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ORIGINAL RESEARCH

The Effect of High-Fidelity Cardiopulmonary Resuscitation (CPR) Simulation on Athletic Training Student Knowledge, Confidence, Emotions, and Experiences

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Context: High-fidelity simulation is widely used in healthcare for the training and professional education of students though literature of its application to athletic training education remains sparse.

Objective: This research attempts to address a wide-range of data. This includes athletic training student knowledge acquisition from high-fidelity simulation, effects on student confidence, emotional responses, and reports of lived experiences in different phases of simulation.

Design and Setting: A mixed methods study design was employed with pre- and postintervention evaluations of students' cardiopulmonary resuscitation (CPR) knowledge, confidence, emotions, and lived experiences via the Presimulation CPR Survey, the Postsimulation CPR Survey, and the Reactions to the Simulation Experience Postsimulation Reflection assignment. The study was conducted in the University's high-fidelity simulation center.

Patients or Other Participants: Twenty undergraduate athletic training students enrolled in a junior-level clinical practicum class.

Results: We identified a significant difference in athletic training student knowledge acquisition (pretest: $\bar{x} = 3.75$, SD = .546; posttest: $\bar{x} = 4.60$, SD = .394) and identified a significant increase through a paired sample *t* test ($t_{19} = -5.640$, $P < .001$). We demonstrated a significant difference in athletic training student confidence (pretest: $\bar{x} = 4.18$, SD = .524; posttest: $\bar{x} = 4.68$, SD = .295). The findings of this paired sample *t* test ($t_{19} = -4.485$, $P < .001$) identify a significant increase in confidence related to CPR skills. Students reported a mean score of 4.5 out of 5.0 (SD = .761) of experiencing emotional reactions to the simulation including anxiety, fear, and nervousness. Students reported on a scale of 5.0, ($\bar{x} = 4.63$, SD = .34) the simulation was overall a positive and valued learning experience.

Conclusions: High-fidelity simulation is highly effective in athletic training education and has similar outcomes in knowledge acquisition, confidence, and emotional responses to other healthcare professional education.

Key Words: High-fidelity simulation, mannequin, experimental learning, deliberate practice

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The Effect of High-Fidelity Cardiopulmonary Resuscitation (CPR) Simulation on Athletic Training Student Knowledge, Confidence, Emotions, and Experiences

Kristin Ann Tivener, MET, ATC; Donna Sue Gloe, EdD, RN-BC

The use of high-fidelity simulation technology for teaching and assessment in medical and practice-based health care professionals has significantly increased over the last decade.[1,2] High-fidelity human patient simulation (HPS), in general, aims to imitate real patients or clinical tasks and/or mirror the real-life circumstances in which health care services are rendered.[1,3] The fidelity or realism of a simulation differs greatly and ranges from HPS to low-fidelity simulation anatomical models and simple mannequins with low output capabilities. Human patient simulation mannequins are capable of simulating human physiological responses, such as realistic heart sounds, breathing patterns, lung sounds, and bowel sounds. These mannequins are equipped with palpable pulses and voice speakers to allow response to students during simulation training. As the educational value of HPS has been explored, evidence has shown that the higher the fidelity of the experience, the easier it is for the student to suspend reality and become immersed in the situation.[4–6] The ability of the student learner to actively engage in lifelike experiences allows effective implementation of classroom knowledge into clinical critical decision-making skills.[7–9] Several studies in medical and allied health education have demonstrated that high-fidelity simulation effectively provides a level of realism necessary for the student to become immersed in a scenario.[9–11] For example, Laschinger et al[11] reported health profession students have emotional responses when providing care through a HPS similar to the response demonstrated in actual patient care, including a stress response to clinical management and nervousness prior to simulation. Such replication of emotional responses during HPS patient care demonstrates the ability of the learner to view the simulation scenario as realistic and effectively become immersed in the simulation, thus allowing the learner to effectively practice clinical critical decision making.[9,11,12] Additionally, several studies[11,13] describe a high learner satisfaction when using HPS compared to low-fidelity and traditional teaching methods. Increased learner enjoyment in educational activities directly translates to increased creativity, involvement, and overall increased engagement in learning.[11,14,]

