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Simulation Prepares an Interprofessional Team to Evacuate a 60-Bed Level 4 Neonatal Intensive Care Unit

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ABSTRACT

In August 2011, a 5.8 magnitude earthquake struck the Baltimore/Washington, District of Columbia, corridor. The event identified a critical requirement to prepare our interprofessional team to evacuate approximately 60 neonatal patients. A needs assessment indicated that 60% of staff members had little or no knowledge of the unit's evacuation plan and 55% of respondents were not aware of their specific role in an emergency evacuation. The neonatal intensive care unit educators in collaboration with the unit's medical team, the leadership team, the hospital emergency management team, and the unit practice and professional council coordinated the design, implementation, and assessment of the simulated evacuation activity. To encourage realism within the simulated activity, prepared manikins were placed in patient rooms and assigned varying levels of acuity. The training session began with a prebrief session that included a description of the evacuation plan, delineation of roles, responsibilities based on scope of practice, use of the evacuation equipment, and unit emergency bags. Participants engaged in a debrief session following each session during which the staff notably expressed an increased confidence with the evacuation plan, roles, and operation of the evacuation equipment. In addition, the debriefing allowed for identification of latent threats, which the planning group used to streamline the evacuation process.

Key Words: evacuation, interprofessional, neonatal, simulation

An emergency evacuation of hospital facilities has come to the forefront of public awareness in the past few years due to emergency situations caused by natural disasters or human factors.[1] Mandates from accrediting bodies require hospital facilities teach emergency preparedness during the onboarding process for all hospital employees.[2] Less attention has been given to the evacuation of facilities. The fear associated with having to evacuate a facility is associated not only as a safety concern for patients and their families but also as a concern for our own safety. The level of fear is heightened when the neonatal population is involved because of their complete dependence on the care providers to provide a safe and secure environment. To address these safety concerns and minimize the fear, a preparedness plan is necessary for the hospital facility and individual units.

Preparedness begins with identifying areas of concern through a needs assessment. It allows for identification of the knowledge gaps of the staff in regard to the evacuation plan and the implementation of the plan. An online needs assessment survey in the form of a Likert scale was used to reach all members of the neonatal intensive care unit (NICU) including the nursing, medical, respiratory, and ancillary staff. Once the knowledge gaps were identified, planning of education could take place. The results of our survey indicated the staff had little to no knowledge of the evacuation

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process. Integration of a simulation activity with the education of the evacuation plan is a strategic method increasingly used in healthcare to identify latent safety threats.[3] Washington, District of Columbia, is a high-risk urban area where the need to evacuate could be due to a multitude of causes (natural or man-made disasters, etc). The NICU at Children's National Medical Center is a 56-bed level 4 NICU that has the capacity to house 60 patients.

OBJECTIVES

The simulation exercise was designed around 3 objectives: ensuring each person could demonstrate knowledge of his or her role in an evacuation, verbalize the evacuation plan, and demonstrate safe use of the evacuation equipment. A plan was developed by an interdisciplinary team that included the NICU education team, the NICU medical unit director, the NICU manager, and the hospital's emergency management officer. It was decided to hold bimonthly simulated evacuation drills of the NICU. All members had input into developing the simulation exercise, but to ensure consistency, the NICU education team led the prebrief session, evacuation, and the debrief session throughout all of the scheduled simulation exercises.

The purpose of these exercises was to replicate the response to major emergency situations. It was thought that this would help improve preparedness on 2 levels. On the individual level, regular drills streamline the evacuation process by identifying needs and defining roles, all while applying the adage "practice makes perfect." Second, at a strategic level, it was proposed that any latent safety threats within the procedures as written would be identified through simulations. The reasoning was that any weaknesses or unforeseen circumstances would quickly be exposed in real-life trials.[4] A key component to the successful implementation of the evacuation plan is to achieve the goal of having all staff members fully trained within 2 years.

