Interprofessional Simulation and Improvement in Teamwork, Collaboration and Communication

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Abstract

Background: Interprofessional development and team behaviors have become a key point of interest over the last ten years. Simulation growth has influenced a variety of different settings in healthcare. Mock code simulation uses high fidelity technology and a variety of debriefing techniques. By joining the two, simulation helps assimilate knowledge demonstrating effectiveness of team dynamics. This educational approach supports students entering the workforce to be more prepared for crisis situations.

Purpose: To analyze and demonstrate mock code simulation effects on perception and team behaviors using providers, nurses, and respiratory therapists regarding teamwork, collaboration and communication. A debrief session was used between code simulations.

Design: A retrospective review with mixed method of descriptive, correlational and quantitative statistics from a convenience sample. A linear regression was used to determine effect of an overall team score (Q12).

Methods: Twelve teams comprised of providers, nurses, and respiratory therapists performed two independent mock codes. Each team was composed of n=5-10 members involving an overall total of 85. The TeamSTEPPS® questionnaire was given prior to and post each mock code for the participants (n=85). The facilitator rated video recordings of the mock code simulations using the T.E.A.M. tool. T.E.A.M. scores were compared between interprofessional teams and all-nurse teams.

Results: The TeamSTEPPS®, 30 item questionnaire had 12 significant pre-post differences ($p<0.05$), with all but one showing improvement. The T.E.A.M. tool had two significant pre-post differences out of 12 team behaviors, both showing improvement ($p<0.05$). When team behavior scores for codes one and two (12 each) were combined and compared for interprofessional presence versus all-nurse teams, 6 out of 12 teams in the interprofessional teams scored statistically significantly better than the all-nurse teams ($p<0.05$). In the same group of scores, a linear regression of an overall effect of team score on Code (one or two) and Interprofessional presence (yes/no) found that the latter was significant ($p=.004$).

Conclusion: The use of mock code simulations with subsequent debriefing can contribute to increased teamwork behaviors, collaboration and communication.

Key words: facilitator, participant, mock code simulation, high fidelity simulation, debrief, collaboration

Table of Contents

Interprofessional simulation and improvements in teamwork, collaboration and communication

Introduction

Healthcare development and focus of patient care delivery has changed over the last few years. Manser (2009) compared healthcare teams to other types of teams (i.e. the military or aviation). She stated teams are dynamic when functioning under stressful conditions or high risk outcomes; and team roles required specific competencies. One of these intense situations healthcare providers experience is cardiac or respiratory resuscitation, also called a code. Codes involve many resources, tasks and abilities to achieve a favorable patient outcome. However, the outcome is not always the desired one. To optimize the patient's positive outcome, the team needs to function together using communication, collaboration, and accomplish goal oriented tasks (Jeffries, 2012). Occasionally, team members leave a code scenario feeling a need for both individual and team improvement. Havyer, Wingo, Comfere et al. (2013) examined teamwork and if improvements were made when observing and reporting for any possible improved outcomes with simulation based training. Those simulations vary in type of situation, yet the focus for this project specifically observed simulation with interprofessional (IP) teams to demonstrate improved teamwork, collaboration, and communication with mock code simulation.

Mock codes are interactive activities that evoke thought process and provide realism. Other professions such as aviation, law enforcement, and the military use simulation within their learning environment to familiarize the participants with a specific skill. It is also intended to increased critical thinking and problem solving skills and increase goal directed behavior. Ideally, when faced with a code in reality, an individual or team trained with mock codes should feel more comfortable, and should use the critical thinking skills attained in training to intervene and to make safe patient care decisions.

Training that occurs in a realistic environment increases participant buy-in and leads to improved training results (van Schaik, Plant, Diane, Tsang, & O'Sullivan, 2001). Mannequins are used for simulation especially in academic programs or in Basic Life Support (BLS) for cardiopulmonary resuscitation (CPR) certification classes. High fidelity simulation has provided an ideal learning environment because it resembles healthcare professional's workplace (Jeffries, 2013). Current mannequins are lifelike with the ability to breathe, display dysrhythmias on the monitor, and remotely talk from another person's control (Aggarwal, Mytton, Derbrew, et al., 2010). These mannequins' exhibit realistic physiologic responses to interventions. In addition to the high fidelity environment, Van Schaik et al. (2011) speak to the importance of the environmental fidelity. Environmental fidelity is at its strongest when it resembles the learner's authentic environment and the learner can directly apply their skills. Environmental fidelity involves two components. First are physical authenticity of the setting and the tools of the person doing the task. Second is the functional authenticity of the skills or tasks as they are applied to the learner's clinical practice (Rosen, Hunt, Pronovost, Federowicz, & Weaver, 2012). Providers are more familiar with this realistic environment, are encouraged to learn from their mistakes and do not risk actual patient safety.

Simulation is a powerful learning tool and can help health professionals increase confidence and gain skills to assist in the safe provision of care (Aggarwal et al., 2010). However, Aggarwal et al. also state experienced physicians have limited access to help facilitate their student's education, particularly because code situations happen at a low-frequency. When a simulation does occur some providers managing tasks may feel inadequate to perform. As a medical student progresses through education, simulation experiences are interwoven throughout for greater familiarity with the healthcare environment and patient scenarios. Upon becoming a physician, continuation in advanced classroom training such as Advanced Cardiac Life Support (ACLS) or Pediatric Advanced Life Support (PALS) is obtained before entering the practice setting. Yet, Cappelle and Paul (1996) demonstrated that knowledge and skills were lost and returned to pre-training level within twelve months after the advanced training, particularly with skill deterioration. Nursing students, too, may have simulation woven in their course work; however, work environment simulation may not be available. Mikrogianakis et al. (2006) believe lack of training or experience translates into decreased preparedness and confidence levels proceed to an unsuccessful outcome.

Faced with critical situations, clinicians can experience breakdown in skills, confidence, teamwork, collaboration, and communication. Team member's sense tension and messages result in misunderstanding, fear and anxiety, whether intended or not. Miscommunication can cause patient errors (Institute of Medicine, 2010). However, implementing effective teamwork and collaboration supports the common goal, values of efficient patient care, and improves patient outcomes (Dillon, Noble, & Kaplan, 2009). She also elaborated on collaboration's true meaning and how it can be extrapolated from different terms. Collaboration is having a common goal within a team, understanding your teammate's skill set and roles, and appreciating what the other members contribute to that team. It is also sharing knowledge, responsibility, trust, and respect by supporting each other. Teamwork and collaboration training has improved patient safety and overall (Dillon et al, 2009; Semler et al. 2015; & Frengley et al. 2011). Thus, Dillon et al. (2009) continued to reiterate instituting a mock code simulation allowed for a safer environment promoting interdisciplinary teamwork, collaboration, and improved communication to perform the task at hand.

Theoretical Framework

The National League for Nursing (NLN)/Jeffries Simulation Framework (Figure 1) is the theoretical framework for this study. The framework consists of five components having changed slightly overtime, used by both masters and doctoral prepared students in healthcare and non-healthcare simulations. The framework is a collaborating tool in simulation and has been validated (Jeffries, 2012). The five components of the model are the facilitator, the participant, educational practices in simulation, simulation and design features, and outcomes.

Jeffries (2012) describes the facilitator role as essential to ensure the success of the simulation experience. Simulations focus on the student’s learning, the facilitator experience, and support engagement by asking probing questions by providing encouragement on how to make decisions. The facilitator helps design the simulation environment and the types of technology incorporated. Facilitators help a student gain insight and identify fears associated during the simulation. Experience and comfort level add to the effectiveness of the facilitator (Jeffries, 2012).

The participant plays a vital part in simulation and their own learning requires motivation and responsibility. Before beginning a simulation, the participant has the ground rules fully explained. Role identification is included in the ground rules and should be within the participant’s current scope of practice. Unnecessary negative feelings about the simulation could develop if filling a role outside their scope of practice. Two types of participant roles covered are response and process based. In response based roles, the participant maintains presence and control; whereas, in process based roles the participant are active in making decisions and seek out information. Jeffries (2012) also points out simulation is an ideal educational tool for millennial learners and their preference for learning involves interactive and teamwork oriented activities. Millennials, the rising generation, increasingly pervade the current workforce and education should reflect their type of learning style.

Five subsets in simulation education practices creating the framework are active listening, feedback, diverse learning styles, student-faculty feedback, and high expectations. Active listening involves an active simulation engagement (Jeffries, 2012). Feedback is an important part of the simulation process, but the facilitator decides when this feedback occurs—during, after, and how often. Feedback should not interfere with the participant's learning. The participant needs to be given the chance to make decisions throughout the simulation, act upon them and then receive timely feedback so the reflective process occurs.

Each participant's specific learning style affects information absorption. There are four types: kinesthetic, tactile, visual and auditory. It is important the facilitator puts forth effort to recognize different learning styles, and acts upon those observations to change or manipulate the simulation environment to meet those needs. The following guides were used for different learning abilities: a clock in the room with the start of a shift time for the visual learners; alarm sounds for the auditory learners; mannequin use for the tactile learner; and using specific equipment on the mannequin for the kinesthetic learners (Jeffries, 2012).

The fourth subset, student-faculty feedback, involves collaborative relationships to create positive impacts during the simulation process. The participant and facilitator can exchange constructive information leading to respect and a climate optimizing the participant's learning (Jeffries, 2012). Goal identification for participants is important and the facilitator can help establish goals prior to starting a simulation.

Objectives or information, fidelity, problem solving, participant support and cues, and reflective thinking are simulation and design features. Objectives are necessary for advancing and guiding the simulation to a desired outcome. At the beginning, participants must be given the opportunity to grasp the objectives to be prepared for the simulation.

As discussed earlier, fidelity is a degree of realism added to the simulation. High fidelity simulation offers the best option for reality for the participant. High fidelity with a mannequin is the best option in learning a skill or task necessary for real life practice. Jeffries (2012) mentions three types of realism categories—equipment, environment, and psychological. Dimensions of real life simulation evolves when the participant visualizes the mannequin breathing, can auscultate lung and heart sounds, watch the monitor for a blood pressure, pulse oximeter and heart rhythm, and palpate a pulse.

Problem solving depends on the participant's ability to comprehend and the simulation's complexity level. A participant will be challenged to think critically and problem-solve; however, the facilitator maintains attainable goals and tasks. If the simulation becomes too difficult, the participant is to receive support and cues so the simulation does not stagnate and can continue progression. If the simulation idles, the facilitator prepares cues and provides probing to the actions the participant needs to accomplish. In high fidelity simulations the mannequin provides most, if not all, of these cues.

Reflective thinking brings the simulation experience to a close. The participant and facilitator debrief on all aspects of the simulation from the beginning to the end, what should have happened, what went well and what improvements could be made. Debriefing and discussion allow for deeper reasoning and self-analysis (Jeffries, 2012).

Lastly, the final component of the NLN/Jeffries Simulation Framework was outcomes. Outcomes encompass skills performed and gained, the participant's and facilitator's satisfaction of the simulation, critical thinking and problem solving utilization, and whether the participant left with gained confidence to perform tasks or skills in the real environment. At the beginning of simulation development, outcomes should be identified, in addition to objectives. Once outcomes are met, the simulation concludes.

Literature Review

A systematic review of the literature from the 1940s to the present was conducted using four major electronic databases— OVID/Medline, CINAHL/ EBSCO Host, PsyINFO and the Cochrane Library searching for randomized control trials. Inclusion criteria were: 1) study either had primary or secondary outcome measuring teamwork, collaboration, and/or communication, 2) all healthcare bedside providers and/or medical/nursing students, and 3) high-fidelity simulation, both in situ and simulation center. Exclusion criteria were: 1) non-English language, 2) patient actors, and 3) lack of statistical measurements. Of note, quasi-experimental and observational studies were retained if there was no control group. Pre and posttest research was acceptable for this review. The terms "simulation" or "mock" were combined with "teamwork," "collaboration," and "communication" resulting in different searches for each site. The Boolean phrase AND was used throughout and MeSH terms were not used. OVID yielded 367 citations after title examination. CINAHL/EBSCO search resulted in seven articles, but all were duplicates of the OVID results. PsycINFO resulted in a total of 65 articles; however, after a review of titles none were selected. The Cochrane Library was also searched and with above combinations resulted in 255 possible articles, including randomized control trials and four were selected. Lastly, an ancestry search of the selected articles yielded ten articles for further review.

Ten articles comprised the final set of relevant studies for review (Figure 2).

The review of literature identified further research on simulation improvement of teamwork, collaboration and communication. Of the ten articles selected for a systematic review, five were randomized control trials (RCTs) (Table 1) and five were either prospective, cohort or observational (Tables 2). The five RCTs sample sizes ranged from 43 to 116 with a mixture of physicians (anesthesia, interns, and residents), nurses, and midwives. Most locations were larger facilities or academic centers—two articles were from one location and the other three had involved two to eight hospitals.

Clay-Williams, McIntosh, Kerridge, and Braithwaite (2013) study consisted of a maternity ward at an acute hospital with 94 participants enrolled. The dropout rate was almost half, leaving 60 who completed the post test. Most of the participants volunteered. This group wanted to test a crew resource management (CRM) intervention to see the effect on team improvement. Groups were randomly placed into one of four groups: Group A was a control group without training participation; Group B was classroom training only; Group C was simulation training only; Group D was classroom training followed by simulation training. Clay-Williams et al. (2013) found no significant difference between the combined groups or with teamwork behaviors in simulation.

The Frengley et al. (2011) article had 40 teams with one physician and three nurses. These authors evaluated simulation intervention improving teamwork within multidisciplinary teams. The 20 study days consisted of ten hours each. Once familiar with the simulator, the groups completed a pre-intervention for airway or cardiac simulation followed by a teamwork presentation, and discussion on teamwork failures. The result showed improvement in the pre to post intervention simulations ($p \leq 0.002$), leadership and team coordination ($p \leq 0.002$), and verbalizing situational awareness ($p \leq 0.004$). The significant theme seen within this group was the ability of the nursing staff stepping into leadership roles instead of physicians. Team reliance and communication were also noted for importance.

Rubio-Gurung et al. (2014) involved 12 level one or two maternities within a region of the AURORE perinatal network consisting of 116 professionals. The groups were split up one pediatrician to nine midwives. The randomly chosen groups had four hours in situ training sessions. All participants went through two scenarios performing as a leader and/or helper. A second evaluation was done three months after the intervention using the same scenarios. Two hundred thirty scenarios were reviewed and the intervention group performed significantly higher than the control ($p<0.001$). The authors admit to sample selection bias. This particular study was relevant to this current study because it involved IP groups; a leader was present and it used the same scenario for the first and second training allowing for a good example for consistent training. Maturation could have been a limitation.

