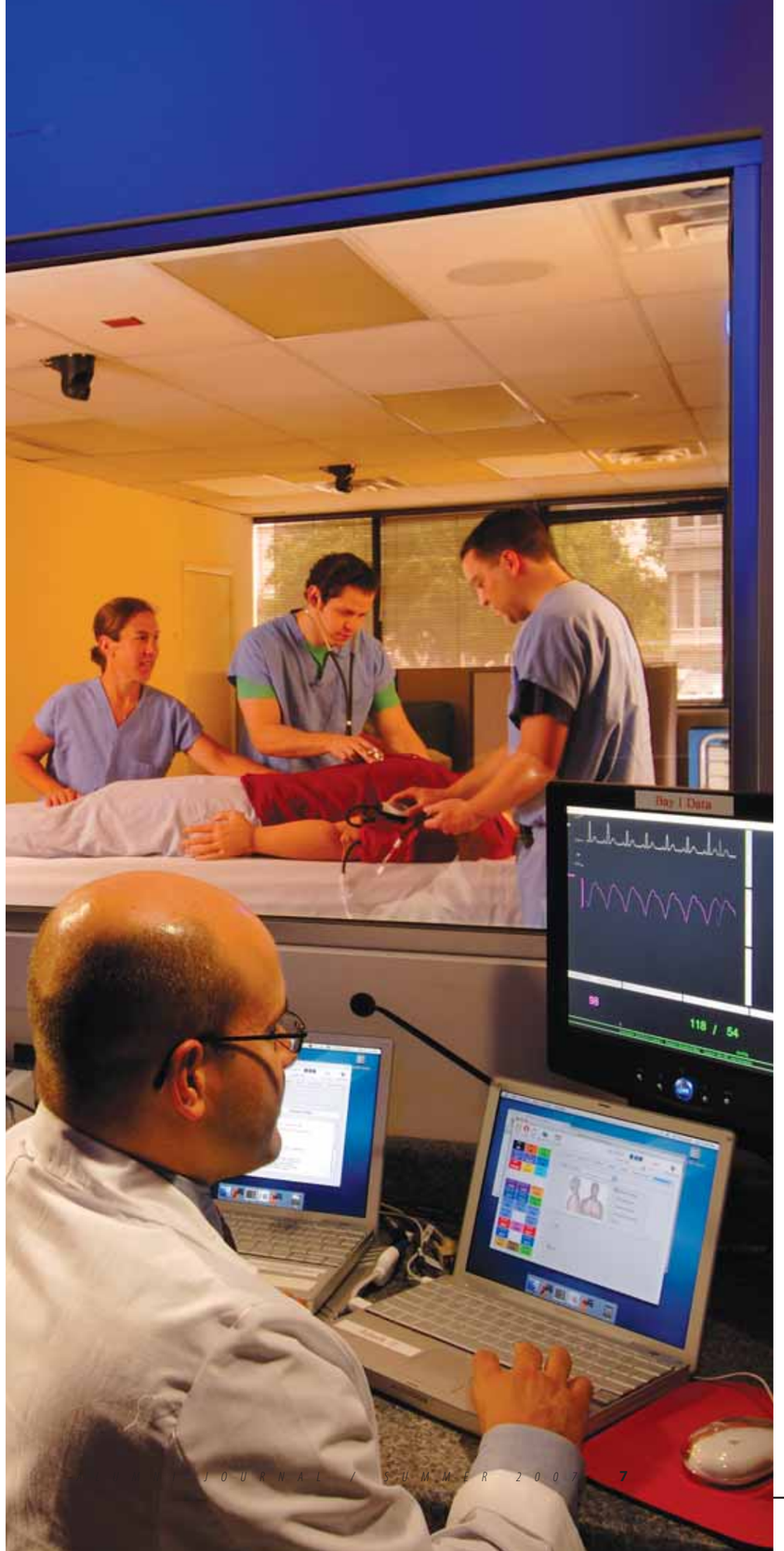

Practice Makes Perfect

Medical simulation allows today's residents to hone their skills with impunity.

