

Making an “Attitude Adjustment”

Using a Simulation-Enhanced Interprofessional Education Strategy to Improve Attitudes Toward Teamwork and Communication

Ambrose Hon-Wai Wong, MD;

Maureen Gang, MD;

Demian Szyld, MD, EdM;

Heather Mahoney, MD

Introduction: Health care providers must effectively function in highly skilled teams in a collaborative manner, but there are few interprofessional training strategies in place. Interprofessional education (IPE) using simulation technology has gained popularity to address this need because of its inherent ability to impact learners' cognitive frames and promote peer-to-peer dialog. Provider attitudes toward teamwork have been directly linked to the quality of patient care. Investigators implemented a simulation-enhanced IPE intervention to improve staff attitudes toward teamwork and interprofessional communication in the emergency department setting.

Methods: The 3-hour course consisted of a didactic session highlighting teamwork and communication strategies, 2 simulation scenarios on septic shock and cardiac arrest, and structured debriefing directed at impacting participant attitudes to teamwork and communication. This was a survey-based observational study. We used the TeamSTEPPS Teamwork Attitudes Questionnaire immediately before and after the session as a measurement of attitude change as well as the Hospital Survey on Patient Safety Culture before the session and 1 year after the intervention for program impact at the behavior level.

Results: Seventy-two emergency department nurses and resident physicians participated in the course from July to September 2012. Of the 5 constructs in TeamSTEPPS Teamwork Attitudes Questionnaire, 4 had a significant improvement in scores—6.4%, 2.8%, 4.0%, and 4.0% for team structure, leadership, situation monitoring, and mutual support, respectively ($P < 0.0001$, $P = 0.029$, $P = 0.014$, and $P = 0.003$, respectively). For Hospital Survey on Patient Safety Culture, 3 of 6 composites directly related to teamwork and communication showed a significant improvement—20.6%, 20.5%, and 23.9%, for frequency of event reporting, teamwork within hospital units, and hospital handoffs and transitions, respectively ($P = 0.028$, $P = 0.035$, and $P = 0.024$, respectively).

Conclusions: A simulation-enhanced IPE curriculum was successful in improving participant attitudes toward teamwork and components of patient safety culture related to teamwork and communication.

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Key Words: Patient safety, Team training, Simulation, Emergency department, Graduate medical education, Interprofessional education, Simulation-enhanced interprofessional education.

In 1999, the Institute of Medicine published a report detailing the high rate of preventable adverse events that occurred during patient care. Although numerous systems

issues were present, teamwork and communication failures emerged as one of the major causes of medical errors.¹ This encouraged increased resources, support, and interest for the study of the effect of teamwork on patient safety. A retrospective closed claim review of emergency department (ED) risk management cases by MEdTeams determined that 43% of errors resulted from problems with team coordination. In these cases, an effective team structure with caregivers trained in team behavior would have mitigated or prevented 79% of the adverse events.² By applying successful team training strategies used in analogous high-stress, high-stakes environments such as aviation and the military that also rely on efficient team actions, MEdTeams were able to show direct effects in clinical outcomes by implementing a team training strategy.³

Policymakers and leaders in health care recognize that interprofessional collaboration (IPC) in the workplace is required to achieve efficient, coordinated, high-quality health

From the Yale Center for Medical Simulation (A.H.-W.W.), Department of Emergency Medicine, Yale School of Medicine, New Haven, CT; Department of Emergency Medicine (M.G., D.S.), New York University School of Medicine, New York, NY; and Department of Emergency Medicine (H.M.), University of California—San Francisco, San Francisco, CA.

Reprints: Heather Mahoney, MD, Department of Emergency Medicine, University of California, San Francisco, 505 Parnassus Ave, L-126, San Francisco, CA 94143-0208 (e-mail: heather.mahoney@ucsf.edu).

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care. The US Department of Defense's Patient Safety Program in collaboration with the Agency for Healthcare Research and Quality (AHRQ) developed TeamSTEPPS, an evidence-based training system, to nationally document and track improvement of patient safety. Training programs using TeamSTEPPS have successfully reduced intensive care unit length of stay⁴ by 50% and demonstrated improved work processes in a labor and delivery setting.⁵ Interest in interprofessional education (IPE) as a means to cultivate and foster IPC continues to grow among administrators, educators, and researchers given the increasing complexity of the organization and delivery of health care.⁶ Interprofessional education aims to encourage different professionals to meet and interact in a joint learning environment to improve collaborative practice and patient care. Both the Accreditation Council for Graduate Medical Education and the Interprofessional Education Collaborative (IPEC) have identified teamwork and interprofessional communication as key milestones and competencies for physician trainees and health care providers.^{7,8}

