Video Teleconferencing with Realistic Simulation for Medical Education

Jeffrey B. Cooper, PhD,[*] Deborah Barron, MD,[+] Richard Blum, MD,[#] J. Kenneth Davison, MD,[@] David Feinstein, MD,[&] Jordan Halasz,[^] Daniel Raemer, PhD,[*] and Roger Russell, MD[§]

[*] Associate Professor of Anaesthesia, Harvard Medical School, Massachusetts General Hospital, Boston, MA
[+] Anesthesiologist, Richmond, VA
[#] Instructor in Anaesthesia, HMS, Children's Hospital Medical Center, Boston, MA
[@] Instructor in Anaesthesia, HMS, Massachusetts General Hospital, Boston, MA
[&] Instructor in Anaesthesia, HMS, Beth Israel Deaconess Medical Center, Boston, MA
[^] Technical Manager, Boston Center for Medical Simulation
[§] Instructor in Anaesthesia, HMS, Brigham and Women's Hospital, Boston, MA
From the Boston Center for Medical Simulation, Boston, MA

BACKGROUND

Realistic simulation is a newly established technology for medical training (1). Its first uses were in anesthesia, but that has since expanded into other medical domains, e.g., emergency medicine, radiology, critical care, ACLS training, and medical student education. Two educational uses of realistic simulators have been for teaching basic skills and for training in management of critical events (Anesthesia Crisis Resource Management) (2). One limitation of this approach is that it does not lend itself to training of large groups. Coincident with the emergence of realistic medical simulation, the technology for video teleconferencing has evolved to where it is now affordable for routine applications. Its use for meetings at a distance is becoming common and desktop units are proliferating. We have combined these technologies to conduct long-distance clinical case discussions with realistic re-enactments of anesthesia critical events. We describe here how we have applied these technologies and report on subjective evaluations by some participants in the programs.

Our objective in this exercise is to address two specific problems of educating via the traditional case-discussion model used in many medical conference: 1). participants can only imagine or speculate on how they would act during the actual event and 2). the presentation and discussion are not acted out in real time, thus losing realism that could enhance learning. Real-time re-enactments could allow testing of alternative hypotheses and explanations for the course of events, thus revealing causes that would otherwise not be identified. By observing what appears to be the real case unfolding in real time, audience members might better learn and appreciate the lessons from conferences. The hypothesis is that such teleconferenced training sessions would enhance the traditional mode of case-based critical education.

DESCRIPTION OF TELECONFERENCING SESSIONS

The concept of using teleconferenced, realistic simulations was tested via several two-way, interactive, simulated cases presented to large audiences in different locales (See table 1). Realistic case simulations were enacted at the Boston Center for Medical Simulation (BCMS),[*] which uses a commercially available, life-like mannequin housed in a simulated medical facility.[±] The technology for realistic simulation has been described extensively (1,4,5). In our application, we provide a highly realistic experience as a means to deeply embed concepts relating to critical-event management. The simulation environment follows that described by Gaba et al. by being a recreating of the real medical environment, e.g., OR, ICU, ED, and by including actors in the roles of personnel other than those being trained (3). Figure 1 is a photograph of the simulation environment configured in the operating room mode. The first experiment was conducted at the Massachusetts General Hospital on May 22, 1997. A scenario was developed based on an actual recent clinical event. An audience of approximately 60 attending staff, residents and CRNA's observed the re-enactment, interacting throughout the entire OR team including an anesthesiologist, "surgeon" and "nursing staff" (the latter two were played by other clinical personnel acting in these roles). The two-way video and audio signals were transmitted over six ISDN phone lines (yielding a transmission rate of 3284 Kilobaud) via a V-Tel teleconferencing system at both sites. Two images were presented to the audience, projected on a large screen via standard LCD projectors. The video display of the CMS operating room was on one screen and the image from a camera trained on a slave physiological monitor was on the other. Throughout the conference, participants on both ends could carry on real time conversations, although the audio characteristics and microphone capabilities limited high fidelity conversations to a subset of about 8 individuals while other participants could use a hand-held microphone that was passed between participants.

