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# Operation continued care: A large mass-casualty, full-scale exercise as a test of regional preparedness

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ABSTRACT

*Background:* Our regional trauma organization, which comprises 7 trauma centers, 30 acute care hospitals and free-standing emergency departments, and 42 emergency medical services agencies, conducted possibly the largest mass-casualty drill to date, totaling 445 victims at 3 sites involving 11 hospitals and 25 agencies and organizations.

*Methods:* The drill was preceded by a tabletop exercise 4 months beforehand called Operation Continued Care Full-Scale Exercise, which consisted of simulated terrorist events at 3 sites to wound 445 moulaged patients. Four law enforcement and 5 fire and emergency medical services departments and 16 supporting organizations and agencies were involved in transporting patients to 11 different hospitals. The 7 objectives for the event addressed coordinating emergency operations, sustaining adequate communications, updating regional bed status, processing resource requests, triaging patients, tracking patients, and patient identification.

*Results:* Of the 445 transported patients, 270 (60%) were entered correctly into the state patient tracking system; 68 (25.2%) upgrades and 34 (12.6%) downgrades from scene triage categories were noted. Multiple opportunities for improvement were identified, with major weaknesses noted in communication and coordination from event sites to the regional trauma organizations and hospitals.

*Conclusion:* The size and complexity of the drill provided experience and knowledge to facilitate future disaster preparedness and highlighted weaknesses in communication and coordination. Large, multijurisdictional, multiagency exercises provide opportunities to stress, evaluate, and improve regional disaster preparedness.



## Introduction

A mass-casualty incident (MCI) is a type of disaster defined not by the absolute number of patients involved but by the event's capability to exceed local resources, thus shifting the focus of medical care from the individual patient to the population as a whole in order to maximize survival.[1] MCIs are caused primarily by natural disasters, terrorist violence, military actions, industrial calamities, and transportation accidents. Whereas earthquakes, volcanic explosions, tsunamis, and wars date to the beginning of recorded history, the phenomena of modern terrorism, in which one or a few individuals commit mass murder, arguably began with the French Revolution and has steadily become more commonplace, peaking in 2014 with over 16,000 terrorist incidents worldwide causing over 40,000 fatalities.[2] Beginning with the Columbine school shooting incident in the United States in 1999, there has been a consistent increase in the frequency of MCIs propagated by active shooters over the last 20 years in the United States.[3,4] In response to these issues, and especially because of the terrorist attacks of September 11, 2001, and Hurricane Katrina in 2005 in the United States, preparing health care facilities and regional trauma systems for resource-overwhelming incidents has been emphasized by the federal government. A major component of preparedness is the regular performance of drills. The US Department of Homeland Security developed specific resource guidelines for disaster drills in 2013 through the Homeland Security Exercise and Evaluation Program (HSEEP). As its stated purpose, "HSEEP provides a set of guiding principles for exercise programs, as well as a common approach to exercise program management, design and development, conduct, evaluation, and improvement planning.

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**Fig 1.** Participating hospitals and event sites. This map of Ohio provides the COTS catchment area (shaded), participating hospitals (solid dots), and event sites (stars).

Exercises are a key component of national preparedness—they provide elected and appointed officials and stakeholders from across the whole community with the opportunity to shape planning, assess and validate capabilities, and address areas for improvement."[5] Based on these principles, the Central Ohio Trauma System (COTS) planned and implemented a full-scale exercise of the size and scope large enough in design to stress regional resources substantially and thereby identify areas of weakness. The purpose of this report is to describe the planning and implementation process, share our results, and facilitate other regions as they conduct similar preparatory drills. The design of the exercise was based on a belief that our region is at risk for a large-scale terrorist attack because the Greater Columbus, Ohio, metropolitan area includes over 2 million people, covers 15 counties, is a center of business and industry, boasts one of the largest universities in the country along with dozens of other universities, and has two professional sports teams.

## Methods

COTS comprises 2 adult level 1 trauma centers, 1 pediatric level 1 trauma center, 2 level 2 trauma centers, 2 level 3 trauma centers, 30 non–trauma center acute care hospitals and free-standing emergency departments, and 42 emergency medical services (EMS) agencies. See Fig 1 for a map of the Ohio Homeland Security regions, the COTS catchment area, the participating hospitals and organizations, and the event sites. At COTS, the Healthcare Incident Liaison (COTS HIL)[6] provides assistance 24 hours a day, 7 days a week, 365 days a year with public health responses and coordination of surges in medical activities in the central, southeast, and southeast central regions of Ohio. The COTS HIL serves to collect and collate health information, promote situational awareness, assist with allocation of resources, and monitor the performance and capacity of member health care systems within these regions. COTS HIL operates within an incident command system structure and is able to deploy medical assets during emergencies.