As medical simulation evolved from needs to fill notable gaps in patient safety, health care educators have increasingly adopted simulation-enhanced IPE to ensure that trainees will effectively function in patient-centered, collaborative health care teams.⁹ Advantages for simulation-enhanced IPE are multifaceted, including flexible and dynamic structures to meet diverse learner needs, experiential learning for higher degrees of engagement, incorporation of structured debriefing to promote peer-to-peer reflection and dialog, and opportunities to reveal cognitive frames around professional and cultural hierarchy and divisions.¹⁰ For instance, crisis resource management simulation training focuses on communication skills and emphasizes the role of human factors, including interprofessional relationships and hierarchy in high-stress, high-risk clinical environments.¹¹ Indeed, simulation-based education has shown increased interprofessional communication and augmented team knowledge.¹²

Within the seminal work of Benjamin Bloom and his taxonomy model of educational objectives, the "affective domain," referring to growth in the learners' attitudes or feelings, is one of the 3 core areas of learning along with knowledge and skills.¹³ Research focusing on health care providers' perceptions of teamwork has demonstrated that staff perceptions of teamwork and attitudes toward safety-relevant team behavior were directly related to the quality and safety of patient care.^{3,14} However, previous patient safety-related IPE interventions have shown mixed results in effecting successful improvements in trainees' perceptions and attitudes.^{15,16} Because health care simulation immerses learners together in an experiential process through a realistic practice environment while facilitating participants' self-reflection of internal frames and perceptions through the debriefing process, simulation-enhanced IPE may be the ideal tool to change clinicians' attitudes toward teamwork and interprofessional communication.

In the ED, efficient resuscitation of acute patients is contingent on caregivers working side by side while using effective teamwork and communication skills to provide reliable and safe care. The objective of this study was to assess and improve ED nursing staff and resident physicians'

attitudes and perceptions toward teamwork, communication, and IPC by implementing a simulation-enhanced IPE curriculum focusing on role identification, leadership development, and team communication. We evaluated this program in 2 ways: (1) directly measuring changes in attitudes toward team training and (2) assessing safety climate changes within the ED as a higher level of impact measurement using previously validated tools.

METHODS

Study Setting and Curricular Development

To ensure that our IPE intervention would directly address the concerns of our staff members, our group of interprofessional educators started the project with a needs assessment via a series of 3 focus groups with 20 key stakeholders from ED nursing, emergency physicians, and administrative leadership to create the training objectives of the course. After extensive discussion, we defined a specific perceived need for training in the adult medical resuscitation room. Within the adult ED, the "medical resuscitation room" was originally created 2 years ago for the rapid resuscitation of medically unstable patients. Nursing administration identified and reported concerns from their staff nurses that they were uncomfortable working in this new setting because of unfamiliarity with the space and paucity of a defined nursing role within the team. Multiple providers expressed concern that there were no formal protocols or guidelines in place for the resuscitation room. More importantly, staff members highlighted the overall lack of emphasis on teamwork and communication between physician and nursing providers in that space, even though they expressed the opinion that the care of the most critically ill patients would require the highest level of collaboration and interprofessional coordination. Thus, this needs assessment yielded the clinical and IPE content for the simulation-training scenarios, developed from previous cases with potential errors and near misses in the medical resuscitation room.

Our institution was a 1200-bed, adult urban teaching tertiary care public hospital in the United States with an academic affiliation. Potential subjects for this study consisted of 50 ED staff nurses and 59 emergency medicine (EM) residents in a 4-year training program for a maximum of 109 possible participants. Attendance for the training course was mandatory for nursing and residents as part of their annual competency training and required simulation-based didactic sessions, respectively. However, participation in the study via completion of the surveys was voluntary, and subjects were recruited upon arrival to the training course by the simulation research steering committee within the department. The sessions were held at the New York Simulation Center for the Health Sciences using the high-fidelity human patient simulator, the Laerdal SimMan 3G manikin (Laerdal Medical, Co; Wappingers Falls, NY).

