eLITERATURE REVIEW
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Simulation and Training

In this Issue...

Simulation-based training provides a realistic medical situation in which learners can gain exposure to clinical tasks, anatomical regions, and/or patients, without experiencing the fear of making mistakes that could harm an actual patient. Specific objectives for these situations create a deliberate path of learning, as the learners first work through a scenario and are then debriefed on their performances, with the goal of developing some predefined knowledge, behavior, or skill and/or to assess a specific competency. The integration of this technique into medical education and competency assessment began in the early 1990s in anesthesiology and has been rapidly implemented for a variety of reasons. Additional research is needed on the use of simulation in medical education to determine whether learning objectives are effectively taught and to correlate these objectives with actual clinical performance that benefits and/or improves patient care.

In this issue, we summarize some of the recent literature that examines the efficacy of simulation on various medical tasks and behaviors in both simulated and real-world environments.

LEARNING OBJECTIVES

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- Discuss evidence evaluating the impact of medical education simulation on performance quality and patient outcomes
- Describe some of the challenges involved in designing tools to assess the effect of medical education simulation on patient care and clinical outcomes
- Identify areas that show promise in the targeted use of high-fidelity simulation technology in health care education

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January 11, 2011

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January 10, 2013

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- **Anthony Bilenki, MA, RRT, Edward E. Lawson, MD, Lawrence M. Nogee, MD and Mary Terhaar, DNSc, RN** indicated they have no relevant financial relationships with any commercial supporters.

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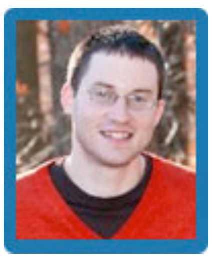

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Janine Bullard, MD and Matthew Trojanowski, RRT have disclosed no relevant financial relationships with commercial supporters.

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The author has indicated that there will be no reference to unlabeled/unapproved uses of drugs or products in the presentation.

COMMENTARY

In October 2010, the American Heart Association (AHA) published guidelines on cardiopulmonary resuscitation and emergency cardiovascular care of neonates. The AHA recommended that the Neonatal Resuscitation Program (NRP) adopt simulation, briefing, and debriefing techniques for the acquisition and maintenance of neonatal resuscitation.[1] Neonatal resuscitation requires professionals to be skilled at recognizing and rapidly interpreting visual, auditory, and tactile cues in the environment. Because neonatal resuscitation is a low-frequency (<1% of live-born infants require extensive resuscitative measures)[2,3] but life-threatening event, it lends itself to simulation. Simulation and the use of crisis resource management (CRM) skills have a longer, more substantiated history in nonmedical areas with no margin for error, such as the military, the airline industry, and the nuclear power industry. Despite the fact that the study of simulation in neonatology is nascent, the 2012 NRP course will abandon the use of passive learning. Instead, learners will complete a self-directed cognitive portion that includes passing a written test before taking the instructor-learner hands-on, interactive portion, which consists of immersive simulation with resuscitation scenarios and facilitated debriefing.[4] Already, the international organization recommends—and soon our national credentialing body will require—neonatal simulation in training and credentialing, so careful scrutiny of the development and the standardized use of this technique is essential.

Over the past decade, graduate training in neonatology has undergone dramatic transformations that have reduced the opportunity to acquire certain cognitive, technical, and leadership skills necessary for the care of the sick newborns. Some changes have

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evolved from neonatal care practices, including decreased opportunities for intubation because of the elimination of routine intubation in infants with meconium-stained fluid and the increased use of continuous positive airway pressure in an effort to avoid mechanical ventilation. Other changes are mandated by oversight agencies to meet expectations of quality and safety as they relate to patient care and the educational goals of training programs, such as the Accreditation Council for Graduate Medical Education's limiting overall duty hours, which will be further restricted in the upcoming months.

Advances in scientific knowledge and technology have led to the survival of infants who have more complex hospital courses and require a greater number of experts to provide specialized care.[5] Little evidence is available on the extent of exposure or level of experience necessary for the initial acquisition of skills or the maintenance of those same skills.[6,7] The diminished exposure to critically ill neonates and the decreased time allocated for faculty to teach in clinical settings,[8] however, necessitate the development of new educational approaches to ensure adequate preparation for the care and safety of future patients. Simulation has been a widely adopted approach in neonatology, as well as in other areas of medicine. Advances in technology, materials, and computer power have allowed the development of increasingly sophisticated equipment that incorporates the variables to which the learner must react, such as simulated heart tones, breath sounds, pulses, and cries (high-fidelity simulation). High-fidelity simulation uses this technology to create a life-like situation in which learners can practice both procedural and decision-making skills. However, a best-evidence approach must be taken in the development of simulation curriculum, processes, allocation of resources, and assessment.

