

Hurricane Irene: Here, Gone, and Back Again

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ABSTRACT

Since 2005, healthcare facilities have begun to place a higher priority on the connection between planning and action in their preparedness measures. This article provides a unique example of how education for emergency managers in exercise design can enable hospitals to improve their disaster preparedness. In looking at the design of a hyper-realistic hurricane response exercise in 2009, one hospital was able to take specific actions that enhanced its response to an actual hurricane incident in 2011. In fact, the design of the 2009 exercise was comprehensive enough that it came very close to mirroring the real 2011 event. The outcomes of this exercise and the response that followed demonstrate the importance of exercise design courses for emergency managers. In addition, this case study illustrates the benefits of using exercises to build working relationships among responder groups and agencies. Finally, the use of lessons learned from exercises and jointly analyzed hazard vulnerabilities enable a robust and all-bases-covered response to actual critical incidents.

INTRODUCTION

The challenges in preparing for complex emergencies and disasters span from the need to consider numerous possible events and the respective likelihoods of their individual occurrences to dealing with the everyday difficulties of coordinating and fostering collaboration among diverse, often-competing individuals and organizations. Across all scenarios, the desired goal is to develop an integrated response network of first responders and first receivers who have a shared vision of the potential threats, as well as sufficient resources or resourcing plans, to achieve the elusive all-hazards response. In order to reach this goal, exercises should be utilized as a method to test current preparedness and response plans, examine issues in the current plans, determine areas of improvement, and apply the lessons learned to new or updated plans. At the educational level, academic institutions must recognize the need for exercise design programs. The implementation of a successful exercise design program in an academic environment can allow for more accurate designs of exercises and lead to better real-world responses to disasters.

Perry (2004) notes that proper disaster planning requires a series of actions designed to anticipate resources, strategies, and tactics needed from an entire jurisdiction that involves both public and private actors involved in the response. He further offers that once plans have been developed, exercises provide an important connection between preparedness and action, as a means both to test response capabilities and to measure personnel training and readiness. As noted in Marks and Potter (2004), the Homeland Security Exercise and Evaluation Program Overview and Doctrine holds that effective exercises:

- test and validate policies, plans, procedures, training, equipment, and interagency agreements
- clarify and train personnel in roles and responsibilities
- improve interagency coordination and communications
- identify gaps in resources
- improve individual performance
- identify opportunities for improvement

Additionally, the 2006 General Accounting Office (GAO) report *Emergency Preparedness and Response* offers that exercises are essential to developing skills, validating effective response actions, and identifying areas in need of improvement. The GAO also recognizes the importance of interdisciplinary and intergovernmental collaboration across planning and exercise activities to execute effective response actions. Noting the prescient and highly realistic 2004 Hurricane Pam exercise conducted by federal, state, and local first responders and officials in New Orleans preceding Hurricane Katrina, the GAO report provides that even with integrated planning and exercise activities, it is imperative that lessons learned from these actions be incorporated into state and local emergency management plans and subsequent resourcing decisions. In order to achieve the goal of improved response actions, education in exercise design needs to be provided to those working in the emergency management field.

In a perfect situation, as envisioned by Quarantelli (1998), the disaster-planning process would accurately predict and devise contingencies for events, in turn eliminating the aftermath of disasters, such as loss of life and property damage. While this is unrealistic, effective planning that is guided by assessments of environmental contingencies (Perry, 2004), incorporating results from hazard vulnerability assessments and lessons learned from previous exercises, as well as responses to real events, can significantly improve actual response actions.

The implementation of exercise design into the academic environment should use the Assessment Design Framework Model (ADFM) as a way to structure a comprehensive educational plan (Bergethon, 2008).

This model is the philosophical core of the Boston University Healthcare Emergency Management (BU-HEM) Masters of Science program's curriculum design.

- The ADFM is made up of a sequence of topics to be included in the curriculum design including:
- performance objectives
- learning elements
- learning trajectories
- assessments
- educational plan

The performance objectives establish what the overall exercise design program will accomplish in teaching. Performance objectives should consist of goals for educating emergency managers in the necessary skills for exercise design, following the Homeland Security Exercise and Evaluation Program (HSEEP) guiding principles. The learning elements are new concepts and skills, as described in HSEEP, that need to be mastered in order for students to achieve the performance objectives. In order to achieve the performance objectives, the learning elements need to be combined with previously learned skills and knowledge of Incident Command Systems (ICS) with the newly learned designing efficient exercises for testing preparedness and response. Learning trajectory refers to the path that students follow to gain the learning elements. Outcomes from the design of the exercise provide for real world testing of the exercise's "authentic" (Bergethon, 2008) assessments of performance by students in the academic environment. The education plan should include what Bergethon (2008) calls "the five E's": engagement, exploration, explanation, elaboration, and evaluation.

