Experience of pharmacy involvement in a disaster simulation exercise within a pediatric hospital emergency department: A pilot project

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Purpose. In this descriptive report, we describe a unique trial of pharmacist participation in a multidisciplinary pediatric emergency department disaster simulation exercise. With the number of disasters increasing worldwide, the role of pharmacists in disaster response is of particular interest to the profession.

Summary. This observational study describes pharmacist participation in a disaster simulation exercise. An evaluation tool was developed to assess participants' performance in the following domains: communication, pharmacotherapy, problem solving/decision making, and teamwork/organization. The observers used a rating scale of "concise/prompt," "needs improvement," or "not done" to evaluate performance on each objective. The participants' self-perceived knowledge of disaster response was assessed with pre- and postsimulation surveys using Likert scales. Five simulation exercises were held from June to October 2019, with 2 pharmacists participating in each simulation. Within the problem solving/decision making and communication domains, pharmacists were concise/prompt 66% of the time, while they were concise/prompt for 88.8% and 92.5% of tasks in the teamwork/organization and pharmacotherapy domains, respectively. Surveys of self-perceived knowledge revealed that while only 10% of pharmacists felt "moderately prepared" prior to the simulation exercise, 80% of pharmacists felt moderately prepared to care for patients during a disaster event after the simulation exercise.

Conclusion. This report describes a unique approach of including emergency department–trained pharmacists in disaster simulation exercises to enhance their professional development, improve team dynamics in a mass casualty scenario, and increase their own reported level of preparedness to effectively manage a surge in critically ill pediatric patients.

Keywords: disaster, emergency, pediatric, pharmacist, simulation training

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Worldwide the number of disasters has increased due to mass casualty incidents (MCIs), natural disasters, and global pandemics. An MCI is defined as "an event that overwhelms the local healthcare system, where the number of casualties vastly exceeds the local resources and capabilities in a short period of time."[1] These events can cause significant human suffering and lead to a sudden surge of critically ill and injured patients into hospital emergency departments (EDs).[2,3] The Centers for Medicaid and Medicare Services Conditions of Participation and the Joint Commission require hospitals to be prepared for such a surge by conducting exercises to test emergency preparedness protocols and training healthcare personnel in their respective roles.[4] These exercises offer healthcare providers, including pharmacists, a safe and efficient training opportunity to care for a large number of critically ill patients while improving processes and team interactions.[2,5]

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While most exercises have focused on the roles of physicians and nurses in disaster events, the participation of other healthcare disciplines, such as pharmacy, is crucial in providing an efficient emergency response. Pharmacists are recommended to be actively involved in cardiopulmonary resuscitation events, medical emergency team committees, and preparatory training programs.[6] This is especially true for pharmacists in hospital EDs, as their presence and role as part of the multidisciplinary team has increased over the years.[7] Pharmacists, in general, are less prepared than their nurse or physician counterparts to respond to a disaster event and are more likely to self-report that they need additional training.[8] In particular, ED pharmacists as frontline healthcare providers must maintain the knowledge and skills to effectively operate in disaster situations.[9]

Comprehensive simulation training has been recognized as an educational method for enhancing behavioral skills in team settings such as aviation and the nuclear power industry as well as medical education.[10-12] Incorporation of simulation has increased in healthcare education in recent decades to supplement comprehensive clinical training among various healthcare professions, including in pharmacy graduate programs.[13] Simulation-based training for disaster preparedness has been shown to be effective in acquiring disaster management skills and to improve participants' confidence.[14,15] At institutions where pharmacists are integrated into the ED staff, their participation in disaster simulations is essential, as it not only fills the gaps in the emergency response plans but also reinforces a pharmacist's position as a fundamental and essential member of the clinical team.[8] At our institution, ED pharmacists respond to all medical codes and trauma response activations in the ED; hence pharmacist involvement in medical care for critically ill and injured patients is the established standard of care. Additionally, they participate in periodic multidisciplinary trauma simulation exercises hosted by a team of simulation experts, with the goal of enhancing team dynamics and collaborative management of patients with trauma. When the ED disaster simulation curriculum was being designed, the pharmacist's role was readily incorporated into the curriculum. The objective of this article is to describe our pilot project of integrating a pharmacist disaster simulation curriculum into the multidisciplinary ED pediatric disaster simulation exercise.

