



Medical Simulation Training

HOW RECENT ADVANCEMENTS HAVE SAVED THOUSANDS OF LIVES.

By PETER BUXBAUM, M2VA CORRESPONDENT

Surgical training has long involved the use of simulators. Practicing procedures on human cadavers is a time-honored part of medical training and represents a simulation of sorts. Surgeons have also trained on live animals such as goats and pigs.

The advancement in military medical training in recent years has resulted in the saving of thousands of lives on the battlefields of Iraq and Afghanistan. The skills and success of military medics and surgeons are attributable to their training and that training has increasingly revolved around the advanced simulators that have been developed in recent years.

Today's simulators feature a realistic look, feel and function to skin, organs and blood. Some are actually designed to be worn by live human actors who can simulate the totality of the patient treatment process.

"The IEDs, poly-trauma, the multiple traumatic amputations that you would encounter in theater can't be replicated for training unless you use simulation," stated Paul Bernal, director of global government business development for CAE Healthcare.

However, the needs of military and veterans medicine are by no means limited to combat casualty care: They run the gamut of medical problems and surgical procedures. The military and veterans medical communities therefore make use of general training simulation as well, such as those designed to train for minimally invasive procedures.

Traditional classroom methods for medical training revolve around textbooks and

PowerPoint presentations, noted Dr. Haru Okuda, national medical director for the Department of Veterans Affairs SimLEARN program. "Then the students go to the ward for hands-on training," he said. "Simulations allow a more proactive approach to training. Trainees can then apply what learn the learned on the simulation."



Dr. Haru Okuda

"Training represents a precursor to actions on the battlefield," said Mark Owens, a military strategic account manager at Laerdal Medical, a developer of medical training simulators. "Medics can be presented with realistic

training simulations and that this results in better combat care for U.S. warfighters on the battlefield."

“There is a revolution in surgical education that is now underway and that this is being led by the U.S. armed forces,” said Dr. Robert Buckman, chief executive officer of Operative Experience Inc. “It’s going to have an impact on worldwide health. Simulations allow training midwives to do a C-section in four months or even four weeks instead of four years. This is going to have an impact around the world in areas underserved by health care infrastructures. Simulations rapidly train civilian surgeons to be prepared for combat situations that they rarely if ever encounter in civilian practice.”

The use of medical training simulators could reduce or eliminate the need for training on live animals. “A research team at the University of Minnesota is evaluating this situation,” said Kit Lavell, executive vice president of Strategic Operations Inc. There is also legislation pending before the U.S. Congress which would eliminate live tissue training by 2017.

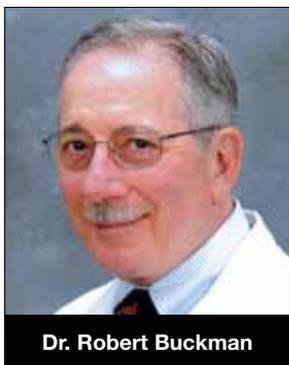
“An animal is a simulator of sort because their tissues are great to work with,” said Buckman, “but they don’t have the same anatomical architecture as humans. Simulators represent as closely as possible the anatomy, tissues and pathologies represented by combat trauma.”

But combat trauma is not the only training requirement for the military medicine. “Military and veterans military hospitals and organizations have a wide range of needs and requirements for training,” noted Dror Paz, vice president of North American sales at Symbionix USA Corp. “It is not limited to combat and disaster relief.” Symbionix specializes in developing and marketing simulators for training practitioners for minimally invasive procedures.

The same logic applies to the VA. “The number of female veterans has doubled over the last 10 years,” said Okuda. “Some of our practitioners needed additional training on procedures involving women’s health.” To

that end, the VA has invested in simulations that train practitioners to perform proper pelvic and breast examinations.

Operative Experience Inc. (OEI) recently participated in Operation Bushmasters, an annual training exercise of the Uniform Services University Medical School. “They used our simulators for almost every aspect of training from point of injury to Level 2 care,” said Buckman. “We trained in excess of 150 students.”



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OEI developed its simulators with a Small Business Innovation Research grant from the U.S. Army. “What the Army wanted was a simulator that could provide rapid combat trauma skills training,” said Buckman. “In response, OEI created training courses using high fidelity and anatomically correct simulators with pathology and wound patterns representative of combat injuries. The simulators consist of artificial tissues, including skin, bone, muscle, fascia, blood vessels and nerves that can be operated on with standard combat surgical instruments.”

OEI point-of-injury simulators emphasize training in damage-control and operative management of high velocity gunshot wounds. They enable instruction in, among other things, the vascular control of blood vessels, damage-control shunting of arteries and veins, and amputations. OEI’s head and neck simulator series enables instruction in procedures associated with high-occurrence traumatic brain injuries such as evacuation of subdural hematoma, evacuation of epidural hematoma, and management of fragment penetration of brain.

CAE’s Caesar patient simulator also provides point-of-injury trauma care experience. According to Bernal, “Caesar can withstand harsh environmental conditions, extreme temperatures and body impact.” Moreover, “he is also a dramatic bleeder.” Caesar is also appropriate for placement in areas where a human actor would be at risk. Bernal gives several situational examples:

“high-angle rescue, a confined space inside a tank or truck or under a collapsed building.”