**Table I**
Objectives for the tabletop exercise

| |
|---|
| 1. Identify the management structure to support effective operational coordination between all agencies and entities |
| 2. Demonstrate the process to prioritize the transport of all simulated patients to the most appropriate facility |
| 3. Identify the process to maintain sustained 2-way communications, including the utilization of tactical radios, the MARCS, paging, and conference calls with both the COTS HIL and the emergency operations center in accordance with applicable plans, policies, and procedures |
| 4. Identify the process for requesting needed resources through appropriate channels in accordance with plans, policies, and procedures |
| 5. Identify and demonstrate the process to triage patients effectively in response to a medical surge event throughout the incident |
| 6. Demonstrate the process to track patients effectively from intake to discharge in response to a medical surge event throughout the incident |

COTS organized and conducted Operation Continued Care Full-Scale Exercise as an inclusive, multijurisdictional, multiagency opportunity to maximally stress the Regional Healthcare Emergency Preparedness Coalition with a large, complex, mass-casualty drill involving simultaneous terrorist events at 3 sites around the city to identify the strengths and weaknesses of the regional trauma system according to HSEEP principles. Owing to the large scale of the event, COTS partnered with a nationally recognized firm, Ascenttra, which specializes in HSEEP and full-scale exercises. Planning started 7 months before the event, and a tabletop exercise was conducted 4 months before the full-scale exercise. The tabletop exercise included 16 participating organizations and was a multimedia-facilitated activity simulating the triage, treatment, and transport of patients in conjunction with incident management. Participating organizations included COTS, 2 adult level 1 trauma centers, 1 pediatric level 1 trauma center, 2 level 2 trauma centers, 6 non–trauma center acute care hospitals, 2 fire departments, and 2 police departments. The 6 objectives of the tabletop exercise are described in Table I. The tabletop exercise was divided into 2 modules: initial notification and response followed by patient reception, treatment, and tracking. Each module began with a scenario review followed by a multimedia update summarizing the key events.

Operation Continued Care Full-Scale Exercise took place on April 4, 2017. Simultaneous mock terrorist attacks occurred at 3 geographically distant sites throughout the city, including a university student rally, a stadium hosting a soccer tournament, and a 5K road race at an airport. At each crowded staged venue, simulated wounds were inflicted with firearms, hand grenades, incendiary devices, and motor vehicles, culminating in 445 mock victims. Participating personnel included controllers, simulators, evaluators, observers, media personnel, and support staff. The objectives were derived from the Office of the Assistant Secretary of the US Department of Health and Human Services for Preparedness and Response (ASPR) 2012 document *Healthcare Preparedness Capabilities: National Guidance For Healthcare System Preparedness*[7] and selected by the exercise-planning team. Seven objectives were chosen and focused on 3 ASPR capabilities (out of 8): emergency operational coordination, information sharing, and medical surge. These objectives were categorized as performed without challenges (P), performed with some challenges (S), performed with major challenges (M), or unable to be performed (U). The objectives for the full-scale exercise are described in Table II.

As the incident developed, law enforcement secured each scene. Each moulaged victim had a card revealing their injuries, and they were then evaluated and triaged by the EMS teams using the Simple Triage and Rapid Treatment (START) method. Transportation to participating hospitals was accomplished using 8 transit authority buses. Once patients arrived at receiving

**Table II**
Full-scale exercise objectives

1. Participants shall identify the management structure to support effective operational coordination between all agencies and entities.
2. Facilities and agencies shall establish sustained, 2-way communications to include MARCS, paging, and conference calls with the COTS HIL and with the local emergency operations center within applicable plans, policies, and procedures within 15 minutes of the onset of the incident.
3. Participating community health care organizations shall use the Central Ohio Healthcare Disaster Information Management System to appropriately update bed status, hospital liaison contact, and MCI information throughout the incident.
4. Participants shall request needed resources through appropriate channels in accordance with plans, policies, and procedures.
5. Hospitals and first responders shall effectively triage patients in response to a medical surge event throughout the incident.
6. Hospitals shall effectively track patients from intake to discharge in response to a medical surge event throughout the incident.
7. Hospitals shall input victims into OHTrac (a program of the Ohio Department of Health used for patient tracking, verifying patient identification, and reunifying family members with patients during a disaster or MCI).

institutions, emergency and surgery staff were brought to surge capacity per their mass-casualty protocols as each patient was then taken through the treatment process. Health care facilities followed patients through the care process to an appropriate disposition while attempting to achieve the stated objectives. Postexercise evaluation of the event was based on these objectives and aligned capabilities, targets, and critical tasks, which were documented in the exercise evaluation guides provided to each evaluator. Additionally, players completed participant feedback forms and provided input during hot-wash, debrief sessions. These documents were then analyzed and compiled into the *After-Action Report/Improvement Plan*.