KEY POINTS

- While there is an abundance of literature describing pharmacists' need to train in disaster preparedness, this is the first study to describe the experience of pharmacist participation in a multidisciplinary simulation exercise in a pediatric emergency department.
- The majority of pharmacists observed excelled at providing pharmacotherapy, while there were opportunities for improvement in communication and problem solving.
- Including pharmacists in a multidisciplinary disaster simulation exercise increases the pharmacist's self-reported level of preparedness to effectively manage a surge in critically ill patients.

Setting

This observational study was conducted in an urban, level 1 pediatric trauma center ED with approximately 60,000 annual visits per year. Pharmacy services within our ED are provided by pediatric emergency medicine pharmacists and technicians 24 hours a day. The ED pharmacy is staffed by 4 full-time emergency medicine pharmacists and intensive care unit (ICU) pharmacists who cover the ED periodically. The ED satellite pharmacy is centrally located within the ED and staffed by a minimum of 1 pharmacist and 1 technician at all times. These ED pharmacists provide various operational and clinical bedside services, including prospective order review of all ED medication orders, sterile preparation and dispensing of medications, pharmacotherapy consults, providing drug information to physicians and nurses, providing medications during medical codes and trauma situations, assisting with medication reconciliation, and teaching pharmacy students and residents. The ED satellite pharmacy is supervised by 2 members of the pharmacy administration (hereafter referred to as the ED pharmacy leadership), who are also pharmacists with significant (10-plus years) experience in emergency and/or disaster medicine.

Course design

A multidisciplinary team of physicians, nurses, and pharmacists designed the overall mass casualty curriculum. This team established objectives and key competencies in line with each discipline's scope of practice. The pre- and postsimulation surveys ("pre and post surveys" hereafter) as well as the intrasimulation objectives for the pharmacists were designed by the ED pharmacy leadership, led by 1 pharmacist with extensive disaster response experience. The 4 curriculum domains were communication, pharmacotherapy, problem solving/decision making, and teamwork/organization. The objectives for each domain are summarized in Table 1. These objectives were designed to mirror an existing institutional pharmacy disaster guide that outlines the steps a pharmacist is expected to take in the event of a sudden surge of patients. Two ED-trained pharmacists were relieved of their clinical duties during the simulation to serve as the participants during each simulation day, and 2 members of the pharmacy administration served as observers to assess the pharmacists in the learning objectives. One observer was from the ED pharmacy leadership, and the other

Table 1. Pharmacy Curriculum Domains and Objectives

Domain	Objectives
Communication	• Alerting chain of command within pharmacy • Communication with the multidisciplinary team
Pharmacotherapy	• Provide timely and appropriate medications for acutely sick patients
Problem solving/decision making	• Access available resources and guidelines during a disaster • Huddle with disaster team to assess need for additional resources
Teamwork/organization	• Huddle with the second pharmacist at the scene • Track and organize patients receiving pharmacotherapy

was chosen from among the pharmacy administration team. These observers from the pharmacy administration team were selected since they would be the first point of contact to implement additional pharmacy resources during a patient surge. Their participation as observers helped them be exposed to disaster simulation while evaluating the participants in nonclinical domains. This helped balance the assessment of both clinical and nonclinical domains.

The scenario for the mass casualty simulation was that of an explosion at an elementary school leading to 25 pediatric patients being transported to the ED. The physician and nurse teams were divided into teams to serve in 3 roles: triage, disaster team leader, and medical team. The triage patients were designated as red, yellow, green, and black based on the START (simple triage and rapid treatment) triage method[16] (Appendix A). The pharmacist participant's focus was on the red patients, who were of high acuity and likely to have pharmacotherapy needs. Of the 2 participants, 1 pharmacist began the simulation exercise with the responsibility to provide pharmacotherapy care to any mass casualty patient requiring immediate intervention until they requested the second pharmacist, who was serving in a backup pharmacist role, to assist. The pharmacists also executed all tasks as if they were in a real-life setting; they made phone calls to notify the pharmacy leadership and request resource allocation, acquired medications from actual storage locations, and used the code cart to simulate preparing medications at bedside by drawing up 0.9% sodium chloride in lieu of the actual medication. Each simulation exercise lasted 15 minutes and was run 3 times, with physician and nurse participants rotating through the roles mentioned above. Thus, pharmacists participating on a given day repeated the same scenario with different teams, for a total of 3 iterations; the 2 pharmacist participants switched between primary and backup roles for each simulation exercise. All pharmacist participants were exposed to all cases included in the simulation as either the primary or backup pharmacist. The observers evaluated the participants as a group rather than as individuals. Pharmacists participated in a 45-minute debriefing with the entire multidisciplinary team at the end of the exercise, followed by a 20-minute discipline-specific debriefing with the pharmacy observers. The study was deemed exempt from review and approved by the hospital's institutional review board.

