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Sim City

By Barbara Pierce

They have pulses, pressures, and pupils that dilate. They can urinate, cry out, and even give birth. They are not human, but they play a critical role in helping health care students and professionals fine-tune skills, build confidence, and optimize outcomes—all without endangering real patients.

On a bright Florida morning, a pregnant woman is struggling through a difficult labor. Six hours after her contractions began, they weaken and stop. Luckily she's in a state-of-the-art teaching facility under the care of a skilled nurse midwife and an attentive group of nursing graduate students. After receiving a pitocin drip, she ultimately gives birth to a healthy baby boy.

Meanwhile, a middle-aged heart patient in a hospital's Coronary Care Unit complains of severe shortness of breath. Guided by the attending cardiologist, several medical students palpate his chest and listen through their stethoscopes for abnormal heart and lung sounds. The probable diagnosis, later confirmed by EKG, is acute mitral valve regurgitation from a damaged heart muscle. The students refer him for urgent surgical repair.

Not far away, a team of paramedics assists an elderly man who has gone into cardiac arrest. One begins chest compressions as a colleague sets up a defibrillator; a third administers intravenous epinephrine and places a flexible tube down the man's airway to keep his lungs ventilated. Though the tension is palpable, the team's



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activities are smoothly coordinated as the ambulance speeds toward the hospital.

All of these scenes are drawn directly from modern health care. Yet they're not strictly real. Rather, they're simulations—learning experiences that take place on technologically advanced mannequins in convincingly replicated clinical environments. It's a powerful approach to health care education that has gathered significant momentum in recent years and is now viewed as a lifesaver.

The University of Miami is playing a leading role in the worldwide effort to realize the enormous potential of simulation. Three different centers—one on the Coral Gables campus and two at the Miller School of Medicine—are home to simulation facilities that combine state-of-the-art technologies with extraordinary expertise.



Forty years ago Michael Gordon, M.D., center, "fathered" Harvey, a cardiopulmonary patient simulator now used around the world.

Today's health care environment is an especially challenging place to learn what tomorrow's caregivers must know. Hospital units hum with high-tech instrumentation. Harried clinicians have more patients to see and less time to teach. Meanwhile, growing data about the prevalence of avoidable medical errors make improving patient safety a top priority. Amid such challenges, computer-controlled simulation enables students and providers to learn, practice, and repeat procedures before performing them on patients.

Technically speaking, simulation education doesn't require a mannequin. Computer-based training sessions are considered micro-simulations; even actors playing 'standardized patients' are simulators of a sort. Still, nothing dramatizes the power of the approach like watching a teaching session (known as a scenario) with a high-fidelity patient simulator—a computerized mannequin that can display the symptoms and vital signs of dozens of conditions, from acute injuries to chronic disease.

Today's high-fidelity simulators can be eerily lifelike. They have heart sounds and

pulses everywhere a person does. As they breathe, their chests rise and fall. They can drool, cough, and urinate. They can moan, cry out, and (with the help of microphones operated by hidden faculty members) carry on conversations with their caregivers. Most importantly, they can respond to the right interventions, flatline when serious mistakes are made, then be reincarnated with a few keystrokes to impart a completely different, equally memorable lesson.

To heighten the illusion of reality, the mannequins typically are placed in environments that closely mimic real clinical settings, such as intensive care units and operating rooms, right down to the hospital beds, monitors, and IV tubes. “People tend to go into simulations with their guard up,” says David J. Birnbach, M.D., professor of anesthesiology, obstetrics, and gynecology and director of the University of Miami/Jackson Memorial Hospital Center for Patient Safety. “So we make the situation as realistic as possible to help them suspend disbelief and forget they’re working on a mannequin.”

To further intensify the experience and take full advantage of teachable moments, faculty members often change preprogrammed scenarios on the fly. They even throw curve balls now and then: “We sometimes imbed mistakes into advanced simulations to see if students can catch them,” says Jay Ober, director of the International Academy of Clinical Simulation and Research at the School of Nursing and Health Studies.

“When you’re doing clinicals, you may see the same thing for several weeks in a row,” says Maria Romano, a senior in the nursing school’s B.S.N. program. “But when you go into the simulation lab, you never know what you’ll get—it’s like Forrest Gump and the box of chocolates. You can’t help but learn, even if you’re just watching.”

Michael Gordon, M.D., says he’s no computer whiz—just a man with “an open mind.” That’s putting it mildly. Gordon’s vision and drive are the impetus behind the creation of a bustling, state-of-the-art center devoted entirely to leading-edge medical education: the Gordon Center for Research in Medical Education, which now occupies the first two floors of the new Clinical Research Building.

It all began with Harvey, a full-sized cardiopulmonary simulation mannequin that can display blood pressure readings, breathing patterns, pulses, and heart and lung sounds associated with more than 30 cardiovascular conditions. The elder statesman of cardiovascular simulators, Harvey is a bona fide celebrity, known to and used by thousands of medical educators and students around the world.



Jay Ober, left, director of the nursing school's International Academy of Clinical Simulation, and Mariano Loo, assistant director, are at the controls of a simulation scenario.

An early champion of the potential of simulation technology to improve medical education, Gordon energetically refuted the prevailing wisdom that students had to practice on real patients. In the 1960s, inspired by the growing use of flight simulators to train pilots and Disney's then-new audio-animatronic technology, Gordon began working with a Spanish Harlem-based firm that animated figures for New York City parades to build the first Harvey.