Many medical and health care education programs include student involvement in clinical experiences in order to develop the critical thinking abilities necessary for effective, long-lasting learning.[15] However, due to the random nature of clinical experiences, it can be difficult for educators to rely solely on clinical experiences to provide students with necessary learning opportunities across a broad range of skills.[7,14,16,17] In some low-incident events in clinical settings, a disconnect is created between the classroom and clinical environment because the student is unable to practice these skills.[18] When used as an adjunct teaching and training tool to augment clinical practice, high-fidelity simulation effectively bridges this gap and allows for deliberate practice of clinical skills.[5,11,12,18,19] Furthermore, research in instructional science has shown that, in order to ensure knowledge and skill mastery and the self-confidence development needed to handle the complexities of advanced clinical decision making, learners must be exposed to deliberate practice opportunities that meet educational objectives.[5,17]

Human patient simulation creates a safe environment to practice clinical skills without causing harm to patients.[1,2,14,20] The ability to practice high-risk clinical skills in a supportive risk-free environment[1] is crucial to developing advanced clinical problem solving, clinical reasoning, and confidence.[14,21] Numerous studies in medical and nursing education[7,11,14,20] have demonstrated that HPS participants are able to practice clinical skills as well as improve self-confidence in the management of high-risk patients through simulation. Consequently, curricula utilizing HPS have been demonstrated to effectively improve patient safety and decrease medical errors in health care delivery.[1,14,20]

One common high-risk clinical skill health care professionals are expected to perform is cardiopulmonary resuscitation (CPR). Professional rescuer CPR is often taught as a course that includes passive lecture and 1-time skill stations.[22] Students are expected to perform the correct sequence of events in order to provide initial management of cardiac emergencies after initial CPR certification. An evidence review of patient survival rates, when correlated with factors such as rate and quality of chest compressions and early defibrillation, reveals that passive lectures and 1-time skill stations are inadequate for providing optimal survival opportunities to patients.[22,23] Additionally, CPR training courses do not address the emotional stress the health care provider experiences when discovering an individual who is pulseless and breathless.[7,9]

Several studies in medical and nursing education[22,24,25] have positively demonstrated the effects of using high-fidelity simulation when training students in first aid and CPR. Through an evidence-based practice review, Sahu and Lata[22] found that using high-fidelity simulation with medical students in emergency practice enhanced emergency awareness and skills. These outcomes directly translated to improved true patient outcomes.[26] In a recent study in undergraduate nursing education, Whyte et al[26] identified a significant relationship between knowledge, performance in simulated task environments, and actual clinical performance. Additional studies identify HPS to be an effective method to improve health profession students' confidence with clinical skills, along with satisfaction with the learning experience, noting proficiency gains in clinical skills give rise to a sense of self-confidence among medical learners.[11,25] Findings on the direct relationship between a student's performance in a simulated scenario and actual clinical performance provide evidence for the effectiveness of simulation as an assessment tool.[26] Studies noted the standardization of simulation to

train and maintain skills used in CPR led to improved patient care during times of decreased senior staffing.[22]

Numerous studies have reported that physicians and nurses display poor adherence to American Heart Association (AHA) guidelines during advanced cardiac life support (ACLS) events[24] and a rapid decline of skill retention after traditional ACLS education.[24,25] In a case-control study of cardiac arrest team responses, Wayne et al[24] reported that, when exposed to deliberate practice opportunities through the use of high-fidelity simulation, physicians and nursing students showed significantly higher adherence to AHA ACLS guidelines versus traditionally ACLS trained students. Furthermore, this study reports data on in-hospital cardiac arrests from the University of Chicago in ACLS trained internal medicine residents. Results demonstrated that the quality of resuscitation efforts from these residents varies and often did not meet published AHA guidelines.[24] It was concluded that residents were poorly prepared, insufficiently practiced, and lacked the confidence to recognize and manage life-threatening cardiac arrests, which were reported to occur infrequently in this unit. Studies such as these illustrate an educational gap in skill application and retention.