Much of the early and current pediatric literature evaluating simulation has focused primarily on learners' subjective experiences, which have usually been positive.[9-11] A smaller but emerging body of evidence has supported simulation as a valid and reliable tool for teaching and assessing a given skill, behavior, or team performance.[12-19] An even smaller body of evidence has demonstrated that simulation education has an impact on the clinical quality of patient care. [20-25]

Three small studies (reviewed in this issue) have evaluated whether simulation improves specific skills needed for a particular task. In 2007, Kory and colleagues reported the results of a prospective study that compared the traditional physician-teaching approach of "see one, do one, teach one" with simulation training in initial adult airway management on a simulated respiratory arrest scenario at the end of 2 years of clinical training. None of the traditionally trained residents performed all necessary and essential tasks. A little more than one-third (38%) of the simulation-trained residents achieved perfect scores. This study demonstrated that simulation was superior to the traditional approach.

Thomas and associates recently assessed teamwork and neonatal resuscitation quality among physician groups that had received a 2-hour teamwork curriculum before undergoing either high-fidelity or low-fidelity NRP training. The frequency of teamwork behaviors and speed of the resuscitation were improved among physicians receiving teamwork training, compared with those receiving no teamwork training. Additionally, residents in the high-fidelity NRP training group had improved teamwork behaviors compared with those in the low-fidelity NRP training group.

Rodgers and coworkers evaluated nurse learners who were trained using either high-fidelity simulation or low-fidelity simulation with the standard Advanced Cardiovascular Life Support (ACLS) course. This 2009 study attempted to clarify which skills might be most effectively taught using the more costly technique of high-fidelity simulation. The authors reported that benefits were achieved with more complex scenarios that used high-fidelity simulation.

Three additional studies (reviewed herein) have addressed the challenging translational science of whether simulation improves actual real-time patient care. In 2008, Knudson and collaborators demonstrated that surgical residents who received training with high-fidelity simulation performed better in crisis-management skills, specifically teamwork, than did those who received didactic lectures; however, no differences were reported with other technical management skills. In contrast, Weidman and colleagues found no differences in the quality of real-patient resuscitation outcomes between simulation training and standard ACLS training for physician residents. A 2006 retrospective study by Draycott and coworkers demonstrated an improvement in clinically important perinatal outcomes after incorporating multidisciplinary training program in obstetric emergencies.

The studies reviewed in this issue have definite limitations and highlight the challenges inherent in a living model with multiple influences that affect the learners, the patients, and the medical system. Providing evidence using objective measures for educational and patient outcomes is critical, however, to justify the financial and personnel resources dedicated to simulation education and to ascertain competency.

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SIMULATION TRAINING FOR RESUSCITATION SKILLS

Kory PD, Eisen LA, Adachi M, Ribaudo VA, Rosenthal ME, Mayo PH. **Initial airway management skills of senior residents: simulation training compared with traditional training**. *Chest*. 2007;132(6): 1927-1931.

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Kory and colleagues compared the initial airway management skills of 32 internal medicine residents who received scenario-based training (SBT) with those of 30 residents who received experiential traditional training (TT). At the beginning of their first year of residency, the residents had received either SBT, using a computerized patient simulator (CPS), or TT, using a traditional apprenticeship model. The TT group did not receive formal SBT with CPS at any time during their residency training. In their third year of residency, all residents were tested on airway skills using a previously validated standardized scenario. Another group of first-year residents was tested on the scenario and served as an untrained (UT) control group. All groups had received ACLS training with certification upon entering their residency and at the end of their second year of residency training.

A total of 11 tasks in the initial airway management of a simulated cardiac arrest were assessed. Tasks were scored as either completed or not completed by 2 independent researchers. No significant differences were reported between the SBT and TT groups with respect to identifying apnea, calling the code team, or attaching a pulse oximeter. However, statistically significant differences were observed between the SBT and TT groups in 8 of the 11 tasks. The most striking differences were in attaching a bag-valve mask (BVM) to high-flow oxygen (ST group, 69%; TT group, 17%; $P < .001$), inserting an oral airway correctly (ST group, 88%; TT group, 20%; $P < .001$), and achieving an effective BVM seal (ST group, 97%; TT group, 20%; $P < .001$). None of the TT residents achieved a perfect score, whereas 38% of the SBT group did ($P < .001$). The authors concluded that residents in the SBT group's performance was superior to that of the residents in the TT group, and training that used CPS offered benefits over a traditional approach to instruction. The TT group performed significantly better than did the UT group in 3 of the 11 tasks, suggesting some improvement in skills with the traditional method of instruction.