Finally, a decision was made to time the events as a means to measure effectiveness of the evacuation procedures. This same measure could also show progress, as changes and improvements are implemented in successive drills. Each simulation was timed from start to finish in an effort to show how long it takes to prepare and successfully transport 3 patients of varying acuity to a predetermined location. The number was arrived at for several reasons. First, to provide a constant when comparing results scientifically. Second, "3" represents the level of patient care found in most NICUs. This translates into differing types and amount of equipment being moved in the evacuation drill.

METHODS

With the responses from the needs assessment, the NICU education team was able to convince the hospital stakeholders that a simulation exercise for our multidisciplinary team was needed. Simulation training was done as part of biannual NICU professional practice day. In an effort not to inundate the staff with multiple days of required training on their off-shifts, this 2-hour simulation exercise was added to our existing skills training that focused on mock codes and low-volume/high-risk skills. The NICU education team worked with the hospital's Department of Nursing Education to provide 3.75 continuing education credits for participation. The simulation was offered to the interprofessional team who self-scheduled to attend one of the 6 sessions offered throughout the year. Participants included the nursing, medical, respiratory, and ancillary staff (see Figure 1).

Prebrief

The evacuation simulation exercises were 2 hours long and consisted of a prebrief session, evacuation exercise, and a debrief session. Before beginning the prebrief session, participants were given a 3-question survey to establish what was known about their roles and the process. The questions included the following: If you had to evacuate, would you know the evacuation plan? Do you know your role in the event of an evacuation? If you had to evacuate today, could you do it safely? During the prebrief session, the NICU education team introduced the participants to the individual requirements of their roles as outlined by the interdisciplinary team and

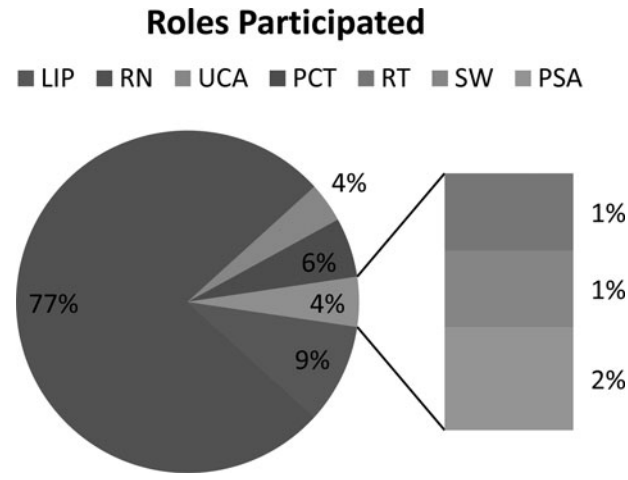

Figure 1. Participation. LIP indicates licensed independent practitioner; RN, registered nurse; UCA, unit communication associate; PCT, patient care technician; RT, respiratory therapist; SW, social worker; PSA, patient service associate.

discussed the overarching evacuation plan. An interactive hands-on demonstration of all of the evacuation equipment was done including examining the contents of the emergency backpacks with attached RN role, drip calculation sheet, and emergency phrase card. The contents of the backpacks were carefully determined in advance by the education team. Considerations had to be made concerning the size and weight so as not to overload the nurse while taking on the rigors of climbing or descending a stairway and carrying a heavy sled and other equipment. Specifically, they hold all the items necessary to provide adequate care for the patient while sequestered in a remote location. Numerous scenarios were considered in the supply process to ensure that all preconceived challenges could be met. The fully stocked backpacks are secured in a locked cabinet in every patient's room. All nurses are issued a universal key so that any patient cabinet can be accessed (see Figure 2).

Finally, the expectation that participants would treat this as a real event and respond in kind was discussed, along with scenarios that could require evacuation.

