

Reducing Patient Harm Through Interdisciplinary Team Training with *In Situ* Simulation

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ABSTRACT

Effective interactions between professionals from highly diverse disciplines is essential in order to achieve high reliability¹⁰ The recognition that team failure is a key factor in patient injury^{9,13} has led to the importance of team skills to providing safe patient care. The use of simulation teamwork training is an effective method to increase safety in healthcare^{11,5} However, simulation-based team training without team performance measurement results in unguided practice for teams, which limits the effectiveness of time and resources spent training¹⁰ The same observation holds for feedback to simulation participants and follow-up from the problems identified in a simulation trial. When participants receive feedback and follow-up in performance problems identified, the experience becomes richer and more meaningful. This presentation summarizes how to develop and implement interdisciplinary team training with practicing professionals using *in situ* hospital simulation. *In situ* simulation offers a whole new insight into health care processes and team functioning to improve patient safety and avoid sentinel events caused by team breakdown and communication failure. We use advanced simulation techniques at the microsystem level to better understand system flaws, process failures and team breakdowns that can lead to sentinel events. Simulation results can be used in a FMEA (Failure, Mode and Effects Analysis). We combine the Agency for

Healthcare Research and Quality (AHRQ) TeamSTEPPS curriculum with *in situ* simulation training to foster a rich learning environment and a language of team skills that can improve team function and decrease the risk of harm to patients.

1.INTRODUCTION

Successful simulation training in healthcare requires performance assessment of both clinical and nontechnical skill⁴¹⁵ on an individual and team level⁹ While simulation training is becoming an important modality for improving patient safety and quality in health care, simulation labs typically focus on individuals gaining competency in technical skills dealing with various clinical episodes. Unlike simulation labs in academic centers, *in situ* hospital simulation training is for interdisciplinary professional teams that have mastered technical skills, but need insight on communication and team dynamics.

We developed the team training program in a large integrated multi-hospital health care delivery system in Minnesota. Our goal was to improve the safety, reliability and quality of patient care services through development, implementation and assessment of *in situ* simulation team training in high hazard critical events. The *in situ* hospital simulation focuses on teamwork and communication skills to determine how leadership is established and transferred based upon an individual team member maintaining their situational awareness as well as the entire team having a shared mental model of the clinical picture, the sense of urgency and the plan of care. We explored how critical communication is achieved in a task-saturated environment during cycles of team formation and re-formation within a simulated emergency event in an actual

hospital setting. This *in situ* simulation involves interdisciplinary teams of nurses, physicians, anesthesiologists, Fairview Health Services nurse anesthetists, operating room technicians, nurse practitioners, and many other hospital staff from other departments.

There are three basic components for safety: 1) the provider, 2) the team, and 3) the system designed for safety. The provider needs to be highly trained, experienced and committed to patient care including quality and safety. The health care team must be proficient in team skills, especially effective communication skills. The system must be not only designed for safety, but vigilance and surveillance in monitoring constant system changes which effect safety. While neither providers nor health care executives are schooled in systems engineering and application for safety⁸ the *in situ* simulation helps to create awareness in both groups of systems problems and team breakdowns.

2. METHODS

We conducted a pilot study of simulated obstetrics emergencies involving physicians, nurses and support staff called, “*In situ* simulation for Obstetric and Neonatal Emergencies,” through a collaboration between Fairview Health Services and the University of Minnesota Academic Health Center from January 2006 to January 2007. Settings for *in situ* simulation were the perinatal units and operating rooms of six community and academic hospitals of the Fairview Health System in Minnesota. All trials were videotaped for use in debriefings and for content analysis by the researchers.

In situ simulation has four key components: 1) a full briefing to participants and the labor and delivery unit, 2) *in situ* simulation scenario, 3) debriefing with all participants and 4) follow-up.

