ORIGINAL RESEARCH

Remote Simulation during COVID-19 Provides Excellent Educational Value but In-Person is Best

Alexandra Milin Glaeser, MD[1] and Edward S. Lee, MD[2]

[1]Assistant Professor, Department of Medicine, UCLA Medical Center
[2]Associate Professor, Department of Medicine, UCLA Medical Center

Abstract

Introduction: Medical simulation has been shown to be beneficial to learning and retention of skills. Our institution has a robust simulation center and curriculum for internal medicine residents. Social distancing guidelines from the COVID-19 pandemic, our interrupted in-person learning. We developed a fully remote curriculum and presented the evaluation.

Methods: Using virtual videoconferencing, we connected remote resident learners, a remote instructor, and a simulation technician who was at the simulation center with a high-fidelity mannequin. Over about 2.5 hours, we took learners through 3 cases, changing patient characteristics based on the learners' decisions. At the end of each session, the residents were surveyed regarding their educational experience. This survey was compared with an identical survey prior to the COVID-19 pandemic to better understand the value and limitations of remote simulation compared with in-person instruction in this observational study.

Results: A total of 268 evaluations were included in the analysis, 106 involved remote instruction. Both in-person and remote simulation were rated highly with all scores greater than 4.85/5. However, for 4 out of 5 items, in-person simulation received statistically higher scores than remote simulation.

Discussion: Simulation is a valuable adjunct to internal medicine residency education, especially when educational objectives are directly applicable to their practice. Our experience transitioning to an innovative remote format received very positive reviews. This structure has the potential to impact education at smaller institutions without access to a simulation center or even to global health partners.

Introduction

The value of medical simulation for long-term learning has been well-described.[1] It aims to provide a realistic medical environment that allows learners to make medical decisions without risk of patient injury. A recent systematic review of 21 simulation studies also illuminated its potential role in preventing medical errors.[2] Another meta-analysis showed that simulation especially helped with acquisition of clinical skills.[3] Remote simulation education, however, is substantially different from in-person simulation with an obvious decrease in fidelity. It is unknown how remote simulation compares to traditional simulation learning.

Our academic institution has a robust simulation center with high-fidelity mannequins. All internal medicine residents rotate through the center yearly. We use the simulation setting as a safe environment to encounter difficult and stressful medical scenarios based on real patient cases. Each session has about 4 residents and covers 3 cases. Due to social distancing guidelines from COVID-19, our in person simulation curriculum was halted. We sought to deliver our curriculum remotely to internal medicine residents during the pandemic using a simulation technician present with the mannequin in the simulation center and a simulation instructor as well as the internal medicine residents in attendance on simultaneous videoconferencing.

The content of our simulation cases is based on a simulation framework that balances acuity of clinical scenarios, with high stakes and the frequency of specific conditions to maximize applicability.[4] Topics include neutropenic fever, narcotic overdose, ventilatory management with asthma exacerbation, torsades de pointes, gastrointestinal bleeding, and tachyarrhythmia management in the setting of vasopressors.

All instructors are trained using simulation educational principles, which aids with the debriefing after conclusion of a case. We follow the Promoting Excellence and Reflective Learning in Simulation (PEARLS) structured debriefing approach as outlined by Eppich and Cheng.[5] Instructors are trained to use an inquisitive approach to debriefing based on Rudolph's debriefing with good judgement,[6] which creates a psychologically safe learning environment while challenging learners in order to maximize the educational value of hands-on simulation. Another tenet of our faculty debriefing relies on identifying and exposing cognitive errors.[7] Educating residents about cognitive errors in this safe learning environment promotes continued reflection while caring for real patients. Given that the key parts

of a debrief can be done via Zoom, we converted our simulations to the remote setting.

Pertinent literature, included a 6-week virtual telesimulation elective for 48 medical students.[8] Students completed 12 clinical scenarios over 6 weeks without the use of a mannequin. Qualitative evaluations were collected and analyzed at the end of the course, suggesting that this was a beneficial experience. Another simulation study examined hybrid in-person and virtual simulation experiences during the pandemic with 14 emergency medicine residents present in the simulation center and 6 participating remotely along with 6 remote medical students.[9] Each session included two simulation scenarios. Learners were surveyed after the session with a total of 23 responses. Similar satisfaction rates were found between remote and in-person learners. Our model provides an example of a different type of innovation compared with existing literature that can be translated into additional opportunities for remote learning on a national and even global scale. Simulation is the subject of our research. To the best of our knowledge, this is the first study that directly compares internal medicine resident experiences with simulation before and during the COVID-19 pandemic. We also have a much more robust number of surveyed learners compared with other studies. We hypothesized that learners would find educational value in remote simulation.

Methods

We included all internal medicine resident evaluations from 7/10/19 to 3/4/20 for case-based in-person simulations as well as evaluations from 8/12/20 to 4/28/20, which were adapted to the remote environment. The in-person dates were selected to include a similar number of evaluations for a comparison group immediately preceding the COVID-19 pandemic.

For the virtual simulations, we used Zoom videoconferencing to connect remote resident learners with an instructor to a simulation technician at the simulation center.[10] Instructors previously received formal training in simulation instruction and debriefing according to the established educational frameworks, but without specific training in remote simulation. A brief orientation covered the expectations of the session, online meeting etiquette, and the limitations of remote simulation. The scenarios began with a case stem presented from the simulation technician's screen. After this, the learners worked through the case by viewing a monitor, interacting with the patient virtually, obtaining a history and physical, requesting testing, and executing treatment plans. A variety of radiology images, point-of-care ultrasound, and laboratory data were available upon request. A virtual defibrillator was also accessible with the ability to perform all of the functions of a normal defibrillator including defibrillation, cardioversion, and pacing.[11] The instructor maintained a private chat with the simulation technician to modify the clinical status of the patient based on the actions of the learners. After completing the case, the instructor debriefed the online learners in a similar manner as in-person sessions. The debriefing period included feedback on teamwork and communication as well as salient aspects of the medical management, based on the actions of the learners during the scenario.