The Vanderbilt study by Semler, Keriwala, Clune et al. (2015) consisted of 52 internal medicine intern physicians in a simulated intensive care room. The doctors compared didactic, demonstration, and simulation based methods for teaching teamwork. The didactic education included a 14 minute slide show with teamwork principles, the demonstration training involved watching a 12 minute video on pulmonary and critical care faculty acting out a simulated emergency and the simulation divided groups into three or four people. Twelve minutes were allotted prior to simulation for teamwork practice before the real simulation. The only significance noted was between the demonstration and didactic intervention ($p=0.045$). Semler, Keriwala, Clune et al. suggest demonstration and simulation have a greater influence on teamwork behaviors than didactic training even though not clearly present in data.

Weller, Torrie, Boyd et al. (2014) involved 43 anesthetists grouped with a nurse and technician from the post anesthesia care unit at two major teaching hospitals. The goal was to improve patient safety by developing communication skills especially when involved in a crisis situation. Nurses and technicians completed two simulations each with different anesthetists. Simulation A consisted of cardiovascular compromise after local anesthesia toxicity and Simulation B was hypoxia due to a pulmonary embolism. Each simulation started with familiarity of the environment followed by a debriefing. Prior to simulation, nurses and technicians were given 'probes '—unique items of clinical information. Probes were shared if the simulation remained idle. These probes aided anesthetists in the scenario; for example, a probe could reveal a patient's blood glucose or if the patient had an irregular heart rhythm. Seventy-eight percent of the time probes were successfully planted and anesthetists gained further insight compared to the control. Results showed probe sharing increased by 24% from the baseline. The only significance was probe sharing provided to the intervention group ($p<0.001$).

Of the other five studies which were prospective, cohort, or observational, three involved medical and nursing students, a level one trauma academic hospital and a pediatric cardiac intensive care unit. The sample range was 37 to 438. Dillon et al. (2009) and Miller et al. (2012) had more qualitative data findings with improved feelings towards teamwork and collaboration.

Dillon et al. (2009) involved fourth year bachelors nursing students and third year medical students in a large urban university. A pretest N of 82 students volunteered to complete the simulation and the remaining watched the recorded video of the simulation. She showed a significant difference only in the medical student groups regarding collaboration ($p=0.013$). However, only 40 completed the posttest due to scheduling conflicts.

Figueroa, Sepanski, Goldberg and Shah (2013) had an interdisciplinary team with nursing, physicians, respiratory therapists and four other categorized participants set up in a simulated pediatric intensive care unit room. The simulation used a nine hour course with a 30 minute didactic portion using a TeamSTEPPS® approach and six real life cases. TeamSTEPPS® involves using knowledge, attitudes and performance to build the skills of leadership, communication, mutual support and situation monitoring within the patient care team. In this particular article, simulations had an emphasis on teamwork and communication. Each team had six participants with attempts to have a nurse, respiratory therapists, and physician present. The facilitator controlled progression of each scenario and followed with a debrief session after each. All were asked to take a pretest, posttest, and a three month evaluation. The overall results outcome using TeamSTEPPS® was significant for closed loop communication ($p<0.05$). The study aimed for improvement in teamwork and communication. However, there may have been bias from the facilitators by working in close proximity in that environment and developing a relationship with the staff.

Hobgood et al. (2010) had 438 students, both nursing and medical from two major universities. All students completed a didactic lecture and then separated into groups. Cohort A was a high fidelity simulation composed of two hours of simulation. Cohort B was a low fidelity role-play without a mannequin. Cohort C was an audience response to didactic lecture, watched TeamSTEPPS® videos with discussion and interactive slides. Cohort D was the control group that completed a didactic lecture followed by watching the same video as Cohort C, yet without interactive slides. The next day, students were randomized by separating 110 participants into different four member groups within the original cohort. Each did a 20 minute exercise of the standardized patient. The groups were scored and blinded to the type of training they had experienced. Only 86.2% completed the data set. The participant’s attitudes toward teamwork were significant (p=0.001) in all cohorts. Yet, no significance noted between cohort groups. The authors stated a limitation was lacking confidence in use of the tool. Multiple instruments were used. Pre-knowledge scores were higher than expected and difficult to estimate the baseline for the students involved.

Miller et al. (2012) approached in situ simulation with trauma activation at a level one trauma center and were in situ. Pre intervention phase scoring happened before activation to obtain baseline data. A didactic phase discussed teamwork and communication. The in situ trauma simulation with use of a mannequin involved nursing, physicians, technicians, clerks, respiratory therapists, and pharmacists. In the design, progression of simulations became gradually more difficult, highlighting the importance for increased teamwork and communication. Debriefs followed for further comprehension and assimilation. The didactic intervention reached 80% of the department and only 25% in situ simulation finished intervention. Overall, significant scores obtained were communication (p=0.012) and direct communication (p=0.032). The convenience sample limitation to the intervention was scheduling lacked results from nights and weekends.

Reising, Carr, Shea, and King (2011) incorporated nursing and medical students, investigated the ability of a simulated model verses the traditional environment to develop interprofessional communication skills. High fidelity intervention consisted of mock code simulation using ACLS, compared to the control of a traditional roundtable without fidelity, and involved discussing a scenario. All students expressed helpfulness of the exercises and content in learning communication skills; however, no significant difference was noted between groups. Comparatively, more stress was experienced for those who partook in the simulation (p=0.000). The gathered information from the literature review shows improvement in perception and performance in teamwork behaviors, collaboration and communication by incorporating simulation separate from or in addition to didactic learning. These studies have varying sample sizes and did not meet the power analysis establishing a true effect. Attrition rate was present in a few studies. Homogeneity was present because the majority had similar characteristics the pooled studies. More research is needed in mock code simulation intervention and impact on team performance. The literature gap and limitations show tools used inconsistently to score improvements in perception or behaviors toward confidence or teamwork. Three consistent education methods are didactic, demonstration, and simulation. The research attempted does not point to one best method. Also, inconsistent sample size variance and how long the simulation training should last are unclear. Articles involved medical and nursing students and clinicians. A research revealed the focus should be current clinicians involved in crisis situations. How are these interprofessionals furthering their education and development of team dynamics and behaviors? Lastly, the majority of articles showed some form of improvement in teamwork, collaboration, and communication although a shorter valid instrument should be identified.

Purpose

The purpose for this study was to investigate the effect of a mock code simulation intervention and debriefing on teamwork, collaboration and communication perceptions.

Question

Does participation in mock code simulation sessions result in improvements in the participant's perceptions of interprofessional teamwork behaviors, collaboration and communication in code performance?

Definition of Terms (Table 3)

Facilitator: Person conducting the simulation providing structure and guidance throughout

Participant: Person who takes part in the simulation learning in order to gain or demonstrate skills and knowledge

Pre-brief: Orientation session before conducting simulation session which lays a foundation for the ground rules and sets up the clinical scenario; time to show available equipment and supplies and simulation room

Debrief: A reflective thinking process and time used for the Interprofessional team to discuss objectives, goals and outcomes of the team performance; time of self and group evaluation

High Fidelity: The use of a 3M SimMan with speaking, vital signs, and assessment finding capabilities where compression, oxygen and/or other interventions can be applied

Reliability: Measurement consistency which an instrument measures each simulation each time under the same conditions

Mock code simulation: The use of simulation with a high fidelity mannequin to perform resuscitation measures like compression, airway protection (oxygen, bag-mask, or intubation), shock and drug administration

Formative Feedback: Supportive and timely feedback communicated to participants with intent to have behavior modified in future performance

Guided Reflection: Used during the debrief, facilitator led, helps to enlighten participants to critical aspects of the simulation allowing learner to grow and assimilate knowledge gained for future practice

Collaboration: sharing a common goal, knowledge, responsibility, trust and respect; understanding a teammate’s skill set and role, having appreciation for a team; working together to produce something (Dillon et al. 2009)

Methods

Research Design

The design was a retrospective review with mixed method of descriptive, correlational and quantitative statistics from a convenience sample from four workshops provided for the nursing staff who attended the mock code simulations.

Sample Characteristics

The sample consisted of the Medical Respiratory Intensive Care Unit (MRICU) staff from a large university medical center in central Virginia. Nursing staff numbers fluctuate between 100 to 125 registered nurses, approximately 12 regularly rotated staffed respiratory therapists through to the unit, five advanced practice registered nurses (APRN), and eight pulmonary critical care fellows. Annually, the nursing team participates in a MRICU staff development workshop. At the end of the workshop, the nurses participate in a mock code simulation for a required competency evaluation.

Inclusion criteria

Registered nurses in the MRICU, respiratory therapists, APRNs and physicians at fellow levels staffed within the unit. Providers and respiratory therapists received an invitation to participate in the mock codes, but it was not made mandatory.

Exclusion criteria

Resident and intern level physicians as they were rotating the entire health system and not vested in the MRICU.

Setting/Site

The MRICU is a 28 bed unit in a university health care institution in central Virginia. The School of Nursing (SON) is affiliated with the university health care institution and has two high fidelity simulation rooms where the sessions were held.

Participants

Each group consisted of five to ten participants' per room. This group size assured each individual would have a role in the code. This meant there could have been up to four groups each workshop day for a total of eight codes conducted per workshop day depending on attendance. Optimally, each simulation group needed to have a provider, nurse and respiratory therapist. The goal was to have all three disciplines represented on each team; however, if a provider or respiratory therapist was not present that day, nursing would still proceed with the mock code simulation. Fourteen teams participated in two codes, for a total of 28 mock codes. Two teams with mock code one and mock code two had to be dropped due to not having a paired video. This resulted in 24 mock codes for review. In 12 of these, the team consisted solely of nurses, and the other 12 included at least one provider or respiratory therapist.

Physical Set Up

The simulation room contained a hospital bed, a high fidelity 3M SimMan, cameras to view participants at two angles, a code cart with the defibrillator on top and simulated vials to mimic actual code drug boxes or containers, oxygen, airway management tools (i.e. ambu-bag, intubation supplies, bite blocks). A monitor was visible to the participants for vital signs and arrhythmia changes during the code. The data were controlled by the facilitator during the simulation sessions. All teams faced the same initial conditions for mock code one and similarly for mock code two. Within the rooms, a large one way window allowed participants to be seen by facilitator during the codes but they could not see beyond. A door between the two control rooms made it easy to visualize both rooms simultaneously. The program controlling the SimMan followed an algorithm where the facilitator only had to press a begin button once the team started the code and pressed a finish button when completed. Completion between the two teams was not the same. The teams were allowed a total of 10 minutes, but could have finished earlier depending on how quickly interventions were applied to the SimMan.

Debrief

After the group completed mock code one, there was a scripted debrief (Appendix 1) that led the discussion of guided reflection and formative feedback regarding the events and process the teams just encountered. The debrief took place in a nearby private classroom with combining the two groups who just completed mock code one. The debrief functioned in a Plus Delta format where positive actions and areas for change were identified (Jeffries, 2012). The teams discussed and formulated a plan for mock code two using constructive feedback that reinforced teammates on process improvement. The facilitator posed the questions, but the participants moved the discussion forward. When the discussion was completed with a maximum time of 15 minutes, immediately the teams were brought into their respective simulation rooms for mock code two to begin. Each team could choose to switch roles between nurses and collaborated on how to proceed with interventions to improve their performance. After the second code, the TeamSTEPPS® posttest questionnaire was handed out reflecting on the two mock codes. A short final debrief was provided to each group. The total timeframe was approximately 55 to 60 minutes. When the participants completed the code and questionnaires, they were free to leave. A total of two sets of questionnaires, the pretest and posttest, were collected from each participant. The debrief was not intended to cause emotional harm, stress or anxiety and if any participant felt these emotions, they were able to leave the study freely.

Measures/Instruments

TeamSTEPPS® (Appendix 2) is a 30 question, 5- point Likert scale, self-report tool where respondents rate their agreement with items. Permission for use of the tools was obtained (Appendix 3). Attitude is measured in five categories: team structure, leadership, situation monitoring, mutual support and communication. The observations are rated on a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5). Researchers Baker, Amodeo, Krokos, Slonim and Herrera (2010) defined four of the five categories in their article. Leadership is an ability to coordinate, guide, motivate, and organize team members while maintaining a positive atmosphere. Situation Monitoring is tracking performance and ensuring proper procedure is done within the environment. Mutual Support is providing feedback and coaching; and this support guides performance improvement because a team member can detect when part of their team experiences task overload. Lastly, Communication begins with a message given to recipient from the sender then verified by recipient; essentially, a closed-loop system. Even though Baker et al. (2010) do not specifically define Team Structure, the first category of the TeamSTEPPS® tool, he says teams consist of more than one individual with specific skills and unique knowledge to perform tasks and have a common goal. These authors also state that teamwork is interaction and coordination which cannot be accomplished unless the team members collaborate (Baker et al., 2010).

The tool was developed by the Department of Defense (DOD) and the Agency for Healthcare Research and Quality (AHRQ) to improve collaboration and communication specifically related to patient safety (Baker, et al.2010). The development of this questionnaire began in 2007 as a pilot and was administered to 485 participants throughout multiple healthcare organizations (Baker et al., 2010). The coefficient ranges were calculated at 0.36 to 0.63 allowing for discriminant validity. Battles and King (2010) confirmed validity AHRQ Hospital Survey on Patient Safety (HSOPS) with a range of 0.60 to 0.79. Also, Cronbach's alpha reliability coefficients ranged from 0.88 to 0.95 displaying internal consistency with the questionnaire (Battles & King, 2010).

The Teamwork Emergency Assessment Measure (T.E.A.M.) (Appendix 4) was used to rate aspects of a group during a simulation aimed the team's effectiveness or improvement from one simulation to the next in three categories: leadership, teamwork, task management, and overall global perspective. This tool was used on the captured videos of the simulations for scoring by the facilitator. First, leadership encompassed team leader direction and overall global perspective of the situation. Teamwork involved: whether communication was being delivered effectively; was the team working together; did they maintain composure and a positive morale; and did they adapt to change and anticipate actions? Task management examined prioritization and guideline perspective and if the guidelines had been followed. The twelfth question, overall global rating, was scored based on the 'gut reaction' of the overall performance rating regarding decision making, team interaction, and accomplished tasks (Cooper et al. 2009). He developed this measure to have a valid and reliable way to measure resuscitation performance teamwork. The content validity index (CVI) after the final development of a twelve item measure was greater than 0.83, and it reached a total CVI of 0.96, a rho of 0.621-1.0, with all p values less than 0.01 (Cooper et al., 2009). The measure was confirmed to have high internal reliability with an alpha coefficient of 0.97.