BY RENÉE GEARHART LEVY

The patient lies on the hospital bed, moaning. He's come to the Emergency Department complaining of chest pains. The resident asks about the context of his pain and examines his heart and lungs. Another resident takes the patient's pulse in his arms and legs. They decide to order an electrocardiogram. The EKG proves their suspicions right: the patient has a myocardial infarction (MI) and is sent to the cath lab.

On another day, the same patient arrives with the same complaints and symptoms. A different team of residents is on hand and no EKG is ordered. Within a short period of time, the patient's condition begins to deteriorate. He develops an abnormal heart rhythm and goes into cardiac arrest.

Fortunately, the patient is only a mannequin, a sophisticated electronic instructional device known in medicine as a simulator. In many ways, he looks and behaves like a living person: his eyes blink, his pupils dilate, his chest expands and contracts as he breathes, and if you place a stethoscope over

the spot where his heart should be, you can hear it beating. But instead of hearts and arteries, these computerized medical mannequins are wired with hard drives, chips and complex software that enables them to talk, groan, emulate sickness and produce human-like secretions, including tears, blood and urine. The mannequin is connected to a computer in a control room, which enables an instructor to program symptoms of a myriad of medical conditions from heart attack and septic shock to appendicitis and trauma, as well as to "speak" for the patient.

In this case, the voice is Elliot Rodriguez, MD '93, HS '96, director of the Department of Emergency Medicine Simulation Program. Located in a suite of offices on East Genesee Street, the center features a simulated emergency bay with four patient mannequins (two adults, a child, and an infant), numerous body part simulators for practicing particular tasks, as well as a *faux* living room, where paramedics in training might discover one of the mannequin patients slumped over in his easy chair while watching television.

"The beauty of this type of simulation is that we can offer immediate feedback," says Dr. Rodriguez. "This really allows them to process and hone not just their technical skills, but their critical thinking skills."

At Upstate, as at medical schools across the country, the use of simulation in medical training is becoming the new norm in procedure-based specialties such as emergency medicine, surgery, and anesthesiology, supplementing the centuries old tradition of "See one, Do one, Teach one."

While medical students and residents still apprentice more veteran physicians to learn their field, changes in medicine and patient expectation have made it more difficult and less accepted for doctors-in-training to practice on real patients. Procedures and recovery that once took place over several days are now performed in a few hours or in outpatient settings. As a result, residents spend less time with individual patients and have fewer opportunities to observe a case from diagnosis to resolution. And as hospitals move to improve patient safety and satisfaction, learning high-risk procedures on living people seems, if not unethical, legally imprudent.

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"Simulation affords the ability to learn and practice skills efficiently and without the concern of being either less than efficient or less than proficient with a real patient," says Lynn Cleary, MD, senior associate dean for education.

As health care is unique among high-risk fields in that learning takes place largely on human beings, "this is all an effort to increase skill level while ensuring patient safety," says Dr. Cleary.

STANDARDIZING MEDICAL EDUCATION

In 1995, two dozen physicians attended the inaugural International Meeting for Simulation in Health Care. More than 1,200 attended their 2007 meeting, doubling attendance from 2006. The explosion in interest and use of simulation in medicine has been spurred not in academia, but by private hospitals. "A lot of it is driven by patient safety and the effort to reduce medical error," says Cleary. "It's being used by regular hospitals preparing their nurses, technicians, and physicians to manage difficult situations.

Indeed, some life-threatening conditions, such as anaphylactic shock or a ruptured aortic aneurysm, occur so infrequently that it's difficult to assess how to handle the situation because a physician may have never faced it.

"Simulation allows us to teach cases not all that commonly seen but that often are the more critical presentations, where you want your physicians to be proficient at managing the situation," says Rodriguez.