This study was limited by the fact that it was not double-blinded. Although participants had no knowledge of study group assignment or purpose, the scorers were not blinded to the group assignment. The study also compared third-year residents from 2 different calendar years, rather than separating third-year residents from the same calendar year into an intervention and a traditional group, which leaves open the possibility of baseline skill differences between the 2 groups.

Only 38% of the SBT group completed all of the essential tasks, suggesting that retention of skills deteriorates quickly over time. This rate of deterioration offered no improvement over other published studies of skills retention.[1-5] Nonetheless, the findings of this study demonstrate the potential use of SBT with CPS to enhance practical skills in initial airway management. Although the study enrolled a small number of participants and had some limitations, it does support the concept that deliberate practice of these skills is more effective in training physicians compared with the traditional teaching model.

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BUILDING TEAMWORK IN NEONATAL RESUSCITATION

Thomas EJ, Williams AL, Reichman EF, Lasky RE, Crandell S, Taggart WR. **Team training in the neonatal resuscitation program for interns: teamwork and quality of resuscitations.** *Pediatrics*. 2010; 125(3):539-546.

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In a randomized, double-blind study, Thomas and associates reported improvements in teamwork behaviors and resuscitation quality after the inclusion of a 2-hour teamwork training intervention in the standard NRP training for noncertified, incoming first-year interns in pediatrics, combined pediatrics and internal medicine, family medicine, emergency medicine, and obstetrics and gynecology. In a secondary analysis, the investigators compared high-fidelity training (HFT) with low-fidelity training (LFT; defined below) of NRP skills and found no statistically significant differences in NRP performance. However, the HFT group did demonstrate increased teamwork behaviors compared with the LFT group.

The study randomized 100 medical interns into 3 groups. The LFT group (n = 31) received the teamwork intervention and standard NRP training using low-fidelity skills stations. The HFT group (n = 33) received the teamwork intervention and standard NRP training using high-fidelity skills stations. The control group (n = 36) received no teamwork intervention and completed standard NRP training using low-fidelity skills stations. The teamwork intervention consisted of a curriculum developed to recognize the frequency, types, and causes of errors in neonatal resuscitation, and to understand and practice team behavior, such as information sharing, inquiry, assertion, verbalizing intentions, workload management, vigilance, and leadership. After the interns received NRP training, with or without the teamwork curriculum, they resuscitated a high-fidelity mannequin based on a standardized "mega code" scenario developed for this study. A total of 43 interns returned in 6 months and resuscitated a high-fidelity mannequin using a different mega code scenario. The codes were video-recorded, then reviewed and scored by 2 sets of blinded, trained observers for teamwork behaviors and NRP performance.

Teamwork behaviors were measured using a calculated teamwork behavior event rate, vigilance, and workload management. NRP quality was assessed using a calculated performance score and resuscitation duration. Results for teamwork behaviors demonstrated that the HFT group had significantly higher teamwork event rates compared with both the LFT ($P = .004$) and the control groups ($P < .001$). The LFT group did not differ significantly from the control group with respect to teamwork event rate ($P = .198$). Both the HFT and LFT groups managed the workload for a greater percentage of the resuscitation than did the control group (100% vs. 96.5%, respectively; $P < .001$). No significant differences were observed among any of the groups in vigilance or NRP performance. The time to complete the resuscitation was significantly shortened in both intervention groups compared with the control group ($P < .001$ and $P = .04$ in the HFT and LFT groups, respectively). The secondary comparison between HFT and LFT revealed no significant difference in workload management ($P = .244$) or duration of resuscitation ($P = .452$).

In the 6-month follow-up assessment, both intervention groups demonstrated more teamwork behaviors ($P = .030$) than did the control group, but there were no statistically significant differences in vigilance ($P = .951$), workload management ($P = .549$), NRP performance ($P = .742$), or resuscitation duration ($P = .314$) in the intervention groups vs. the control group.