Based on these findings, research suggests supplemental training involving high-fidelity CPR simulation will improve mastery of these skills and provider self-confidence in these medical provider settings.[5,7,9] The long-term retention effects of skills practiced in simulation experiences for health care profession students appear to diminish over time, establishing a need for continued practice to maintain competency.[11,27,28] It remains debatable how often supplemental training with HPS is recommended. Boet et al[29] reported complex procedural skill retention for a minimum of 1 year after a single HPS training session in anesthesia residents. Other studies[27,28] have demonstrated similar long-term skill retention following high-fidelity simulation cardiac arrest team responses. Factors such as level of performance, clinical incidence, teaching practices, adherence guidelines, retrospective analysis, and motivation have all been identified as factors influencing successful engagement in supplemental re-training.[12]

In searching the sports medicine and athletic training literature, no original research studies were found regarding the use of high-fidelity simulators in the professional CPR education and training of these students. Cardiopulmonary resuscitation is a high-risk, low-incidence event in athletic training, and athletic training students must hold a current health care provider CPR certification.[30] Due to the nature of athletic training settings, students do not often encounter an event requiring the use of CPR during their clinical experiences. If the event does occur, the students are often relegated to an observation role or participate under strict instruction from their clinical preceptor due to the severity of the case. Therefore, athletic training students are lacking deliberate practice opportunities in their clinical experience settings to master the knowledge and skills and gain the confidence needed to handle the complexities of advanced clinical decision making involving CPR. When used as an adjunct to clinical experiences, high-fidelity simulation is an ideal educational tool to provide students with a realistic and safe learning environment for the practice of higher-level critical thinking and complex clinical judgment skills.[7,9,14,22] Additionally, HPS could allow the participant to experience the emotional stress of the discovery and management of a patient who is pulseless and lifeless.[25] Simulation decreases the variability of clinical experiences among students by providing all students with deliberate practice opportunities to manage specific clinical events, such as CPR, that they may not otherwise have encountered in their clinical rotations.[7]

The lack of evidence in simulation as an effective CPR teaching tool in athletic training education prompted this purposeful review of medical and health care simulation educational outcomes along with the design of an original research study. Review of high-fidelity simulation effectiveness on multiple aspects of medical and health care education demonstrates an evidence-based platform for the integration of this educational tool into athletic training programs and was used to design the CPR simulation. Considering the lack of evidence specifically relating to effects of high-fidelity simulation on athletic training education, this study addresses a wide range of data, including: athletic training student knowledge acquisition from simulation, effects on student confidence, emotional responses, and reports of lived experiences in different phases of simulation.

Research Questions and Objective

The purpose of this original research study was to explore the knowledge, confidence, emotions, and lived experiences of athletic training students that participate and observe a CPR high-fidelity simulation. Based on the lack of evidence specifically related to effects of high-fidelity simulation in athletic training education, the following research questions will be addressed:

(a) Do athletic training students gain CPR knowledge from participation in a high-fidelity simulation?
(b) How does participation in a high-fidelity simulation involving CPR affect the confidence and emotions of an athletic training student related to this skill?
(c) What lived experiences do athletic training students report in the different phases of high-fidelity simulation for a scenario involving CPR?

METHODS

Study Design

A mixed-methods study design was employed using pre- and postintervention evaluations of students' CPR knowledge, confidence, emotions, and lived experiences via the Presimulation CPR Survey, the Postsimulation CPR Survey, and the Reactions to the Simulation Experience Postsimulation Reflection assignment. The reason to use both a quantitative survey and a qualitative reflection assignment was the advantage of producing a variety of data related to the knowledge, confidence, emotions, and lived experiences from participants in the simulation.

Participants

The undergraduate athletic training students registered in ATC 340 Clinical Practicum III participated in this study at a

Table 1. Topic Areas Assessed

Survey Instrument	Topics Assessed
Presimulation Cardiopulmonary Resuscitation Survey	Knowledge, confidence
Postsimulation Cardiopulmonary Resuscitation Survey	Knowledge, confidence, emotions
Reactions to the Simulation Experience Postsimulation Reflection Assignment	Emotions, experience

Commission on Accreditation of Athletic Training Education (CAATE) accredited program in the Midwest. There were 20 students enrolled in this class, which is taught in a traditional face-to-face setting, which is highly concentrated in laboratory and skill-based activities. This convenience sample consisted of 9 male and 11 female students (age = 21.2 ± 1.01 years), 18 (90%) white, 1 (5%) African American, and 1 (5%) Native American. Students had been enrolled an average of 3.25 ± 0.55 years and held Health Care Provider CPR certification for 3.35 ± 1.81 years. Outside of their athletic training student clinical involvement, 2 (10%) have held additional positions as emergency medical technicians, and 4 (20%) have served as lifeguards. Institutional review board approval for data collection was obtained from the human subjects committee at the university. Following a signed informed consent, 100% of the students chose to be participants in the study.

