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An Evacuation Simulation in Multiple Neonatal Intensive Care Units Across a Single City: Lessons Learned

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Abstract

Objective: Evacuations of neonatal intensive care units (NICUs) in emergency situations pose specialized challenges given their population of critically-ill neonates. Most of the literature on this topic describes planned evacuations and simulations due to natural disasters, usually involving only NICU staff. This study examines a unique emergent NICU evacuation simulation involving multiple responders occurring on a citywide scale.

Methods: A simulated evacuation in response to a fire was conducted in 6 different NICUs in El Paso, Texas. The exercise utilized response from NICU staff and first responders. A standardized tool, by independent evaluators, was used to evaluate staff competencies while reactions were assessed using post-exercise surveys.

Results: This city-wide multidisciplinary simulation improved NICU personnel skills in evacuation and also introduced first responders to this specialized patient population. Areas of strength across all NICUs included teamwork, knowledge of evacuation equipment, and patient tracking. Areas for improvement included lack of adequate equipment for post-evacuation care, understanding implications of smoke exposure, alternative evacuation routes, incident command structure, and unified communication.

Conclusions: This successful, citywide NICU evacuation simulation improved knowledge among participants, introduced first responders to a specialized patient population, and provided valuable lessons on neonate-specific themes that can be incorporated to improve citywide emergency preparedness.

In the last 2 decades, hospitals have dealt with natural disasters that required emergency evacuation of patients, including critically ill neonates. This vulnerable population, being completely reliant on staff and technology, suffers heavily from compromised care during emergencies.[1,2] As a result of this, their emergent evacuation is a high-risk activity for which planning and practicing is imperative. Understanding this, the Centers for Medicare and Medicaid Services (CMS) in 2016 established national emergency preparedness requirements to ensure adequate planning for disasters and coordination with federal, regional, and local emergency systems.[3] The Joint Commission (TJC) also issued specific requirements for emergency management and preparedness, known as Standards of Care for Disaster Preparedness and Response.[4] Hospitals are mandated to have a disaster management program, the Emergency Operations Plan (EOP), that addresses emergency preparedness and planning activities. It requires periodic actual or simulated testing of the EOP, including evacuation.[4]

Most literature discussing evacuation challenges and disaster management is focused on the adult population. Most of the neonatal evacuation literature has stemmed from evacuations for hurricanes. Evacuation of a level 3 NICU during Hurricane Katrina taught the importance of teamwork, charged battery-operated equipment, ensuring patient identification, pre-prepared hospital transfer summaries, and creative solutions to move patients when normal egress routes were blocked.[5] Lack of technology during power failure prompted staff to rely on observation and assessment skills and alternate methods for thermoregulation for the smallest neonates.[6] Hurricane Ike forced NICU personnel to make use of alternate water sources,[7] and Hurricane Sandy taught a level 3 NICU the importance of a clear command structure, having backup medical records, personnel, and equipment, and having a flexible plan during its evacuation of 19 infants.[8]

Other natural disasters have necessitated the evacuation of critically ill infants, including the 2016 Kunamoto earthquakes in Japan, which again required making do with limited technology,

and displayed the importance of maintenance of thermoregulation for neonates. Also highlighted was a lack of regional coordination to assist in transfer of neonates to other facilities.[9] A study of challenges and advantages encountered by staff in NICU evacuations during the 2018 California wildfires stressed the importance of evacuation equipment, creativity with resources such as the use of car seats as transporters for stable infants, command structure, interhospital communication, and the impact of smoke on air quality. Most importantly, a significant portion of surveyed participants noted a need for practice prior to these types of events in order to improve performance during a real evacuation.[10]

In 2012, a NICU in El Paso, Texas, experienced a fire with subsequent electrical failure that prompted a planned, full-scale evacuation of the entire hospital. Fire fighters were readily available during this event, and it was noted during debriefing that staff heavily relied on them for evacuation. Hence, the NICU did not have to notify internal command and the public of an evacuation, used little evacuation equipment, did not coordinate vertical patient evacuation, did not determine the evacuation route, did not identify ongoing care needs emergently, and relied on firefighters to prioritize patient and staff safety, among other tasks. This occurred despite the NICU staff regularly fulfilling CMS and TJC requirements for emergency preparedness.