Evacuation

The NICU education team simulated 3 patients representative of our unit's population and placed them in different rooms throughout the unit. Roles were assigned including the role of parent; the team had to deal with evacuating not only the patient but also the sometimes frantic parent who may or may not speak English. The charge nurses and the medical team member participating in the evacuation triaged the simulated patients; they then communicated to the staff the order in which the patients would be leaving the unit. The bedside RN retrieved the emergency backpack from the locked cabinet in each patient's room and used the RN role attached to the backpack as a guide so that nothing was missed. Respiratory therapists brought portable oxygen to the bedside of the patients requiring oxygen and then transitioned them to the new oxygen source. Patient care technicians (PCTs) brought to the bedside the evacuation equipment needed to safely evacuate the patient. A tray for the intubated patients that allows the nurse to handbag the patient and a sled for nonintubated patients that allows for the evacuation of up to 3 patients at once. Nurses helped each other secure the trays to themselves and the intubated patients in the tray. The PCT helped the bedside nurse secure the nonintubated patients into the sled. All infusions, except inotropes, were removed from the pumps, and drip rates were initiated using the precalculated drip sheet attached to the emergency backpack. Inotropes remained on the pump, and the pump was carried out with the patient. An "X" was placed on the door of the patient's room as the patient was evacuated to indicate the room was empty, and the unit secretary marked off each staff member and patient as they left the unit. Charge nurse 2 left the unit with the first patient, taking with them the emergency supply bag along with code medications and accounting for the staff and patients as they exited the building (see Table 1). Charge nurse 1 and the medical team member stayed in the unit until the last patient was evacuated and then made a final sweep of the unit to ensure each room was empty before leaving the unit. The patients were evacuated from the sixth floor using the stairwells to an assigned meeting place outside of the hospital. In an actual emergency, the hospital's emergency management officer dictates the assigned meeting place, which is dependent on the nature and severity of the event. For the purpose of our evacuation exercise, the need for constant had to be balanced with providing the

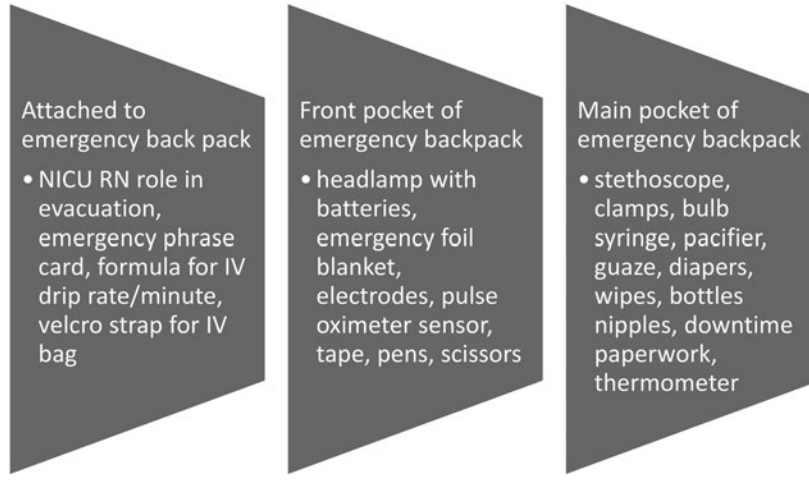

Figure 2. Contents of emergency backpacks.

Table 1. Emergency supply bag contents

Suction catheters 5/6 and 8	Center
Suction tubing	Center
Band Aids	Center
Heel warmers	Center
10-mL syringes	Center
Blue clamps	Side
Red caps	Side
Stethoscopes	Side
Vest	Side
Suture removal kits	Side
Flashlight with batteries	Front
Pens	Front
Tape	Front
1-mL syringe	Center
3-mL syringe	Center
IV catheters Braun	Center
IV catheters BD	Center
IV start kits	Center
Saline flushes	Center
Blunt needles	Center
4 × 4	Center
Saline wipes	Center
Chloroprep	Center
Povidone-iodine	Center
Hypafix	Center
Sterile water vials	Side
Butterfly needles	Side

Abbreviation: IV, intravenous.