Learning assessment

A pharmacy-based evaluation tool outlining all the objectives was used to assess the pharmacist participant's performance by the two observers (Appendix B). The participants were evaluated in groups of 2, and observers used a rating scale of "concise/prompt," "needs improvement," and "not done" when evaluating the participants' performance in meeting program objectives. The observers also had space to provide comments during the global assessment of each participant's performance. The physicians and nurses had the opportunity to provide direct, informal feedback to the pharmacist participants during the multidisciplinary team debriefing. One of the ED pharmacy leadership members was always one of the observers and oriented the second observer to the evaluation tool to provide consistency. Each participant's self-perceived knowledge of disaster response was also assessed with pre and post surveys using Likert scales. Participants were asked to self-report challenges they encountered during the simulation as well as any actions or changes that they would like implemented on the post survey. The pre survey was completed by the participants a day before the simulation exercise. The participants were given 15 minutes to complete the post survey at the completion of the simulation exercise, before the discipline-specific debriefing.

Analysis plan

All data was manually recorded on the evaluation tool and later entered into Microsoft Excel 2016 (Microsoft Corporation, Redmond, WA). Descriptive analysis was used to calculate the frequency of rating scale scores in the evaluations as well as Likert scale ratings in pre and post surveys using Microsoft Excel.

Results of simulation training

Five simulation days were held from June 2019 to October 2019. Two ED-trained pharmacists participated in each of the 5 simulation days, for a total of 10 pharmacist participants. Each pharmacist participant was involved in 3 simulation exercises per simulation day, with a total of 27 evaluations available for analysis. One observer did not return their 3 evaluations; therefore, those evaluations were not included in the analysis. Seven observers participated in this study. Two members were from the ED pharmacy leadership (one of whom was always present as one of the observers), and 5 other members were from the pharmacy administration team. Participant pharmacists had clinical pharmacy experience ranging from 2 to 20 years, with a median of 7 years. Additional information regarding the pharmacist participants' background and experience is in Table 2.

Within the problem solving/decision making domain, it was observed that participants were concise/prompt 66% of the time, while there was room for improvement (defined as either needing improvement or not accomplishing the objective) 33% of the time. Data on pharmacist performance within curriculum domains can be found in Table 3. Observers noted that pharmacists could better utilize the pharmacy technicians as an additional resource to prepare and deliver medications. Additionally, pharmacists did not always utilize the existing institutional pharmacy disaster guide, which outlines the steps that the pharmacist is expected to take in the event of a sudden surge of patients. Similarly, within the communication domain, it was observed that participants were concise/prompt 63% of the time, while there was room for improvement 37% of the time. Observers found that pharmacists frequently failed to initiate notification of the pharmacy leadership, which is required to mobilize additional resources promptly. Additionally, enhanced communication with other healthcare team members, such as the physicians and nurses, to clarify medication orders for the patients was noted as an area for improvement. Participants were concise and prompt 88.8% and 92.5% of the time in the teamwork/organization and pharmacotherapy domains, respectively. The comments provided by the evaluators as part of their global assessment are described in Table 4. The pharmacy-specific debriefing incorporated the feedback related to global assessment themes and challenges encountered by pharmacists during the simulations.

Before this training, only 1 out of the 10 pharmacist participants had reportedly received mass casualty training and none of them had participated in a real-life mass casualty event. Pre and post surveys revealed that prior to the simulation exercise, only 10% of the pharmacists felt "moderately prepared," 50% felt "somewhat prepared," and 40% felt "minimally prepared" to care for patients in a mass casualty event (Table 5). In contrast, 80% of the pharmacists stated that they felt moderately prepared to care for patients in a mass casualty event after participating in the simulation exercise. When asked about the challenges encountered during the simulation exercise, most pharmacists stated that multitasking, task prioritization, and communication (both within the team and with the pharmacy leadership) to obtain more resources were the most common challenges encountered. Participants' feedback was requested regarding actions and changes required to further enhance the ability to assess, meet, and respond to a disaster event. The requested changes correlated with the challenges encountered during the simulation exercise; these included providing tools for increased communication, quick mobilization of resources, and increased simulation practices to improve multitasking and task prioritization skills.