This study is 1 of only 2 published randomized, double-blind studies that investigate the use of teamwork training in interns' medical education. The neonatal-focused team-based curriculum did demonstrate initial and 6-month sustained improvements in teamwork behaviors; however, it had limited impact on NRP quality outcomes, with improvement noted only in the rate of the resuscitation process. The authors suggested that the curriculum may not have improved NRP performance because task performance was not part of the curriculum objectives. Perhaps the teamwork curriculum would have had a greater impact on NRP quality if it had been designed for the multidisciplinary effort that is typical of a neonatal resuscitation team. Improvement in teamwork behavior on the part of the interns evaluated might have had practical benefits that were effective in other measurements of quality outcomes not assessed in this study.

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ASSESSING THE RESULTS OF SIMULATION TRAINING

Rodgers DL, Securro SJ, Pauley RD. **The effect of high-fidelity simulation on educational outcomes in an advanced cardiovascular life support course.** *Simul Healthc*. 2009;4(4):200-206.

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In a causal-comparative design, Rodgers and coworkers compared educational outcomes after ACLS training using either high-fidelity simulation (HFS) or low-fidelity simulation (LFS). All features of the high-fidelity simulators, including palpable pulses, chest excursion on breathing, and mannequin-generated voice, were activated and accessible to the participating student nurses. All information pertaining to the scenario came from the simulator. For the LFS course, the high-fidelity mannequin activated only the basic electrocardiogram (ECG) rhythm. Students obtained information about the scenario by questioning the instructor. Senior undergraduate nursing students self-selected 1 of 2 ACLS courses offered on separate weekends. Unbeknownst to the students, 1 ACLS group (n = 18) used LFS, and the other ACLS group (n = 16) used HFS. A written pretest was administered to each group to determine existing ACLS knowledge. The results of the pretest significantly favored the LFS group (P = .005). Both groups received the standard ACLS course and used debriefing methods consistent with the technology available, with the HFS group reviewing audio-video recordings and simulator-generated logs, and the LFS group reviewing a written log of events. After completing the ACLS course, each group participated in a video-recorded skills performance evaluation using a high-fidelity simulated cardiac arrest. Blinded expert raters scored the groups' performances using a modified ACLS score sheet, overall team leader performance, and team function. A written posttest was also administered to both groups.

Statistical analysis demonstrated that the HFS group achieved a higher mean score for all of the 14 technical skills evaluated, with 9 of the 14 reaching statistical significance. Basic skills needed at the beginning of the simulated cardiac arrest were similar between the 2 groups, whereas skills needed as the scenario became more complicated reached statistical significance. The most striking differences were in perception of the team leader's apparent knowledge (P = .005) and confidence (P = .006), as well as in the ability to follow the appropriate ACLS algorithm (P = .008), recognize ECG changes (P = .013), and provide postresuscitative care (P = .001). No statistically significant difference was reported between the posttest written scores of the 2 groups. However, the rate of improvement in cognitive knowledge from pretest to posttest was significantly higher in the HFS group (P = .002).

The results of this study suggest that HFS training is associated with superior integration of cognitive knowledge, basic psychomotor skills, and critical thinking required in complicated ACLS scenarios. Because the sample size was small and was limited to a single type of health care provider that had little clinical working experience, generalizing these findings to other professionals and levels of experience would be difficult. Extrapolating whether the improved performance translates into better real clinical performance or patient outcomes was not part of the scope of this study. However, the authors demonstrated that HFS training generates improved knowledge and performance capabilities with simulated cardiac arrest management compared with current LFS teaching methods in the standard ACLS course.

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IMPACT OF SIMULATION TRAINING ON PERFORMANCE DURING ACTUAL EVENTS

Weidman EK, Bell G, Walsh D, Small S, Edelson DP. **Assessing the impact of immersive simulation of clinical performance during actual in-hospital cardiac arrest with CPR-sensing technology: a randomized feasibility study.** *Resuscitation*. 2010;81(11):1556-1561.

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In a prospective, randomized, interventional feasibility study, Weidman and collaborators sought to detect improvements in specific cardiopulmonary resuscitation (CPR) quality measures on real in-hospital resuscitations after second-year internal medicine residents had received a high-fidelity 4-hour resuscitation course. This study is one of only a few studies that have attempted to evaluate an incremental benefit in clinical outcome as a consequence of a simulation training curriculum vs. a traditional training method.