Since his 1968 debut at an American Heart Association conference, Harvey—named after Gordon's Georgetown mentor, W. Proctor Harvey, M.D.—has been regularly updated by a national consortium of respected physicians and educators known as The M.I.A.M.I. (Miami International Alliance for Medical-education Innovation) Group. Lighter and more portable, today's Harvey features an ever-expanding repertoire of disease states, including stroke. He can be used alone or in conjunction with UMedic, a robust multimedia computer-based curriculum developed at the Gordon Center over the past quarter-century.

"I was raised on Harvey," says Vivian Obeso, M.D. '00, assistant professor of clinical medicine and Gordon Center faculty member. "The beauty is that you can use him throughout—from first-year courses to fellowships."

Now nearly 40, Harvey is still in many ways the heart of the Gordon Center's medical education activities. In fact, one of its most popular courses—an elective taught by Joseph Esterson, M.D., that combines working with the mannequin and learning to read electrocardiograms—is known informally as "Harvey."

"Too many young doctors today rely on expensive tests because they haven't learned how to perform a good physical exam," says Esterson, the center's director of cardiology training programs. "But it's a wonderful and valuable thing to be able to make an accurate diagnosis using only your hands and a stethoscope."

“Over just a few weeks, a lot of things really fell into place for me with Harvey,” says Nathan Connell, a fourth-year medical student. “It’s like an immersion course in the language of cardiopulmonary diagnosis.”

Since what happens before a patient gets to the hospital can be more important than what happens afterward, the Gordon Center trains more than 15,000 paramedics, EMTs, and ACLS (acute care life support) personnel per year from agencies throughout Florida and several other states in prehospital and emergency health programs. These frontline caregivers must be prepared not only for common emergencies like the cardiac symptoms Harvey presents but also for large-scale crises such as natural disasters or terrorist attacks. The Gordon Center also trains U.S. Army Forward Surgical Trauma Teams prior to their deployment. And, through a grant from the Department of Defense, the Center for Patient Safety teaches U.S. military physicians, army medics, nurses, and anesthesiologists how to work more effectively as teams before they’re deployed.

At the nursing school’s International Academy for Clinical Simulation and Research, Harvey is a valued member of a large and varied family of some 16 different patient simulators—nearly every high-fidelity simulator on the market. These “patients” represent a variety of ages and ethnic groups. Located within the new M. Christine Schwartz Center for Nursing and Health Studies, the 5,500-square-foot academy is one of the nation’s first comprehensive simulation centers designed for nursing and health science education. The facility includes a variety of simulation labs and suites that replicate both pediatric and adult clinical settings, as well as computer labs and a high-tech control room.

The academy’s director, Jay Ober, is also its creator; he joined the faculty specifically to build this ambitious program after years of experience in simulation education. Ober has the distinction of having introduced patient simulation into the United States Air Force Reserves, where he served as the director of aircrew training, flight nurse instructor, and assistant chief of staff development. In addition to his post at the University, Ober travels the hemisphere helping other facilities develop simulation education programs. “After all, when you take a simulator out of the box, you can’t just drop in a quarter,” Ober says. “A simulator is only as good as the person teaching with it.”

Ober also serves as an international welcoming committee of sorts, hosting ministers of health and heads of major medical facilities worldwide who come to the academy seeking insight on this one-of-a-kind system. “Everybody wants to replicate not only the model that we use to teach our students but also the methods we use to run and evaluate the simulation,” Ober says.

With his seemingly inexhaustible supply of energy and drive, Ober is clearly a man on a mission—one fueled in part by painful personal experience. “My mother went into cardiac arrest as the result of a medical error,” he says. “When I became a critical care nurse, I witnessed a culture in which people are afraid to admit mistakes. We must remove that stigma and improve education to minimize those errors. Simulation is the best way I’ve ever seen to do that.”



Susana Barroso-Suarez of the School of Nursing and Health Studies guides students through labor and delivery with a maternity simulator, Noelle.

Helping make patients safer is the goal of the UM/Jackson Center for Patient Safety, which provides several simulation-based courses in its state-of-the-art, 2,200-square-foot simulation facility. The events typically bring physicians, residents, and nurses together, just as they would be in real life, to improve their ability to work together effectively.

“Historically, medical students aren’t taught how to communicate with other members of the health care team,” says Birnbach, who has focused on patient safety issues for the past several

years. “So when are they supposed to learn?”

“For example, a physician may call out orders into thin air during a Code Blue without designating who should do them,” Birnbach continues. “Yet even the barristas at Starbucks will shout back ‘soy decaf latte’ to make sure they heard your order accurately. We need to build simple yet crucial communication skills that ensure appropriate care actually gets delivered.”

While the center is run by the Miller School of Medicine’s Department of Anesthesiology, Birnbach says that most of its scenarios don’t have anything to do with anesthesia. More than 1,000 residents come through each year to take required safety courses, working with simulation scenarios that pertain to their area of interest, whether it be pediatrics, surgery, or internal medicine.

According to Birnbach, simulations at the center are often based on real medical errors and near misses. “We can re-create actual medical errors and then tape them,” he says. “When students watch these reenactments, they see an error unfolding before their eyes. It’s a very powerful experience.”



As the applications for simulation education expand, the technology continues to advance. High-fidelity simulators are constantly being updated with new scenarios and symptoms; for example, visual cues important to clinical diagnosis—such as skin color changes and sweat—are in the works.

Despite the fascinations of the technology, however, the dozens of dedicated educators using simulation here at the University never forget its ultimate goal: healthier patients. As nursing dean Nilda P. Peragallo puts it, “With simulation, students get into the habit of practicing in the safest manner possible.

“At the end of the day, that’s what it’s all about.”

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