As is evidenced by all these events, evacuation of critically ill neonates requires careful preparation, as well as the existence of a NICU emergency response plan which should be based on the most current literature including published neonatal evacuation toolkits.[11–14] It also necessitates that providers for neonates work within the greater context of disaster preparedness in hospitals, cities, and regions.[1] Unless education on NICU emergency management is provided upon hire to the hospital and as regular training, NICU personnel may not be clear as to their expected responsibilities in emergency neonatal evacuation.[12]

There is literature supporting the use of evacuation simulations to improve staff competency in disaster preparedness for neonatal intensive care units.[11,15–18] To our knowledge, however, there is no literature describing evacuation simulation for NICUs on a citywide scale that includes actual response by community first responders. Here, we evaluate an evacuation exercise occurring across 6 NICUs in El Paso, Texas, utilizing firefighters and ambulance providers. The purpose of this simulation was multi-fold: to test the effectiveness of hospital-specific evacuation processes in each NICU, to evaluate NICU personnel's knowledge and competency in these, and to familiarize first responders with this specialized patient population. This was accomplished by assessing staff reactions to the simulation with post-exercise surveys, evaluating areas of strength and areas for improvement in each unit's evacuation response with a standardized assessment tool, and requesting first responder feedback. The eventual goal was to incorporate generalizable NICU-specific guidelines from these lessons learned to improve each hospital's internal processes as well as to incorporate them into a comprehensive citywide hospital disaster management plan.

Methods

This simulation included evacuation exercises at each of 6 Level II-Level IV neonatal intensive care units from different hospitals in El Paso, Texas. Out of these, 1 of these hospitals was a free-standing children's hospital with 50 NICU beds. The rest were general hospitals with a NICU, ranging from 6 to 35 beds. Each NICU had to respond to a simulated electrical fire in the neonatal intensive care unit itself and vertically evacuate 6 simulated patients of varying acuity into awaiting ambulances in the hospital parking lot with intent to transfer to another facility. This was undertaken over 6 months and was facilitated by the Border Regional Advisory Council (RAC) in concert with staff from each NICU after a need was identified from the 2012 real life evacuation in one of the NICUs.

The Border RAC is a healthcare coalition charged with developing and implementing an inclusive trauma and emergency health system,[19] for El Paso and other surrounding counties. The City of El Paso is located in El Paso County, a county on the Texas-Mexico border which is large in terms of area (approximately 1012 square miles) and population (839238).[20] Members of the Border RAC Perinatal Subcommittee met with representatives from each NICU's management, nursing staff, medical staff, hospital safety office, the El Paso Fire Department (EPFD), and local emergency medical service representatives in a series of planning meetings prior to the actual simulations.

On each NICU's simulation day, after a pre-exercise briefing, the simulated fire was discovered within each NICU with staff having to initiate emergency procedures and vertically evacuate the area to an awaiting ambulance in the hospital parking lot. Elevators could not be used. Evacuated simulated patients included 1 of the highest acuity (intubated, mechanically ventilated, and on multiple continuous intravenous infusions), 2 of medium-acuity (on oxygen and intravenous infusion), and 3 low-acuity patients (on gavage feedings). The evacuation exercise included actual response from the EPFD and ambulance services. Although all personnel had annual, passive, hospital-specific emergency operations training mandated by CMS and TJC, staff from only 1 of these NICUs had previously participated in an actual evacuation. There were about 30 participants in each simulation. These comprised of nurses, respiratory therapists, and neonatologists. Though planned participants did sign in, many more came to help during the exercise, thus making identifying actual participants challenging.

The core facility capabilities and emergency response objectives tested are listed in Table 1. These were based on objectives for hospitals and other agencies developed by the Federal departments of Health and Human Services, and Homeland Security,[21–23] and tailored to opportunities identified during the previous actual fire-related evacuation. Completion of these objectives was evaluated by each hospital's Hospital Safety Officer and Border RAC staff using a standardized tool across all NICUs, based on exercise evaluation guidelines from the Homeland Security Exercise and Evaluation program (HSEEP)(Supplement 1).[23] The same Border RAC staff provided some 'interrater reliability' as they were present for each NICU's evacuation simulation. EPFD participants were also asked to provide open-ended feedback on the utility of the simulations and NICU staff performance.