Instrument

The Pre- and Postsimulation CPR Survey instruments, as well as the Reactions to the Simulation Experience Postsimulation Assignment, were developed by the research team and used to assess student knowledge, confidence, emotions, and lived experiences before and after the simulation (Table 1). Cardiopulmonary resuscitation knowledge was assessed through 5 questions on both the Pre- and Postsimulation CPR surveys using a Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Confidence was assessed using the same Likert scale on the Pre- and Postsimulation CPR Survey, but included 6 questions relating to the student's self-reported confidence when performing CPR. Emotions were assessed on the Postsimulation CPR Survey through 1 question using the abovementioned Likert scale. Additionally, emotions, lived experiences, and reactions were evaluated through several open-ended questions in the Reactions to the Simulation Experience Postsimulation Reflection assignment (Table 2).

All 3 instruments, the Presimulation CPR Survey, the Postsimulation CPR Survey, and the Reactions to the Simulation Experience Postsimulation Reflection Assignment, were examined for content validity by a panel of experts (n = 6). No necessary modifications were found or made based on their feedback. Reliability of the Pre- and Postsimulation CPR Survey was determined in a test-retest study in a sample of athletic training students (n = 20) who had previously completed the Clinical Practicum III course. Cronbach α was calculated for all the items at the value of .70 or higher. Reliability of the Reactions to the Simulation Experience Postsimulation Reflection Assignment was not conducted due to the qualitative nature of information collected in these questions.

Procedures

The Presimulation CPR Survey was administered to all student participants 1 day prior to the simulation by the classroom instructor whom is also the lead researcher. The students participated in and/or observed the CPR simulation in 1 of 3 laboratory dates using the Nursing Department Simulation Center on campus which is equipped with SimMan Laerdal high-fidelity mannequins. Students were randomly placed into 3 even groups; 2 groups of 6 and 1 group of 8 individuals in order to maximize hands-on time in the simulation center. Each group was scheduled to have 1 day in the simulation center. Within each group, students were paired, and each pair participated in 1 simulation scenario that required the use of CPR and observed their peers in other scenarios on the day of their scheduled simulation. The peer observers were in the same room as the pair participating in the simulation and were able to see and hear all actions taking place in the scenario. However, the peer observers were given strict instruction by the investigators to not speak, assist the participating pair, or intervene in the simulation in any way.

The students participated in 1 CPR simulation laboratory day for this study. During that day, they participated in 1 high-fidelity simulation as the responder, and they observed their peers in 2 other high-fidelity simulations. Therefore, they were exposed to 3 different CPR high-fidelity simulations on this laboratory day; 1 as a participant and 2 as an observer. The investigators controlled the high-fidelity mannequin's physiologic responses outside of the simulation room within a computer control room behind a 1-way glass mirror. The pair of participating students completed the simulation together. The only instructions given were to respond to the scenario that was presented as an athletic trainer. The participating pair was given access to a kit of materials that they had stocked 1 week prior to the simulation. Students were previously given instructions to stock their kits with materials they would want as an athletic trainer covering an event. Materials included, but were not limited to, an automated external defibrillator, stethoscope, CPR mask, tape and bandage materials, and gloves. During the simulation scenario, neither student was assigned the lead role in assessing the victim or responding to the scenario. The investigators purposefully did not assign roles to the participating pair in order to allow the participants to fully experience their communication and teamwork abilities.

Within each simulation scenario, the students were required to initiate an assessment, activate the Emergency Medical System (EMS), perform CPR, use an automated external defibrillator and other emergency medical equipment, and give a report to paramedics responding to the call. The role of the EMS paramedics responding to the call was played by 2 senior-level athletic training students. The scenarios were as follows:

(a) During the second period of a high school football game, you suddenly hear fans screaming for help. You look into the stands and see that a middle-age spectator is lying face down on the steps;
(b) A soccer player runs into the athletic training room and frantically screams that another player became uncon-

scious after coughing and choking during their team dinner;

(c) During a high school football game, 2 players collide as they are going up for a pass that is thrown. Neither gets up after the play;

(d) A runner slowly starts to fall back from the group during a marathon and soon collapses onto the ground. A crowd of spectators gathers around the patient before you can reach them. Each of the scenarios was randomly assigned to each pair of participants and was not previously seen by the participants or peer observers in the group.

