

life Virtual encounters

Are the days of newly qualified doctors practising skills on real patients numbered? Doctors in the United States are making their first diagnoses and their first mistakes on plastic, wires and computer circuits, rather than flesh and blood. **Vishnu Madhok explains**

It sounds like one of those riddles that you find in Christmas crackers: what can't be hurt or killed but has a pulse, breathing lungs, and a beating heart? The answer to this particular puzzle is the rather futuristic sounding "virtual patient." Such "patients" resemble life-like mannequins, with plastic ears and hair, injectable veins, moving eyes, and interchangeable genitals. The virtual reality type simulators can be programmed to simulate a wide range of medical emergencies and then respond accordingly as the doctor treats the patient.

Virtual patients combine video and computer images with tactile feedback. Doctors insert needles and surgical tools into a plastic box whose innards give the sensation of cutting flesh or pushing through organs such as the throat or colon. A video screen shows what a doctor would watch during the procedure.

Plastic makes perfect

Professors from over half of the 120 medical schools across the United States that use virtual patients already say that simulators have helped their students and residents build confidence and perfect skills, but, more importantly, simulators have enabled trainees to make mistakes before they treat real patients. Adam Levine, director of the anaesthesiology resident programme at Mount Sinai School of Medicine, New York, describes virtual patients as an "extraordinary advantage" and says that they are used in problem based clinical skills sessions, for which few facilities are currently available.


Virtual patients offer a variety of advantages to teach both basic science and clinical medicine. Levine explains that the virtual patients can be used to educate students even before their clinical years begin: "The simulators can be used as an alternative to animal labs, to demonstrate physiological and pharmacological

principles, without destroying life. The modelled pulmonary and cardiovascular systems are quite complex. At Mount Sinai the medical students participate in three integrated simulator based labs during their physiology courses, to illustrate and emphasise the clinical relevance of pulmonary, cardiovascular, and autonomic nervous system basic science principles."

Students encounter a wide variety of clinical situations during their simulator education. They care for patients with moderate to severe pulmonary and cardiovascular system problems. They learn and practise airway management, manage severe asthma, develop a differential diagnosis, and manage patients with hypoxaemia and ventilation of one lung. Trauma patients with severe hypotension, cardiogenic shock, and septic shock are also simulated.

Using other virtual reality training devices in the centre, students learn and perform bronchoscopy and colonoscopy as components of their classes in gastroenterology and pulmonary medicine

It is well known that learning clinical medicine from actual patients on busy wards is a "hit or miss," and not every student can see every clinical situation.

Levine explains that simulation is a way of guaranteeing that the educational experience is the same for all. "Because simulators are programmable and reproducible, every medical student can be guaranteed to care for the same patient with the same problems, hence unifying students' educational experience. Because it is known in advance what the patient and clinical situation will be, the prerequisite skills to care for this patient can be planned and covered ahead of time, thus enriching the educational experience. The simulated patient can be: paused, rewound, replayed, and fast-forwarded; this assures that every student can learn at their own pace and can learn through trial and error." 



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Advantages of simulation for research, training, and performance assessment

- No risk to patients
- Many scenarios can be presented, including uncommon but critical situations in which a rapid response is needed
- Participants can see the results of their decisions and actions; errors can be allowed to occur and reach their conclusion (in real life, a more capable clinician would have to intervene)
- Identical scenarios can be presented to different clinicians or teams
- The underlying causes of the situation are known
- With mannequin based simulators, clinicians can use actual medical equipment, exposing limitations in the interface between human and machine
- With full recreations of actual clinical environments complete interpersonal interactions with other clinical staff can be explored and training on teamwork, leadership, and communication provided
- Intensive and intrusive recording of the simulation session is feasible, including audiotaping, videotaping, and even physiological monitoring of participants (such as electrocardiography or electroencephalography); there are no issues of patient confidentiality—the recordings can be preserved for research, performance assessment, or accreditation

A model student

Some have expressed concern that training with virtual mannequins is taking a backward step in the emphasis that medical schools have placed on teaching medical students skills such as empathetic communication, bedside manner and etiquette. But Levine says that sometimes students get so caught up in a training scenario that they are upset if a monitor shows that the patient has died.

One anaesthesiology resident, who could not insert a breathing tube after sedating a patient for surgery, frantically resorted to mouth to mouth resuscitation. “The students were just so desperate to get oxygen to this patient, who was dying in front of them,” Levine says.

Levine stressed that the simulator was a teaching device and that how it is incorporated into the curriculum was depend on the people using it. “During the encounters with virtual patients, I teach and emphasise communication, empathy, and bedside etiquette. The students are encouraged to treat the simulator as if it were an actual patient. In addition, these skills are also emphasised during critical events, when the stress is high and these skills are known to take a back seat to the emergent patient care. Also working as a team member can also be taught and communicating with peers is every bit as important when considering the students’ professionalism.”

Advocates of virtual patients

C-3PO drops by for a laparotomy

enthusied that advanced simulators offer better surgery practice than cadavers, pigs, and dogs.¹ Jeffery Hammond, professor of surgery at Robert Wood Johnson Medical School in New Brunswick, said, “I think every school is ultimately going to determine that this is one of the most effective and cost effective ways to train students.”

Counting the cost

Responding to concerns about the similarity of virtual patients to the actual human interior and how this affects the transition to operating on real patients, the American College of Surgeons has proposed national guidelines for simulator centres. These aim to ensure that surgeons are uniformly qualified. Hammond also says that two studies have shown that surgical residents trained on simulators made fewer errors and operated more quickly than those who received the traditional “see one, do one, teach one” training.

But cost is an issue. The small group, interactive simulator sessions are extremely labour intensive and many medical schools do not have the manpower to provide the simulator-based education. Purchasing a simulator is also expensive. Hammond says that scaled down simulators cost at least \$40 000 (£21 000; €31 000), and the most high tech ones cost over \$200 000. With different models teaching different skills, putting together a bare bones lab costs at least \$600 000, and a top of the range centre can cost \$2.5 million.

In a recent report looking at an on-campus simulator programme at Harvard Medical School, initial evaluations among preclinical and clinical students indicated that simulation is highly accepted and increasingly demanded. For some learners, simulation may allow them to understand and retain complex information more efficiently than with traditional methods. Moreover, the process of teaching by simulation shows that it can be integrated into existing curricula of almost any medical school or teaching hospital in an efficient and cost effective manner.² And students seem to like it—feedback on simulation sessions from students have indicated that they find it highly beneficial. Levine said: “They universally love it and continue to request more and more simulator time.”

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1 Fleg A. Animal Behaviour: *studentBMJ* 2004;12:221-264.

2 Gaba DM. Anaesthesiology as a model for patient safety in health care. *BMJ* 2000;320:785-8.