NICU staff were subsequently given a post-simulation evaluation (Figure 1), assessing overall exercise design using an 8-question, Likert scale questionnaire. Likert scales ranged from 1 (Strongly Disagree) to 5 (Strongly Agree). The post-simulation evaluation also provided an opportunity to list strengths noted during this exercise as well as areas for improvement. Data from these evaluations was organized thematically to provide a summary of staff responses to the utility of this city-wide NICU evacuation exercise and over-arching lessons learned from it. This study was exempt from Institutional Review Board Review under Texas Tech University Health Sciences Center EL Paso requirement 45 CFR Part 46 Subpart B, Section 1-2i.

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Table 1. Core capabilities and emergency response objectives for each neonatal intensive care unit evacuation exercise

Core Capability	Objective
Communication	Establish emergency/disaster communication utilizing equipment and methods to include: - Appropriate and timely external notification of the emergency and coordinate with public safety. - Effective and timely internal notification. ○ Notification of hospital operator, activation of fire alarm, notification of necessary personnel within 5 minutes of incident. - Effective communication within the facility among the various elements and locations of emergency response to include utilization of all communication methods used such as telephones, radios, cell phones, and runners.
Staff Responsibilities	Utilization of fire response procedures – **R**escue, **A**larm, **C**onfine, **E**xtinguish/Evacuate (RACE)
Safety and Security	Secure the area and assure the safety of associates, visitors, and patients.
Patient and Clinical Support Activities **Resources/Assets**	Coordinate triage and initiate evacuation from NICU within 10 minutes, ensuring patient care was provided during horizontal and vertical (if applicable) evacuation.
Staff Responsibilities **Facility Emergency Response**	Activation of hospital command center within 10 minutes of initial fire and utilization of hospital incident command system.
Resources/Assets	Issue public information, alert, warnings, and notifications to the public in a timely manner.
Patient Clinical and Support Activities	Tracking of patients and staff during evacuation.

Analysis

Data were analyzed using SAS 9.4 software (SAS Institute, Inc., Cary, North Carolina). A median response value for each question on the 8-item Likert scale post-exercise questionnaire was calculated, along with interquartile ranges, for all 6 of the NICUs combined. Medians were presented with 95% distribution-free confidence intervals. When a NICU staff group chose 2 adjacent categories equally (e.g., 4 and 5), the average values of the 2 consecutive numbers were used in the analysis.

Staff responses to free text questions about strengths of each unit performing the evacuation, areas for improvement, and recommendations for future simulations were categorized into common thematic areas and summarized by frequency. Independent evaluator (Hospital Safety Officer and Border RAC evaluators) and EPFD responses were also collected and categorized by frequency of areas where NICU staff performed tasks with major challenges or were unable to perform them.

Results

Staff reaction and evaluation

Median values for staff responses to Likert questions regarding the design of the evacuation exercise are listed in Table 2. In general, staff at all the NICUs felt very positively (unanimously choosing 'strongly agree') about their involvement in the exercise, improvement in their understanding and familiarity of resources, and better preparedness to deal with a similar scenario.

There were several general themes common to staff responses on strengths noted in each facility during the simulation (Table 3). NICU staff's knowledge and utilization of transport equipment, including evacuation vests and transporters/ sleds as well as intravenous infusion pumps and ventilator equipment, and their ready availability, were seen as major strengths in all the units. Rapid notification of the operator with requests for help and quick response from other departments, including security and engineering, were also seen as very positive. Other recurring themes were strong leadership and good teamwork. Useful strategies included headcounts for patients, keeping identifiers with patients, and use of other care areas such as the post-anesthesia recovery area (PACU) to serve as rally points

