

# New Frontiers in Medical Education: Simulation Technology at Campbell University School of Osteopathic Medicine

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Campbell University School of Osteopathic Medicine is using a variety of medical simulation systems in the training of its medical students. The simulators allow students to learn and practice skills in a controlled environment, and they enable faculty to challenge students with a broader range of conditions than might ordinarily be encountered during medical training.

**A** changing medical practice environment is requiring new models for training health care professionals, and medical educators are rapidly incorporating technology into medical education curricula [1]. Technology-enhanced simulation is one component of this new educational paradigm [1]. A combination of factors has led to increased use of clinical simulation across the continuum of health care education. Among these factors are an increased focus on patient safety; the call for a new training model not based solely on apprenticeship; the need to practice and hone skills in a controlled environment; and a desire for standardized, on-demand educational opportunities with outcomes-based evaluation [2]. Medical simulation training has been fostered by the valuable lessons learned from other professions that use simulation for training, such as aviation, the military, and astronautics [3]. In addition, a 2011 review of the literature on technology-enhanced simulation training for health care professionals [1] found that, compared with no intervention, such training is associated with improved outcomes in knowledge, skills, and behaviors.

Simulation is best used as an adjunct to patient care experiences, and its integration into the curriculum should be well planned and outcome-driven [3, 4]. Before simulation is incorporated into the curriculum, medical educators should first determine the circumstances under which such training will have the most impact. The simulation experience must be planned, scheduled, implemented, and evaluated in the context of a broader medical curriculum. Integration of simulation can occur at the course level or across an entire curriculum [3, 4]. However, it has been demonstrated that simulation exercises are most successful when they become part of the standard curriculum rather than being an additional component [5, 6].

Simulations that cover a broad range of patient abnormalities and treatment responses allow students to confront a wider range of disease experiences than they might encounter in clinical training with patients [5]. Simulation may be of particular benefit to prepare students to handle disease processes in a rural area where specialists may not be available. Simulation training also allows for standardization of experience, which will ensure that students are uniformly evaluated on all course competencies.

Campbell University School of Osteopathic Medicine, whose first class of students began training in August 2013, utilizes a variety of medical simulation mannequins, task trainers, and virtual clinical skill systems. The selected systems were targeted to complement the outcomes-based curriculum developed by the faculty. The school has the capability of providing students with realistic simulated experiences that allow them to practice their clinical skills before evaluating and treating real patients. In the simulation lab, students are exposed in a structured environment to both common and uncommon patient situations, some of which are potentially life-threatening.

## The Simulation Center

Campbell University has a 9,600-square-foot high-fidelity simulation center in the Leon Levine Hall of Medical Sciences. The simulation center replicates several patient care environments and can train students in a wide range of clinical scenarios. It contains an operating room, an emergency department, an intensive care unit, a birthing suite, a virtual simulation room, 12 objective structured clinical examination (OSCE) suites, an 8-seat computer lab, a 75-seat classroom, and debriefing rooms.

The OSCE center is a versatile 12-bed exam room area, in which each suite is a functioning replica of a real patient exam room. Here students practice their interpersonal com-

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munication, physical examination, and clinical assessment skills with standardized patients (actors who present symptoms in a standardized way). All exam rooms are equipped with digital audio and video recording equipment that is hosted by streaming servers, which allows faculty members to provide students with specific feedback regarding their clinical performance.

There is also a virtual hospital, a 9-bed hospital unit where students can care for high-fidelity mannequins in faculty-driven clinical scenarios that encourage problem solving, assessment, intervention, and debriefing. This area of the facility supports training in suturing, airway management, intravenous pump insertion, and other advanced skills.

In the acute care area of the simulation center, patient simulators represent critically ill patients in a range of clinical case scenarios. The area can be used to replicate a recovery room, a preoperative holding area, or a triage bay.

In addition to replicating several clinical settings, the simulation center has several advanced simulation mannequins. For example, the Noelle labor and delivery simulator (Gaumard Scientific) [7] allows each simulated delivery to be precisely controlled while devices track students' actions. The fetus can be manipulated to resolve a delivery dilemma, and students receive instant feedback regarding force and torque on the fetus as well as fetal head position. All data are graphed and synchronized with the fetal monitor for debriefing and evaluation. The fetus is released on command after the instructor has observed and logged required competencies.

The Human Patient Simulator (HPS; CAE Healthcare) [8] uses patented cardiovascular, respiratory, neurological, and pharmacological modeling to simulate breathing, which allows for training in anesthesia, respiratory care, and critical care. The simulator has oxygen and carbon dioxide gas exchange, and it can present complex surgical, critical care, and drug interaction scenarios. The HPS can simulate several patient conditions, including acute ventricular failure, anxiety/pain/stress, hypertension, hypotension, chronic hypertension, bradycardia, tachycardia, and ventricular failure.