Study Protocol and Timeline

Twelve 3-hour sessions were conducted from July to September 2012. To promote sustainability, we incorporated training sessions within already established mandatory

training periods for nursing and residents. Nursing staff in the adult ED was required to complete annual competency training for continued hospital employment. With support from nursing and department administration, we used 3 hours of this required period for this team training curriculum. For EM residents, simulation didactics occurred on a weekly basis in the simulation center on Wednesday afternoons. Also with approval from the residency administration, we replaced 12 of those sessions for the team training course. Furthermore, using the “spacing effect” from the psychology literature to maximize knowledge transfer and retention,¹⁷ we implemented reinforcement of the training course and translation of teamwork training to the clinical environment via regularly scheduled in situ simulations. These consisted of abridged versions of the 2 scenarios used in the course conducted in the physical space of our ED adult resuscitation room with a portable high-fidelity mannequin and were scheduled on regular biweekly sessions from September 2012 to June 2013. Finally, a brief electronic newsletter (*Teamwork Pearls*) was sent out to all ED staff on a monthly basis reinforcing principles learned in the training session. No other patient safety or teamwork-related educational interventions or initiatives were implemented in the department while this project was in effect, and none of the participants had any formal training in teamwork/communication skills before the initiation of our intervention.

Given that there was attending-level supervision 24 hours per day in the ED, we realized that the attending physician was a crucial member of the team and would affect team culture. To gain support from the EM faculty, they were recruited as instructors for the simulation sessions. These instructors were trained before the sessions on team training and debriefing strategies and cotaught with nursing leadership. Nursing leadership provided the continuity, session to session, whereas the EM faculty complemented the teaching team and became a vehicle for transferring the collaborative practice philosophy to the clinical arena. This initial pool of team instructors was then used to train the remaining nursing and faculty instructors for future sessions. During this process, EM faculty also received IPE exposure.

Simulations and Curriculum Description

Because our primary purpose for the intervention was to improve staff attitudes and perceptions of teamwork and interprofessional communication, we tailored all aspects of the simulations and debriefing topics toward that goal. The TeamSTEPPS curriculum was adapted to introduce teamwork and communication skills in a multistep manner to the participants.¹⁸ In addition, we placed both the learners and instructors in an interprofessional structure to reflect and model the spirit of IPE. Finally, we incorporated all 4 primary interprofessional competency domains identified by the IPEC⁸ in the steps described later. A detailed curriculum plan for this pilot course including specifics of the scenarios, didactic materials, and structured debriefing has been recently published,¹⁹ and key simulation-enhanced IPE components are highlighted later.

In summary, this team training course was a 3-hour experience consisting of an introductory lecture, 2 simulation

cases of high-acuity patients (sepsis, complete heart block/cardiac arrest) requiring efficient resuscitation and coordinated teamwork among the learners with structured debriefing after each case, and a brief final wrap-up session. The focus of the course was on teamwork and effective communication, and thus, the medical knowledge goals were secondary. In fact, we explicitly stated the clinical premises of the 2 cases that the learners were going to encounter during the introductory session.

Preparation

Before the course, we distributed a presession handout (see Appendix 1, <http://links.lww.com/SIH/A256>) outlining the new departmental team roles and responsibilities (IPEC competency 2) for the adult resuscitation room. These role definitions were formally approved and supported by ED administration and addressed staff concerns regarding the lack of formal team structure in the resuscitation room. The document dictated 3 specific roles for resident physicians and 3 specific roles for nursing staff with 1 physician and 1 nursing team leader, along with delineation of responsibilities for the attending physician and ancillary staff members. To reflect this structure and facilitate transfer to the clinical environment, we designed each simulation to incorporate 3 physician and 3 nursing learners into a 6-member interprofessional learner team mirroring the roles in the distributed document. Please also refer to Appendix 2 (<http://links.lww.com/SIH/A257>) for the supply list of materials and equipment used during the course.

Introduction

The course began at a conference room where learners were interspersed with instructors seated in a classroom format. The instructor team introduced themselves and asked each participant to state their name and role in the ED. Next, the instructors led a 30-minute introductory lecture on the goals/objectives of the course, the implementation of the formal 6-member team structure, and roles for the resuscitation room, and discussed tools and strategies for effective communication and teamwork based on TeamSTEPPS principles tailored to improve staff attitudes toward IPC. The interprofessional instructor team then moved learners to the simulation rooms for an orientation to simulation and the high-fidelity manikin.

Simulation Cases

Primary educational objectives for the simulations directly addressed outcomes that would improve IPC and are listed in Table 1. We developed 2 simulation scenarios using the event-based training technique.²⁰ Key branch points and critical actions of both scenarios were specifically designed to guide participants toward better understanding of interprofessional communication (IPEC competency 3) and the value of teams and task completion through teamwork (IPEC competency 4). The scenarios ended at 15 minutes regardless of whether the team has completed all critical clinical actions or reached a final disposition for the patient. The main goal was to give the learners opportunities to display potential communication and teamwork skills during the simulation and create a mechanism to generate discussions surrounding collaborative practice to impact participants' perceptions of

TABLE 1. Session Objectives

After this initial team training session, our goals for the learners were as follows:

- (1) Identify the different roles of the resuscitation team.
- (2) Describe characteristics of effective leadership strategies during medical resuscitation.
- (3) Demonstrate appropriate team strategies including listening, summarizing orders, as well as providing and initiating data gathering.
- (4) Determine effective communication skills such as closed-loop communication, summarizing patient status and the 2-challenge rule.

teamwork and interprofessional communication in the debriefing process.