Currently, the Department of Homeland Security’s Center for Domestic Preparedness uses Caesar for decontamination training exercises. “We are always working on improving our products,” stated Bernal. “With Caesar, we are adding injuries and writing new scenarios based on the latest health care threats, injuries and mechanisms of injury.”

Laerdal Medical develops simulators that run the gamut of combat procedures applicable both to first responders and to clinicians delivering services at higher levels of care. “Military medical organizations are emphasizing training for the platinum 10 minutes,” said Owens. “Immediate treatment on the battlefield increases survivability. That is where much of our efforts are concentrated.”

Laerdal’s manikins exhibit realistic reactions, such as variations in pulse and eye dilation, to the procedures performed on them. The chest rises and falls appropriately and the manikin emits a hissing sound which shows that a chest needle has been applied correctly in the case of a tension pneumothorax (a sucking chest wound) procedure.

“If the procedure is not performed well the manikin will expire,” said Owens. “The negative result is important because data is captured throughout the procedure. After the session, the instructor can debrief the learner individually or in a classroom environment. If the procedure is performed correctly the mannequin will respond accordingly.”

Embedded in the manikin is a wireless connection that transmits the training session to the instructor’s tablet computer. “Instructors can increase the complexity of the situation remotely from the tablet,” Owens explained. “The training scenarios can be modified and customized based on the needs of the customer.”

Strategic Operations’ Cut Suit is a simulator that is worn by a live human actor. “The product is designed to enable training for care under fire as well as the transition up the echelon of care with battlefield effects,” said Lavell. “The actors and trainees can be put into realistic situations where trainees can learn procedures for combat casualty care for the three most preventable causes of death on the battlefield: hemorrhage, tension pneumothorax and airway blockage.”

The Cut Suit simulates realistic bleeding of the arms and legs and can be supplied with Strategic Operations’ blood pumping system, which can be used to train on the application of tourniquets. “The simulator allows

the trainee to stop bleeding without injuring the actor because there is a protective shield between the person and the tourniquet," said Lavell. "If the tourniquet is not applied properly, the bleeding won't stop and the patient will bleed out."

The point of working on a human patient rather than a manikin is to simulate realistic interactions between patient and provider. "You can look into the patient's eyes, they can cry, scream, act hysterically and even give misleading information, all the things that casualties do on the battlefield," said Lavell.

Strategic Operations recently introduced a new device called blast pants, which can be used with a live human patient to train on treating groin injuries. The company's IV and suture sleeve is also used with a live patient. The blood pumping system simulates blood flow with a reservoir and electrical pump and can be used with other Strategic Operations products. The company recently introduced a six-in-one trainer that provides learning experiences for all of the tactical combat casualty care procedures for a variety of head, neck and nasal injuries on a single device.

Simbionix specializes in simulators that train on minimally invasive procedures such as laparoscopies, endoscopies, bronchoscopies, gynecological and endovascular surgeries that are not used on the battlefield. These minimally invasive procedures involve inserting cameras and small tools inside a patient through a small incision rather than performing an operation by cutting the patient open.

"Our simulators are for the operating room environment," said Paz. "These are used by institutions training physicians and surgeons and by doctors seeking to increase their skill levels increase comfort level, and all together contribute to better procedures outcomes and patients' safety. The simulators we sell to military medical organizations and VA hospitals are the same we sell to our commercial customers, such as teaching and university hospitals, and are typically incorporated into residency/fellowship and other training programs."

In this case, computers are integrated into the simulator to offer virtual reality simulation to improve students' hand-eye coordination, in-depth perception and overall procedural performance. "The trainee will have an experience as close as it gets to real life," said Paz. "We incorporate haptic feedback technology, which uses the sense of touch to apply vibrations and motions to the training experience." Simbionix recently

added ultrasound and arthroscopy simulators to its repertoire of products.

In 2009, the VA inaugurated its Sim-LEARN program, an effort to standardize simulation across the VA system. "We are looking at the use of simulators in the VA," said Okuda. "Some of our facilities are being brought up to speed. We are in the process of developing a national skills program and national curricula based on the clinical gaps we have identified within the VA." One area of emphasis, in addition to women's health issues, involves airway management.

Some of the simulations are being developed in the VA's own innovation centers. One recent development has been an avatar that is used to train clinicians in interviewing techniques with geriatric patients.

Dror expects medical simulators to become even more realistic and comprehensive in the future, with more incorporation of haptic feedback as well as three-dimensional depictions and advanced software development. "Computer power is constantly advancing, and that improves the realism of the simulators," he said. "We also enable doctors to practice on specific patient data through our PROCEDURE Rehearsal Studio simulator, where doctors can load their specific patient CTA scans and practice on the simulator before performing the actual endovascular procedure in the operating room."

Owens also expects greater realism from future medical training simulators with improvements in the developments of synthetic tissues, which will further reduce the dependence on live animals. He also expects that the future will see more requirements for simulators from the military medical community, despite the promise of federal budget cutbacks.

"The Army currently has 28 medical simulation training centers around the world," he said. "They expect to expand to 40 by 2017. The military recognizes that simulation training reduces performance risk. It enables organizations to better control the pace of training. Instead of having students sitting around in an emergency room waiting for situations to present themselves, they can schedule training for procedures on realistic simulators.

"Simulators are expensive," Owens acknowledged, "but the costs are offset by reducing risk and saving lives." ★

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