Virtual and Augmented Reality
Put a Twist on Medical Education

Bridget M. Kuehn, MSJ

Building on nearly 3 decades of experience using virtual reality to build immersive therapies for patients with posttraumatic stress disorder (PTSD), psychologist Skip Rizzo, PhD, is tackling a new challenge—training clinicians to more skillfully handle delicate interactions with patients. To treat patients with PTSD, Rizzo and his colleagues re-create traumatic situations that trigger intense emotional responses and enable therapy. He's found it particularly useful for a younger generation of veterans who have grown up with virtual reality gaming.

“We draw in a digital generation of young service members that are at home with this technology,” said Rizzo, the associate director for Medical Virtual Reality at the University of Southern California Institute for Creative Technologies. “It’s not science fiction to them. It’s engaging.”

Now, he’s using this same technology to create interactive artificially intelligent, virtual patients complete with personalities and credible clinical circumstances. The virtual patients give clinicians a chance to practice difficult conversations about sensitive topics like substance abuse, mental illness, or sexual assault.

“It gives novice clinicians a chance to mess up a bunch with a virtual patient, before they get their hands on a live one,” Rizzo said. While these and other applications of augmented reality and virtual reality (AR/VR) in medical education are fairly new, there is emerging data supporting their value as an adjunct to more traditional training modalities.

Tough Talks

It may seem counterintuitive that virtual patients could help clinicians improve their interactions with real ones, but those using the technologies say it provides the students with valuable experience and feedback.

“Learners need to develop a road map or a script or a pathway of how they’re going to approach a patient,” explained clinical educator Paul Seale, MD, a family physician at Navicent Family Health Center in Macon, Georgia. Practicing such a mental “script” with a virtual patient can allow learners to “know how to word things in such a way that they’re not going to be off-putting or offensive to the patient,” especially with sensitive topics, he said.

Seale and his colleagues at the Southeastern Consortium for Substance Abuse Training received a more than $900 000 grant from the Substance Abuse and Mental Health Administration to provide screening and brief intervention training to nurse practitioners in 8 Southeastern states. They worked with Kognito, a company that leverages gaming technology to build a range of health care training simulations using evidence-based content, to develop virtual patient simulations that were used alongside more traditional methods. The VR simulations were conducted after lectures and before trying simulated patient interviews with actors or interactions with real patients, Seale said.

“They were much more comfortable and prepared for their live interviews,” Seale said of the participating nurse practitioners.

Such virtual patient simulations that train clinicians to conduct screening and interventions for patients with alcohol or substance use problems have been shown to boost physicians’ skill and confidence. As a result, they are much more likely to engage in these difficult conversations in real life, explained Ron Goldman, co-founder of Kognito. According to Goldman, the ability of these programs to provide interactive and unique experiences keeps clinicians engaged.

“Your experience will be very different than mine because we say different things [to the virtual patient] as we go,” Goldman said. At the end of each interaction the simulations provide clinicians with a score on how well they’ve managed the conversation, which often serves as motivation to try again, he said.
Clinicians may initially be skeptical about interacting with a digital character on a computer screen, but once the virtual patient starts providing credible answers to their questions the interaction unfolds just like it would with a live actor, Rizzo said. Another advantage of the virtual patient training modules is that they can be used by distance learners or tweaked for other types of clinicians. For example, similar simulations are also being used to train physicians and social workers.

"The actual skillset is pretty much the same," Seale said. "[The simulations] are very useful for such a wide range of learners."

Rizzo and his colleagues are developing the next generation of virtual patient that will use cameras and microphones to track trainees’ facial expressions, eye gaze, head pose, or vocal cues.

"The idea is to make it so the virtual patient might react in a certain way if the doctor doesn’t engage them with face-to-face contact. He’s always looking down at his notepad. He’s very curt with his responses," Rizzo explained.

Rizzo anticipates that virtual reality will increasingly be used as a tool in both clinical training and mental health care. But for those designing VR tools, he said it’s important to ensure that safety and feasibility trials are conducted. He also emphasized the importance of following ethical guidelines established by the Institute of Electrical and Electronics Engineers, an influential professional organization that represents more than 400,000 technology professionals. The guidelines emphasize the need to ensure the well-being of people interacting with computer programs that use artificial intelligence and to monitor for unintended harmful consequences.

"We can’t get so enamored with the technology that we skip over things that might give us precautionary information about how people react and interact with this content," Rizzo said.

**Interactive Anatomy**

Virtual patients are just one way this technology is being applied in clinical education. Programs around the world are experimenting with ways to use it to help trainees develop hard skills like a mastery of anatomy.

With an augmented and virtual reality device, medical students at Bond University in Queensland, Australia, can manipulate a virtual 3-dimensional (3D) model of the brain or enter a virtual world that allows them to skim the surface of the spine or look inside a kidney (Video). "Augmented reality allows the student to hold the structure, and virtual reality allows them to navigate within and around structures in an entirely controlled environment," explained Christian Moro, PhD, an assistant professor at Bond University.