Six nursing and 6 physician learners attended each course day, and we conducted 2 immersive simulation rooms simultaneously with 3 nurses and 3 physicians learning together per room in their new formal departmental roles. For the nursing team leader position, volunteers were requested among the nursing participants at the beginning of each day's session. In contrast, the most senior resident physicians in attendance each day played the physician team leader role in each room because the senior residents always acted in the leadership role during resuscitations in our department. The interprofessional instructor teams stayed in their respective rooms and conducted the same scenario twice while the 6-member learner team swapped rooms upon completion of the first scenario and debriefing. The team leaders stayed in their roles for the second case to provide them an opportunity to practice the leadership skills they gained from the first scenario and debriefing discussions.

The first case was of an elderly male who presented in rapidly worsening respiratory distress secondary to bacterial pneumonia, requiring the team to perform early goal-directed therapy for sepsis including intravenous fluids, antibiotics, central venous access, vasopressors, airway management and disposition to the intensive care unit. Critical actions that required a coordinated team effort centered on early recognition of refractory hypotension and management of a difficult airway in a rapidly decompensating patient. The second case involved a 60-year-old male who presented in cardiogenic shock secondary to complete heart block necessitating transcutaneous pacing, who then decompensated into ventricular fibrillation cardiac arrest requiring advanced cardiovascular life support and cardiac resuscitation. Key components related to IPC included interprofessional care coordination for a critically ill bradycardic patient and rapid detection of cardiac arrest with immediate continuous chest compressions and minimal interruptions.

Structured Debriefing

After the conclusion of each case, the instructors guided the 2 learner groups to separate conference rooms to conduct the debriefings. The interprofessional team of simulation-trained physician and nursing educators used techniques of advocacy-inquiry along with elements of psychological safety.²¹ As Rudolph et al²² describe, the debriefing process allows educators to understand the cognitive frames underpinning the participants' actions and thought processes during the simulations as well as their daily clinical practice. We strongly believed that changing our staff's frames around the values and ethics of interprofessional practice (IPEC

competency 1) would directly impact their attitudes toward teamwork and communication. As a result, our instructors ensured that the major discussion points focused on key actions during the simulations related to teamwork and communication successes/failures to help our learners gain insight into interprofessional cooperation as well as unique challenges and contributions of different health care professions. After each debrief, learners were given a short break as well as a brief moment to gather their thoughts before they were brought back to the simulation rooms for the second scenario.

Final Discussion and Wrap-up

After the conclusion of the 2 scenarios, the learners were brought back to the main conference room, where the group debriefed as a whole. The instructors first asked for overall thoughts and impressions on the simulations. Next, they reviewed the main clinical knowledge and teamwork learning points and ended with each of the learners citing their major take-home points from the course. Instructors also offered an optional tutorial for those participants that were interested in reviewing some of the more difficult clinical aspects of the cases back in the simulation rooms, including early goal directed therapy for sepsis, advanced cardiovascular life support algorithms and transcutaneous pacing. Finally, we distributed the postsession handout that summarized key "teamwork pearls" (see Appendix 3, <http://links.lww.com/SIH/A258>) to the participants as they left the simulation center to cement their knowledge regarding teamwork and interprofessional communication strategies.

Measurements

Because our goal was to impact staff attitudes toward teamwork and communication, our primary method of evaluation focused on assessing change in attitudes toward team training in our participants. The TeamSTEPPS Teamwork Attitudes Questionnaire (T-TAQ) was designed to measure individual attitudes related to the core components of teamwork that are captured within TeamSTEPPS.²³ It has been frequently used both to assess specific needs within a clinical unit or health care institution and to determine if a teamwork intervention produced a desired attitude change. The specific individual attitudes measured are toward team structure, leadership, mutual support, situation monitoring, and communication. A recent rigorous analysis of the T-TAQ using a survey-based method with 1700 health care professional participants confirmed the instrument's construct validity.²⁴ We distributed the T-TAQ survey before and after session at each day of the course.

