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Use of in-situ simulation to investigate latent safety threats prior to opening a new emergency department

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ABSTRACT

Introduction: The opening of a new emergency department creates numerous unknowns that can become latent safety threats (LSTs) to patient welfare. Healthcare providers can also experience increased stress working in a novel environment, which has been shown to negatively affect decision making, teamwork, and ultimately patient safety.

Methods: In order to identify LSTs and orient staff, multidisciplinary teams participated in 15 in-situ simulations followed by focused debriefing sessions that stressed uncovering LSTs prior to the ED's opening. Participants also received an electronic, de-identified survey requesting feedback and recollection of any additional LSTs not mentioned during the debriefing. Staff members were then sent the NASA-Task Load Index questionnaire during the first week of opening, which focused on the staff members stress level.

Results: Over 100 healthcare workers of various disciplines participated in 15 in-situ simulations over the course of one day. Thirty-five LSTs were identified and modified before the opening of the new emergency department. The majority (93%) of participants felt that simulations helped them orient to the new space. While the absolute level of stress was the same between cohorts, irritation and discouragement were 16% less in the group completing the simulation.

Discussion: In-situ simulations performed prior to the opening of a new emergency department identified 35 modifiable latent safety threats. Simulations were an effective way to orient staff to the new space and seemed to decrease the level of discouragement and irritation of healthcare workers during the first few weeks of the emergency department's opening.

1. Introduction

The opening of a new, emergency department is fraught with numerous unknowns. Hurricane Sandy 2012 created chaos for much of New York City including the Emergency Department (ED) at New York University Langone Medical Center (NYULMC), which was flooded and destroyed during the storm. Patient care was moved to a temporary unit, while construction of a new, state of the art emergency department began. Considerable planning went into this new ED. How to best utilize this new physical space, how to optimize patient flow, and how to maximize patient safety had been extensively reviewed and discussed, but could not be tested *a priori*.

In-situ simulation has gained credibility for studying and evaluating new facilities and systems. In situ-simulation literally means simulation "in position." Instead of simulation performed in a specified facility, it is done in the work environment, so that it is fully integrated with clinical operations (Guise and Mladenovic, 2013). It can be essential for detecting hazards or latent safety threats (LSTs) involving information transfer, technology, system weaknesses, and staffing inadequacies that may not be discovered by simply theorizing about the care delivery process (Rodriguez-Paz et al., 2009). These hazards can then be identified and rectified before patient care is compromised. This attention to human factors and ergonomics (HFE) in design and implementation can optimize overall system performance, mitigate patient safety threats, and improve job satisfaction, motivation, and technology acceptance (Carayon et al., 2014). Other institutions have successfully used in-situ simulation to test for LSTs before the opening of their new spaces. Four days before Rhode Island Hospital opened its new ED, two in-situ test pilot sessions with multi-disciplinary teams identified multiple equipment issues, including missing laryngoscope blades, nonexistent defibrillator connector cables, and a lack of thoracostomy tubes. Several ergonomics issues were identified as well, including an airway equipment tray that was easily knocked off the shelf during

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a code (Kobayashi et al., 2006). Additionally, prior to the opening of a new satellite ED in Cinncinatti, in-situ simulations uncovered 37 latent safety threats, most of which involved equipment or resource allocation. Examples included lack of defibrillators, insufficient oxygen flow to support two bag-mask ventilations, lack of an infant warmer, and the inability for the charge nurse to see patient monitors, amongst other safety issues (Geis et al., 2011).

"To Err is Human" noted that faulty systems, processes, and conditions lead people to make mistakes (Institute of Medicine (IOM), 1999). Our primary goal for this project was to test whether in-situ simulation could identify faulty systems and processes before they could negatively impact patient safety in the new ED. Our secondary goal was to assess how performing in this new clinical space would affect staff performance. Acute stress has been shown to affect decision making and teamwork (Flin et al., 2009); and therefore patient care. Caring for the sick and dying, increasingly heavy workloads, as well as organizational and teamwork pressures have all been associated with healthcare worker stress. We propose that working in a novel environment with unfamiliar layout design and unknown location of critical equipment would add to this stress. We hoped, however, that running simulation mock codes prior to the opening of the new ED would help mitigate some of these stressors.

In an attempt to test the system prior to the opening of the new ED at NYULMC, we designed six different in-situ simulations. We hypothesized that the simulations could identify LSTs, improve layout and work flow, as well as orient the staff and decrease stress during the first few weeks of opening.

