

**Grant Number:** U18 HS16634-01  
**Grant Period:** 9-30-2006 to 10-1-2008  
No-cost extension: 10-1-2008 to 9-30-2009

**Reporting Period:** Close-Out Report

**Title of Project:** Improving Resuscitation Team Response to Inpatient Critical Events by Simulation

**Principal Investigator:** Jose F. Pliego, MD

**ESNAP Questions:**

1. *Change in personnel or personnel effort?*  
No change in personnel or personnel effort after that described in the Grant Progress Report.
2. *Carryover of more than 25%?*  
We requested a 12-month, no-cost extension for October 2008 to September 2009, for \$156,731 total costs. This was about 26% carryover during the no-cost extension.
3. *Change in human or animal subjects use?*  
No change in human or animal subjects use.

**Project Abstract:**

Our project proposes to implement teamwork training based on naval research on high-performance teams under stress (Cannon-Bowers and Salas, 1998; Salas, 2001). Our teamwork training curriculum will use high-fidelity simulations of critical clinical events to train all multidisciplinary resuscitation teams (Rapid Response Teams [RRTs] and Code Blue Teams) in a tertiary care hospital that serves a large rural patient population. Our ultimate aim is to decrease mortality rates in non-expectant (non-Do Not Resuscitate), non-intensive care unit patients in an acute care inpatient facility. By improving team coordination processes and teamwork knowledge, skills, and attitudes in resuscitation teams, we believe that we will decrease mortality rates in non-expectant adult inpatients in non-intensive care unit settings, decrease the number of Code Blue alerts, decrease the time to initiate appropriate treatments in Code and Rapid Response Teams and, ultimately, change the institutional culture of patient safety. This project will evaluate the impact of our theory-based team training simulations on individual, team, and institutional processes and outcomes related to patient safety. As this is a research project measuring the impact of team training interventions on real patient outcomes and real workplace scenarios, our research design will be a prospective cohort pre-post design. Our metrics for success are based on the patient safety culture and high-performance team training research of Cannon-Bowers and Salas, Helmreich, and Sexton. We plan to compare baseline observational, self-report, and patient outcomes data (Phase I) with identical data that we will collect (Phase III) after implementing simulation-based team training based on Serfaty's team training model and Baker et al's 2003 recommendations for team training in medicine (Phase II). We plan to translate research developed for the training of high-performance naval teams working under intense stress to the medical environments of multidisciplinary Rapid Response Teams and Code Blue Teams in hospitals.

We believe that team coordination training using high-fidelity simulators and reflective videotaped debriefings will help patient safety by improving medical team communication and coordination of efforts during life-threatening situations by changing hospital culture to be more attuned to patient safety and, ultimately, by decreasing the rate of unexpected deaths in non-intensive care settings. Our findings with RRTs will have public health implications because of the relevance to rural and small community hospitals that serve many rural and underserved Americans. Because many of these hospitals do not have 24-hour, 7-day-a-week in-hospital medical staff coverage to respond to immediate crisis management events, training multidisciplinary RRTs in team communication and coordination will be all the more crucial to saving lives.

### **Project Summary:**

The overall objective of this proposal is to evaluate the impact of multidisciplinary team training using simulated clinical critical events on non-expectant, non-ICU inpatient mortality rates and critical team process and outcome measures. This proposal focuses specifically on multidisciplinary teamwork training using simulated critical events with two types of resuscitation teams: Rapid Response Teams (RRTs) and Code Blue Teams (CBTs) in our institution. Critical events are defined as acute deteriorations in clinical status that could result in injury or death if left untreated. Our central hypothesis is that critical event multidisciplinary team simulation strategies will improve patient safety by enhancing team coordination processes, response times, and successful rescue in an inpatient healthcare setting. The rationale for the proposed research is that, through team simulation training strategies, we may improve teamwork in multidisciplinary resuscitation teams. These teams manage critical events in a clinically complex environment that directly affects patient outcome.