Data Collection and Procedures

Participants were assigned numbers which were then written on the forms before the workshops. Only the facilitator knew the coinciding number with the participant. The forms consisted of the informed consent for participation including videotaping, the demographic questionnaire (Appendix 5), and the TeamSTEPPS® Teamwork Attitudes Questionnaire (T-TAQ) pre-test questionnaire. Participants completed the forms before orientation and returned the form for the facilitator to securely store. The identical TeamSTEPPS® T-TAQ posttest was immediately collected following the end of the workshop and placed in a manila folder maintaining confidentiality.

When the MRICU workshop education was completed, the participants came to the SON building to the pre-brief room for further instruction, checked in for attendance, and completed above mentioned forms. The orientation instruction was scripted (Appendix 6). The allotted time for the orientation was short, approximately five to ten minutes. The simulation process was explained to the participants emphasizing mutual respect, professional behaviors, confidentiality, and safety in making mistakes. Opportunity for questions or concerns was provided prior to simulation. The facilitator chose teams prior to the day using the list of attendees provided by the education committee, first by selecting a provider(s) for each team, followed by respiratory therapist and finally randomly assigning the nursing team to respective teams, one through four. Half of the non-selected nursing teams, teams three and four, waited for the next simulation round (approximately an hour later) and partook in additional respiratory education provided separately by the MRICU education committee. Prior to the first mock code simulation, orientation to the room and equipment was made available for approximately five minutes. The clinical scenario and objectives were read by the facilitator before beginning the first mock code

(Appendix 7). The first code began after orientation to the room, clinical scenario and objectives had been covered. For each simulation room, the participants simulation started by assessing the patient (SimMan) with an atrial fibrillation with rapid ventricular rate (Afib with RVR). Within two minutes, participants observed a fatal rhythm on the monitor beginning the code process. The facilitator was behind the one-way window. Both rooms were able to be viewed simultaneously without the groups seeing or hearing each other.

The high fidelity simulation via the 3M SimMan was an electronic code program including up to three different rhythms to be identified during the code. For the code to move forward in the program and the code to cease effective completion of interventions, proper compression depth and frequency, and oxygenation technique needed to take place. The group would have to start compressions, place defibrillator pads, place hard board under patient, and oxygenate with an ambu-bag the entire code. Shock would be indicated if the rhythm noted was ventricular fibrillation (Vfib) or ventricular tachycardia (Vtach). Lastly, administration of code drugs like epinephrine and amiodarone was expected per ACLS guidelines (Craig-Brangan & Day, 2015). Once these items were met per the program algorithm, the SimMan would have a pulse, return to a sinus rhythm/tachycardia and the code ended. Mock code one and mock code two were identical for each group. Codes did not last longer than 10 minutes each.

Protection of Human Subjects

The study was approved by International Review Board (IRB) at Virginia Commonwealth University and the University of Virginia before conducting the mock code simulation review (Appendix 8). Informed consent (Appendix 9) was obtained from participants regarding disclosure allowing use of their data, including use of videography and was written to be understandable and honest. The facilitator kept assigned numbers confidential during study’s entirety and all documents were collected maintained in a secure envelope locked in a safe at the facilitator's home. The videos are kept in a secure database provided by the SON and can only be accessed by the facilitator's secure login. Participants were not faced with coercion or forced to complete pre or posttests. The tests were made to be completely optional. The debrief script was provided and deception was not part of the study; all information would be given if or when requested. Approval was obtained by the simulation lab director (Appendix 10).

Data Analysis

Microsoft Excel (2010) data were imported into IBM SPSS (version 23) for quantitative data analysis in coordination with a statistician (IBM, 2015). Demographic data were analyzed for descriptive statistics. Originally, data were collected from 88 participants; however, due to lack of consent, three dropped out, leaving a set of 85 for analysis.

The completed pre and posttest (N=85) for the TeamSTEPPS® tool were entered into Excel using a 5- point Likert scale─ one "strongly disagree," two "disagree," three "neutral," four "agree," and five "strongly agree" before importing into SPSS. The TeamSTEPPS® questionnaire had four of the 30 items that were stated in a negative sense (questions 20, 21, 24, and 30). These questions were reverse coded. Paired sample *t*-tests were performed for each of the 30 question pre-post pairs. One participant's variables were missing from pretest questions one through eleven.

The facilitator completed the T.E.A.M. tool for each mock code, with n= 24 videos. The facilitator conducted all scoring with consistency and randomization by selecting videos to watch to diminish video bias of mock code one and mock code two. T.E.A.M. questions one through eleven were based on a 5- point Likert scale. Zero was "never/hardly ever," one "seldom," two "about as often as not," three "often," and four "always/nearly always". Question twelve was an overall score of how the team performed defined by one "poorly" through ten "outstanding."

T.E.A.M. data from the 24 videos were analyzed in three ways. First, the scores from mock code one and mock code two were compared using paired *t*-tests or Sign tests on questions one through twelve. Second, the Wilcoxon Signed-Rank test was used because distributions did not satisfy the independent *t*-test. It compared the presence of a provider and/or a respiratory therapist on a team verses teams of all registered nurses and their effect on team behaviors and effectiveness. Lastly, a linear regression compared the dependent variable of the overall score (Q12) to estimate the effect of a predictor if the other was controlled. The predictors were limited to two—Code (mock code 1 or mock code 2) and Interprofessional team (a provider or respiratory therapist present or all registered nurses).

Results

Demographic variables are displayed below (Table 4). The sample size was an N =85. The sample was predominantly female (90.5%). When combining the first two age groups, (20-25 and 25-30 years), over half represented were registered nurses (56.5%). Two to five years was the common number of nursing experience (24.7%) as well as the years of ICU experience (27.1%). Seventy-eight (91.7%) of participants were registered nurses, three (3.6%) were providers (one APRN and two physicians), and four (4.7%) respiratory therapists. Fifty-two of the participants were ACLS certified (61%) and 69 had previously been involved in simulation training (81.2%) (Table 4).

Table 4

Demographic Data (N=85)

Gender	n (%)
Female	77 (90.5)
Male	8 (9.5)
Age Range	n (%)
20-25	23 (27.1)
26-30	25 (29.4)
31-35	9 (10.6)
36-40	9 (10.6)
41-45	4 (4.7)
46-50	9 (10.6)
50+	6 (7)
Years of Nursing Experience	
Less than 6 months	10 (11.8)
6 months to <1 year	5 (5.9)
1 to <2 years	15 (17.6)
2 to <5 years	21 (24.7)
5 to <10 years	13 (15.3)
10 to <15 years	9 (10.6)
15 to 20 years	4 (4.7)
20+ years	8 (9.4)

Years of ICU Experience		
Less than 6 months	14 (16.5)	
6 months to <1 year	8 (9.4)	
1 to <2 years	15 (17.6)	
2 to <5 years	23 (27.1)	
5 to <10 years	6 (7.1)	
10 to <15 years	9 (10.6)	
15 to 20 years	3 (3.5)	
20+ years	7 (8.2)	
Profession	n (%)	
Registered Nurses	78 (91.7)	
Providers	3 (3.6)	
Respiratory Therapist	4 (4.7)	
Previous Participation	yes (%)	no (%)
ACLS	52 (61.2)	33 (38.8)
Simulation training	69 (81.2)	18 (18.8)

TeamSTEPPS® Data

The results of the paired sample *t*-tests for each of the 30 question items found 12 questions were statistically significant ($p<0.05$). Eleven of the 12 showed improvement in mean scores from pre- to post-, while one (Q2) had a significant negative change. The *p*-value for the test was in the .05-.09 range for six additional questions (Q6, 10, 19, 24, 26 and 30). Only Q2 had a mean score drop from pre- to posttest. Of the 30 questions, mean scores increased from pretest to posttest for 21 of the questions (Table 5).

Table 5

Pre to post test results of the TeamSTEPPS® T-TAQ, by question item

Question		Pretest	Posttest	Mean Increase	*t*	df	*p*
	N	M (SD)	M(SD)				
Team Structure							
Q2: patients are part of team	84	4.81	4.69	-0.12	-2.424	83	0.018*
Q3: administration influence	84	4.24	4.39	0.15	2.07	83	0.042*
Q4: team's mission > individual	84	3.94	4.29	0.35	3.632	83	0.000*
Leadership							
Q9: honest mistakes	84	4.67	4.77	0.1	1.999	83	0.049*
Situation Monitoring							
Q13: scan the environment	85	4.39	4.62	0.23	3.446	84	0.001*
Q14: monitoring patients	85	4.54	4.67	0.13	2.001	84	0.048*
Q15: report changes	85	4.46	4.6	0.14	2.647	84	0.01*
Mutual Support							
Q22: offering to help	85	4.4	4.52	0.12	2.291	84	0.024*
Q23: assert patient safety concerns	85	4.54	4.67	0.15	2.252	84	0.027*
Communication							
Q27: adverse events	85	4.35	4.48	0.03	2.082	84	0.04*
Q28: ask questions	85	4.15	4.42	0.27	3.581	84	0.001*
Q29: standardized methods	85	4.18	4.4	0.22	3.204	84	0.002*

*$p\leq0.05$, two-tailed

T.E.A.M Data

This tool was used on the videos taken of the mock code simulations. It was scored based on team behaviors and effectiveness. The paired sample *t*-test compared the mean T.E.A.M. question scores for the two codes (mock 1/mock 2) for 8 of the 12 T.E.A.M. questions. Two of the questions score changes were significant ($p<0.05$) (Table 6). There were only 12 teams, so the distributions of the changes in the question scores had to be close to normal in order to apply the paired-sample *t*-test, which restricted the use of the test to 8 items.

Table 6

Paired t-test comparison T.E.A.M. question scores for mock code 1/mock code 2

Question	N	mock 1 Mean (SD)	mock 2 Mean (SD)	Mean Change	*t*	df	*p*
3	8	2.75 (.622)	3.42 (.669)	.667 (.985)	2.345	11	.039*
7	8	3.08 (.669)	3.75 (.452)	.667 (.888)	2.602	11	.025*

N=12; *$p\leq0.05$, two-tailed

Four questions were excluded from the analysis due to distributional requirements for the paired *t*-test for small samples. The non-parametric Sign test was used to test changes in questions four (p=.344), five (p=.453), eight (p=.453) and nine (p=.344). These tests were not statistically significant ($p<0.05$). In order to investigate the effect of the IP presence on the team's performance, the 24 T.E.A.M. code scores, combining mock codes 1 and 2, were divided into two groups. Group one (Interprof 0) was composed of code scores from the teams with only registered nurses (n=12) and Group 2 (Interprof 1) was composed of code scores from teams that included a provider and/or respiratory therapist in addition to registered nurses (n=12) (IP team). Differences between question scores from the two groups were tested using Independent *t*-test analysis for Q12 (the overall score) and the Wilcoxon Rank Sum test for questions 1 through 11. Question 12, the global score, the IP mean score ,8.50, was significantly greater than the all-nurse mean score of 7.08 (p=.007). The distributions for questions 1 through 11 of the two groups did not satisfy the normality assumption of the Independent *t*-test; therefore, the Wilcoxon Rank Sum test was used. For all 11 questions, the mean rank of the IP team scores was higher than the mean rank of the all-nurse team scores. Questions with significance were 1 (*p*=.005), 2 (*p*=.007), 9 (*p*=.020), 10 (*p*=.024), and 11 (*p*=.028).

A linear regression of T.E.A.M. Question 12, the global score, on both Code (mock 1 or mock 2) and Interprof (1=IP team and 0=all-nurse) was performed. The model was significant (p=.004) with the adjusted R-square of .35.

Table 7

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std Error	Beta			Lower	Upper
(Constant)	5.708	0.737		7.747	0	4.176	7.241
1 Code	0.917	0.444	0.347	2.063	0.052	-0.007	1.841
Interprof	1.417	0.444	0.536	3.188	0.004	0.493	2.341

Dependent variable: Q12=overall team rating

In the bivariate test, the *p*-value was .144 for Q12 verses Code. The regression shows that when Interprof is taken into account, or controlled, Code came close to significance (*p*=.052). The estimated effect of the code being Code 2 as opposed to Code 1 increased the mean of Q12 by .92 points. The regression also shows the effect of the Interprof group on Q12 remains significant when Code is held constant (*p*=.004). The estimated effect of having IP teams increased the mean by 1.42 (Table 7).

Discussion

Demographics

The majority of participants were female. This representation was not unexpected in the medical field, particularly in nursing. The participants in this study were both young in both nursing and ICU experience. A vast majority (81%) had prior simulation experience in a mock code setting, which could have created a bias when performing this mock code simulation because previous experiences could have created a positive or a negative perception. Sixty-one percent were ACLS certified. As previously mentioned, knowledge and skill retention is diminished or lost if not used regularly (Cappelle & Paul, 1996). The registered nurses participate in mock code simulation annually and would need to have exposure in a real code to effectively maintain those specific skills in the interim. It is unknown when the participant received certification to truly appreciate if skill deterioration could have affected their performance and perception during these mock codes. It might be helpful in the future to investigate more detail to these questions.

TeamSTEPPS®

In the Team Structure category, (Q2) participant's perceptions of patients were not a critical component of the team, demonstrated a statistically significant negative mean change from mock code 1 to mock code 2. Patient involvement of the team has evolved over the last few years and has become important to the healthcare team dynamic. This group's results did reflect differently. The rationale could be that the SimMan was not viewed as a live patient, the simulation was not real as he did not respond as a normal patient, or the teams decided other aspects of the simulation took precedence. The participant's perception mean score increased significantly with facility's administration can influence direct success of team (Q3) and a team's mission is of greater value than the goals of the individual team members (Q4). Collaboration is demonstrated here because teams need administrative support and shares a common goal that is valued higher than an individual's goal. By the increased attitude and perception of the mean, exhibited this group's grasp the importance of a team mission and goal, thus illustrating collaboration.

In the Leadership category there was one significant change— effective team leaders view honest mistakes as learning opportunities (Q9). By having leaders who understand simulation and its emotional safety grants participants' freedom to make mistakes and errors. Simulation provides education shaping leaders to have this quality. All participants are encouraged to learn from mistakes. The debrief session is an ideal time for discussion, constructive critiques or formative feedback, and goal setting before attempting the simulation again. If an error or mistake occurred, was addressed in the debrief, then not only does the individual recognize the importance of preventing it again, but the team is also aware.

The third category, Situation Monitoring, had three questions related to significant changes. First, participants can be taught to enter their environment scanning for important situational cues (Q13). Mock code simulation teaches observation to detail. A simulation contains tools and items supporting the participant's actions, i.e. administering medications or oxygen. Secondly, monitoring the patient provides an important contribution to effective team performance (Q14). When the team saw a blue light from the SimMan's mouth, representing decreased oxygen levels, or hypoxia, participants were cued into administering supplemental oxygen. In addition, the SimMan provided important data to act upon to bring the simulation to its conclusion. The third significant change involved the importance for individuals to scan and report any changes even if individuals were not directly involved in direct care of a patient

(Q15). For example, a nurse would not walk by a patient's room and ignore a patient struggling to breath, but would go into the room providing assistance or immediately notify the nurse caring for them. Overall, this mock code simulation demonstrated improvement in situational awareness.

