New Body of Knowledge

SIMULATORS ARE 'MUST-HAVE' TOOLS FOR TODAY'S MEDICAL EDUCATORS

By S. A. Unger

Photos by K. C. Kratt

Sick patients have a lot to teach. If it weren't for them, medical students, residents and practicing physicians wouldn't have opportunities to acquire skills, discover aptitudes or transfer knowledge.

In years past, such patients could be found in hospitals, where they stayed for days, weeks or sometimes even months—a "captured audience" of sorts, resigned to being treated until fully recovered.

Today, concentrated populations of hospital inpatients are increasingly hard to find, as are the indispensable teaching moments they provide for all health-care professionals.

The reason for their scarcity is not a secret in today's world of managed care, where the word "outpatient" has almost become a redundancy.

While the trend toward ambulatory care may be lowering health-care costs, it has turned the world of medical education on its head.

Gone are the days when "see one, do one, teach one" on a hospital ward epitomized how a student or resident learned to perform a medical procedure.

Given this void, medical educators have had to find innovative ways to ensure that hands-on skills training still takes place.

One such innovation gaining increased attention is the use of computerized mannequins that simulate actual patients. Like an actor stepping onto the stage in the nick of time to resolve a seemingly intractable problem, these highly life-like physiological models are growing in sophistication with each passing year and are rapidly becoming "must-have" educational tools, whether it be to teach a second-year medical student how to intubate a patient or to train an experienced surgeon how to perform a new laparoscopic procedure.

This fall, the UB School of Medicine and Biomedical Sciences joined the growing ranks of medical schools across the country that have made simulators a part of their curriculum.

A full-body simulator, manufactured by Medical Education Technologies, Inc. (METI), was provided to the school as a gift from Margaret Paroski, MD '80, and her husband, Peter Martin, Sr.

A longtime professor of neurology at UB, Paroski is former interim dean for the School of Medicine and Biomedical Sciences and former senior associate dean for admissions and medical education. Currently, she is executive vice president and chief medical officer for Kaleida Health System, the largest health-care provider in Western New York.

The decreasing number of hospital inpatients is not the only trend driving the need for simulators in medical education, Paroski explains.

"In years past, you did not nearly have the focus on supervision and credentialing that you now have," she says. "This is an era of much greater accountability, and medical students, residents and practicing physicians are required to demonstrate competence prior to performing procedures.

"We also have changing attitudes about whom we practice on," she continues. "It's no longer acceptable—and rightfully so—to practice on animals, as we did when I was in medical school 30 years ago, and no one wants to be the patient when a medical student inserts a Foley catheter for the first time.

"I look back at the first CVP [central venous pressure] line that I put in as an intern," she recalls. "I did it with a resident giving me instructions over the telephone. Nobody reviewed the anatomy with me, no one talked to me about the complications and, most of all, no one had any idea about whether I was competent to do the procedure. Today, such a thing would never happen."

James Hassett, MD, director of UB's surgical residency training program, concurs. "Patient safety is what's driving the move toward simulation in medical education," he says.

"If I tell a patient that I'm going to perform a procedure on him and I'm also going to help train a resident to do the procedure, then I have to be able to guarantee the best possible outcome, regardless of who's operating. So, what we've realized is that, from a patient safety standpoint, we have to do a better job of simulating all sorts of things—thought processes as well as technical events. And this has opened the door to a whole industry that uses simulation techniques to improve the training environment."