Discussion

To our knowledge, our study is the first to describe the experience of

Table 2. Pharmacist Participant Experience

Variable	Value (*n* = 10)
Years of experience as clinical pharmacist, median	7
Postgraduate year 1 pharmacy practice residency, No. (%)	7 (70)
Postgraduate year 2 pediatric pharmacy residency, No. (%)	4 (40)
Board Certified Pharmacotherapy Specialist, No. (%)	4 (40)
Board Certified Pediatric Pharmacy Specialist, No. (%)	5 (50)

Table 3. Pharmacist Performance in Curriculum Domains

	No. (%) of Ratings (*n* = 27)		
Domain	Concise/Prompt	Needs Improvement	Not Done
Communication	17 (63)	7 (26)	3 (11)
Pharmacotherapy	25 (92)	2 (7)	0 (0)
Problem solving/decision making	18 (67)	7 (26)	2 (7)
Teamwork/organization	24 (89)	3 (11)	0 (0)

Table 4. Observers' Global Assessment Comments

Domain	Comments
Communication	• Participant did not immediately alert chain of command. • Participants should be more vocal. • [Participant] did not notify the team when leaving to obtain a medication from the pharmacy or automated dispensing machine.
Pharmacotherapy	• Participants could have been better prepared by preparing some of the anticipated medications in advance. • Provider asked for mannitol, but pharmacist prepared hypertonic saline (appropriate dose).
Problem solving/decision making	• Participant did not utilize pharmacy technician as an additional resource to draw up large medication doses or to deliver additional medications as needed. • Participant could check on stable patients during downtime periods
Teamwork/organization	• Both participants were sharing a single code cart to draw up medications for their respective patients. • Both participants were checking on the same patients. • Participants had good communication and teamwork while proactively drawing up medications.

pharmacist participation in a multidisciplinary disaster simulation exercise in a pediatric ED. While there is an abundance of literature regarding the need for pharmacists to be incorporated into disaster preparedness,[17-19] our study describes a unique approach of including ED-trained pharmacists in disaster simulation exercises to enhance their professional development and improve team dynamics in a mass casualty scenario. Multidisciplinary simulation exercises provide a safe environment for pharmacists to review their emergency preparedness resources, hone practice skills, engage with their pharmacy team members as well as the ED team, and identify areas for improvement by themselves and the department. After completion of this training exercise, pharmacists' self-perceived level of preparedness increased. Some noteworthy recommendations were made by the pharmacist observers, which included participants better utilizing their pharmacy team resources (eg, technicians, the pharmacy leadership) to coordinate further support and consistently practicing excellent communication skills. In our case, these exercises also provided insight into components of the pharmacy-specific disaster response that needed reinforcement, clarification, and even modification; this included clarifying the contact who should be immediately paged in the event of an MCI notification, as well as reinforcing the need for extra resources during such event.

Although variable from our pilot study design, there is existing literature available regarding pharmacy involvement in disaster response. Watson et al[17] conducted a Delphi study defining pharmacists' role in prevention, preparedness, response, and recovery of disasters. Other articles detail surveys of pharmacists on their disaster preparedness, advocate for increasing pharmacists' role in disaster response, and describe disaster management elective courses in pharmacy education.[20-22] In 2012, Feret and Bratberg[23] published a description of their experience integrating pharmacists into Rhode Island Department of Health preparedness activities. These activities included participating in a simulated response to a biochemical terrorist attack, during which pharmacists assisted in mass antimicrobial dispensing; participation in the Strategic National Stockpile Preparedness Course; and development of a comprehensive manual for point-of-dispensing activities for Rhode Island municipalities. Previous emergency preparedness simulation studies involving pharmacy students are described in the literature.[24,25] However, our study is still distinctive because ED-trained pharmacists with years of experience were included in our pilot program. As evidenced by these examples, the role of pharmacists in disaster response is of interest to the profession and activities to prepare for this role are ongoing.

In our study, the measurable objectives used to assess the participants' performance, combined with the pre and post surveys, revealed valuable information on how to further assist and prepare them in the event of a patient surge. When broken down by domain, communication and problem solving/decision making were identified as areas where most pharmacists could improve their performance (as shown in Tables 3 and 4). Clear and concise communication, as well as comprehensive knowledge sharing between team members, can help improve patient care in an already fast-paced and busy environment and was a main focus of this simulation exercise and evaluation. When the pharmacist initially responding to an MCI gets very involved in patient care prior to alerting the pharmacy chain of command and requesting additional resources to help manage the influx of high-acuity patients, this leads to downstream effects including challenges with task prioritization and multitasking. Thus, requesting additional resources at