Briefing always emphasized communication and teamwork skills, the importance of participants doing what they would normally do in a real clinical scenario, and the need to suspend one’s disbelief and move past simulation limitations. Simulations were videotaped with still cameras fed to an observation room and a hand-held camera that provided the tape for viewing at debriefings. Debriefing took place in a comfortable conference room with a television for viewing the simulation. Debriefing started with the junior member of the team and gave all participants a chance to comment on the simulation. Video was then reviewed and the simulation videotape was stopped periodically to discuss what occurred from a communication and teamwork standpoint. Participants were allowed to add further comments at the end of the videotape review. Communication and teamwork breakdowns were documented throughout the debriefing, and latent conditions in the work environment were identified by the participants and recorded.

Obstetric scenarios were written based on sentinel events: abruptio placenta after a motor vehicle accident, and ruptured uterus in a patient with previous cesarean. Scenarios were then placed into “event sets”, a technique adopted from the Federal Aviation Administration’s Advanced Qualification Program for airline pilot simulation⁶. Each scenario was designed to prompt specific human factor behaviors such as leadership, shared mental model, situational awareness, and structured communication techniques of Situation, Background,

Assessment, Recommendation and Response (SBAR-R), and closed loop communication. The scenarios were developed with specific triggers (sudden clinical changes) and distracters, such as the inability to speak English, refusal of cesarean, aggressive family member and others, used to mimic a real-life incident. Simulations started with a nurse encounter with a patient and significant other, and proceeded to the requirement of calling a “code” cesarean, the delivery of the baby and neonatal resuscitation. Standardized patient and fetal monitor simulator were used for labor and delivery and when the simulation required moving to the operating room manikins (SimMan and SimBaby Laerdal) were employed.

Prior to *in situ* simulation debriefings teamwork and communication skills were discussed with emphasis on TeamSTEPPS curriculum as developed by AHRQ¹ TeamSTEPPS is an evidence-based curriculum of communication and teamwork strategies and tools that have been shown to improve team performance in any inpatient or outpatient setting. The emphasis of *in situ* simulation is to help individuals learn how to become better team members. The focus is not to train a large number of individual teams to competency, but rather to train individuals to become effective team members through focused communication and team behaviors. Based on video analysis of the first 35 simulations, we provided a didactic curriculum to all participants which emphasizes the key factors found to effect the performance of a team of individuals suddenly put together in an emergency. These were 1) situational awareness, 2) SBAR-R (situation, background, assessment, recommendation, and response), 3) read-backs or closed-loop communication, and 4) shared mental model.

Follow-up consisted of a simulation team debriefing at the end of the participants debriefing to reflect on potential improvements for the unit and future simulations. Information regarding process improvement from participants was generated as late as one week after the *in situ* simulation, but was not considered for the study.

3. RESULTS

In situ simulations took place on six Labor & Delivery units in the Fairview Health Services system and averaged approximately 45 minutes to complete. Debriefings of these simulations averaged two hours.

3.1 Assessing design for safety:

In situ simulation provides a prospective way of looking at care processes that affect patient safety. It allows for assessment of interdisciplinary team function, interdepartmental coordination, communication effectiveness, policy compliance, testing of new processes and observation of technical skills. The debriefing is a rich environment with multidisciplinary input into system weaknesses, where participant’s comments about communication and teamwork errors, could be captured.

This collective intelligence of the participants during the debriefing proved valuable in conducting a Failure Mode and Effects Analysis (FMEA) for the labor and delivery unit. Following the Joint Commission’s six-step model for FMEA⁷ we took the self-reported data and then calculated a risk priority number (RPN) for each of the failure modes. This not only

satisfied a Joint Commission requirement, but also gave the administrative team a framework for implementation of countermeasures that could prevent patient harm ³

The FMEA results showed that the top three failure modes, based on RPN, were 1) unclear role definition of team members during emergency cesarean, 2) inconsistent process for ordering blood products in the operating room, and 3) lack of closed-loop communication between the operating room and the blood bank. These FMEA results were based on 12 simulations and debriefings at one hospital.