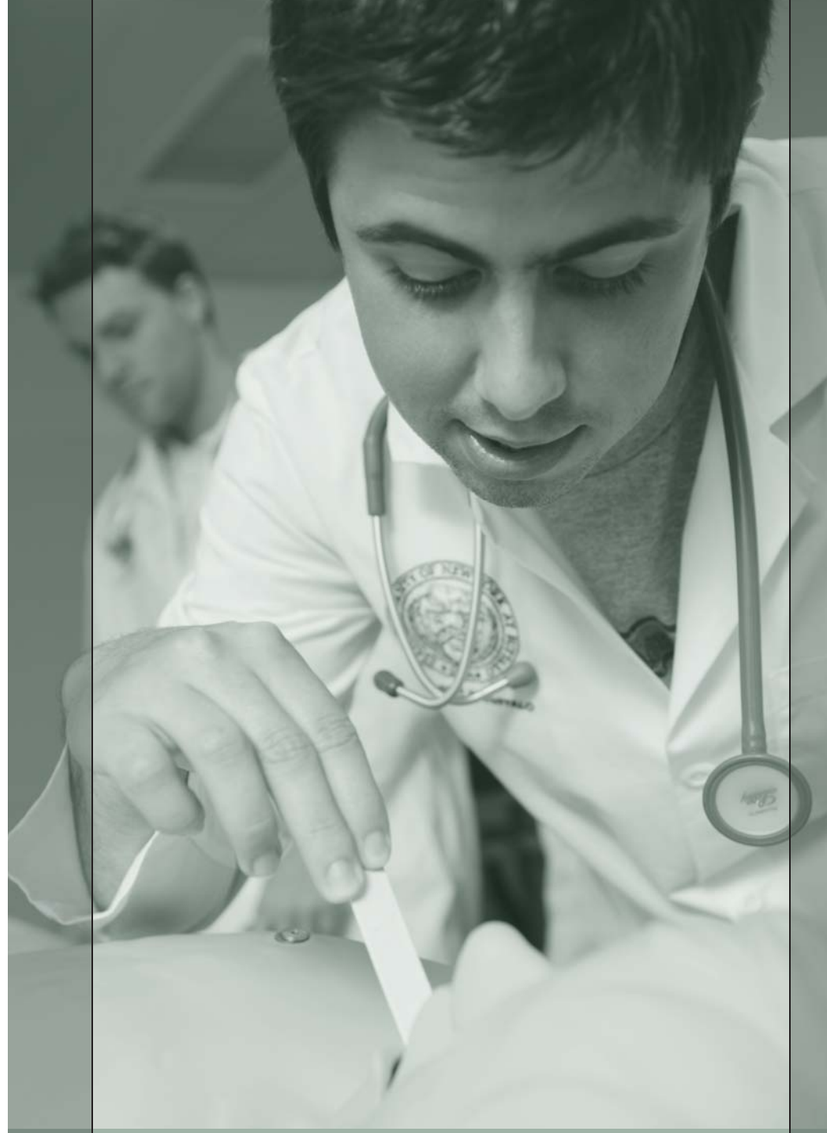
Over the years, anesthesiology professionals—both anesthesiologists and nurse anesthetists—have played a leading role in moving simulators to the foreground as viable learning tools for health-care professionals.

Mark Lema, MD, PhD, professor and chair of anesthesiology at UB and Roswell Park Cancer Institute, says that while simulation training can effectively address safety concerns, it also has the potential to address broader issues related to quality of care.

"It's great for me to say that we want to bring people in to do simulation so that they can be safer anesthesiologists. The reality, however, is that anesthesiology is very, very safe right now, as currently there are about six deaths per million cases. So, in addition to helping us remove the rare events that do cause those six deaths, we have other things to teach with simulators. For example, they can help us decrease perioperative morbidity."

David Milling, MD '93, assistant dean for multicultural affairs and director of the school's Clinical Practice of Medicine II Course, explains that simulators also give educators a tremendous amount of flexibility with regard to when and under what conditions students and residents can be trained.

"One of the difficulties in learning a new procedure has always been that you had to wait for a specific condition or set of circumstances to appear in a patient," he says. "And it didn't always occur at a time when the student and



This fall, second-year students in the Clinical Practice of Medicine II Course got their first look at the school's new simulator. Pictured above is Sean Rudnick.

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Pictured left are Matt Sheldon, *left*, and Matt Paladino, *right*.

Pictured right are, Sheldon, *left*, Sean Rudnick, *center*, and Mary O.

supervisor were present. With simulators, you can teach a procedure in an organized, controlled fashion as part of the curriculum."

Milling also points out that simulators can help teach one skill, in particular, that is critical to the practice of medicine, yet often remains illusive: teamwork.

He and other faculty members foresee a time in the not-too-distant future when simulator training at UB will become a coordinated effort among the university's health-sciences schools.

"In a code or a resuscitation situation in the hospital, there is more than one discipline involved," notes Milling, who worked as a hospital pharmacist for four years prior to attending medical school. "You have nurses, respiratory therapists and pharmacists in the room, for example, in addition to physicians. When you look at that type of scenario, it broadens what you can teach with simulators and dovetails well with the communication-skills training we focus on in the Clinical Competency Center using standardized patients."

Lema says he can envision a time when there will be a skills lab rotation for students, where, in addition to learning basic procedures, they will be taught how to communicate under less-than-ideal work conditions, when medical errors tend to occur.

"For example, you could bring them into the lab ostensibly to teach them how to insert a chest tube," he says, "when in fact what you'd really be planning for them to work on is how to respond to an emergency situation or how to deal with conflict resolution, whether it be with a demeaning physician, an uncooperative nurse or a difficult patient. Those are the kinds of things that will help them develop teamwork and better communication skills."

Adrenaline Rush

A measure of just how realistic modern medical simulators are is the fact that, in some medical schools, faculty no longer let a simulator "die" because students become upset. Instead, many teachers intervene when they see that decisions are being made by students that could be fatal to a patient.

