

The Value of Virtual Patients in Medical Education

Naveed Saleh, M.D.
Texas A&M University

In this systematic review, I examined the use of virtual patient simulations as a medical teaching tool. Virtual patients are computer-based patient simulations used to educate and test medical knowledge and skills. I concentrated on Western systems of medical education and limited my search to English-language journal articles published from 2005 to 2010. I examined potential advantages and disadvantages of virtual patients, results from experimental studies on virtual patients, and practice-based tips. A chief finding of my literature review is that research supports the proper integration of virtual patients into medical curricula. One limitation of the use of virtual patients is that development can be expensive and resource intensive. One solution is the creation of a virtual commons or online community where resources are shared.

Key words: virtual patient, medical education, virtual commons

Introduction

Medical education gurus are very interested in cultivating computer-generated virtual patient encounters (computer-assisted interaction) and have been since the 1990s.¹ For example, the Liaison Committee on Medical Education agreed to allow the use of virtual patients to meet clerkship requirements.² In 2007, the Association of American Medical Colleges "renewed the call for a different target for research on instructional technology."¹ Probably the biggest boost for the move toward virtual patient instruction was the 1999 inclusion of virtual patients on the United States Medical Licensing Exam (USMLE) Step 3.² Internationally, many European institutions are working to develop virtual patients.^{2,3}

*What is a virtual patient?*² When using a virtual patient, a student (e.g., a medical student or, less commonly, a resident) plays the role of a health care professional treating a computer-based simulated patient. A virtual patient should be distinguished from a standardized patient, who is typically an actor trained to interact with a trainee.

Virtual patients are commonly used to teach clinical interviewing skills, bioethics, basic patient communication, history taking, and clinical decision-making skills.⁴

Virtual patient theory. It is important to distinguish different pedagogical frameworks that characterize virtual patient cases. A simple distinction can be made between *static* and *dynamic* cases.⁵ A more expansive list of distinguishing characteristics includes: *linear-passive cases*, *linear-interactive cases*, *branching cases*, and *student-authored cases*.³

Static patient interactions have been used most frequently in computer-based training. The purpose of a static patient case is to teach students how to ask relevant questions and to order relevant tests in the context of a patient's medical condition. Additionally, the goal of the static patient is to teach students to recognize abnormal findings and to infer a diagnosis followed by development of an appropriate treatment plan.

In contrast, in dynamic interactions, conditions progress over time, allowing students to be pressured to make decisions. This allows students to practice a vast range of skills such as medical history taking, physical examination, ordering and reviewing laboratory tests, requesting additional investigations, and planning treatments.

Linear-passive cases progress in one direction without options. They lend themselves well to small group tutorials.³ Linear-interactive cases also progress in one direction, but offer choices. (Some experts characterize linear-interactive cases as exploratory.)⁶ An example would be a virtual history and physical exam replete with assessment and plan. For example, different tests can be ordered to help confirm or discard differential diagnoses. Branching cases allow multiple choices with multiple outcomes. Consequently, various choices beget different clinical scenarios. In student-authored cases, a medical student creates a part of or a whole virtual patient as an exercise.

A survey distributed by researchers from the Association of American Medical Colleges and Harvard Medical School found that 26 of 108 (24%) responding American and Canadian medical schools had developed virtual patient case scenarios.² Of these, case scenarios were used mostly in undergraduate medical education rather than residency and tested primarily internal medicine and pediatrics topics. One limitation of the survey is that it solicited information only about virtual patient instruction development at individual institutions and did not include the development of virtual patient scenarios by private industry or institutions loosely affiliated with academic institutions.

Naveed Saleh, M.D.
11424 Caminito Garcia
San Diego, CA 92131
writer@naveedsaleh.com

Methods

To perform the systematic review presented here, I initially checked the PubMed (MeSH) database for relevant key words. "Education, medical," which includes both undergraduate and graduate medical education, along with the exact term "virtual patient" (no such term exists in the database) seemed most appropriate.

On April 7, 2010, I performed a journal article search in the PubMed database searching for education, medical and "virtual patient." I limited my search to English-language articles written from the previous five years. The rationale was that technology advances quickly and more recent studies would yield results with more "real-world" validity.