### **Specific Aims:**

- Adapt appropriate team simulations to the needs of resuscitation teams responding to critical clinical events;
- Improve team coordination processes and teamwork knowledge, skills, and attitudes in resuscitation teams;
- Decrease mortality rates in non-expectant (non-Do Not Resuscitate [DNR] adult inpatients in a non-ICU setting on general hospital floors;
- Decrease the number of Code Blue alerts;
- Decrease the time to initiate appropriate treatments in Code and Rapid Response Teams (RRTs).

### **Studies and Results:**

#### Phase I

1. We acquired data for the patient safety baseline inpatient mortality rates in non-expectant, non-ICU patients in our tertiary care inpatient hospital.
2. We performed a team training needs assessment that included a series of 12 mock codes in the Center for Advanced Medicine. This needs assessment functioned as a tool for identification of key team elements, such as

interpersonal, communication, and leadership skills that need to be improved. During our team training needs assessment, we identified that a key factor in resuscitation responses involves the transition of roles from first responders (floor nurses) to the CBTs and RRTs. Thus, the need to train all individuals was deemed necessary and significant for the study. Consequently, we expanded our training to all floor nurses who respond to Code Blues and incorporated their training with the RRTs and Code Blue Teams. We received significant administrative support and feedback from our study and are recommending the implementation of mock codes using high-fidelity simulation within hospital policy.

3. We obtained self-reports of perceived individual knowledge, skills, and attitudes related to teamwork and patient safety in members of Code Blue Teams.
4. We performed a team training needs assessment by implementing a series of 12 mock codes using high-fidelity clinical simulation in the Scott & White Center for Advanced Medicine (CAM). The following study was determined exempt by the Scott & White Institutional Review Board. Upon initiation of the study, the CBT and RRT members and program directors were informed that they would be participating in mock code exercises for 4 weeks. A high-fidelity simulator, SimMan® (Laerdal), was strategically placed at different locations in the Scott & White CAM at six times during the normal day shift, three times at night, and three times on the weekend. The times were selected to maximize the number of participants and to take into consideration rotations of residents and interns. However, the days, times, and locations of the codes were unknown to the CBTs prior to the call; directors of each CBT member were informed of the details. Each Code Blue was called as a normal code by a study investigator, and, if an actual code was called during the mock code, the mock code was aborted. The CAM is an eight-floor facility; because emergency room and ICU respond to their floor codes, we performed the mock codes on floors 3 to 8. Each floor experienced two mock codes. For the first mock codes, the SimMan was placed in a patient bed; on the second code, the SimMan was placed on the floor away from a room. The scenario of each code was realistically created according to the site of the mock code (i.e., in the trauma unit, the patient was a 35-year-old, male, non-DNR motorcycle accident patient, who became unconscious). Teams were notified, when called to a mock code, to proceed as if in reality and to give first-line ACLS medicine and electrical shock. After each mock code, participants were debriefed on their measured performance in order to assess any barriers to effective response and decision making. A study debriefing form was used to document participant self-reported responses to mock codes. All training exercises and debriefings were recorded on video to accurately document the response to the scenario. All participants were notified that the study was finished after completion of the last mock code to ensure authenticity of subsequent Code Blues. We identified several team performance items that needed improvement, such as team communication, role clarity and flexibility, transition of floor nurses to Code Blue Teams, leadership, and fixation errors. We also identified technical and organizational gaps that needed improvement.
5. We reviewed existing scenarios that have been developed for training and code teams and RRTs, and we are currently finalizing a schedule rotation for training. The model for our team coordination training consists of the following:
  - Didactic training on recognizing signs and symptoms of stress in self, team members, the team, and the environment, with instruction on five general team coordination strategies to adapt to increases in workload and stress in high-intensity clinical scenarios.

- Teams complete two simulations and receive and provide team process feedback.
- Before and after training teams complete a simulation scenario in a real work environment.

## Phase II

We implemented team coordination training using high-fidelity simulation.

To facilitate the complete training of all participants, RRTs, CBTs, and floor nurses, we altered the site for the team training to our Scott & White hospital campus rather than at the Temple College Simulation Center. We received two rooms in our ICU ward for the team training from Scott & White. The rooms were furnished similar to our hospital rooms to create a completely realistic Scott & White patient room setting. We received a crash cart from Scott & White and are acquiring a second through institutional support. Rooms were equipped with audio-visual equipment. The rooms were available for the entire length of the grant for team training using high-fidelity simulation. This gave us the opportunity to maximize the number of trainees in our hospital who are responding to resuscitation efforts and thus significantly improve inpatient safety and care as well as healthcare provider education and training.