Standard simulation training includes a debriefing immediately after simulation to review the events of the simulation and the actions taken by the participants, since it is in the debriefing where much of the learning takes place. Immediately following the scenario, participants and peer observers participated in an instructor-led debriefing. This faculty-facilitated group discussion consisted of what was done well, identification of changes that could have been done differently, and the thought processes behind the decisions that were made. The students shared their reactions and the feelings they had prior to the simulation, during the scenario, and following the completion of their simulation experience. The debriefing in this study contained 3 questions. The first question was, "How did the simulation go?" This question was prompting the group to review the actions in the simulation. The second question asked, "What went well in the simulation," and the third asked, "What about the simulation would you do differently?" The aim of the debriefing was student self and group analysis of the actions taken during the simulation. The instructor conducting the debriefing for this study is an experienced facilitator in simulation debriefing. Every effort was made for the student to evaluate their own actions as well as the actions of their team. This environment is constructed to be psychologically safe to enhance learning and self-evaluation. There was no attempt by the instructors to influence the student input except to clarify student comments and encourage thoughtful reflection on the experience.

In highly critical events, emotions and stress can influence actions;[7,12,31] therefore, it takes time to assimilate actions and reactions from this type of experience into learning.[7,13] The postsimulation reflection assignment was conceived as a way to capture the students' reflections and would provide insight into their way of thinking after a processing period. Therefore, within 2 weeks of completing the simulation, the Postsimulation CPR Survey and Reactions to the Simulation Experience Postsimulation Reflection assignments were administered (Table 2). Students were instructed to reflect on their simulation experience and provide a deep analysis of the questions related to the postsimulation experience. Students were encouraged to answer all questions honestly, and no class grade was affiliated with their responses.

Quantitative Analysis

The quantitative data were imported from the Presimulation CPR Survey and the Postsimulation CPR Survey into SPSS Statistical Package for Windows (version 21, Chicago, IL) for statistical analysis. To quantify the effects of the simulation, the difference between responses on the Pre- and Postsimulation CPR Surveys were calculated and responses grouped into 2 sets of pre/postoutcome measure pairs, knowledge and confidence. Survey questions 1, 3, 5, 7, and 9 addressed knowledge, while survey questions 2, 4, 6, and 8 addressed confidence. Paired-sample t tests examined the effect of the simulation on the variables. Emotional effects of the simulation were reported through a descriptive histogram, as no pre/postcomparison was possible since question 10 addressing this variable was only present on the Postsimulation CPR Survey. Additionally, lived experiences from the simulation were reported through a descriptive histogram on questions 12, 14, and 15 of the Postsimulation CPR Survey.

Qualitative Analysis

Emotions and lived experiences were analyzed in the Reactions to the Simulation Postsimulation Experience Assignment using Dedoose software.[32] Dedoose is a cross-platform application for analyzing qualitative and mixed methods research with text, photos, video, spreadsheet data, etc. The data is uploaded into the software package where multiple researches can code the data. This allows for sorting coded information into themes, as well as graphing codes to analyze their frequency in the data. The text from the Reactions to the Simulation Postsimulation Experience Assignment was uploaded into Dedoose and organized into 3 outcome groups: patients who died, patients who lived with complications, and patients who lived without complications. The qualitative data was then independently coded by 2 experienced qualitative researchers. One coder, the second author, was 1 of the researchers, and the second coder was not directly involved with the study. Once the qualitative data was independently coded, the coders compared their results for agreement. Differences were resolved with discussion until consensus was reached. As the researchers worked through the discussion of the coded themes, it was felt that the Dedoose software accurately achieved theme reporting, and no additional themes emerged from the discussion.

RESULTS

A paired t test revealed significant improvements in both athletic training student CPR knowledge, $t_{19} = -5.640$, $P < .001$ (pretest: $\bar{x} = 3.75$, SD = 0.546; posttest: $\bar{x} = 4.60$, SD = 0.394) and self-confidence, $t_{19} = -4.485$, $P < .001$ (pretest: $\bar{x} = 4.18$, SD = 0.524; posttest $\bar{x} = 4.68$, SD = 0.295) following the CPR simulation. The improved confidence score was also reinforced after analysis of the Reaction to the Simulation Experience assignments, where 100% (n = 20) of students stated their confidence increased following participation in the simulation. On the Postsimulation CPR Survey, students reported a mean emotional score of 4.5 out of 5.0 (SD = 0.761), indicating a high level of anxiety, fear, and nervousness before the scenario. This was confirmed by the results of our analysis of the Reaction to the Simulation Experience Assignment, where 100% of the students (n = 20) described their presimulation emotions as nervous or anxious.