Table 5. Pharmacists' Self-Ratings of Preparedness

	No. (%) of Pharmacists (n = 10)				
	Very Prepared	Moderately Prepared	Somewhat Prepared	Minimally Prepared	Not at All Prepared
Pre survey – "How prepared are you to efficiently triage and multitask to provide medications to many patients (>10) in a mass casualty event?"	0 (0)	1 (10)	5 (50)	4 (40)	0 (0)
Post survey – "Thinking back before the drill, how prepared were you to efficiently triage and multitask to provide medications to many patients (>10) in a mass casualty event?"	0 (0)	0 (0)	6 (60)	4 (40)	0 (0)
Post survey –"If there is a mass casualty event today, how prepared are you to efficiently triage and multitask to provide medications to many patients (>10) in a mass casualty event?"	0 (0)	8 (80)	2 (20)	0 (0)	0 (0)

the first alert of a patient surge is crucial to a successful disaster response. Additionally, effective and closed-loop communication amongst healthcare providers is just as necessary for effective resuscitations. It was noted that communication between pharmacists collaborating to care for high-acuity patients was often present. However, the global assessment demonstrated themes related to pharmacists needing to be more vocal when communicating with the multidisciplinary team. These themes were discussed during the pharmacy-specific debriefing sessions led by the observer from the ED pharmacy leadership. The participants appreciated that simulation exercises exposed them to stressful situations, provided a safe environment to learn, and felt real enough to expose areas for improvement by them personally as well as by the system. Pharmacists requested periodic simulation exercises to practice and maintain their ability to respond to disaster events.

As seen in Table 3, the pharmacists excelled in the pharmacotherapy domain by being concise/prompt 92.5% of the time during the simulation exercise. This result may be attributable to the role that ED-trained pharmacists currently play in the ED at our institution. They are extensively involved in providing medications at the bedside in high-acuity situations and were able to successfully demonstrate the same during the disaster simulation exercise.

Our study validates previously published literature[17,18] indicating that it is essential to define the pharmacist's role in disaster preparedness and provide training programs that enable pharmacists to perform their roles effectively. Pharmacists who participate in disaster response need additional skills beyond being a pharmacotherapy expert, such as being able to adapt to a rapidly changing environment, problem solving under immense pressure, task prioritization, and effective communication. Our study showed that while the majority of pharmacists excelled at providing pharmacotherapy, there was room for improvement in the communication and problem solving/decision making domains. Although structured, multidisciplinary, simulation-based training would be an ideal way to practice and refine these skills, periodic tabletop simulation exercises may prove beneficial as well.[25,26] These exercises also present a mechanism for pharmacy leaders to critically evaluate and modify their existing guidelines to ensure readiness.

While this study highlighted the importance of simulation exercises for pharmacy personnel, there were also limitations. This was a pilot study held at a pediatric tertiary center, with a small number of participants. Additional studies may be needed to validate these results and prove generalizability to other EDs. Secondly, although the evaluation tool used to assess pharmacist participants was reviewed and approved by a seasoned pharmacist with extensive disaster response experience, it was not externally validated. Additionally, observers did not have a group education session prior to the simulation to provide instruction regarding use of the tool. Instead, the evaluation tool was reviewed with the observers on the day of the simulation exercise to orient them to the form and provide an overview of the objectives prior to the simulation. Therefore, the assessments made by the observers may not have been standardized and were primarily subjective, and interrater reliability may have been inconsistent. No prior externally validated tool or formal definitions for assessing pharmacists during an MCI currently exists. Therefore, our pilot project necessitated creation of our own tool. Future work in this area should include creating and validating an evaluation tool for pharmacists during an MCI or simulation. Observer bias also needs to be considered, as the pharmacist participants were aware they were being observed and assessed, which may have potentially altered their behavior.

The observers evaluated the participants in groups of 2 and, hence, global assessments were made for a team of pharmacists in each exercise. This eliminated the possibility of assessing a learning effect or evaluating whether performance varied between full-time ED pharmacists and ICU pharmacists.

The implementation and evaluation of this pilot project has provided useful training and experience to the ED-trained pharmacists while also serving as a baseline starting point to expand this disaster simulation exercise going forward. This pilot project focused on the process of incorporating pharmacists into disaster simulation exercises within a pediatric ED. Future simulations should focus on thoroughly evaluating the clinical effectiveness of this enhanced pharmacist training as well as assessing the effectiveness and influence of pharmacists' contribution to the simulation experience for the entire multidisciplinary team. While this simulation was held in a pediatric ED, it would be just as valuable to perform in an adult ED setting. As pharmacy school curriculums continue to evolve, increased focus is being placed on interprofessional education; this exercise provides continuity from education into practice. An interesting future direction would be incorporating student learners from multiple disciplines into this training.