Another patient simulator, SimMan 3G (Laerdal Medical) [9], measures the quality of cardiopulmonary resuscitation, providing real-time feedback regarding compression rate, depth, release, and hands-off time. In addition, SimMan 3G can respond appropriately to treatment; it automatically registers the amount, speed, and type of drug and activates the appropriate physiological responses.

"Harvey," a cardiopulmonary patient simulator used with the UMedic Multimedia Computer Curriculum in Cardiology [10], simulates nearly any cardiac disease by varying blood pressure, pulse, heart sounds, and murmurs. The simulator is structured to start with common, less complex conditions and then progress to more rare and complex diseases. For example, the software packages include normal heart sounds, innocent murmurs, aortic valve stenosis, hyperten-

sion, angina pectoris, pulmonary stenosis, and ventricular septal defect. In addition, the current version of Harvey's software covers history, bedside findings, all laboratory data, and medical and surgical treatment.

The SonoSim Ultrasound Training Solution [11] provides didactic, knowledge assessment, and hands-on training modules that use real patient ultrasound cases. The opportunity to practice in a risk-free virtual environment allows students to perfect their skills, and clinical scenarios subsequently challenge users to apply their newly acquired skills in ultrasound image acquisition and interpretation.

Finally, SimCapture (B-Line Medical) [12] allows the recording of each simulation training activity and automatically creates a portfolio for each student. The SimCapture debriefing software generates trend lines for physiological data and log files for each training event. Educators are able to generate numerous reports in multiple formats to track the usage and effectiveness of their simulation programs.

Curriculum integration is critical to the success and effectiveness of simulation-based health care education [5]. Outcomes are achieved more effectively when simulation is incorporated into a new or existing curriculum using an organized and systematic approach [5]. A comprehensive approach will lead to improved outcomes if it begins by defining or identifying learning outcomes and then matches the learning objectives to the educational methods best suited to teach those objectives [3]. When incorporating simulation into an educational program, simulation technology leaders should meet with and enlist the cooperation of curriculum planners, such as the curriculum planning committee or course director. Providing faculty support—in the form of training, protected time, scenario development tools, and technical support—is also incredibly important in encouraging faculty members to embrace this modality [3]. As with all educational interventions, simulation should be assessed in terms of learning outcomes and participant satisfaction, and modifications can be made as needed [3].

## Team Approach

Evidence increasingly shows that conducting simulation training in the context of team training and systems-based practice is a crucial component to improving patient outcomes [3, 13, 14]. If practitioners are expected to function in an interprofessional practice, then schools and colleges must provide students with interprofessional training opportunities. Campbell University has initiated an interprofessional education program to enhance the training of all of its health care students, including those in its pharmacy, physician assistant, public health, and osteopathic medicine programs. (Physical therapy and nursing students will also be included once these programs are fully implemented.) This pathway will begin in the first year of each discipline's educational program and will continue through the final advanced clinical experiences.

Campbell University recently hosted its initial interpro-

fessional education event for first-year students, which included 3 small-group discussions facilitated by faculty from all programs, and a panel discussion on the current status of rural health in North Carolina. Fifty-four faculty facilitators helped with this program: 19 from pharmacy practice, 6 from pharmaceutical sciences, 7 from physician assistant studies, 2 from clinical research, 3 from physical therapy, 2 from public health, and 15 from osteopathic medicine. Student evaluations were collected and showed consistently excellent evaluations. The interprofessional education committee also collected many constructive comments that will facilitate the planning of future events. We believe that multidisciplinary examination of patient processes will help students better understand the diversity of issues they will encounter in their medical practice.

## Conclusion

The goal of health care education is to develop competent and caring health care practitioners who are capable of providing the highest level of care to their patients. Determining the optimal path and the elements needed to arrive at this destination remains a challenge and is a work in progress. Over the past 2 decades, electronic simulation has entered the scene in a dramatic fashion, and its use has grown exponentially [1]. Borrowing from other high-risk fields that have been using simulation for quite some time, such as aviation and astronautics, we have begun to determine the most effective and efficient ways to use simulation technology in health care education [3]. We are learning how to create successful educational programs and lasting educational results using a mastery learning model in which frequent assessments provide feedback that is used to guide future instruction. Research continues to uncover best practices for achieving desired educational outcomes, improved clinical care, and better patient outcomes [3]. Through the use of electronic simulation training, programs can train highly effective medical practitioners who will significantly improve patient care throughout our region. NCMJ

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