

Crash-Test Medicine

UVM's new Clinical Simulation Lab employs mannequins that sweat, bleed and breathe
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Courtesy of Raj Chawla, UVM Medical Photography

Resuscitating a high-fidelity mannequin

It's early afternoon on a stormy Wednesday, and a team of emergency medical technicians is working to resuscitate an infant whose heart has stopped. One EMT hooks the tiny child up to a heart monitor. Another places a mask over the baby's mouth and rhythmically squeezes the bag to which it's attached. Still another team member presses the infant's chest with his thumbs, counting out each compression — seven, eight, nine — until he gets to 15. Then he repeats. Meanwhile, another EMT prepares a needle for an intraosseous line and inserts it into the child's shin to give medicine.

It's hard to tell if the infant is responding to the pediatric advanced life support being ably administered by the ambulance crew. His pallor doesn't change, and he never opens his eyes or starts crying. Then again, he was never alive to begin with.

The infant is one of a number of mannequins used by health care professionals in the region to advance their training in areas such as life support, catheterization and delivering babies. He lives at the new Clinical Simulation Laboratory on the [University of Vermont's College of Medicine](#) campus. The \$4 million lab, which opened in March funded by private donations and federal grants, is on the cutting edge of medical training.

Over the years, simulation technology has been responsible for improving health care quality, patient outcomes and general safety. By using highly specialized and eerily lifelike

mannequins that can bleed, sweat, talk and give birth, among other things, medical professionals are able to perfect procedures before employing them on actual humans.

Most hospitals and medical schools around the country have some type of simulation program, explains Cate Nicholas, the lab's director of operations. Indeed, UVM and **Fletcher Allen Health Care** have used simulation with their students for years. But the opening of the 9000-square-foot lab marks a new collaboration between the two entities and offers a dedicated environment in which students can run through every possible scenario where simulation is feasible, from lumbar puncturing to chest tube insertion.

The impressive simulation facility was built to replicate a hospital setting. There are six in-patient hospital rooms, complete with beeping monitors, fluorescent lights, gurneys and video cameras to record students. Faculty can use the video the way coaches use tapes of football games to assess their players.

In another part of the lab, a multipurpose room can be set up to mimic an operating room, an emergency room or an intensive care unit. A training lab featuring body-part models — detached heads, arms, organs and so on — allows students to learn how to draw blood (gone is the old grapefruit method), care for wounds and insert a central line, or catheter into the jugular vein. A virtual-reality lab teaches surgical techniques.

All these bells and whistles aren't just for kicks. Along with standardized patients — community members who play the role of patients — simulation serves an essential purpose in contemporary medical education. In med schools today, instruction time is limited, leaving fewer opportunities for patient interaction. Simulation provides a bridge between classroom tuition and real-world experience, says Dr. Michael Ricci, director of clinical simulation.

Plus, notes Nicholas, people learn best in physical environments that look, sound and even smell like the environment where they will be applying their knowledge. If the lab can simulate what a bluish-tinged ER patient suffering from shortness of breath might look like, the chances are higher that students will retain that information. And, of course, simulation beats the ubiquitous PowerPoint presentation any day.

The most exciting part of the lab is the mannequins. These humanoid shells filled with tiny computers and lung-like bellows can be divided into two main categories — low fidelity and high fidelity. The lab's eight low-fidelity mannequins, like the infant the EMTs are trying to

revive, can't bleed or breathe. Since they cannot show symptoms, an instructor reads scenarios, and the students treat the patient accordingly.

The high-fidelity simulacra are straight out of a horror film in which machines built to resemble humans blink, talk and push babies out of their wombs. They run about \$75,000 each; the lab owns eight. These high-tech mannequins (don't call them dummies) sit seat-belted into chairs lining one of the lab's corridors. They wear johnny gowns and pained expressions on their faces. With mouths agape and eyes wide open, the mannequins all give the impression of having succumbed to the same painful, shocking death.

In one of the simulated hospital rooms, two gurneys each hold a high-fidelity mannequin. One is a child with theatrically long eyelashes wearing a pair of oversized shorts and a T-shirt. Around its neck is a cervical collar, as if it suffered from whiplash. For now, the child is a girl, though the sex organs are interchangeable. On the other bed sits a pregnant woman clad only in a flimsy gown.

Eric Zelman, a senior simulation specialist at the lab, lifts off the top of the mother's rubbery belly to expose a full-term fetus. Then he presses a button, which results in the baby being pushed through the flesh-like vaginal canal head first. The baby comes out slippery, just like a real newborn. But the mannequin is goopy with silicone spray, not amniotic fluid.

Depending on the lesson students are learning, the pregnant mother can have any number of complications with her delivery, including a breech birth or a postpartum hemorrhage. The technicians can even rig it so the baby gets her shoulders stuck on the mother's pelvic wall.

At the back of the room, near a two-way mirror, sit two disembodied arms — one black, one white — connected to a fake-blood-pumping machine made by a company called Limbs & Things. It's important, Nicholas says, for students to learn how to draw blood from and insert IVs in arms of all colors and shapes. They even have an arm with "elderly skin."

It takes some time to get used to these lifelike plastic people, says Dr. Rich Salerno, the attending physician in the pediatric ICU who instructs the EMTs on pediatric advanced life support. Salerno was an early adopter of simulation because of its obvious benefits to patient care. But first he had to adjust to the mannequins.

"The first couple times, it's like, *Gee whiz, it breathes, it wheezes, it talks,*" he says. But soon students come to view the mannequins as real patients.

Zelman says the students practice until they get past the awareness that the mannequins are machines. Once they do, they begin to take the procedures seriously.

“You’d be surprised, when this guy stops breathing,” Zelman says, placing his hand on a full-size mannequin whose chest is rising and falling with each pseudo-inhalation, “how fast the adrenaline runs.”

Simulation participants range from nursing, physical therapy and medical students to practicing nurses and physicians, EMTs, National Guard members, and hospital employees who need to know critical life-support skills. Often, for these people, the experience of trying to save the mannequin’s life is just as intense as if it were a real person. For that reason, Nicholas explains, instructors never create scenarios in which the students’ mechanized patients die. “It’s quite devastating” to lose a patient, even if it was never alive to start with, she says.

If students don’t get a procedure quite right, it’s OK — there’s plenty of fake blood, sweat and syringes with which to try again. And the patient will never complain about getting stuck for the 20th time with a needle. “It’s a safe environment in which to learn or make a mistake,” Ricci says.

Simulation isn’t just a more comfortable way for students to learn medicine; it also reduces risks to the patients who will eventually receive their care. In the time FAHC and the medical school have been using mannequins for central-line training, the infection rate in real patients has gone down by 81 percent. Ricci says there’s a “pretty direct correlation” between learning through simulation and lowered infection rates. Since a positive outcome is the holy grail of medicine, most instructors are on board with the method.

“There is demonstrated improvement in patient care, and the risk of complications is less when you have someone training on a simulator,” Ricci says. “People just learn better by doing.”