Teaching with the Times

By Karen Burbach and Lisa Spellman

It is one of the most recent high tech advances in medical education: the patient simulator.

The next best thing to a real person, the patient simulator allows dental students, budding doctors and fledgling nurses to practice their skills, make mistakes, experience the consequences and try again.

Simulators – popular in the classroom of America's academic health science centers – are one example of how medical education has gone high-tech. Even stethoscopes, which date back to the early 1800s, are being used with a modern educational twist.

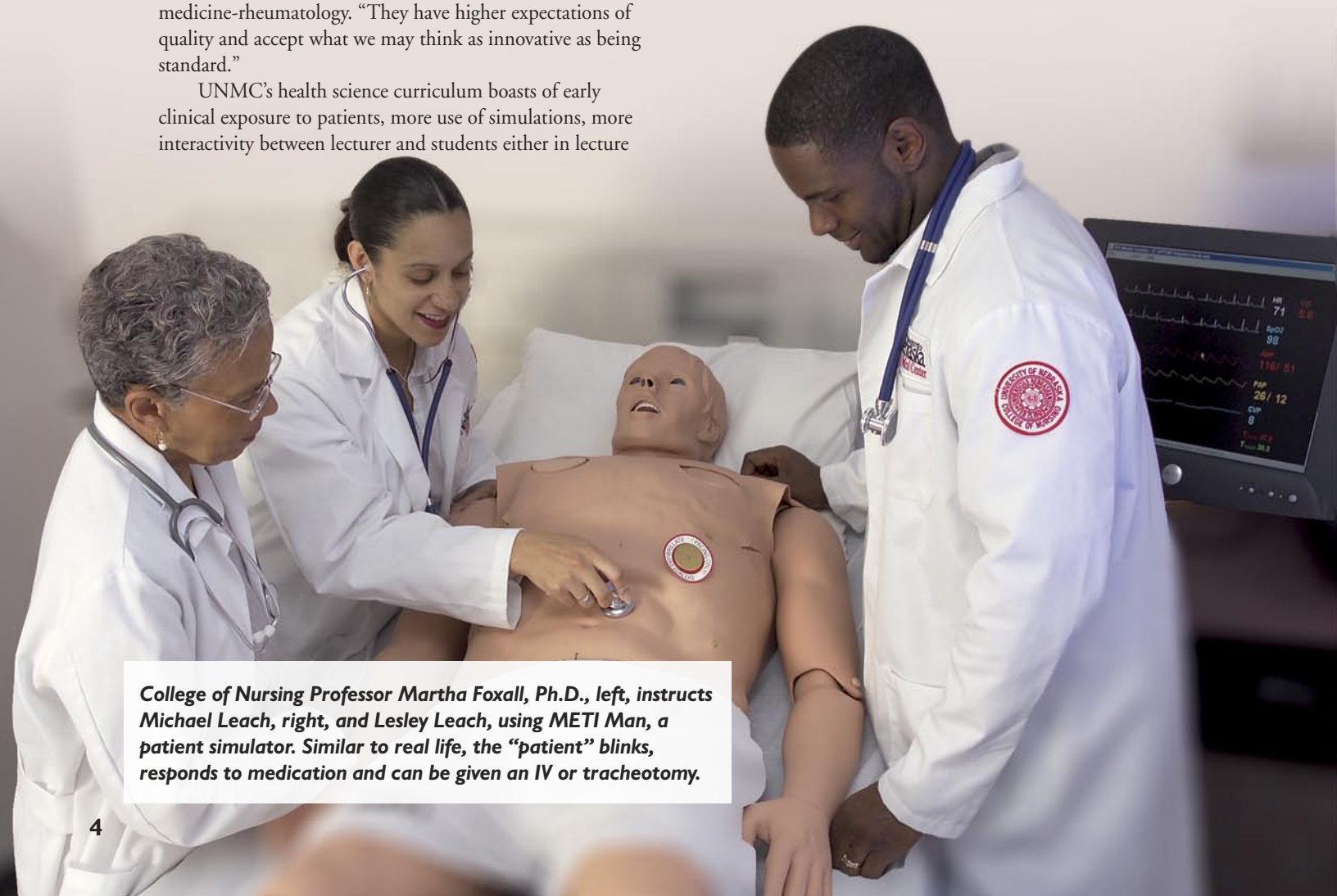
"Students are much more comfortable using electronic resources," said Gerald "Jay" Moore, M.D., associate dean of the College of Medicine and professor of internal medicine-rheumatology. "They have higher expectations of quality and accept what we may think as innovative as being standard."