As part of AHRQ's "The Effect of Health Care Working Conditions on the Quality of Care" research portfolio, a model outlining aspects of organizational climate and its relationship to worker and patient outcomes was developed by a team of interdisciplinary scholars analyzing current research to date in 2003. They validated their findings and developed a safety climate questionnaire with results correlating to patient outcomes.^{4,25} In 2004, this Hospital Survey on Patient Safety Culture (HSOPS) was released by AHRQ and is now used by hospitals in the United States and internationally.¹⁸ This survey has subsequently been

linked to outcomes data and correlated for expected improvements in patient safety.^{26,27} To demonstrate a higher level of impact of our simulation-enhanced IPE intervention, we used 6 of the 12 patient safety constructs of the HSOPS, which were relevant to teamwork and communication skills to reflect results at the “behavior” level according to Kirkpatrick’s model of program evaluation.²⁸ For the purposes of this study, we used the version for hospital-based training. The HSOPS was distributed immediately before the session in person and 12 months after the session via a Web-based interface to the participants of the course.

We hypothesized that there would be a significant improvement in teamwork attitudes from presession to post-session results in T-TAQ as well as an improvement in the metrics relevant to teamwork, handoffs, and communication at 1 year after the intervention in HSOPS as a result of our simulation-enhanced IPE curriculum.

Study Design

This was a survey-based study, and questionnaires were distributed for completion in person immediately before each team training session and upon the completion of each day’s educational activities. A supplemental follow-up online distribution of the patient culture (HSOPS) survey was performed at 1 year after the intervention to assess sustainability of changes to the safety culture. An information sheet with elements of informed consent was distributed to staff members before participation in the study. Completion of surveys was taken to signify implied consent. Our study was granted approval as exempt status through the New York University School of Medicine’s Institutional Review Board. No identifying information was collected from the study participants, and a waiver of consent was granted because the study was of minimal risk.

Statistical Analysis

Baseline demographic data obtained from HSOPS were analyzed via the χ^2 test. Both survey instruments used a Likert-type response scale ranging from 1 (strongly disagree) to 5 (strongly agree) for all survey measures. As dictated by the T-TAQ Manual, the T-TAQ individual questions were grouped into 5 teamwork constructs—team structure, leadership, situation monitoring, mutual support, and communication. Presession and postsession survey responses were compared for each teamwork construct using the independent 2-tailed Student *t* test. To ensure that the sample followed a normal distribution, Wilcoxon tests were performed, and these gave the same results as the *t* tests with regard to statistical significance. Analysis of HSOPS data was based on guidelines from AHRQ.¹⁷ Survey questions were grouped into 12 separate patient safety constructs, with 6 of them directly related to teamwork and communication. Responses correlating to “agree” or “strongly agree” on the 5-point Likert scale within the survey were counted as a positive response, and a χ^2 test was used to compare pooled positive responses between the presession and 1-year follow-up time points. For all of these analyses, a $P < 0.05$ was deemed statistically significant. All statistical testing was performed with SPSS software (version 21.0; Chicago, IL).

RESULTS

Changes in Participant Attitudes

Over 12 sessions from July to September 2012, a total of 72 staff members participated in the course. Survey response for T-TAQ was 100%. Of the 5 teamwork construct question groups, 4 had a significant improvement in scores—6.4%, 2.8%, 4.0%, and 4.0% for team structure, leadership, situation monitoring and mutual support, respectively ($P < 0.0001$, $P = 0.029$, $P = 0.014$, and $P = 0.003$, respectively). The communication construct had a near-significant 2.6% improvement ($P = 0.107$) (Fig. 1).

Impact on Safety Culture

For HSOPS, there were 72 and 32 participant survey responses before the session and at 1 year, respectively. Baseline demographics for survey responders for presession and one-year postsession are displayed in Table 2, and no statistical differences were noted in the duration of employment at the hospital or department, number of work hours per week, staff position, or length of experience in current profession.

Of 6 safety culture composites directly related to teamwork/communication, 3 showed a significant improvement in the percentage of positive responses—20.6%, 20.5%, and 23.9%, for frequency of event reporting, teamwork within hospital units, and hospital handoffs and transitions, respectively ($P = 0.028$, $P = 0.035$, and $P = 0.024$, respectively). One construct not directly related to teamwork/communication significantly decreased in percentage of positive responses—21.4% for hospital management support for patient safety. Otherwise, the 8 other composites did not demonstrate significant changes. Please refer to Table 3 for a summary of the results.

