think about what I would do in certain situations and in a way I will definitely remember" and "I feel much better prepared for the ICU next year and think these should be mandatory for the course."

DISCUSSION

Simulation allows learners to practice the application of knowledge and skills from the classroom in life-like scenarios and is well suited as an educational method to prepare trainees during the COVID-19 pandemic. Specifically, telesimulation is a powerful tool that can be used to enhance the training of our learners despite limitations to in-person training. We demonstrated that the implementation of a telesimulation-based course focusing on critical care cases is both feasible and well received by trainees. Although not as effective as in-person simulation, our study provided evidence that there was still a trend toward improvement in self-reported

Table 3. Comparison of average postsimulation comfort levels by simulation modality

Category	In-Person (Mean ± SD)	Remote (Mean ± SD)	*P* Value
Identification of critically ill patients	4.07 ± 0.46	3.92 ± 0.76	0.5436
Recognizing respiratory distress	4.33 ± 0.49	4.08 ± 0.86	0.3334
Interpretation of EKGs	3.87 ± 0.74	2.62 ± 0.87	0.0004
Interpretation of CXRs	4.00 ± 0.00	3.54 ± 0.88	0.0512
Administration of IV fluid	4.00 ± 0.65	3.62 ± 0.96	0.2216
Escalation of care	4.20 ± 0.77	4.00 ± 1.23	0.6049
Running code	2.40 ± 1.24	2.54 ± 0.78	0.7314
Communication	4.33 ± 0.62	3.85 ± 0.90	0.1028

Definition of abbreviations: CXR = chest X-ray; EKG = electrocardiogram; IV = intravenous; SD = standard deviation.

Tabular comparison of comfort levels between in-person and remote learners during their postsimulation course surveys. Comfort level was assessed using 5-point Likert-like scale (1 = extremely uncomfortable, 2 = somewhat comfortable, 3 = neither comfortable nor uncomfortable, 4 = somewhat comfortable, 5 = extremely comfortable).

comfort across technical and cognitive domains in telesimulation learners.

There are many innovative ways to integrate telecommunication and simulation. The implementation of telesimulation can be quite varied and include *1*) a remote facilitator and in-person learners with high-fidelity models (9, 12); *2*) an in-person facilitator with high-fidelity models and remote learners (11, 19); *3*) a remote facilitator, remote learners, and remote standardized patients (13); *4*) a remote facilitator and remote learners with low-fidelity models (6, 8, 20, 21); and *5*) virtual reality simulations (22). Furthermore, telesimulation can be active, with the progression of the case from actions directed by remote learners (9, 11–13, 19), or passive, with the progression led by in-person learners and discussion of interventions by remote learners (10, 14). We focused on this passive approach, as it allows for some in-person learners to actively participate and also has the ability to accommodate a large number of remote learners. No studies have directly compared the different types of telesimulation or have shown benefit of one approach over the other.

It is well established that in-person simulation increases provider readiness and knowledge (23–32). Additionally, studies have provided evidence that the benefits of in-person simulation courses are comparable among active in-person participants versus passive in-person observers (33–36). Until recently, there was a relative paucity of literature on the efficacy of its virtual counterpart, telesimulation. However, in the past year, telesimulation has grown because of the rise of pandemic-related distance learning. With the rapid adoption of telesimulation during the pandemic, new studies have evaluated the feasibility of telesimulation as an educational modality (9–13). Additionally, studies have demonstrated that active participants in telesimulation achieve increased self-reported confidence and knowledge, similar to active participants in in-person simulation (6, 11, 21). However, it is unknown whether passive participants in telesimulation may derive a similar benefit. Our study suggested that a telesimulation course can improve provider confidence in passive remote learners. As confidence may not equate to knowledge acquisition (37), future telesimulation studies still need to be performed to evaluate its impact on knowledge acquisition in remote learners.

Clinician educators that are planning to adapt their simulation curriculum to remote learning should select a telesimulation technique that matches their resources and identify learning outcomes that are amenable to telesimulation (38). This may require a focus on more cognitive domains rather than technical and behavioral ones (38, 39). Although earlier telesimulation traditionally centered on practicing and perfecting procedural skills using low-fidelity models (6, 8, 21), recent telemedicine studies with high-fidelity mannequins demonstrated a benefit in the cognitive aspects of learning (11). In this study, there was a trend toward improvement across technical and cognitive domains during a comparison of pre- and post-course surveys in the telesimulation learners, but there was no difference in mean comfort levels with communication. As remote learners were not able to perform closed-loop communication with other team members or actively communicate with consultation services, this finding is not unexpected. Further studies using remote learners in telesimulation may have to adapt their learning objectives to deliver a successful telesimulation course.