The following case study provides an example in which an academic activity developed as part of course work in the BU-HEM program resulted in a realistic exercise scenario being executed in an operational healthcare facility. The outcomes of this exercise proved to be beneficial in the response to an actual disaster experienced by that facility. This case study demonstrates the importance of educating future emergency managers in development and design of plausible exercises, which have been shown to prepare hospitals for effective response to emergency events.

HURRICANE IRENE: HERE, GONE, AND BACK AGAIN

Historically, the Sandwich, Massachusetts, Fire Department (SFD) has maintained a close partnership with the staff of Spaulding Hospital, a 60-bed critical rehabilitation facility that is situated six miles from the Sagamore Bridge. Spaulding is the last healthcare facility before exiting Cape Cod. To fulfill its Joint Commission on Accreditation of Healthcare Organizations (JCAHO) requirements, Spaulding Hospital's engineering and safety staff conducts an annual hazard vulnerability analysis (HVA). In addition, SFD conducts quarterly inspections of Spaulding and collaborates on an annual evacuation drill. Through these joint activities, a determination was made in 2006 to conduct a series of hurricane drills for Spaulding's staff with escalating levels of response and planning challenges, known as injects. The purpose of this disaster exercise partnership was to better prepare Spaulding for coastal storms, having witnessed the devastating impact of Hurricane Katrina on healthcare facilities in the Gulf. This public-private partnership proved to be invaluable to the facility's response to Hurricane Irene in 2011. From 2006 to 2010, Spaulding and SFD conducted hurricane drills that engaged all appropriate hospital and public safety staff. Each year, the scenario was adjusted and revised to take into account lessons learned from prior exercises.

The annual SFD-Spaulding storm response exercises are considered hybrid tabletops, as they incorporate both functional and seminar components. In 2009, the Sandwich fire inspector and SFD liaison to

Spaulding collaborated with Spaulding's director of facilities to implement a hybrid exercise that was unprecedentedly comprehensive in its planning and response activities. As a part of this series of annual hurricane preparation drills, the BU-HEM program was engaged to develop a functional exercise. The goal of this exercise was to test the effectiveness of preexisting standard operation procedures (SOP) at Spaulding Hospital in response to a severe hurricane.

Through the exercise design course, developed using the ADFM system, the students incorporated an understanding of technical knowledge, disaster physics, medical consequences, disaster lifecycle, and ICS to construct the functional exercise. Students researched weather and hurricane tracks that affected the Northeastern United States over the previous 50 years in order to develop a realistic scenario for the exercise. Students worked out the logistics of the exercise, including the designation of role players and evaluators. Students determined that for the exercise to effectively test preexisting SOPs at Spaulding, as well as provide the staff at Spaulding with training, Spaulding staff would evacuate role players during the exercise, using newly acquired equipment at the hospital. As part of this process, students attended lectures on exercise design and HSEEP. These lectures focused on developing the skills necessary to build the planned Spaulding exercise, such as understanding the nature of a hybrid exercise, how it differs from a full-scale exercise, and how this type of exercise is beneficial for building the public-private relationship between Spaulding Hospital and SFD.

On August 15, 2009, SFD and Spaulding staff rolled out Operation Hurricane Irene, aptly named after the Army's "go" term in *Black Hawk Down* (Bowden 1999). Uncannily, a hurricane named Irene actually hit Cape Cod two years later under circumstances shockingly similar to the simulation. In the exercise, Spaulding staff was presented with a 72-hour window to carry out all preparatory activities before the simulated storm hit. This 72-hour notification immediately activated Spaulding's Code Purple, the hurricane and evacuation code, and put several activities into motion. Staff updated and restocked supplies, evacuated critical patients in advance of the storm, and began notifying employees of storm staffing measures. As the planning period ended on August 19, 2009, the functional exercise began and the simulated Hurricane Irene "hit." Among the exercise injects were damage to the building, loss of communication, and staffing issues. While all of these were common injects, the realistic nature of the scenario was heightened by the actual boarding of windows, a one-hour shutoff of facility power, and a test of the employee credentialing mechanism.

Several failures and adverse outcomes from the exercise were documented and Spaulding staff took appropriate action in response to these deficiencies. Table 1 documents the lessons learned during Operation Hurricane Irene in 2009, actions taken by Spaulding staff to respond to these issues, and how these new capabilities were operationalized by both Spaulding and the town of Sandwich. These actions enabled the facility to respond in a more coordinated and robust manner to the threats posed by the real-life Hurricane Irene, which struck in 2011.