Eligible second-year internal medicine residents who had previous ACLS certification were randomized into 1 of 2 groups. The control group (n = 16) received standard resuscitation training, including a review of the defibrillator and resuscitation protocols. The intervention group (n = 14) received the standard training, as well as a 4-hour high-fidelity simulation course specifically designed with scenarios, videotaping, and facilitated debriefings. Outcomes included surveys completed by trainees about their knowledge and confidence of ACLS, as well as objective measurements of mean chest compression depth, chest compression rates, ventilation rates, and no-flow fraction during actual arrests using specialized equipment over a 12-month period from July 2007 to June 2008.

No significant differences were reported in self-reported levels of knowledge regarding how to manage a cardiac arrest. A total of 98 cardiac arrests were led by study participants (46 intervention group, 52 control group). No significant differences were found between the simulation and control groups with respect to correctly identifying ventilation rate (58.3% vs. 45.5%, respectively; P = .54), chest compression depth (66% vs. 54.6%, respectively; P = .55), chest compression rate (91.7% vs. 90.9%, respectively; P = .95), defibrillation algorithm (58.3% vs. 81.8%, respectively; P = .22), or other CPR quality indicators, such as return to spontaneous circulation (56.5% vs. 51.9%, respectively; P = .65) or survival to discharge rates (15.2% vs. 9.6%, respectively; P = .42).

This study yielded unexpected findings, because other studies had demonstrated self-reported improvements in confidence and decision-making abilities, and improvement in simulated CPR quality, after an immersive simulation curriculum. This study might have failed to detect a difference because the quality of adherence to ACLS guidelines was already high in the control group. The simulation curriculum also lacked specific objectives to target task improvements that might have affected the quality of the CPR performance. Another reason no differences were identified might have been related to the fact that only team leaders received simulator training. Data on chest compression and ventilation rates were collected after real resuscitations by other providers who had not received the simulation training. Therefore, these objective outcome measures may have been inappropriate for assessing this educational intervention. Additionally, more residents in the control group had received ACLS certification within the previous 6-month period (45.5% vs. 8.3% in the simulation group). It has been suggested that the rate of knowledge and skills retention may deteriorate after 6 months, rendering a difference more difficult to detect. Despite the negative findings of this study, the method of connecting simulation-based training with objective, in situ performance outcomes was innovative. Future studies evaluating the efficacy of a specific training method to direct clinical practice and improved patient outcomes are warranted.

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OBSTETRIC EMERGENCY TRAINING AND IMPROVED NEONATAL OUTCOMES

Draycott T, Sibanda T, Owen L, et al. **Does training in obstetric emergencies improve neonatal outcome?** *BJOG*. 2006;113(2):177-182.

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Using a retrospective cohort observation study design of 19,460 infants, Draycott and colleagues compared the incidence of 5-minute Apgar scores ≤6 and prospectively identified cases of hypoxic-ischemic encephalopathy (HIE) before and after the introduction of a 1-day training course in obstetric emergencies. In 2000, all medical personnel at a tertiary hospital in the United Kingdom attended a specially created training session that included didactic teaching, practice in interpreting fetal monitoring, and hands-on drill stations for obstetric emergencies.

Obstetric and neonatal outcomes data were separated into 2 time periods: "pre-training," from 1998 to 1999, and "post-training," from 2001 to 2003. Infants were excluded who had known major anomalies, were born at an outside hospital, were delivered by elective repeat caesarean section, were born of a multiple-gestation pregnancy, or had a breech presentation (management practices for breech deliveries changed during this period). Infants were identified and classified prospectively with HIE because of enrollment in hypothermia treatment trials initiated in 1998. Baseline data were similar between the 1998 to 1999 and 2001 to 2003 groups except with respect to average maternal age (28.8 years vs. 29.2 years respectively, $P < .001$), nulliparous women (43.6% vs. 46.2%, respectively; $P < .001$), induction of labor (23.6% vs. 25.2%, respectively; $P < .001$), and emergency caesarean section (9.3 vs. 11.4%, respectively; $P < .001$).