Figure 1: CENTER FOR MEDICAL SIMULATION CONFIGURED AS AN OPERATING ROOM

For the image, please refer to http://www.jcafulltextonline.com/action/showFullTextImages?pii=S0952-8180%2800%2900148-3.

The conference began with an interview with a live (simulated) "*patient*". The audience was given information about the "patient's" history and physical exam and then proceeded to question the "patient" (in real life, a retired cardiologist), who had prepared responses appropriate to the situation being simulated. During a short break, a presentation was given about an aspect of the patient's history, which permitted time to rearrange the setting at the simulation center. The audience then returned to the OR, where the "patient" was now the realistic mannequin simulator on the operating table. The anesthesiologist, with consultation from the audience, proceeded with the induction. There were some minor perturbations in vital signs, which were treated.

After another short break and didactic presentation (primarily to simulate the passage of time in the procedure), the audience returned to the procedure in progress. The patient was now experiencing unexplained variations from his previously stable state. The audience asked a broad range of questions, which were answered by the anesthesiologist, who also consulted with the surgeon, interacted with a nurse and technician, and carried out other normal activities. The interactive, rapid-paced, dialogue led to discovery of the cause of what was now a deteriorating condition.

Seven other conferences have been conducted with variations on the original case and other simulated procedures (see table 1). The audiences have included those in local hospital department rounds and large audiences at three national meetings. At the Society for Pediatric Anesthesia Conference in 1998, each audience participant was also given the opportunity to select from multiple options for actions by the anesthesiologist via a polling system installed at each seat. The results were displayed immediately and used to suggest actions to the clinician managing the case.

The technology for conducting these seminars is now fairly accessible. As few as three ISDN lines can be used. In that case, the monitor image is merged with the image of the operating room using a digital video mixer. The cost of use of ISDN lines varies with distance but is currently approximately $20/hr. locally and on the order of $100/hr for long distance.

EVALUATION

To assess audience opinions regarding our conference demonstrations of these two technologies, a survey was given to the audience participants in our largest teleconference, the winter meeting of the Pediatric Society of Anesthesia in 1998. Surveys were distributed to 150 participants; 103 were returned (69% response rate). Participants were asked to rate four aspects of the program on a five-point Likert scale (1 = lowest, 5 = highest). The results ware graphed in Figure 2. The overall quality was highly rated (98% of ratings either "very good" or "excellent"). Ninety-three percent of respondents felt that the goals of the teleconferencing session were met (ratings of four or five). Realism of the scenario was highly rated (93% either "very good" or "excellent"). In response to the question "the educational value of the presentation was much greater than that of a standard case conference", 97% of respondents gave a score of either four or five. Because these scores may be somewhat reflective of the entertainment value of the program, further study is needed to assess the added value of the interactive simulation for education versus standard conference formats. A representative sample of audience comments about the presentation is listed in Appendix 1.

Figure 2: TELECONFERENCE SURVEY RESULTS FROM THE 1998 WINTER MEETING OF THE SOCIETY FOR PEDIATRIC ANESTHESIA (N = 103)

For the image, please refer to http://www.jcafulltextonline.com/action/showFullTextImages?pii=S0952-8180%2800%2900148-3.

DISCUSSION

Each video teleconference presented new technical challenges. This is still a new technology to most facilities. New ISDN phone lines usually had to be installed (at a cost of approximately $100 per line; hotel and conference facilities generally add charges beyond the phone company line charge). There are at least five different types of ISDN switches, which are compatible with software adjustments. Video teleconferencing equipment (H.320 standard compatible) must be available at each audience site. Internet connectivity for this application is a likely possibility in the future. The bandwidth of the internet does not yet support this application due to limitations on speed and resolution.

We found that considerable planning and practice were required to re-enact the scenarios in a way that

would convey the lesson. Just as in our routine ACRM courses, the students or audience can take many paths from the intended lesson. The moderator and the faculty playing the role of patient or anesthesiologist must be sufficiently knowledgeable to respond appropriately when questioned or if the simulation path takes an unexpected turn. Although there have been some difficulties both technically and with the simulated clinical environment, to date we have not had a failure that disrupted any of our medical conferences.