A major area for improvement was a lack of understanding of, and communication with the hospital incident command structure by staff, as well as poor communication with first responders. Another weakness was the lack of equipment (such as incubators) for the resumption of care at rally points, such as the PACU or ER (Table 3). Difficulty with alternate resources and evacuation routes, such as if 1 exit route was blocked or if the location of evacuation equipment was inaccessible, were other common themes. Though the staff performed very well at patient tracking, less attention was paid to headcounts for staff and visitors (Table 3). In a few of the units, there were also problems with staff re-entering the fire area to retrieve additional equipment prior to transfer (Table 3) and difficulty with maintaining appropriate thermoregulation for the patients. Most importantly, staff in every unit commented that doing more drills of this nature would be beneficial (Table 3), with nurses in 2 different units stating, 'We need more drills with Border RAC and EPFD throughout the year.'

Independent evaluator assessments

The timed objectives were completed in the majority of NICUs. Notification of fire within 5 minutes was performed without challenges in 83% (5 out of 6) of the NICUs. Establishment of a hospital incident command within 10 minutes was performed without challenges in 67% (4 of 6) of the NICUs. Triage and initiation of evacuation within 10 minutes was performed without challenges in 67% (4 of 6) of the NICUs.

Areas where staff performed with major challenges or were unable to perform as assessed by hospital safety officers and Border RAC staff were also similar across all 6 NICUs (Table 4). All the NICUs had difficulties with appropriate labeling and storage of medication for evacuation. Similarly, many did not pack an adequate supply of formulas, diapers, wipes, intravenous tubing and solutions, etc. for a real evacuation situation, which in this scenario was enough to provide continuing care during evacuation/in staging location, and for ambulance transport to get to another facility. Other common themes included lack of assessment for and attention to staff/families who may have been injured in the scenario, and lack of coordination with agencies who could assist with supply needs. All hospitals had challenges with notification to the public about the emergency.

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After Action Evaluation

Thank you for participating in this exercise. Your observations, comments, and input are greatly appreciated, and provide invaluable insight that will better prepare our nation against threats and hazards. Any comments provided will be treated in a sensitive manner and all personal information will remain confidential. Please keep comments concise, specific, and constructive.

Part I: General Information
Please enter your responses in the form field or check box after the appropriate selection.

Agency/Organization Affiliation: _____
Number of Exercises Previously Participated In: 0 1-5 5-10 15+

Part II: Exercise Design
Please rate, on a scale of 1 to 5, your overall assessment of the exercise relative to the statements provided, with 1 indicating strong disagreement and 5 indicating strong agreement.

Assessment Factor	Strongly Disagree				Strongly Agree
Pre-exercise briefings were informative and provided the necessary information for my role in the exercise.	1	2	3	4	5
The exercise scenario was plausible and realistic.	1	2	3	4	5
Exercise participants included the right people in terms of level and mix of disciplines.	1	2	3	4	5
Participants were actively involved in the exercise.	1	2	3	4	5
Exercise participation was appropriate for someone in my field with my level of experience/training.	1	2	3	4	5
The exercise increased my understanding about and familiarity with the capabilities and resources of other participating organizations.	1	2	3	4	5
The exercise provided the opportunity to address significant decisions in support of critical mission areas.	1	2	3	4	5
After this exercise, I am better prepared to deal with the capabilities and hazards addressed.	1	2	3	4	5

Part III: Participant Feedback

1. The following strengths were observed during this exercise (please select the corresponding capability and applicable element related to the strength):

Strengths		Element	
		Planning	
		Organization	
		Equipment	
		Training	
		Exercise	

2. The following areas for improvement were observed during this exercise (please select the corresponding capability and applicable element related to the area for improvement):

Areas for Improvement		Element	
		Planning	
		Organization	
		Equipment	
		Training	
		Exercise	

3. Please provide any recommendations on how this exercise or future exercises could be improved or enhanced.

Figure 1. NICU evacuation exercise participant evaluation.