UNMC's health science curriculum boasts of early clinical exposure to patients, more use of simulations, more interactivity between lecturer and students either in lecture halls or small group sessions, and a heavier reliance on electronic information management.

"Because there is such a rapid expansion of knowledge this gives the health care worker the ability to apply information from many different sources and refine it for the best patient care," Dr. Moore said.

Within a few short years, that educational experience will get another boost when students learn in the new Center for Health Science Education, a 131,296-square-foot facility. The center will be home to the UNMC College of Medicine at the northeast corner of 42nd Street and Emile Street in Omaha.

The improved clinical facilities, 16 simulated clinic rooms with two larger rooms for patient simulators and



College of Nursing Professor Martha Foxall, Ph.D., left, instructs Michael Leach, right, and Lesley Leach, using METI Man, a patient simulator. Similar to real life, the "patient" blinks, responds to medication and can be given an IV or tracheotomy.

an eight-bed nursing ward, will enable UNMC to further enhance the use of standardized patient simulation – hiring individuals to act as patients and simulate a medical problem – for evaluating and training students, Dr. Moore said.

Students now learn clinical skills in four rooms that are small and outdated. The new space will provide a much more realistic view of what students will encounter during their board examinations and ultimately, when they enter private practice.

Elsewhere on campus, students are studying in virtual labs and residents and medical students have the ability, from specific areas on campus, to securely download patient data onto Palm pilots.

UNMC's physical therapy division is incorporating an interactive audience response system, which enables faculty members to ask students questions and immediately record their responses on a screen. The technology provides instant feedback on a particular lesson or procedure.

"Enhanced technological instruction complements our existing curriculum," Dr. Moore said, "but face-to-face interaction between faculty and students remains important."

UNMC College of Medicine Dean John Gollan, M.D., Ph.D., agrees. "Technological tools have, no doubt, expanded our ability to comprehensively teach academic medicine, yet we must always remember that no piece of technology can ever replace the faculty members who educate our students or the patient's need for having a knowledgeable and compassionate health care provider at the bedside."

Patient-simulator mimics life

METI Man, a $48,000, adult-size mannequin featuring the physical characteristics of an adult male, is being used in the UNMC College of Nursing as a teaching tool to enhance the education of nursing students.

With METI Man, nursing students in each of the four divisions of the College of Nursing can practice taking blood pressure, listening to lung sounds and checking for a pulse.

That's because METI Man is able to simulate heart and lung functions, as well as cry, urinate and produce fake blood and mucus.

The simulator features 25 pre-configured patient profiles representing various ages, medical history and gender.

As a teaching tool, METI Man is used to educate nursing students about how to assess patients, how to react during a crisis and how to communicate with patients. A log of each simulation is automatically recorded and available for later review by the student and instructor.

The simulator also can accurately mirror the human response to intravenous drugs (through the built in Drug Recognition System), CPR and intubation. It can be programmed to simulate an emergency, including diabetic coma, congestive heart failure and septic shock.

"This helps the student first get over any feelings of anxiety he or she might have in dealing with a crisis and become more confident in their ability to help patients," said Patricia Carstens, director of the nursing college's Learning Resource Center.