## Results

In preparation for the full-scale event, the tabletop exercise provided participating hospitals and agencies the opportunity to assess policies, plans, and procedures pertaining to disaster and surge events. In addition, the tabletop exercise allowed participants to become familiar with a standardized triage system and to assess the flow of patients in the context of COTS HIL resource management and bed tracking; all of these exercises and evaluations were in concordance with the HSEEP-identified value for tabletop exercises.[5]

For the full-scale exercise, 445 moulaged mock patients were transported to 11 different hospitals, which involved 4 law enforcement and 5 fire or EMS departments and 16 supporting organizations and agencies. Of the 445 transports, 298 (67%) were entered into OHTrac (a state program of the Ohio Department of Health used for patient tracking, verifying patient identification, and reunifying family members with patients during a disaster or MCI); 28 (6%) of the individual patient data were entered incorrectly and unavailable for analysis. The triage data of the remaining 270 patients were analyzed post hoc, showing that there were 102 (37.8%) changes with 68 (25.2%) upgrades and 34 (12.6%) downgrades from initial scene triage categories. Refer to Fig 2 for a flow chart of transported patients, entries into OHTrac, and over- or undertriage. Of the 298 patients entered into OHTrac, the initial triage category at the scene was available for 296, demonstrating 2 dead, 3 expectant, 50 delayed, 116 minor, and 125 immediate categories.

The *After-Action Report/Improvement Plan* of the full-scale exercise presented each of the 7 objectives in the context of its ASPR-defined performance measure (emergency operational coordination, information sharing, or medical surge) with strengths, areas for improvement, references, and analyses. All 7 objectives were rated S or performed with some challenges, meaning the targets and critical tasks associated with the health care preparedness capability were completed in a manner that achieved the objective and did not negatively affect the performance of other activities. Performance of this activity did not contribute to additional health or safety risks for the public or for emergency workers, and it was conducted in accordance with applicable plans, policies, procedures, regulations, and laws. Opportunities to enhance effectiveness or efficiency, however, were identified. A brief summary of the strengths that were identified included the COTS HIL operations center and staff, the detailed performance of EMS at each site, the use of tactical radios, use of the multiagency radio communication system (MARCS), and conference calls for information sharing, updates by the hospitals of the Central Ohio Healthcare Disaster Information Management System, anticipation of resource needs, efficient triage at multiple emergency departments and incident sites, effective patient tracking at multiple hospitals, and 67% entrance of patients into OHTrac. Identified areas for improvement included a lack of incident-site communication with each other or the COTS HIL, no use of the National Incident Management System–recommended incident complexes at incident sites, incomplete information entry in the Central Ohio Healthcare Disaster Information Management System by hospitals, minimal and sometimes inaccurate use of resource requests by hospitals, instituting the START triage at the incident sites before removal to an established triage/treatment/transport point, ineffective patient tracking at some hospitals, 6% of patients entered inaccurately by hospitals into OHTrac, and ineffective use of OHTrac by some hospitals. From these strengths and areas for improvement, the *After-Action Report/Improvement Plan* identified communication as a major weakness, stating "There was very little coordination and communication between the incident sites and HIL or hospitals. There seemed to be no process or coordination to determine to which hospitals patients should go, which resulted in some hospitals being overwhelmed while others received very few patients."