2. Materials and methods

2.1. Setting

This project was conducted throughout the course of one day three weeks prior to the opening of the new emergency department in NYULMC. External clinical, educational, operational, and other stressors precluded other testing days. NYULMC is a busy academic, level 2 trauma center with over 60,000 ED patient visits per year. Because of flooding of the old ED space, patients had been cared for from October 2012 until the opening of the new ED on the 16th floor of the hospital in an urgent care center, which, despite not being designated as a 911 receiving center, achieved admission rates of approximately 30%. With the re-opening of a the new ED, patients were to be triaged to a "core" section of three adult medical teams, a fast track area, and a separate pediatric area. Both the fast track and dedicated pediatric areas were new concepts in patient care for the ED staff, as prior to the flood, all patients were treated in one main ED space.

2.2. Participants

Multidisciplinary teams consisting of nurses, residents, attendings, consulting services, patient care technicians, clerks, and registration were scheduled to participate in 15 different in-situ simulations throughout the day. Each resident participated in one simulation, while some of the nursing staff participated in up to three.

This project was approved as exempt by the institutional review board of NYULMC. Participation in the simulations was viewed as a mandatory component of the orientation process; however, completion of all surveys were voluntary and anonymous. Those that could not attend were required to participate in similar orientation activities on a different day. Implied consent for the survey was based on whether a participant completed the online, anonymous questionnaire.

2.3. Approach

We developed high stakes simulations of patients presenting as a cardiac arrest, stroke, septic shock, trauma, pediatric respiratory distress, and a precipitous labor and delivery. The cases were run two or three times each, with residents, attendings, nurses, patient care technicians, registration and clerks participating in each simulation. Multiple cases were run simultaneously.

In addition to the new ED space, NYULMC ED leadership planned to introduce several new process changes as part of the ED opening. Registration was to occur immediately upon patient arrival, so that all documentation of patient care could be entered directly into an electronic medical record. Bedside "team triage" was also envisaged following activation of a new alert system. All medications were to be dispensed only after bar-coded correlation with patients' identifications, again requiring patients to be registered immediately upon arrival.

In collaboration with our Health Information Technology (HIT) department, we specifically wanted to evaluate these new process changes, as well as test the HIT/Computerized Provider Order Entry (CPOE) systems in the new space. Each of our simulated patients was assigned an "actual" individual medical record number and was "registered" in the active HIT/CPOE environment during the simulation to test these systems changes. Pharmacy was able to pre-stock the medication dispensing systems with vials of simulated medications that were to be part of the simulations. The central laboratory and blood bank were able to time the accession of blood specimens and release blood for the simulated trauma and labor patients. As our consultants were unfamiliar with even the location of the new ED space, they also participated in the simulations and agreed to come to the ED when paged to determine the fastest access and routing.

2.4. Theory and calculation

Throughout each simulation, we used a checklist to evaluate LSTs specific to each scenario. Each of the checklists focused on system issues, clinical operation concerns, equipment malfunction, equipment availability, as well as ergonomic concerns and layout design. Each simulation was immediately followed by a structured debriefing that focused on uncovering these LSTs. Each debriefing was led by a physician and nurse leadership pair. Each simulated case was run in real time and took between 30 and 40 min, with the debrief lasting for 20 to 30 min. Upon completions of all 15 cases, all participants received an electronic, de-identified survey requesting additional feedback and recollection of any additional LSTs not mentioned during the debriefing session.

Subsequently, during the first two weeks after the opening of the emergency department, all staff members were asked to complete the NASA-Task Load Index. The NASA-Task Load Index is a validated tool which assesses workload on six separate domains including: mental demand, physical demand, temporal demand, performance, effort, and frustration of workers (Hart and Staveland, 1988). This survey has been used across multiple specialties, including simulated flight and healthcare settings and has been shown to accurately measure perceived work load and stress (Hart and Staveland, 1988; Gregg, 1994; Weinger et al., 2004; Hart, 2006). Each of the six domains are divided into 10 data points ranging from low to high. The score is then adjusted on a 100 point scale with scores less than 30 considered low perceived stress. Moderate stress ranges from 40 to 60, and high stress scoring >60. Confidentiality of our participants was maintained by requiring participants to use only their team role as an identifier for the survey (Gardner et al., 2013).

The primary outcome measure of our simulations was LSTs identified. Secondary outcomes were staff member's perception