The authors found a statistically significant reduction in the number of 5-minute Apgar scores ≤ 6 between the 1998 to 1999 and 2001 to 2003 groups (73 in 8430 live births vs. 49 in 11,030 live births, respectively; relative risk [RR] = 0.51; 95% confidence interval [CI], 0.35 to 0.74); $P < .001$) and the incidence of HIE (23 in 8430 live births vs. 11 in 11,030 live births, respectively; RR = 0.50; 95% CI, 0.26 to 0.95; $P = .032$). There was a reduction in the rate of HIE categorized as moderate or severe in the pretraining vs. posttraining time period, but it did not reach statistical significance. As older age, nulliparous state, and induced labor are all risk factors for poor neonatal outcomes, the results might have underestimated the risk reduction between the groups. Because the above risk factors were in the posttraining group, the increased rate of emergency caesarean section in this group might have been the result of these risk factors or the training intervention.

This was the first study to demonstrate a significant improvement in a clinical outcome after an educational intervention that used simulation. Because of the observational study design, several unknown factors might have affected the reductions in 5-minute Apgar scores ≤6 and HIE. As part of a national goal to reduce negligent harm in obstetrics by 25%, other initiatives were introduced in the United Kingdom during the same time period. Therefore, attributing the observed improvements in outcome solely to the educational intervention would likely overstate its impact.

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RECOMMEND TO A COLLEAGUE
NEWSLETTER ARCHIVE

TRANSLATING TRAUMA TRAINING SKILLS FROM A SIMULATED ENVIRONMENT TO REAL TIME

Knudson MM, Khaw L, Bullard MK, et al. **Trauma training in simulation: translating skills from SIM time to real time**. *J Trauma*. 2008;64(2):255-263.

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RECOMMEND TO A COLLEAGUE
NEWSLETTER ARCHIVE

In 2008, Knudson and coworkers were the first to report on the impact of an educational curriculum designed to teach trauma resuscitation and crisis management skills using high-fidelity simulation on real-life trauma performances by midlevel surgical residents. The study team created a curriculum that comprised 5 surgical trauma scenarios. The scenarios were taught in a didactic lecture (LEC) format or in a human-performance simulator (SIM) format to 2 randomized groups of midlevel surgical residents who would be leading trauma events in the next 3 months. Each scenario incorporated 2 hours of teaching and included videotapes of "good" and "bad" examples of trauma resuscitations performed by residents not included in the study. Each group received a written learning objective posttest and course evaluation form on completion of the program. The first 4 major trauma resuscitations led by 10 residents (4 in the LEC group and 6 in the SIM group) were video-recorded in the emergency department after the curriculum was completed. Two trauma surgeons blinded to the mode of teaching scenario used specifically designed but not validated assessment tools to score aspects of both technical treatment skills (part I) and behavior crisis management skills (part II) of the video recordings. The judges had good prestudy interrater reliability (IRR) for part I (0.93) but only fair IRR for part II (0.63).

Both groups had similar scores on the posttest learning objectives assessment (LEC, 65% ± 14% vs. SIM, 66% ± 14%). Both groups rated the LEC and SIM curricula as a positive experience. A total of 40 resuscitation tapes were reviewed separately by the 2 judges. The SIM group received fewer "poor/fail" scores (SIM, 25% ± 0% vs. LEC, 29% ± 13%) and more "excellent" scores (SIM, 17% ± 6% vs. LEC, 6% ± 8%) than the LEC group, but the differences were not statistically significant. Results from part I—the technical treatment skills—showed similar performances between the SIM and LEC groups, with no significant difference between groups in committing critical technical errors. In part II, however, the SIM group performed consistently higher in all categories, but the overall mean score difference between the 2 groups was only 9%. The most significant difference was in teamwork behaviors: specifically, the SIM group averaged 15% higher (P = .04) than the LEC group. The IRR among the judges was 0.6 for the subjective scoring, 0.74 for part I, and ranged from 0.2 to .0.42 on components for part II.

Several drawbacks to this study limit conclusions about the benefit of a simulation curriculum over a didactic curriculum on real-life performances. The assessment tools developed for this study were not validated and lacked IRR. This was particularly true for grading the nontechnical/behavioral skills in part II. Despite these challenges, the SIM group trended toward better team behavior skills than did the LEC group. This study was one of the first to evaluate a method of training on real-life trauma resuscitations. Unlike studies that used a controlled simulated environment, there was a host of uncontrolled challenges in the "live" environment. Patients presented with different, unique combinations of injuries and physiologic responses. The team involved in the resuscitation varied in composition and overall experience. This study was also one of the first that attempted to develop assessment tools that can be used in real-life situations. Although elucidating the influence of a training curriculum in the real environment and reducing subjectivity in the evaluation of clinical performance is complex, it is essential for future studies.

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Presented by JHUSOM & IJHN in collaboration with DKBmed.