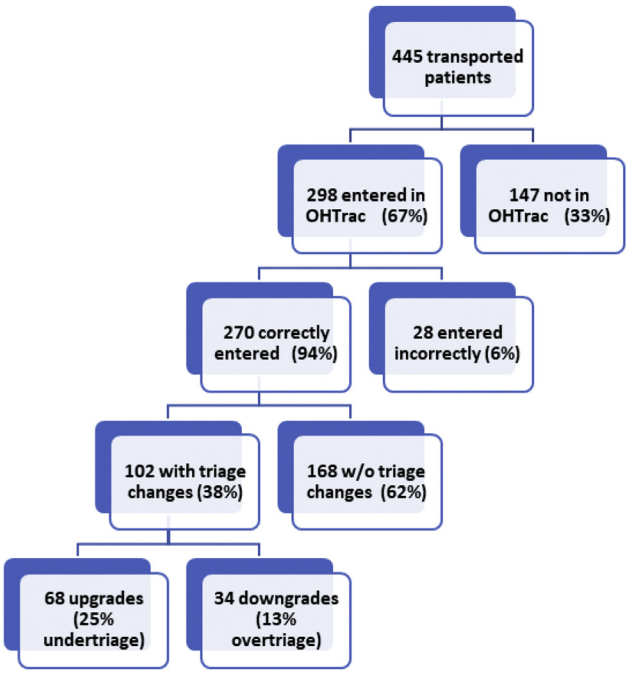


**Fig 2.** Flow chart of transported patients, entries into OHTrac, and over- or undertriage.

## Discussion

The rates of 13% overtriage and 25% undertriage are consistent with other studies documenting mass-casualty drills,[8–10] where the 2 most common triage protocols, START and SALT (Sort, Assess, Life-saving interventions, Treat/Transport), have been noted to produce consistently high rates of overtriage.[11,12] Frykberg[8] concluded that overtriage as a component of MCIs from bombings directly correlates to a linear increase in mortality.[8] A more recent simulation-based study of mass casualty not limited to bombings questioned this linear relationship in the context of other etiologies; this study suggested that a critical surge-to-capability ratio, defined as the relative number of critical patients to available and staffed treatment units, may be more accurate in predicting mortality.[13] Further opportunities exist to explore this relationship between disaster cause and mortality and to define more accurate, yet easily employable, triage protocols.

The largest and most complex mass-casualty drills are full-scale exercises that, when encompassing an entire regional trauma system, demonstrate particular promise in identifying gaps in disaster preparedness.[14] As stated by McCormick et al,[15] full-scale exercises "allow agencies and organizations to validate response plans, policies, and procedures; clarify organizational internal and external roles and responsibilities; determine how well independent response systems integrate; identify resource gaps in the operational environment; and test agreements with other public and private entities." Our drill was consistent with both real-world disasters and other drills by also identifying communications as a major weakness of overall preparedness.[16] Specifically, we found breakdowns in communication from scene to scene, from the scenes to the COTS HIL and from hospitals to the COTS HIL; these breakdowns led to a lack of coordination in transporting patients, thereby causing a disproportionate influx to certain institutions. If coordination between the scene and the hospital could have been accomplished through improved communication, this opportunity may have led to a more even distribution of patients to appropriate facilities and improved provision of needed resources from the COTS HIL to individual hospitals. This area of breakdown in communication was identified as a weakness that should be stressed and improved upon in further drills and could be facilitated by the use of scene-specific, National Incident Management System–recommended incident command complexes by first responders. In addition, more frequent feedback from hospitals to the COTS HIL regarding their patient loads and needed resources would allow subsequent feedback to the scene incident command for a more balanced triage and patient distribution. Lack of communication from incident sites to definitive care facilities has been identified as an opportunity for improvement by multiple real-world events,[17,18] and the regional trauma organization (RTO) represents a possible and vital intermediary to solve this problem.

The American College of Surgeons has emphasized the concept of the RTOs consisting of trauma centers in the geographic area, non–trauma center health care facilities, prehospital agencies, and public health organizations as a vital part of injury care and prevention by promoting collaboration, data collection, and policy change within that region.[19] Mass-casualty drills are a valuable component of this process of injury prevention within a regional trauma system.[20] Within COTS, the emergency preparedness division houses the RTO, and the COTS HIL functions as the regional health care coordinating agency for Ohio Homeland Security regions 4, 7, and 8, covering all of central, southern, and southeast Ohio.

Operation Continued Care Full-Scale Exercise was viewed as a way to align the goals of our regional trauma system with the values stated by the American College of Surgeons and the guidelines set forth in the HSEEP. The implementation of patient-tracking systems is a component of recommended HSEEP initiatives. Although only 67% of patients were entered into OHTrac state-sponsored tracking system, this represents a substantial improvement over the previous rates of approximately 50% of patients in our prior drills. Opportunities for improvement exist, and it was felt that more frequent orientation at individual hospitals combined with ongoing training would aid in improving this rate further. This expectation was evidenced by greater usage and accuracy rates at hospitals more familiar in its use and specifically the trauma centers. Lessons learned from our exercise are included in Table III.

