Human Patient Simulation and Distance Education: A Review

Cameron K MacGougan, BSc,* MD, Ken H Lam^ BSc, MD

** Emergency Medicine Resident, Royal College of Physicians and Surgeons of Canada program. Department of Emergency Medicine, University of Alberta, Edmonton, Alberta, Canada.*

^Clinical Lecturer, University of Alberta, Department of Emergency Medicine, Edmonton, Alberta, Canada

Abstract

High Fidelity Human Patient Simulation (HPS) and Distance Education (DE) are two new tools available to medical educators. HPS make use of a computerized 'patient' mannequin to simulate medical problems. HPS allows for knowledge integration through experiential learning while optimizing patient safety. It is not a tool for every learning objective - it is expensive, labor intensive and despite having face validity has not been validated by other means. DE facilitates learning between physically separated learners and educators, by allowing students to access educational materials from anywhere. Quality materials take time and effort to develop properly, but educators can spread the cost of development over the increased numbers of students compared to traditional methods. Although DE is well suited to knowledge based topics it is not ideal for all curricula. HPS and DE are not substitutes for training on real patients but represent bridges which make this transition smoother and safer.

MeSH words: Medical Education, Distance, Simulation, Curriculum, Emergency Medicine

Introduction

The goals of any teacher are to facilitate the learning of facts, procedures, concepts or principles by building on the learner's previous understanding [1]. Teachers should look at these goals and then choose the most appropriate tool to bring about that change. Traditional medical education is based on classroom teaching and bedside clinical instruction with real patients and staff physicians. The purpose of this article is to examine two new tools for medical education, High-Fidelity Human Patient Simulation (HPS) and Distance Education (DE), outlining their evolution, advantages, limitations, and appropriate application in an Emergency Medicine (EM) curriculum.

High-Fidelity Human Patient Simulation (HPS)

Simulation is the artificial representation of the real-world to achieve an educational goal via experiential learning [2]. This part of the review will focus on high-fidelity human patient simulation (HPS) describing HPS, outlining its evolution, advantages, limitations, and application of this technology into an EM curriculum.

What is HPS?

A HPS mannequin is a computerized 'patient' designed to simulate a real patient. Depending on the model, the learner is able to perform a variety of interventions, including invasive procedures, during the simulation. With 'correct' anatomy and physiology, the physical

findings and real-time monitoring built into it the mannequin are capable of simulating almost any acute illness desired.

The 'fidelity' of the mannequin is the extent to which the appearance and behaviour of the simulation match what is seen in real life [3]. As technology advances the engineering fidelity of simulators continues to grow [3, 4]. Just as important as the technology is the optimization of psychological and case fidelity [5]. Psychological fidelity requires the learner and teacher to 'play pretend' as the physical and emotional environment is re-created for the simulation. Case fidelity requires the simulation be well designed. Peer-review of the simulation is essential to ensure that it is realistic and that points of controversy are clarified [6].

HPS Evolution

This field of education has come a long way since the first high-fidelity simulator, Sim One, which was developed in the 1960s to teach endotracheal intubation [7]. After work done by anesthesia groups in the 1980s, HPS has seen exponential growth in a number of different specialties including EM [8, 9]. By 2003 Good et al found 1/3 of US medical schools were using HPS as part of their curriculum [6]. The latest METI© HPS technology includes: portable mannequins, complex computer modeling of physiology and pharmacology, the ability to do procedures such tube thoracostomy, and realistic physical findings such as peripheral pulses [10].

HPS Advantages

HPS does not compromise patient safety. Traditional teaching of EM has been done using real patients. The problem with this is trying to balance the conflicting needs of training physicians while maintaining patient safety [11]. HPS offers an alternative to putting patients at risk by allowing students to make mistakes in a safe, controlled environment, even to the point of killing the simulated patient. Participants can deliberately repeat elements of the case to see the potential outcomes.

HPS is a form of experiential learning where the learner constructs knowledge by linking new information with previous knowledge and understanding [3]. Facts, procedures, concepts, and principles can be taught in a more realistic context. Participants can be exposed to rare events. Team-work skills such as communication, leadership and resource management, which are not taught well through standard educational means, are taught effectively in an HPS environment [12]. Structured de-briefing of a case anchors the experiential learning objectives. De-briefing allows both feedback and reflective learning by the participant.