El-Paso fire department's comments

EPFD participant responses were similar to independent evaluator and staff comments. Solid teamwork and the ability of the NICU staff to start evacuation before EPFD arrival was seen as a strength. They were similarly impressed by staff knowledge of patient needs and use of evacuation equipment. Areas for improvement included lack of organization and communication within the incident command structure, with EPFD members noting a need for an assigned liaison to improve communication flow to first responders and a need for more clearly defined roles for staff. They also reiterated the

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Table 2. Summary of the responses to Part II (Exercise Design) questions from the 6 NICUs*

Assessment Factor	Median Value	95% Distribution-Free Confidence Interval	IQR†
Pre-exercise briefings were informative and provided the necessary information for my role in the exercise.	4.00	3.00 – 5.00	1.00
The exercise scenario was plausible and realistic.	4.00	4.00 – 5.00	0.00
Exercise participants included the right people in terms of level and mix of disciplines.	5.00	4.00 – 5.00	0.50
Participants were actively involved in the exercise.	5.00	4.00 – 5.00	0.00
Exercise participation was appropriate for someone in my field with my level of experience/training.	4.75	4.50 – 5.00	0.50
The exercise increased my understanding about and familiarity with the capabilities and resources of other participating organizations.	5.00	5.00 – 5.00	0.00
The exercise provided the opportunity to address significant decisions in support of critical mission areas.	5.00	5.00 – 5.00	0.00
After this exercise, I am better prepared to deal with the capabilities and hazards addressed.	5.00	5.00 – 5.00	0.00

*Data are from Likert scales that ranged from 1 (Strongly Disagree) to 5 (Strongly Agree). When a NICU chose 2 adjacent categories (e.g., 4 and 5), the average values of the 2 consecutive numbers were used in the analyses.
†IQR=interquartile range.

Table 3. Selected themes from NICU staff identified from the participant evaluations

	Theme	Number of NICUs Reporting This Theme*
Areas of Strength	Patient Headcounts/Tracking Performed	6
	Quick arrival of personnel reinforcements from other departments	6
	Availability and knowledge of evacuation equipment	5
	Teamwork	4
	Clear leadership assumed within NICU	4
	Successful use of a staging area/rally point in another part of hospital	3
	Quick internal notification of incident	3
Areas for Improvement	Lack of understanding of incident command structure	6
	Lack of enough resources/equipment for care in staging areas/rally points	5
	Inadequate communication with EPFD	5
	Evacuation route unclear or lack of knowledge of alternative evacuation route	5
	Head counts/tracking of staff and visitors	4
	Staff slow to move away from fire areas/ re-entered fire areas	3
	Requested more evacuation drills	6

*Out of 6 NICUs

need for knowledge of alternate evacuation routes and alternate equipment storage locations when certain areas were blocked. Resuscitation equipment located at each exit and being able to perform full resuscitation and resume care in a mobile setting were additionally listed by EPFD as areas of need.

EPFD participants also shared insights specific to their roles as first responders. These included practical areas for improvement such as walking briskly, not running, while carrying patients and the use of 'spotters' for staff carrying patients in stairwells as well as assigning a staff member to the exit of each stairwell to ensure all staff, EPFD, and patients had evacuated. They also expressed that staff were unrealistic about the ramifications of smoke exposure which would have impacted order of patient evacuation and reentry into certain areas once evacuated. For example, they commented that staff spent too much time trying to evacuate the sickest patients first, when, intubated patients would have been more protected from smoke exposure, and more emphasis should have been placed on rapid evacuation of multiple lower acuity patients. They noted that this limited evacuation scenario would have been much more difficult if they had to evacuate the whole unit. Finally, many EPFD participants had never seen a premature infant before. They expressed a need for future simulation scenarios such as this 1 to strengthen first responder knowledge of the specialized needs of this patient population and to engender trust between NICU staff and first responders.

Limitations

This exercise was valuable to both NICU staff, who had little practical evacuation experience, and to first responders, who had little experience with this specialized patient population. However, the simulation and its assessment did have some limitations. Since the fire was a simulated threat, it was hard for the NICU staff to imagine and respond to its implications, particularly to understand the ramifications of smoke exposure. The simulation also only involved a few simulated patients, when a real situation may very well be much more complex, calling for a full-scale evacuation of all admitted NICU patients and their families with transport to other facilities. Finally, though NICU staff, hospital safety officers, and Border RAC staff observers had more objective evaluation rubrics, firefighters were asked for their unstructured comments verbally which made their responses more difficult to organize and evaluate.