In essence, it allows for standardization of the education system. By providing a structured simulation curriculum, a department can prepare its residents not only for the worst-case scenarios, but the most common as well.

"You can't predict within any given shift what types of cases a resident is going to see," says Rodriguez. "One might go an entire month without seeing a single heart attack patient in the Emergency Department, while another resident might take care of three or four during the same month."

Through simulation, Rodriguez can schedule a heart attack for 2:30 on Tuesday and be confident that each resident is getting the training he or she needs.

Using simulation to provide standardized medical education has been a staple of the Upstate College of Medicine for some time. Second-year medical students spend a significant portion of time learning clinical skills through the aid of standardized patients—actors trained to present with particular complaints and symptoms. A key feature of the new Setnor Academic Building is the Clinical Skills Teaching Center, which includes 22-exam rooms outfitted with closed-circuit cameras. Students "treat" standardized patients to develop examination, interviewing and diagnostic skills and are evaluated by faculty members who observe from another room.

"It's very hard to evaluate students on the same basis using real patients because there are so many variables," says Cleary. The reproducibility found with standardized patients is an essential component of simulation. "If you were going to evaluate someone on their ability to manage septic shock, you could present the same set of data with a mannequin in a controlled simulation center. You can't really do that in real life."

Spencer Ferrin, MD, HS '09, checks the heart beat on a simulated patient experiencing an arrhythmia with the assistance of William Santiago, MD, HS '08, Rosetta Grella, MD, HS '07, and instructor Elliot Rodriguez, MD '93, HS '96.

At Upstate, simulation is an integral part of the residency programs in the departments of surgery and emergency medicine, and will be added to anesthesiology with the incoming group of residents.

The most sophisticated simulation equipment by far is that owned by the Department of Emergency Medicine, which opened its Simulation Center in 2005. Emergency medicine residents spend approximately 15 hours each year running through various simulations geared toward their level of training.

"A first year is going to have more straightforward, cardinal cases, while third-year cases may involve more systems-based issues, may incorporate medical/legal aspects, or highly complex patient presentations," says Rodriguez.

HANDS-ON, NO RISK

While the Department of Emergency medicine's use of simulation is the most advanced on campus, they are not alone. The Department of Surgery has long used various forms of simulation to develop residents' proficiency at basic skills such as tying knots and sewing sutures.

"In the old days, we took a third-year medical student, put him on the medical wards, and essentially said 'go be a doctor,'" says John Fortune, MD, professor of surgery and director of trauma.

"But to be a good doctor, you've got to practice. To be a good surgeon, you're going to have to tie a thousand knots, and you can't do that in the operating room."

Instead, the Department of Surgery is moving to standardize their educational clinical curriculum through simulation, in movement with a national trend in that direction.

Last summer, for the first time, first-year

After their simulation, Drs. Ferrin, Grella, and Santiago discuss their decision-making with Elliot Rodriguez, MD '93, HS '96, medical director of the Emergency Department Simulation Center.

surgical residents left the clinical arena for two weeks, which they spent in the simulation lab practicing the psychomotor skills necessary for common open surgical procedures.

"During that time, each resident probably closed 50 lacerations, sewed up four or five pieces of bowel and a few blood vessels, and tied a thousand knots," says Dr. Fortune. "When you spend 10 days tying knots eight hours a day, you get pretty good at it."

The department's second focus is in the area of laparoscopy, used by senior residents and attending physicians. "Many of the moves being a laparoscopic surgeon are counter-intuitive," says Paul Cunningham, MD, chairman of the Department of Surgery. According to Dr. Cunningham, a fulcrum in the laparoscope makes the movement at the end of the instrument the opposite of the movement of your hand. "It is a skill-set that is acquired; it is not a natural thing."

The Department of Anesthesiology is also adding simulation components, one of Nancy Nussmeier, MD's first priorities after joining the department as chair.