HPS Limitations

HPS is not a substitute for training on real patients but is a bridge to make this transition smoother and safer.

HPS is expensive. A mid-range HPS simulator, useful for most EM applications, costs $30 – 40,000 USD [9]. Other resources needed include: software upgrades, adjunctive equipment, equipment maintenance, physical space and funding for support staff [9, 13]. These costs can be minimized by collaborating with other specialties to create regional simulation centers, but remain a significant barrier to implementation of HPS [14].

HPS requires manpower [9]. The value of good support staff, such as actors and technicians, cannot be underestimated in creating a realistic environment that immerses the participant [15]. HPS also requires a physician leader with an interest in simulation. A successful HPS program requires a team of health care professionals to prepare the cases, to ensure integration into the existing curriculum, to moderate the simulation and to facilitate the de-briefing.

Despite the fact that HPS has face validity, it has not been properly validated. Most of the HPS validation studies have been limited to learner satisfaction and self-assessment. From this literature it is clear that HPS is highly valued by learners [16, 17]. However we do not know if HPS improves patient outcomes or if it is superior to other educational tools [18]. Given the multitude of variables in a teaching intervention like HPS, it is not surprising that it is difficult to produce good randomized controlled trials to support its use [19].

Distance Education (DE)

Distance education (DE) facilitates learning between physically separated learners and educators. This second part of the review will describe the evolution, advantages, limitations, and potential application of DE.

What is Distance Education?

Distance education (DE) has existed since the late 1800's [20]. The basic premise is that a communications medium bridges physically separated learners and teachers. Early correspondence education used postal delivery of paper-based materials to learners [21, 22]. Later radio and television were used to broadcast information. All of these media allowed distribution, but little interaction or feedback [23]. The Internet has accelerated the adoption of distance education by allowing multimedia presentation of concepts. Computer mediated conferencing (CMC) promotes a degree of student/teacher and student/student interaction that was impossible 20 years ago [24, 25]. CMC's act like small group sessions and allow participants to carry on discussions. They can be in real time or asynchronous to allow for time zone differences.

Distance Education Advantages

DE implies a separation of learner and teacher. Traditionally this was because of geographic distance. Increasingly people are looking to DE because of temporal distance: professionals want to upgrade skills without taking time off work. In countries such as Canada, where a small population is spread across a large surface area, DE is useful for both reasons. DE can deliver a quality experience without lost income from time off work, being away from family, and travel costs.

DE works particularly well for knowledge based topics. Educators and students are able to discuss key theories using CMC's and written assignments can be submitted electronically by e-mail.

Another advantage of DE is the ability to spread the cost of development over many students. The main cost is in the development of the learning materials [21]. These costs are then spread across the tuition of many learners. With DE there can be more learners because a quality product can be accessed anywhere by more people than a course offered at a traditional post-secondary institution.

Distance Education Limitations

DE is not meant to replace traditional face-to-face interaction. DE is not ideal to teach team management, communications, or motor skills. Educators need to become familiar with the limitations of the technology, rather than thinking 'technology can solve everything'.

Another current practical limitation is created by the educator and not the concepts nor the technology of DE. It concerns the lack of appropriate quality educational materials. In the past, many educators have transcribed existing lecture notes into a web based format [1]. This is simply posting information, rather than creating an overall educational package, because it ignores the elements of interaction, feedback, and evaluation which learners require [24]. It also does not take full advantage of the new medium at hand.

Distance Education Applications

An example of DE in the field of Emergency Medicine (EM) is an introductory on-line Disaster Medicine course. It was developed by EM residents and faculty at the University of Alberta using a distance education format. Journal articles, video and audio clips, and a study guide are posted on the Internet. Learners are expected to work through the available material and perform they own literature searches. An asynchronous CMC allows students to share their opinions with each other. Facilitators can also introduce questions to stimulate discussion. In short the CMC provides a small group discussion experience.

Conclusion

DE and HPS have seen exponential growth in recent years and are becoming common medical education tools. Despite this, they are not appropriate for every learning objective. DE allows teachers to reach more students than face-

to-face learning and works well for knowledge based topics, but is less useful for teaching motor skills. Conversely HPS allows for knowledge integration through experiential learning while optimizing patient safety. The cost, manpower issues and lack of validation of HPS need to be considered prior to its use. DE and HPS are valuable adjunct teaching assets if properly integrated into a well designed curriculum.