"When you watch people working with simulators, they sweat, their heart rate goes up and they exhibit all the signs of someone feeling pressure," says Raymond Dannenhoffer, PhD, director of the Office of Medical Computing and professor of anatomy, whose IT team consulted on the purchase of the simulator and now provides technical support for it. "It's very hard for them to step back and say, 'Oh, this is only a fake case; I don't have to take it seriously.' When they are in the throes of their 'patient' having a problem and they have to make a decision about what to do, they are very much caught up in the moment, and that's the value of these tools."

The METI simulator at UB is driven by a computer whose software includes a series of 12 pre-programmed learning scenarios, six of which have been purchased by the school to date.

These scenarios include such events as myocardial infarction, congestive heart failure with pulmonary edema, COPD exacerbation with respiratory failure, pneumonia with septic shock, splenic rupture with pneumothorax, and a stab wound to the chest.

The mannequin's skin is life-like to touch, its eyes blink, its chest rises and falls with each breath, and its pulse throbs. If a scenario calls for it, its pupils can constrict or dilate, its tongue can swell, its breathing can become shallow, its pulse can become thready, and its stomach can distend. It can bleed, pass out, drool, gurgle, wail and vomit. It can also "talk" in response to questions posed by medical personnel.

One day it can be programmed to realistically portray a patient with respiratory problems; the next day, it can present with heart problems. This versatility enables faculty to program increasingly complex scenarios in synch with the pace at which the skills of students and residents advance.

"It's extremely interesting to see how everything changes," says Milling, commenting on the mannequin's realistic physiological responses. "You are able to inject it and when you do, the whole protocol with regard to vital signs—heart rate, blood pressure and so on—changes. It's very life-like in terms of the reactions you get.

"For example," he continues, "you are able to demonstrate somebody who has a hemothorax [blood in the chest cavity]. You can listen with your stethoscope and hear a dull sound on one side, which tells you that you need to go ahead and put in the chest tube. Or, you can create various airway conditions to simulate a person who is having an allergic-type anaphylactic reaction."

Dannenhoffer stresses that the computer-driven scenarios available with today's simulators are so sophisticated that students and residents, in addition to performing exams and basic procedures, can actually "treat" the patient. Furthermore, the treatments, and the consequences of the treatments, can be customized by faculty.

"Basically, you can think of it as a big tree diagram," he says about the software program that operates each scenario. "If you inject 100 mgs of a particular drug, for example, what are the consequences?

"You can either run the scenarios as they were pre-programmed by METI and follow them to the end, depending on what the students, residents and attendings do along the way; or, our faculty can go in and decide all the parameters and create their own customized cases."

The Future Is Near

This fall, faculty at UB began training on the simulator and exploring ways to integrate it into the curriculum at both the undergraduate and graduate levels.

"I think there will be a learning curve similar to what we experienced 15

Milling also points out that simulators can help teach one skill, in particular, that is critical to the practice of medicine, yet often remains illusive: teamwork. He and other faculty members foresee a time in the not-too-distant future when simulator training at UB will become a coordinated effort among the university's health-sciences schools.

Lema, who is president of the American Society of Anesthesiologists, says that the ASA has created a national work group called the Committee on Simulation Education, which published a white paper on this topic in January 2006. "The committee has identified nine criteria that its members feel should form the basis for accrediting simulation centers so that they develop a uniformity," he explains.

years ago, when we began incorporating standardized patients into the curriculum," Paroski predicts. "It took a while to get people to be willing to learn how to write a case and to learn how to use it for grading, but now it has caught on."

As was the case with standardized patients, accrediting agencies and professional medical societies will no doubt be driving forces in advancing the use of simulators in medical education.

"In 2001, the Institute of Medicine [of the National Academy of Sciences] published a monograph called *Crossing the Quality Chasm* in which they called for changes in medicine that address quality and safety," says Lema. "Among other things, they recommended the use of simulation whenever possible."

The Association of American Medical Colleges (AAMC) and its Accreditation Council for Graduate Medical Education (ACGME) are studying the issue and faculty are anticipating that mandates will be outlined in the coming years.

All agree that some specialties—such as anesthesiology, emergency medicine, radiology and surgery, to name a few—will be affected more than others.

"Because of the sophistication of the computers, which enable us to generate highly accurate and authentic models, I don't think there's any question that simulators are going to play a greater role in educational processes," says Merril Dayton, MD, professor and chair of surgery.

He explains that, in surgery, simulators have become an integral part of teaching and training in large part due to the concomitant introduction of laparoscopic technologies.

