Simulation Training

A Multidisciplinary Approach

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ABSTRACT

Emergency situations arise in health care every day. High-risk environments such as NICU and labor and delivery units are more susceptible to such emergencies. Approximately 10% of all newborns require assistance with their breathing in the delivery room, and 1% to 10% of newborns require intensive resuscitation including intubation and chest compressions. The World Health Organization estimates that skillful resuscitation of neonates can protect 1 million infants per year. So, the question remains that how do health care providers acquire and maintain experience and expertise if during their training and practice, it is not possible to encounter all types of patients, clinical situations, and diseases? This difficulty is compounded by the fact that we learn and train separately in our own disciplines. The airline, military, and nuclear power industry suggest that multidisciplinary simulation can safely bridge the gap between education and clinical practice. This article will discuss the importance of multidisciplinary high-fidelity simulation training as an effective tool in the development and maintenance of resuscitation expertise across disciplines, the history of simulation, simulation legislation, and the evidence behind simulation and explore the art and utilization of medical simulation in a multidisciplinary setting.

KEY WORDS: debriefing, multidisciplinary, healthcare, scenario, simulation, simulator

Simulation as a primary tool for developing critical skills training did not begin in the health care field. In the 1930s, simulation became popular in the aviation industry with the advent of the Link trainer, which was used in flight and military applications. After further review of postcrash “black box” recordings and analysis of in-flight crises, the aviation industry discovered that 67% of mistakes made during flight involved deficiencies in communication. The aviation and space industries to mandate annual training in crew resource management (CRM) and flight simulation and require trainees to display true cognitive, technical, and behavioral skills, while working in a realistic environment. By placing emphasis on effective teamwork, communication, and skill demonstration, simulation training effectively increased safety and reliability within aviation, space, military, and nuclear power industries.

Although long recognized as effective, simulation in health care has been slow to evolve secondary to past limitations in technology and cost-effectiveness. Anesthesiologists and members of the operative health care teams were the first to embrace medical simulation for resident training in high-risk operations where human error can result in patient morbidity and mortality. Video recordings of mock
resuscitations on human patient simulators led to the creation of an effective medical “flight simulator,” which then underwent further technological development and standardization by the military. As a result, medical simulation today is an affordable, standardized, and highly effective method of training and reducing human error in the health care industry.

SIMULATION LEGISLATION

Despite the high incidence of medical errors, health care is one of the few high-risk industries that do not currently require routine rehearsals and debriefings. In 1999, the Institute of Medicine issued a report entitled To Err is Human: Building a Safer Health System. This report illustrated that 70% of mistakes in medicine are due to human error. Surprisingly, these sentinel mistakes were not due to gaps in medical knowledge. Rather, the majority of errors resulted directly from a lack of teamwork and effective communication.5

In 2004, the Joint Commission Issued a Sentinel Event Alert where 47 sentinel event cases were reviewed. The root causes were found to be errors in communication (72%) and safety culture (55%).6 Problems identified included rare use of closed-loop communication and health care provider discomfort when publicly identifying impending errors. As a result, the Joint Commission recommended team training to teach health care staff to communicate more effectively during critical events and debriefings to evaluate performance within hospital systems.6

Randy Forbes (Republican-Virginia) and Patrick Kennedy (Democrat-Rhode Island) reintroduced legislation in 2009 that supports simulation in health care. The Enhancing SIMULATION Act of 2009 HR 855 focuses on safety in medicine utilizing leading advanced simulation technologies to improve outcomes now. Specifically, this act will help to create medical simulation centers of excellence across the United States of America, as well as provide leadership and research into advancing the field of simulation. Furthermore, it will assist in establishing medical simulation grants for academic and professional organizations, promote innovation in medical simulation within the Department of Health and Human Services, and will aid in establishing a coordinating council for federal government collaboration on medical simulation efforts.7 This act has been referred to the House Committee on Energy and Commerce, where as of publication, it awaits further action.

THE ART OF MULTIDISCIPLINARY HEALTH CARE SIMULATION

Multidisciplinary health care simulation is an attempt to recreate one or more aspects of medical care by creating a realistic and safe learning environment. Through simulation, members of different health care disciplines are able to practice their skills as a team in areas of communication, assessment, diagnosis, and treatment of the patient just as they would in a real situation. The team training is not only interactive and realistic, but also provides immediate feedback for learners through the debriefing process. Simulation is also designed to train to the team’s weaknesses rather than strengths, thus minimizing the risk of repeated failures and false confidences. Finally, multidisciplinary health care simulation helps improve outcomes that are difficult to teach or assess by conventional methods of education.

The art of multidisciplinary health care simulation involves 3 main teaching methods. The first method is the scenario. A well-planned scenario will ensure that the participant(s) are immersed in a realistic situation. Simulated events are often most effective when they have been experienced and documented by the person(s) creating the scenario. In addition, the experience is best thought through for a multitude of possible responses that the learner might take and the realistic consequence of each separate action. These situations might encompass immediate events such as those surrounding the unexpected delivery of a critically ill infant with congenital heart disease or a congenital diaphragmatic hernia. They may also include training for ongoing high-risk procedures such as full body cooling, extracorporeal life support, or the transport of a sick infant. In addition, simulation can be used to teach better communication techniques including the delivery of bad news. Finally, scenarios offer excellent assessment modules for certifications.