3.1.1 Lessons for interdisciplinary teams:

Changes in the perinatal unit at the system level are communicated as an outcome of the simulation. Feedback from participants after the simulations are documented and can be very revealing as cognitive changes may occur several days after simulation. Examples of changes to hospital processes based on in situ simulation included relocating phones for ease of access, establishing a “OB Hemorrhage Panel” that can be requested by a nurse or doctor and immediately signals the lab that Labor & Delivery is the top priority and automatically orders blood work and blood for the unit, changing pediatric crash carts, and trial implementation of colored OR caps to distinguish staff in different roles, such as a red cap for a circulating nurse.

In situ simulation is an effective method of experiential learning that reinforces the value of becoming an expert team member. The realistic simulation scenarios have deliberate design features that create stress and influence participants to gain awareness of key communication and team learning behaviors. Nurses who had routinely performed the role of the circulator have had behavioral changes that they confirm when interviewed. Many now recognize that when they are rushing into the operating room with the patient, this is a “critical juncture” that demands clear communication with the neonatal team and the newly forming anesthesia team. They recognize that it is easy for them to become “task saturated” or be “multitasking” during patient preparation. To maintain their own situational awareness they may need to ask for help or designate another staff member to do some of the tasks. This is also an important moment to utilize clear “closed loop communication” with another provider so that one person works on a task. Failure can lead to two people trying to accomplish something, or no one attending to the need. The former contributes to inefficiency and the latter to ineffectiveness.

3.1.1.1 Culture of safety improvements

The Safety Attitudes Questionnaire (SAQ) by Sexton (Sexton, et al, 2006) was administered to one entire Fairview hospital two months prior to *in situ* simulation. Twelve *in situ* simulations were performed at this hospital over four months. The SAQ was repeated six months after the last simulation. The hospital’s aggregate data for the SAQ showed a decline or no significant change in team and safety scores. However the perinatal unit had six key indices that showed statistically significant improvement. These included the following questions and their percent improvement from the year 2005 (prior to *in situ* simulation) to 2006 (after simulation): 1) “Personnel frequently disregard rules or guidelines that are established for this clinical area.” Percent of respondents that disagreed strongly increased 43%. 2) “Important issues are communicated at shift

changes.” Percent of respondents that agreed strongly increased 39%. 3) “The physicians and nurses here work together as a well-coordinated team.” Percent of respondents that agreed strongly increased 36%. 4) “In this clinical area, it is difficult to speak up if I perceive a problem with patient care.” Percent of respondents that disagreed strongly increased 54%.

The other two statistically significant changes in the SAQ were in the number of respondents reporting a positive teamwork climate (increased by 5.9%), and those reporting a positive safety climate (increased by 1.4%). The number of respondents for the perinatal unit was 112, with the number of physicians participating decreasing slightly.

Table 1 summarizes the uses and applications of in situ simulation for interdisciplinary team training. The six applications identified in the table refer to the variety of learnings in our pilot study including basic research (exploring the dynamics of rapidly formed teams as well as team formation and reformation), assessing team performance and system problems (identifying breaches in defensive barriers), conducting team training (creating an interdisciplinary team experience), improving culture (through an increased culture of safety), improving safety design (through enhanced FMEA analysis), and improving team communication skills (by incorporating the AHRQ TeamSTEPPS concepts).

Area	Example
Basic Research	Team formation and reformation
Assess Team Performance	Identify Breaches in Defensive Barriers
Team Training	Interdisciplinary team Experiences
Improving Culture	Culture of Safety
Improving Safety	FMEA Analysis
Improving Team Communication	TeamSTEPPS

4. DISCUSSION

Interdisciplinary team training with *in situ* simulation is an experiential, prospective way for staff and hospitals to identify weaknesses in team behavior and processes that effect patient safety. This provides a novel way to conduct a FMEA, as the debriefings following *in situ* simulations possess a rich learning and sharing environment that illuminates the latent conditions and active failures that healthcare teams face on a daily basis.