This summer, new anesthesiology residents will adjunct their training with computer-based anesthesia simulations that mimic the operating room environment. "It enables residents and medical students to go through the thought process of how they would deal with anesthetic situations," says Susan Nostrame, MD, clinical associate professor of anesthesiology and associate director of the anesthesiolgy residency program.

Dr. Nostrame believes use of simulation in resident training is particularly well suited to the high-tech, high-risk field of anesthesiology. "When a life-threatening situation occurs, patient safety takes precedence over resident learning and the attending physician usually takes over. By using simulation, you actually allow them to manage these situations and practice without any risk to the patient," she explains.

A COSTLY SOLUTION

While there is little debate about the value of using simulators in medical education, the major obstacle remains the cost. High-fidelity simulators—those computerized models that simulate total body functions come with appropriately sophisticated price tags. The adult mannequins used in the Emergency Simulation Center cost $45,000 each. A model that can be put to sleep with real anesthetic can run $250,000.

Creation of the Emergency Medicine Simulation Center was made possible by a $350,000 federal grant secured by department chair John McCabe, MD '79, funded in part to assist in community emergency preparedness efforts (the mannequins can manifest symptoms of various bioterror attacks).

The Department of Surgery has been fortunate to partner with manufacturer Ethicon Endosurgery, which has allowed the department to access several laparoscopic "trainers," allowing residents to practice and become facile in the technique.

Dr. Fortune himself is working to develop a low-cost "disposable" simulator for surgery. "Once you cut or stick it with a needle or stick a tube in it, it's never the same again," he says of current surgical models, which are designed so that you can replace the part that has been marred.

The METI models used by Emergency Medicine are commonly used by the military and can withstand being dropped out of a helicopter. That's not needed to teach someone how to sew, says Fortune, who hopes to build a cheap simulator for as little as $10 per student, "so they can really cut it up like they need to," he says.

Dr. Cunningham concedes that cost is currently the major barrier to a wider use of simulation in the department, a barrier that the institution alone may not be able to solve.

"We support the public's opinion that it's inappropriate for doctors in training to practice upon them," he says. "But technology is very expensive to obtain and to maintain. As a society, we have to answer the question of how we are going to pay for this. Our public is clamoring for error-free surgery, and the most technologically advanced surgery, and they want us to practice on inanimate objects. That's going to cost a lot of money."

Just this spring, Cleary met with representatives from the departments of emergency medicine, surgery, and anesthesiology to discuss how Upstate Medical University as a whole can come together to use available simulation resources, as well as to plan for the future. The issue has also been made an institutional priority by President David R. Smith, MD, who included "development of Simulation Training in Medical Education" as part of a five-year plan for Upstate's growth.

Financing simulation may become an issue of medical competition. Predicts Fortune, "If patients don't want to come to a hospital where they think they're going to get practiced on then it will put us at a disadvantage in the competitive medical field."

SAFER DOCTORS FASTER

Medical simulators offer immediate training opportunities, overcoming the problem of having to wait for suitable real-life cases to present themselves. They allow easy access to a wide variety of clinical scenarios, including rare complications that allow trainees to benefit from observing the reasoning of an acknowledged expert as they work through difficult situations.

And while practice makes perfect is a hard axiom to argue against, advocates of medical simulation readily admit there is no empirical evidence to support that it produces better doctors.

"There's no doubt that you still have to work on real patients to learn, but most of us intuitively feel that the ability to practice through no-risk simulation is valuable for skill building as well as standardizing the learning process," says Nostrame.

Or as Rodriguez puts it, "Do you want a doctor treating his first MI on your mom or dad?"

Perhaps whether simulation produces a better doctor throughout the course of his or her career isn't the most important point. If it makes one better *faster*, and *safer* faster, that's valuable enough.

"We do know that active learning is retained better than passive learning," says Rodriguez. "You can read something on a page and understand it, but how do you translate that into your actions? That's really what this is all about. Taking medical knowledge and learning how to apply it." ■