When a student doesn't give the right dosage of medication, METI Man will react accordingly. METI Man also is capable of simulating death and will expire dependent upon the type of care given by the student. "This not only gives the student the chance to learn from his or her mistakes," said Carstens, "but to also experience what they will ultimately encounter at some point – the death of a patient."

Another interesting feature of METI Man is that there is a speaker in his head, which can be used by the instructor to "talk" to the student via a microphone. "This is an excellent way for nursing students to develop effective communication skills appropriate for dealing with a variety of patients, from young adults to senior citizens," Carstens said.

Dental College

The new dental chairs and units at the UNMC College of Dentistry are impressive to patients, but the renovated north clinic's hidden advantage is its dual use as a simulation training center.

"Before remodeling, the north clinic was primarily for patient care," said John Reinhardt, D.D.S., dean of the College of Dentistry. "But when we redesigned the area, we incorporated the features of a simulation laboratory into the new clinic."

The result is a 5,600-square-foot, dual-purpose clinic that includes mannequin-style heads that attach to the new dental chairs during classes.

The north clinic renovation project is part of an ongoing renovation program at the college. The project cost between $1 million and $1.2 million. A combination of private donations and a new student fee are paying for the project. The student fee is specifically designated to pay for replacement of all 173 dental chairs and operatories.

In combining the patient and simulation clinics, students have a more realistic experience than they would in a laboratory-type simulation clinic, Dr. Reinhardt said.

Simulation training has become the standard in pre-clinical and continuing dental education, he said. "This is an improvement over the separate

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Mannequins with plastic teeth allow for students to practice procedures multiple times before ever working on a human.

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laboratory-type simulation areas at other dental schools," said Dr. Reinhardt, who helped plan and design a simulation clinic at the University of Iowa College of Dentistry before coming to UNMC.

"Simulation allows students to repeat irreversible procedures, like preparing teeth for fillings or crowns, over and over again," said Larry Haisch, D.D.S., the faculty project director for the north clinic renovation.

That's because the plastic teeth in the mannequin jaws are removable and inexpensive to replace, Dr. Haisch said.

The simulation facility also can be used for hands-on continuing education courses for dentists, dental hygienists and dental assistants. In these courses, dentists and staff can learn new techniques and try them out on simulators before performing the same techniques on patients.

The 47 mannequin heads, one for each treatment cubicle in the north clinic, consist of a metal skull and removable mouth and jaw with magnetic arches. The teeth in the arches are held in place by screws and can be removed. A rubbery latex mask is fitted over the jaw to simulate the cheeks, nose and mouth.

Each comes with a drainage tube to suck away fluids and a fiberglass torso. A glide bar mounts the mannequin to the headrest on the chair.

Another advantage of the dual-purpose clinic is the presence of state-of-the-art communications equipment. Each dental operatory has a 17-inch flat screen monitor and computer, which is linked to a central broadcast station in the clinic.

This enables instructors to present live or previously recorded visual demonstrations of procedures to classrooms in the College of Dentistry building in Lincoln or to a remote teaching site, such as the West Division Dental Hygiene Program in Gering, Neb.

"The simulation clinic eases our students' transition from pre-clinical education to patient experiences and makes our teaching more effective for this multimedia-oriented generation," Dr. Reinhardt said.

Moving from microscopes to computers, virtual slides

In the past, UNMC students would move slides of cellular structures under a microscope. Now, first-year medical students are studying virtual images using a computer screen.

Professors in UNMC's Department of Genetics, Cell Biology and Anatomy have replaced aging student microscopes and slide collections with flat computer screens, which allow students to view cell structures with the click of a mouse.

Virtual labs are becoming increasingly common in medical schools across the country, said associate professor Gordon Todd, Ph.D.

Today, students in histology and pathology watch as the instructor projects a virtual slide overhead on a dozen classroom monitors. With the click of a mouse, students then find the same image on their computers, where they can scan, magnify and review the structure.