I then searched for journal articles from the same period using the Communication & Mass Media Complete Database. I used the same key words ("medical education" and "virtual patient").

After reading titles and abstracts for every listed article, I decided to review articles with a general scope. I did not include studies that examined a specific diagnosis or specific physical exam findings. I also limited my search to Western medical institutions. Appreciating the difference between Eastern and Western culture, I was concerned that cultural differences would confound results. My search yielded eight articles. The articles included experimental studies evaluating the use of virtual patients, review articles, and articles providing tips on virtual patients.

Additionally, I decided to include one article outside of the date parameters because the article presented information on what I judged was a timeless theoretical framework integral to an understanding of virtual patient interaction. The title of the article is "Random comparison of 'virtual patient' models in the context of teaching clinical communication skills" by Bearman and colleagues.⁸

Findings

Although the number of experimental studies investigating the utility of virtual patients is limited, there is still much quality research on the subject. Additionally, findings from studies of virtual patient use are positive and encouraging. The following are some of the results of studies and lists of practice-based tips.

Virtual patients: pros and cons. Virtual patients have been said to offer many advantages to medical schools and residency programs including: efficiency, standardization, easy accessibility, interactivity, decreased instructor workload, exposure to rare but critical cases (e.g., a ruptured aortic aneurysm), personalized learning, immediate and personalized instruction and feedback, efficacy, improvement of clinical skills in a non-threatening experimental environment, student autonomy, and links to the medical literature (e.g., PubMed).¹⁻⁵

Stated disadvantages of virtual patients are that they are: expensive and resource intensive, difficult to integrate into

medical curricula, difficult to edit and author, limited by technology, limited by lack of diversity (race, culture, and discipline), and poor at evaluating complex cognitive skills such as empathy, negotiation, and conveying bad news.^{1,2,6,7} In fact, the individual institutional development of virtual patients can be so cost prohibitive that the American Association of Medical Colleges developed the Consortium on Medical Education and Technology to foster multi-institution collaborative efforts.³ Apparently European medical educators came to the same conclusion. Many European medical schools also work in consortia to develop virtual patient instruction.³

Virtual patients vs. standardized patients. A New York University School of Medicine study found that health care professionals evaluated with either virtual patients or standardized patients were equally comfortable with and equally prepared to respond to both types of patient simulations. Additionally, improvement in diagnostic skills and abilities was equivalent among both groups.⁴

Virtual patients: narrative vs. problem-solving design. Bearman and colleagues evaluated communications skills in medical students divided into two groups: 1) those students whose curriculum included *narrative* virtual patient cases, and 2) those whose curriculum included *problem-solving design* virtual patient cases. Medical students were compared to baseline evaluations. Narrative cases are cohesive and follow a patient over time. Problem-solving designs are linear and follow the same patient through a specific problem. Communication skills evaluated included: appropriate use of open and direct questioning, listening, engagement with the patient, exploration of presenting complaints, use of appropriate language, involvement of the patient in consultation, collection of appropriate data, and use of attentive body language and eye contact.⁸

The researchers found no difference in communications skills between the two groups.

Inter-personal communication. Sijstermans and colleagues⁵ observed that medical students who were exposed to virtual patients felt more confident than students in a control group. Students used a 5-point Likert scale to evaluate their own confidence.

Virtual patients and empathy. Deladisma and colleagues⁷ evaluated empathetic non-verbal responses in students interacting with virtual patients and in students interacting with standardized patients. Although both groups of students were engaged in eye contact with patients, students in the standardized patient simulations showed more empathy as measured by head nodding and body lean toward the patient. One obvious limitation of this study is that, although the virtual patients were quite realistic, they were not real. Students might have realized this and minimized non-verbal communication. Interestingly, other researchers found that students can feel responsible for the care of their virtual patients, thus, ostensibly attributing human qualities to computer-simulated patients.⁵

Integration. Berman and colleagues¹ showed that students are satisfied when virtual patients are integrated into the medical curriculum and show an increase in perceived knowledge and skills. The virtual patients used in the study were robust, well-developed pediatrics cases. Predictably, students were more satisfied when virtual patient cases took the place of other curriculum, not when virtual patients were added to existing curriculum.¹

According to Triola and colleagues,⁴ "Current evidence suggests that the use of VPs [virtual patients] as a component of escalating simulations from computer-based to SP [standardized patient] to actual clinical encounters may be the most appropriate and effective strategy."