**Table III**
Lessons learned

1. Coordinate communication between incident sites and the COTS HIL.
2. Establish incident complexes at each incident site.
3. Implement hands-on training on the use of the state patient-tracking system (OHTrac) to improve updated and complete patient identification and status.
4. Hospitals should update the COTS HIL frequently and use it for resource requests, as needed.
5. Tracking patients from intake to discharge at every hospital was not accomplished.
6. Disaster preparedness is ongoing and requires never-ceasing vigilance.

In conclusion, Columbus is at risk as a target for a large-scale terrorist attack, and therefore we sought to prepare appropriately. The size and complexity of Operation Continued Care Full-Scale Exercise placed intended and marked strain on our regional trauma system. This exercise lead to improved disaster preparedness by allowing participants to become more knowledgeable of their roles and responsibilities, identifying the need for information sharing and coordination, and identifying equipment and resource needs to support multiple incident sites. Despite the large number of patients, area hospitals were able to adjust to surge capacity. The value of vigilance and preparation by prehospital personnel, individual hospitals, and regional systems by the implementation of regular drills cannot be overstated. These are opportunities to gain potentially life-saving insights into both strengths and weaknesses at every level of an agency, institution, or system preparing for a disaster that hopefully will never occur.

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## Conflict of interest/Disclosure

The authors have no conflicts of interest.

## References

1. Armstrong J, Berg B, Doucet J, et al. Preparation: Overview of disaster and mass casualty management. In: Doucet JJ, ed. *Disaster Management Emergency Preparedness Course Manual*. 2nd ed. Chicago, IL: American College of Surgeons; 2016:2–19.
2. National Consortium for the Study of Terrorism and Responses to Terrorism (START). 2018. Global terrorism database [data file]; 2018. http://www.start.umd.edu/gtd. Accessed February 9, 2019.
3. Blair JP, Schweit KW. *A Study of Active Shooter Incidents, 2000-2013*. Washington, DC: Texas State University and Federal Bureau of Investigation, US Department of Justice; 2014.
4. Schweit KW. *Active Shooter Incidents in the United States in 2014 and 2015*. Washington, DC: Federal Bureau of Investigation, US Department of Justice; 2016.

5. Homeland Security Exercise and Evaluation Program (HSEEP). Homeland Security, April, 2013
6. Homeland Security Digital Library. Lessons learned information sharing. Incident management: The Central Ohio Trauma System's Hospital Incident Liaison [data file]; 2012. https://www.hsdl.org. Accessed February 10, 2019.
7. *Healthcare Preparedness Capabilities: National Guidance for Healthcare System Preparedness*. Washington, DC: US Department of Health and Human Services, Office of the Assistant Secretary for Preparedness and Response; 2012.
8. Frykberg ER. Medical management of disasters and mass casualties from terrorist bombings: How can we cope. *J Trauma*. 2002;53:201–212.
9. Jones M, White ML, Tofil N, et al. Randomized trial comparing two mass casualty triage systems (JumpSTART versus SALT) in a pediatric simulated mass casualty event. *Prehosp Emerg Care*. 2014;18:417–423.
10. Schenker JD, Goldstein S, Braun J, et al. Triage accuracy at a multiple casualty incident disaster drill: The Emergency Medical Service, Fire Department of New York City experience. *J Burn Care Res*. 2006;27:570–575.
11. Kahn CA, Schultz CH, Miller KT, Anderson CL. Does START triage work? An outcomes assessment after a disaster. *Ann Emerg Med*. 2009;54:424–430.
12. Culley JM, Svendsen E. A review of the literature on the validity of mass casualty triage systems with a focus on chemical exposures. *Am J Disaster Med*. 2014;9:137–150.
13. Hupert N, Hollingsworth E, Xiong W. Is overtriage associated with increased mortality? Insights from a simulation model of mass casualty trauma care. *Disaster Med Public Health Prep*. 2007;1(1 suppl):S14–S24.
14. Klima DA, Seiler SH, Peterson JB, et al. Full-scale regional exercises: Closing the gaps in disaster preparedness. *J Trauma Acute Care Surg*. 2012;73:592–597; discussion 597–598.
15. McCormick LC, Hites L, Wakelee JF, Rucks AC, Ginter PM. Planning and executing complex large-scale exercises. *J Public Health Manag Pract*. 2014;20(suppl 5):S37–S43.
16. Trunkey D, Ackerman M, Anderson R, Jaffe D. *US Trauma Center Preparedness for a Terrorist Attack in the Community: The Study of the Impact of a Terrorist Attack on Individual Trauma Centers. Washington DC: National Foundation for Trauma Care*. 2006:1–48.
17. *Regional Trauma Systems: Optimal Elements, Integration, and Assessment, American College of Surgeons Committee on Trauma: Systems Consultation Guide*. Nathens AB, ed. Chicago, IL: American College of Surgeons; 2008:13-14.
18. Lockey DJ, Mackenzie R, Redhead J, et al. London bombings July 2005: The immediate pre-hospital medical response. *Resuscitation*. 2005;66:ix–xii.
19. The Boston Trauma Center Chiefs' Collaborative. Boston Marathon bombings: An after-action review. *J Trauma Acute Care Surg*. 2014;77:501–503.
20. Skryabina E, Reedy G, Amlot R, Jaye P, Riley P. What is the value of health emergency preparedness? A scoping review study. *Int J Disaster Risk Reduction*. 2017;21:274–283.