The overall mean comfort levels were lower in the telesimulation learners, even as a direct comparison showed no differences in cognitive performance measures on the postsimulation scores of in-person and remote learners. We hypothesize that a passive approach to learning may explain this difference, as hands-on experience represents a critical component in the learning process. Although prior studies have shown that knowledge acquisition during in-person simulation is equivalent between active in-person participants and passive in-person observers, most of these studies actively engaged the passive participants by having them use checklists to critique performance (33, 35) or having them believe that they will be called upon to assist (34). In our study, there was no tool to encourage engagement of all telesimulation participants. Although the chat function introduced an element of participation from the remote learners, it was not mandatory for each telesimulation learner to contribute, and some remote learners maintained their passive status without any level of active engagement. Even though the facilitator prompted further discussion among the remote students during the simulation, other tools, such as checklists, may be an option to maintain engagement of all learners during the telesimulation course.

In addition, we question whether the effectiveness of the telesimulation debriefing may result in this difference. In simulation, the experience itself acts as a catalyst for learning, which occurs during the subsequent debriefing (5). Debriefing with a computer interface has specific challenges. Our facilitators noted that it was more difficult to engage the remote learners than the in-person learners. The web-based format interfered with the nonverbal cues of the participants. Participants were not able to consistently show positive reinforcing gestures to the responses of other learners, such as leaning forward or nodding. This inability to match body language may affect group interaction. Although having all noncontributing participants muted decreased ambient noise, the mere action of unmuting resulted in a delay in response and provided an additional barrier for participants to add to the conversation. Furthermore, there were also times when two participants unmuted at the same time and accidentally interjected over one another, impacting the group dynamic. These constraints in virtual communication may discourage participation by all virtual learners and ultimately impair the success of the telesimulation model. Strategies to overcome these barriers include the following: increasing visibility of all parties on one screen (i.e., using a gallery view with each participant on video), having all participants unmute instead of a select few (mimicking the in-person debrief), soliciting feedback from each individual in a psychologically safe environment, explicitly providing words of appreciation, and considering the use of smaller breakout rooms (40).

In general, telesimulation enables the education of learners at an offsite location by eliminating distance barriers. This has the potential to disseminate content to individuals at remote locations and allow collaboration among different institutions. In addition, telesimulation is able to accommodate a larger number of learners per session compared with in-person simulation, as it can support a near limitless number of remote learners. However, in our study, this educational intervention was not as effective for remote learners compared with active in-person participants. Although a telesimulation model based on large numbers of passive participants may be more scalable than in-person simulation, it may not provide as much benefit as passive in-person observation or active remote participation, thus limiting its utility in medical curriculums. Future studies evaluating the efficacy of telesimulation should be performed using some of the strategies mentioned to optimize remote learning, as the means to provide high-efficacy telesimulation on a larger scale would be a great boon to the field of medical education.

Our study has several limitations that merit discussion. This is a single-center study and a small sample size by design. The study may not be large enough to demonstrate differences between the two subsets. As this was a voluntary course, its results may be biased by self-selection of the study's subjects. Randomization would have improved the study design; however, limitations to student in-person availabilities made randomization infeasible. In addition, the surveys were not coded to specific individuals, so a paired statistical analysis was not possible. Analysis was based on the initial assignment of students to in-person versus remote intervention and may be skewed by the three participants who crossed over. Our assessment was subjective in nature, as the primary outcome was self-reported comfort. Future studies may benefit from a more objective assessment of clinical skills.

In conclusion, remote learning with telesimulation is feasible, and this teaching modality can be effectively incorporated into a simulation curriculum for medical students. Clinician educators should select a telesimulation technique that matches their resources and may have to adjust their learning objectives to this digitized format. Furthermore, they should consider the use of checklists or other tools to optimize telesimulation debriefing if their telesimulation model includes remote learners. Educators should be aware that a telesimulation-based simulation course may not be as effective for remote learners as active in-person participants but still suggests the ability to improve provider readiness across technical and cognitive domains when approaching critical care cases.

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