The fourth category, Mutual Support, had two questions with significant changes—offering help to another team member's individual work tasks is an effective tool for improving team performance (Q22) and the importance of asserting patient concerns until the individual is certain it has been addressed (Q23). The participant's perception increased significantly reflecting teamwork can improve as a result of codes. Caring for a sick patient can be difficult for one person to do and help from your team mates can increase positive team behaviors. For example, members of a group with a small sample size (n=5) had to assist each other during the codes performing multiple tasks. Patient safety is a priority. Mock code simulation can help improve participants' assertiveness in code situations identifying tasks that need to be accomplished and empowers the participant to be assertive to give that direction. This can be done is a calm and respective manner. The team's effectiveness could be compromised if mutual support was a not priority. Performing chest compressions is extremely tiresome, and after two minutes of this task one becomes exhausted and performance decreases effects of patient outcomes.

The Communication Category had three significant changes. First, adverse events may be reduced by maintaining an information exchange with patients and their families (Q27). For example, before a nurse administers a medication, they state what would be given allowing the patient or family to question rationale. This allows for a crosscheck and an additional layer of protection. Similarly, a code team member states what task they were about to perform allowing for team members, or leaders, to recognize or accept the statement. Second, mock code simulation can improve team member's questioning attitudes when they prefer to work with team members who ask clarifying questions about information provided (Q28). Third, standardized methods to patient hand off and information sharing is important (Q29). Mock code simulation can improve use of standard methods when handing off patients. Codes require communication. If a person does not clearly verbalize their actions and rationale, the team can become confused. Confusion can lead to frustration and a less than optimal outcome or even patient error (Reader, Flin, & Cuthbertson, 2007).

T.E.A.M. Data

A paired *t*-test compared mean T.E.A.M. scores from mock code 1 to mock code 2. The T.E.A.M. instrument was separated into four categories: Leadership, Team Work, Task Management, and Overall Score. Four questions were excluded from the paired *t*-test because of the normality assumption of the test was not satisfied. The results for the paired *t*-tests showed significant improvement in the Team Work category that the team communicated effectively (Q3) and the team adapted to changing situations (Q7). There were no other significant changes in the other categories for this test. The mock code simulation demonstrated an improvement in teamwork and communication because effectiveness scores increased.

There was some evidence of improvement (*p*-value between .05 and <.10) in the team prioritized tasks (Q10) and the team followed approved standards and guidelines (Q11) from the Task Management category. The tool did not specifically state what standard or guideline, but the teams were scored based on the ACLS guidelines for resuscitation. The teams demonstrated improvement in recognizing rhythm changes and performed a task specific for that rhythm. The team asked questions, relayed ideas, and stated tasks completed. Teams recognized if shock was indicated, when chest compressions were not as effective or that it was timing for the next medication.

Tests were also conducted comparing the T.E.A.M. score of IP groups to those of nursing groups. This resulted in six significant differences between the groups. Rejection of the null hypothesis and examination of the ranks of the score showed IP teams were more likely to have higher scores than uni-professional teams. Improvement grew as the mock code progressed. Significance was noted in all four categories within the T.E.A.M. tool.

The Leadership Category included the leader knew what was expected and gave appropriate direction (Q1) while also having global perspective of the situation (Q2). Typically, the leader is assigned at the beginning of a code, or claims to be the leader. This leader chooses a position in the room that will provide them with the best view of everyone present, including the patient. The leader needs to see the monitor, give orders, ask questions, and see if the interventions are working. The team leader in these groups was either designated at the beginning or assumed the role as the code began. The group's scores reflected improvement of behaviors and effectiveness of this leader throughout mock code 1 to mock code 2.

In the Team Work Category, IP teams tended to score higher on teams anticipated actions (Q9). By having ACLS certification, a participant can expect the sequence or typical pattern of a code. Certain rhythms or timeframes call for different but specific actions. These teams' behavior mean increased from code 1 to 2 as the participants became either more familiar or comfortable with the actions—especially considering the code program was identical.

In the Task Management Category, IP teams tended to score higher in prioritizing tasks (Q10), and following approved standards and guidelines (Q11). The leader role was clearly defined, roles were assigned, and task performance was greater in the IP group. Again, if a participant had ACLS experience this may have influenced their knowledge of the standards and guideline and instituting the appropriate task. This group had 61.2% of individuals ACLS prepared.

The mean Overall global score on non-technical performance (Q12) was significantly greater for IP teams than for all-nurse teams confirming the positive influence on performance from having multiple professions present. A linear regression of Q12 confirmed this positive effect on IP presence and Code. The regression did show strong evidence in improved team behaviors from mock code 1 to mock code 2.

Strengths and Limitations

The study's strengths was the sample size (*N*= 85). The facilitator was a registered nurse in the MRICU and coordinated with the education committee for the mock code simulation. This potential bias was reduced by random assignment of the nursing staff. By removing this threat of bias, internal validity could be demonstrated. Lack of maturation was a strength because the study reviewed tests and videos after completion of the mock codes and did not re-evaluate participants later in time. Additionally, using a realistic target population within the healthcare field for simulation specifically current practicing providers was optimal. Registered nurses, providers and respiratory therapists can directly affect patient outcomes and mock code simulation can influence of the care provided. The target population is similar to other healthcare samples and subjects resulting in generalizability, or external validity. Generalizability is critical and influential in evidence based practice because it helps future nurses to determine if the study could be applied to other populations and identify best practice (Schmidt & Brown, 2009).

Additional strengths included support from the nursing unit's management team for collaboration and the staff continually being involved in simulations. The SON clinical simulation director graciously made the Clinical Simulation Lab (CSL) and her technician readily available for the MRICU staff to participate in simulation, all inclusive of the program, electronics, SimMan, and extra rooms to house the staff.

The TeamSTEPPS® tool was a reliable resource for testing this group size; however, when analyzing the data, it was noted that the participants may have not clearly read the question or gave responses without true comprehension or opinion was a limitation. The facilitator acknowledged the possibility the participants may not completely read or answer questions as the majority of their peers. Another limitation was the TeamSTEPPS® had a ceiling effect, meaning there was little or no room for improvement on high values from the first set of answers. Participant's exposure to the pretest may have influenced how they responded to the posttest.

The T.E.A.M. limitation was having two groups created a smaller sample size (n=12) making the statistical methods dependent on the distributions of the variables. An increased sample size may influence the results. An additional variable was that the participants were unpaid as well as the physical distance of the Simulation lab from the nursing units.

Practice Implications

Healthcare simulations are the future because they offer realism, clinical relevance and availability, and can influence a novice clinician to gain experience with lifelike scenarios. Mock code simulations are one aspect of simulation training in medical and nursing schools and in the workplace. These simulations can be timely and safe for staff to perform when provided the useful tools, space, and instruction. The debrief session impacts knowledge assimilation and is recommended in coordination with simulation (Jeffries, 2012).

This study demonstrated simulation can be an opportunity for nursing units to work in a collaborative process with vital IP team members. Ultimately, this mock code simulation demonstrated improved team behaviors. Teams need to collaborate and provide support to reach common goals of improved outcomes and patient safety. Nursing's role and influence in the healthcare arena can lead the way by facilitating activities that bring IP teams together.

This study demonstrated the use of mock code simulation can improve teamwork behaviors, collaboration, and communication. Teamwork behavior improved in offering to help others and anticipating actions within the task the team is involved. Collaboration was shown by having a team's mission greater than their own, also by anticipating other's needs, helping with patient's that are not under your direct care and by scanning the environment. This collaboration translates into the workforce creating a climate change for decreased patient errors, patient safety, and possibly improve patient outcomes (Dillon et al., 2009; Havyer et al, 2013; IOM, 2010; & Mikrogianakis et al, 2006). Communication can be effective and improved by reporting changes in the environment, asserting patient concerns, and maintaining constant information exchange. Simulation can move education to a new level with realism in clinical scenarios by using a high fidelity simulation (Jeffries, 2012). Nursing can impact a huge part of that responsibility and can lead this change in IP team behaviors. Mock code simulation can be a difficult skill that requires IP buy-in and being able to have availability to efficiently work together as clinicians can be critical in a crisis/code not seen on a regular basis.

Future research could include more current practicing teams already existing within an institution. Then organize mock code simulations to have a mock code 1, debrief, and mock code 2. When including a debrief, a team can reflect and give timely feedback. A tool should be used that is not cumbersome and confusing if participants do not accurately interpret the questions.

Conclusion

The use of mock code simulation with current practicing healthcare teams can demonstrate increase teamwork behaviors, collaboration and communication within IP teams. The participant's perceptions improved in team structure, leadership, and largely in situational monitoring, mutual support and communication. IP teams demonstrated improved behaviors in leadership, teamwork and task management. The recommendations for future simulations is to continue providing it within current practice IP teams and explore other tools for validation. Simulation continues to be a valid mechanism for enhancing mock codes. Data shows that there was improvement in all categories

Products of the DNP Scholarly Project

The results will be reported to an open forum for defense of the Doctorate of Nursing Practice (DNP) degree. According to author guidelines of Clinical Simulation in Nursing, the official journal of *The International Nursing Associates for Clinical Simulation Learning* (INACSL) and the Association of Standardized Patient Educators (ASPE) (Appendix 11), a manuscript for publication was produced after the DNP project completion (Appendix 12). The study submitted an abstract to the American Association of Critical Care Nurses (AACN) local Richmond, Virginia Odyssey conference in March of 2017 and presented a poster displaying results of the study and how it can be applied to practice in other units or locations.

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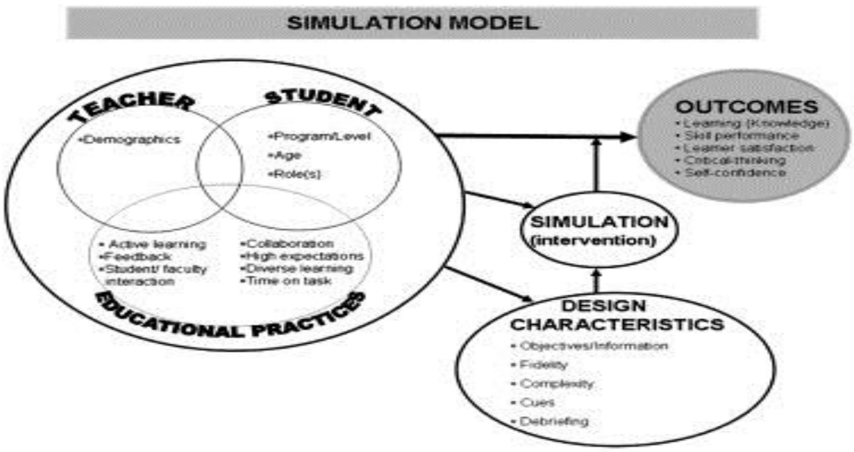
Figure 1.

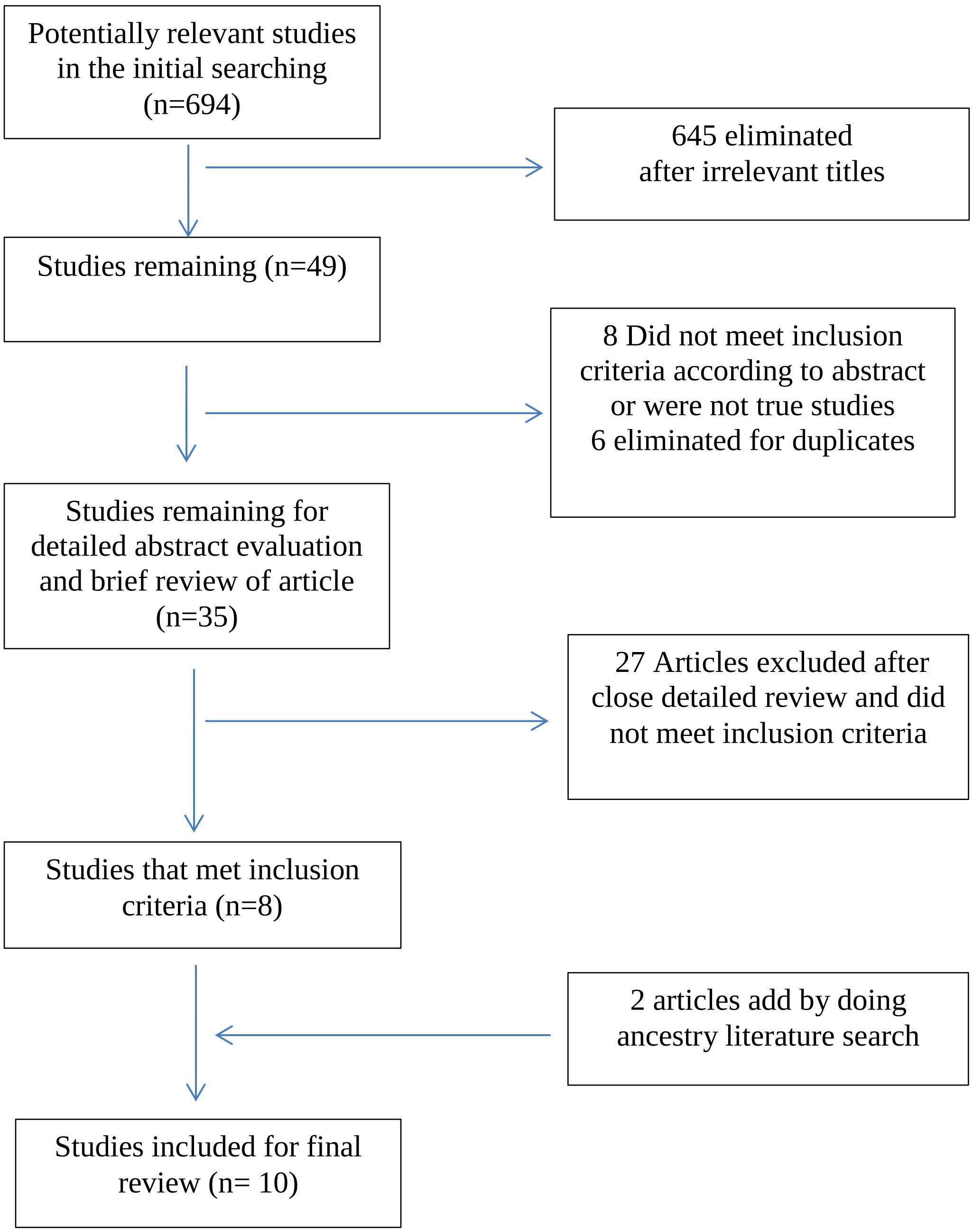
National League of Nursing/Jefferies Simulation Framework Model



(Jeffries, 2012)

Figure 2.