Virtual patients: characteristics of effective simulations and tips on developing patient simulations. Research shows that effective virtual patient simulations should provide opportunities for trial-and-error, allow the student unrestricted opportunity to query and examine the patient, allow the student to control certain time aspects of the virtual patient simulation, and allow the student to observe virtual anatomic and physiologic changes.⁵ Additionally, principles guiding virtual patient design emerged from a focus group consisting of medical students on their pediatric clerkship. These principles included relevance, appropriate level of difficulty, interactivity, optimal use of media, recapitulation of key learning points, authenticity, and questions and explanations tailored to the critical-thinking process.⁹

Posel and other researchers at McGill University provide 12 tips authors should consider before developing virtual patient simulations. These include: (1) developing relevant case content and a suitable case model, (2) organizing and storyboarding ideas, (3) matching case complexity to case objectives, (4) including feedback from the start of the simulation, (5) supporting individualized learning, (6) designing the virtual patient in ways that encourage collaborative learning, (7) encouraging interactivity and engagement, (8) developing intuitive and logical case navigation, (9) ensuring privacy, (10) branching to include expert treatment plans, (11) choosing of the right authoring program, and (12) including instruction and feedback throughout the instructional cycle.⁶

Conclusion

Currently, few medical schools can afford to develop virtual patient cases.² One solution is for consortia of medical institutions to work together to develop a *virtual commons*³ or virtual online communities where resources are shared. Perhaps by working together, institutions can learn how to best integrate virtual patients into current curricula.

Acknowledgments

I thank Stephen E. Bales, Ph.D., Texas A&M University, and

Barbara Gastel, M.D., M.P.H., Texas A&M Health Science Center, for their assistance.

References

1. Berman N, Fall LH, Smith S, Levine DA, Maloney CG, Potts M, Siegel B, Foster-Johnson L. Integration strategies for using virtual patients in clinical clerkships. *Acad Med* 2009;84:942-9.
2. Huang G, Reynolds R, Candler C. Virtual patient simulation at US and Canadian medical schools. *Acad Med* 2007;82:446-51.
3. Ellaway R, Poulton T, Fors U, McGee JB, Albright S. Building a virtual patient commons. *Med Teacher* 2008; 30:170-4.
4. Triola M, Feldman H, Kalet AL, Zabar S, Kachur EK, Gillespie C, Anderson M, Griesser C, Lipkin M. A randomized trial of teaching clinical skills using virtual and live standardized patients. *J Gen Intern Med* 2006;21:424-9.
5. Sijstermans R, Jaspers MWM., Bloemendaal PM, Schoonderwaldt EM. Training inter-physician communication using the dynamic patient simulator. *Int J Med Inform* 2007;76:336-43.
6. Posel N, Fleischer D, Shore BM. 12 Tips: Guidelines for authoring virtual patient cases. *Med Teacher* 2009;31:701-8.
7. Deladisma AM, Cohen M, Stevens A, Wagner P, Lok B, Bernard T, Oxendine C, Schumacher L, Johnsen K, Dickerson R, Raij A, Wells R, Duerson M, Harper JG, Lind DS. Do medical students respond empathetically to a virtual patient? *Am J Surg* 2007; 193:756-60.
8. Bearman M, Cesnik B, Liddell M. Random comparison of "virtual patient" models in the context of teaching clinical communication skills. *Med Educ* 2001;35:824-32.
9. Huwendiek S, Reichert F, Bosse HM, De Leng BA, Van der Vleuten CPM, Haag M, Hoffmann GF, Tönshoff B. Design principles for virtual patients: A focus group study among students. *Med Educ* 2009;43:580-8.