Conclusion

Our pilot study demonstrated that multidisciplinary disaster simulation exercises are beneficial to the pharmacists staffing in the ED setting. By participating in this simulation, pharmacists were able to practice skills beyond pharmacotherapy, including adapting to a rapidly changing environment, problem solving, and prioritizing tasks under high-pressure situations. This helped improve their self-reported level of preparedness to effectively manage a surge in critically ill and injured patients and refine their communication as part of the collaborative patient care team. Future studies should focus on the clinical benefit of pharmacist involvement and impact on other medical disciplines during an MCI.

Disclosures

Dr. Chung has been a consultant to Rubius Therapeutics regarding COVID-19 policies and procedures. The other authors have declared no potential conflicts of interest.

References

1. DeNolf RL, Kahwaji CI. EMS mass casualty management. In: *StatPearls*. StatPearls Publishing; October 15, 2020. Accessed March 10, 2021. https://www.ncbi.nlm.nih.gov/books/NBK482373/
2. Chung S, Shannon M. Hospital planning for acts of terrorism and other public health emergencies involving children. *Arch Dis Child*. 2005;90(12):1300-1307. doi:10.1136/adc.2004.069617
3. Xiao N, Dutta S, Sharman R, Rao HR. A simulation-based study in a hospital emergency department: Capacity and workflow issues. In: *Proceedings of 15th Americas Conference on Information Systems 2009*. Association for Information Systems; 2009:4158-4165.
4. 42 CFR §482.55 - Condition of participation: emergency services. Cornell Law School Legal Information Institute. Accessed October 12, 2020. https://www.law.cornell.edu/cfr/text/42/482.55
5. Gowing JR, Walker KN, Elmer SL, Cummings EA. Disaster preparedness among health professionals and support staff: what is effective? An integrative literature review. *Prehosp Disaster Med*. 2017;32(3):321-328. doi:10.1017/S1049023X1700019X
6. Johnson PN, Mitchell-Van Steele A, Nguyen AL, Stoffella S, Whitmore JM. Pediatric pharmacists' participation in cardiopulmonary resuscitation events. *J Pediatr Pharmacol Ther*. 2018;23(6):502-506. doi:10.5863/1551-6776-23.6.502
7. Subramaniam V, Calis KA, Dombrowski RC, et al. ASHP statement on the role of health-system pharmacists in public health. *Am J Health-Syst Pharm*. 2008;65(5):462-467. doi:10.2146/ajhp070399
8. Alkhalili M, Ma J, Grenier S. Defining roles for pharmacy personnel in disaster response and emergency preparedness. *Disaster Med Public Health Prep*. 2017;11(4):496-504. doi:10.1017/dmp.2016.172
9. Ortmann MJ, Johnson EG, Jarrell DH, et al. ASHP guidelines on emergency medicine pharmacist services. *Am J Health-Syst Pharm*. 2021;78(3):261-275. doi:10.1093/AJHP/zxaa378
10. Wallin CJ, Meurling L, Hedman L, Hedegård J, Felländer-Tsai L. Target-focused medical emergency team training using a human patient simulator: effects on behaviour and attitude. *Med Educ*. 2007;41(2):173-180. doi:10.1111/j.1365-2929.2006.02670.x
11. Datta R, Upadhyay KK, Jaideep CN. Simulation and its role in medical education. *Med J Armed Forces India*. 2012;68(2):167-172. doi:10.1016/S0377-1237(12)60040-9
12. Aggarwal R, Mytton OT, Derbrew M, et al. Training and simulation for patient safety. *Qual Saf Health Care*. 2010;19 (suppl 2):i34-43. doi:10.1136/qshc.2009.038562
13. Tait L, Lee K, Rasiah R, et al. Simulation and feedback in health education: a mixed methods study comparing three simulation modalities. *Pharmacy (Basel)*. 2018 May 3;6(2):41. doi:10.3390/pharmacy6020041
14. Hewett EK, Nagler J, Monuteaux MC, et al. A hazardous materials educational curriculum improves pediatric emergency department staff skills. *AEM Educ Train*. Published online December 2017. doi:10.1002/aet2.10077
15. Cicero MX, Whitfill T, Overly F, et al. Pediatric disaster triage: multiple simulation curriculum improves prehospital care providers' assessment skills. *Prehospital Emerg Care*. 2017;21(2):201-208. doi:10.1080/10903127.2016.1235239
16. Clarkson L, Williams M. EMS, mass casualty management. In: *StatPearls*. StatPearls Publishing; 2020. Accessed March 22, 2021. https://www.ncbi.nlm.nih.gov/books/NBK459369/
17. Watson KE, Singleton JA, Tippett V, Nissen LM. Defining pharmacists' roles in disasters: a Delphi study. *PLoS One*. 2019;14(12):e0227132. doi:10.1371/journal.pone.0227132
18. Pincock LL, Montello MJ, Tarosky MJ, Pierce WF, Edwards CW. Pharmacist readiness roles for emergency preparedness. *Am J Health-Syst Pharm*.