The integration of realistic simulation with video teleconferencing has the potential for other applications similar in concept to what we have described here. In several conferences, we demonstrated how these technologies can be used for remote monitoring and consultation. The sessions need not be as elaborate or resource-intensive as the above applications. For instance, we have also conducted lectures for a pharmacology course for medical students. If the modality proliferates, the technical challenges will be mastered and less intensive preparation will be needed to convey the lesson objectives. We encourage others to employ this approach and to devise experiments to assess its efficacy and effectiveness.

ACKNOWLEDGEMENTS

APPENDIX 1:   ILLUSTRATIVE AUDIENCE COMMENTS

1. "This should be the format for oral boards - performance can be assessed."
2. "Regarding telemedicine it will be or is indeed helpful. However, don't you think that HMOs could take advantage and use one physician to telesupervise several operating rooms?"
3. "This format is much more provocative than a routine case conference."
4. "Technology to new heights! If this could be extended to include info databases about drugs and interactions, it would be a very comprehensive teaching tool."
5. "This is a fabulous way to reinforce case objectives."
6. "Had me fooled early on." *In response to realism of the scenario.*
7. "I think it would be much more valuable participating rather than observing."
8. "Cannot supplement a conventional case conference, but is an excellent teaching tool."
9. "As with most case conferences, relatively long time (and in this case, expense) for few points."
10. "While technology is entertaining and fun, a standard case conference can be equally informative and educational."

11. "Interesting, but is it worth the time or the money?"

12. "I would enthusiastically attend a conference at a university medical center with quality like this. It is much more difficult to stay focused with standard case formats. This is far superior."

Footnotes

*BCMS is a non-profit 501(c)3 corporation and a collaborative of the anesthesia departments affiliated with Harvard Medical School [www.harvardmedsim.org].

+MedSim - Eagle®, Binghamton, NY

REFERENCES

1. Gaba DM. Simulators in anesthesiology. *In*: Advances in anesthesia. Mosby-Year Book Inc. 1997;V14

2. Gaba DM. Fish KJ. Howard SK. Crisis management in anesthesiology. Churchill Livingstone. 1994.

3. Howard SK. Gaba DM. Fish KJ. et al. Anesthesia crisis resource management training: teaching anesthesiologists to handle critical incidents. Aviat Space Environ Med. 1992;63:763–70. [PubMed: 1524531]

4. Gaba DM. DeAnda A. A comprehensive anesthesia simulator environment: recreating the operating room for research and teaching. Anesthesiology. 1988;69:387–94. [PubMed: 3415018]

5. Holzman RS. Cooper JB. Gaba DM. et al. Anesthesia crisis resource management: real-life simulation training in operating room crises. J Clin Anesth. 1995;7:675–87. [PubMed: 8747567]

Figures and Tables

TABLE 1:

SIMULATION CLINICAL CASE DISCUSSION TELECONFERENCES

Location	Type	Date	# People (approx.)
Massachusetts General Hospital	clinical case conference	5/21/97	75
Brigham and Women's Hospital	clinical case conference	7/2/97	100
Children's Hospital Medical Center, Boston	clinical case conference	1/7/98	75
Society for Technology in Anesthesia, Tucson, AZ	society meeting	1/15/98	150
Society for Pediatric Anesthesia, Phoenix, AZ	society meeting	2/13/98	150
Harvard Medical School Pharmacology, Boston, MA	medical school course	2/23/98	100
Dartmouth Grand Rounds, NH	clinical case conference	3/11/98	50
Harvard Anesthesia Review Course, Boston, MA	review course	5/22/98	150
Harvard Medical School Pharmacology, Boston, MA	medical school course	2/22/99	100

Articles from The Journal of Education in Perioperative Medicine : JEPM are provided here courtesy of

Society for Education in Anesthesia