The next method involves the simulator, which mimics a patient, physical space, and/or equipment designed to replicate a critical event. SimNewB is a high-fidelity simulator especially intended for the neonatal arena designed by Laerdal, headquartered in Wappingers Falls, New York, with the assistance of the American Academy of Pediatrics. Its functions consist of realistic anatomy with variations in tone and color ranging from pink and vigorous to limp and cyanotic. The simulator can cry, grunt, and hiccup. The airway is designed to allow for training in all aspects of newborn airway management including the use of positive-pressure airway devices and the placement of ETT and LMA. SimNewB provides realistic heart and breath sounds, and can respond to the learner’s actions by altering its chest rise and lung compliance. The simulator has a patent umbilicus with a life-like pulse that can be palpated, cut, and catheterized for intravenous access. Intraosseous access in both legs is also possible. Gaumard, based in Miami, Florida, produces another effective newborn simulator called Newborn Hal that has many of the above features and is also tetherless for use in mobile or transport scenarios.

Gaumard also produces Noelle, a high-fidelity birthing maternal simulator for training personnel in
to replicate meconium on the baby. These sensory cues deliver a more realistic experience.

The most important part of simulation is debriefing. Dr. David Gaba once stated that “simulation is just an excuse to debrief,” and a survey conducted in 2000 by Rall et al. determined that debriefing following simulation is “crucial to the learning process.” Debriefing the participants immediately following the simulation gives him or her the opportunity to be part of a detailed review of the simulation scenario and his or her responses to critical events. Each aspect of the simulation including level of teamwork, communication, technical skills, and critical decision making can be effectively analyzed and discussed as a group. This is best accomplished using video debriefing, whereby participants watch their own performances and the video feed is stopped at critical moments for discussion and teaching. Debriefing also allows for immediate feedback, an important technique found to increase the effectiveness of adult knowledge acquisition (Figure 2).

**FIGURE 2.**

Infant moulage, which represents a meconium-covered newborn.

SimNewB is pictured as a newborn infant covered in “pea soup” to represent the visual cues and smell of meconium. This is done to aid in the suspension of disbelief for the participants. Photograph by Leigh Ann Cates.

**UTILIZATION OF MULTIDISCIPLINARY HEALTH CARE SIMULATION**

As discussed earlier, multidisciplinary health care simulation provides exposure to complicated and high-risk clinical events without putting either the patient or the team members at risk. It constructs a safe, nonpunitive atmosphere for unlimited practice of technical skills and training in risky procedures; enables direct observation and assessment of competency and skill...
level of each team member in a realistic situation; immerses participants in the learning environment; and provides immediate feedback to participants. As a result, multidisciplinary health care simulation increases communication and teamwork within a multidisciplinary team to more effectively deliver urgent care to a critically ill patient and concerned family members (Figure 3).

The most exciting part of multidisciplinary health care simulation is that we must no longer be in our separate training silos. Simulation can train a multidisciplinary team to perform in their role that would actually perform at the bedside or in the field. The group of participants can be composed of physicians, nurses, nurse practitioners, respiratory therapists, pharmacists, and even child life specialists, just to name a few. This unique manner of training is invaluable in ensuring that a team not only accurately performs an assessment and executes the tasks required, but also communicates and works well as a team, while delivering compassionate care.

Figures 4, 5, 6, 7, and 8 show multidisciplinary health care simulation at Texas Children’s Hospital Simulation Center. These are examples of how Texas Childrens Hospital utilizes multidisciplinary health care simulation in training scenarios. A multidisciplinary team runs through a complete gamut of situations to develop team work and optimal crisis management.

**EVIDENCE-BASED PRACTICE**

There is mounting evidence that health care simulation training is extremely beneficial. Hospitals funded under a US Department of Defense medical simulation trial program in 2009 found that when simulation was used as a training tool, the medical error rate decreased from 30% to 4%. These numbers suggest that simulation could possibly reduce medical error costs by at least $17 billion across the United States. In addition, Shapiro and Simmons in 2002 found that high-fidelity multidisciplinary health care simulation reduced the clinical error rate from 30.9% to 4.4% and significantly improved teamwork attitudes and staff assessments of institutional support.

Further support for increased use for health care simulation can be found in several studies. In 1998,
Kaczorowski et al\textsuperscript{12} found on repeat testing of family medicine residents 6 to 8 months after participation in the traditional neonatal resuscitation program that there was a marked decrease in knowledge and skill performance. However, in 2006, Morgan et al\textsuperscript{13} studied 299 students using high-fidelity simulation to evaluate learning specifically in the management of unstable cardiac arrhythmias. They found that their improved performance was statistically significant on a written test.

Simulation has been found to be helpful in increasing technical skill proficiencies, particularly in airway management. A study by Overly et al\textsuperscript{14} in 2007 discovered that high-fidelity simulation provided a more detailed evaluation of both institutional teaching efficacy and practitioners’ ability to manage a patient’s airway. Anderson et al\textsuperscript{15} in 2006 also found that after exposure to high-fidelity simulated ECLS emergencies, subjects tested demonstrated significant improvements in their technical and communication skills.

In conclusion, high-fidelity multidisciplinary health care simulation is an excellent tool for improving teamwork across disciplines, fostering communication, practicing technical skills, and improving patient outcomes and safety. For this reason, simulation-based training will likely become the standard for advanced licensure and board certification.\textsuperscript{16} The time has come to embrace health care simulation as a key component of quality improvement in our hospitals and multidisciplinary training programs.

For more information on multidisciplinary health care simulation at Texas Children’s Hospital, please view this video on our Web site at mms://video.texaschildrenshospital.org/PresentationVideoFinalMixCopyQuickTimeH.264.wmv.

References
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