Inclusion flow chart



Developed by Lisa Milam (2016)

Table 1

Randomized Control Trials

Author	Subjects and Setting	Purpose	Study design	Intervention and comparison	Measures	Statistics	Key Findings
Clay-Williams, McIntosh, Kerridge, & Braithwaite, (2013)	n=94 doctors, nurses, and midwives pre-intervention. n= 60 completed post-intervention. Area Health Service in New South Wales, Australia acute hospital settings of five hospitals from 75 to 640 beds	To test crew resource management (CRM) intervention to improve teamwork	RCT	Randomly placed into one of four groups--Group A=control group with no training participation; Group B= class room training only; Group C= simulation training only; Group D= classroom followed by simulation training	Mayo High Performance Teamwork Scale (MHPTS)	A negative significant different found in the classroom vs control group (mean diff 15.60, 95% CO 6.18-25.02, p=0.002).	Over the course of the trial the sample went from 157 to 75--almost half of the sample lost.
Frengley, Weller, Torrie, Dzendrowskyj, Yee, Paul,	n= 40 teams consisting of one doctor and three	Evaluate simulation intervention on improving	Self-Controlled randomized crossover	Study allows for equal time with simulator. Over 20 study	Teamwork Behavior Rater	Overall, teamwork showed improvements	Importance to rely on teams and not individuals;

Author	Subjects and Setting	Purpose	Study design	Intervention and comparison	Measures	Statistics	Key Findings
Shulruf, & Henderson, (2011)	nurses. Simulated critical care ward with a high fidelity simulator within a university simulation center	teamwork in multidisciplinary critical care teams	with blind assessors	days/10 hours each. Each group did pre-intervention then a post-intervention simulation of either cardiac and one airway		in the pre to post-intervention simulations $p \leq 0.002$	enhanced communication
Rubio-Gurung, Putet, Touzet, Gauthier-Moulinier, Jordan, Beissel, Labaune, Blanc, Amamra, Balandras, Rudigoz, Colin, & Picaud, (2014)	n=12 maternity units consisting of 116 professional from Level 1 and 2 AURORE perinatal network; each maternity had 1 pediatrician and 9 midwives	Evaluate if an in situ high fidelity simulation training program would improve efficacy in staff performance; teamwork was a third aim.	Multi-center randomized control trial	I: 6 groups randomly chosen had a 4 hour in situ training session with Sim New B. A second evaluation was completed three months after the intervention using the same scenarios. C: did not complete 4 hour session	Team Emergency Assessment Measure	After the training, the intervention was significantly higher than control (19.9 {13.3-25.0} vs 31.1 {20.8-36.8}, $p<0.001$)	High fidelity simulation in the delivery room improved teamwork skills. No difference was noted between the control groups for level 1 or 2.

Author	Subjects and Setting	Purpose	Study design	Intervention and comparison	Measures	Statistics	Key Findings
Semler, Keriwala, Clune, Rice, Pugh, Wheeler, Miller, Banerjee, Terhune, & Bastarache, (2015)	n=52. Vanderbilt University's Center for Experiential Learning and Assessment facility; two classrooms and three simulation suites set up like an ICU room. All incoming internal medicine interns	To compare didactic, demonstration based and simulation based methods for teaching residents teamwork.	Single center, observer-blinded randomized control trial	All randomized via a 1:1:1 ratio. Didactic training, Demonstration training, and Simulation training. Three hours after training, evaluation simulation was completed	Teamwork Behavior Rater	Significance was noted to be higher in the demonstration group vs the didactic group (p = 0.045), but any other combination did not show significance. Simulation had a trending of improvement whereas didactic did not.	Demonstration and simulation regarding teamwork training have a greater influence in teamwork behaviors than didactic training.
Weller, Torrie, Boyd, Frengley, Garden, Ng, & Frampton, (2014)	n=43 anesthetists working with PACU nurse and technician from 2 major teaching hospitals.	To improve patient safety by improving communication in a crisis	Randomized, blinded pre and post-test	Subjects completed two simulations each with a 3G SimMan.	SNAPPI call out score	Probes were successfully planted 78% (60-91%) of the time; anesthetists learned on average 27% (10-49%)	Probe sharing increased by 24% from baseline

Author	Subjects and Setting	Purpose	Study design	Intervention and comparison	Measures	Statistics	Key Findings
	Final sample was n=40					from the probes given.	

Table 2.

Prospective, Cohort, Observational

Author	Subjects and Setting	Purpose	Study design	Intervention and comparison	Measures	Statistics	Key Findings
Figueroa, Sepanski, Goldberg, & Shah (2013).	n=37 (23 nurses, 5 physician trainees, 5 respiratory therapists, and 4 uncategorized participants. Occurred off site in Memphis, TN with three rooms set up like a Pediatric Cardiac ICU using exact equipment	Multi-disciplinary training improves teamwork, collaboration and confidence	observational cohort	A didactic portion. Six real life cases. Simulations had emphasis on teamwork and communi-cation. All were asked to take a pretest, posttest and a three month evaluation.	Team-STEPPS	Outcome was significant ($p < 0.05$) for close loop communi-cation	There is still a need to further assess and evaluation the use of simulation with specific populations and teams.
Dillon, Noble, & Kaplan (2009)	Fourth year Baccalaureate nursing students and third year medical students. Large, urban university. n= 82 pre-test; n=	Identify student's perceptions of interdisciplinary collaboration by the use of simulation	pretest/post-test design	I: mock code learning exercise, used a high-fidelity simulator C:Those who did not participate were able to view the tape	The Jefferson Scale of Attitudes Toward Physician Nurse Collabor-ation	Significant difference was noted in medical students for collaboration $F(1,7) = 7.38$, $p = 0.013$	Half of sample did not complete test. The qualitative data from medical students appreciated nursing's role

Author	Subjects and Setting	Purpose	Study design	Intervention and comparison	Measures	Statistics	Key Findings
	40 posttest completion			recordings of simulation			
Hobgood, Sherwood, Frush, Hollar, Maynard, Foster, Sawning, Woodyard Durham, Wright, & Taekman (2010).	n=438 students (235 fourth year medical and 203 final semester nursing); four health professional schools at two major universities	Improve care and patient safety by using teamwork training enhancing communication	Randomized assignment placed into 4 cohorts	All students completed didactic lecture. Cohort A--high fidelity simulation; Cohort B--low fidelity role play with no mannequin; Cohort C--audience response didactic; and Cohort D--didactic lecture (CONTROL)	Four instruments used: 36 item CHIRP-Teamwork Attitudes, 12 item Teamwork Knowledge, 10 item Standardized Patient Evaluation, and 20 item Mayo High Performance Teamwork Scale (MHPTS).	Participants attitudes toward teamwork (F_{3370}=48.7, p = 0.001)	Multiple instruments utilized; and lack of confidence in the use of the TeamSTEPPS instrument in scoring behaviors so results may not be accurate.

Author	Subjects and Setting	Purpose	Study design	Intervention and comparison	Measures	Statistics	Key Findings
Miller, Crandall, Washing-ton, & McLaugh-lin (2012).	n=39 trauma activations; Level 1 trauma center/academic center	In situ trauma simulation implementation in the emergency department would improve teamwork and communication	Observational study with convenience sample	Pre-intervention phase-- scoring baseline data. Didactic phase-given lecture and discussion of teamwork and communication; in situ trauma simulation (ISTS)--real trauma activation scores	Clinical Teamwork Scale	Scores that remained significant through the decay phase was overall communication ($p = 0.012$) and directed communication ($p = 0.032$)	Observer variability, insufficient power and communication did show improvement.
Reising, Carr, Shea, & King (2011)	n=41 senior bachelor nursing students and n=19 second year medical students; 30 participants were in each group	Investigate the ability of a simulated vs traditional environment to develop interprofessional communication skills	Prospective descriptive survey including quantitative and qualitative data; using a convenience sample	I: high fidelity simulation mock code in advanced cardiac life support (ACLS) scenario; C: traditional roundtable (no fidelity) which was discussion of scenario; both had facilitators	Instrument not mentioned; used a tool called Jefferies Model	More stress was experienced by those who did the simulation ($p = 0.000$) compared to roundtable.	The intent of the study was to show improved communication, but it showed that stress was a huge component.

Table 3.

Definition of Terms (Meakim et al., 2013)

Facilitator	Person conducting the simulation providing structure and guidance throughout	**Reliability**	Measurement consistency which an instrument measures each simulation each time under the same conditions
Participant	Person who takes part in the simulation learning in order to gain or demonstrate skills and knowledge	**Mock code simulation**	The use of simulation with high fidelity mannequin to perform resuscitation measures like compression, airway protection (oxygen, bag-mask, or intubation), shock and drug administration.
Pre-brief	Orientation session before conducting simulation session which lays a foundation for the ground rules and sets up the clinical scenario; time to show available equipment and supplies and room the simulation will be performed	**Team STEPPS Teamwork Attitudes Questionnaire**	Tool used for pre and posttest; a 30 item teamwork attitudes questionnaire that has five categories with a specific set of questions regarding team structure, leadership, situation monitoring, mutual support and communication.
Debrief	A reflective thinking process and time used for the interprofessional team to discuss objectives, goals and outcomes of the team performance; time of self and group evaluation.	**Team Emergency Assessment Measure (TEAM)**	Tool used by facilitator to rate team regarding aspects of the group during a simulation to the team's effectiveness or improvement specifically leadership, team work and task management
High Fidelity	The use of a 3M SimMan with speaking, vital sign, assessment finding capabilities where compression, oxygen and/or other interventions can be applied.	**Formative Feedback**	Supportive and timely feedback communicated to participants with intent to have behavior modified in future performance
Collaboration	sharing a common goal, knowledge, responsibility, trust and respect; understanding a teammate's skill set and role, having appreciation for a team	**Guided Reflection**	Used during the debrief, facilitator led, helps to enlightened participants to critical aspects of the simulation allowing the learner to grow and assimilate knowledge gained for future practice.

Table 5-*Pre to post test results of the TeamSTEPPS® T-TAQ, by question item*

Question	*N*	Pretest M (SD)	Posttest M (SD)	Mean Increase	*t*	df	*p*
Team Structure							
Q1: feedback on patient care	84	4.69	4.69	0	0	83	1
Q2: patients are part of team	84	4.81	4.69	-0.12	-2.424	83	0.018*
Q3: administration influence	84	4.24	4.39	0.15	2.07	83	0.042*
Q4: team's mission > individual	84	3.94	4.29	0.35	3.632	83	0.000*
Q5: anticipate needs	84	4.48	4.57	0.09	1.379	83	0.171
Q6: high performing team	84	4.31	4.46	0.15	1.885	83	0.063^
Leadership							
Q7: leaders to share	84	4.82	4.85	0.03	0.575	83	0.567
Q8: informal opportunities	84	4.6	4.68	0.08	1.54	83	0.127
Q9: honest mistakes	84	4.67	4.77	0.1	1.999	83	0.049*
Q10: model behavior	84	4.86	4.77	0.09	-1.975	83	0.052^
Q11: discuss plans	84	4.62	4.65	0.03	0.575	83	0.567
Q12: team members help	85	4.73	4.79	0.06	1.043	84	0.3
Situation Monitoring							
Q13: scan the environment	85	4.39	4.62	0.23	3.446	84	0.001*
Q14: monitoring patients	85	4.54	4.67	0.13	2.001	84	0.048*
Q15: report changes	85	4.46	4.6	0.14	2.647	84	0.01*
Q16: emotional and physical of others	85	4.53	4.61	0.08	1.305	84	0.195
Q17: offer assistance	85	4.66	4.56	0.1	-1.269	84	0.208
Q18: emotional and physical of self	85	4.6	4.55	0.05	-0.684	84	0.496
Mutual Support							
Q19: understand the work	85	4.52	4.65	0.13	1.738	84	0.086^
Q20: asking for assistance**	85	4.44	4.19	0.25	-1.434	84	0.155
Q21: providing assistance**	85	4.45	4.25	0.2	-1.298	84	0.198
Q22: offering to help	85	4.4	4.52	0.12	2.291	84	0.024*
Q23: assert patient safety concerns	85	4.54	4.67	0.15	2.252	84	0.027*
Q24: personal conflicts and safety**	85	4.2	3.93	0.27	-1.792	84	0.077^
Communication							
Q25: committing errors	85	4.65	4.69	0.04	0.942	84	0.349
Q26: poor communication	85	4.24	4.4	0.16	1.717	84	0.09^
Q27: adverse events	85	4.35	4.48	0.03	2.082	84	0.04*
Q28: ask questions	85	4.15	4.42	0.27	3.581	84	0.001*
Q29: standardized methods	85	4.18	4.4	0.22	3.204	84	0.002*
Q30: impossible to train**	85	4.25	3.94	0.31	-1.937	84	0.056^

*p<0.05, two-tailed; ^p<0.1, two-tailed; **questions were reverse coded

Appendix 1

Debrief Script

Debrief Script

Thank you for completing mock code 1. We are now going to discuss what went well or not well during the simulation.

1. How did you feel throughout the simulation experience?
2. What was the main goal of the simulation?
3. What influenced your actions for interventions in this clinical scenario?
4. What went well? What improvements could be made?
5. Are you satisfied with the ability to work together?

Final debrief questions:

6. If you could do it all over again what would you do differently?
7. What are you going to take away with you and apply to practice?

Once group has openly discussed the following questions, the facilitator will open for any other comments or concerns. Then the facilitator will make or identify any critical critiques not already mentioned, ending with highlighting the positive teamwork aspects seen.

The team will then proceed back to finish mock code 2.

Notes: +	Δ

Appendix 2--*TeamSTEPPS Teamwork Attitudes Questionnaire (T-TAQ)*

TeamSTEPPS® 2.0

TeamSTEPPS Teamwork Attitudes Questionnaire (T-TAQ)

Instructions: Please respond to the questions below by placing a check mark (√) in the box that corresponds to your level of agreement from *Strongly Disagree* to *Strongly Agree*. Please select only one response for each question.

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Team Structure						
1.	It is important to ask patients and their families for feedback regarding patient care.					
2.	Patients are a critical component of the care team.					
3.	This facility's administration influences the success of direct care teams.					
4.	A team's mission is of greater value than the goals of individual team members.					
5.	Effective team members can anticipate the needs of other team members.					
6.	High performing teams in health care share common characteristics with high performing teams in other industries.					
Leadership						
7.	It is important for leaders to share information with team members.					
8.	Leaders should create informal opportunities for team members to share information.					
9.	Effective leaders view honest mistakes as meaningful learning opportunities.					
10.	It is a leader's responsibility to model appropriate team behavior.					
11.	It is important for leaders to take time to discuss with their team members plans for each patient.					
12.	Team leaders should ensure that team members help each other out when necessary.					