DISCUSSION

We found significant improvements in staff attitudes toward teamwork and effective communication via responses from the validated T-TAQ survey as a result of implementing a simulation-enhanced IPE curriculum tailored to affect participants’ attitudes and perceptions toward interprofessional collaborative practice. Since the conclusion of our intervention, several studies have shown that team behavior training for health care staff improved participant teamwork and communication knowledge across different acute care settings.^{29,30} Using a health care simulation methodology to augment IPE, we were able to improve teamwork and communication attitudes for ED personnel.

In addition, we wished to evaluate our instruction program both at a higher level of impact and over a longer time course. As the HSOPS¹⁸ measured changes in the safety culture of our departmental unit, results from the survey correlated with the level 3 “behavior” level according to Kirkpatrick’s model of training evaluation.²⁸ A recent study demonstrated a direct correlation between adoption of team behaviors with positive responses on the HSOPS constructs.³¹ Our intervention was successful in sustaining changes to 3 of the 6 safety culture survey constructs directly related to teamwork and communication at 1 year with frequency of event reporting, teamwork within hospital

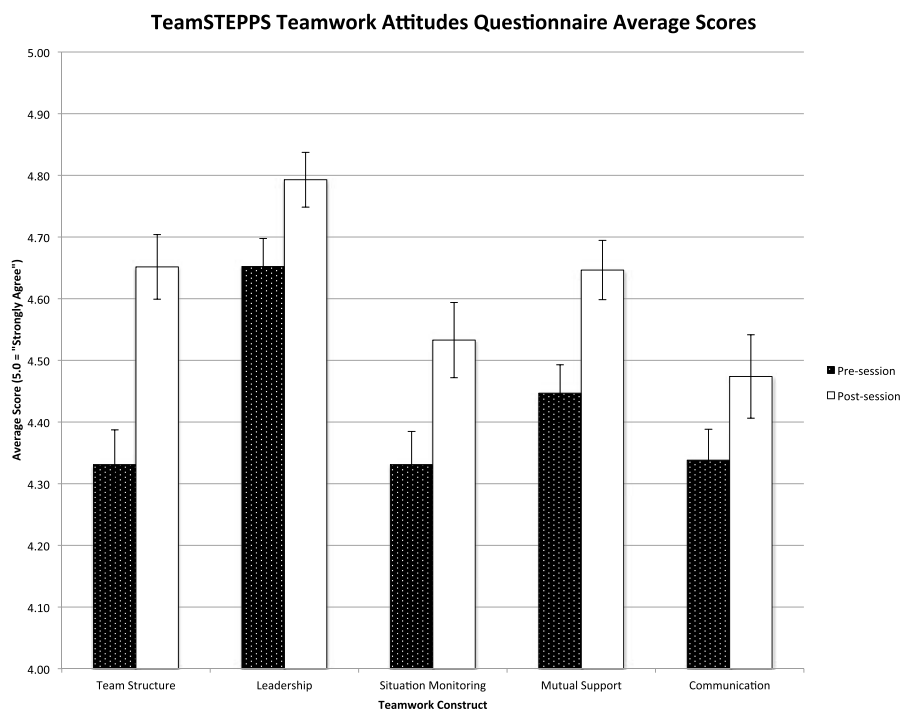


FIGURE 1. TeamSTEPPS Teamwork Attitudes Questionnaire average scores.

units, and patient handoffs and transitions. These areas of patient safety directly reflected the goals of improving staff attitudes toward teamwork and communication based on our initial departmental needs assessment. Demonstrating improvements in teamwork processes, including safety or teamwork climate, is the next layer in evaluating

team training interventions that can ultimately lead to direct impact in patient outcomes.³² However, a recent meta-analysis on team training in health care found that only 16 of the 26 studies identified since 2010 evaluated impact at the level of teamwork processes, with 12 of these reporting significant improvements.³³ More importantly, the reviewers identified

TABLE 2. Demographics

How Long Have You Worked in This Hospital?				What Is Your Staff Position in This Hospital?				
	2012	2013	P		2012	2013	P	
<1 year	7	0	0.53	Registered Nurse	41	16	0.20	
1–5 yr	47	21		Resident Physician	31	15		
6–10 yr	5	5		How long have you worked in your current specialty or profession?				
11–15 yr	3	2			2012	2013	P	
16–20 yr	6	1		<1 yr	7	0	0.19	
≥21 yr	4	2	1–5 yr	45	19			
How long have you worked in your current hospital work area/unit?				6–10 yr	4	5		
	2012	2013	P	11–15 yr	2	2		
<1 yr	8	1	0.35	16–20 yr	9	3		
1–5 yr	47	21		≥21 yr	6	2		
6–10 yr	8	7		Typically, how many hours per week do you work in this hospital?				
11–15 yr	1	0			2012	2013	P	
16–20 yr	6	1		20–39	20	12	0.58	
≥21 yr	2	1		40–59	39	15		
				60–79	11	4		
				80–99	2	0		

