Training Residents in ACLS/Code Response Using a Computerized Medical Simulator: Improving Resident Comfort and Preparedness

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Internal Medicine residents are responsible for leading the code response team at most teaching hospitals, yet many graduating interns (PGY1s) may feel unprepared to run codes. Currently, the only formal training for house staff is the two-day American Heart Association's Advanced Cardiac Life Support (ACLS) course, generally required at the beginning of internship, with recertification necessary every two years. This course does not address leadership skills or a resident's self-reported sense of comfort with leading a code team within a teaching hospital. Prior investigations have highlighted the deterioration in knowledge of important ACLS protocols, with knowledge levels at or near ACLS training levels within 6 months.[1,2] Schwid and Sivarajan showed that the use of computerized ACLS simulator on CD-ROM improves retention of the guidelines better than textbook review alone.[3] Others have shown that refresher courses can enhance performance in a mock resuscitation setting, with improvements maintained, in part, over several months.[4] The use of more life-like simulation training has recently come into favor, through a variety of commercially available medical simulators. We designed an ACLS training program with such a medical simulator for interns preparing for their PGY2 year, namely those residents about to assume responsibility for leadership of the code team. Prior to the simulation training sessions, we collected baseline data regarding interns' experiences in code situations and comfort with the anticipated transition to leading the code team, as they advance to the PGY2 year of training.

Our investigation involved the use of a computerized Medical Simulator (MedSim') to better prepare house staff to lead a code response team. We believed that such practical training was lacking, while certainly important for housestaff about to transition to a leadership role in running resuscitation efforts in our institution. The goal of our project was to give our interns some practical experience in a life-like simulation of three ACLS scenarios, while assessing improvements in their self-reported level of comfort with the role of team leader and preparedness for dealing with future code situations.

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Methods

Thomas Jefferson University Hospital is a 550-bed teaching hospital with 37 categorical residents in each year of training and 6 preliminary medicine residents. The code blue team consists of two upper year residents (PGY2 or PGY3) assigned to lead the resuscitation effort and two interns to provide the actual care. Interns complete 8 blocks of inpatient assignments with time on the code team. PGY2's are assigned to rotations with overnight coverage and leadership of codes during 8 blocks, while PGY3's are assigned to only 2 blocks. All PGY1s were asked to participate in simulation training of code situations during the last quarter of the academic year (April/May 2000), prior to the start of their PGY2 year. Interns participated in teams of three and were asked to complete a questionnaire (QRE) and sign consent before taking part in the training exercise. A follow-up QRE was administered again at the start of their PGY2 year, after the interns had completed training. All responses were confidential and did not have any personal identifying information. A follow-up QRE was completed by residents continuing in the categorical internal medicine residency program.

MedSim' was designed to run several simulated Code Blue scenarios that were developed by the residency program leadership. The simulator consists of a computerized mannequin with synthesized heart and lung sounds, palpable pulses, pupillary responses, a functional airway, and IV access. The cardiac rhythm, BP, and oxygen saturation are displayed on an ICU monitor. Medications given by trainees through an electronic stop-cock lead to anticipated physiologic responses. Each resident performed one standard scenario while the other two residents assisted. The scenarios, unknown to the trainees, included tension pneumothorax with pulseless electrical activity, symptomatic bradycardia, and ventricular fibrillation. A primary resident was assigned as code leader. The other residents were assistants, charged with following the code leader's instructions, including airway intubation and ventilation, CPR, and medication administration. For each of the three scenarios, the residents would rotate their responsibilities. Each scenario had a different

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outcome. All sessions were videotaped so that actual performance could be reviewed. After all three scenarios were completed, the residents underwent a debriefing with a Chief Medical Resident or faculty member. These sessions included review of videotapes, review of critical assessments and decision-making of the team leader, and discussion of the correct course of action according to established ACLS protocols.

The QRE used a standard 5-point Likert scale to measured residents' comfort level leading a code team, familiarity with ACLS protocols, and sense of preparedness to run resuscitation efforts. We also collected data regarding the intern's experience with codes over the first 9 months of their PGY1 year of training. Statistical analysis was performed on a PC microcomputer using the SPSS statistical package (SPSS Inc., Chicago, Illinois). Analysis consisted of chi-square tests to relate dichotomous and nominal variables. Paired t-tests were used for pre- and post- intervention comparison on the several scale measures. Data dispersion was expressed as one standard deviation and significance set at a level of 95% or greater ($P < .05$).

Results

Forty-one interns completed the simulation training and pre-QRE. Thirty-six of them completed the post-QRE at the start of their PGY2 year. Two prelimary medicine interns opted not to participate because of career interests that did not include direct patient care. One categorical resident missed the simulation training because of vacation. All participating residents indicated that they were currently certified in ACLS (confirmed by residency program records). On average, the interns had attended between 6 –10 codes during the preceding 9 months of training (options for response included 1-5, 6-10,11-15, etc). Only 4 of 41 (10%) were given an opportunity to lead the resuscitation effort under the guidance of their senior resident prior to the simulation exercise. The 4 interns who indicated that they had led a code, had only done so one time each.

Prior to the intervention, trainees felt uneasy leading the code team. Only 7/41 (17%) interns said they felt "comfortable" running a code.

The simulated training program significantly increased house staff sense of comfort and preparedness in running codes. We observed improvement in their sense of comfort in leading the Code Blue team (1 to 5 scale, with 5 as highest): 2.61 + 0.90 in the pre-intervention vs. 3.25 + 0.87 post-intervention questionnaire ($p = .003$). We also observed an increase in their sense of preparedness: 2.67 + 0.79 pre- vs. 4.03 + 0.97 post-intervention ($p < .001$). Residents were enthusiastic about the training, and nearly all (33/36, 92%) requested a follow-up simulator session. Figure 1 shows the pre and post intervention comparisons of the resident's response to the question "I am prepared to lead the Code Team".