The Simulation Lived Experiences

Simulation participation also stimulated similar responses regarding student learning or realizations, where 100% of the students (n = 20) described having a positive learning experience. This theme was evident in statements such as, "I

Table 2. Survey Instruments in Entirety. Scales of Frequency Percentages for Participant Response Totals (n = 20) Reflecting Survey Results Within Survey

Question	1 = Strongly Disagree (%)	2 = Moderately Disagree (%)	3 = Neutral (%)	4 = Moderately Agree (%)	5 = Strongly Agree (%)
Presimulation CPR Survey					
1. The first step when initially approaching a scene with a patient who appears nonresponsive is to activate EMS.	15	25	0	15	45
2. I have the skills and knowledge to perform CPR on a victim/patient.	0	0	0	30	70
3. When performing CPR on an adult, compressions should be delivered with 2 hands at a depth of 1.5–2 in.	0	0	0	40	60
4. In a situation where I had to perform CPR, mentally I would be able to remain calm.	0	10	10	55	25
5. When performing ventilations on an unconscious adult, if breaths are delivered too forcefully, the lungs could overinflate.	30	20	20	20	10
6. In a situation where I had to perform CPR, I would remember all the steps and the correct order of those steps to perform this skill.	0	5	10	65	20
7. In providing care for an unresponsive adult patient (no pulse and not breathing), after activating EMS, the next step would be delivering 30 chest compressions followed by 2 rescue breaths.	0	0	5	25	70
8. In a situation where someone needed CPR, I would not hesitate or doubt my abilities.	0	5	5	65	25
9. When using an AED, pads should be applied to the patient's bare chest before turning the unit on.	35	5	0	5	55
Postsimulation CPR Survey					
1. The first step when initially approaching a scene with a patient who appears nonresponsive is to activate EMS.	0	0	0	30	70
2. I have the skills and knowledge to perform CPR on a victim/patient.	0	0	0	10	90
3. When performing CPR on an adult, compressions should be delivered with 2 hands at a depth of 1.5–2 in.	0	0	0	0	100
4. In a situation where I had to perform CPR, mentally I would be able to remain calm.	0	0	5	45	50
5. When performing ventilations on an unconscious adult, if breaths are delivered too forcefully, the lungs could overinflate.	50	30	15	5	0
6. In a situation where I had to perform CPR, I would remember all the steps and the correct order of those steps to perform this skill.	0	5	5	30	60
7. In providing care for an unresponsive adult patient (no pulse and not breathing), after activating EMS, the next step would be delivering 30 chest compressions followed by 2 rescue breaths.	5	0	0	5	90

Table 2. Continued.

Question	1 = Strongly Disagree (%)	2 = Moderately Disagree (%)	3 = Neutral (%)	4 = Moderately Agree (%)	5 = Strongly Agree (%)
8. In a situation where someone needed CPR, I would not hesitate or doubt my abilities.	0	0	0	25	75
9. When using an AED, pads should be applied to the patient's bare chest before turning the unit on.	65	20	5	0	10
10. I experienced anxiety/fear/nervousness before the simulation.	0	5	0	35	60
11. I am better prepared to handle a real-life CPR/emergency situation following the simulation experience.	0	0	0	20	80
12. The simulation felt like a real patient-clinical experience to me.	0	5	0	55	40
13. My confidence in my ability to handle a medical emergency increased as a result of the simulation experience.	0	0	0	25	75
14. Participation in the CPR simulation should be a mandatory part of athletic training student education.	0	0	0	0	100
15. I reacted to the simulation experience the same as I believe I would have in a real-life emergency.	0	0	0	40	60
Reactions to the Simulation Experience, Postsimulation Reflection Assignment					
1. As you approached the victim in your simulation, what emotions did you experience?					
2. Describe the emotional responses you experienced during the different parts of the simulation.					
3. (A) Did your patient live or die?					
(B) Based on the outcome of your patient in your scenario, how did you react when you first learned if the patient lived or died?					
4. What have you learned about yourself, your ability, and your skills with CPR based on this simulation experience?					

Abbreviations: AED, automated external defibrillator; CPR, cardiopulmonary resuscitation; EMS, Emergency Medical System.

learned I knew exactly what to do in an emergency situation," and, "I learned I do have the CPR skills to save somebody and I am able to stay pretty calm and level headed throughout a stressful situation." When asked in the Postsimulation CPR Survey if students thought the simulation felt like a real experience and if participation in the simulation better prepared them to handle a real-life clinical situation, students reported an overall very positive lived experience ($\bar{x} = 4.63$, SD $= 0.34$).