Additionally, the needs assessment of teams during the mock code exercise in the CAM identified key facility, human, organizational, and technical errors that needed to be addressed at a system level. Thus, we used simulation as a troubleshooting tool for the identification of errors in a new hospital facility that can limit patient safety and then rectified those errors to improve patient safety.

### *Training Intervention Objectives*

- Criteria for calling a Rapid Response Team
- Use of SBAR communication during critical events
- Familiarization with equipment (i.e., crash cart, defibrillator)
- Responsibilities of first responder
- Lethal heart rhythms
- Human factors component
- Two simulation encounters of increasing complexity of cases
- Debriefing

### *Training Implementation Data*

Dates of training:	August 2007 – January 2008
Sessions:	132 3-hour sessions were conducted in 10 hospital units
Participants:	359 participants, of which 278 were Unit Nurses 18, Internal Medicine Residents 16, Anesthesiology Residents 12, ICU Nurses 22, Respiratory Therapists 9, Pharmacists 4, Hospital Supervisors

### Phase III

In situ post-training mock codes: 12 mock codes were performed similar to that described in the needs assessment section. The mock codes were used to evaluate enhanced team coordination response times.

Post-intervention patient safety data assessment

Pre-training: August 06 – July 07

Post-training: August 07 – July 08 \*December 2008

Comparing similar 12-month data to minimize interference of seasonal and epidemiological factors:

Monthly data points were analyzed using Poisson regression models to assess time effects before, during, and after training took place. These data are currently in preparation for manuscript submission.

### **Conclusions:**

- Developed an on-site simulation-based program training multidisciplinary teams to improve coordination processes and increase patient safety.
- RRT underutilization due to system barriers may be overcome with simulation-based programs.
- The participation of the RRT ICU nurses was an important component of our training program, because it promoted interdisciplinary communication among unit nurses and staff utilizing the RRT.
- This study heightens the importance of RRTs and their impact on hospital mortality rates and of methods of hospital education and training.
- Rapid response team utilization can be improved with multidisciplinary simulation training.
- Further research will be needed to assess sustainability as well as additional systems and relationships to patient safety outcomes.
- The study widened the appreciation of simulation-training with leadership and staff and stressed its role in patient safety at our hospital.
- The effort focused simulation and patient safety research efforts on system awareness, identification, and integration.

### *Impact on Simulation-Based Training Interventions at the Hospital*

- General Nurse Orientation: 4 weeks into GNO, medical & surgical nurses attend a 4-hour Dr. Rapid/Blue course in the ICU simulation labs (since Nov '09).
- Internal Medicine Interns & PGY2 will be attending multidisciplinary training in the ICU simulation labs 1 month prior to their rotation on the CBT (since June '09).

## Publications

### Manuscripts

1. J Pliego, T Errichetti, H Wehbe-Janek. SimCom-T: An instrument to assess communication of healthcare teams. *Journal of Communication in Healthcare* 2008: 1(2): 168-181.
2. J Pliego, H Wehbe-Janek, MH Rajab, J Browning, R Fothergill. Ob/Gyn boot camp using high-fidelity human simulators: Enhancing residents' perceived competency, confidence in leadership role, and stress hardiness. *Simulation in Healthcare* 2008: 3(2): 82-89. (DOI:10.1097/SIH.0b013e318658188)
3. F Villamaria, J Pliego, H Wehbe-Janek, N Coker, H Rajab, S Sibbitt, P Ogden, K Musick, J Browning, J Hays-Grudo. Using simulation to orient and improve code blue teams at a new hospital facility. *Simulation in Healthcare* 2008: 3(4): 209-216 (DOI: 10.1097/SIH.0b013e31818187f3)
4. H Wehbe-Janek, C Lenzmeier, P Ogden, MP Lambden, P Sanford, J Herrick, J Pliego, C Colbert. A qualitative analysis of nurses' perceptions of a simulation-based training program for rapid response and resuscitation events. *In review*.