The use of “event set” triggers and distracters induces team interaction and stresses interdisciplinary team function. Consequently the fidelity and acuity of the simulation is increased and creates ample opportunity for team members to make mistakes and allows observers to appreciate where processes break down. This provides a rich source for process improvement. We did not compare our *in situ* simulation FMEA results with a traditional FMEA for the specific Labor & Delivery unit in this current study.

In situ simulation and subsequent debriefing also provides a forum for the collective intelligence of hospital staff. Healthcare teams rarely train together and rarely have an outlet for multidisciplinary discussions about how care is delivered. *In situ*

simulation provides this outlet and we have shown how these discussions can further the patient safety process by identifying risks, but it is important to note that the debriefings are also “teaching” moments where communication tools and strategies (as in TeamSTEPPS) can be demonstrated to the healthcare team. Videotape is stopped at clinical triggers and distractors so that participants can see what key behaviors they did or did not employ. The time and space continuum of simulating on the healthcare team’s unit provided the context fidelity required to observe the team’s communication strengths and weaknesses not only in the patient’s room, but in hallways, on the phone, and with other teams that joined the simulation (such as lab technicians, pharmacy, rapid response team, etc.). It became readily apparent that *in situ* simulation provides the environmental cues necessary for team members to utilize their human factor skills, such as situation awareness, communication and shared mental models. Much of the useful conversation in debriefings revolved around understanding an environmental cue, knowing what communication and teamwork strategy or tool to use, and how that knowledge contributed to an improved shared mental model for the team.

The SAQ survey results reveal that the attitudes of the Labor & Delivery unit improved tremendously, while the rest of the hospital remained stagnant or declined. Although cause and effect is not proved, this is powerful evidence that participating in *in situ* simulation may contribute to a positive safety and teamwork culture. Great camaraderie was exhibited during debriefings at all six hospitals, and testimonials abound from the participants (and administrators) as to how *in situ* simulation changed not only their unit, but also their personal lives. It is now a challenge to take the large amount of qualitative information and demonstrate a reduction in true patient harm. This must take into consideration process measures, as showing a reduction in perinatal harm is difficult due to the low overall numbers of bad outcomes.

Many lessons were learned from conducting *in situ* simulation. Modification of the simulation to optimize the experience for the team was important and generally involved feedback from the participants as to how to increase the fidelity of the *in situ* simulation. Examples included using real people in the labor suite, not a manikin, and requiring the team to transfer the manikin from a gurney to the operating room table rather than placing the manikin on the operating room table prior to simulating.

As can be seen, *in situ* simulation has many benefits, including identification of latent conditions that may affect patient safety, teaching of team skills, the opportunity for team discussions centering on improved team performance, and the observation of team skills, technical skills, individual leadership and communication.

Salas proposes five phases for to train and assess teamwork skills: information, demonstration, practice, feedback and remediation¹¹ Measurement practices guide learning and corrective feedback as well as helping to ensure that learners possess the requisite competencies for effective on the job performance¹⁰ The two most important performance measurements that should be provided for team training are: 1) what meaningful feedback should be given to the team and each

individual member, and 2) what further training is required by the team or individual members?¹⁰ Our study suggests two other important uses of in situ simulation: 1) what latent conditions can be identified dormant in the health care process and 2) how can training information be used by individuals and health care teams to proactively assess risk? The former is accomplished by developing realistic, validated scenarios with event sets that stress the process and team performance in a way that allows intense interrogation of the process not otherwise possible. The latter is to improve FMEA studies. Although the immediate causes of most sentinel events are almost always linked to human fallibility, the root cause analysis is expected to reach well beyond this level to underlying organizations systems and processes that can be redesigned to create protections against future human error and to protect patients from harm when human error does occur⁸. The in situ simulation helps enhance the validity and accuracy of FMEA studies, going beyond a retrospective RCA study which occurs after an injury occurs.

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