experience of varying meeting places. To accomplish this goal, a different meeting place is chosen annually. By doing so, progress can be monitored in a meaningful way among like drills while teams still have an opportunity to maneuver all of the possible exit routes and meeting places over time. For the purpose of this exercise, the interdisciplinary team chose to focus on exiting the building with a vertical evacuation rather than a lateral evacuation. A lateral evacuation involves moving patients to safety behind the protection of barrier doors on the same floor, which any staff member can do independently if his or her patient is in immediate danger. An order to evacuate the building may only be issued by the hospital emergency management office. A lateral evacuation would not have exposed the staff to the experience of using each piece of evacuation equipment, nor would they have had an understanding of the inherent exhaustion associated with the overexertion of those carrying heavy equipment while traversing hallways and stairs (see Figure 3).

Each evacuation drill was timed; the clock started after the medical team working with the charge nurses triaged the patients. Different scenarios such as extubations played out in the stairwells during the evacuation, requiring the team to respond to the situation. The education team observed the evacuation exercise to evaluate individual knowledge of roles and safe use of the equipment, offering guidance and clarifying any questions as needed. After all participants reached the assigned meeting place, a debrief session was held.

Debrief

The debrief session included the following questions: What did we do well as a team? What could we improve upon as a team? Other questions that engaged everyone were as follows: What happened that surprised you? How are we going to support a team member or family member who may not be coping during the crisis? Who is responsible for ensuring that all visitors are evacuated? Discussions surrounding ethical dilemmas and the participants' concerns about their own safety and their families were a topic at each debrief session. Lessons learned and what processes should be changed or improved varied by the experience of the staff

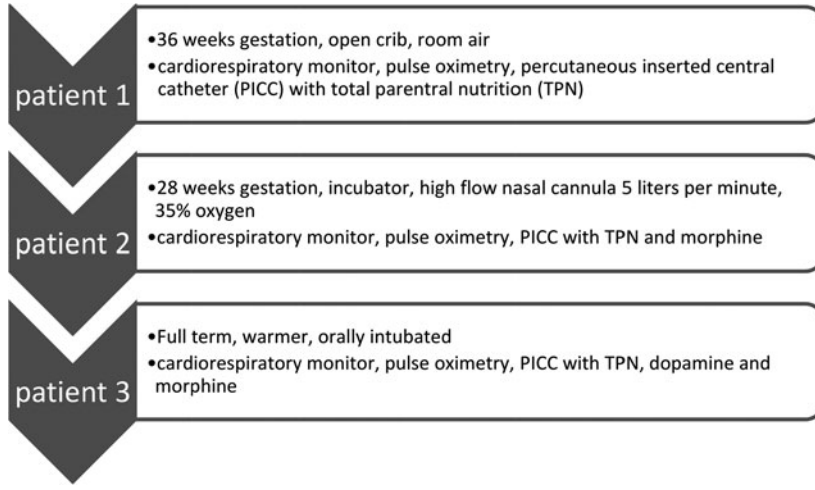

Figure 3. Simulated patients.

participating in the exercise. Lessons learned also included identifying safety threats, which were resolved during each debrief session; these were then implemented for the next evacuation drill to increase the efficiency of subsequent drills, thus decreasing the time required for the evacuation (see Table 2).

Each debrief session ended with the participants completing the same 3 question survey about their roles and the process.

Lessons learned

Many valuable insights have been garnered by running simulation drills, allowing us to tweak the procedures in ways both big and small. The single most surprising revelation concerned one of the most basic of functions in any NICU. Once intravenous tubing set is removed from the Alaris pump, you must manually calculate the drip rate. It is vital to maintain a consistent delivery of fluids to our most vulnerable patients. The response was to create a laminated card and attach it to the emergency backpack that converted the ordered rate of milliliters per hour to drips per minute that could be referenced to when needed. We also took the additional step of educating the newer generation of nurses who have never had to manually calculate drip factors.