2011;68(7):620-623. doi:10.2146/ajhp090659

19. Terriff CM, Newton S. Pharmacist role in emergency preparedness. *J Am Pharm Assoc*. 2008;48(6):702-708. doi:10.1331/JAPhA.2008.00543
20. Melin K, Rodríguez-Díaz CE. Community pharmacy response in the aftermath of natural disasters: time-sensitive opportunity for research and evaluation. *J Prim Care Community Health*. 2018;9:2150132718813494. doi:10.1177/2150132718813494
21. Montana M, Mathias F, Rathelot P, Lacroix J, Vanelle P. Development and evaluation of an elective course on the pharmacist's role in disaster management in France. *J Educ Eval Health Prof*. 2019;16:1-13. doi:10.3352/jeehp.2019.16.19
22. Schumacher L, Bonnabry P, Widmer N. Emergency and disaster preparedness of European hospital pharmacists: a survey. *Disaster Med Public Health Prep*. Published online November 19, 2019. doi:10.1017/dmp.2019.112
23. Feret B, Bratberg J. A ten-year experience of a pharmacist consulting team for statewide bioterrorism and emergency preparedness. *Med Health R I*. 2012;95(9):279-280.
24. Hannings AN, von Waldner T, McEwen DW, White CA. Assessment of emergency preparedness modules in introductory pharmacy practice experiences. *Am J Pharm Educ*. 2016;80(2):23. doi:10.5688/ajpe80223
25. Pate A, Bratberg JP, Robertson C, Smith G. Evaluation of a tabletop emergency preparedness exercise for pharmacy students. *Am J Pharm Educ*. 2016;80(3):50. doi:10.5688/ajpe80350
26. Abraham RT, Walls RT, Fischer M, et al. Tabletop scenarios for realism in bioterrorism and threat preparedness. *W V Med J*. 108(6):12-17.

Appendix A—Categorization of triaged patients by injury severity in disaster simulation exercise[a]

Patient #	Age	Gender	Ambulatory?	Comments
Red (immediate): severe injuries but high potential for survival with treatment; taken to collection point first				
1	10	M	N	Respiratory rate 0, pulse present; large right chest wound/crush injury to torso
2	10	F	N	Respiratory rate 0, RR 12 with repositioning; pulse present; facial and chest crush injuries
3	10	M	N	Posturing/seizing – facial contusions and occiput bogginess with battle sign
4	10	F	N	Agonal breathing; chest and abdomen bruising
Yellow (delayed): serious injuries but not immediately life-threatening				
5	10	F	Y	Right forearm with obvious deformity, poor perfusion, sensation normal
6	9	F	Y	1st and 2nd degree burns to arm and chest, smoke exposure, blunt chest trauma
7	9	M	Y	Difficulty breathing 2/2 smoke inhalation
8	9	F	N	Swelling to right thigh, R femur fracture
9	10	M	N	Multiple lower extremity burns and unstable pelvis, crush injury to pelvis
10	10	F	Y	Right open forearm fracture
11	9	F	Y	Abdominal pain with bruising
12	9	M	N	Lower extremity crush injury; delayed extraction
13	9	M	Y	Abrasions to face and head, 3 cm scalp laceration, +loss of consciousness
14	9	F	N	Bilateral lower extremity 2nd degree burns from knees down
Green (walking wounded): minor injuries				
15	9	F	Y	Crying hysterically, answers appropriately, no obvious injuries
16	9	F	Y	Face/thigh/arm lacerations; multiple abrasions
17	9	F	Y	Abrasions to head and neck
18	9	M	Y	No obvious injuries; seems stunned
19	10	M	Y	Small laceration to right eyebrow
20	9	F	Y	Abrasions to right lower extremity but can walk
21	9	M	Y	No obvious injuries
22	10	M	Y	Facial bruising and swelling
23	9	F	Y	L shoulder pain, abrasions to left arm
Black (deceased/expectant): injuries incompatible with life or without spontaneous respiration				
24	9	F	N	Apneic, no pulse, crush injury to chest, open head wound
25	9	F	N	Apneic, no pulse, abdomen firm and distended with bruising

[a]Triage color categories adapted from reference 16.