References

1) Training for Improved Performance Project. Training for Improved Performance Series. Athabasca University, Athabasca, 1990.
2) Flanagan B, Nestel D, Joseph M. Making patient safety the focus: Crisis resource management in the undergraduate curriculum. Med Ed 2004;38:56-66.
3) Maran NJ, Glavin RJ. Low- to high-fidelity simulation – a continuum of medical education? Med Educ 2003;37(Supple.1):S22-S28.
4) http://www.hmc.psu.edu/simulation/sim_list/sim_list.html (website viewed September 20, 2004)
5) Issenberg SB, McGaghie WC, Hart IR, Mayer JW, Felner JM, Petrusa ER, et al. Simulation technology for health care professional skills training and assessment. JAMA 1999;282(9):861-866.
6) Good ML. Patient simulation for training basic and advanced clinical skills. Med Educ 2003;37(Supple.1):S14-S21.
7) Grenvik A, Schaefer J. From Resusci-Anne to Sim-man: The evolution of simulators in medicine. Crit Care Med 2004;32(Supple.2):S56-S57.
8) McLaughlin SA, Doezema D, Sklar DP. Human simulation in emergency medicine training: A model curriculum. Acad Emerg Med 2002;9(11):1310-1318.
9) Bond WF, Spillane L. The use of simulation for emergency medicine resident assessment. Acad Emerg Med 2002;9:1295-1299.
10) http://www.meti.com/hps.html (website viewed Nov 2, 2004)
11) Ziv AZ, Wolpe PR, Small SD, Glick S. Simulation-based medical education: An ethical imperative. Acad Med 2003;78(8):783-788.
12) Reznek M, Smith-Coggins R, Howard S, Kiran K, Harter P, Sowb Y, et al. Emergency Medicine Crisis Resource Management (EMCRM): Pilot study of a simulation-based crisis management course for Emergency Medicine. Acad Emerg Med 2003:10(4):386-389.
13) Kurrek MM, Devitt JH. The cost for construction and operation of a simulation centre. Can J Anesth 1997;44:1191-1195
14) Girard M, Drolet P. Anesthesiology simulators: Networking is the key. Can J Anesth 2002;49(7):647-649.
15) Seropian MA. General concepts in full scale simulation: Getting started. Anesth Analg 2003;97:1695-1705.
16) Morgan P, Cleave-Hogg DA. A Canadian simulation experience: Faculty and student opinions of a performance evaluation study. Br J Anesth 2000;85(5):779-781.
17) Gordon JA, Wilkerson WM, Shaffer DW, Armstrong EG. "Practicing" medicine without risk: Students' and educators' responses to high-fidelity patient simulation. Acad Med 2001;76(5):469-472.
18) Weller JM. Simulation in undergraduate medical education: Bridging the gap between theory and practice. Med Educ 2004;38:32-38.
19) Prideaux D. Researching the outcomes of educational interventions: A matter of design. BMJ 2002;324:126-127.
20) Shale, D. Toward A Reconceptualization Of Distance Education. The American Journal Of Distance Education 1988; 2(3) 25-35.
21) Inglis, A. Is Online Delivery Less Costly Than Print And Is It Meaningful To Ask? Distance Education 1999; 20(2).
22) Tait, A. Editorial: Reflections on Student Support in Open and Distance Learning. IRRODL 2003; 4(1).
23) Mills, R. The role of study centers in open and distance education: A glimpse of the future. In R. Mills & A. Tait (Ed.), Supporting the Leaner in Open and Distance Learning (pp. 73-87). Pearson Professional Ltd., Washington, 1996.

24) Crawford, G. Introduction to Distance Education and Training: -DDE 601 Readings, (43-54) Athabasca University, Athabasca, 2000.

25) Keegan, D. Foundations of Distance Education. (3rd Edition). Routledge, New York, 1996.

Competing interest: None declared
Funding: This review did not receive direct funding.

Acknowledgement: Department of Emergency Medicine, University of Alberta for their assistance in kind.

This article has been peer reviewed.

Correspondence to: Dr. Ken Lam
Royal Alexandra Hospital, 541 – 10240 Kingsway Avenue
Edmonton, Alberta, Canada, T5H 3V9
Tel: (780) 907-8119
Fax: (780) 407-3314
E-mail: khlam@ualberta.ca