Further insight was gained by actually transporting the med sled up and down the stairwells. It was discovered that maneuvering around the corners at each landing was not possible if the oxygen tank was positioned on the inside. As a result, all sleds are now labeled for proper oxygen tank placement. Another

Table 2. **Lessons learned**[a]

	Resolutions
Equipment failures	
Tape failed to secure the IV fluid bag to the shoulder of the nurse. IV fluid bag must remain at shoulder level to prevent blood backing up into the tubing.	Purchased Velcro straps to secure IV fluid bag to the backpack.
Using a marker to make an "X" on the patient door to signify the room was empty did not work well.	Use tape to make a large "X" on the door.
Patient sleds will not round the corners in the stairwells if the oxygen tank is secured to the inside of the evacuation sled.	"Oxygen tank here" written on the outside of the evacuation sleds.
Manikin's head hit the oxygen tank.	"Head here" written on the inside of the evacuation sleds.
Communication failures	
Not all patients had parent contact information card at the bedside; there would be no way to contact the parent in case of evacuation.	Emergency contact card at the bedside is now a safety check that is documented each shift.
No way to communicate quickly with non–English-speaking families in case of evacuation.	Emergency phrase card in Spanish, French, and Amharic attached to emergency backpacks.
Communication between the staff is cut off, hospital-issued phones do not work outside of the facility.	A list of staff personal cell phone numbers is kept in the emergency supply bag that charge nurse 2 takes out of the building.
Inability to locate the NICU group once out of the building.	Charge nurse 2 will wear a bright green vest labeled "NICU"; the vest is kept in emergency supply bag.
Equipment issues	
Takes 3 people to evacuate 1 intubated critically ill infant. We do not have enough people to evacuate all infants.	Utilize anyone on the unit to help, parents, social workers, case managers, etc. Purchase oxygen cylinder shoulder sling to eliminate need for 1 person.
Inline suction too heavy and may cause an unintended extubation.	Remove inline suction from the ET tube and place a red cap on the open port; added to RN role.
Not enough chemical mattresses on the unit for all infants under 1200 g.	Chemical mattresses placed in each patient room with emergency backpacks.
Hard to see feet and stairs while wearing the evacuation tray.	Move the tray to the side to see your feet and stairs; have another person help guide the nurse down the stairs.
Vest for the evacuation tray digs into the back of neck when the weight of the infant is added.	Place folded baby blanket around your neck before putting on the vest.

Abbreviations: ET, endotracheal; IV, intravenous; NICU, neonatal intensive care unit.
[a]For a complete list of lessons learned and resolutions, contact the authors.

lesser, but equally helpful, outcome was the finding that using lifelike mannequins enhanced the overall realism and authenticity of the entire process (see Figure 4).

The execution of regular evacuation simulation drills has proven invaluable to our ability to effectively adapt and modify the policies and procedures employed by the NICU.[5] Almost every exercise has produced actionable results. Equipment failures/issues, communication concerns/questions, safety issues, and logistical hurdles have all been identified by the systematic administration and coordination of managed simulations.

RESULTS

A total of 70% ($n = 213$) of staff members participated in the simulated evacuation drills from June 2015 to August 2017. There were 10 bimonthly simulated drills, and the staff ranged from 6 to 45 participants per session. Some sessions were cancelled because of the decreased number of individuals registered. A minimum of 6 individuals were required to complete an evacuation drill. Groups greater than 12 individuals were divided into 2 teams, which rotated between the low-volume/high-risk skills with mock codes and the evacuation drills. Staff knowledge increased significantly by a mean of 62% after post–simulated evacuations across disciplines. Results findings in Figure 5 indicated that staff members strongly agreed that they knew their role and evacuation plans and would be able to safely evacuate. Evacuation times also improved from 21 minutes to a low of 16 minutes. In addition, our statistical analysis showed $P < .001$, which indicates a significant increase in knowledge gained.

Figure 4. Evacuation sled with oxygen tank and infants.