TABLE 3. Results for Hospital Survey on Patient Safety

Constructs Related to Teamwork/Communication	Year	n	% Positive Response (4 and 5)	P
Frequency of event reporting	2012	70	20.0%	0.028*
	2013	32	40.6%	
Teamwork within hospital units	2012	72	63.9%	0.035*
	2013	32	84.4%	
Communication openness	2012	72	18.1%	0.648
	2013	32	21.9%	
Feedback and communication about error	2012	72	58.3%	0.482
	2013	32	65.6%	
Teamwork across hospital units	2012	72	11.1%	0.07
	2013	32	25.0%	
Hospital handoffs and transitions	2012	72	41.7%	0.024*
	2013	32	65.6%	
Constructs not related to teamwork/communication	Year	n	% Positive Response (4 and 5)	P
Overall perceptions of safety	2012	72	20.8%	0.415
	2013	32	28.1%	
Supervisor/manager expectations	2012	72	19.4%	0.776
	2013	32	21.9%	
Organizational learning/continuous improvement	2012	72	66.7%	0.057
	2013	32	46.9%	
Nonpunitive response to error	2012	72	16.7%	0.526
	2013	32	21.9%	
Staffing	2012	72	8.3%	0.862
	2013	32	9.4%	
Hospital management support for patient safety	2012	72	37.5%	0.032*
	2013	31	16.1%	

* indicates *P* values that were significant.

only 1 study conducted at Cincinnati Children's Hospital as based in an ED setting where the authors incidentally found a decrease in patient safety events from 12 to 2 occurrences after implementing their team training intervention.³⁴ Our improvements in processes related to teamwork and transitions of care will contribute to the growing body of literature that simulation-enhanced IPE interventions can directly impact health care staff safety performance.

Although the primary objectives for this initial training intervention focused on improving attitudes toward teamwork and communication within the resuscitation room, we were also interested in investigating our department's performance in the other areas of patient safety climate. Additional results from HSOPS revealed that our ED staff's positive responses toward hospital management support for patient safety significantly decreased. Qualitative feedback from staff participants afterward consistently expressed gratitude for implementing the course as well as the in situ simulations but described a dire need for improving staffing structure and supervisory support in their work environment. One participant wrote, "I just want to say that at night we are always short-staffed for RNs, PCTs, phlebotomists, and EKG technicians, and the load of patients is enormous. This is especially [true] when the [intoxicated] population increases on Friday and Saturday." During our initial needs assessment, we had received anecdotal reports that echoed these results. However, this was the first instance that established concrete evidence to support claims for increased

systems support in these areas. Our institution is a 1200-bed public and urban safety-net hospital, and national comparative database reports from HSOPS have consistently shown that larger bed size and government-owned status each independently correlated with lower positive percentages.³⁵ These valuable data can be used to emphasize to our administrative stakeholders that there are ongoing active needs within our department requiring change. In addition, our future team training efforts can tailor toward addressing these disparities if we secure further administrative buy-in to do so.

Despite these constraints, we were successful in improving multiple facets in patient safety climate parameters directly related to teamwork and communication. During debriefing sessions of our simulations and subsequently in our weekly in situ simulations, staff members identified administrative and workflow deficiencies within our department and implemented multiple quality improvement initiatives as a result. These initiatives were directly related to teamwork and communication improvements, including the creation of a formal physical floor plan for members of the interprofessional team during a resuscitation, addition of a digital clock for nursing to track precise timing of clinical actions, formal announcement of a "critical alert" for new patients entering the resuscitation space, and coordination with emergency medical services to streamline patient flow for the critically ill cases identified in triage. Our pilot course also subsequently generated further interest in IPE and team training, prompting 5 faculty and 2 nursing staff members to complete the TeamSTEPPS Master Trainer Certification and triggering similar simulation-enhanced IPE efforts in the pediatric emergency and trauma services units.