Views on Accountability

An unanticipated subtheme, accountability, became evident after the Reaction to the Simulation Experience Assignment. The patient outcomes in the simulation were directly related to the students' performances (Table 3 illustrates the 3 simulation outcomes in relationship to the students' cited acceptance of accountability). The students' views on their own accountability, however, were varied. While some students took full responsibility for their actions in the simulations, others claimed only partial responsibility or were unable to connect their actions with the outcomes. For example, some students accepted full responsibility when the simulated patient died. One student said:

> *I believed our CPR portion of the scenario was sound; however, our error in in-line stabilization was what I was questioning myself on, and it ended up killing our patient. This was heartbreaking.*

In contrast, other students were unable to take responsibility for their actions and stated, ". . . after reflection on the simulation and the skills that were applied, it was clear that the death wasn't from a lack of care on our part," and ". . . knowing the patient had congestive heart failure made me feel relieved because it wasn't anything we did that made him die."

Table 3. Accountability Theme

	Patient Lived	Patient Lived with Complications	Patient Died
Accepted full accountability	5 (number of students)	1	1
Accepted partial accountability	2	3	2
Accepted no accountability	0	1	5

Similar student reactions were found in the "lived with complications" outcome group, where some students accepted full responsibility with comments such as, "It made sense because we weren't as quick as we should have been initiating CPR, thus compromising oxygen flow to the brain." Others continued to only accept partial responsibility. One student in this latter group stated, "I felt like I could have done more to help the patient, when in reality I probably could not." Finally, some students were unable to take responsibility for their actions at all, where 1 student stated, "The patient survived so I had done things right." Finally, students whose patient lived through the scenario (5 out of 7 in the lived outcome) tended to take full responsibility for their patient's outcome. One student said, "It was an extreme confidence boost to know that someone survived a traumatic event due to our intervention." Similarly, another student stated, "I was relieved, happy, and satisfied that we had done enough to keep him alive until EMS got there."

DISCUSSION

Effects on Knowledge

The participants demonstrated significant knowledge and skill improvements related to CPR performance when compared pre- to postsimulation. These positive findings agree with previous studies involving the use of simulated learning experiences for deliberate practice opportunities in medical and other health care education.[5,12,25] One study[10] in nursing education reported that simulation training enabled students to improve their resuscitation knowledge to a greater extent than those in a control group that used low-fidelity (simple anatomical models with low output), traditional training. One interesting result from previous literature, however, reports mixed findings on whether cognitive gains remained positive over time. In 1 study,[33] the authors found CPR knowledge levels increased immediately after simulation training, but deteriorated after 10 weeks, although not dropping to the original level. Since this investigation did not address cognitive gains over time, future research in athletic training education may warrant an exploration into knowledge retention over time following simulation.

Effects on Confidence

A significant increase in self-confidence was identified between pre- and postsimulation assessments. Self-confidence related to medical and health care education reflects a student's prior and current attitudes as well as the information gained through formal and information educational experiences.[13] Most students in these disciplines report their confidence in their skills increases following simulation training.[9,11,13] Laschinger et al[11] reports that medical students' self-confidence increases when simulation training was provided as an alternate clinical experience. This study supported previous health care literature in that a significant increase in athletic training students reported confidence in emergency skills involving CPR following high-fidelity simulation was found. Due to the nature of athletic training clinical settings, it was known that students in this study would likely not have a great number of clinical experiences, if any, which involved using emergency skills involving CPR. Therefore, the researchers hypothesized that providing a deliberate practice opportunity for the student to use CPR in a simulated environment would positively relate to confidence using these skills. This is, in fact, what was demonstrated in the study. Following participation in the simulation, 1 student said, "I learned that I am very capable of doing things I have been taught. I needed this simulation to really prove that I can do things under pressure and in a real situation." Another student stated, "I am more confident and less fearful of the possibility of having to deal with an emergency someday." It would be interesting to further study if the athletic training students' confidence effectively transitions to the clinical setting during actual emergency management requirements.

Effects on Emotions

Research has shown that the higher the fidelity (realism) of the simulation, the more engaged the student becomes with the scenario.[4,7,21] In this study, students reported strong emotional reactions to the high-fidelity simulation scenario, including increased anxiety and nervousness, which are similar to those experienced during a real patient encounter. One student said, "I was nervous, scared, and doubting my ability and knowledge of CPR and overall patient care before the simulation," and another echoed, "I was nervous about what I would do."