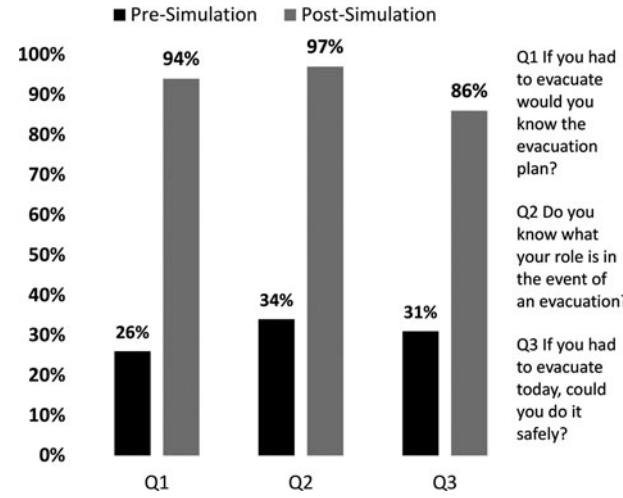

Figure 5. Knowledge check questions.

DISCUSSION

The evacuation of a hospital facility is a necessary skill for staff members due to emergency situations beyond their control. Safety of the patients, families, and staff should be the number one focus of evacuation plans.[6] The training necessary to successfully implement an evacuation plan should be done on a routine basis for all hospital facility staff members. Simulation offers the staff an opportunity to better understand the evacuation process through actual implementation.

Prior to the introduction of the evacuation simulation, the staff reported a knowledge deficit of the plan for safe evacuation of the unit and the facility. Of those surveyed, 26% stated they knew the evacuation plan and 31% felt they could evacuate safely. Formal knowledge of the plan described during the prebriefing session allowed for the staff to understand the process for the facility and the unit to evacuate safely. In addition, the survey results showed a deficit in the staff's knowledge, with only 31% understanding their specific role during an evacuation. Prior to the prebrief session, the staff received checklists based on their specific role and duties during an evacuation. The checklists allowed for the staff to have a clearer understanding of their respective roles and perform their roles as described. To assist with the staff improving their performance in an evacuation, emergency backpacks were created and introduced during the prebrief session.

The emergency backpack serves as a tool for transport and continuation of the patient's care in an emergency environment.

The evacuation exercise was announced to the entire hospital through correspondence with security and signage placed throughout the directed evacuation route. On the basis of their roles, the staff was assigned to

manage the evacuation of the 3 simulated NICU patients along with their family members. The patients were of varying acuity, which allowed for realism and understanding of the order in which patients should be evacuated from the facility. Timing of the evacuation served as a method to improve staff awareness of what would occur in a real-life evacuation. During the evacuation, the staff had to delegate and coordinate with various staff members while troubleshooting as challenges arose.

At the completion of the simulation exercise, staff members debriefed. The debrief session was done in a quiet area for the staff to reflect on their experience and determine whether the evacuation was successful. Identifying safety threats of the evacuation plan, roles, and equipment are just a few of the areas the staff discusses. The postevacuation survey revealed a significant improvement in the staff's understanding of the evacuation plan to 94%. The institution of roles and duties was shown to be successful, with 97% of staff members knowing what their role in an evacuation was. The use of simulation for an evacuation exercise has proved to be a successful method for this particular unit. The improvement in their knowledge and implementation of an evacuation increased their comfort level of being able to safely evacuate to 86%.

Recognizing the significant gain of knowledge and the increase in the staff's comfort level with evacuation, it has prompted the NICU to require all staff members stay proficient by completing an evacuation simulation exercise biannually. To deal with the influx of new staff members, the NICU education team now includes an evacuation simulation exercise as part of the new graduate nurse orientation program.[7] This program is a 6-month bedside and didactic program designed to prepare the new graduate nurse to function independently in the NICU. Experienced new hires are scheduled to attend an evacuation exercise in the first year of employment.

The evacuation of a NICU is a challenging task; however, preparation through simulation exercises improves the likelihood of the safe transport of patients, families, and staff from harm's way. The process continues to evolve as the NICU education team develops new evacuation scenarios and increases the acuity and the number of patients who must be evacuated to safety.

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