Table 1. Mitigation and Impact of Operation Hurricane Irene, 2009, Lessons Learned

Lessons Learned in Operation Hurricane Irene, 2009	Actions Taken by Spaulding to Mitigate Deficiency	Related Impact during 2011 Hurricane Irene response
<ul style="list-style-type: none"> The generator did not fully support the command center, as there were no lights working in the command center. 	<ul style="list-style-type: none"> Ordered a complete check-up on all electrical outlets with a report on which outlets were red (plugged into emergency generators). 	<ul style="list-style-type: none"> When power outage occurred, Spaulding began operating on a generator with no complications; ARES (Amateur Radio Emergency Services) used to notify Emergency Operations Center (EOC).
<ul style="list-style-type: none"> The communications system failed and required the use of a fire department 800 MHz radio for communications to the local EOC. There was no communication with Spaulding’s headquarters in Boston, MA, over 60 miles away. 	<ul style="list-style-type: none"> Ordered installation of a radio antenna on the facility roof to follow town’s emergency communications plan, based on ARES. Wrote protocol for a fire department radio on every storm. Installed a permanent radio operator’s desk in the hospital command center staffed by an ARES operator from the town of Sandwich’s Community Emergency Response Team (CERT), providing the facility with a dedicated communications channel to the town’s EOC. Installed a WINLINK terminal, which allows for low bandwidth email using short-wave radio. 	<ul style="list-style-type: none"> The town of Sandwich EOC went active at 2300 hours on August 27, 2011, with full communications team including ARES operations. Spaulding Hospital command center went active on August 28, 2011 at 0600 hours, staffed with an ARES operator.
<ul style="list-style-type: none"> Employees were unable to charge their cell phones and smart devices while working. 	<ul style="list-style-type: none"> Designated an employee support room with snacks and drinks for employee relief, as well as several power strips plugged into red outlets. These outlets enabled staff to recharge mobile devices, allowing them to keep in contact with home. 	<ul style="list-style-type: none"> Employee support room made available on August 28, 2011 at 0600 hours.
<ul style="list-style-type: none"> The supplies were only at a bare minimum as required for the facility. 	<ul style="list-style-type: none"> Wrote a protocol to order a surplus of supplies during hurricane season, eliminating the need for staff to perform emergency ordering while facing potential storms. 	<ul style="list-style-type: none"> On June 1 every year, staff orders a surplus of supplies, so Spaulding is stocked for hurricane season.

In late August 2011, the National Weather Service issued alerts of a large, dangerous hurricane taking an unusual path up the East Coast, with a predicted landfall between New York City and Providence, Rhode Island. On August 27, 2011, Spaulding Hospital activated its storm plan. A command and general staff meeting was held with SFD, EOC, and Public Health representatives to discuss Spaulding's plans and the town's response. Part of this discussion involved finalizing a plan for Spaulding to take in medical outpatients who rely on power at their homes as guests at their facility.

The town of Sandwich Emergency EOC was activated at 2300 hours on August 27, 2011, with a full communications team including ARES operations. On August 28, 2011, at 0600 hours, the Spaulding Hospital Command Center was activated and staffed with the addition of an ARES operator, along with the employee support room. Other Sandwich public safety agencies were fully staffed and prepared for a storm response. The worst of the storm was predicted for a 12-hour block, starting at 0600 hours on August 28; by 0900 hours, Hurricane Irene had disrupted power to 85% of the community. Spaulding lost power at 0800 hours and the facility made the switch over to its generator with no complications. The notification of the loss of power was made through ARES operations so as not to tie up the emergency channels.

Additional benefits of the 2009 exercise came to light throughout the response to Hurricane Irene in 2011. For example, hourly reports during the hurricane noted that there was minor damage to the building. Building damage had been simulated and practiced in the 2009 exercise. The fact that critical patients had been preemptively evacuated, and that the remaining patients had been moved to more secure sections within the facility, proved to be prudent decisions by Spaulding staff. The staff also noticed a greater level of composure, as nearly all impacts made by Irene had been planned for and exercised prior to the actual event. Even when minor damage and power loss occurred, the staff was prepared and responded seamlessly.

On reflection, the two most important preparatory actions taken as a result of the 2009 exercise were the installation of the ARES antenna and establishment of a base station for direct communication with the EOC using the WINLINK radio internet system. An agreement had also been brokered with the local ARES representative to have an operator stationed at Spaulding during a hurricane, providing the town's EOC with direct contact to the hospital, the importance of which was highlighted during the 2009 HVA conducted by Spaulding staff.