As our second time point in the HSOPS data followed implementation of these additional strategies to improve patient care in the resuscitation room, improvements in the teamwork/communication-related constructs may have reflected these changes in addition to our original simulation-enhanced IPE curriculum. However, these additional developments were precipitated directly by our educational intervention, and the quality improvement initiatives were discovered as a result of the simulations both during the 12 weeks of the course and subsequently in the physical space of the adult resuscitation room. Moreover, knowledge decay and retention are major issues when the educational intervention occurs in one discrete setting. Literature from cognitive and educational psychology have demonstrated that the "spacing effect," where learning elements are reintroduced on multiple occasions spaced in time, significantly improved long-term learning.³⁶ Our hope was that the in situ simulations would address this need as condensed reiterations of the original IPE course. Recent successful large-scale simulation-based patient safety programs have also incorporated adjunct initiatives in addition to the primary simulation educational curriculum to effect sustained process and culture changes.^{37,38} The April 2015 Institute of Medicine report titled, "Measuring the Impact of Interprofessional Education on Collaborative Practice and Patient Outcomes," has tasked the medical community to align IPE initiatives with organizations responsible for collaborative practice to increase the effectiveness of IPE initiatives and create feedback loops between

practice and education.³⁹ Our hope was that this comprehensive simulation-enhanced educational program would align with administrative strategies that improved our staff's clinical practice while contributing to the ultimate development of an integrated, interprofessional health care delivery system for our most critically ill patients.

LIMITATIONS

One potential confounder of our study was the effect of an unexpected natural disaster that affected our city and hospital: Hurricane Sandy landed 1 month after the completion of our course in the fall of 2012. The ED and hospital remained closed for 2 months, and as a result, many nursing and ancillary staff worked temporarily in other local health care facilities within the same public city hospital system to which our hospital belonged. Our hospital was able to re-open within 2 months, and greater than 95% of our staff members returned to the facility before the second HSOPS survey distribution. However, the disruption in our hospital's operations as a result of the hurricane may have contributed to the worsened safety climate measures related to hospital management support in our survey results. Conversely, participants' potentially negative experiences in the various clinical sites before their return to our facility may have falsely improved the responses related teamwork/communication constructs. The effects of Hurricane Sandy likely affected our survey response rate as well, as fewer than half of our participants submitted responses at 12 months. However, written feedback from our staff suggested that the simulation-enhanced IPE intervention might have mitigated some of the effects from the natural disaster. As one participant wrote on the HSOPS survey at 12 months after the intervention, "Thank you, team training [leadership]! Training events with our department's nursing staff have been so helpful for team morale during [Hurricane Sandy]."

Another potential limitation pertained to our exclusion of attending physicians as learners in this pilot team training curriculum. Unfortunately, this is a common obstacle with team training interventions, as it carries significant financial burden for the department and requires administrative support to provide protected time and commitment for faculty development. However, our physician trainees were required to supervise and perform effectively as attending physicians in the ED during their final training year. Therefore, we were able to preserve the team model used in our department during the simulations even without the attending physician. Moreover, 10 faculty members contributed toward our efforts while indirectly receiving IPE exposure by participating as educators for the course. Additional attending physicians participated as team leaders during our biweekly in situ resuscitations after the completion of the course.

Because of our study design, we were unable to place every nursing and physician learner in the leadership role during the simulations. In general, the most senior resident physician acted as the physician leader because of the structure of graduated responsibility inherent to the training program, whereas the nursing leader was randomly chosen among the nursing learners in attendance. This may have

impacted the results of the teamwork attitudes survey. Moreover, a potential power dynamic may have been in play between the professions because the physicians were technically in training as opposed to the nurses who were independent practitioners. We believe that this difference had minimal impact, as the resident physicians practiced with a high level of independence in the clinical environment and worked with nursing staff as equals in the resuscitation room. Finally, despite the fact that the training program was mandatory, participation in the study was voluntary, which may have introduced an element of bias in the survey responses.

CONCLUSIONS

In summary, a simulation-enhanced IPE curriculum successfully improved staff teamwork attitudes and multiple facets of patient safety climate related to teamwork and communication effectiveness in the ED. Our results demonstrated that using simulation in the IPE arena not only significantly enhanced health care workers' attitudes toward effective teamwork and communication behaviors but also directly impacted teamwork processes and potentially patient safety outcomes and parameters. This is important in the chaotic and busy ED setting, especially in an urban safety-net type institution where personnel may have more concerns regarding staffing or supervisory oversight. The next steps in simulation-enhanced IPE research will hopefully lead us toward sustainable, translatable, and outcomes-based efforts to improve patient safety by activating the highest levels of team effectiveness when caring for the critically ill patient.

Future work may include involvement of other disciplines including critical care and cardiology consultants, data collection over multiyear periods, comparison of different methods of training implementation, as well as a higher level of evaluation to include patient outcomes or direct indices of care safety and quality.^{10,32,40,41} Finally, validation studies of our IPE curriculum across different clinical sites may expand the applicability of the training methodology used in our study to a wider spectrum of institutions and departments.

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