PLEASE CONTINUE TO THE NEXT PAGE

TeamSTEPPS® 2.0

#	Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Situation Monitoring						
13.	Individuals can be taught how to scan the environment for important situational cues.					
14.	Monitoring patients provides an important contribution to effective team performance.					
15.	Even individuals who are not part of the direct care team should be encouraged to scan for and report changes in patient status.					
16.	It is important to monitor the emotional and physical status of other team members.					
17.	It is appropriate for one team member to offer assistance to another who may be too tired or stressed to perform a task.					
18.	Team members who monitor their emotional and physical status on the job are more effective.					
Mutual Support						
19.	To be effective, team members should understand the work of their fellow team members.					
20.	Asking for assistance from a team member is a sign that an individual does not know how to do his/her job effectively.					
21.	Providing assistance to team members is a sign that an individual does not have enough work to do.					
22.	Offering to help a fellow team member with his/her individual work tasks is an effective tool for improving team performance.					
23.	It is appropriate to continue to assert a patient safety concern until you are certain that it has been heard.					
24.	Personal conflicts between team members do not affect patient safety.					

PLEASE CONTINUE TO THE NEXT PAGE →

TeamSTEPPS® 2.0

Communication		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
25.	Teams that do not communicate effectively significantly increase their risk of committing errors.					
26.	Poor communication is the most common cause of reported errors.					
27.	Adverse events may be reduced by maintaining an information exchange with patients and their families.					
28.	I prefer to work with team members who ask questions about information I provide.					
29.	It is important to have a standardized method for sharing information when handing off patients.					
30.	It is nearly impossible to train individuals how to be better communicators.					

Please provide any additional comments in the space below.

Thank you for your participation!

Appendix 3

Permission obtained for tool use

June 29, 2016

Dr. Battles
Center for Quality Improvement and Patient Safety
Agency for Healthcare Research and Quality
540 Gaither Road
Rockville, MD 20850

RE: Permission to use TeamSTEPPS tool

Dear Dr. Battles:

I am writing to ask permission for use of the TeamSTEPPS tool. I will be conducting a mock code simulation in the fall of 2016 with nursing, providers and respiratory therapy. I know this tool is reliable and has been validated, in addition, my clinical expert Dr. Carla Nye at the Virginia Commonwealth University has highly recommended me to use this particular tool. I have also sent a request to Dr. David Baker via email.

If you have any questions, please email me or [Attorney or Advocate Name] at lam9zw@virginia.edu or cfk9m@virginia.edu.

Thank you for your time in reading this and your consideration. I anxiously await your response.

Sincerely,

Lisa Milam

RE: Use of TeamSTEPPS tool in Doctorate of Nursing Practice Project in Virginia
Sent By: David Baker **On:** Jun 06/29/16 11:26 AM
To: Lisa Milam

"David Baker"
+ Add to Address Book

Hi Lisa,

TeamSTEPPS is a public domain training kit so anyone can use it, no permission needed. Most of the measures are also in the public domain. If you have any additional questions, I am happy to discuss them with you.

DB

RE: Use of TEAM tool in Doctorate of Nursing Practice Project in Virginia
Sent By: Simon Cooper **On:** Jun 06/29/16 7:12 PM
To: Lisa Milam

"Simon Cooper"
+ Add to Address Book

Please do Lisa – see website below for you to download material

Simon

Professor Simon Cooper (PhD),
(Emergency Care and Research Development),
School of Nursing, Midwifery and Healthcare, Federation University Australia, Room 2W-262, Gippsland Campus, Churchill, Victoria.
Tel. +61 3 5122 8032

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WEBSITES:
Patient deterioration management (FIRST2ACT) http://first2actweb.com/
Emergency Teamwork Assessment (The TEAM Tool) http://medicalemergencyteam.com/
Eye tracking technology in emergencies http://emergencyeyetracking.com/
-

Please cite the following papers: Cant R, Cooper SJ. (2011) **The benefits of debriefing as formative feedback in nurse education**. Australian Journal of Advanced Nursing; 29(1) 37-47.. Open access At: http://www.ajan.com.au/Vol29/29-1_Cant.pdf

Generic qualitative research: A design for qualitative research in emergency care? Cooper S. Endacott R. (2007) Generic qualitative research: A design for qualitative research in emergency care? *Emergency Medicine Journal*. 24; 816-819. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2658349/

Affiliations:
Visiting Professor, School of Nursing and Midwifery, University of Brighton (UK).

UNIVERSITY of VIRGINIA

Lisa Milam <lam9zw@virginia.edu>

Use of TEAM tool in Doctorate of Nursing Practice Project in Virginia

1 message

Lisa Milam <lam9zw@virginia.edu> Wed, Jun 29, 2016 at 10:30 AM
To: Simon.Cooper@med.monash.edu.au

Dear Dr. Cooper,

I am writing because I will be conducting a mock code simulation study in Richmond, Virginia in the Fall of 2016. I have done a review of literature on simulation and have found that your tool, Team Emergency Assessment Measure, is reliable and validated. It would be incredibly useful for rating mock code simulation teams for my simulation study. This simulation will have nursing, providers and respiratory therapy present to take part in two mock codes. I would like to use your TEAM tool to rate these teams when they are performing the simulation and conduct a paired t test for my statistical results.

Would it be possible that I could have your permission in using this tool for my study?

I anxiously await your reply.

Have a bless day!

Respectfully,

Lisa Milam, AG-ACNP, CCRN,
DNP student
University of Virginia

Appendix 4--*Teamwork Emergency Assessment Management (TEAM) Tool*

Team Emergency Assessment Measure (TEAM)

Introduction

This non- technical skills questionnaire has been designed as an observational rating score for valid, reliable and feasible ratings of emergency medical teams (e.g. resuscitation and trauma teams). The questionnaire should be completed by expert clinicians to enable accurate performance rating and feedback of leadership, team work, situation awareness and task management. Rating prompts are included where applicable. The following scale should be used for each rating:

Never/Hardly ever	seldom	About as often as not	Often	Always/Nearly always
0	1	2	3	4

Team Identification

Date: Time: Place:

Team Leader: Team:

Leadership: It is assumed that the leader is either designated, has emerged or is the most senior - If no leader emerges allocate a '0' to question 1 and 2.	**0**	**1**	**2**	**3**	**4**
1.The team leader let the team know what was expected of them through direction and command	☐	☐	☐	☐	☐
2. The team leader maintained a global perspective *Prompts: Monitoring clinical procedures and the environment? Remaining 'hands off' as applicable? Appropriate delegation.*	☐	☐	☐	☐	☐
Team Work: ratings should include the team as a whole i.e. the leader and the team as a collective (to a greater or lesser extent).	**0**	**1**	**2**	**3**	**4**
3. The team communicated effectively *Prompts: Verbal, non-verbal and written forms of communication?*	☐	☐	☐	☐	☐
4. The team worked together to complete the tasks in a timely manner	☐	☐	☐	☐	☐
5. The team acted with composure and control *Prompts: Applicable emotions? Conflict management issues?*	☐	☐	☐	☐	☐
6. The team morale was positive *Prompts: Appropriate support, confidence, spirit, optimism, determination?*	☐	☐	☐	☐	☐
7. The team adapted to changing situations *Prompts: Adaptation within the roles of their profession?* *Situation changes: Patient deterioration? Team changes?*	☐	☐	☐	☐	☐
8. The team monitored and reassessed the situation	☐	☐	☐	☐	☐
9. The team anticipated potential actions *Prompts: Preparation of defibrillator, drugs, airway equipment?*	☐	☐	☐	☐	☐
Task Management:	**0**	**1**	**2**	**3**	**4**
10. The team prioritised tasks	☐	☐	☐	☐	☐
11.The team followed approved standards and guidelines *Prompt: Some deviation may be appropriate?*	☐	☐	☐	☐	☐

Overall:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
12. On a scale of 1-10 give your global rating of the team's non-technical performance	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Comments:____

Appendix 5

Demographic Questionnaire

Demographic Questionnaire

Gender: male female

Age:
20-25 years
26-30
31-35
36-40
41-45
46-50
>51

Profession: nurse provider respiratory therapist

Years of experience:
≤ 6 months
>6 months -- < 1 year
1 – 2 years
2 - <5 years
5 - ≤ 10 years
10 - < 15 years
15 – 20 years
>20 years

Time in ICU (ICU experience):
< 6 months
>6months - <1 years
1 - <2 years
2 - <5 years
5 - <10 years
10 - <15 years
15 – 20 years
>20 years

Are you ACLS certified? Yes or No

Have you participated in an interprofessional simulation before? Yes or No

Appendix 6

Orientation Script

Orientation Script

Thank you for joining the team today for a Mock Code Simulation. There will be team selected with a provider, a respiratory therapist and nursing randomly divided equally and each team will do a mock code 1 and 2 with a debriefing session in between. A pretest has already been handed out and completed. Approximately 45 minutes to one hour will be devoted to the mock simulation. A posttest will be provided at the end. Once the team has entered the simulation room, the team will be oriented to the environment and given the clinical scenario with objectives before proceeding.

Ground rules:

This is a safe area where each person is to be respected and open dialogue is encouraged, even if it means constructive criticism. Teams cannot change for the better if they cannot be open with each other. There are to be no cell phones during simulation. Each team member will function in the role they are trained, i.e., nursing will do nursing roles, provider will lead the code and/or intubate, and respiratory will manage the oxygenation and machines. Please state and clarify all interventions made throughout the code in order for the code to progress and come to completion. The facilitator will let the team know when the code has come to completion, usually when the patient has returned to a sinus rhythm and has a pulse.

Any questions?

Appendix 7

Clinical Scenario:

A 64 year old Caucasian male, Scott Jones, admitted from the Emergency Department (ED) this morning for acute respiratory distress for COPD vs CHF exacerbation, placed on BIPAP and transferred to the MRICU for further management. His past medical history is ETOH abuse for 40 years, smoking, Type II Diabetes Mellitus, obesity, CAD, NSTEMI, and an EF of 45%. He is a retired truck driver who is widowed and has two estranged children. He is A+Ox3, but only can speak in words, not phrases. VS: 38.1 oral temperature, 128 HR regular, 35 RR, BP 88/54, SATS 89% on BIPAP setting of 12/5 with 80% FiO2. His last ABG was pH 7.21, pCO2 87, pO2 64, HCO3 24, SATS 88%. No changes on the BIPAP have been made yet because of change of shift. After receiving report, the nurse goes to gather medications and makes their way into the patient's room.

Objectives:

1. Identify primary rhythms noted in mock code
2. Administers medication per ACLS protocol (see https://www.acls.net/aclsalg.htm for algorithms)
3. Delivers appropriate shock to patient when indicated
4. Compress patient to appropriate depth
5. Oxygenate patient
6. Demonstrate effective teamwork, collaboration and communication throughout codes

Appendix 8

IRB Approval Letter

VIRGINIA COMMONWEALTH UNIVERSITY

VCU

Make it real.

Office of Research and Innovation
Office of Research Subjects Protection
BioTechnology Research Park
800 East Leigh Street, Suite 3000
P.O. Box 980568
Richmond, Virginia 23298-0568

(804) 828-0868
Fax: (804) 827-1448

TO: Darci Bowles

CC: Darci Bowles
Lisa Milam

FROM: VCU IRB Panel A

RE: Darci Bowles ; IRB HM20008144 Interprofessional simulation and improvement in teamwork, collaboration and communication

On 11/21/2016, the referenced research study ***qualified for exemption*** according to 45 CFR 46.101(b), categories **1 and 2**.

The information found in the electronic version of this study's smart form and uploaded documents now represents the currently approved study, documents, and HIPAA pathway (if applicable). You may access this information by clicking the Study Number above.

If you have any questions, please contact the Office of Research Subjects Protection (ORSP) or the IRB reviewer(s) assigned to this study.

The reviewer(s) assigned to your study will be listed in the History tab and on the study workspace. Click on their name to see their contact information.

Attachment – Conditions of Exempt Approval

Conditions of Exempt Approval:

In order to comply with federal regulations, industry standards, and the terms of this approval, the investigator must (as applicable):

1. Conduct the research as described in and required by the Protocol.

2. Provide non-English speaking patients with a translation of the approved Consent Form in the research participant's first language. The Panel must approve the translation.

3. The following changes to the protocol **must be** submitted to the IRB panel for review and approval before the changes are instituted. Changes that do not meet these criteria do not have to be submitted to the IRB. If there is a question about whether a change must be sent to the IRB please call the ORSP for clarification.

   THESE CHANGES MUST BE SUBMITTED:
   - Change in principal investigator
   - Any change that increases the risk to the participant
   - Addition of children, wards of the state, or prisoner participants
   - Changes in survey or interview questions (addition or deletion of questions or wording) that change the level of risk or adds questions related to sexual activity, abuse, past or present illicit drug use, illegal activities, questions reasonably expected to provoke psychological anxiety, or would make participants vulnerable, or subject them to financial, psychological or medical risk
   - Changes that change the category of exemption or add additional exemption categories
   - Changes that add procedures or activities not covered by the exempt category(ies) under which the study was originally determined to be exempt
   - Changes requiring additional participant identifiers that could impact the exempt category or determination
   - Change in inclusion dates for retrospective record reviews if the new date is after the original approval date for the exempt study. (ex: The approval date for the study is 9/24/10 and the original inclusion dates were 01/01/08-06/30/10. This could be changed to 01/01/06 to 09/24/10 but not to end on 09/25/10 or later.)
   - Addition of a new recruitment strategy
   - Increase in the planned compensation to participants

4. Monitor all problems (anticipated and unanticipated) associated with risk to research participants or others.

5. Report Unanticipated Problems (UPs), following the VCU IRB requirements and timelines detailed in VCU IRB WPP VIII-7).

6. Promptly report and/or respond to all inquiries by the VCU IRB concerning the conduct of the approved research when so requested.

7. The VCU IRBs operate under the regulatory authorities as described within:
   - U.S. Department of Health and Human Services Title 45 CFR 46, Subparts A, B, C, and D (for all research, regardless of source of funding) and related guidance documents.
   - U.S. Food and Drug Administration Chapter I of Title 21 CFR 50 and 56 (for FDA regulated research only) and related guidance documents.
   - Commonwealth of Virginia Code of Virginia 32.1 Chapter 5.1 Human Research (for all research).