This strong emotional reaction indicates that the students took the scenario seriously and regarded it as a real clinical experience. Furthermore, the athletic training students frequently referred to the high-fidelity mannequin as "my patient," rather than "the mannequin," in the debriefing and reflection assignments. Therefore, it can be concluded that the students' actions in and reactions to these simulations might represent those they would display in an actual clinical emergency.

The Simulation Lived Experiences

Based on the Reaction to the Simulation Experience Postsimulation Reflection Assignment, all students reported that practicing emergency skills in the simulated clinical environment was a positive learning experience and a good use of their time. In the reflection assignment, students were asked, "What have you learned about yourself, your ability, and your skills with CPR based on this simulation experience?" Students responded that, "This was an amazing activity. I loved it!" and, "Doing the simulation was so cool because it really allowed me to see what I can do well in emergency situations." One student stated:

> *I was so stressed out before the simulation because it seemed intimidating, but after going through it, I am so happy that I was able to have this experience, I learned a lot about my abilities.*

Based on these types of reactions, it was concluded that the students were highly satisfied with the high-fidelity simulation learning experience. This finding is consistent with Laschinger et al,[11] who found high learner satisfaction when using high-fidelity simulation when compared to low-fidelity and traditional teaching methods and that, as enjoyment in the activity increases, so does the amount of student interaction (ie, increased creativity, asking more questions, and overall increases engagement in learning).[17]

Similarly, Gordon et al[14] suggested debriefing sessions following simulation allows for the learner to reflect on the case, identify strengths and weaknesses, and gain feedback

necessary for skill improvement. Students in this study responded positively to the feedback provided through the instructor-led debriefing immediately following each scenario. Similar findings have been identified in athletic training literature, where individual reflection assignments, such as journal writing and feedback from clinical preceptors, have been found to facilitate critical thought, express feelings, and assist in bridging the gap between classroom and clinical knowledge for athletic training students.[34,35] Furthermore, the development of self-reflection is a vital component to the promotion of clinical decision making skills and full integration of evidence-based practice in athletic training.[35,36] The results of this study support these identified clinical advantages to individual reflection and feedback in athletic training; specifically, students want more exposure to emergency management scenarios and the opportunity to practice critical thinking and active learning in a supportive, risk-free environment.

Views on Accountability

Personal accountability was an interesting subtheme that emerged during analysis of the Reactions to the Simulation Reflection Assignment. The depth of students' acceptance of their actions was unexpected and emphasized the need to teach students to take responsibility for their performance. The challenge for health care education instructors, therefore, is to provide activities and information which emphasize the link between action and consequence and the importance of using the best evidence-based care techniques possible. This does not negate the instructor's responsibility, however, to also teach students that death or long-term disability may occur regardless of the intervention performed. In our study, the patients' outcomes were a direct result of the students' actions. Unfortunately, most students who experienced a negative outcome (patient died or lived with permanent disability) lacked the ability or insight to relate their actions to those consequences. On the other hand, students with positive outcomes (patient lived) more directly associated their own performance with the result. Therefore, this subtheme needs further exploration.

Limitations

This study is limited in its generalizability due to the small sample size and limited subject pool. A randomized, multi-university, widely dispersed geographic sample, in which a control group could be selected, would have made the study stronger. Even though the surveys were reliable and valid, other studies should confirm these findings.

The facilitator may also have inadvertently influenced the student reflections during the debriefing, even though a standardized debriefing process was used and they were both experienced and not the course instructor. An interesting future study may include analysis of the reactions to the simulation experience immediately before and after debriefing sessions following the simulation to determine if the debriefing itself influences results.

CONCLUSIONS

Results indicated that athletic training students are able to improve CPR knowledge and increase confidence when exposed to practice opportunities with a high-fidelity simulation device. Additionally, students reported strong emotional reactions to HPS, viewed simulation as a positive overall experience, and indicated high learner satisfaction when provided a realistic clinical scenario through which to practice important clinical skills. While students displayed varying views on patient-outcome accountability, conclusions cannot be drawn without further research. Therefore, this study concluded that high-fidelity simulation is highly effective in athletic training education and that many simulation outcome similarities exist between this profession and other medical and health care disciplines.

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