At the close of each session, whether remote or in-person, we collected an anonymous evaluation from all participants. Anonymity was used to minimize bias. The evaluation used items on a Likert scale from 1-5 with 5 being the most favorable educational experience. The questions included applicability to current practice, type of learning environment, effectiveness of staff and instructors, and impact on future practice. The evaluation included both quantitive and qualitative feedback to understand and improve the simulation curriculum for internal medicine residents. Means, standard deviations, and a 2 sample t test assuming unequal variances were performed for each survey question using Excel software. Given the quality improvement nature of the study with no risk to participants, this study fell into the IRB exempt category.

Results

A total of 268 evaluations from internal medicine residents were included in our analysis. Prior to COVID from 7/10/19 to 3/4/20, 162 in-person teaching evaluations were collected. During remote simulation from 8/12/20-4/28/20, 106 resident evaluations were obtained. There were 24 faculty instructors who received evaluations during this study. Nearly all participants had prior experience with simulation earlier in residency or in medical school. Both in-person and remote simulation were rated highly overall with all scores above 4.85 (Table). For 4 out of 5 questions, in-person simulation received statistically significantly higher scores than remote simulation.

Table. Comparison of In-Person and Remote Simulation Evaluations.

Question	Average Score[a] In-Person	Average Score[a] Remote	P value
1) This was a positive learning experience and effective use of my time.	4.97	4.85	0.0031
2) The course content was relevant to my training level or practice.	4.98	4.90	0.025
3) The simulation center staff was helpful and responsive.	4.99	4.94	0.033
4) I learned information/skills that I would incorporate into my practice.	4.98	4.91	0.014
5) I would recommend this course to my colleagues.	4.96	4.89	0.063

[a]Rated on a 5-point scale (1=Poor, 5=Excellent)

In addition, qualitative free-text comments were collected with similar general sentiments in both sessions. When asked about what things in their practice would change, there were team-work-based comments such as "closed loop communication" and "delegating tasks" as well as specific medical management comments such as "overdrive pacing for torsades," "use of ultrasound in codes," and "initial ventilator settings in patient intubated for asthma." Several learners asked for a summary tip sheet based on the cases to be distributed at the close of the session. Given that we reuse cases from year to year, this was not provided. A constructive comment for the remote sessions would be to have a virtual ventilator in order to better visualize current ventilation settings and adjustments. Another resident noted that it felt was less patient-centered as they were not directly interacting with the patient and more focused on the numbers. Comments on the remote nature were generally positive including, "We need more of these!…it is invaluable to our learning to become leaders in critical situations" and "Amazing experience! Very well done particularly for it being remote."

Discussion and Limitations

Simulation is a valuable tool for teaching internal medicine residents as is evidenced by resoundingly positive reviews. Residents agreed that they were learning skills directly applicable to their practice and were able to list specific knowledge and skills that they could implement after the session. A tenet of simulation is flexibility and adapting to the learners' actions. By transitioning to remote simulation, we adhered to social distancing guidelines while still providing a quality educational experience that received excellent marks. As expected, the fidelity of remote simulation is not as robust as in-person instruction based on the quantitative aspect of our survey. However, learners can still benefit substantially as evidenced by highly-rated remote session evaluations.

A limitation of our study is the subjective nature of the reviews from the residents. However, because we used the same survey before and during the COVID-19 pandemic strengthens comparing perceptions of in-person versus remote simulation. The nature of the form does not allow for assessment of actual knowledge or skills gained. Prior research showed the effectiveness of simulation training suggests remote simulation has similar ability to improve learners' knowledge and skills. Further study would be needed to confirm this hypothesis.

Transitioning to a remote environment, we learned that organization and setting expectations for the learners and staff is key. Slides to introduce students to patient scenarios were helpful over videoconferencing. One unique characteristics of our study is having the simulation instructor physically present with the mannequin, which may increase the fidelity of the simulation. There are inherent limitations to performing simulations remotely. Elements of mannequin exam, such as auscultation of the lungs and heart cannot be performed by learners. Physical exam findings were mostly reported by the simulation technician when asked by the learner. In addition, actually performing chest compressions and intubation of the mannequin are not possible remotely, making it impossible to gain hands-on experience with these kinds of skills. On the other hand, allowing learners to focus primarily on the cognitive aspects of the case could enhance their learning of clinical reasoning and decision-making. In our experience, teamwork and communication are not as natural in the remote environment, although most groups improved as they went through subsequent cases, something which typically occurs in the in-person environment.

We have resumed in-person simulations for the internal medicine residents. However, we have used the remote model for several medical school simulations that logistically were too difficult to do in-person. We also hope to incorporate more remote simulations into the residency curriculum. Beyond pandemics, there are many opportunities for this valuable tool including bringing cognitively engaging learning opportunities to institutions without access to a simulation center such as small residencies or even to global health partners. Another future direction is virtual reality simulation, which is already available at our institution. We continue to innovate our curriculum with new high-fidelity technology to deliver the highest-quality learning environment to our residents, medical students, and faculty.

Our model of remote simulation provides a reasonable alternative to in-person instruction as is evidenced by favorable resident reviews. Yet, given inherent limitations to the remote environment, the educational value of in-person simulation remains superior.

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