Determination of Agent, UVA

UNIVERSITY of VIRGINIA IRB-HSR
Institutional Review Board for Health Sciences Research

DETERMINATION OF UVa AGENT FORM

INFORMATION ABOUT THIS FORM

- This form is to determine if UVa personnel are or are not considered to be working as an Agent* for UVA on this project.
- If it is determined that UVA personnel are considered to be working as an Agent* for UVA the study, then your team will be required to provide an additional submission to the IRB-HSR, unless the project is determined to not involve human subject research. See Determination of Human Subject Research Form

***Agent**- *all individuals (including students) performing institutionally designated activities or exercising institutionally delegated authority or responsibility.*

Enter responses electronically. Email the completed form to IRBHSR@virginia.edu for pre-review.

An IRB staff member will reply with any changes to be made.

Name of Individual to be Working on Project:	Lisa Milam
Email:	lam9zw@virginia.edu
Phone:	8049380227
UVa Messenger Mail Box #	n/a
Project/Protocol Title if Known:	☐ Unknown or Title: Interprofessional simulation and improvement in teamwork, collaboration and communication
Explain your role in the project: (200 words or less)	Graduate DNP student, conducting research
Explain the reason for traveling to the outside institution.	I work at VCU and have the opportunity to work with quality improvement regarding mock codes in the Medical Respiratory ICU

FOR IRB-HSR OFFICE USE ONLY

☒ UVa personnel are not considered to be working as an Agent for UVa on this project.
No approvals from the UVa IRB-HSR are required.
UVA Tracking # 19506

☐ UVa personnel are considered to be working as an Agent for UVa on this project.
Submit a research application to the UVa IRB-HSR.

Joanna Faulconer __________ December 7, 2016
Signature of IRB Chair, Director or Designee — Date

Website: http://www.virginia.edu/vpr/irb/hsr/index.html
Phone: 434-924-2620 Fax: 434-924-2932 Box 800483

Appendix 9

Consent

Mock Code Simulation Informed Consent Agreement

Please read this consent agreement carefully before you decide to participate in the study.

Purpose of the research study: The purpose of the study is to participate in two mock code simulations with a debrief session in between to analysis the change in perception of teamwork, collaboration and communication in mock code performance.

What you will do in the study: The participant will be assigned to a simulation team after taking a pre-test, perform mock code 1 with team, take part in a debrief session, followed by mock code 2 which is the same code previously performed. Once the second mock code is completed, the participant will be asked to complete a posttest. The participant will be videotaped during both simulations to be reviewed by the facilitator. Data collected will be the pre and posttest questionnaire regarding teamwork dynamics. Participants may decline to fill out tests, and/or may skip any question on the pre or posttests that may make them feel uncomfortable.

Time required: The study will require about **1** hour of your time. The pre-brief will be approximately 5 minutes, followed by 10-15 minutes for mock code 1, 15 minutes for the debrief, and 10-15 minutes for mock code 2. There is the potential for downtime in between sessions for movement of people from simulation room to private classroom.

Risks: There are potential physical risks while doing compressions if proper positioning is not performed. A real defibrillator will be used during the mock code that can deliver a live shock and has the potential to harm if not cleared from pads and SimMan. Psychological harm, in every attempt, will be avoided because this simulation is a safe zone and mistakes are allowed and participants will be encouraged to speak freely.

Benefits: There are no direct benefits to you for participating in this research study. The study may help us understand the use of interprofessional teamwork in further simulations performed or attempted. There is no payment benefit to this study.

Confidentiality: The facilitator will hold and possess all paper and video data collected. Paper data will be stored in a manila envelope and locked in a safe at the facilitator's home when not in use. The video data will be stored on a disc also store in the facilitator's locked safe at their home. Video data may be seen by the education committee for future education and/or the director of the simulation laboratory may be privy to data in collaboration of analysis of the TEAM.

Data linked with identifying information: The information that you give in the study will be handled confidentially. Your name will be assigned a random number that the facilitator will only know and further information will be assigned that code number. The list connecting your name to this code will be kept in a locked file. When the study is completed and the data have been analyzed, this list will be destroyed. Your name will not be used in any report. Video tape data once fully reviewed will be destroyed. Because of the nature of the data, it may be possible to deduce your identity; however, there will be no attempt to do so and your data will be reported in a way that will not identify you.

Voluntary participation: Your participation in the study is completely voluntary. You do not have to fill out the pre or posttest. There is no penalty for not completing the pre or posttests.

Payment: You will receive no payment for participating in the study.

If you have questions about the study, contact:
Lisa Milam, AG-ACNP, CCRN
7417 Wellington Woods Road
Richmond, VA 23231
Telephone: 804-938-0227
Email address: lam9zw@virginia.edu

Catherine Kane, Ph.D, RN, FAAN
UVA School of Nursing
Claude Moore Nursing Education
University of Virginia, Charlottesville, VA 22903.
Telephone: (434) 924-0100
Email address: cfk9m@virginia.edu

If you have questions about your rights in the study, contact:
Tonya R. Moon, Ph.D.
Chair, Institutional Review Board for the Social and Behavioral Sciences
One Morton Dr Suite 500
University of Virginia, P.O. Box 800392
Charlottesville, VA 22908-0392
Telephone: (434) 924-5999
Email: irbsbshelp@virginia.edu
Website: www.virginia.edu/vpr/irb/sbs

Agreement:
I agree to participate in the research study described above.
Signature: ____ Date: ____________

Appendix 10

Letter of Approval

VCU

School of Nursing
School of Nursing Building
P.O. Box 980567
Richmond, Virginia 23298-0567
804 828-0724 • Fax: 804 828-7743
TDD: 1-800-828-1120
www.nursing.vcu.edu

June 30, 2016

Dear Dr. Kane,

I am the Director of the Clinical Learning Center at the Virginia Commonwealth School of Nursing. It has been a pleasure to work the Lisa Milam over the last month during her DNP residency. She and I have discussed her DNP project, the aims, and the general plans. The VCU School of Nursing Clinical Learning Center is willing to support Lisa in her DNP project. While we have to work within the constraints of our academic offerings, the Clinical Learning Center should be able to support all or a portion of her planned simulations. Thank you for the opportunity to work with such an engaged student.

Sincerely,

Carla Nye, DNP, CPNP-PC, CNE, CHSE
Director, Clinical Learning Center
VCU School of Nursing

Appendix 11

Author Guidelines for *Clinical Simulation in Nursing*

https://www.elsevier.com/journals/clinical-simulation-in-nursing/1876-1399/guide-for-authors

Clinical Simulation in Nursing is an international, peer reviewed journal published online monthly. *Clinical Simulation in Nursing* is the official journal of the International Nursing Association of Clinical and Simulated Learning (INACSL) and the Association of Standardized Patient Educators (ASPE) and reflects the mission of these organizations. The journal accepts manuscripts meeting one or more of the following criteria:

- Research articles and systematic reviews using simulation and or standardized patients
- Practice articles using simulation and or standardized patients
- Innovative teaching/learning strategies developed through simulation and technology
- Innovative implementation and management strategies for simulation within practice and academic centers; and
- Articles updating knowledge, guidelines, regulations, and legislative policies that impact nursing and health care education and practice

WORD LIMIT for article categories (excluding abstracts and references)
Original paper- 3500 (4 tables and/or 4 figures)
Review article - 4000 (8 tables)
Short communication - 1500 (3 tables)
Book/software/product review - 1200 words
Letter to the Editor - 200 words
REFERENCE LIMIT
Original paper - 40
Review article - 75
Short communication – 20
Documents should include page numbers, continuing line numbering and the following headings: Background, Sample, Method, Results, and Conclusion. Each subsection is given a brief heading. Each heading should appear on its own separate line. Manuscripts may not exceed 1750 words in length, excluding abstract and references (separate documents). References are restricted to the most essential and limited to one page in length. References must conform to APA style. The author must assume responsibility for the accuracy of references.
All Research Briefs must include a structured abstract of approximately 150 words (does not count toward page limit), using the following headings: Background, Sample, Method, Results, and Conclusion. Tables and figures are discouraged and only used at the editor's discretion. Highlights are mandatory for this journal. They consist of a short collection of bullet points that convey the core findings of the article and should be submitted in a separate editable file in the online submission system. Please use 'Highlights' in the file name and include 2- 3 bullet points (maximum 85 characters, including spaces, per bullet point). This does not count toward the page limit.
Provide 1-2 key point statements that summarize the main points of your article.
List no fewer than three (3) key words that literature searches would use to locate your manuscript if it were published.

Interprofessional Simulation and Improvement in Teamwork, Collaboration and Communication

Lisa Milam, MSN, RN, CCRN

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Mailing Address: 7417 Wellington Woods Road, Henrico, VA 23231

Abstract:

Background:

The study evaluated mock code simulation's effect on perception and team behaviors regarding teamwork, collaboration and communication.

Sample:

Registered nurses, providers, and respiratory therapists from a large medical center (N=85).

Methods:

A retrospective review of descriptive and quantitative statistics was utilized. TeamSTEPPS® and T.E.A.M. were the instruments used. Two mock codes were conducted with a debriefing session between codes. Mock codes were composed of all-nurse teams compared to Interprofessional teams.

Results:

Statistically significant team behavior changes were notes as well as pre-post changes. Interprofessional presence on the team was also found to be statistically significant.

Conclusions:

The use of two mock code simulations, utilizing Interprofessional teams, with debriefing can contribute to increased teamwork behaviors, collaboration and communication.

Keywords:

mock code simulation, high fidelity simulation, debrief, collaboration

Highlights/Key Words (5 bullet points):

- Simulation showed improved scores with Interprofessional involvement
- Mock code simulations demonstrated improved team behaviors
- Simulations are timely, safety, and provide realism
- Mock code simulation interprofessional teams can collaborate and communicate to improve patient outcomes
- Mock code simulation can increase situational awareness

Background

Healthcare Interprofessional (IP) development and focus of patient care delivery has changed over the last few years. Team members include physicians, nurses, and respiratory therapists. In Manser's (2009) article, she compared these teams to the military or aviation and emphasized teams can be dynamic when functioning under stressful conditions or high risk outcomes. Teams have members with specific roles that collaborate together in order to function properly and require specific training to be competent. A code, whether cardiac or respiratory, is one of these stressful situations healthcare teams experience where competence is crucial. Codes involve many resources, tasks and abilities to achieve a favorable outcome. In order to optimize the patient's positive outcome, the team needs to use teamwork, communication, and collaboration to accomplish goal oriented tasks (Jeffries, 2012).

Mock code simulation training consists of activities to evoke thought process and providing realism while being completely interactive. After completing mock code simulations, the participant and team should feel more comfortable to use their critical thinking and hands-on skills to intervene and make safe and appropriate decisions. Part of what makes a simulation interactive and lifelike is the use of high fidelity mannequins. High fidelity mannequins have evolved becoming more realistic in physiological responses (Aggarwal, Mytton, Derbrew, et al., 2010). This is commonly used in Basic Life Support (BLS) and Advanced Cardiac Life Support (ACLS) training simulation.

Simulation is a powerful learning tool and can help health professionals achieve safer care and improve confidence (Aggarwal et al., 2010). It can be used with current clinicians to help solidify skills when not in constant use. Research has demonstrated knowledge and skills were lost and returned to pre-training level within twelve months after the advanced training

(Cappelle and Paul, 1996). Lack of training or experience is believed to translate into decreased preparedness and confidence levels that proceeds to an unsuccessful outcome (Mikrogianakis et al., 2006).

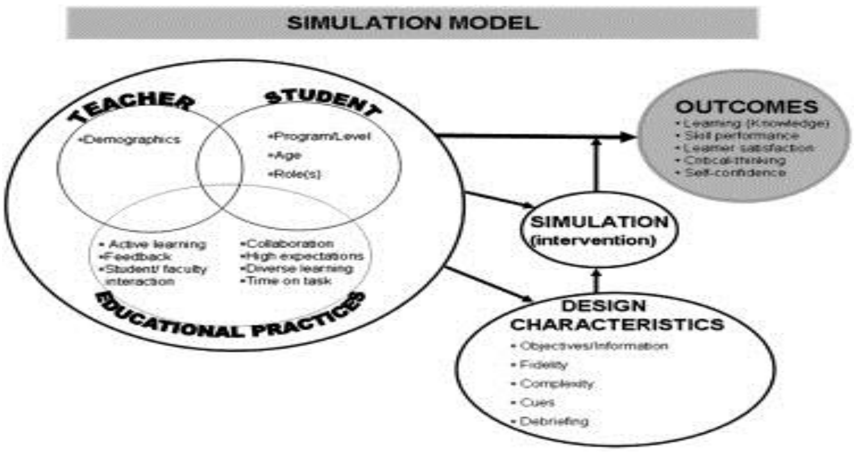
When faced with critical situations, clinicians can experience breakdown in skills, confidence, teamwork, collaboration, and communication and this could jeopardize patient safety and outcomes. Team members sense tension and messages result in misunderstanding, fear and anxiety, whether intended or not. Miscommunication can cause patient errors (Institute of Medicine, 2010). However, implementing effective teamwork and collaboration supports the common goal, values of efficient patient care, and improves patient outcomes (Dillon, Noble, & Kaplan, 2009). Instituting mock code simulations with current practicing clinicians supports increased outcomes, patient safety, and improved team behaviors (Dillon et al, 2009; Semler et al. 2015; & Frengley et al. 2011).

Theoretical Framework

The National League for Nursing (NLN)/Jeffries Simulation Framework (Figure 1) was the theoretical framework for this study. The framework is a collaborating tool in simulation and has been validated (Jeffries, 2012). It consists of five components used by both masters and doctoral prepared students in healthcare and non-healthcare simulations. The five components of the model are the facilitator, the participant, educational practices in simulation, simulation and design features, and outcomes. The model emphasizes the relationship that needs to be built between the facilitator and participant, and between participants.

Figure 1.

National League of Nursing/Jefferies Simulation Framework Model



(Jeffries, 2012)

Materials and Methods

The design was a retrospective review with mixed method of descriptive, correlational and quantitative statistics from a convenience sample from four workshops provided for the nursing staff who attended the mock code simulations.

The sample consisted of the Medical Respiratory Intensive Care Unit (MRICU) staff from a large university medical center in central Virginia. Annually, the nursing team participates in a MRICU staff development workshop. At the end of the workshop, the nurses participate in a mock code simulation for a required competency evaluation. Respiratory therapist and providers (Fellows, Advanced Practice Providers (APPs) and Physician Assistant) were invited to attend the mock code simulation, but it was not mandatory. Resident and intern level physicians were excluded if they were rotating the entire health system and were not vested in the MRICU.

The MRICU is a 28 bed unit in a university health care institution. The School of Nursing (SON) is affiliated with the university health care institution and has two high fidelity simulation rooms where the sessions were held.

Each group consisted of five to ten participants' per room. This meant there could have been up to four groups each workshop day for a total of eight codes conducted per workshop day depending on attendance. Optimally, each simulation group needed to have a provider, nurse and respiratory therapist. The goal was to have all three disciplines represented on each team; however, if a provider or respiratory therapist was not present that day, nursing would still proceed with the mock code simulation.