Discussion

As with other published evacuation training,[18,24–26] staff from all of the 6 NICUs in El Paso responded positively to simulation of evacuation, feeling that this exercise improved their knowledge of the strategies and resources needed for an evacuation of neonates. In every unit, they desired more practice for emergency situations in order to be more prepared should the 'real thing' ever occur. Despite some challenges with plausibility, the success of this

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Table 4. Selected tasks performed with major challenges or unable to be performed by NICU staff on independent evaluator assessments

Tasks	Number of NICUs Reporting This Theme*
NICU staff labels and stores patient's medication properly, when transporting from one area to another	6
Unified Command personnel will develop a message and select appropriate person to deliver message to the media and alert the public to the incident, as soon as possible	6
NICU staff establishes minimum supply of formulas for infant feeding. NICU staff has adequate supply of waterless hand cleaners, gloves, diapers, feeders/nipples, IV tubing and solutions	5
Hospital Command Staff will be communicating and coordinating all response activities with other agencies in the Hospital Command Center that have arrived to assist	4
NICU staff gathers and utilizes alternative medical equipment to use during the evacuation process such as self-inflating bag valve masks, gas powered ventilators, battery powered monitors such as pulse oximeters, bulb syringes or other non-electric suction devices, flashlights, additional blankets/hats, chemical warming mattress, battery operated fans, and baby evacuation vests	3
Ensure others who may have been injured during the incident, receive the appropriate treatment	2

*Out of 6 NICUs

simulation adds to the current data that simulation is an effective way for hospitals to bolster staff knowledge in emergency preparedness.[18,26] Advanced nursing and respiratory therapist training should indeed include continued education on emergency communication and decision-making,[24] and the lessons learned in this evacuation simulation speak to the importance of actual practice for emergency scenarios to meet TJC and CMS standards for hospital disaster preparedness, rather than having personnel complete passive training on the topic.

NICUs and first responders in El Paso were able to identify common strengths across the participating facilities. In general, they were able to make a fire notification, set up an incident command, and initiate evacuation in a timely way. Staff knowledge of evacuation equipment specific to neonates, such as evacuation vests and infant med sleds, was very good. This has been supported in the literature as crucial to rapid evacuation.[10,15] El Paso's NICUs also felt they had good teamwork and rapid utilization of assistance from other departments, both of which have been used advantageously in other real NICU evacuations.[8,10,27] Patient tracking using a back-up system for documentation and identification, and the use of rally points were other strengths common to El Paso units which are also strongly supported in the literature.[5,10,13,26] A person could speculate that although almost none of these staff had been through an actual evacuation or drill before, they utilized strategies learned in passive training, or that had been successful in other patient care scenarios, such as the use of backup documentation during electronic medical record downtime, familiarity with equipment for patient transport situations, use of other available personnel in low staffing situations, and internal leadership and communication for other unanticipated scenarios such as codes.

Areas in which each of the units struggled were more specific to actual evacuation. The inability to resume full care because of a lack of full equipment when arriving at other staging areas was a common theme. Unlike a transport for imaging, having no incubators available without another way to maintain temperature long term, and not having a full complement of necessary care and resuscitation supplies (diapers, formula, etc.), is untenable for actual evacuation. Indeed, in actual evacuation situations, NICU personnel have had to come up with some creative solutions for thermoregulation and transportation for neonates.[5,6,9,10] As noted by both staff and firefighters, staff also struggled with finding alternate routes when their typical routes were blocked due to the emergency. These kinds of experiences call for flexibility in planning and creating new alternatives if necessary, something that has also been encountered in actual evacuation scenarios, with NICU staff in 1 hospital in New Orleans even drilling a hole in the wall to create new access when a typical evacuation route was flooded during Katrina.[5] First responders also commented that staff struggled with the ramifications of smoke exposure and how it impacted the order of evacuation and reentry into previously evacuated areas which has been echoed in real life fire evacuations.[10] Staff often felt they did not have a clear understanding of the hospital-wide incident command structure and their role within that. This was also supported by firefighter comments which stressed the need for improvement in coordination with first responders. Along that vein, like published experience in actual disasters,[5,6,9] there was little in the way of communication with outside facilities and the public. Some of the latter, along with lack of a search for injuries and reentry into the fire area, may have been due in part to the artificiality of the exercise.