Appendix B—Evaluation tool used in disaster simulation exercise

DATE OF SIMULATION OBSERVED: ________

Evaluator Name: ________________________

Instructions:

Please check each item, according to the participants' level of performance. Please mark N/A when appropriate and time markers where requested. Please feel free to write down any additional comments about the participant's performance plus any other observations.

NOTE where the word "recommends" appears in the objectives, the pharmacist would only be expected to intervene and "recommend" a therapy if the prescriber requests assistance or is requesting a medication that is not standard practice.

The participant demonstrated the following:

Task	Concise and prompt	Needs Improvement*	Not done	Not applicable	Comments (*if you mark needs improvement, please explain)
OBJECTIVES					*ANSWER KEY*
Accesses Code Triage Job Action code sheet from the Shared drive					
Huddles with Disaster Team Leader (RN & MD) to determine the number of patients and acuity					
Pages Charge Pharmacist (0223) to alert them about code triage (# of patients) and need for extra resources. (Charge pharmacist should notify pharmacy AOD but this will not be measured)					Extra resources may include hypertonic saline, mannitol Code trays (already 6 in ED – 4 code carts, 2 extra trays in ED pharmacy)
Requests at least 1 extra pharmacist and tech be sent to the ED right away					
Brief huddle with second pharmacist to divide workload and priorities					
Uses clipboard or has other organization tool to track all patients and their medications					

Appendix B—Continued

Task	Concise and prompt	Needs Improvement*	Not done	Not applicable	Comments (*if you mark needs improvement, please explain)
OBJECTIVES					*ANSWER KEY*
Provide medications for the following acute sick patients					
Red team – Patient 1 Recommends appropriate intubation medications per RSI guidelines.	☐	☐	☐	☐	Mark N/A if teams asks for Etomidate/Rocuronium
Consults code book for dosing and prepares/labels correct amount (saline) in syringe	☐	☐	☐	☐	
Red team – Patient 2 Recommends appropriate intubation medications per RSI guidelines.	☐	☐	☐	☐	Considers succinylcholine instead of rocuronium (if no contraindications) since patient has facial trauma (could be difficult intubation)
Consults code book for dosing and prepares/labels correct amount (saline) in syringe	☐	☐	☐	☐	
Red team – Patient 3 Recommends appropriate seizure medications per the Initial Management of Seizure Guideline	☐	☐	☐	☐	Recommends nasal/IM midazolam if patient doesn't have an IV line placed per seizure guideline
	☐	☐	☐	☐	
Physically walks to the Pyxis machine to obtain controlled substances as needed.	☐	☐	☐	☐	DO NOT actually pull out controlled substances.
Recommends appropriate intubation medications per RSI guidelines. Recommends/obtains 3% hypertonic saline and mannitol	☐	☐	☐	☐	Intervene if the pharmacist is drawing up saline for an IN medication dose only – we must provide air only in the syringe for IN medications or else we will harm the manikin.
Consults code book for dosing and prepares/labels correct amount (saline) in syringe	☐	☐	☐	☐	Draws up mannitol/hypertonic saline in syringes (do not administer from IV bag)
Red team – Patient 4 Recommends appropriate epinephrine doses for PEA per the PALS guidelines	☐	☐	☐	☐	Mark N/A if team asks for an appropriate dose
Consults code book for dosing and prepares/labels correct amount (saline) in syringe	☐	☐	☐	☐	
Prepares at least two doses and reminds team at 3-5 minute interval if not requested by team leader	☐	☐	☐	☐	Times interval between epinephrine doses (NOTE: facilitator may artificially speed up time and that is OK)

Abbreviations: AOD, administrator on duty; ED, emergency department; IM, intramuscular; IN, intranasal; IV, intravenous; MD, physician; N/A not applicable; PALS, pediatric advanced life support; PEA, pulseless electrical activity; RN, registered nurse; RSI, rapid sequence intubation. Pyxis is a registered trademark for an automated dispensing system manufactured by Becton, Dickinson and Company.