Moro and an interdisciplinary team at the university developed the software that generates the images using a consumer game-building tool called Unity. Such consumer-gared resources and advances in computer engineering have enabled creation of these medical education tools, according Moro.

In a head-to-head study of 59 anatomy students randomized to the same anatomy lesson using either virtual or augmented reality or a tablet-based lesson that included a 3D model and a 10-minute narrative by a surgeon, Moro and his colleagues show that these new tools were as effective as the tablet. Students also liked the new technology better.

"A textbook or tablet app seemed to feel like learning was a chore to the students," Moro said. "The 3D environments in virtual reality and augmented reality were perceived as more lifelike, more interesting, and more enjoyable."

The next generation of this teaching technology—interactive holograms—is already in development at the Cleveland Clinic and Case Western University where educators are conducting pilot tests of Microsoft’s HoloLens technology. The technology will be built into the university’s new health education campus, which is expected to open in the summer of 2019.

"There’s a lot of interest in figuring out innovative and new ways in which we can teach students," said Jennifer McBride, PhD, associate professor of surgery and director of virtual anatomy education.

The HoloLens technology is considered a mix-reality device, one that places virtual objects in the context of the real world. It consists of an untethered headset with a transparent lens. A student wearing the headset can interact with a 3D computer-rendered image that is overlaid on the classroom, McBride explained. A team of anatomical experts, including McBride, artists with experience creating 3D anatomical renderings and animations, and technical experts collaborated to produce the lessons.

"There’s a way for this to be used that can help the students understand spatial relationships that can be somewhat difficult for us to show with a gross specimen," McBride said. It also gives students an opportunity to personalize their training, by choosing exactly what they want to see. McBride and her colleagues plan to assess HoloLens and the best way to use it by working it into their existing anatomy curriculum. It will become one of the stations, in addition to cadaver tissue sections and imaging stations that students rotate through as part of a lesson.

But the technology is not without drawbacks. Some students report mild eye strain, headaches, or motion sickness when
The Good and Bad News of Health Care Employment

David M. Cutler, PhD

Health care has long been one of the bright spots in the US employment situation. As people have moved out of manufacturing, health care has been a prominent landing place. Just this year, health care passed retail trade to become the largest employer in the economy. Furthermore, health care is a relatively stable industry. Because demand for care remains relatively constant across recessions and expansions, health care employment declines less in recessions than does employment in other industries.

However, economists prefer not to see health care as a jobs program. Every person employed in health care is one less person available to work in other industries. Thus, people should work in health care only if the extra care is more valuable than the output would be in some other industry. If health care employment is expanding because of additional administrative burdens or because clinical personnel are being hired to perform unnecessary procedures, the additional employment will not be worth the cost. Suspecting that this is the case, economists are wary whenever they see news that health care employment is rising.

Even as the growth of medical spending has slowed in recent years, health care employment has continued to increase. Between 2010 and 2016, health care employment grew by 1.7% annually, the same pace as national employment growth. Are these additional workers adding value or are they a waste of resources? To get some insight into this, I looked at data on health care employment in 2010 and 2016. The news is both good and bad.

The Bad News: Lots of Administrative Workers
The bad news is that health care employs a wealth of nonclinical workers. In the medical system as a whole in 2016, there were 22 times as many nonphysician and non-dentist workers as there were physicians and dentists. About 17% of these employees were registered nurses (RNs), 46% were other health care workers (technicians, home health aides, nursing aides, and others), and 37% were nonmedical workers (such as business managers and office assistants).

To put this in perspective, compare physician offices with comparable other professionals. In physician offices in 2016, there were 5.8 nonphysician employees for every physician. The comparable figures are 1.9 for law offices and 1.8 for accounting practices. Somewhat surprisingly, dental offices are about as employee-heavy as physician offices, with 7.5 nondentist personnel per dentist (though many of these are dental assistants). If changes could be made so that physicians’ offices would not need half of the additional nonphysician employment relative to law offices, the savings would be on the order of $7 billion annually.

The Good News: Employment Growth Seems Valuable
The good news is that the growth in employment does not seem to be associated with increased administrative expense. Physicians’ offices in 2016 had about the same ratio of nonclinical personnel to physicians as they had in 2010. The same is true of the medical sector as a whole. And the number of people employed in very specific administrative tasks such as computer support, medical records technicians, and data entry is virtually unchanged.

If not administrative work, what are all the new employees in the past 6 years doing? Most of the increased employment is for clinical tasks, 2 areas in particular. About 27% of the increased employment is personal care aides. The aides are predominantly employed in home health care, community care facilities for the elderly, and substance abuse and mental health facilities. The increase in aides is not surprising and is likely valuable,