The simulation room contained a hospital bed, a high fidelity 3M SimMan, cameras to view participants at two angles, a code cart with the defibrillator on top and simulated vials to mimic actual code drug boxes or containers, oxygen, airway management tools (i.e. ambu-bag, intubation supplies, bite blocks). A monitor was visible to the participants for vital signs. A large one way window allowed participants to be seen by facilitator during the codes. A door between the two control rooms made it easy to visualize both rooms simultaneously. The program controlling the SimMan followed an algorithm where the facilitator only had to press a begin button once the team started the code and pressed a finish button when completed. Completion between the two teams could vary depending on how quickly they completed interventions to resuscitate the patient. The teams were allowed a total of 10 minutes, but could have finished earlier depending on how quickly interventions were applied to the SimMan.

Before starting the first mock code, participants completed a demographic questionnaire and pre-test TeamSTEPPS® (Appendix A). Orientation to the simulation room was provided and the clinical scenario was read. Teams were allowed time to discuss roles prior to initiation. Mock code one was started for a maximum of ten minutes. After the group completed mock code one, there was a scripted debrief that led the discussion. A Plus Delta technique was used to simulate the discussion regarding positive aspects of the code and team, and areas for improvement with constructive and/or reflective feedback so they could return to mock code two and could choose to perform it differently the second time (Jeffries, 2012). If errors or mistakes were noted, it was addressed in the debrief. Mock code two was identical. The final debrief and post-test TeamSTEPPS® was given after the second mock code. The total time was no more than 60 minutes. The mock codes were video recorded for the facilitator to review and use the Team Emergency Assessment Measure (T.E.A.M) tool (Appendix B) to score team behaviors on effectiveness and improvement from one simulation to the next.

Both tools are well used and have been validated. The TeamSTEPPS® questionnaire is a 30 question, 5-point Likert scale assessing teamwork attitudes in five categories: team structure, leadership, situation monitoring, mutual support, and communication. The tool was developed by the Department of Defense (DOD) and the Agency for Healthcare Research and Quality (AHRQ) to improve collaboration and communication specifically related to patient safety (Baker, et al.2010). The development of this questionnaire began in 2007 as a pilot and was administered to 485 participants throughout multiple healthcare organizations (Baker et al., 2010). The coefficient ranges were calculated at 0.36 to 0.63 allowing for discriminant validity. Battles and King (2010) confirmed validity AHRQ Hospital Survey on Patient Safety (HSOPS) with a range of 0.60 to 0.79. Also, Cronbach's alpha reliability coefficients ranged from 0.88 to 0.95 displaying internal consistency with the questionnaire (Battles & King, 2010).

The T.E.A.M. tool rated aspects of the group during mock code one and two. Four categories were scored: leadership, teamwork, task management, and overall score. Cooper and colleagues (2009) developed this measure to have a valid and reliable way to measure resuscitation performance teamwork. The content validity index (CVI) after the final development of a twelve item measure was greater than 0.83, and it reached a total CVI of 0.96, a rho of 0.621-1.0, with all p values less than 0.01 (Cooper et al., 2009). The measure was confirmed to have high internal reliability with an alpha coefficient of 0.97.

The study was approved by International Review Board (IRB). Informed consent was obtained from participants regarding disclosure allowing use of their data, including use of videography. The tests were made to be completely voluntary.

Results

Fourteen teams participated in two codes, for a total of 28 mock codes. Data were collected from 88 participants; however, three participants were removed from the study due to lack of proper consent leaving an N of 85 for analysis. Two teams with mock code one and mock code two had to be dropped due to not having a paired video resulting in 24 mock codes for review. In 12 of these, the team consisted of all nurses, and the other 12 included at least one provider and/or respiratory therapist.

The demographic data revealed 90.5% were female, 27.1% were between ages 20 to 25 years, and 27.1% had two to five years intensive care experience. A vast majority (81%) had prior simulation experience. Sixty-one percent were ACLS certified. Registered nurses comprised 91.7% of the participants with 3.6% being providers and 4.7% were respiratory therapists.

The TeamSTEPPS® pre and posttest were entered into SPSS (version 23) for paired *t*-test analysis. Twelve of the 30 questions were found statistically significant ($p<0.05$) (Table 1).

Eleven of the 12 questions showed improvement in the mean scores from pre- to post-, while one (Q2) had a significant drop in the mean score.

Table 1

Pre to post test results of the TeamSTEPPS® T-TAQ, by question item

Question	*N*	Pretest M (SD)	Posttest M(SD)	Mean Increase	*t*	df	*p*
Team Structure							
Q2: patients are part of team	84	4.81	4.69	-0.12	-2.424	83	0.018*
Q3: administration influence	84	4.24	4.39	0.15	2.07	83	0.042*
Q4: team's mission > individual	84	3.94	4.29	0.35	3.632	83	0.000*
Leadership							
Q9: honest mistakes	84	4.67	4.77	0.1	1.999	83	0.049*
Situation Monitoring							
Q13: scan the environment	85	4.39	4.62	0.23	3.446	84	0.001*
Q14: monitoring patients	85	4.54	4.67	0.13	2.001	84	0.048*
Q15: report changes	85	4.46	4.6	0.14	2.647	84	0.01*
Mutual Support							
Q22: offering to help	85	4.4	4.52	0.12	2.291	84	0.024*
Q23: assert patient safety concerns	85	4.54	4.67	0.15	2.252	84	0.027*
Communication							
Q27: adverse events	85	4.35	4.48	0.03	2.082	84	0.04*
Q28: ask questions	85	4.15	4.42	0.27	3.581	84	0.001*
Q29: standardized methods	85	4.18	4.4	0.22	3.204	84	0.002*

*$p \leq 0.05$, two-tailed

T.E.A.M. data from the 24 videos were analyzed in three ways. First, the scores from mock code one and mock code two were compared using paired *t*-tests or Sign tests on questions one through 12. Four questions were excluded from the paired t-test because of the normality assumption was not satisfied. Of the eight, two of the question score changes were significant ($p<0.05$): the team communicated effectively (Q3) and the team adapted to changing situations (Q7) (Table 2).

Table 2

Paired t-test comparison eight mean T.E.A.M. question scores for mock code 1/mock code 2

Question	mock 1 Mean (SD)	mock 2 Mean (SD)	Mean Change	*t*	df	*p*
3	2.75 (0.622)	3.42 (0.669)	0.667 (0.985)	2.345	11	0.039*
7	3.08 (0.669)	3.75 (0.452)	0.667 (0.888)	2.602	11	0.025*

N=12; *$p \leq 0.05$, two-tailed

Second, the Wilcoxon Signed-Rank test was used on questions one through 11 because distributions did not satisfy the independent *t*-test. It compared all registered nurse teams (n=12) and the presence of a provider and/or a respiratory therapist on a team (n=12). Five of the 11 questions had increased significance: the leader knew what was expected and gave appropriate direction (Q1; p=0.005) while also having a global perspective of the situation (Q2; p=0.007), teams anticipated actions (Q9; p=0.020), prioritizing tasks (Q10; p=0.024), and following approved standards and guidelines (Q11; p=0.028). An independent t-test was performed on the overall score (Q12) and the IP mean score (8.50) was significantly greater than the all-nurse mean score (7.08).

Lastly, a linear regression compared the dependent variable of the overall score (Q12) to estimate the effect of a predictor if the other was controlled. The predictors were limited to two—Code (mock code 1 or mock code 2) and IP team (a provider and/or respiratory therapist present and registered nurses). It resulted with the adjusted R-square of 0.35 and the model was significant (p=0.004) (Table 3). The regression showed when IP was controlled Code came close to significance (p=0.052) and an estimated effect of the code being Code 2 as opposed to Code 1 increased the mean of Q12 by 0.92 points. The regression also showed when Code is held constant, Q12 remained significant (p=0.004) with an estimated effect of having IP teams increased the mean by 1.42 points.

Table 3

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std Error	Beta			Lower	Upper
(Constant)	5.708	0.737		7.747	0	4.176	7.241
1 Code	0.917	0.444	0.347	2.063	0.052	-0.007	1.841
Interprof	1.417	0.444	0.536	3.188	0.004	0.493	2.341

Dependent variable: Q12=overall team rating

Discussion

The study demonstrated significant improvements in teamwork, collaboration, and communication. In the TeamSTEPPS® Team Structure category, team support and importance in a team's goal or mission exhibited collaboration. The Leadership category demonstrated significance in having effective team leaders who view honest mistakes as learning opportunities. Effective leaders who understand simulation and its emotional safety help participants learn from mistakes or errors and are encouraged to improve from them. In the Situational monitoring category, teamwork was demonstrated by participants working together discovering cues, monitoring the patient, and acting upon the important data provided by the SimMan to achieve a favorable outcome. Teamwork can also was seen in the Mutual Support category by helping teammates can increase positive team behaviors. Caring for a sick patient can be difficult for one person to do. With mutual support, mock code simulation can help improve participant's assertiveness in code situations identifying tasks that need to be accomplished and empowers the participant to give instruction. Communication demonstrated multiple significant improvements: allowing open information exchange, clarifying questions, and standardized methods for hand-offs. Codes require communication and if a person does not clearly verbalize their actions or rationale, then the team can become confused. Confusion can lead to frustration and a less than optimal outcome or even patient error (Reader, Flin, & Cuthberson, 2007).

The T.E.A.M. demonstrated increased team behaviors and effectiveness, specifically within IP teams. Teams were able to communicate effectively, adapt to changing situations, anticipated actions, prioritizing tasks and following standards and guidelines. The overall score was significantly higher in the IP group than all-nurse group confirming the positive influence on performance from having multiple professions present.

Strengths of the study were sample size, realistic environment and lifelike simulation. The limitations include single site evaluation, convenience sample, a ceiling effect on the TeamSTEPPS® tool, and a small representation of IP providers as well as the sample size with the T.E.A.M. tool (n=12).

Conclusion

Healthcare simulations offer realism, clinical relevance and availability, and gained the experience from lifelike scenarios (Aggarwal et al., 2010; Rosen et al., 2012; & van Schaik et al., 2001). Mock code simulations should be conducted with a two-step offering of codes. Time may be a factor when considering how to conduct mock code simulations, but if a single code is the only feasible option due to time, a debrief session should always be provided. Debrief sessions allow teams to reflect and decide what they can improve upon and debriefing helps assimilate knowledge. It is possible to have two codes organized into an hour timeframe. By having a second code, teams can act upon the skills and knowledge obtained to make immediate improvements and implement them in their current practice. The mock code simulation also can give a clearer understanding to the participant of their teammate's roles and how to function together. Ultimately, incorporating IP teams into mock code simulations has shown a positive improvement in teamwork, collaboration and communication.

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Conflict of Interests—none

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Appendix A

TeamSTEPPS® 2.0

TeamSTEPPS Teamwork Attitudes Questionnaire (T-TAQ)

Instructions: Please respond to the questions below by placing a check mark (√) in the box that corresponds to your level of agreement from *Strongly Disagree* to *Strongly Agree*. Please select only one response for each question.

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Team Structure						
1.	It is important to ask patients and their families for feedback regarding patient care.					
2.	Patients are a critical component of the care team.					
3.	This facility's administration influences the success of direct care teams.					
4.	A team's mission is of greater value than the goals of individual team members.					
5.	Effective team members can anticipate the needs of other team members.					
6.	High performing teams in health care share common characteristics with high performing teams in other industries.					
Leadership						
7.	It is important for leaders to share information with team members.					
8.	Leaders should create informal opportunities for team members to share information.					
9.	Effective leaders view honest mistakes as meaningful learning opportunities.					
10.	It is a leader's responsibility to model appropriate team behavior.					
11.	It is important for leaders to take time to discuss with their team members plans for each patient.					
12.	Team leaders should ensure that team members help each other out when necessary.					

PLEASE CONTINUE TO THE NEXT PAGE

TeamSTEPPS® 2.0

Communication		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
25.	Teams that do not communicate effectively significantly increase their risk of committing errors.					
26.	Poor communication is the most common cause of reported errors.					
27.	Adverse events may be reduced by maintaining an information exchange with patients and their families.					
28.	I prefer to work with team members who ask questions about information I provide.					
29.	It is important to have a standardized method for sharing information when handing off patients.					
30.	It is nearly impossible to train individuals how to be better communicators.					

Please provide any additional comments in the space below.

Thank you for your participation!

Appendix B

Team Emergency Assessment Measure (TEAM)

Introduction

This non- technical skills questionnaire has been designed as an observational rating score for valid, reliable and feasible ratings of emergency medical teams (e.g. resuscitation and trauma teams). The questionnaire should be completed by expert clinicians to enable accurate performance rating and feedback of leadership, team work, situation awareness and task management. Rating prompts are included where applicable. The following scale should be used for each rating:

Never/Hardly ever	seldom	About as often as not	Often	Always/Nearly always
0	1	2	3	4

Team Identification

Date: Time: Place:

Team Leader: Team:

Leadership: It is assumed that the leader is either designated, has emerged or is the most senior - If no leader emerges allocate a '0' to question 1 and 2.	**0**	**1**	**2**	**3**	**4**
1.The team leader let the team know what was expected of them through direction and command	☐	☐	☐	☐	☐
2. The team leader maintained a global perspective *Prompts: Monitoring clinical procedures and the environment? Remaining 'hands off' as applicable? Appropriate delegation.*	☐	☐	☐	☐	☐
Team Work: ratings should include the team as a whole i.e. the leader and the team as a collective (to a greater or lesser extent).	**0**	**1**	**2**	**3**	**4**
3. The team communicated effectively *Prompts: Verbal, non-verbal and written forms of communication?*	☐	☐	☐	☐	☐
4. The team worked together to complete the tasks in a timely manner	☐	☐	☐	☐	☐
5. The team acted with composure and control *Prompts: Applicable emotions? Conflict management issues?*	☐	☐	☐	☐	☐
6. The team morale was positive *Prompts: Appropriate support, confidence, spirit, optimism, determination?*	☐	☐	☐	☐	☐
7. The team adapted to changing situations *Prompts: Adaptation within the roles of their profession?* *Situation changes: Patient deterioration? Team changes?*	☐	☐	☐	☐	☐
8. The team monitored and reassessed the situation	☐	☐	☐	☐	☐
9. The team anticipated potential actions *Prompts: Preparation of defibrillator, drugs, airway equipment?*	☐	☐	☐	☐	☐
Task Management:	**0**	**1**	**2**	**3**	**4**
10. The team prioritised tasks	☐	☐	☐	☐	☐
11.The team followed approved standards and guidelines *Prompt: Some deviation may be appropriate?*	☐	☐	☐	☐	☐

Overall:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
12. On a scale of 1-10 give your global rating of the team's non-technical performance	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Comments:____