# Discussion


**Dr Jonathan Saxe** (Indianapolis, IN): Thank you very much. That was a well-presented paper and substantive paper. I do have some questions for the authors.

1. In reviewing the manuscript, I had difficulty discerning the exact hypothesis of the project. What is your premise for this interesting work?
2. In the paper, you describe an elaborate pre-event tabletop exercise. How did the tabletop exercise inform your mass-casualty exercise? What parameters were seen on the tabletop exercise that you actually implemented and were they effective?
3. Communication issues during the event seem to have contributed to over- and undertriage. What recommendations would you make to mitigate over- and undertriage during a mass-casualty event?
4. Did your mass-casualty exercise uncover staffing issues at your hospital?

This paper is very informative and demonstrates a substantive effort taken by the COTS organization. I recommend the paper to the membership, and I appreciated the opportunity to review the manuscript.

**Dr J. Allen McElroy:** Thank you, Dr. Saxe. With respect to our null hypothesis, it was really designed not as a comparative study but as a descriptive study, so we didn't really have a null hypothesis. The purpose was truly just to describe the event and then hopefully to discover our weaknesses and then share those with others so that they can potentially learn from them.

Your second question pertaining to what were the findings of the tabletop exercise, it was difficult enough to fit the information regarding just the full-scale event into 10 pages, and so I opted to leave much of what we discovered from the table top out when I edited. The findings were similar to the full-scale exercise, with the exception that we didn't really use OHTrac actively as far as the patient-tracking system from the state. Because it was in a contained space and not the real world, we didn't have similar problems with communication either.

What parameters seen at the table top were implemented in the TTX and were they effective? I think the use of the single, defined pre-triage system—we use START, I mentioned, instead of SALT—and then also just the establishment of an EOC through the RTO early or an EOC at COTS as the regional trauma organization. Those were both things that we saw at the tabletop exercise that, when used as part of the full-scale exercise, were indeed very valuable.

You had asked about table tops being valuable as a precursor to a large-scale exercise. I would say yes, but I would also temper that with the fact that tabletop exercises can be performed in exclusion of full-scale exercises and still have value in and of themselves. A tabletop exercise is a way to validate an individual institution or a group's policies and procedures and also to engage with some of the governmental forms of agency that maybe we don't as institutions get to see on a regular basis.

I think you can also look within HSEEP itself and look at the way they described table tops. They basically talk about enhancing awareness, validating plans and procedures, identifying strengths and weaknesses of your individual hospitals' disaster plans.

How was communication evaluated to mitigate over- and undertriage?

I struggle with that question. I don't see communication and over- and undertriage as necessarily being related. We evaluated our means of communication. We didn't really look at how that communication really affected over- or undertriage. I guess my answer to you would be that's an opportunity for improvement or potential exploration in the future.

I believe your sixth question, what recommendations to mitigate over-/undertriage in a chaotic environment? I would give a shout out to our EMS agencies. I think they did an excellent job with triage. I think our rates of over- and undertriage were actually right in line with what you see in the literature. So, as far as mitigating it in a chaotic environment, it's best defined by the National Incident Management System, and they describe basically using

communications that have been integrated, common terminology, interoperability, and predefined platforms. With that, that tends to mitigate many of those issues.

Last but not least, was staffing an issue at any of the receiving hospitals? It really was not. Interestingly, one of our level 1s was offline due to real-world events; the hospital flooded. We did this with 1 level 1 and 2 level 2s and a pediatric level 1. For all intents and purposes, the level 3s were there not really to do much because they are geographically distant. And staffing was not an issue.