Discussion

The survival of hospitalized patients with critical arrhythmias is clearly linked to the physician's correct treatment of the potentially deadly arrhythmia, combined with availability of equipment and coordination of care of the resuscitation team.[5,6] Medical simulation offers a realistic model to train house staff to coordinate and lead a code team, while offering practical exposure to common code situations.

At our institution, we found that interns approaching the completion of their PGY1 year did not feel prepared to run the code team, despite certification in ACLS. Few had actual experience leading the code team as interns and the number of codes attended was quite low (not more than 10 resuscitation efforts). We found that house staff comfort and sense of preparedness was enhanced through lifelike training with a medical simulator and mock scenarios with formal post-simulation debriefing. Interns were overwhelmingly eager to undergo further simulated training.

Our study, based on an educational intervention, did not involve a control group. However, it is unlikely that such an increase in housestaff confidence could have occurred for other reasons. First, our data indicate that individual intern experience with code blue situations was infrequent, less than once per 4-week block. Thus, few interns would have had further significant experience during the last few blocks of their internship. Moreover, we do not require our interns to recertify in ACLS at the end of internship since their certificates are valid for two (2) years. At our

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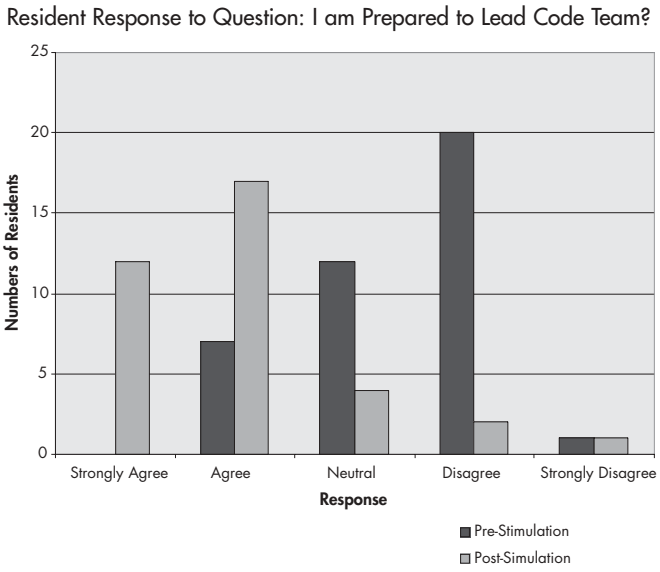

institution, the majority of inpatient night call and responsibility for leading codes occurs during the PGY2 year prior to required recertification. While requiring ACLS training annually would represent an alternate educational strategy, more formal simulation with a group is the only way to address team leadership skills- a major focus of our simulations and debriefing sessions.

Since we report only on improvements in self-reported measures of comfort and preparedness, the impact of our findings does not extend to knowledge or performance. Arguably, performance would be the ultimate standard to judge such an intervention. Similar practical training, but using a CD-ROM based format, combined with expert debriefing or follow-up has been associated with improvements in knowledge of ACLS protocols.[3] The advantage, however, of a true simulated training program such as ours is threefold. In our simulations, interns gained experience in leading a resuscitation team, worked with the necessary equipment utilized in an actual hospital resuscitation, and performed the important manual skills required in codes, including airway control and ventilation, chest compression, and needle decompression of pneumothorax. Faculty or Chief Residents observed the performance and provided direct expert feedback regarding performance of critical aspects of the resuscitation. Moreover, the use of videotape enhanced the reliability and objectivity of the debriefing.[7]

We have found that at our institution, graduating medical interns' sense of comfort with leading the code team is lacking. We have shown that comfort and sense of preparedness can be enhanced through a program of simulation training with expert feedback. Future work will be required to see whether improvements in comfort level or sense or preparedness correlate with increased measures of knowledge or actual outcomes. The availability of new technology in simulation training affords a novel and ethical approach to training housestaff that may yield benefits for hospitalized patients who suffer an arrest.

References

1. Lowenstein SR, Libbey LS, Mountain RD, et al. Cardiopulmonary resuscitation by medical and surgical house-officers. Lancet 1981;ii:679-681.

2. Curry L, and Gass D. Effects of training in cardiopulmonary resuscitation on competence and patient outcome. Can Med Assoc J 1987;137:491-496.

3. Schwid HA, Rooke GA, Ross BK, Sivarajan M. Use of a computerized advanced cardiac life support simulator improves retention of advanced cardiac life support guidelines better than a textbook review. Critical Care Medicine 1999;27(4):821-824.

4. Stross JK: Maintaining competency in advanced cardiac life support skills. JAMA 1983;249:3339-3341.

5. Kaye W, Mancini ME, Rallis SF: Advanced cardiac life support refresher course using standardized objective based Mega Code testing. Crit Care Med 1987;15:55-60.

6. Tunstall-Pedoe H, Bailey L, Chamberlain DA, Marsden AK, Ward ME, Ziderman DA. Survey of 3765 cardiopulmonary resuscitations in British hospitals (the BRESUS study): methods and overall results. BMJ 1992;304:1347-51.

7. Liu P, Miller E, Herr G, et al: Videotaper reliability: A method of evaluation of a clinical performance examination. J Med Educ 1980;55:713-715.