### Abstracts – Oral Presentations/Workshops

1. J Pliego, T Errichetti, H Wehbe-Janek. A theory-based model of debriefing high-fidelity simulations: Transferring competencies from the simulation workshop to the workplace. 13<sup>th</sup> Ottawa International Conference on Clinical Competence (Ozzawa). Workshop
2. J Pliego, T Errichetti, H Wehbe-Janek. Challenges of debriefing high-fidelity simulations: Transferring competencies to on-the-job performance. 2008 Association for Medical Education in Europe (AMEE) conference, Prague, Czech Republic. Workshop
3. H Wehbe-Janek\*, J Pliego, F Villamaria, MH Rajab, S Sheather. Simulation-based training promotes rapid response team utilization and improves in-patient mortality rates. 2009 International Meeting on Simulation in Healthcare. *Simulation in Healthcare*, in press. Awarded 3<sup>rd</sup> Place in Patient Safety Research Projects
4. C Lenzmeier, H Wehbe-Janek, C Colbert, MP Lambden, J Herrick, P Sanford, P Ogden, J Pliego, L Duckett. A qualitative study of nurses' perspectives of a simulation-based multidisciplinary team training program. 2009 National Conference on Undergraduate Research.

### Abstracts – Poster Presentations

1. J Pliego, F Villamaria, H Wehbe-Janek, N Coker, H Rajab, S Sibbitt, P Ogden, K Musick, J Browning, J Hays Grudo. Simulation is an effective strategy for orienting code blue teams and troubleshooting facilities and responses to critical events in a new hospital facility. 2008 International Meeting on Simulation in Healthcare. *Simulation in Healthcare* Syllabus 2008: 3(5) Supplement, Abstract 45.
2. J Pliego, T Errichetti, H Wehbe-Janek, J Hays-Grudo. Validation of SimCom-T: An instrument measuring team communication as a unit. 2008 International Meeting on Simulation in Healthcare. *Simulation in Healthcare* Syllabus 2008: 3(5) Supplement Abstract 54.
3. J Pliego, T Errichetti, H Wehbe-Janek. Using the SimCom-T to assess team communication during simulation training. 13<sup>th</sup> Ottawa International Conference on Clinical Competence (Ozzawa). March 2008
4. J Pliego, H Wehbe-Janek\*, F Villamaria, N Coker, MH Rajab, S Sibbitt, P Ogden, K Musick, J Browning, J Hays Grudo. Using simulation to orient code blue teams to a new hospital

facility. Agency for Healthcare Research and Quality (AHRQ) 2008 Conference, Bethesda, MA. September 7-9.

5. C Lenzmeier, H Wehbe-Janek, C Colbert, MP Lambden, J Herrick, P Sanford, P Ogden, J Pliego. A qualitative study of nurses' perspectives of a simulation-based multidisciplinary training program. 2008 Research Experiences for Undergraduates in Multidisciplinary and Translational Health Science - Scott & White and Texas A&M HSC COM Annual Symposium
6. H Wehbe-Janek\*, C Lenzmeier, C Colbert, MP Lambden, J Herrick, P Sanford, P Ogden, J Pliego. A qualitative study of nurses' perspectives of a simulation-based multidisciplinary training program. 2008 International Meeting on Simulation in Healthcare. *Simulation in Healthcare* 2009: 4(5) Supplement, Abstract 86
7. H Wehbe-Janek\*, J Pliego, F Villamaria, MH Rajab, S Sheather. Simulation-based training promotes rapid response team utilization and improves inpatient mortality rates. 2008 International Meeting on Simulation in Healthcare. *Simulation in Healthcare*, 2009: 4(5) Supplement, Abstract 4

### **Awards**

The following abstract was awarded the 3<sup>rd</sup> Place Patient Safety Abstract Award at the 2008 International Meeting on Simulation in Healthcare in Orlando, Florida, in January 2009.

H Wehbe-Janek\*, J Pliego, F Villamaria, MH Rajab, S Sheather. Simulation-based training promotes rapid response team utilization and improves inpatient mortality rates. *Simulation in Healthcare*, 2009: 4(5) Supplement, Abstract 4