DISCUSSION

As is evident from this case, the Spaulding staff was better prepared to respond to and handle the real 2011 Hurricane Irene as a result of an effective exercise designed to test and improve the existing hospital SOPs through after action reports and lessons learned, to train staff, and to strengthen the relationship between Spaulding Hospital and SFD. These results were facilitated by the involvement of an academic partner, BU-HEM. The realistic activities performed in the 2009 Hurricane Irene exercise, including the actual shut down of electrical power at Spaulding, provided crucial testing of facility preparedness, resulting in necessary mitigation actions and "hands-on" experience for hospital staff. The commitment to making the 2009 exercise believable, a clear recommendation from Perry (2004), provided evidence of what Marino (2008) notes as "heightened awareness and sharpened response to the emergency situation." Finally, this case demonstrates a move supported by Jackson (2008) toward evaluation and measurements

that focus on counting supplies and evaluating system-wide and individual response capabilities in isolation.

The hospital's longstanding public-private partnership allowed, as Perry (2004) notes, working relationships to be developed between responder groups and agencies. In addition, the demonstrated use of lessons learned from annual exercises, the outcomes of HVAs performed by Spaulding Hospital, and the quarterly inspection reports from SFD comport to the recommendations to use existing data sources to create practical "real-world" exercise scenarios (Jackson, 2008). Furthermore, these coordinated response planning activities support the Taylor, Rowe, and Lewis (1999) recommendation to synergize response plans that are focused on consequence management and involve increased prior coordination, expressly including exercise objectives designed to collaboratively train a cadre of local response actors.

CONCLUSIONS

The successful results of the exercise Operation Hurricane Irene became truly evident two years later, through the successful response to the actual Hurricane Irene. As presented in Table 1, the exercise helped prepare the Spaulding staff for the inevitable hurricane that struck in 2011. The generator, which prior to the exercise did not support the command center, worked without complications during the actual Hurricane Irene. Simulating building damage during the exercise allowed for the staff to be prepared for the minor damage that did occur during the actual hurricane. The exercise further showed the benefit of practice for the Spaulding Hospital staff; they were calmer and more comfortable with their response efforts during the 2011 Hurricane Irene.

This case study conveys the importance and value of educating emergency managers in exercise design. Educating emergency managers in the field of exercise design is crucial to fostering successful disaster preparedness. The ADFM system is an educational and pedagogical paradigm that encourages educational programs to build on prior knowledge of (in this case) emergency management while teaching new information such as exercise design and execution. Programs developed using the ADFM system provide students with a comprehensive education in the development and execution of exercises that will provide private and public entities with the necessary practice and training required to better prepare for disaster. The ADFM system also encourages the use of real-world testing to further reinforce what students have learned. This authentic assessment (Bergethon 2008) both provides students with hands-on experience as well as offering the private and public sectors the opportunities to improve their preparedness and response to disasters.

REFERENCES

- Bergethon, P. (2008). Practice issues in neurology. *Continuum Lifelong Learning in Neurology* 14(2): 158-167
- Bowden, M. (1999). *Black Hawk down: A Story of modern war*. New York, NY: New American Library
- Government Accountability Office. (2006). *Emergency preparedness and response: Some issues and challenges associated with major emergency incidents—the critical importance of realistic exercises and after-action reports: Testimony before the Little Hoover Commission, State of California* (GAO-06-467T). Washington, DC: Author.
- Jackson, B. (2008). *The problem of measuring emergency preparedness: the need for assessing “response reliability” as part of homeland security planning*. Santa Monica, CA: RAND Corporation.
- Marino, J. (2008, January 21). How effective is your response plan? *Disaster Recovery Journal Online*. Accessed June 22, 2012. Retrieved from <http://www.drj.com/tools/model/how-effective-is-your-response-plan.html>
- Marks, L. & Potter, M. (2004, July/August). Drilling for results: The quest for objective exercise evaluations. *Homeland First Response*, 2(4), 32-34.
- Perry, R. (2004, June). Disaster exercise outcomes for professional emergency personnel and citizen volunteers. *Journal of Contingencies and Crisis Management*, 12(2), 64-75.
- Quarantelli, E. (1998). Major criteria for judging disaster planning and managing and their applicability in developing societies (preliminary paper 268). University of Delaware: Disaster Research Center.
- Taylor, S., Rowe, A., & Lewis, B. (1999). Consequences management in need of a timeout. *Joint Force Quarterly*, 22, 78-85.