Virtual images are much sharper than those on traditional slides, students say, plus the computer screen allows them to follow the teacher more closely and view cell structures more clearly.

Unlike the microscopes, histology students can study a magnified view of the epithelium, complete with blue, red, yellow and green annotations, which highlight particular areas within the respiratory system. The technology allows everyone to see the same digitized image, compared with glass slides where images can vary from slide to slide. In some cases, students said, cover slips are coming off the glass slides, rendering them unusable.

Researchers also find the virtual lab useful because it allows them to analyze particular images with investigators across the country. Plus, the students said, the virtual lab allows them to study in places other than the library or lab.

Computer screens such as this one have replaced microscopes in the histology laboratory.

Students can quickly learn to master the traditional microscope, if they need to, Dr. Todd said. "It's more difficult to learn what you're looking for in the cell structure than to learn how to use the microscope," he said.

A grant enabled UNMC to buy a specialized microscope to convert its aging glass slide collection into virtual slides. The microscope has a motorized stage and camera that connects to a computer, which allows it to move sequentially from field to field, and then combine the images into a large picture.

Some of the virtual images are created from upwards of 6,000 separate pictures that are stitched together, Dr. Todd said. Scanning one glass slide can take anywhere from 30 minutes to four hours, he said.

Once professors have scanned UNMC's histology and pathology slide collections, the microscope will be available as a Core Facility to researchers who want to look at the same image with a geographically distant collaborator.

Changes to gross anatomy lab benefits students

Last fall, Jon Henning and four other medical students huddled around the waist-high table of their cadaver in search of the brachiocephalic vein.

In the past, the first-year students would have flipped through a chunky anatomy atlas to find the vessel. Instead, a 50-inch screen that projects the precise location of the vein in the upper chest guided their dissection.

It's a new world inside UNMC gross anatomy, which has moved from a strong reliance on textbooks and anatomy atlases to online images.

Today, medical, physician assistant and physical therapy students at UNMC are studying gross anatomy in a newly renovated lab with computers at each cadaver station. Instead of viewing anatomical images in a textbook, students view enlarged images online via 29 video projectors and pull-down screens. UNMC was one of the first medical schools to implement the TV monitors in the gross anatomy lab.

At the foot or head of each cadaver station, a 50-inch projection screen hangs from the ceiling to enhance the students' 10-week introduction of the structural organization of the human body.

"The renovations are amazing," said Todd Lovgren, M.D., who graduated from the College of Medicine in May. "Nebraska's anatomy lab took a big step into the 21st century."

In the past, students spent precious lab time paging through a cadaver dissection guide developed by UNMC's Robert Binhammer, Ph.D., and a hefty, commercial anatomy atlas. Today, the contents of the soft-covered dissection guide are available on the Web, allowing students to find anatomical terms, definitions and images with the click of a mouse. The key anatomical words in the guide are linked to nearly 700 images in Frank Netter's thick human anatomy atlas.

"Displaying the images so everyone can see is a real benefit," Dr. Todd said. "Anything you can do to increase the students' efficiency in learning the material is beneficial."

Henning agrees, glancing toward the projection screen. "(The atlas) is pretty voluminous so it takes a long time to find the exact slide. The links allow us to go directly to the slide."

A mouse at each cadaver station gives students the ability to project the information on the large screens for all to see, rather than crowding together to view the smaller, textbook images. Being able to point directly to structures on the screens enhances the small group-teaching environment.

"Reviewing important structures in the gross anatomy lab has become more productive than before," said Ben Solomon, a third-year medical student. "Students can spend less time flipping through Netter's Atlas of Human Anatomy, and more time focusing on the cadaver. It also makes the lab a little more interactive since all five students in the lab group can easily view the same picture on the screen instead of crowding around one book."

Andrew Livingston, a third-year medical student, has seen the benefits of the project. "This method of combining virtual gross anatomy with the time-honored tradition of cadaver dissection well illustrates that the latest technology can be combined with medical education," he said.