Concepts specific to the evacuation of neonates (compared to adults) were important in this limited scenario. For example, the complete reliance of the patient on the care provider and equipment, the inability of the patients to identify themselves, and the ability to simultaneously transport multiple patients by 1 provider were fully taken into account by staff members at all of the hospitals. These are all concepts with which they were familiar on a day-to-day basis. These facets of neonatal care, however, were foreign to EPFD participants who responded to the simulations, many of whom were surprised at the small size and complex needs of the patients. Need for external thermoregulation, though typically understood by staff in NICUs, became more challenging in the setting of evacuation to the outside, a problem also encountered in actual evacuation scenarios.[8,9] There was other neonate-specific situational awareness that was lacking though, such as communication with the obstetric department about maintaining availability to attend high-risk deliveries or diverting high risk mothers elsewhere.[8,9]

This multidisciplinary, simulated exercise tested the hospital staff's annual training required by regulatory agencies. This previous training likely accounted for the knowledge of evacuation equipment, evacuation route, and system for patient tracking. However, it showed that passive training does not consider equipment needs for post-evacuation care, alternative evacuation routes, understanding of incident command structure, and unified communication with first responders, the public, and other facilities. This simulation helped strengthen NICU staff knowledge and comfort with disaster preparedness in their respective units and helped augment each hospital's EOP with specific attention to the needs of a very vulnerable patient population: critically ill neonates. It identified common strengths and weaknesses surrounding neonatal evacuation that can be used as lessons for the future in the

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framework of each hospital's evacuation process, as well as in El Paso's emergency response planning, including introducing first responders to this special population of patients.

However, what remains untried in a city like El Paso that experiences little in the way of natural disasters or severe weather events, is a real mass evacuation event. El Paso hospitals have experienced and handled a mass casualty event in the wake of the August 3, 2019 shootings where patients had to be triaged to the appropriate hospital,[28] and more recently, during the 2020 COVID-19 Pandemic when hospitals were overwhelmed and had to transport patients out of the city for various medical needs, but a mass evacuation affecting the pediatric and neonatal population has never been forced. Local and regional medical emergency authorities in the area, in conjunction with the Texas Emergency Medical Task Force,[29] are set up to coordinate regional response capabilities but have not been tested for mass hospital evacuation, unlike those in South East Texas who have responded to multiple hurricanes.[30] It may be very beneficial to regional disaster planning for future exercises to include evacuation of multiple departments within a facility where the total focus is not only the NICU. Simulated mass evacuation from multiple hospitals with need for coordination with local first responders, as well as local and regional emergency medical authorities, including simulated briefs to the public and communication about transfer of care with accepting facilities may be a beneficial test of the system.

Conclusion

Simulation for neonatal evacuation improved NICU staff knowledge of, and comfort in emergency preparedness across multiple NICUs in a city-wide evacuation exercise and was the only 1 of its kind to include actual response from first responders. This aspect highlighted the need for first responders to continue to be exposed to specialized patients like critically ill neonates, and the need for continued simulations to build trust and mutual sharing of expertise between first responders and NICU personnel. Although all hospitals are mandated to have an emergency operations plan and to provide staff education on it, this exercise proved that a multidisciplinary simulation can provide much more robust 'real life' experience that is more beneficial to all invested parties than simple knowledge checklists or online trainings. This simulation additionally provided important lessons for NICUs regarding need for improvement in the ability to resume full care during evacuation and transport, need for improved understanding of hospital incident command structure, and need for improved communication with outside agencies, resources, and the public. These themes can be used to improve education, and planning, for disaster preparedness from both a hospital as well as a city-wide level. Future directions could include a simulated mass evacuation from multiple hospitals to include regional emergency response authorities to identify opportunities for improvement in the whole system.

Supplementary material. To view supplementary material for this article, please visit https://doi.org/10.1017/dmp.2022.158

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