"In the 1990s, with the advent of laparoscopic surgery, there developed a need for residents to learn how to tie knots in the abdomen using these longer instruments, and the learning curve for this is fairly steep. It's a whole different set of technical skills that we've had to master that we didn't use 15 years ago.

"Because of the high percentage of cases that are now done laparoscopically," Dayton continues, "there's a need for residents to be able to 'hit the ground running,' so that when they start to operate on patients, they already have some of these skills. And the best way to teach them these skills, we have found, is with simulation."

Recently, the Residency Review Committee (RRC) for surgery, a body of the ACGME, required that all surgical training programs establish a skills training lab by 2008, although it's still not clear how the committee is defining these labs.

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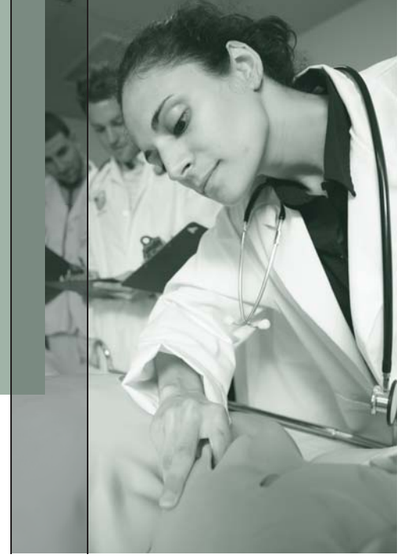
Pictured *right* is Liz Meinert, Class of 2009.



Hassett says that what this portends is "that it's just a matter of time now before the ACGME includes this requirement in its institutional review." As a result, he adds, each medical school must now decide whether it will make the RRC's requirement an institutional requirement.

"Essentially, around the country, folks at places like the American College of Surgery and the American Medical Association are still working their way through certifying simulation activities," Hassett concludes. "However, I think that in 10 years you can expect them to be part of 85 to 90 percent of all training."

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As a senior officer of the ASA, Lema will help to decide how the society moves forward on this issue. "We will be looking at facilities that will serve as simulation training centers with the idea that ASA will evolve into one of the specialties that will require simulation for recertification," he says, noting that anesthesiologists must be recertified every 10 years.

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The Funding Question

While there is little disagreement about the important role simulators will play in the future of medical education, concerns loom large about their costs.

A fully equipped simulator center—and, ultimately, that's a goal for most medical schools—will include not just one or two full-body "adult" simulators, but a diverse range of models geared toward specialties such as pediatrics/neonatology (simulator "babies"), or surgical fields such as arthroscopy, hysteroscopy and gynecology. There are even software programs aimed at patient care in the event of a bioterrorism attack.

"The unit costs are tremendous, and there are significant costs to maintain them, although we can assume that the more they are sold, the more the cost will come down, but it's going to be a real challenge because no one has the dollars," explains Hassett.

UB has an additional challenge, says Dayton. "Being a community hospital–based medical school, our students and residents are very spread out geographically. For example, I have residents at six different hospitals in Buffalo. For residents to break away from the hospital and drive 20 minutes to the South Campus to work at the simulation lab is hard. Yet it would be very expensive to put one of these centers in every hospital; these are some of the things we're going to have to work out."

For years, Lema has strongly advocated for a simulator center to be established in Buffalo and acknowledges that such an undertaking will more than likely require state, corporate and philanthropic support.

"When you think about the expense, it's a start-up expense," he emphasizes. "Yes, there's a certain amount of maintenance each year, but when it comes to education, I really think this is an area where the community, for example, could see tangible benefits from their donation dollars, especially when you consider that a significant percentage of people who train in Buffalo stay here to practice. Relative to what the community would get back, it's not that expensive."

Lema's perspective is one shared by Paroski, who says that when she and her husband, Peter, decided to donate the METI simulator to the medical school, their motives for doing so were simple. "One of the greatest gifts I have received in my life is the education I received at UB's medical school," she says. "I know some people say, 'I paid tuition, I don't owe anything.' But, personally, I don't feel that way because, for what I paid in tuition, I feel I received a phenomenal education, and there's a tremendous need to invest in the future. I like to remind people that if you look at who we are training today, they are only going to be as good as we make them. Peter and I feel this is an investment we can't go wrong on." BP

The METI simulator was provided to the school as a gift from Margaret Paroski, MD '80, and her husband, Peter Martin, Sr., *pictured above.*

The gift is affectionately named "The Great L.H." (Lawrence Henry) in honor of Martin's father, who suffered a severe stroke in 1987. "The care he received—both good and not-so-good—prompted us to invest in technology that will accelerate and improve a student or young doctor's exposure to very challenging cases," says Martin.