The Olney Family Foundation, the Alumni Class of 1953 and the UNMC College of Medicine funded the gross anatomy renovations.

As a gross anatomy tutor for first-year medical students, Livingston said he benefits from the advantages. "I can point to the projected slides and immediately reinforce what we are reviewing on the cadaver," he said. "The advancements in the gross lab save time and leave more time for dissection."

Infrared transmission of heart sounds teach auscultation

Stethoscopes – the most recognizable of all medical instruments – are being used in the classroom with a twist.

For years, cardiologist Andrew J. Weis, M.D., has taught students how to listen for the subtle differences in heart sounds and murmurs.

With more than 400 combinations of heart sounds and murmurs, knowing how and what to listen for is key to diagnosing many heart problems.

"I've been a product of both the bedside exam, as well as high-tech echocardiography," Dr. Weis said. "They should complement each other in cardiac diagnosis."

With today's technology, students no longer have to rely on actual patients to help them "hear" distinct heartbeats. Instead, an entire classroom of students can simultaneously listen to the heartbeat of a patient with mitral valve prolapse or an atrial septal defect thanks to infrared stethophones.

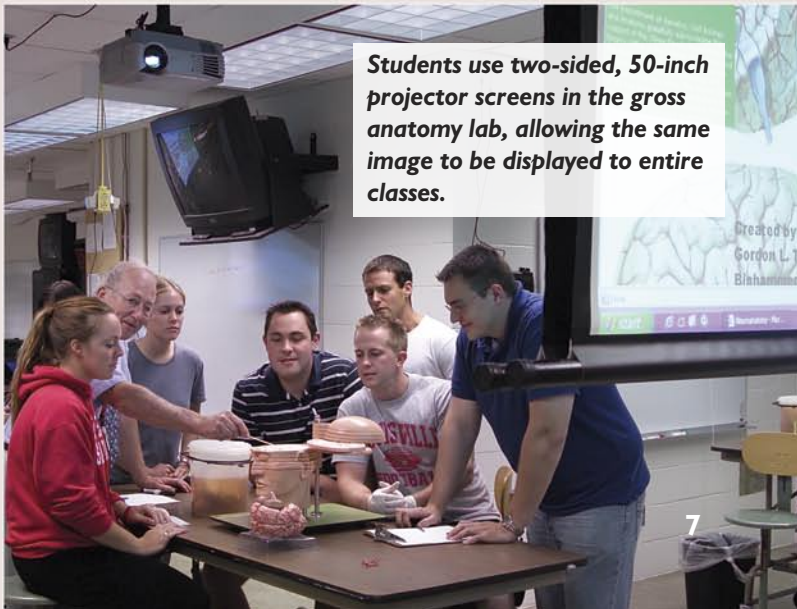
These stethophones, which feature a 2- by 3-inch infrared receiver box instead of a chestpiece, receive transmitted sound waves from a computer simulator. The wireless technology allows students to experience the heartbeat as though they have placed a stethoscope on a person's chest.

"It gives you a good idea of what you should be hearing," he told the group.

Dr. Weis also uses the technology to instruct physician assistant and second-year medical students, as well as internal medicine residents and other interested parties. Over the years, it has evolved, he said, from having wires feed to each student's stethophone out of a computer to the current wireless system.

In addition, every sound is displayed simultaneously as a phonocardiogram, with an ECG, on a large screen, which provides students with a visual representation of what they are hearing, Dr. Weis said. "It's an outstanding audio-visual teaching modality," he said.

The artificial heartbeats can be built with respirations – to show how it affects the heart sounds. Individual clicks, snaps or murmurs can be added or removed, which allows students to learn every aspect of a sound complex – one part at a time. ■



Students use two-sided, 50-inch projector screens in the gross anatomy lab, allowing the same image to be displayed to entire classes.